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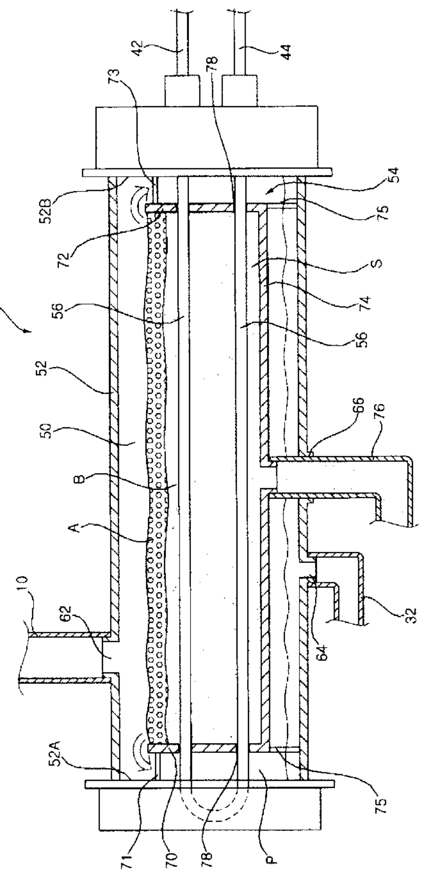
(54) **CHILLER**

(57) According to the present invention, a chiller comprises: a compressor configured to compress a refrigerant; a condenser configured to condense the refrigerant compressed by the compressor; an expander configured to expand the refrigerant condensed by the condenser; and an evaporator in which the refrigerant expanded by the expander cools cold water. The evaporator comprises: a shell comprising a space therein through which the refrigerant passes; an inner tube through which cold water passes and disposed such that the cold water exchanges heat with the refrigerant; and an oil overflow member disposed in the shell and defining an oil passage between the oil overflow member and the shell such that the oil overflow into the oil passage and then flows toward a lower inner portion of the shell along the oil passage. Since the maximum height of oil in the shell can be controlled, a gaseous refrigerant can be quickly absorbed into the compressor to prevent deterioration in performance stemming from an excessive height of an oil foaming layer.

[Fig. 3]



EP 2 541 164 A1

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Description

[Technical Field]

[0001] The present invention relates to a chiller supplying cold water to demand sources of the cold water, particularly a chiller that can return oil in an evaporator.

[Background Art]

[0002] In general, chillers that supply cold water to demand sources of cold water such as an air conditioner or a freezer include a compressor, a condenser, an expander, and an evaporator, through which a refrigerant circulates.

[0003] The evaporator in chillers is implemented by a liquid refrigerant heat exchanger to allow heat exchange between a refrigerant and water (hereafter, referred to as cold water), is connected with demand sources of cold water through a water pipe, and circulates and supplies cold water cooled by the refrigerant to the demand sources of cold water.

[0004] In the chillers, oil is discharged with the refrigerant when the compressor is driven, and flows into the evaporator and collects therein, after sequentially passing through the condenser and the expander together with the refrigerant.

[Disclosure]

[Technical Problem]

[0005] The chillers according to the related art have a problem in that the oil flowing in the evaporator positioned over the refrigerant, such that the oil prevents the gaseous refrigerant from being discharged when the amount of oil is large, and thus performance may be deteriorated.

[0006] The present invention has been made in an effort to solve the problem of the related art described above, it is an object of the present invention to provide a chiller that can maintain the level of oil in an evaporator and prevent deterioration of performance due to excessive oil.

[0007] It is another object of the present invention to provide a chiller that can control a refrigerant region and an oil region and maximize the contact area between a refrigerant and an inner tube.

[0008] It is an object of the present invention to provide a chiller that can keep cooling cold water without an oil return operation for returning oil in an evaporator.

[Technical Solution]

[0009] A chiller according to the present invention includes: a compressor configured to compress a refrigerant; a condenser configured to condense the refrigerant compressed by the compressor; an expander configured to expand the refrigerant condensed by the condenser; and an evaporator in which the refrigerant expanded by the expander cools cold water, in which the evaporator includes: a shell having a space therein through which the refrigerant passes; an inner tube through which cold water passes and that is disposed such that the cold water exchanges heat with the refrigerant; and an oil overflow member disposed in the shell and defining an oil passage between the oil overflow member and the shell such that the oil overflow into the oil passage and then flows toward a lower inner portion of the shell along the oil passage.

