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(54) **Compressor oil recovering apparatus and multi-unit air conditioner equipped with the same**

(57) A compressor oil recovering apparatus is disclosed which is capable of smoothly re-supplying, to a compressor, oil separated in an oil separator after emerging from the compressor, thereby achieving an enhancement in the reliability of the compressor, and thus, an enhancement in the performance of an air conditioner using the compressor oil recovering apparatus. A multi-unit air conditioner using the compressor oil recovering

apparatus is also disclosed. The compressor oil recovering apparatus includes an oil separator adapted to separate oil from a refrigerant discharged from a compressor, an oil recovering port provided at the compressor, and an oil recovering tube having one end connected to the oil separator, and the other end connected to the oil recovering port.

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Description

[0001] This application claims the benefit of Korean Patent Application No.P2004-94996, filed on November 19, 2004, which is hereby incorporated by reference as if fully set forth herein.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The present invention relates to an air conditioner, and more particularly, to a compressor oil recovering apparatus and a multi-unit air conditioner equipped with the same.

Discussion of the Related Art

[0003] Generally, air conditioners perform procedures of compressing, condensing, expanding and evaporating a refrigerant to cool and/or heat a confined space. Such air conditioners are classified into a cooling type wherein a refrigerant flows only in one direction through a refrigerant cycle, to supply cold air to a confined space, and a cooling and heating type wherein a refrigerant flows bidirectionally in a selective manner through a refrigerant cycle, to selectively supply cold air or hot air to a confined space.

[0004] Also, such air conditioners are classified into a general type wherein one indoor unit is connected to one outdoor unit, and a multi-unit type wherein a plurality of indoor units are connected to one outdoor unit. For the multi-unit type, an air conditioner may be implemented which includes at least one outdoor unit.

[0005] Meanwhile, the outdoor unit of such a multi-unit air conditioner includes at least one compressor corresponding to the load of the indoor units, and an oil separator connected to a refrigerant discharge line of the compressor, and adapted to separate oil from a refrigerant discharged from the compressor.

[0006] The compressor sucks low-temperature and low-pressure refrigerant gas, compresses the sucked refrigerant gas into high-temperature and high-pressure refrigerant gas, and discharges the resulting refrigerant gas. When such high-temperature and high-pressure refrigerant gas is discharged from the compressor, oil present in the compressor is also discharged together with the refrigerant. The oil contained in the discharged refrigerant is again fed to the compressor after being separated from the refrigerant in the oil separator.

[0007] In the conventional multi-unit air conditioner, however, problems occur when the oil separated by the oil separator is returned to the compressor via a refrigerant suction line.

[0008] That is, the oil separated by the oil separator may be re-discharged together with the refrigerant discharged from the compressor via the refrigerant discharge line, without being returned to the compressor via

the refrigerant suction line. This is because there is a pressure difference between the refrigerant suction line and the refrigerant discharge line due to the flow rate of the refrigerant discharged through the refrigerant discharge line. As a result, shortage of oil may occur in the compressor.

[0009] Such oil shortage may cause abrasion and performance degradation of the compressor. As a result, the compressor exhibits a degradation in reliability.

[0010] The performance degradation of the compressor results in a degradation in the efficiency of the multi-unit air conditioner using the compressor, thereby causing a degradation in cooling/heating performance.

SUMMARY OF THE INVENTION

[0011] Accordingly, the present invention is directed to a compressor oil recovering apparatus and a multi-unit air conditioner equipped with the same that substantially obviate one or more problems due to limitations and disadvantages of the related art.

[0012] An object of the present invention is to provide a compressor oil recovering apparatus which is capable of smoothly re-supplying, to a compressor, oil separated in an oil separator after emerging from the compressor, thereby achieving an enhancement in the reliability of the compressor, and thus, an enhancement in the performance of an air conditioner using the compressor oil recovering apparatus, and to provide a multi-unit air conditioner using the compressor oil recovering apparatus.

[0013] Additional advantages, objects, and features of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The objectives and other advantages of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[0014] To achieve these objects and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, a compressor oil recovering apparatus comprises: an oil separator adapted to separate oil from a refrigerant discharged from a compressor; an oil recovering port provided at the compressor; and an oil recovering tube having one end connected to the oil separator, and the other end connected to the oil recovering port.

[0015] The providing of the oil recovering port may be achieved at positions where oil recovered through the oil recovering tube does not interfere with refrigerant flows respectively sucked along a refrigerant suction tube of the compressor and discharged along a refrigerant discharge line of the compressor.

[0016] The oil recovering port may be arranged at a position of the compressor corresponding to a level of oil initially sealed in the compressor.

[0017] The compressor oil recovering apparatus may

further comprise an adjuster adapted to adjust an amount of oil recovered from the oil separator to the compressor in accordance with an oil storage state of the compressor. The adjuster may comprise an oil sensor adapted to sense an amount of oil stored in the compressor, and a solenoid valve adapted to control supply or cut-off of the oil supplied to the compressor, and an amount of the supplied oil, based on the sensed oil amount. The oil sensor may be arranged in the compressor. The solenoid valve may be arranged at the oil recovering tube. The adjuster may comprise a float adapted to sense a level of oil stored in the compressor, and a float valve adapted to control supply or cut-off of the oil supplied to the compressor, and an amount of the supplied oil, based on the sensed oil level. The float valve may be arranged at the oil recovering tube.

[0018] The compressor oil recovering apparatus may further comprise a strainer arranged at the oil recovering tube, and adapted to filter the oil recovered to the compressor through the oil recovering tube to remove foreign matter contained in the oil.

In another aspect of the present invention, a multi-unit air conditioner comprises: an outdoor unit comprising a plurality of compressors, and an outdoor heat exchanger; a plurality of indoor units connected to the outdoor unit, each of the indoor units comprising an indoor heat exchanger; a plurality of oil separators each adapted to separate oil from a refrigerant discharged from an associated one of the compressors; a plurality of oil recovering port provided at the plurality of compressors, respectively; and a plurality of oil recovering tubes each having one end connected to an associated one of the oil separators, and the other end connected to the associated oil recovering port corresponding to the associated oil separator.

[0019] The providing of each of the oil recovering ports may be achieved at positions where oil recovered through the oil recovering tube does not interfere with refrigerant flows respectively sucked along a refrigerant suction tube of the associated compressor and discharged along a refrigerant discharge line of the associated compressor. The oil recovering port may be arranged at a position of the compressor corresponding to a level of oil initially sealed in the compressor.

[0020] The multi-unit air conditioner may further comprise an adjuster adapted to adjust an amount of oil recovered from each of the oil separators to the compressor associated with the oil separator in accordance with an oil storage state of the associated compressor. The adjuster may comprise oil sensors each adapted to sense an amount of oil stored in an associated one of the compressors, and solenoid valves each adapted to control supply or cut-off of the oil supplied to an associated one of the compressors, and the amount of the supplied oil in accordance with the oil amount sensed by the oil sensor corresponding to the associated compressor.

[0021] The oil sensors may be arranged in the associated compressors, respectively. The solenoid valves may be arranged at the oil recovering tubes, respectively.

The adjuster may comprise floats each adapted to sense a level of oil stored in an associated one of the compressors, and float valves each adapted to control supply or cut-off of the oil supplied to an associated one of the compressors, and an amount of the supplied oil, based on the oil level sensed by the float corresponding to the associated compressor. The float valves may be arranged at the oil recovering tubes, respectively.

