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(54) **AIR CONDITIONER**

(57) An air conditioner includes oil balancing pipes (30a to 30c) that extract lubricating oil stored in an oil separator (7) and each of compressors (3a to 3c) in which a specified amount of the lubricating oil or more is stored, a distributor (43) that distributes the lubricating oil led from the oil separator (7) and the compressors (3a to 3c) to a plurality of channels, and oil return pipes (55-57) that communicatively connect the distribution channels of the distributor (43) and a refrigerant inlet pipe of each of the compressors (3a to 3c) to return the lubricating oil to each of the compressors (3a to 3c), wherein the distributor (43) can be fixed easily and reliably by mounting and fixing the distributor (43) to a refrigerant inlet pipe (16) in a horizontal attitude along a horizontal portion of the refrigerant inlet pipe (16) to reduce production variation and also to prevent a pipe fatigue fracture by avoiding pipe stress concentration accompanying the compressors (3a to 3c) being driven.

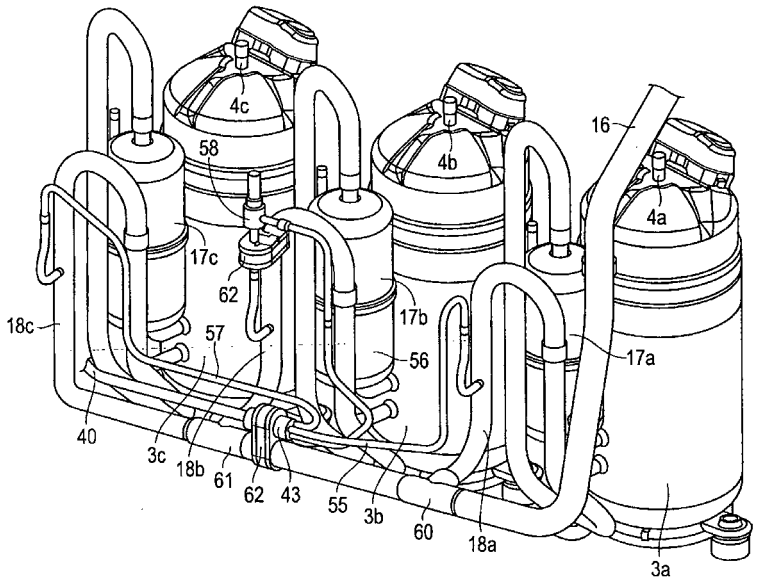

FIG. 2

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Description

Technical Field

[0001] The present invention relates to an air conditioner configuring a refrigerating cycle by an outdoor unit including a plurality of compressors and a plurality of indoor units and in particular, relates to improvement of an oil return structure to equally store lubricating oil in each compressor.

Background Art

[0002] An optimal air conditioner for a building including a plurality of air-conditioned locations is known. Such a kind of air conditioner includes an oil return circuit that extracts lubricating oil stored in each compressor in which a specified amount of oil or more is stored via an oil balancing pipe and supplies the extracted lubricating oil to compressors with insufficient lubricating oil.

[0003] A gas refrigerant at high temperature/high pressure discharged from each compressor contains oil liquor of lubricating oil and there is a plurality of compressors and thus, the amount of discharged lubricating oil cannot be ignored. Therefore, an oil separator is provided in the refrigerating cycle to separate the oil liquor of lubricating oil contained in a discharged gas. The separated lubricating oil liquor is also returned to each compressor via the oil return circuit.

[0004] The problem is whether lubricating oil can be returned to each compressor equally. Providing an electromagnetic change-over valve in the oil return circuit to avoid an imbalance of the oil amount can be considered, but costs are affected. If a capillary tube is mounted on the oil return circuit for the purpose of detecting the oil level, it is difficult to adapt to changes in operating capacity of the compressor and changes of the number of operating units, leading to differences of the oil return amount.

[0005] For example, an example using a branch unit capable of distributing in three directions in place of a T tube as a branch pipe connected to three compressors to distribute lubricating oil for oil return is disclosed (see, for example, Jpn. Pat. Appln. KOKAI Publication No. 2006-112668).

[0006] More specifically, the branch unit includes a strainer portion including an inflow port of lubricating oil, a connecting pipe whose one end is connected to an outflow port of the strainer portion, and a distributor connected to the other end of the connecting pipe. The distributor has a plurality of outflow paths provided at an end thereof and each outflow path is connected to the outflow port.

Disclosure of Invention

[0007] Normally, a distributor used for refrigerant splitting is provided at some distance from the source of vibration such as a compressor to avoid a pipe fatigue fracture. However, a secondary side pipe in the distributor for oil return is connected to a refrigerant inlet pipe communicatively connecting an accumulator and an inlet portion of the compressor.

[0008] Thus, the distributor is provided in a position very close to the compressor and vibrations accompanying the compressor being driven are propagated from the secondary side pipe to the distributor, leading to a pipe fatigue fracture. Moreover, the splitter disclosed in the above literature is in a substantially vertical attitude with the inflow port directed downward and the outflow port directed upward so that the splitter is mounted to allow lubricating oil to flow upward from below.

[0009] If the branch unit is installed obliquely, the lubricating oil in the pipe becomes imbalanced and is split by the branch unit while imbalanced. The branch unit is described to take up a vertical attitude for the above reason, but on the other hand, vibrations propagated from the compressor are more likely to be amplified, accelerating the pipe fatigue fracture.