[0010] The oil overflow member has a receiving space therein which receives the refrigerant expanded by the expander and where at least a portion of the inner tube is positioned.

[0011] The top of the oil overflow member is open.

[0012] The oil overflow member has a left part spaced from an inner left side of the shell and a right part spaced from an inner right side of the shell and the left part.

[0013] An inner tube through-hole through which the inner tube passes is formed at at least one of the left part and the right part of the oil overflow member.

[0014] The oil overflow member further has a circumferential portion formed between the left part and the right part and defining the receiving space between the left part and the right part.

[0015] The circumferential part is spaced from the shell.

[0016] The circumferential part has a semicircular cross-section.

[0017] Oil overflow member-fixing members that fix the oil overflow member to be spaced from the shell are installed between the shell and the oil overflow member.

[0018] The shell has a refrigerant outlet at the top and an oil outlet at the bottom, and a refrigerant inlet through which the refrigerant expanded by the expander flows into the receiving space is connected to the oil overflow member.

[0019] The shell has a refrigerant inlet-through portion through which the refrigerant inlet passes.

[0020] The refrigerant inlet-through portion is spaced from the oil outlet.

[0021] An oil return channel for returning the oil to the intake side of the compressor is connected the oil outlet.

[0022] A chiller according to the present invention includes: an ejector; an ejector intake pipe guiding some of a high-pressure refrigerant discharged from a compressor to the ejector by connecting the ejector with a discharge pipe of the compressor; an evaporator oil intake pipe guiding the oil in an evaporator to be sucked into the ejector when a high-pressure refrigerant flows to the ejector, by connecting the evaporator with the ejector; and an ejector outlet pipe returning the refrigerant passing through the ejector to the compressor.

[0023] The oil overflow member is installed at a height where the oil can overflow, when the compressor is driven.

[Advantageous Effects]

[0024] The chiller according to the present invention having the configuration described above has the advantage in that since the maximum height of oil in the shell can be controlled, a gaseous refrigerant can be quickly absorbed into the compressor to prevent deterioration in performance due to excessive height of an oil foaming layer.

[0025] Further, it has the advantage in that the oil in the oil overflow member can be quickly discharged, such that performance is improved.

[0026] Further, it has the advantage in that the oil quickly returns to the compressor without a specific oil return operation for returning oil in an evaporator, when the amount of oil in the evaporator is too large.

[0027] Further, it has the advantage in that the contact between the oil and the inner tube is minimized and the contact between the refrigerant and the inner tube is maximized, thereby improving performance.

[Description of Drawings]

[0028] FIG. 1 is a configuration diagram of an embodiment of a chiller according to the present invention.

[0029] FIG. 2 is a cross-sectional view of the evaporator shown in FIG. 1.

[0030] FIG. 3 is a cross-sectional view showing an evaporator of another embodiment of a chiller according to the present invention.

[Mode for Invention]

[0031] Exemplary embodiments of the present invention will be described hereafter in detail with reference to the accompanying drawings.

[0032] FIG. 1 is a configuration diagram of an embodiment of a chiller according to the present invention.

[0033] A chiller according to the present embodiment includes a compressor 2 configured to compress a refrigerant, a condenser 4 configured to condense the refrigerant compressed by the compressor 2, an expander 6 configured to expand the refrigerant condensed by the condenser 4, and an evaporator 8 in which the refrigerant expanded by the expander 6 cools cold water.

[0034] The compressor 2 that is a part compressing the refrigerant evaporated by the evaporator 8 may be configured by one of a rotary compressor, a scroll compressor, and a screw compressor, may be configured such that the operation capacity is variable, and may be configured to compress the refrigerant in several steps.

[0035] The compressor 2 is connected with a compressor intake pipe 10 through which the refrigerant evaporated by the evaporator 8 passes to be sucked into the compressor 2, and a compressor discharge pipe 12 through which the refrigerant discharged from the compressor 2 passes.

[0036] An oil separator 14 separating oil, which is discharged with the refrigerant when the refrigerant is discharged from the compressor 2, from the refrigerant may be installed between the compressor 2 and the condenser 4.

[0037] When the compressor 2 is directly connected with the condenser 4, the compressor discharge pipe 12 is connected with the condenser 4.

[0038] When the oil separator 14 is installed between the compressor 2 and the condenser 4, the compressor discharge pipe 12 is connected with the oil separator 14 and the oil separator 14 is connected to an oil separator-condenser connection pipe 16.

