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(54) **Cooling plant**

(57) Cooling plant including a cooling medium supply plant which cooling medium supply plant has means for supplying cooling medium to one or more freezers which cooling medium after use in each freezer is circulated back to said cool-ing medium supply plant by return circulation means, and where each of the one or more freezers has active freezing means and a cooling medium container and pump designed for each respective freezer, where circulation of cooling medium is controlled between the active freezing means and the cooling medium container, such that only gas is circulated back to the cooling medium supply plant.

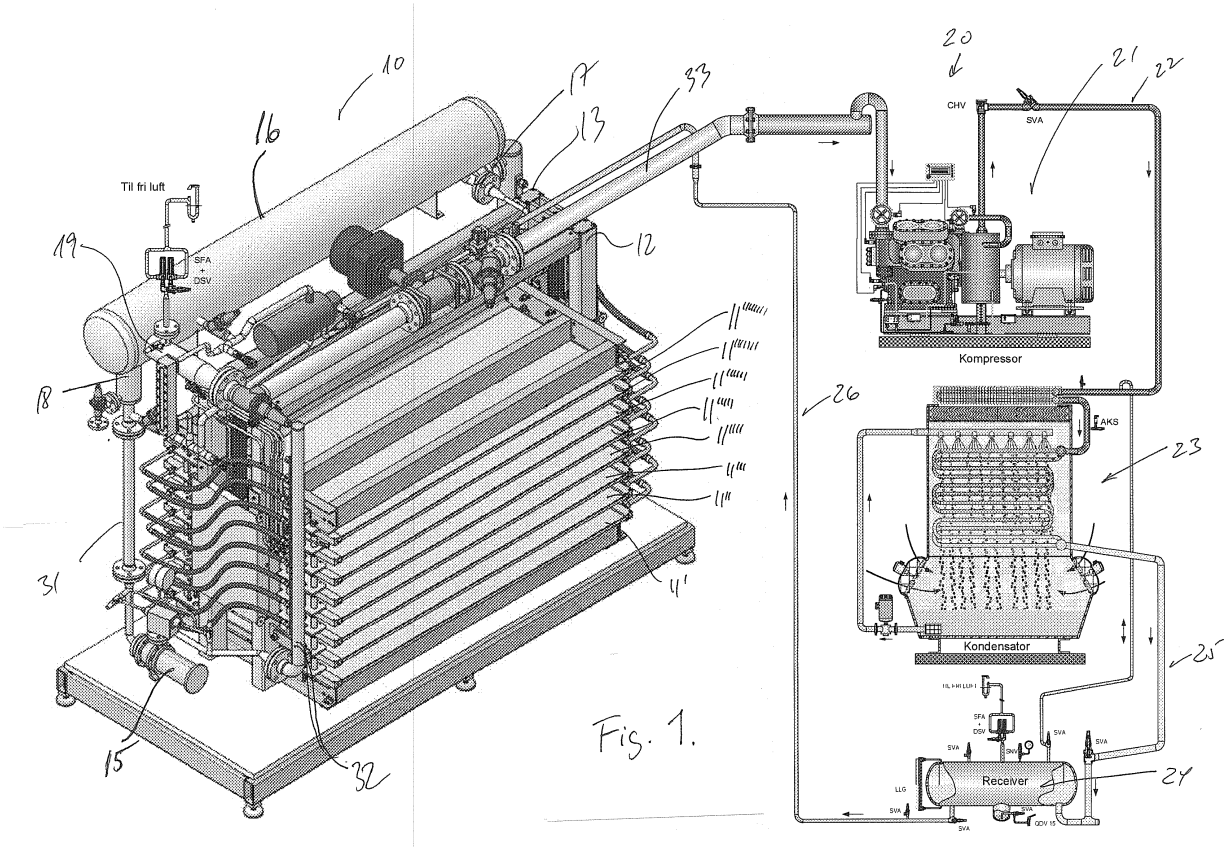

Fig. 1.

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Description

Field of the Invention

[0001] The present invention relates to a cooling plant as well as a method of operating a cooling plant according to the invention.

Background of the Invention

[0002] In the processing of food there is often a freezer installation involved in that quite a number of food items are stored, transported and sold as frozen foods. Freezing is a very energy intensive process requiring an effective cooling plant as well as an effective, active freezer means.

[0003] The same considerations apply to other technical fields where it is desirable to utilise freezer installations.