[0022] The multi-unit air conditioner may further comprise strainers each arranged at an associated one of the oil recovering tubes, and adapted to filter the oil recovered to the compressor corresponding to the associated oil recovering tube through the associated oil recovering tube to remove foreign matter contained in the oil. In another aspect of the present invention, a multi-unit air conditioner comprises: an outdoor unit comprising a plurality of compressors, and an outdoor heat exchanger; a plurality of indoor units connected to the outdoor unit, each of the indoor units comprising an indoor heat exchanger; a plurality of oil separators each adapted to separate oil from a refrigerant discharged from an associated one of the compressors; a plurality of oil recovering port provided at the plurality of compressors, respectively; a plurality of oil recovering tubes each having one end connected to an associated one of the oil separators, and the other end connected to the associated oil recovering port corresponding to the associated oil separator; a plurality of temperature sensors each arranged in an associated one of the compressors, and adapted to sense an internal temperature of the associated compressor; and a uniform distribution tube which communicates with the compressors, and uniformly distributes oil to the compressors, based on the temperatures respectively sensed by the temperature sensors.

[0023] The multi-unit air conditioner may further comprise a strainer arranged at the uniform distribution tube, and adapted to filter oil flowing through the uniform distribution tube to remove foreign matter contained in the oil.

[0024] It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the invention and together with the description serve to explain the principle of the invention. In the drawings:

[0026] FIG. 1 is a schematic view illustrating a first embodiment of a compressor oil recovering apparatus according to the present invention;

[0027] FIG. 2 is a schematic view illustrating a second embodiment of a compressor oil recovering apparatus

according to the present invention;

[0028] FIG. 3 is a partially-broken perspective view illustrating a first embodiment of a multi-unit air conditioner according to the present invention;

[0029] FIG. 4 is a schematic view illustrating a refrigerant cycle established during a cooling operation of the multi-unit air conditioner shown in FIG. 3;

[0030] FIG. 5 is a schematic view illustrating a compressor oil recovering structure included in an outdoor unit shown in FIG. 3;

[0031] FIG. 6 is a schematic view illustrating another compressor oil recovering structure included in the outdoor unit shown in FIG. 3;

[0032] FIG. 7 is a partially-broken perspective view illustrating a second embodiment of a multi-unit air conditioner according to the present invention;

[0033] FIG. 8 is a schematic view illustrating a refrigerant cycle established during a cooling operation of the multi-unit air conditioner shown in FIG. 7;

[0034] FIG. 9 is a schematic view illustrating a compressor oil recovering structure included in an outdoor unit shown in FIG. 7; and

[0035] FIG. 10 is a schematic view illustrating another compressor oil recovering structure included in the outdoor unit shown in FIG. 7.

DETAILED DESCRIPTION OF THE INVENTION

[0036] Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[0037] First, a first embodiment of a compressor oil recovering apparatus according to the present invention will be described with reference to FIG. 1.

[0038] As shown in FIG. 1, the compressor oil recovering apparatus according to the first embodiment of the present invention includes a compressor 83, which is included in an air conditioner, an oil separator 85 for separating oil from a refrigerant discharged from the compressor 83, and an oil recovering port 830 provided at the compressor 83.

[0039] The compressor oil recovering apparatus also includes an oil recovering tube 163 having one end connected to the oil separator 85, and the other end connected to the oil recovering port 830.

[0040] The connection of the oil recovering port 830 is achieved at positions where oil recovered through the oil recovering tube 163 does not interfere with refrigerant flows respectively sucked along a refrigerant suction tube 83b of the compressor 83 and discharged along a refrigerant discharge line 83a of the compressor 83. That is, the oil recovering port 830 communicates with a lower portion of the compressor 83 at a position lower than the refrigerant suction line 83b. In accordance with this arrangement, it is possible to prevent oil, which is re-intro-

duced into the compressor 83 through the oil recovering tube 163, from being discharged from the compressor 83, together with the refrigerant flowing in the compressor 83, before the oil is stored in the compressor 83. The compressor oil recovering apparatus further includes a strainer 163a arranged at the oil recovering tube 163, and adapted to filter the oil recovered to the compressor to remove foreign matter contained in the oil.

[0041] It is preferred that the oil recovering port 830 be formed at a position of the compressor 83 corresponding to the level of the surface of oil initially sealed in the compressor 83.

[0042] The compressor oil recovering apparatus further includes an adjuster for adjusting the amount of oil supplied from the oil separator 85 to the compressor 83 in accordance with the oil storage state of the compressor 83.

[0043] The adjuster includes an oil sensor 173a adapted to sense the amount of oil stored in the compressor 83, and a solenoid valve 173b adapted to control the supply or cut-off of the oil supplied to the compressor 83, and the amount of the supplied oil in accordance with the oil amount sensed by the oil sensor 173a. The oil sensor 173a is arranged in the compressor 83, and the solenoid valve 173b is arranged at the oil recovering tube 163.

[0044] Hereinafter, operation of the compressor oil recovering apparatus having the above-described configuration according to the first embodiment of the present invention will be described.

[0045] When the compressor 83 operates, low-temperature and low-pressure refrigerant gas is sucked into the compressor 83 through the refrigerant suction line 83b. The sucked refrigerant is compressed to a high-temperature and high-pressure state while passing through the compressor 83, and is then discharged from the compressor 83 through the refrigerant discharge line 83a.

[0046] When the high-temperature and high-pressure refrigerant is discharged from the compressor 83, oil present in the compressor 83 is also discharged together with the refrigerant. The refrigerant is then introduced into the oil separator 85 which, in turn, separates oil from the refrigerant. The oil separated by the oil separator 85 is stored in the oil separator 85. The stored oil is subsequently supplied to the compressor 83 via the oil recovering tube 163 connected to the oil recovering port 830.

[0047] Since the oil recovering tube 163 communicates with the lower portion of the compressor 83 at a position lower than the refrigerant suction tube 83b, as described above, the oil in the oil separator 85 can be supplied to the compressor 83 through the oil recovering tube 163 without any interference with the refrigerant which flows in the compressor 83. Accordingly, the oil supplied to the compressor 83 is smoothly received in the lower portion of the compressor 83.

[0048] Meanwhile, the oil, which is re-introduced into the compressor through the oil recovering tube 163, as described above, can be selectively supplied to the com-

pressor 83 only when the supply of the oil is required, using the adjuster. That is, the oil sensor 173a senses the oil storage state of the compressor 83 during the operation of the compressor 83. Based on the sensed oil storage state, the opening degree of the solenoid valve 173b can be adjusted to adjust the amount of oil supplied to the compressor 83. Thus, it is possible to not only supply the oil stored in the oil separator 85 at the point of time when shortage of oil occurs in the compressor 83, but also to smoothly store the supplied oil in the lower portion of the compressor 83.

[0049] Next, a second embodiment of a compressor oil recovering apparatus according to the present invention will be described with reference to FIG. 2.

[0050] As shown in FIG. 2, the compressor oil recovering apparatus according to the second embodiment of the present invention includes a compressor 83, an oil separator 85, an oil recovering port 830, an oil recovering tube 163, a strainer 163a, and an adjuster, identically to the above-described first embodiment.

[0051] Contrary to the first embodiment, however, the adjuster of the second embodiment includes a float 183a adapted to sense the level of oil stored in the compressor 83, and a float valve 183b for controlling the supply or cut-off of the oil supplied to the compressor 83, and the amount of the supplied oil in accordance with the oil level sensed by the float 183a. The float valve 183b is arranged at the oil recovering tube 163.

[0052] Similarly to the first embodiment, in accordance with the second embodiment, it is possible to not only supply the oil stored in the oil separator 85 immediately at the point of time when shortage of oil occurs in the compressor 83, but also to smoothly store the supplied oil in the lower portion of the compressor 83.

[0053] Next, a first embodiment of a multi-unit air conditioner according to the present invention will be described with reference to FIGs. 3 to 6.