[0039] An example when the oil separator 14 is installed will be described hereafter.

[0040] The oil separator 14 is connected to the compressor intake pipe 10 and an oil return pipe 18 and the oil separated from the refrigerant from the oil separator 14 is returned to the compressor 2 through the oil return pipe 18 and the compressor intake pipe 10.

[0041] The condenser 4 that is a part condensing the refrigerant compressed by the compressor 2 may be configured by a shell-tube type of heat exchanger or may also be configured by a fin-tube type of heat exchanger.

[0042] When the condenser 4 is configured by a shell-tube type of heat exchanger, a condensing space where the refrigerant can be condensed is defined in a shell, a coolant tube through which a coolant passes is disposed in the condensing space, and the coolant tube is connected with a demand source such as a cooling top by coolant pipes 24 and 26, such that the refrigerant is condensed by exchanging heat with a coolant while passing through the shell.

[0043] When the condenser 4 is configured by a fin-tube type of heat exchanger, a condensing fan installed around the condenser 4 supplies cold air such as the external air to the condenser 4 and the refrigerant passing through the tube is condensed by exchanging heat with cold water such as the external air.

[0044] The condenser 4 is connected with the expander 6 by a condenser-expander connection pipe 28.

[0045] The expander 6 that is a part expanding the refrigerant condensed by the condenser is configured by a capillary tube or an EEV (Electronic Expansion Valve).

[0046] The evaporator 8 that is a part evaporating the refrigerant expanded by the expander 6 is connected with the expander 6 by an expander-evaporator connection pipe 30.

[0047] The evaporator 8 is configured by a shell-tube type of heat exchanger and the refrigerant flowing into the evaporator 8 is evaporated in the evaporator 8 and sucked into the compressor intake pipe 10.

[0048] The oil that is not separated by the oil separator 14 when the chiller operates flows into the evaporator 8 after sequentially passing through the condenser 4 and the evaporator 6 together with the refrigerant and is positioned over the gaseous refrigerant of evaporator 8.

[0049] An evaporator oil return channel 32 configured to return the oil in the evaporator 8 into the intake pipe

10 of the compressor or the compressor 2 is connected to the evaporator 8.

[0050] The evaporator oil return channel 32 is a kind of bypass channel that allows bypass of a portion of or the entire compressor intake pipe 10.

[0051] The evaporator oil return channel 32 has one end connected to the evaporator 8 and the other end connected to a side of the intake pipe of the compressor or a side of the compressor.

[0052] The evaporator oil return channel 32 may return oil by using only the intake force of the compressor 2 or may return oil by using an ejector 34.

[0053] The evaporator oil return channel 32, when returning oil by using the ejector 34, includes an ejector intake pipe 2 configured to guide some of a high-pressure refrigerant discharged from the compressor 2 by connecting the compressor discharge pipe 12 with the ejector 34, an evaporator oil intake pipe 38 configured to guide the oil in the evaporator 8 to be sucked into the ejector 34 when the high-pressure refrigerant flows to the ejector by connecting the evaporator 8 with the ejector 34, and an ejector outlet pipe 40 configured to return the oil and the refrigerant passing through the ejector 34 to the compressor intake pipe 10 or the compressor 2.

[0054] The ejector 34 that is a part generating an intake force at the evaporator oil intake pipe 38 when the coolant passing through the ejector intake pipe 36 passes through the ejector 34 at a high speed may be configured by a vacuum ejector.

[0055] For the ejector 34, a main channel is formed between the ejector intake pipe 36 and the evaporator oil intake pipe 38 and a join channel is formed between the main channel and the evaporator oil intake pipe 38.

[0056] The ejector 34 is formed such that the join channel and the main channel are perpendicular to each other, and the entire shape of the main channel and the join channel may be formed in a T-shape.

[0057] The evaporator 8 is connected with a cold-water demand source, such as a cooling coil, by cold water pipes 42 and 44 and cold water cools the cold-water demand source while circulating through the cold water pipe 42, the evaporator 8, the cold water pipe 44, and the cold-water demand source.

[0058] FIG. 2 is a schematic view of the evaporator shown in FIG. 1 and FIG. 3 is a partial-cut cross-sectional view of the evaporator shown in FIG. 1.

[0059] The evaporator 8 includes a shell 52 having a space 50 therein through which the refrigerant passes, an oil overflow member 54 disposed in the shell 52 and defining an oil passage between the oil overflow member 54 and the shell 52 such that oil overflows into the oil passage P and then flows toward a lower inner portion of the shell 52 along the oil passage P, and an inner tube 56 through which cold water passes and that is disposed such that the cold water exchanges heat with the refrigerant.

