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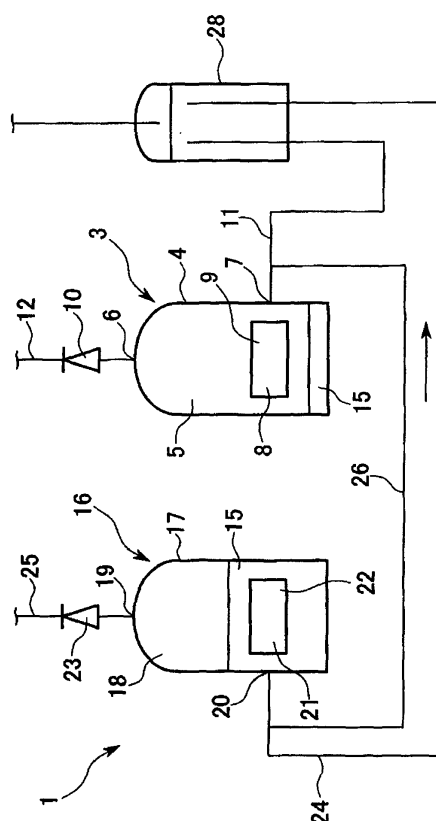
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(54) **Air Conditioner**

(57) An air conditioner (1) including a plurality of high-pressure shell type compressors comprising a first compressor (3) to operate continuously during an air conditioning operation of the air conditioner, and at least one second compressor (16) to operate in parallel with the first compressor (3), if necessary, during the air conditioning operation, the second compressor (16) having an internal pressure established in a shell of the second compressor in a stopped state of the second compressor such that the internal pressure is maintained above a suction pressure of the second compressor, the air conditioner further including a bypass tube (26) to connect a suction tube connected to a shell of the first compressor (3) and a suction tube connected to the shell of the second compressor (16). By the bypass tube (26), it is possible to surely prevent oil from being left in a suction tube of a compressor or suction tubes of compressors in a stopped state of the compressor or compressors during operation of the air conditioner to prevent compression of oil from occurring in the compressor or compressors, and thus, to surely prevent the compressor or compressors from being damaged due to compression of oil.

FIG 1



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Description

[0001] The present invention relates to an air conditioner including a plurality of high-pressure shell-type compressors.

[0002] An air conditioner having a plurality of high-pressure shell type compressors connected in parallel is well known. During operation of the air conditioner at least one of the plural compressors is continuously operated, and if necessary, if the heating/cooling load is high, at least one of the remaining compressors is additionally operated, to ensure that a room is maintained at a pleasant temperature and humidity. On the other hand, when the cooling/heating load to be processed by the air conditioner is low, all but one of compressors are inactive. A problem arises when an inactive compressor is reactivated. While the compressor is inactive, a very small amount of high-pressure refrigerant penetrates the shell of the inactive compressor, thereby causing the internal pressure of the shell to be higher than the pressure of a suction tube connected to the shell and reach the saturated pressure at ambient temperature or the discharge pressure of the first, variable-speed compressor. As a result, oil existing in the shell is forcibly discharged from the compression chamber into the suction tube, and is left in the suction tube. When the compressor is reactivated again, the oil left in the suction tube is introduced from the suction tube into the compression chamber and compressed. Due to such oil compression, the compressor may be damaged.

[0003] In JP-A-2001-324230, each compressor is provided with an oil reservoir (high pressure) connected to the suction tube (lower pressure) of the other compressor by a bypass tube in order to feed surplus oil from the suction tube to the oil reservoir.

[0004] However, in the proposed air conditioner, oil compressed in the compression chamber of each compressor and oil fed through the bypass tube connected to the compressor remain in the suction tube of the compressor when the compressor is inactive. The remaining oil is then compressed when the compressor is reactivated again, thereby causing damage to the compressor.

[0005] The air conditioner, according to the invention, is characterised by a bypass tube interconnecting the inputs of the compressors.

[0006] The air conditioner may further include suction tubes connected to the inputs of the compressors. The bypass tube may interconnect the suction tubes. Consequently, due to the suction created by the active compressor in order to suck refrigerant from the suction tube thereof, any oil discharged into the suction tube of an inactive compressor will be sucked into the suction tube of an active compressor via the bypass tube. Thus, the discharged oil is not left in the suction tube of the inactive compressor. Therefore, damage upon reactivation of the inactive compressor due to oil compression is prevented.

[0007] Additionally preferred features of the invention are defined in claim 3.

[0008] An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

5 Figure 1 is a schematic view illustrating an air conditioner according to the present invention.

[0009] Referring to Figure 1, the air conditioner 1 comprises a plurality of high-pressure shell type compressors. In more detail, it includes a first compressor 3, a second compressor 16, a heat exchanger (not shown), and a liquid separator 28. The operation of the air conditioner 1 is controlled by control means (not shown).

10 **[0010]** The first compressor 3 includes a high-pressure shell 4, a compressor body 8, and a drive motor 9. A compression chamber 5 is defined in the shell 4. An outlet 6 is formed at a top portion of the shell 4 to connect the interior of the compression chamber 5 with the exterior of the compression chamber 5. The outlet 6 is connected to a discharge tube 12 through a check valve 10. The check valve ensures that the refrigerant only flows in one direction, from the outlet 6 to the discharge tube 12.