[0010] The present invention is made in view of the above circumstances and an object thereof is to provide an air conditioner that includes a plurality of compressors, allows a distributor included to return oil in balance to each compressor to fix easily and reliably to reduce production variation and also to prevent a pipe fatigue fracture by avoiding pipe stress concentration accompanying the compressor being driven.

[0011] In order to satisfy the object, an air conditioner configuring a refrigerating cycle by an outdoor unit including a plurality of compressors connected in parallel and a plurality of indoor units of the present invention comprises an oil balancing pipe that extracts lubricating oil stored in each of the compressors in which a specified amount of the lubricating oil or more is stored; a distributor that leads lubricating oil liquor from the oil balancing pipe and distributes the lubricating oil liquor to a plurality of channels; and an oil return pipe that communicatively connects a distribution channel of the distributor and a refrigerant inlet pipe of each of the compressors to return the lubricating oil to each of the compressors, wherein the distributor is mounted and fixed to the refrigerant inlet pipe in a horizontal attitude along a horizontal portion of the refrigerant inlet pipe of the compressors.

Brief Description of Drawings

[0012]

FIG. 1 is a block diagram of a refrigerating cycle of an air conditioner according to an embodiment of the present invention.

FIG. 2 is a perspective view showing an oil return structure to a compressor according to the embodiment.

FIG. 3 is a side view showing the structure of a distributor according to the embodiment.

Best Mode for Carrying Out the Invention

[0013] An embodiment of the present invention will be described based on the drawings.

[0014] FIG. 1 is a block diagram of a refrigerating cycle of an air conditioner.

[0015] The air conditioner includes one outdoor unit 1 and a plurality (four in this case) of indoor units 2A to 2D.

[0016] The outdoor unit 1 includes a first compressor 3a, a second compressor 3b, and a third compressor 3c as a plurality of compressors. Check valves 5a to 5c are provided in discharged refrigerant pipes 4a to 4c connected to the compressors 3a to 3c and further the discharged refrigerant pipes are converged to one refrigerant pipe 6. In other words, the first to third compressors 3a to 3c are connected in parallel with the refrigerant pipe 6.

[0017] An oil separator 7 having a function to separate lubricant oil liquor contained in a gas refrigerant, a first port Qa and a second port Qb of a four-way valve 8, two outdoor heat exchangers 9a, 9b connected in parallel, two outdoor expansion valves 10a, 10b connected in parallel, a liquid tank 11, and a first packed valve 12 as a connection portion of a liquid pipe 20 of the outdoor unit 1 are connected to the refrigerant pipe 6. A refrigerant pipe 13 connected to a third port Qc of the four-way valve 8 is connected to a second packed valve 14 to be a connection portion of a gas pipe 21 of the outdoor unit 1. A refrigerant pipe connected to a fourth port Qd of the four-way valve 8 is connected into an accumulator 15.

[0018] A refrigerant pipe 16 bent into a U-shape inside the accumulator 15 is branched off in three directions before accumulators 17a to 17c provided in inlet portions of the first to third compressors 3a to 3c before being connected to the respective compressors 3a to 3c.

[0019] Particularly, the refrigerant pipe 16 bent into a U-shape inside the accumulator 15 and extending along the first to third compressors 3a to 3c is called a main inlet refrigerant pipe. A refrigerant pipe 18a branched from the main inlet refrigerant pipe 16 and connected to the accumulator 17a of the first compressor 3a is called a first inlet refrigerant pipe.

[0020] Similarly, a refrigerant pipe 18b branched from the main inlet refrigerant pipe 16 and connected to the accumulator 17b of the second compressor 3b is called a second inlet refrigerant pipe and a refrigerant pipe 18c branched from the main inlet refrigerant pipe 16 and connected to the accumulator 17c of the third compressor 3c is called a third inlet refrigerant pipe.

[0021] As will be described later, a refrigerant delivered from the accumulator 15 is drawn into the first to third compressors 3a to 3c from the refrigerant pipe 16 via the first to third refrigerant pipes 18a to 18c respectively. Thus, the first compressor 3a is positioned most upstream and then the second compressor 3b and the third compressor 3c are positioned downstream in this order.

[0022] The liquid pipe 20 extending toward the indoor units 2A to 2D is connected to the first packed valve 12. Similarly, the gas pipe 21 extending toward the indoor units 2A to 2D is connected to the second packed valve 14.

[0023] The liquid pipe 20 is split into a plurality of pipes in a terminal portion thereof and the pipes are connected to respective heat exchangers 23a to 23d included in the indoor units 2A to 2D via expansion valves 24a to 24d respectively. The gas pipe 21 is also split into a plurality of pipes in a terminal portion thereof and the pipes are connected to respective heat exchangers 23a to 23d inside the indoor units 2A to 2D.

[0024] The refrigerating cycle of the air conditioner is configured as described above.

[0025] An outdoor fan 25 is arranged opposite to the outdoor heat exchangers 9a, 9b included in the outdoor unit 1 and the operation thereof is controlled by an outdoor controller electrically connected to a remote controller (not shown) together with the first to third compressors 3a to 3c.

[0026] The outdoor unit 1 includes an inverter, which rectifies the voltage of a commercial AC power supply and converts the rectified voltage to an AC voltage of a frequency in accordance with an instruction of the outdoor controller to output the AC voltage. The first to third compressors 3a to 3c are variable-capacity types and are each driven by output of the inverter.

[0027] Indoor fans 26a to 26d are arranged opposite to the indoor heat exchangers 23a to 23d included in the indoor units 2A to 2D respectively. These indoor fans 26a to 26d are driven and controlled by operating the remote controller.

[0028] Further, the outdoor unit 1 is provided with an oil balancing circuit, which will be described in detail below.