[0060] The shell 52 that is a part forming the external appearance of the evaporator is formed in a cylindrical shape with a space 50 therein, to be long in the transverse direction.

[0061] The shell 52 has a refrigerant outlet 62 at the top and an oil outlet 64 at the bottom.

[0062] For the shell 52, the compressor intake pipe 10 is connected to the refrigerant outlet 62 and the evaporator oil return channel is connected to the oil outlet 64.

[0063] The shell 52 has a refrigerant inlet-through portion 66 through which a refrigerant inlet 78 passes.

[0064] The refrigerant inlet-through portion 66 is formed to be spaced from the oil outlet 65.

[0065] The oil overflow member 54 has a receiving space S therein and the refrigerant expanded by the expander is received and the inner tube 56 is positioned in the receiving space S.

[0066] The oil overflow member 54 is a kind of container that is a member dividing the space 50 of the shell 52 into the receiving space S and the oil passage P and filled with oil, and the refrigerant flowing in the receiving space S is evaporated while exchanging heat with the cold water of the inner tube 56 in the receiving space S.

[0067] An oil foaming layer A at the upper portion of the receiving space S and a refrigerant layer B where the refrigerant is positioned is formed under the oil foaming layer A in the receiving space S when the chiller operates, and it is preferable that the inner tube 56 is installed at a position lower than the top of the refrigerant layer B.

[0068] The top of the oil overflowing member 54 is open. The gaseous refrigerant evaporated in the receiving space S is discharged to the refrigerant outlet 62 after passing through the top of the oil overflow member 54.

[0069] The oil overflow member 54 has a left part 70 spaced from the inner left side 52A of the shell 52 and a right part 72 spaced from the inner right side 52B of the shell 52 and the left part 70.

[0070] The oil overflow member 54 is formed such that the gap between the left part 70 and the right part 72 is larger than the gap between the left side 52A of the shell 52 and the left part 70 and larger than the gap between the right side 52B of the shell 52 and the right part 72. That is, the length of the receiving space S is formed to be larger than the length of the oil passage P.

[0071] The oil overflow member 54 further has a circumferential part 74 formed between the left part 70 and the right part 72 and defining the receiving space S between the left part 70 and the right part 72.

[0072] The circumferential part 74 is spaced from the shell 52.

[0073] The circumferential part 74 has a semicircular cross-sectional shape.

[0074] The refrigerant inlet 76 allowing the refrigerant expanded by the expander 6 from flowing into the receiving space S is connected to the circumferential part 74.

[0075] The refrigerant inlet 76 is a communicating pipe that communicates with the oil overflow member 54 such that the refrigerant expanded by the expander 6 directly flows into the oil overflow member 54.

[0076] The refrigerant inlet 76 protrudes integrally with the oil overflow member 54 and is connected to the expander-evaporator connection pipe 30, such that a portion of the oil overflow member 54 can function as the refrigerant inlet 76.

[0077] For the refrigerant inlet 76, as a portion of the expander-evaporator connection pipe 30 is connected to the oil overflow member 54 through the shell 52, a portion of the expander-evaporator connection pipe 30 can function as the refrigerant inlet 76.

[0078] The refrigerant inlet 76 may also function as a separate connection pipe that allows the expander-evaporator connection pipe 30 and the oil overflow member 54 to communicate with each other by connecting one end to the oil overflow member 54 and connecting the other end to the expander-evaporator connection pipe 30.

[0079] Meanwhile, for the shell 52 and the oil overflow member 54, a left oil passage is formed between the left side 52A and the left part 70, a right oil passage is formed between the right side 52B of the shell 52 and the right part 72, and a circumferential oil passage is formed between the circumferential surface of the shell 52 and the circumferential part 74.

[0080] At least one of the left part 70 and the right part 72 of the oil overflow member 54 may be in close contact with the shell 52 such that at least one of the left oil passage and the right oil passage is not formed.

[0081] The circumferential part 74 of the oil overflow member 54 may be in close contact with the shell 52 such that the circumferential oil passage is not formed.

[0082] All of the left part 70, the right part 72, and the circumferential part 74 of the oil overflow member 54 may be spaced from the shell 52 such that oil passages are formed between the shell 52 and them.