15 **[0011]** An inlet 7 is formed at one side of a lower portion of the high-pressure shell 4. The inlet 7 is connected with the liquid separator 28 via a suction tube 11, so that refrigerant from the liquid separator 28 is sucked into the compression chamber 5 via the suction tube 11 and inlet 7.

20 **[0012]** The second compressor 16 is adapted to operate, if necessary, in addition to the first compressor 3. The second compressor 16 includes a high-pressure shell 17, a compressor body 21, and a drive motor 22. A compression chamber 18 is defined in the shell 17. An outlet 19 is formed at a top portion of the shell 17 to connect the interior of the compression chamber 18 with the exterior of the compression chamber 18. The outlet 19 is connected to a discharge tube 25 via a check valve 23, which ensures that refrigerant only flows in the direction from the outlet 19 to the discharge tube 25.

25 **[0013]** An inlet 20 is formed at one side of a lower portion of the high-pressure shell 17. The inlet 20 is connected with the liquid separator 28 via a suction tube 24, so that refrigerant from the liquid separator 28 is sucked into the compression chamber 18 via the suction tube 24 and inlet 20.

30 **[0014]** A certain amount of lubricant oil 15 is provided in the interior of each of the compression chambers 5 and 18 to lubricate the compressor bodies 8 and 21. The compressor bodies 8 and 21 may comprise a rotary type compressor for compressing the refrigerant.

35 **[0015]** The liquid separator 28 collects refrigerant from the heat exchanger, and discharges only gaseous refrigerant into the first compressor 3. That is, the liquid separator 28 prevents the compressor body 8 from being over-loaded due to compression of liquid-state refrigerant.

40 **[0016]** The first compressor 3 and second compressor 16 are arranged in parallel in the refrigerant circuit of the

air conditioner. Refrigerant discharged from the discharge tubes 12 and 15 is introduced into the refrigerant circuit and passes through a cooling or heating cycle in a heat exchanger (not shown). The refrigerant emerging from the refrigerant circuit is introduced into the liquid separator 28, and is then separated into the suction tube 11 and the suction tube 24.

[0017] The suction tube 11 of the shell 4 included in the first compressor 3 and the suction tube 24 of the shell 17 included in the second compressor 16 are connected by a bypass tube 26. The connection of the bypass tube 26 with the suction tubes 11 and 24 may be achieved by mounting commercially available standard connectors (for example, nipples) to holes provided at the suction tubes 11 and 24 by means of screw fastening or welding.

[0018] Operation of the air conditioner 1 will now be described.

[0019] When the cooling/heating load is low, only the first compressor 3 operates continuously and the second compressor 16 is inactive. In the inactive state, a very small amount of high-pressure refrigerant penetrates the shell 17 of the second compressor 16, thereby causing the internal pressure of the shell 17 to be higher than the pressure of the suction tube 24 and reach the saturated pressure at ambient temperature or the discharge pressure of the first, variable-speed compressor. As a result, the lubricant oil 15 existing in the shell 17 is forcibly discharged from the compression chamber 18 into the suction tube 24.

[0020] The oil discharged from the compression chamber 18 into the suction tube 24 is fed into the suction tube 11 of the first compressor 3 in operation via the bypass tube 26 by virtue of the suction force generated in the first compressor 3 to suck refrigerant from the suction tube 24. Thus, the lubricant oil 15 is not left in the suction tube 24 of the inactive second compressor 16. Accordingly, it is possible to prevent the second compressor 16 from being damaged due to compression of oil from the suction tube 24 when the second compressor 16 is re-activated.

[0021] Since the matter moving between the compressors is limited to oil and sucked gas refrigerant, standard compressor products may be used. Accordingly, a reduction in the manufacturing costs is achieved.

[0022] Although an embodiment of the invention has been described with respect to an air-conditioner having two compressors, the number of compressors is not limited to two. Three or more compressors may be used.

[0023] Moreover, although the invention has been described with respect to a single embodiment, it will be appreciated by those skilled in the art that changes may be made to this embodiment.

Claims

1. An air conditioner (1) comprising a plurality of high-pressure shell-type compressors (3, 16) ar-

ranged in parallel **characterised by** a bypass tube (26) interconnecting the inputs (7, 20) of the compressors.

2. An air conditioner (1) according to claim 1, wherein respective suction tubes (11, 24) are connected to the inputs (7, 20) of the compressors (3, 16) and the bypass tube (26) interconnects the suction tubes such that oil (15), released from an inactive one of the compressors into its suction tube (24), is sucked into the suction tubes (11) of one or more active ones of said compressors (3).

3. An air conditioner comprising a plurality of high-pressure shell type compressors comprising a first compressor to operate continuously during an air conditioning operation of the air conditioner, and at least one second compressor to operate in parallel with the first compressor, if necessary, during the air conditioning operation, the second compressor having an internal pressure established in a shell of the second compressor in a stopped state of the second compressor such that the internal pressure is maintained above a suction pressure of the second compressor, the air conditioner further comprising:

a bypass tube to connect a suction tube connected to a shell of the first compressor and a suction tube connected to the shell of the second compressor.

FIG 1