[0029] One end of a first oil balancing pipe 30a is connected to a predetermined height position on a case side face of the first compressor 3a and the other end of the first oil balancing pipe 30a is connected to an oil storage capsule 31. The first oil balancing pipe 30a is provided with a check valve 32a and a capillary tube 33a and a first temperature sensor 34 is provided downstream of the capillary tube 33a.

[0030] One end of a second oil balancing pipe 30b is connected to a predetermined height position on the case side face of the second compressor 3b and the other end of the second oil balancing pipe 30b is connected to the oil storage capsule 31. The second oil balancing pipe 30b is provided with a check valve 32b and a capillary tube 33b and a second temperature sensor 35 is provided downstream of the capillary tube 33b.

[0031] One end of a third oil balancing pipe 30c is connected to a predetermined height position on the case side face of the third compressor 3c and the other end of the third oil balancing pipe 30c is connected to the oil storage capsule 31. The third oil balancing pipe 30c is provided with a check valve 32c and a capillary tube 33c and a third temperature sensor 36 is provided downstream of the capillary tube 33c.

[0032] A bypass pipe 38 branched from the high-pressure side refrigerant pipe 6 is connected to one end of the oil storage capsule 31 and the bypass pipe 38 is provided with a capillary tube and a fourth temperature sensor 39. An oil balancing guide pipe 40 and a balance pipe 41 are connected to the other end of the oil storage capsule 31.

[0033] The oil balancing guide pipe 40 is connected to the inflow port of a distributor 43 described later via a first electromagnetic opening and closing valve 42. A fifth temperature sensor 44 is provided in the oil balancing guide pipe 40 between the oil storage capsule 31 and the first electromagnetic opening and closing valve 42.

[0034] The balance pipe 41 is provided with a second electromagnetic opening and closing valve 46 and a check valve 47 and is connected to a balance pipe packed valve 48. When a plurality of outdoor units is connected in parallel, the balance pipe packed valve 48 is provided to balance the compressor and the amount of lubricating oil included in each outdoor unit.

[0035] One end of an auxiliary bypass pipe 49 is connected to between the check valve 47 and the balance pipe packed valve 48 in the balance pipe 41. The other end of the auxiliary bypass pipe 49 is connected to the main inlet refrigerant pipe 16 between the accumulator 15 and the first refrigerant pipe 18a and a parallel circuit of a check valve 50a and a fourth electromagnetic opening and closing valve 50b is connected to the halfway portion.

[0036] On the other hand, a first oil delivery pipe 51 is connected to the bottom of the oil separator 7 and a second oil delivery pipe 52 is connected to a side portion of the oil separator 7.

[0037] The first oil delivery pipe 51 is provided with capillary tube and a third electromagnetic opening and closing valve 53 and is connected to between the first electromagnetic opening and closing valve 42 of the oil balancing guide pipe 40 and the distributor 43. The second oil delivery pipe 52 is provided with only a capillary tube and is connected to between the oil storage capsule 31 in the oil balancing guide pipe 40 and the first electromagnetic opening and closing valve 42.

[0038] The distributor 43 is to be mounted, as will be described later, in a horizontal attitude and an inflow port is opened on one end face and three outflow ports are provided on the other end face. Inside the distributor 43, a channel connected to the inflow port is split into three channels and each channel is communicatively connected to the outflow port.

[0039] As shown in FIG. 3, a first outflow port Rf is positioned on an upper left side in a side view of the distributor 43, a second outflow port Rg is positioned in a lower center, and a third outflow port Rh is positioned on an upper right side. The first outflow port Rf and the second outflow port Rh are positioned at substantially the same height.

[0040] A first oil return pipe 55 is connected to the first outflow port Rf and also connected to the first inlet refrigerant pipe 18a branched from the main inlet refrigerant pipe 16. A second oil return pipe 56 is connected to the second outflow port Rg and also connected to the second inlet refrigerant pipe 18b branched from the main inlet refrigerant pipe 16.

[0041] A third oil return pipe 57 is connected to the third outflow port Rh and also connected to the third inlet refrigerant pipe 18c branched from the main inlet refrigerant pipe 16. An oil reflux cutoff valve 58 as an electromagnetic opening and closing valve is provided, among the three installed compressors 3a to 3c, only in the second oil return pipe 56 arranged in the center and connected to the second compressor 3b.

[0042] The oil balancing circuit is configured as described above.

[0043] FIG. 2 is a perspective view showing an actual pipe structure around the first to third compressors 3a to 3c.

[0044] The first compressor 3a is arranged on the right side in FIG. 2, the second compressor 3b is arranged in the center, and the third compressor 3c is arranged on the left side. The compressors 3a to 3c are longitudinally mounted, have the discharged refrigerant pipes 4a to 4c projecting in respective upper end portions, and have the accumulators 17a to 17c provided along the respective side portions.

[0045] A pipe extending along the installation surface from an upper portion of the first compressor 3a is the main inlet refrigerant pipe 16 connected to the accumulator 15 (not shown) and is provided up to the vicinity of the third compressor 3c. A T-shaped pipe 60 is provided in a region near the first compressor 3a of the main inlet refrigerant pipe 16 and the first inlet refrigerant pipe 18a is connected thereto.

[0046] The first inlet refrigerant pipe 18a is formed by rising along the accumulator 17a connected to the first compressor 3a once before being bent into an inverted U-shape. Then, the first inlet refrigerant pipe 18a is formed in a U-shape after extending to the installation surface and bent into an inverted U-shape again above the accumulator 17a before being connected to the upper end portion of the accumulator 17a.