[0083] It is preferable that all of the left part 70, the right part 72, and the circumferential part 74 of the oil overflow member 54 are spaced from the shell 52 such that the refrigerant filling up the receiving space S of the oil overflow member 54 quickly overflows.

[0084] Meanwhile, oil overflow member-fixing members 71, 73, 75 that fix the oil overflow member 54 to be spaced from the shell 52 may be installed between the shell 52 and the oil overflow member 54.

[0085] That is, in the oil overflow member 54, the receiving space S between the left part 70, the right part 72, and the circumferential part 74 is filled with the refrigerant and the oil, the portion of the inner tube 56 which is positioned in the receiving space S of the oil overflow member 54 evaporates the refrigerant in the receiving space S, and the oil overflowing the oil overflow member 54 is discharged after flowing between the oil overflow member 54 and the shell 52 through the oil passage P.

[0086] The oil overflow member 54 is installed at a height where oil can overflow when the compressor 2 is driven.

[0087] When the upper end of the oil overflow member 54 is too high, oil cannot overflow, and when the upper end is too low, the refrigerant can overflow with the oil to the oil passage P even under partial load, such that it is possible to set the height of the upper end with reference to the maximum load and it is the most preferable to set the height of the upper end such that the oil in the receiving space S can overflow when the compressor 2 is driven, that is, the compressor 2 operates with 100% capacity.

[0088] An inner tube through-hole 78 through which the inner tube 56 passes is formed at at least one of the left part 70 and the right part 72 of the oil overflow member 54.

[0089] The inner tube 56 is installed such that at least a portion is positioned in the receiving space S and it is preferable that the portion is positioned as much as possible in the receiving space S.

[0090] The operation of the present invention having the configuration described above is described hereafter.

[0091] First, when the compressor 2 is driven, refrigerant and oil are discharged from the compressor 2 and some of the oil returns to the compressor 2 through the oil return pipe 18 and the compressor intake pipe 10 after being divided by the oil separator 14.

[0092] The oil not separated from the refrigerant by the oil separator 14 flows with the refrigerant into the condenser 4, the refrigerant is condensed in the condenser 4, and the refrigerant and the oil flow into the expander 6.

[0093] The condensed refrigerant is expanded in the expander 6 and flows with the oil into the evaporator 8.

[0094] The refrigerant and the oil flowing in the evaporator 8 fill the receiving space S of the oil overflow member 54 through the refrigerant inlet 76.

[0095] The oil and the refrigerant filled in the receiving space S evaporate while exchanging heat with the inner tube 56 and the oil foaming layer B is formed as the oil is positioned over the refrigerant layer A, in which when the oil foaming layer B is higher than the upper end of the oil overflow member 54, the oil and some of liquid refrigerant overflow the upper end of the oil overflow member 54 and flow to the oil passage P.

[0096] The oil and some of liquid refrigerant in the oil passage P flow to the oil outlet 64 through between the shell 52 and the oil overflow member 54, and are sucked into the compressor intake pipe 10 through the evaporator oil return channel 32.

[0097] Meanwhile, the gaseous refrigerant evaporated in the receiving space S of the oil overflow member 54 passes through the oil foaming layer B remaining in the receiving space S, in which the maximum height of the oil foaming layer B keeps constant, such that the gaseous refrigerant quickly passes through the oil foaming layer B.

[0098] The gaseous refrigerant that has passed through the oil foaming layer B, as described above, flows to the upper portion of the oil overflow member 54 and then is sucked into the compressor intake pipe 10 through the refrigerant outlet 62.

[0099] The refrigerant sucked in the compressor intake pipe 10 is sucked into the compressor 2 together with the oil returned through the oil return channel 32 and the oil return pipe 18, such that the oil and the refrigerant continuously circulates/returns, as described above.

Claims

1. A chiller comprising:

    a compressor configured to compress a refrigerant;
    a condenser configured to condense the refrigerant compressed by the compressor;
    an expander configured to expand the refrigerant condensed by the condenser; and
    an evaporator in which the refrigerant expanded by the expander cools cold water,
    wherein the evaporator includes:

    a shell having a space therein through which the refrigerant passes;
    an inner tube through which cold water passes and that is disposed such that the cold water exchanges heat with the refrigerant; and
    an oil overflow member disposed in the shell and defining an oil passage between the oil overflow member and the shell such that the oil overflow into the oil passage and then flows toward a lower inner portion of the shell along the oil passage.