[0004] In the art a number of cooling plant designs exist which are specifically designed to save energy in order to make the freezing process cheaper and potentially also faster.

[0005] A common drawback of these freezer installations is the cost of providing a cooling plant which is sufficiently large to service the freezer during the freezing time, i.e. the period when non-frozen items are placed in the freezer until they reach the desired temperature. A further problem is that with relatively large installations a substantial amount of liquid is circulated in the installation requiring relatively large pipe diameters and relatively large pumps in order to move sufficient energy through the system in order to achieve the freezing capabilities. This circulation of freezing media requires a substantial amount of energy.

Object of the Invention

[0006] Consequently it is an aim of the invention to address these disadvantages and provide further advantages.

Description of the Invention

[0007] The invention achieves this by providing a cooling plant including a cooling medium supply plant which cooling medium supply plant has means for supplying cooling medium to one or more freezers which cooling medium after use in each freezer is circulated back to said cooling medium supply plant by return circulation means, and where each of the one or more freezers has active freezing means and a cooling medium container and pump designed for each respective freezer, where circulation of cooling medium is controlled between the active freezing means and the cooling medium container, such that only gas is circulated back to the cooling medium supply plant.

[0008] The provision of a cooling medium container and a pump on each freezer provides the possibility of circulating the cooling medium for as long as it takes the active freezing means to transfer energy from the objects to be frozen into the cooling medium thereby creating evaporation and consequently a transfer of the cooling medium from a liquid state to a gas state.

[0009] The cooling medium container is constructed such that as the cooling liquid is circulated through the active freezing means the pump and the cooling medium container, only liquid cooling medium is circulated, whereas cooling medium in its gas form is sucked back to the cooling plant for further treatment in order to be returned to the liquid state.

[0010] The fact that only gas is recirculated back to the cooling plant provides a substantial saving in energy, as it is much easier to move gas than to move liquid. At the same time the cooling ability, i.e. the cooling liquid's ability to draw heat from the active freezing means is optimized in that the cooling medium is maintained in circulation in each freezer until it is transferred into its gas state, in which state it is sucked back to the cooling plant.

[0011] In a further advantageous embodiment of the invention the cooling medium container has an inlet and two outlets, where a first outlet provides fluid communication to the pump and a second outlet provides gas communication to the cooling medium supply plant, and where said inlet is in communication with the active freezing means.

[0012] The particular arrangement of the cooling medium container particularly having two outlets is advantageous in that the first outlet which advantageously may be positioned at the bottom of the cooling medium container drains off any liquid, whereas the second outlet, typically arranged in the top part of the cooling mediums container, lets the gas, i.e. the evaporated cooling medium be sucked back to the cooling plant. Naturally, in this configuration of the cooling medium container gravity helps to separate the cooling media in its phases, i.e. gas and liquid, but other types of separation may also be contemplated, for example in a cyclone or the like.

[0013] In a further advantageous embodiment of the invention a condenser screen is arranged in the cooling medium's flow path inside the cooling medium container. The condenser screen is arranged such that as cooling medium having been through the active freezing means enters the cooling medium container it will shortly after being released from the inlet be confronted with the screen. The condenser screen will to a large extent separate droplets or tiny liquid components from the gas such that the gas being sucked back to the cooling plant is as liquid free as possible and at the same time as much liquid is separated from the circulating gas in order to save transport energy and be able to utilize the cooling fluid medium in the most efficient way.

[0014] For this purpose the inlet inside the cooling medium container is provided with a nozzle in the shape of a pipe arranged orthogonal to the cooling medium's flow path inside the container. With this configuration it is en-

sured that the recycled cooling medium once it enters the cooling medium container is agitated such that gas and liquid is effectively separated.

[0015] In a still further advantageous embodiment the first inlet additionally is in fluid communication with the cooling medium supply plant, for introducing additional/fresh fluid cooling medium into the cooling medium container. By adding additional fresh cooling medium in fluid state to the contents of the cooling medium container in the first inlet, it is ensured that a thorough mix of used and fresh media is obtained such that a substantially constant and controllable freezing cycle might be achieved by the active freezing means.

[0016] In this connection it should be mentioned that by active freezing means are meant any means such as for example a horizontal or vertical plate in a plate freezer which comes into contact with the products to be treated in the freezer such as for example fish, meat or the like. The term active does not indicate that the plates are active apart from having heat transfer characteristics which facilitates the transfer of energy from the products to be frozen to the cooling medium.