As shown in FIGs. 3 and 4, the multi-unit air conditioner according to the first embodiment of the present invention includes an outdoor unit 80, which includes a plurality of compressors 83 and 84, and an outdoor heat exchanger 82, and a plurality of indoor units 51, 52, 53, and 54 connected to the outdoor unit 80. Each of the indoor units 51, 52, 53, and 54 includes an indoor heat exchanger 74. The multi-unit air conditioner also includes a plurality of oil separators 85 and 86 each adapted to separate oil from a refrigerant discharged from an associated one of the compressors 83 and 84, a plurality of oil recovering port 830 and 840 each provided to an associated one of the compressors 83 and 84, and a plurality of oil recovering tubes 163 and 164 each having one end connected to an associated one of the oil separators 85 and 86, and the other end connected to an associated one of the oil recovering port 830 and 840 corresponding to the associated oil separator 85 or 86.

[0054] As shown in FIG. 5, the providing of each of the oil recovering port 830 and 840 is achieved at positions where oil recovered through the oil recovering tube 163

does not interfere with refrigerant flows respectively sucked along a refrigerant suction tube 83b or 84b of the associated compressor 83 or 84 and discharged along a refrigerant discharge line 83a 84a of the associated compressor 83 or 84. That is, each of the oil recovering port 830 and 840 communicates with a lower portion of the associated compressor 83 or 84 at a position lower than the associated refrigerant suction line 83b or 84b. In accordance with this arrangement, it is possible to prevent oil, which is re-introduced into the compressors 83 and 84 through the oil recovering tubes 163 and 164, from being discharged from the compressors 83 and 84, together with the refrigerant flowing in the compressors 83 and 84, before the oil is stored in the compressors 83 and 84. The multi-unit air conditioner further includes strainers 163a and 164a respectively arranged at the oil recovering tubes 163 and 164, and adapted to filter the oil recovered to the compressors 83 and 84 through the oil recovering tubes 163 and 164 to remove foreign matter contained in the oil.

[0055] It is preferred that the oil recovering port 830 and 840 be formed at a position of the associated compressor 83 or 84 corresponding to the level of the surface of oil initially sealed in the associated compressor 83 or 84.

[0056] The multi-unit air conditioner further includes an adjuster for adjusting the amount of oil supplied from each of the oil separators 85 and 86 to the associated compressor 83 or 84 in accordance with the oil storage state of the associated compressor 83 or 84.

[0057] The adjuster includes oil sensors 173a and 174a each adapted to sense the amount of oil stored in an associated one of the compressors 83 and 84, and solenoid valves 173b and 174b each adapted to control the supply or cut-off of the oil supplied to an associated one of the compressors 83 and 84, and the amount of the supplied oil in accordance with the oil amount sensed by the oil sensor 173a or 174b corresponding to the associated compressor 83 or 84. The oil sensors 173a and 174a are arranged in the compressors 83 and 84, respectively, and the solenoid valves 173b and 174b are arranged at the oil recovering tubes 163 and 164, respectively.

[0058] Meanwhile, FIG. 6 is a schematic view illustrating another compressor oil recovering structure in the outdoor unit of FIG. 3. This compressor oil recovering structure includes an adjuster having a configuration different from that of the above-described adjuster. As shown in FIG. 6, the adjuster includes floats 183a and 184a, and float valves 183b and 184b, contrary to the above-described oil sensors 173a and 174a, and solenoid valves 173b and 174b. Each of the floats 183a and 184a senses the level of oil stored in an associated one of the compressors 83 and 84. Each of the float valves 183b and 184b controls the supply or cut-off of the oil supplied to an associated one of the compressors 83 and 84, and the amount of the supplied oil in accordance with the oil level sensed by the float 183a or 184b correspond-

ing to the associated compressor 83 or 84. The float valves 183b and 184b are arranged at the oil recovering tubes 163 and 164, respectively.

[0059] Hereinafter, operation of the multi-unit air conditioner having the above-described configuration according to the first embodiment of the present invention will be described.

[0060] When the multi-unit air conditioner operates, the compressors 83 and 84 suck low-temperature and low-pressure refrigerant gas through the refrigerant suction lines 83b and 84b, respectively. The sucked refrigerant is compressed to a high-temperature and high-pressure state while passing through the compressors 83 and 84, and is then discharged from the compressors 83 and 84 through the refrigerant discharge lines 83a and 84a, respectively.

[0061] When the high-temperature and high-pressure refrigerant is discharged from the compressors 83 and 84, oil present in the compressors 83 and 84 is also discharged together with the refrigerant. The refrigerant is then introduced into the oil separators 85 and 86 which, in turn, separate oil from the refrigerant. The oil separated by each oil separator 85 or 86 is stored in the oil separator 85 or 86. The oil stored in each of the oil separators 85 and 86 is subsequently supplied to an associated one of the compressors 83 and 84 via an associated one of the oil recovering tubes 163 and 164 connected to an associated one of the oil recovering ports 830 and 840.

[0062] Since each of the oil recovering tubes 163 and 164 communicates with the lower portion of the associated compressor 83 or 84 at a position lower than the associated refrigerant suction tube 83b or 84b, as described above, the oil can be supplied to the associated compressor 83 or 84 through the oil recovering tube 163 or 164 without any interference with the refrigerant which flows in the associated compressor 83 or 84. Accordingly, the oil supplied to each compressor 83 or 84 is smoothly received in the lower portion of the compressor 83 or 84.

[0063] Meanwhile, the oil, which is re-introduced into the compressor through each of the oil recovering tubes 163 and 164, as described above, can be selectively supplied to the associated compressor 83 or 84 when the supply of the oil is required, using the adjuster. That is, each of the oil sensors 173a and 174a, which are arranged in respective compressors 83 and 84, senses the oil storage state of the associated compressor 83 or 84 during the operation of the associated compressor 83 or 84. Based on the sensed oil storage state, the opening degree of the associated solenoid valve 173b or 174b can be adjusted to adjust the amount of oil supplied to the associated compressor 83 or 84. Thus, it is possible to not only supply the oil stored in each oil separator 85 or 86 at the point of time when shortage of oil occurs in the associated compressor 83 or 84, but also to smoothly store the supplied oil in the lower portion of the associated compressor 83 or 84.

[0064] Meanwhile, the refrigerant, from which oil has been separated in the oil separators 85 and 86, is intro-

duced into the indoor heat exchangers 74 of the indoor units 51, 52, 534, and 54, which operate in cooling mode, after passing through a 4-way valve (designated by "87b" in FIG. 4), the outdoor heat exchanger 82, and an expansion device 88a, in this order. The refrigerant, which passes through the indoor heat exchangers 74, is evaporated while cooling air present around the indoor heat exchangers 74, thereby causing the indoor unit 51, 52, 53, and 54 to function as coolers. The refrigerant is then returned to the compressors 83 and 84 after passing through the 4-way valve 87b and an accumulator (designated by "87a" in FIG. 4). For reference, when it is desired to operate the indoor units 51, 52, 53, and 54 as heaters, this can be achieved by changing the flow of the refrigerant via the 4-way valve 87b such that the refrigerant flows in a direction reverse to that of the cooling mode.

[0065] Next, a second embodiment of a multi-unit air conditioner according to the present invention will be described with reference to FIGs. 7 to 10.

[0066] As shown in FIGs. 7 and 8, the multi-unit air conditioner according to the second embodiment of the present invention includes an outdoor unit 80, a plurality of indoor units 51, 52, 53, and 54, a plurality of oil separators 85 and 86, a plurality of oil recovering ports 830 and 840, a plurality of oil recovering tubes 163 and 164, strainers 163a and 164a, and an adjuster, identically to those of the multi-unit air conditioner according to the first embodiment.

[0067] Since these elements have the same configurations and functions as those of the first embodiment, no detailed description thereof will be given.