2. The chiller of claim 1, wherein the oil overflow member has a receiving space therein which receives the refrigerant expanded by the expander and where at least a portion of the inner tube is positioned.

3. The chiller of claim 2, wherein the top of the oil overflow member is open.

4. The chiller of claim 3, wherein the oil overflow member has a left part spaced from an inner left side of the shell and a right part spaced from an inner right side of the shell and the left part.

5. The chiller of claim 4, wherein an inner tube through-hole through which the inner tube passes is formed at at least one of the left part and the right part of the oil overflow member.

6. The chiller of claim 4, wherein the oil overflow member further has a circumferential part formed between the left part and the right part and defining the receiving space between the left part and the right part.

7. The chiller of claim 6, wherein the circumferential part is spaced from the shell.

8. The chiller of claim 6, wherein the circumferential part has a semicircular cross-section.

9. The chiller of claim 1, wherein oil overflow member-fixing members that fix the oil overflow member to be spaced from the shell are installed between the shell and the oil overflow member.

10. The chiller of claim 2, wherein the shell has a refrigerant outlet at the top and an oil outlet at the bottom, and
    a refrigerant inlet through which the refrigerant expanded by the expander flows into the receiving space is connected to the oil overflow member.

11. The chiller of claim 10, wherein the shell has a refrigerant inlet-through portion through which the refrigerant inlet passes.

12. The chiller of claim 11, wherein the refrigerant inlet-through portion is spaced from the oil outlet.

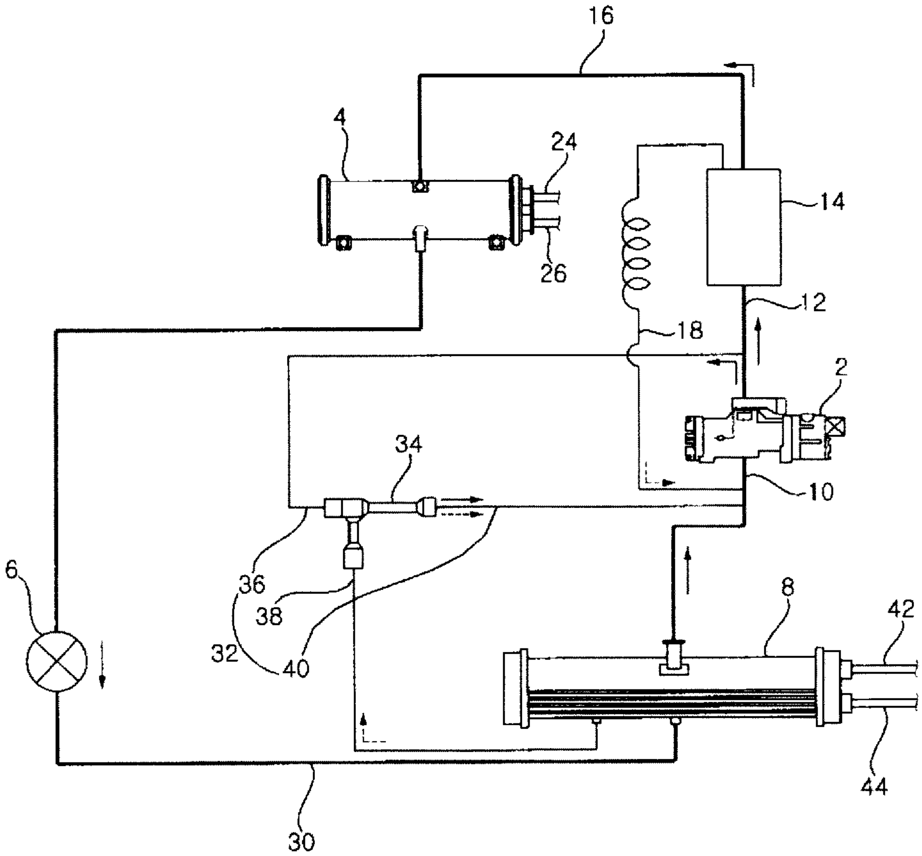
13. The chiller of claim 10, wherein an oil return channel for returning the oil to the intake side of the compressor is connected the oil outlet.