[0017] In a still further advantageous embodiment of the invention the cooling medium supply plant comprises

1. a compressor in fluid communication with
2. a condensator in fluid communication with
3. a receiver in fluid communication with multiple freezers,
4. where said compressor further sucks cooling medium in the form of gas back from the multiple freezers.

[0018] As the plant receives cooling media in gas form, the efficiency in the compressor may be elevated in that the transformation of gas to liquid when homogenous gas, i.e. not liquid containing gas is received, is easier to control and as such the efficiency of the compressor may be elevated.

[0019] The same is true for the provision of a receiver, i.e. a tank to collect and distribute the fluid cooling medium from, which may act as a buffer with respect to the one or more freezers in that the demand for cooling liquid may fluctuate due to the number of freezers connected to the cooling plant and due to each freezer's separate demand for a provision of cooling fluid.

[0020] In a still further advantageous embodiment of the invention a distribution manifold is provided in said means for supplying cooling medium to the one or more freezers and a return manifold is provided in said return circulation means, where both manifolds comprise multiple means for connecting and disconnecting means for supplying cooling medium respectively receiving return gas from each of the one or more freezers.

[0021] The manifold, both the distribution and the return manifold, are provided for easy connection and disconnection of freezers to the cooling plant. It may for example be desirable to be able to move the freezing capacity from one location to a different location and with a cooling plant according to the present invention it is possible to leave the cooling medium supply plant in one location and just move the freezers to a different location where the need for a freezing capacity is larger. It is much cheaper and faster just to move the freezers without the cooling medium supply plant, as usually the plant requires a substantial amount of installation work. At the same time the cooling medium does not need to be moved with the freezers as the receiver may contain the entire amount of cooling liquid required in a situation where a number of freezers are moved off to a different location.

[0022] The manifolds therefore provide easy access to the connection and disconnection of freezers and thereby make it fairly simple to remove one or more freezers from the cooling plant as desired.

[0023] The invention also discloses a method for operating an cooling plant according to the invention as described above.

Description of the Drawing

[0024] In order to better understand the functionality of the present invention, the invention will be explained with reference to a detailed embodiment with reference to the accompanying drawings in which

Figure 1 illustrates a schematic overview of a freezing installation

Figure 2 illustrates a cross-section through a cooling medium container

Detailed Description of the Invention

[0025] In figure 1 is illustrated a schematic overview of a cooling plant according to the present invention. For the sake of clarity only one freezer 10 is illustrated, but in reality any number of freezers may be connected to the cooling medium supply plant. The cooling medium supply plant 20 comprises a compressor 21 which by means of a pipe 22 is in liquid connection with a condensator 23. Inside the condensator the compressed gas and liquid being transferred from the compressor 21 through the pipe 22 is further cooled such that liquid cooling medium is led to a receiver 24 by pipe means 25. The arrangement and construction of the cooling medium supply plant as described above is relatively traditional.

[0026] From the receiver 24 the cooling medium is led to the freezer 10 by means of a pipe 26.

[0027] In this embodiment the freezer 10 is in the shape of a horizontal plate freezer where a number of horizontal plates 11'-11"""" are constructed such that cooling medium may be guided through the plates. The plates are brought in close physical contact with the products to be frozen. The plate freezer has means 12, 13 for moving the plates vertically thereby creating larger openings between each of the plates 11'-11"""" in order to be able to

place the product to be frozen between adjacent plates. After placement of products the plates are pushed together in a vertical direction slightly squeezing the product arranged between the plates in order to create a good thermal conductive contact between the products to be frozen and the freezing plates 11-11"""". Within the present invention active freezing means shall therefore be construed as the plates which are in contact with the product to be frozen with respect to this particular embodiment.

[0028] The type of freezer installation is not a limiting factor on the invention as such, but it should be noted that particularly horizontal and vertical plate freezers are advantageous with the present invention.

[0029] The cooling medium is led to the freezer 10 by the pipe 26 and circulated into the freezing plates 11'-11"""" in order to create the freezing capability of the freezer 10. As the cooling medium circulates through the plates, the medium will absorb heat from the product placed between the plates and eventually the medium will evaporate. As long as not all medium has evaporated, i.e. there is a liquid fraction left, there is still some freezing capacity left in the cooling medium, and it should therefore be recirculated into the plates in order to absorb even more heat from the products. For this purpose a pump 15 as well as a cooling medium container 16 is provided. By connecting the return fluid/gas mix from the plates 11'-11"""" to the cooling medium container 16 by means of an inlet 17 the cooling medium container will after some activity in the freezer 10 comprise cooling medium both in an aqueous/liquid phase and in a gas phase.