[0047] Also, a T-shaped pipe 61 is provided in a portion near the second compressor 3b of the main inlet refrigerant pipe 16 and the second inlet refrigerant pipe 18b is connected thereto. The second inlet refrigerant pipe 18b is also bent in exactly the same manner as the first inlet refrigerant pipe 18a and connected to the upper end portion of the accumulator 17b provided along the second compressor 3b.

[0048] A third inlet refrigerant pipe 19c is directly formed successively in the terminal portion of the main inlet refrigerant pipe 16. The third inlet refrigerant pipe 18c is also bent in exactly the same manner as the first and second inlet refrigerant pipes 18a, 18b.

Then, the third inlet refrigerant pipe 18c is connected to the upper end portion of the accumulator 17c provided along the third compressor 3c.

[0049] On the other hand, the distributor 43 is mounted in a portion of the main inlet refrigerant pipe 16 in the horizontal attitude as a region provided along the installation surface of each of the compressors 3a to 3c in the main inlet refrigerant pipe 16. That is, the distributor 43 is mounted along a horizontal region of the main inlet refrigerant pipe 16 and thus takes up a horizontal attitude.

[0050] The oil balancing guide pipe 40 extending from the oil storage capsule 31 (not shown) is connected to the left-side portion of the distributor 43 in FIG. 2. A total of three oil return pipes 55, 56, 57, two in an upper portion and one in a lower portion, extend from the right-side portion thereof.

[0051] One pipe in the upper portion, the first oil return pipe 55, is formed along a horizontal portion of the main inlet refrigerant pipe 16 once and then by rising along the first inlet refrigerant pipe 18a and is connected to a halfway portion thereof. The pipe in the lower portion, the second oil return pipe 56, is formed along the horizontal portion of the main inlet refrigerant pipe 16 once and then by rising along the second inlet refrigerant pipe 18b.

[0052] Then, the second oil return pipe 56 is bent into the horizontal direction at substantially the same height as a region where the second inlet refrigerant pipe 18b is bent into an inverted U-shape before being connected to the oil reflux cutoff valve 58. In FIG. 2, only the valve element of the oil reflux cutoff valve 58 is shown and an electromagnetic coil portion is omitted.

[0053] The second oil return pipe 56 coming out of the oil reflux cutoff valve 58 is fixed to the second inlet refrigerant pipe 18b via a pipe fixture 62 and connected to the second inlet refrigerant pipe 18b in a lower region. The other pipe in the upper portion of the distributor 43, the third oil return pipe 57, is bent in order to be parallel to the oil balancing guide pipe 40 before being connected to a rising portion of the third inlet refrigerant pipe 18c.

[0054] Next, the flow of the refrigerant in a refrigerating cycle circuit will be described.

[0055] When the first to third compressors 3a to 3c are driven, a gas refrigerant at high temperature/high pressure discharged from each of the first to third compressors 3a to 3c is led:into the refrigerant pipe 6 via the discharged refrigerant pipes 4a to 4c connected respectively. Then, the refrigerant pipe 6 supplies the gas refrigerant to the oil separator 7 where lubricating oil liquor contained in the gas refrigerant is separated.

[0056] The gas refrigerant from the oil separator 7 is led into the four-way valve 8 and then, during cooling operation, led into the outdoor heat exchangers 9a, 9b for heat exchange with an outdoor air. The gas refrigerant is condensed to a liquid to change into a liquid refrigerant before being led into each of the indoor units 2A to 2D via the outdoor expansion valves (10a, 10b) , the liquid tank 11, the first packed valve 12, and the liquid pipe 20 sequentially.

[0057] In the indoor units 2A to 2D, the liquid refrigerant is adiabatically expanded by the expansion valves 24a to 24d before flowing into the indoor heat exchangers 23a to 23d, where the liquid refrigerant exchanges heat with an indoor air in the respective indoor heat exchangers 23a to 23d before being evaporated. At this point, the indoor air is deprived of evaporative latent heat to change the indoor air into a cold air. A cold air is blown indoors by the action of the indoor fans 26a to 26d to achieve a cooling operation.

[0058] An evaporative refrigerant delivered from the indoor heat exchangers 23a to 23d comes out of the indoor units 2A to 2D and then is led into the outdoor unit 1 from the gas pipe 21 and the second packed valve 14. In the outdoor unit 1, the evaporative refrigerant is led from the four-way valve 8 into the accumulator 15 for vapor-liquid separation and then split into the first to third inlet refrigerant pipes 18a to 18c from the from the main inlet refrigerant pipe 16.

[0059] The evaporative refrigerant is drawn into the first to third compressors 3a to 3c from the first to third inlet refrigerant pipes 18a to 18c via the accumulators 17a to 17c. The evaporative refrigerant is compressed in each of the compressors 3a to 3c to become a gas refrigerant at high temperature/high pressure before circulating through the above path again.

[0060] The refrigerant during heating operation is led in the direction opposite to the direction during cooling operation by switching the four-way valve 8. The refrigerant is condensed in the indoor heat exchangers 23a to 23d of the indoor units 2A to 2D to give off heat to an indoor air. The indoor air changes to a warm air and is blown indoors to achieve an indoor warming operation.

[0061] Next, the flow of lubricating oil in the oil balancing circuit will be described.

[0062] Lubricating oil is stored in each sealed case of the first to third compressors 3a to 3c and the oil level height may be higher than the connection position of the first to third oil balancing pipes 30a to 30c connected to the respective side portions.