14. A chiller comprising:

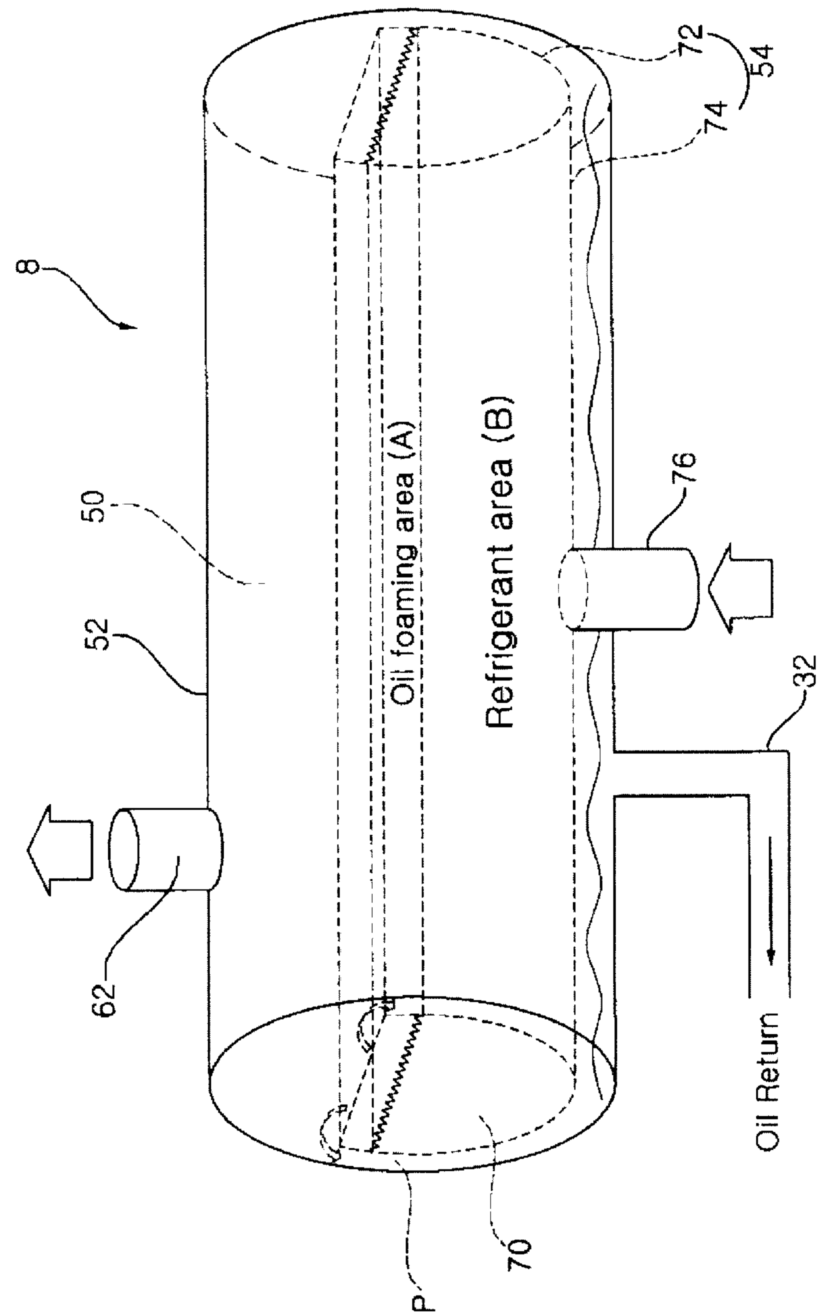
    an ejector;
    an ejector intake pipe guiding some of a high-pressure refrigerant discharged from a compressor to the ejector by connecting the ejector with a discharge pipe of the compressor;
    an evaporator oil intake pipe guiding the oil in an evaporator to be sucked into the ejector when a high-pressure refrigerant flows to the ejector, by connecting the evaporator with the ejector; and
    an ejector outlet pipe returning the refrigerant passing through the ejector to the compressor.

15. The chiller of claim 1, wherein the oil overflow member is installed at a height where the oil can overflow, when the compressor is driven.