[0068] Accordingly, similarly to the first embodiment, the multi-unit air conditioner according to the second embodiment can not only supply the oil stored in each oil separator 85 or 86 immediately at the point of time when shortage of oil occurs in the associated compressor 83 or 84, but also can smoothly store the supplied oil in the lower portion of the associated compressor 83 or 84.

[0069] As shown in FIG. 9, the multi-unit air conditioner according to the second embodiment also includes a plurality of temperature sensors 153 and 154 each arranged in an associated one of the compressors 83 and 84, and adapted to sense an internal temperature of the associated compressor 83 or 84. The multi-unit air conditioner further includes a uniform distribution tube 150 which communicates with the compressors 83 and 84, and uniformly distributes oil to the compressors 83 and 84, based on the temperatures respectively sensed by the temperature sensors 153 and 154.

[0070] Each of the temperature sensors 153 and 154 is arranged in an associated one of the compressors 83 and 84 while being adjacent to an end of the uniform distribution tube 150 corresponding to the associated compressor 83 or 84.

[0071] It is preferred that each end of the uniform distribution tube 150 be arranged at a level not lower than a lower limit of the oil level of the associated compressor

83 or 84. For example, each end of the uniform distribution tube 150 is arranged at a level lower than the position where an end of the associated oil recovering tube 163 or 164 communicating with the associated oil recovering port 830 or 840.

[0072] In the multi-unit air conditioner of the second embodiment, accordingly, it is possible to prevent oil from being non-uniformly distributed in the compressors 83 and 84 due to a difference between the amounts of oil stored in the compressors 83 and 84 caused by a variation in operation load occurring during the operation of the multi-unit air conditioner.

[0073] That is, the suction pressures of the compressors 83 and 84 may be different from each other due to a variation in operation load occurring during the operation of the multi-unit air conditioner. As a result, oil may be non-uniformly distributed to the compressors 83 and 84. Such non-uniform oil distribution can be prevented by the temperature sensors 153 and 154 arranged in respective compressors 83 and 84, and the uniform distribution tube 150 communicating with the compressors 83 and 84 in common. In detail, the temperature sensors 153 and 154 arranged in respective compressors 83 and 84 sense respective internal temperatures of the compressors 83 and 84. When the temperature sensed by each of the temperature sensors 153 and 154 is not higher than a critical temperature of the associated compressor 83 or 84, the compressors 83 and 84 are alternately operated for a predetermined time. As a result, oil flows from one of the compressors 83 and 84, in which a larger amount of oil is stored, to another one of the compressors 83 and 84, in which a smaller amount of oil is stored, through the uniform distribution tube 150 connected between the compressors 83 and 84. Accordingly, oil is uniformly distributed in the compressors 83 and 84. Here, the critical temperature of the compressors 83 and 84 corresponds to the internal temperature of the compressors 83 and 84 exhibited during the operation of the compressors 83 and 84 when a minimal amount of oil required in each of the compressors 83 and 84 is stored.

[0074] Meanwhile, FIG. 10 is a schematic view illustrating another compressor oil recovering structure in the outdoor unit of FIG. 7. This compressor oil recovering structure includes an adjuster having a configuration different from that of the above-described adjuster. As shown in FIG. 10, the adjuster includes floats 183a and 184a, and float valves 183b and 184b, contrary to the above-described oil sensors 173a and 174a, and solenoid valves 173b and 174b. Each of the floats 183a and 184a senses the level of oil stored in an associated one of the compressors 83 and 84. Each of the float valves 183b and 184b controls the supply or cut-off of the oil supplied to an associated one of the compressors 83 and 84, and the amount of the supplied oil in accordance with the oil level sensed by the float 183a or 184b corresponding to the associated compressor 83 or 84. The float valves 183b and 184b are arranged at the oil recovering tubes 163 and 164, respectively. Using this adjuster, it

is possible to not only supply the oil stored in each oil separator 85 or 86 immediately at the point of time when shortage of oil occurs in the associated compressor 83 or 84, but also to smoothly store the supplied oil in the lower portion of the associated compressor 83 or 84, similarly to the case using the above-described adjuster.

[0075] The multi-unit air conditioner according to the present invention, which has been described, has various effects.

[0076] First, in accordance with the present invention, the oil, which is separated from the refrigerant in the oil separators, is smoothly supplied to the oil storing section of each compressor without any interference. Accordingly, there are advantages of preventing abrasion and noise from being generated in the compressors, increasing the life of the compressors, and enhancing the system efficiency of the air conditioner.

[0077] Second, in accordance with the present invention, the oil discharged from each compressor together with the refrigerant is directly recovered to the compressor via a single oil path defined by the oil separator, oil recovering port, and oil recovering tube associated with the compressor. Accordingly, there is an advantage in that it is possible to efficiently recover compressor oil.

[0078] Third, in accordance with the present invention, it is possible to continuously supply an appropriate amount of oil, based on the oil storage state of each compressor. Accordingly, it is possible to prevent oil shortage in the compressors, and non-uniform oil distribution between the compressors, and thus, to achieve an enhancement in the performance of the compressors.

[0079] Fourth, in accordance with the present invention, oil can be uniformly distributed to the compressors immediately at the point of time when shortage of oil occurs in one of the compressors. Accordingly, there are advantages of preventing abrasion and noise from being generated in the compressors, and increasing the life of the compressors.

[0080] Fifth, in accordance with the present invention, it is possible to execute the operation for uniformly distributing oil to the compressors, only when non-uniform distribution of oil in the compressors occurs. Accordingly, it is possible to minimize the consumption of electric power, and thus, to effectively reduce the consumption of energy.

[0081] Sixth, since the performance of the compressors is enhanced in accordance with the present invention, the performance and efficiency of the multi-unit air conditioner using the compressors are enhanced. Accordingly, there is an advantage of an enhancement in cooling/heating performance.

[0082] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit or scope of the inventions. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

Claims**1.** A compressor oil recovering apparatus comprising:

an oil separator adapted to separate oil from a refrigerant discharged from a compressor;
 an oil recovering port provided at the compressor; and
 an oil recovering tube having one end connected to the oil separator, and the other end connected to the compressor.

2. A multi-unit air conditioner comprising:

an outdoor unit comprising a plurality of compressors, and an outdoor heat exchanger;
 a plurality of indoor units connected to the outdoor unit, each of the indoor units comprising an indoor heat exchanger;
 a plurality of oil separators each adapted to separate oil from a refrigerant discharged from an associated one of the compressors;
 a plurality of oil recovering port provided at the plurality of compressors, respectively; and
 a plurality of oil recovering tubes each having one end connected to an associated one of the oil separators, and the other end connected to the associated oil recovering port to the associated oil separator.

3. The compressor oil recovering apparatus according to claim 1 or claim 2, wherein the connection of the oil recovering tube is achieved at positions where oil recovered through the oil recovering tube does not interfere with refrigerant flows respectively sucked along a refrigerant suction tube of the compressor and discharged along a refrigerant discharge line of the compressor.**4.** The compressor oil recovering apparatus according to claim 1 or claim 2, wherein the oil recovering port is arranged at a position of the compressor corresponding to a level of oil initially sealed in the compressor.**5.** The compressor oil recovering apparatus according to claim 1 or claim 2, further comprising:

an adjuster adapted to adjust an amount of oil recovered from the oil separator to the compressor in accordance with an oil storage state of the compressor.

6. The compressor oil recovering apparatus according to claim 5, wherein the adjuster comprises:

an oil sensor adapted to sense an amount of oil stored in the compressor; and

a solenoid valve adapted to control supply or cut-off of the oil supplied to the compressor, and an amount of the supplied oil, based on the sensed oil amount.