[0030] By further providing two outlets 18, 19 it is possible to segregate the liquid and gas phase of the cooling medium. The liquid phase will due to the effect of gravity assemble in the bottom part of the liquid medium container 16 and be evacuated from the container 16 by the outlet 18. The outlet 18 is connected by a pipe 31 to the pump 15 which again by means of a manifold 32 circulates the gas back into the freezing plates 11'-11 """".

[0031] The gas fraction is let out through the outlet 19 and by suction means arranged in the compressor 21 sucked back through the pipeline 33 to the cooling medium supply plant 20.

[0032] At certain temperatures the cooling medium will be very close to the phase transfer temperature, and for this reason the pipe 31 should have a certain length in order to make sure that only liquid is lead through the pump 15 and recirculated into the freezing plates 11. Tests have indicated that if the pipe 31 is too short also a gaseous phase of the cooling medium will be circulated into the cooling plates thereby lowering the capacity of the freezer. Unless the pump is specifically designed for the mixture of gas and liquid, the pump efficiency is severely diminished when gas is present. Furthermore gas may cause cavitation in the pump.

[0033] In figure 2 is illustrated a cross-section through the cooling medium container 16 such that the outlay of the interior of the container 16 may be illustrated. The gas and liquid mixture is introduced into the container 16 by the inlet 17. The inlet 17 has a further branch pipe 34 through which additional cooling medium in liquid form may be added to the liquid or gas/liquid mixture introduced through the inlet 17 into the container 16.

[0034] In the opposite end of the container 16 are provided two outlets 18, 19 making it possible to drain off any liquid through the outlet 18 which is connected to a pipe 31 (only small portion illustrated). The outlet 18 is connected to the pump means 15 as described above such that the liquid phase of the cooling medium introduced into the cooling medium container 16 may be recirculated into the active freezing elements, in this embodiment freezing plates 11'-11"""". Due to the heat exchange in the freezer part the freezing liquid will evaporate and become a gas which gas is sucked out of the container 16 by the outlet 19 where the outlet 19 has an inlet 19' at the very top part of the container 16. In this manner it is possible to introduce in one end a mixture of liquid and gas through the inlet 17 and due to the segregation into a liquid and gas phase through the flow path inside the container 16 from the inlet to the two outlets 18, 19 where the mixture is segregated into a liquid part which is drained off through the outlet 18 and a gas part which is sucked out through the outlet 19 through pipe means 33 (see figure 1) back to the compressor unit 21.

[0035] In order to further speed up or instigate the precipitation inside the container 16 a condenser screen 36 is arranged in the gas/liquid's flow path between the inlet 17 and the outlet 18, 19. As the mixture of gas and liquid hits the screen 36, small particles will condensate and remain in the liquid state and therefore be drained off by the outlet 18 and recirculated in the freezing plates 11'-11"""". The gas portion will have a smaller concentration of very small liquid particles and as such be a purer gas which is easier and therefore more economic to such back to the compressor plant as discussed above.

[0036] Above the invention has been described with reference to a horizontal plate freezer, but it will be obvious to the person skilled in the art that by implementing the inventive concepts of the present invention and in particular the cooling medium container in connection with a pump for recirculation of cooling medium to the active freezing means as long as there is cooling liquid medium left in the system such that only gas is pumped or sucked back to the cooling medium supply plant, the invention will bring advantages.

[0037] Consequently, the invention should only be limited by the scope of the appended claims.

Claims

1. Cooling plant including a cooling medium supply plant which cooling medium supply plant has means for supplying cooling medium to one or more freezers which cooling medium after use in each freezer is circulated back to said cooling medium supply plant

by return circulation means, and where each of the one or more freezers has active freezing means and a cooling medium container and pump designed for each respective freezer, where circulation of cooling medium is controlled between the active freezing means and the cooling medium container, such that only gas is circulated back to the cooling medium supply plant.

2. Cooling plant according to claim 1 **characterized in that** the cooling medium container has an inlet and two outlets, where a first outlet provides fluid communication to the pump and a second outlet provides gas communication to the cooling medium supply plant, and where said inlet is in communication with the active freezing means.

3. Cooling plant according to claim 1 or 2 **characterized in that** a condenser screen is arranged in the cooling medium's flow path inside the cooling medium container.