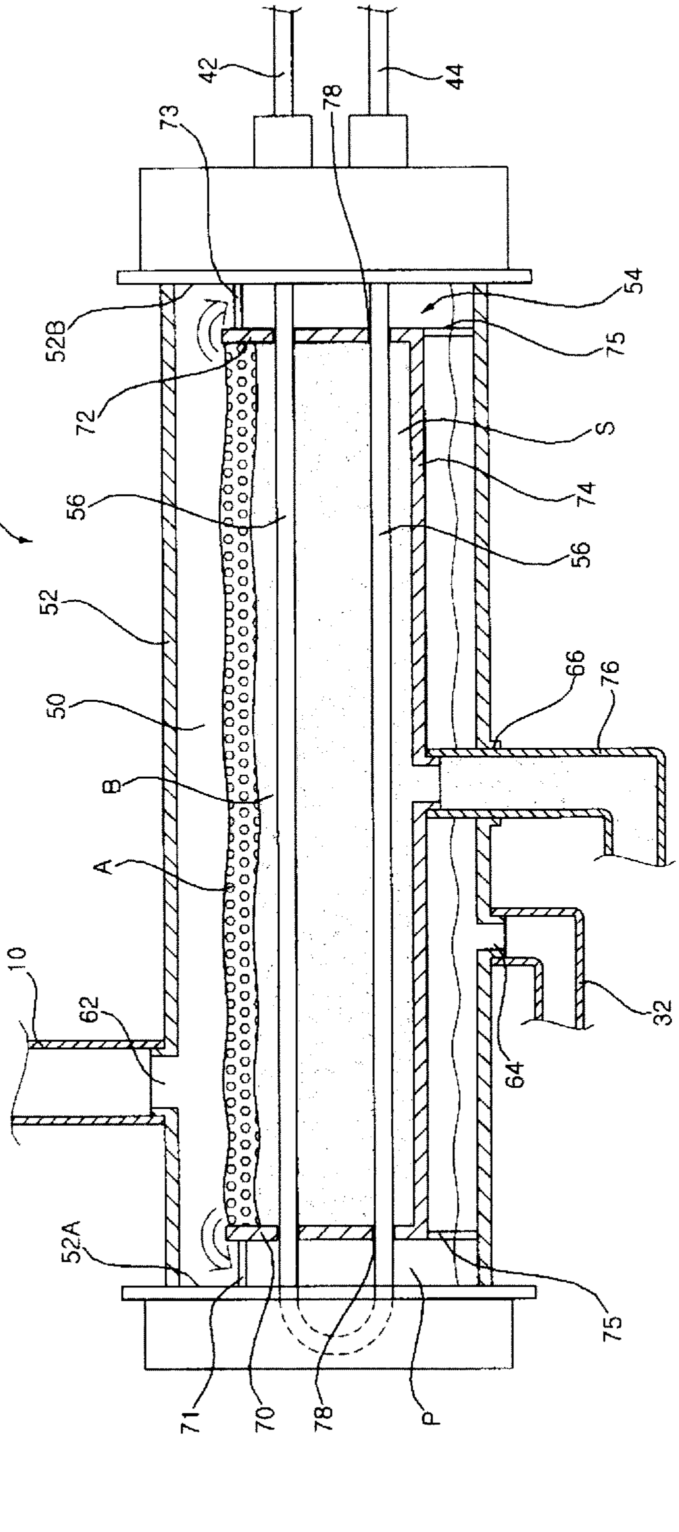
[Fig. 1]



[Fig. 2]


8
50
52
62
Oil foaming area (A)
Refrigerant area (B)
76
32
Oil Return
72
74
54
70
P

[Fig. 3]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INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2010/003721

A. CLASSIFICATION OF SUBJECT MATTER

F25B 1/00(2006.01)i, F28D 7/06(2006.01)i, F25B 45/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F25B 1/00; F04B 27/10; F25B 41/00; F25B 43/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Utility models and applications for Utility models: IPC as above
Japanese Utility models and applications for Utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS (KIPO internal) & Keywords: oil, separate, tube, overflow

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 10-0590653 B1 (MODINE KOREA, LLC) 19 June 2006 Claims 2, 3 and figure 3	1-15
A	JP 10-054627 A (SAMSUNG ELECTRON CO LTD) 24 February 1998 Claims 1-3 and figures 1-3	1-15
A	JP 2006-194534 A (DENSO CORP) 27 July 2006 Claims 1-3 and figures 1-3	1-15
A	EP 1477670 A3 (KABUSHIKI KAISHA TOYOTA JIDOSHOKKI) 17 November 2004 Abstract, figure 1	1-15
A	JP 2005-055113 A (DENSO CORP) 03 March 2005 Claims 1-3 and figures 1-3	1-15

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 MARCH 2011 (10.03.2011)	**14 MARCH 2011 (14.03.2011)**

Name and mailing address of the ISA/KR	Authorized officer
Korean Intellectual Property Office Government Complex-Daejeon, 139 Seonsa-ro, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

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