7. The compressor oil recovering apparatus according to claim 6, wherein the oil sensor is arranged in the compressor.**8.** The compressor oil recovering apparatus according to claim 6, wherein the solenoid valve is arranged at the oil recovering tube.**9.** The compressor oil recovering apparatus according to claim 5, wherein the adjuster comprises:

a float adapted to sense a level of oil stored in the compressor; and
 a float valve adapted to control supply or cut-off of the oil supplied to the compressor, and an amount of the supplied oil, based on the sensed oil level.

10. The compressor oil recovering apparatus according to claim 9, wherein the float valve is arranged at the oil recovering tube.**11.** The compressor oil recovering apparatus according to claim 1 or claim 2, further comprising:

a strainer arranged at the oil recovering tube, and adapted to filter the oil recovered to the compressor through the oil recovering tube to remove foreign matter contained in the oil.

12. A multi-unit air conditioner comprising:

an outdoor unit comprising a plurality of compressors, and an outdoor heat exchanger;
 a plurality of indoor units connected to the outdoor unit, each of the indoor units comprising an indoor heat exchanger;
 a plurality of oil separators each adapted to separate oil from a refrigerant discharged from an associated one of the compressors;
 a plurality of oil recovering port provided at the plurality of compressors, respectively;
 a plurality of oil recovering tubes each having one end connected to an associated one of the oil separators, and the other end connected to the associated oil recovering port corresponding to the associated oil separator;
 a plurality of temperature sensors each arranged in an associated one of the compressors, and adapted to sense an internal temperature of the associated compressor; and
 a uniform distribution tube which communicates with the compressors, and

uniformly distributes oil to the compressors,
based on the temperatures respectively sensed
by the temperature sensors.

13. The multi-unit air conditioner according to claim 12, 5
further comprising:

a strainer arranged at the uniform distribution
tube, and adapted to filter oil flowing through the
uniform distribution tube to remove foreign mat- 10
ter contained in the oil.