4. Cooling plant according to claim 2 **characterized in that** the inlet inside the cooling medium container is provided with a nozzle in the shape of a pipe arranged orthogonal to the cooling medium's flow path inside the container.

5. Cooling plant according to any of claims 2 to 4 **characterized in that** the first inlet additionally is in fluid communication with the cooling medium supply plant, for introducing additional/fresh fluid cooling medium into the cooling medium container.

6. Cooling plant according to claim 1 wherein said cooling medium supply plant comprises:

5. a compressor in fluid communication with
6. a condensator in fluid communication with
7. a receiver in fluid communication with multiple freezers,
8. where said compressor further sucks cooling medium in the form of gas back from the multiple freezers.

7. Cooling plant according to claim 1 wherein a distribution manifold is provided in said means for supplying cooling medium to the one or more freezers and a return manifold is provided in said return circulation means, where both manifolds comprise multiple means for connecting and disconnecting means for supplying cooling medium respectively receiving return gas from each of the one or more freezers.

8. Method of operating a cooling plant comprising one or more freezers according to any of claims 1 to 7 wherein the cooling plant produces cooling medium which cooling medium in liquid form is distributed to each of the one or more freezers in response to each freezer's demand, where each freezer has a cooling medium container and a pump, where each freezer circulates the cooling medium such that only gas is returned to the cooling plant.

9. Method according to claim 8 wherein a distribution manifold is provided in said means for supplying cooling medium to multiple freezers and a return manifold is provided in said return circulation means, where both manifolds comprise means for connecting

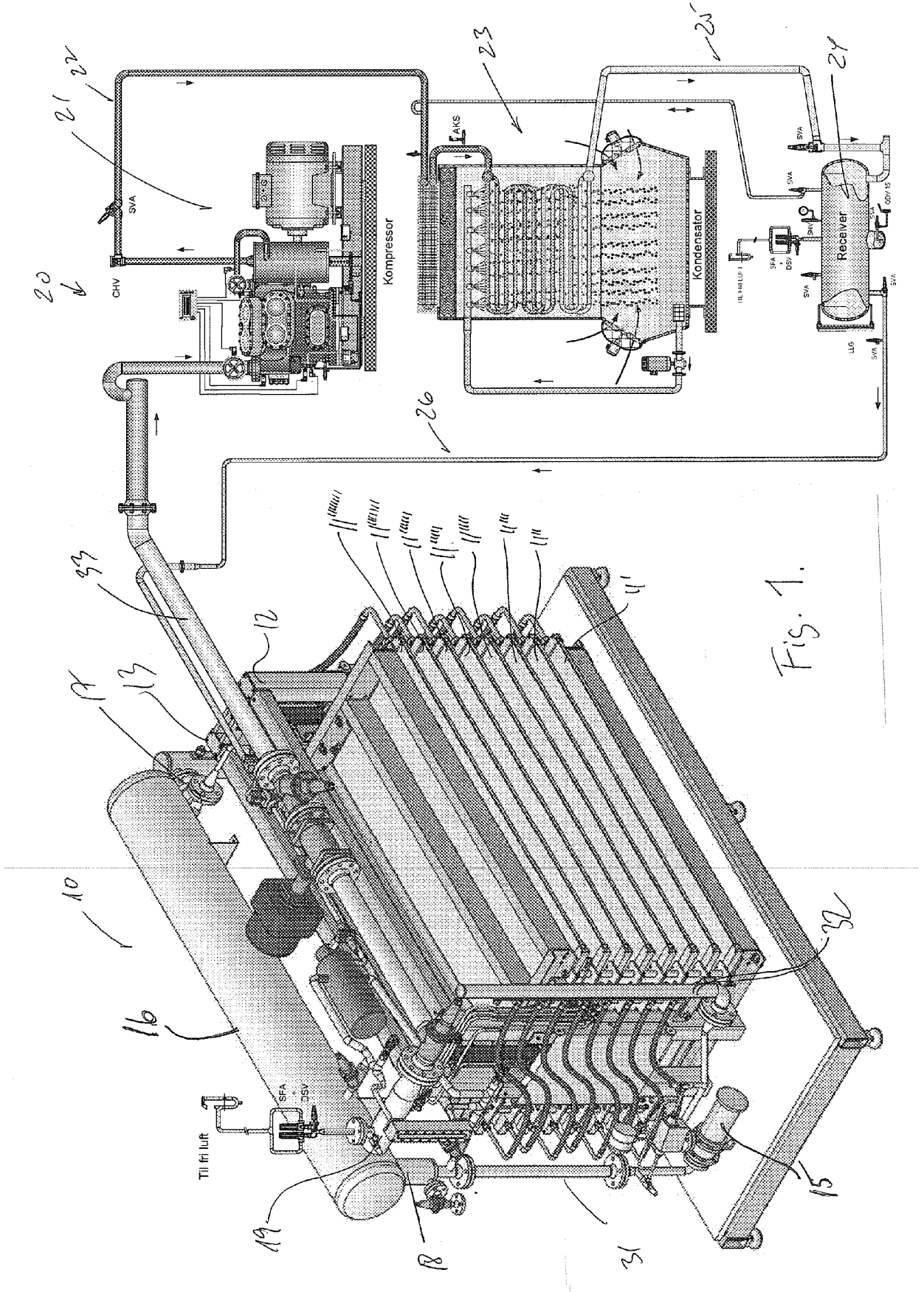
Kompressor
Kondensator
Receiver
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Fig. 1.