[0063] Lubricating oil for the portion exceeding the connection position of the first to third oil balancing pipes 30a to 30c is delivered to the first to third oil balancing pipes 30a to 30c as surplus lubricating oil. Then, the lubricating oil is led to the oil storage capsule 31 via the capillary tubes 33a to 33c.

[0064] A small amount of gas refrigerant at high pressure split from the high-pressure side refrigerant pipe 6 into the bypass pipe 38 flows into the oil storage capsule 31. The lubricating oil flowing into the oil storage capsule 31 is led into the oil balancing guide pipe 40 by pressure applied from the bypass pipe 38 via a capillary tube.

[0065] The first electromagnetic opening and closing valve 42 provided in the oil balancing guide pipe 40 is normally controlled to open and the lubricating oil flowing out of the oil storage capsule 31 is guided into the distributor 43. In the distributor 43, the lubricating oil is led to channels split into three directions from the inflow port before flowing out from the respective outflow ports.

[0066] That is, in the distributor 43, the lubricating oil is equally split into the first to third oil return pipes 55 to

57. Then, the lubricating oil is led from the first to third oil return pipes 55 to 57 into the first to third inlet refrigerant pipes 18a to 18c respectively. Particularly, the lubricating oil led into the second oil return pipe 56 is circulated through the oil reflux cutoff valve 58 controlled to be open.

[0067] The lubricating oil having flown into the first to third inlet refrigerant pipes 18a to 18c circulates through the refrigerating cycle and is drawn into the first to third compressors 3a to 3c together with the evaporative refrigerant delivered from the accumulator 15.

[0068] For example, the oil level height of the first compressor 3a may be higher than the connection position of the first oil balancing pipe 30a, the oil level height of the second compressor 3b may be lower than the connection position of the second oil balancing pipe 30b, and the oil level height of the third compressor 3c may be in the connection position of the third oil balancing pipe 30c. That is, the oil levels of the first to third compressors 3a to 3c may be imbalanced.

[0069] In such a case, lubricating oil flows into the first oil balancing pipe 30a connected to the first compressor 3a and a gas refrigerant at high pressure flows into the second oil balancing pipe 30b connected to the second compressor 3b. The lubricating oil and the gas refrigerant having flown into the oil balancing pipes 30a, 30b are gathered in the oil storage capsule 31 and flow out in a mixed state to be led into the oil balancing guide pipe 40.

[0070] Then, the lubricating oil and the gas refrigerant flow from the oil balancing guide pipe 40 into the distributor 43 and equally split into three channels. The lubricating oil and the gas refrigerant are led from the distributor 43 into the first to third compressors 3a to 3c via the first to third oil return pipes 55 to 57 and the first to third inlet refrigerant pipes 18a to 18c.

[0071] In this manner, lubricating oil moves from a compressor with a large amount of lubricating oil, for example, the first compressor 3a to a compressor with a small amount of lubricating oil, for example, the second compressor 3b. Thus, the oil levels of the first to third compressors 3a to 3c are quickly balanced.

[0072] On the other hand, a gas refrigerant discharged from the first to third compressors 3a to 3c contains a portion of lubricating oil stored in each of the compressors. Such a mixed fluid is discharged into the discharged refrigerant pipes 4a to 4c and then led from the high-pressure side refrigerant pipe 6 to the oil separator 7. In the oil separator 7, lubricating oil liquor is separated from the gas refrigerant.

[0073] The third electromagnetic opening and closing valve 53 is provided in the first oil delivery pipe 51 connected to the bottom of the oil separator 7 and the third electromagnetic opening and closing valve 53 is normally in a closed state. Thus, the lubricating oil liquor separated here is once stored in the oil separator 7 and only a gas refrigerant is led into the four-way valve 8.

[0074] The lubricating oil stored in the oil separator 7 increases and at last rises to the connection position of the second oil delivery pipe 52 connected to the side portion thereof. Te lubricating oil for a portion exceeding the connection position of the second oil delivery pipe 52 flows from the oil delivery pipe 52 into the oil balancing guide pipe 40 before being returned, as described above, to the first to third compressors 3a to 3c via the distributor 43 and the first to third oil return pipes 55 to 57.

[0075] For some reason or other, the oil levels in the sealed cases of all the compressors 3a to 3c may fall at the same time. In such a case, an opening signal is issued to the third electromagnetic opening and closing valve 53 provided in the first oil delivery pipe 51 at the bottom of the oil separator 7 and also a closing signal is issued to the first electromagnetic opening and closing valve 42 in the oil balancing guide pipe 40.

[0076] All lubricating oil stored in the oil separator 7 is led from the first oil delivery pipe 51 into the oil balancing guide pipe 40 and drawn into the first to third compressors 3a to 3c via the distributor 43, the first to third oil return pipes 55 to 57, the main inlet refrigerant pipe 16, and the first to third inlet refrigerant pipes 18a to 18c before being equally distributed among these compressors 3a to 3c.

[0077] In an embodiment of the present invention, the distributor 43 for oil return is mounted on a horizontal portion of the main inlet refrigerant pipe 16 connected to the compressors 3a to 3c via the pipe fixture 62 to take up a horizontal attitude.

[0078] That is, the secondary side pipe on the distribution side of the distributor 43 is connected to the first to third inlet refrigerant pipes 18a to 18c and thus is provided in a position very close to the first to third compressors 3a to 3c.

[0079] Thus, vibrations of the first to third compressors 3a to 3c being driven are more likely to be propagated to the distributor 43 via the first to third inlet refrigerant pipes 18a to 18c and the main inlet refrigerant pipe 16.