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FIG. 1

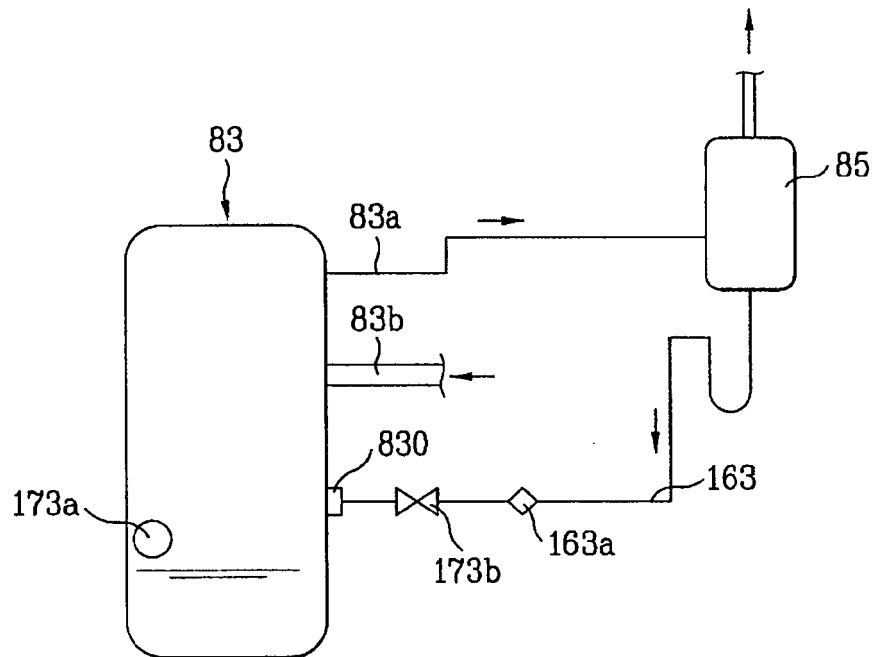


FIG. 2

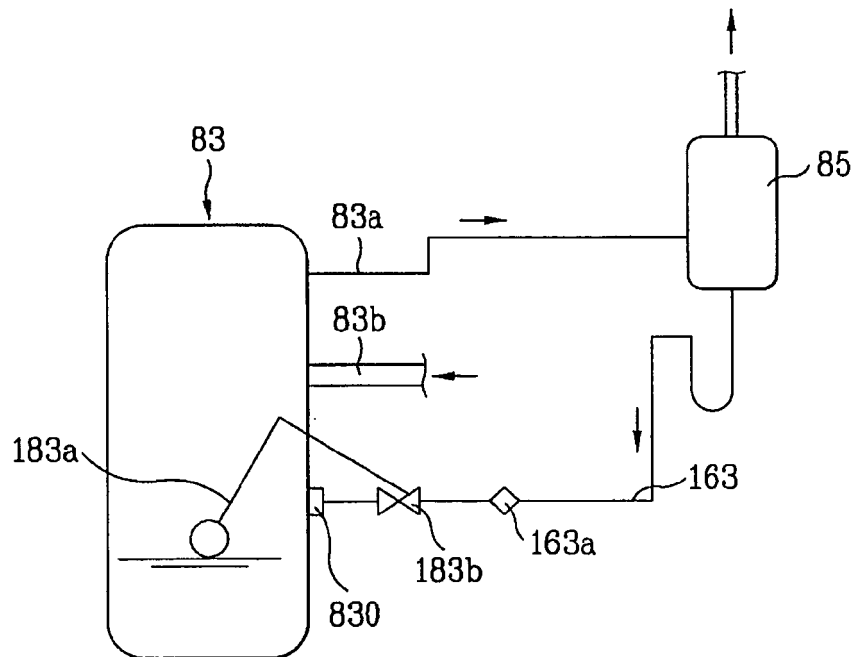


FIG. 3