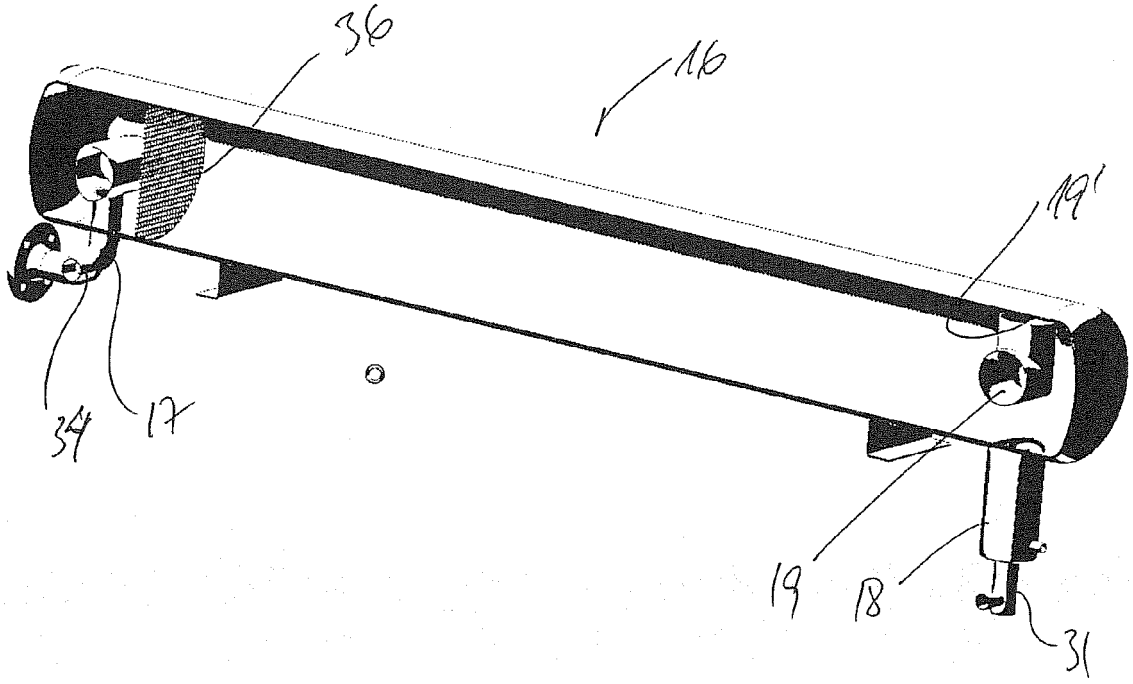

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 14 18 7582

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	GB 04540 A A.D. 1909 (DETTMAR ERNST [US]) 24 February 1910 (1910-02-24) * the whole document *	1-9	INV. F25B41/00 F25D16/00 F25B43/00
X	US 2009/314023 A1 (LABASTE MAUHE LAURENT [FR] ET AL) 24 December 2009 (2009-12-24) * the whole document *	1,2,5-9	
A	US 5 255 526 A (FISCHER HARRY C [US]) 26 October 1993 (1993-10-26) * the whole document *	1-9	

TECHNICAL FIELDS SEARCHED (IPC)
F25B
F25D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	30 January 2015	Lucic, Anita

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 14 18 7582

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30-01-2015

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