[0080] However, as described above, the same vibration system is created by mounting and fixing the distributor 43 in a horizontal attitude to the main inlet refrigerant pipe 16 so that a pipe fatigue fracture can be prevented.

[0081] If the distributor is mounted in a vertical attitude, it takes a lot of time and effort to correct the inclination of the distributor and dimensional control of connection pipes is troublesome, but according to the present embodiment, the distributor 43 in a horizontal attitude is mounted and fixed to the main inlet refrigerant pipe 16 and thus, no time and effort is needed for the control so that it becomes possible to reduce product variations and cut production costs.

[0082] In the outdoor unit 1 including a plurality of compressors, operating compressors and non-operating compressors may be mixed. In such an operation condition, the ratio of lubricating oil flowing back via the oil balancing circuit may not be equal.

[0083] It is assumed, for example, that the first compressor 3a and the second compressor 3b are operating and the third compressor is non-operating. In this case, the amount of lubricating oil returned from the distributor 43 to the first compressor 3a via the first oil return pipe

55 and the amount of lubricating oil returned to the second compressor 3b via the second oil return pipe 56 are the same.

[0084] The distributor 43 includes three channels for one inflow port and is configured so that the lubricating oil flows equally through these channels. Naturally, the same amount of lubricating oil is led from the distributor 43 to the third oil return pipe 57 to move to the third compressor 3c.

[0085] However, as described above, the third compressor 3c is non-operating and thus, the lubricating oil flowing from the third oil return pipe 57 into the third inlet refrigerant pipe 18c is not drawn into the third compressor 3c. The lubricating oil has nowhere to go and flows from the third inlet refrigerant pipe 18c into the main inlet refrigerant pipe 16.

[0086] Then, due to a suction force of the second compressor 3b on the upstream side, almost all lubricating oil flowing into the third oil return pipe 57 is led into the second inlet refrigerant pipe 18b. Here, the lubricating oil joins lubricating oil led via the second oil return pipe 56 before being drawn into the second compressor 3b.

[0087] In the end, the ratio of the amounts of lubricating oil flowing back into the first compressor 3a and flowing back into the second compressor 3b becomes 1:2 and while too much lubricating oil is stored in the second compressor 3b, the lubricating oil is insufficient in the first compressor 3a.

[0088] In the present invention, the second oil return pipe 3b includes the oil reflux cutoff valve 58 and is controlled to close the oil reflux cutoff valve 58 in the above situation. From the above, lubricating oil is led from the distributor 43 to the first oil return pipe 55 and the third oil return pipe 57, but does not flow to the second oil return pipe 56.

[0089] The lubricating oil flows back from the first oil return pipe 55 to the first compressor 3a and the lubricating oil flows back from the third oil return pipe 57 to the second compressor 3b. No lubricating oil flows back unchangingly to the non-operating compressor 3C.

[0090] That is, the second oil return pipe 56 communicatively connected to the middle compressor 3b of three compressors includes the oil reflux cutoff valve 58, which is controlled to close in the above situation. As shown in FIG. 3, the first outflow port Rf and the third outflow port Rh of the distributor 43 are positioned at substantially the same height and thus, substantially the same amount of lubricating oil flows into the first oil return pipe 55 and the third oil return pipe 57. That is, the same amount of lubricating oil flows back to the first compressor 3a and the second compressor 3b so that lubricating oil is mutually in proper quantities.

[0091] Further, if an oil shortage temporarily arises in one of the first to third compressors 3a to 3c, the amount of lubricating oil held in operating compressors can be adjusted by controlling the oil reflux cutoff valve 58 to open or close.

[0092] For example, the second compressor 3b may run out of oil while the oil reflux cutoff valve 58 is closed. The lack of oil can be known by comparing detected temperatures of the fourth temperature sensor 39 provided in the bypass pipe 38 and first to third temperature sensors 35 to 37 provided in the first to third oil balancing pipes 30a to 30c.

[0093] If lubricating oil flows to the first to third oil balancing pipes 30a to 30c, detected temperatures of these tubes becomes higher than the detected temperature of the bypass pipe 38. Conversely, if a refrigerant flows to the first to third oil balancing pipes 30a to 30c, the detected temperature of the bypass pipe 38 becomes higher than the detected temperatures of these tubes, indicating that the first to third compressors 3a to 3c run out of oil.

[0094] If, as described above, the second compressor 3b is detected to have run out of oil while the oil reflux cutoff valve 58 is closed, the oil reflux cutoff valve 58 is controlled to open. As shown in FIG. 3, the second outflow port Rg of the distributor 43 is, among three outflow ports, in the:lowest position and thus, more lubricating oil flows into the second oil return pipe 56 connected to the second outflow port Rg than into the oil return pipes 55, 57. Therefore, the amount of lubricating oil returning from the second oil return pipe 56 to the second compressor 3b increases to balance the amounts of lubricating oil held by the first compressor 3a and the second compressor 3b.

[0095] The present invention is not limited to the above embodiment as it is and can be embodied by modifying structural elements without deviating from the scope thereof in the time of the working. Then, various inventions can be formed by appropriately combining a plurality of structural elements disclosed in the above embodiment.

Industrial Applicability

[0096] According to the present invention, an air conditioner achieving effects such as being easy and reliable to fix a distributor to reduce production variations and being able to prevent a pipe fatigue fracture accompanying a compressor being driven.