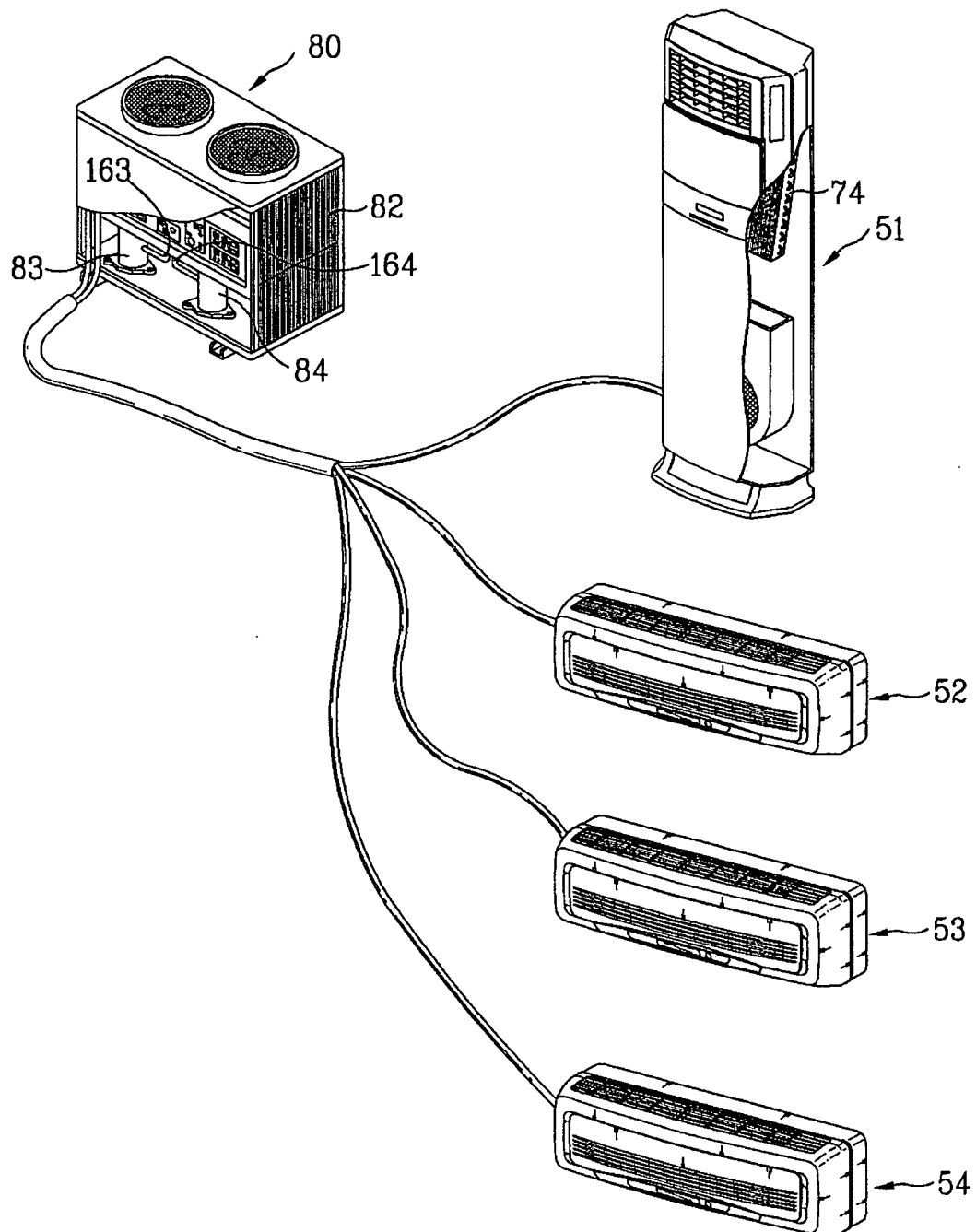


FIG. 4

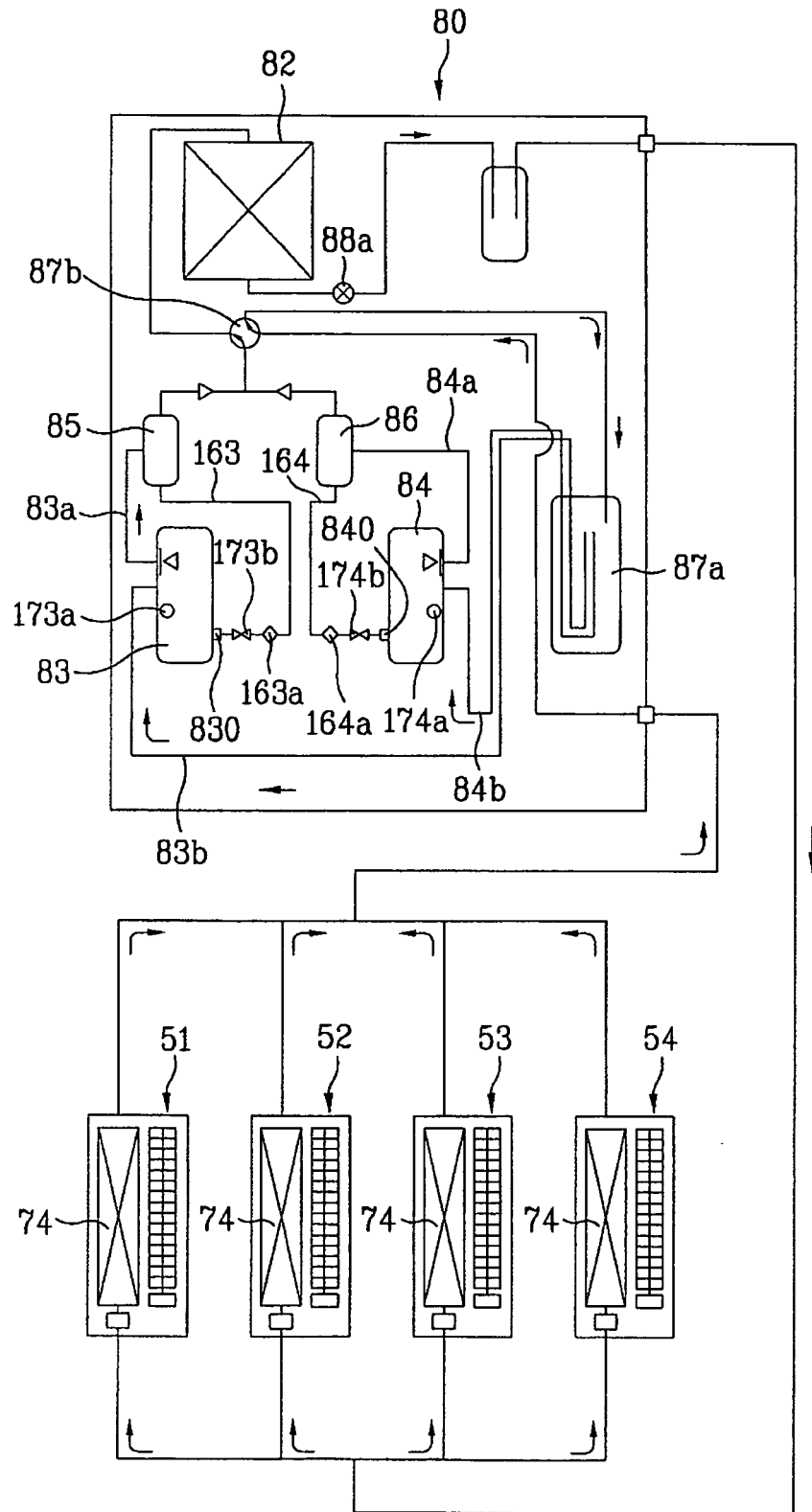


FIG. 5

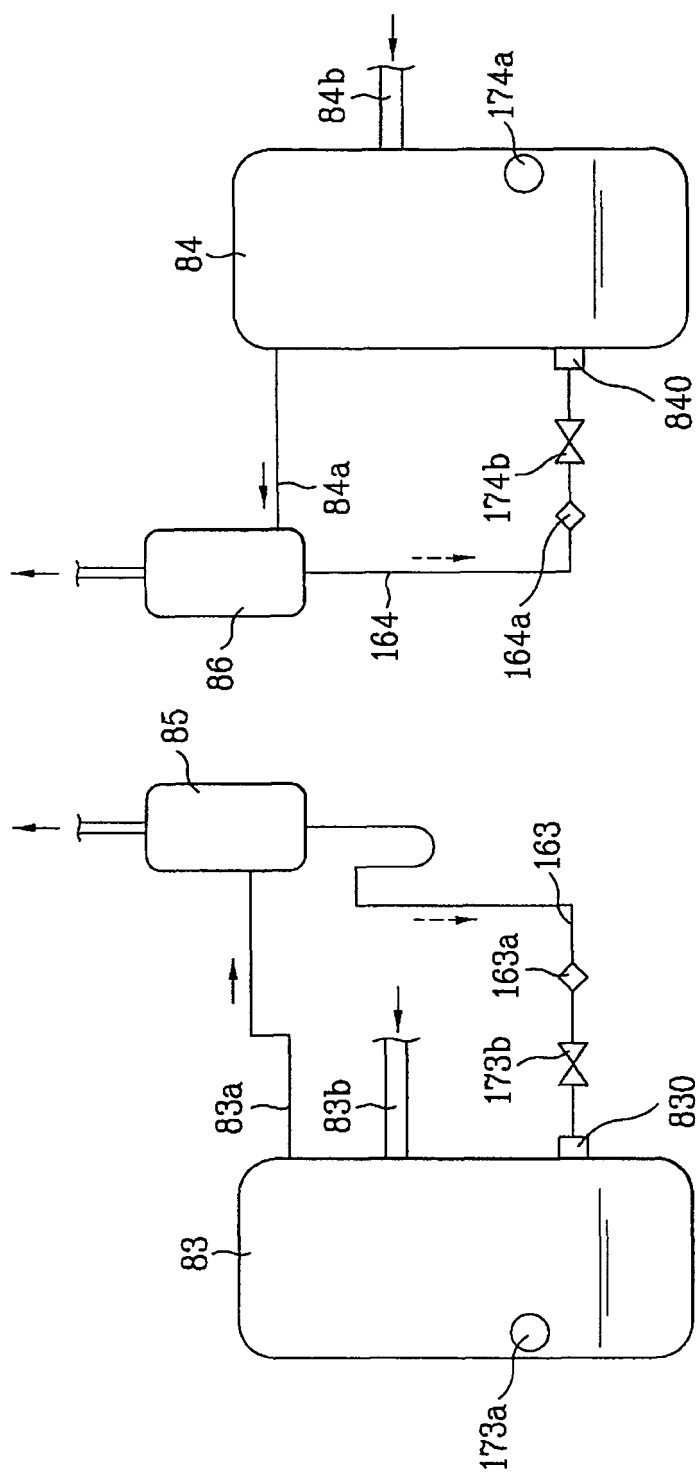


FIG. 6

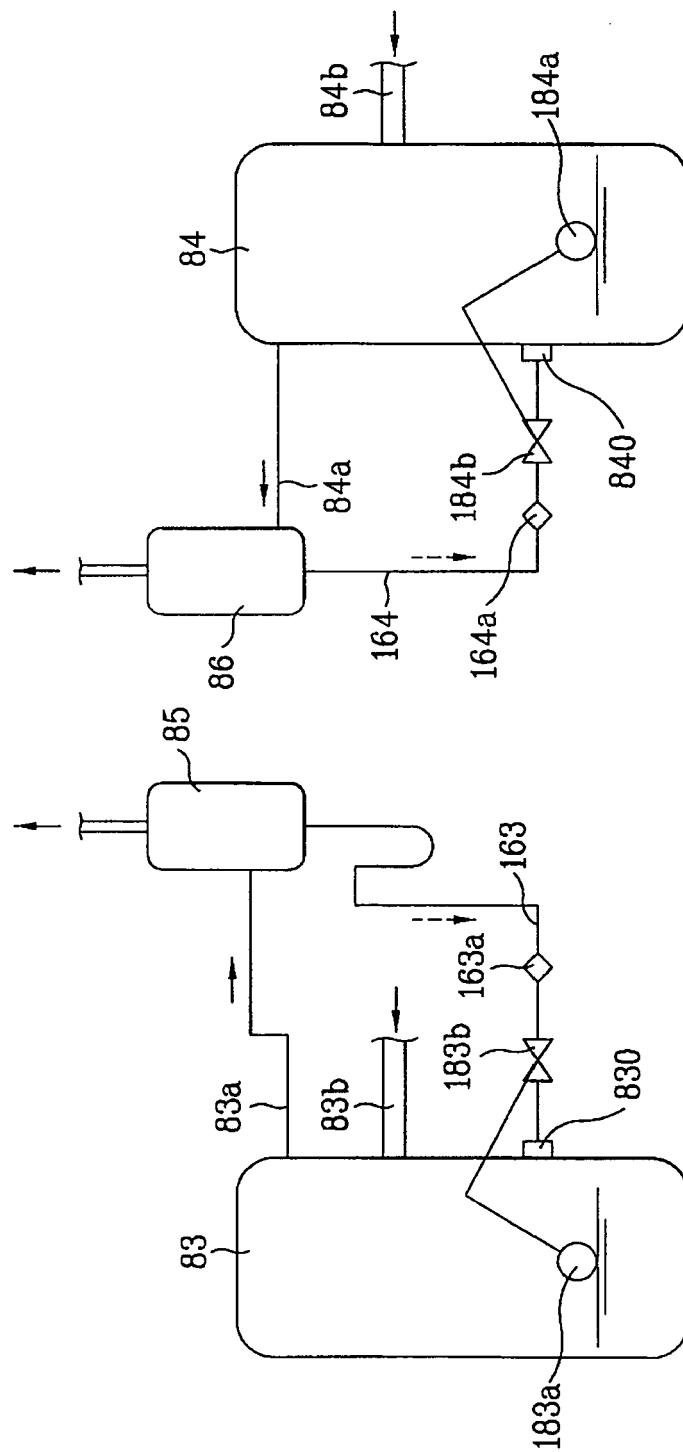