Claims

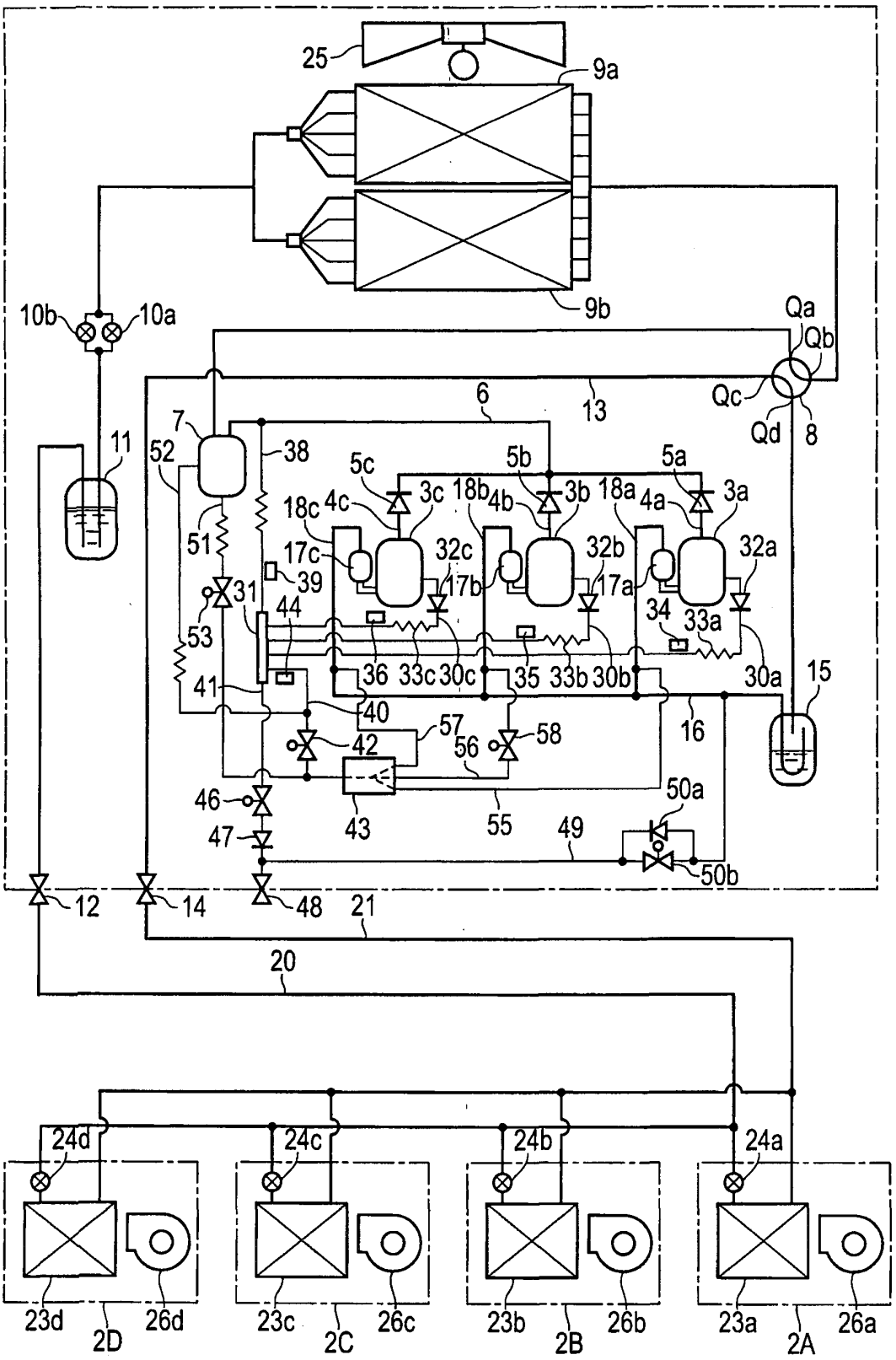
1. An air conditioner configuring a refrigerating cycle by an outdoor unit including a plurality of compressors connected in parallel and a plurality of indoor units, **characterized by** comprising:

an oil balancing pipe that extracts lubricating oil stored in each of the compressors in which a specified amount of the lubricating oil or more is stored;

a distributor that leads lubricating oil liquor from the oil balancing pipe and distributes the lubri-

cating oil liquor to a plurality of channels; and an oil return pipe that communicatively connects a distribution channel of the distributor and a refrigerant inlet pipe of each of the compressors to return the lubricating oil to each of the compressors, wherein
the distributor is mounted and fixed to the refrigerant inlet pipe in a horizontal attitude along a horizontal portion of the refrigerant inlet pipe of the compressors.

2. The air conditioner according to claim 1, **characterized in that**
the compressors include three units in parallel and an oil reflux cutoff valve is provided in the oil return pipe into which the lubricating oil is most likely to flow.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10b
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Qb
Qc
Qd
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6
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7
11
52
38
5c
5b
5a
18c
4c
3c
18b
4b
3b
18a
4a
3a
51
17c
39
32c
32b
32a
31
17b
17a
34
33a
44
53
36
33c
30c
35
33b
30b
30a
15
41
40
57
58
16
42
56
46
50a
47
43
55
49
50b
12
14
48
21
20
24d
24c
24b
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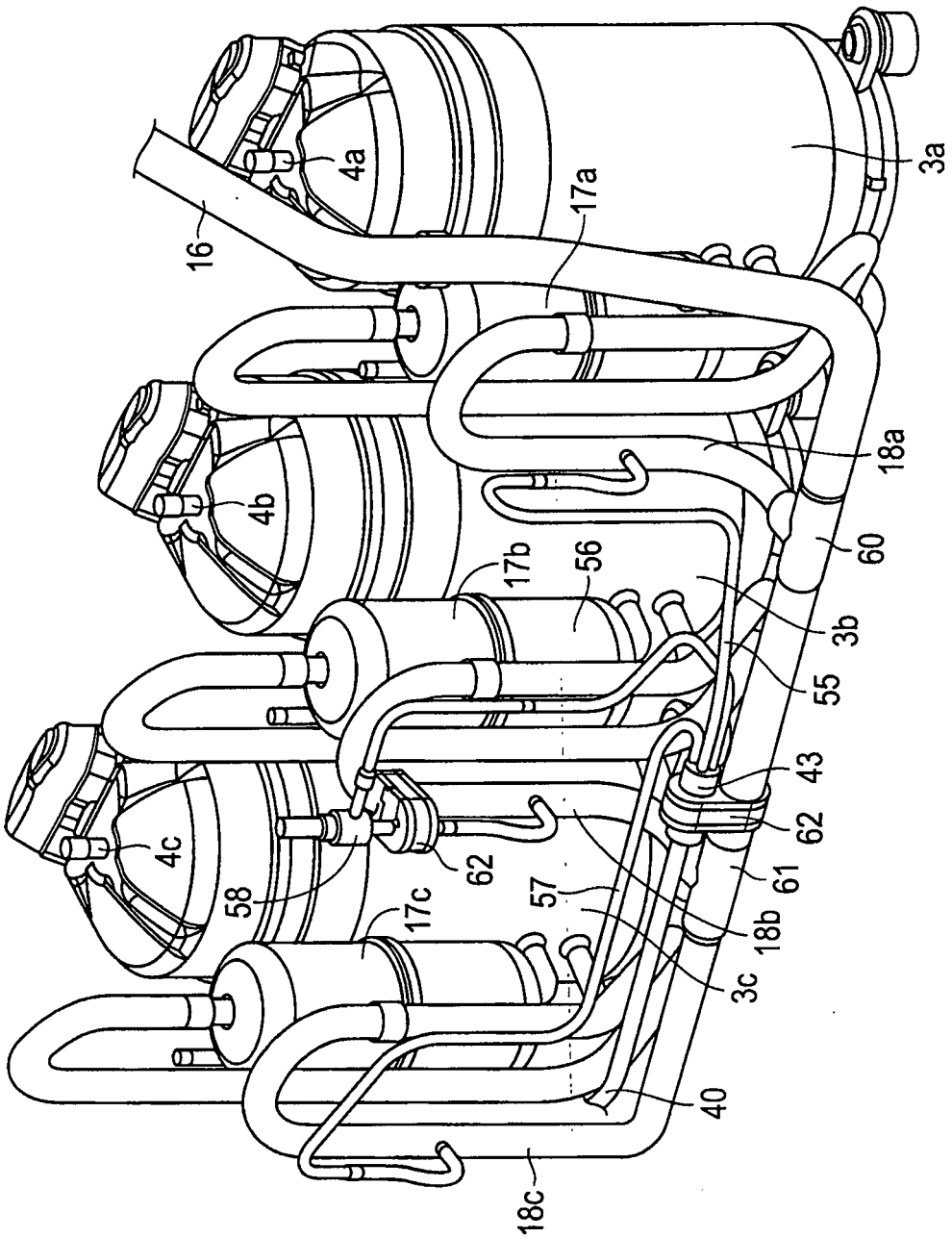
23d
2D
26d
23c
2C
26c
23b
2B
26b
23a
2A
26a

FIG. 1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4b
18a
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17b
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4c
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17c
18b
3c
40
18c

FIG. 2

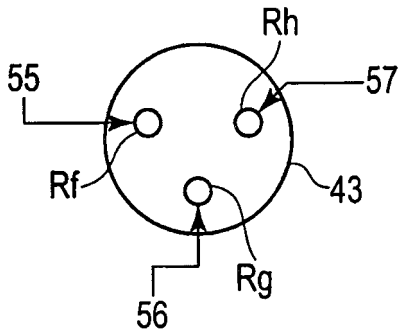

FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/053165

A. CLASSIFICATION OF SUBJECT MATTER
F25B1/00(2006.01)i, *F24F1/30*(2011.01)i, *F25B41/00*(2006.01)i, *F25B41/04*(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)
F25B1/00, F24F1/30, F25B41/00, F25B41/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2011
Kokai Jitsuyo Shinan Koho 1971-2011 Toroku Jitsuyo Shinan Koho 1994-2011

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2006-112668 A (Fujitsu General Ltd.), 27 April 2006 (27.04.2006), paragraphs [0008] to [0009], [0025] to [0038]; fig. 1 to 3 (Family: none)	1,2
Y	WO 2004/076945 A1 (Toshiba Carrier Corp.), 10 September 2004 (10.09.2004), page 7, line 9 to page 9, line 1; fig. 1 & EP 1605211 A1 & KR 10-2005-0107451 A & CN 1751213 A & RU 2297577 C	1,2
Y	JP 2006-250435 A (Yanmar Co., Ltd.), 21 September 2006 (21.09.2006), paragraphs [0047] to [0053]; fig. 5 to 7 (Family: none)	1,2

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

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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
13 May, 2011 (13.05.11)	24 May, 2011 (24.05.11)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/053165

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2000-274885 A (Sharp Corp.), 06 October 2000 (06.10.2000), paragraphs [0006] to [0008], [0053] to [0055]; fig. 4 (Family: none)	1,2

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2006112668 A **[0005]**