FIG. 7

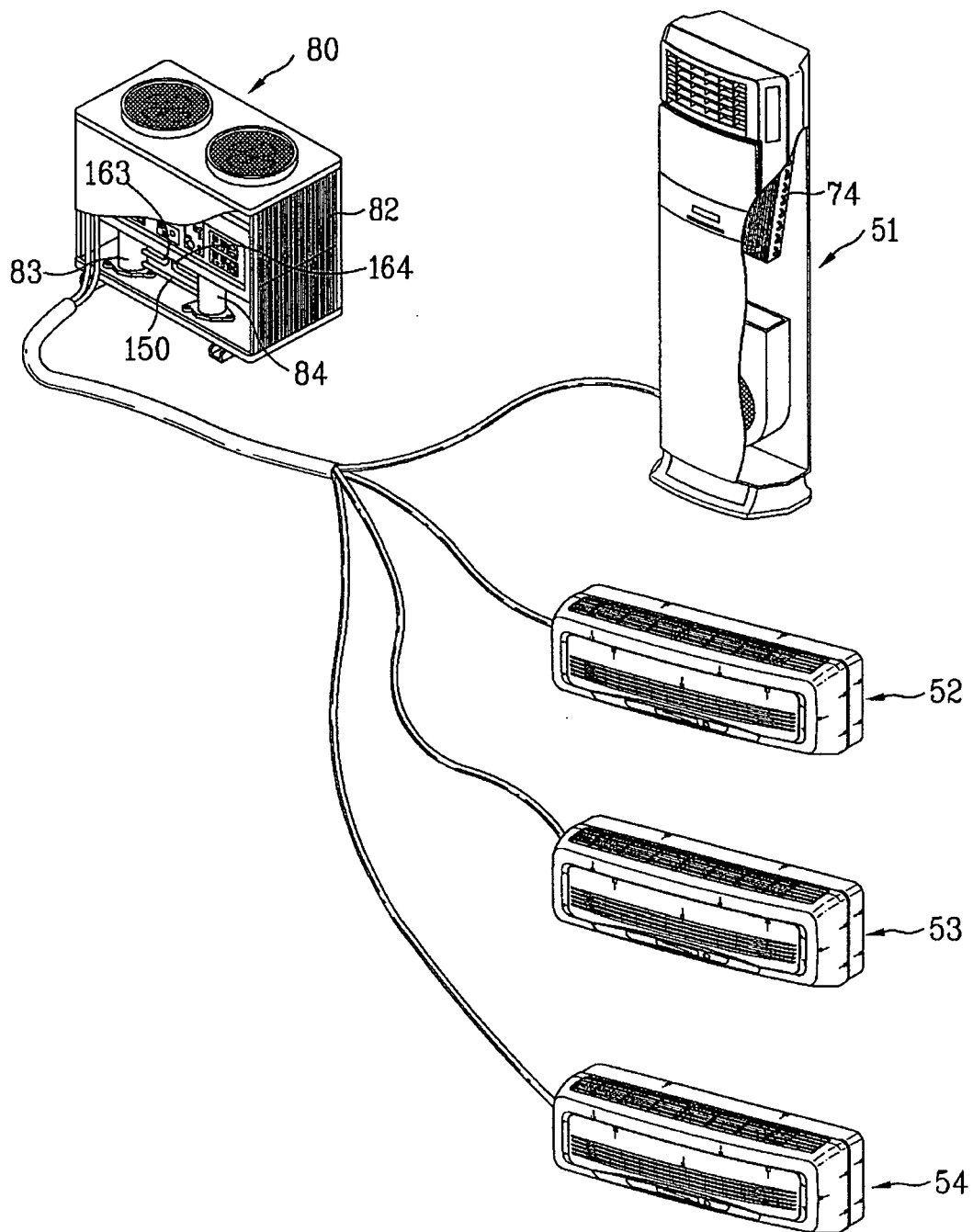


FIG. 8

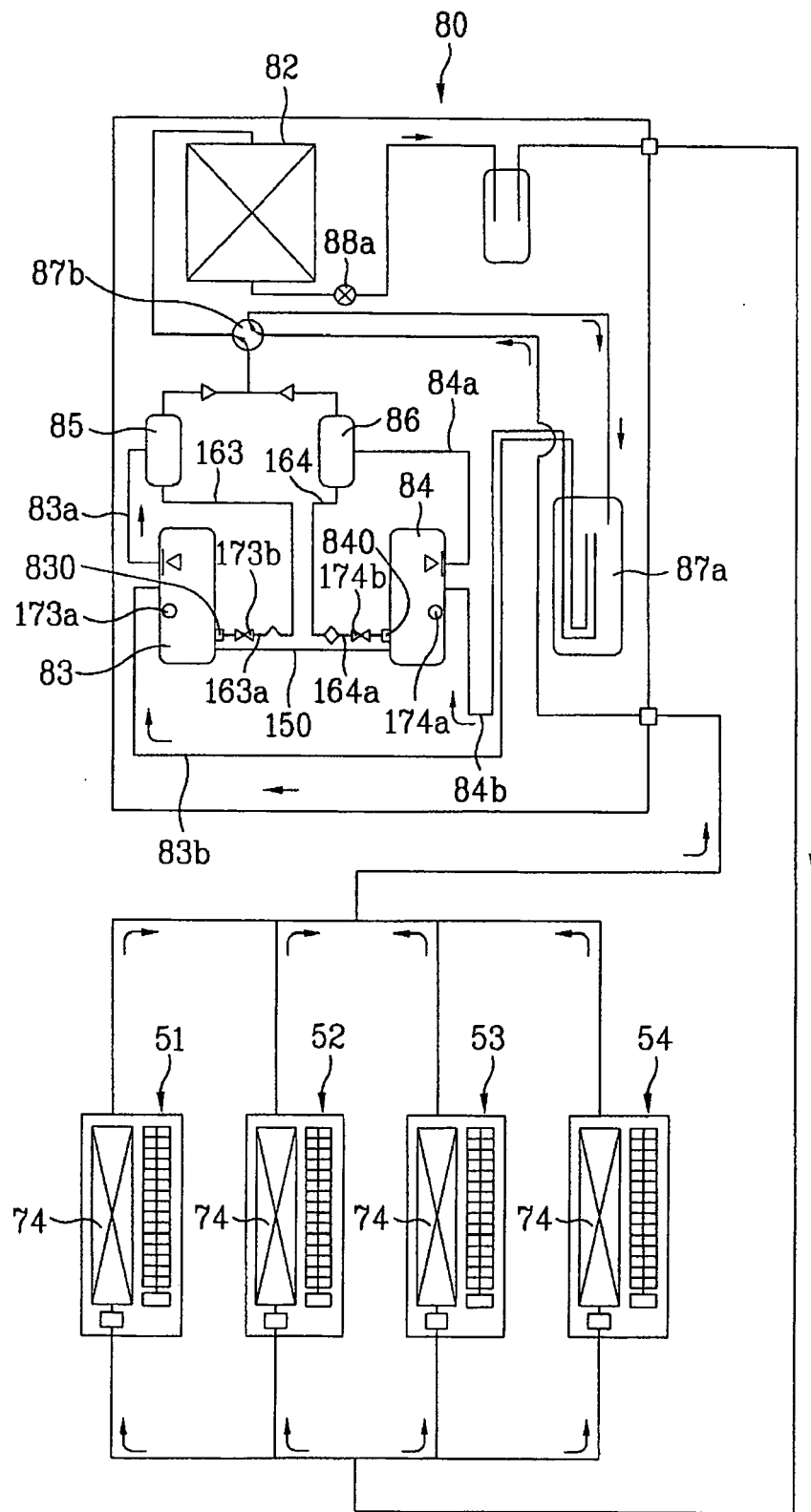


FIG. 9

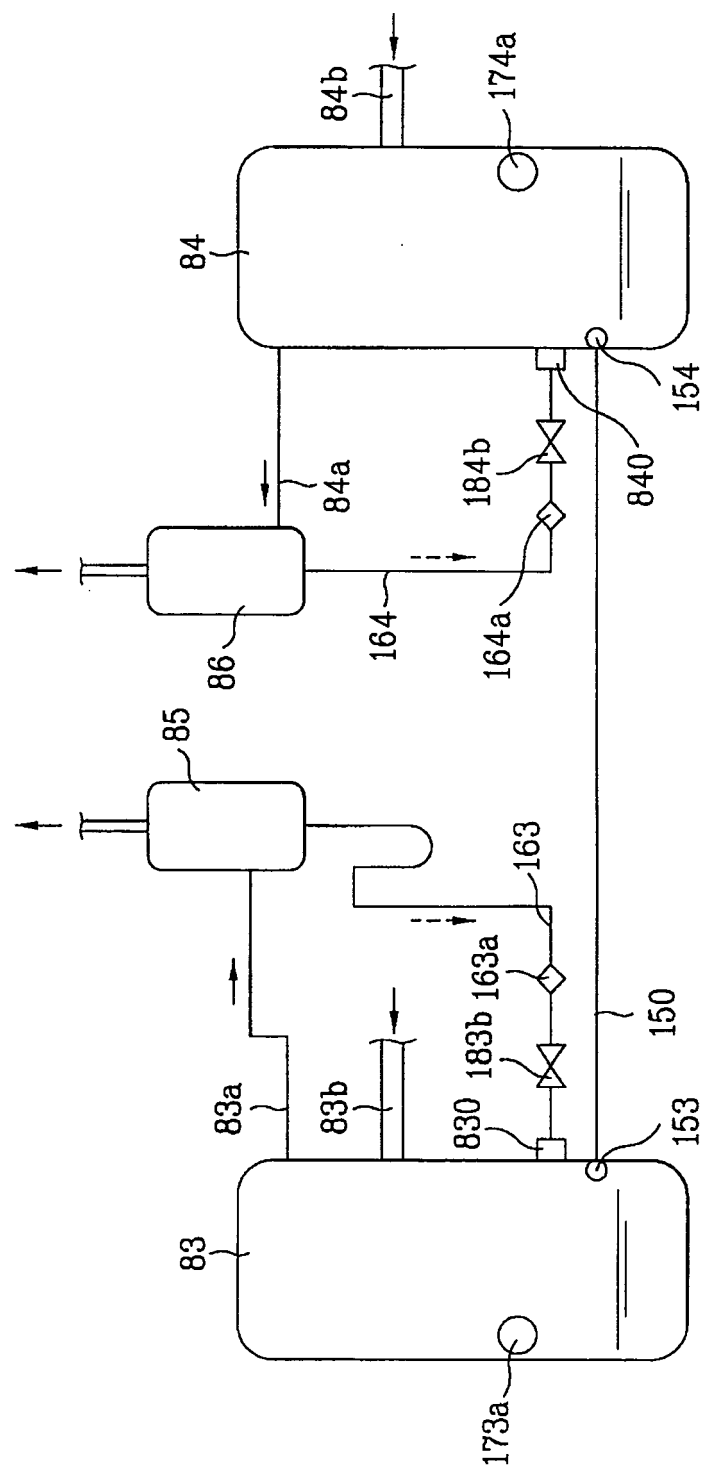


FIG. 10

