Fig. 3
Fig. 4
APPARATUS FOR SEPARATING LUBRICANT FROM A REFRIGERANT LUBRICANT MIXTURE IN A RECIPROCATING TYPE AUTOMOTIVE AIR CONDITIONER COMPRESSOR

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7 Claims

This application is a continuation of Ser. No. 838,104 filed July 1, 1969 now abandoned.

This invention relates to apparatus for separating a lubricant from a refrigerant-lubricant mixture which circulates in a reciprocating type automotive air conditioner compressor, and more particularly to improvements of the refrigerant circulating system of the device for effectively separating the lubricant from the mixture at the suction portion of the compressor.

In a conventional reciprocating type compressor using a swash plate for driving a piston, a refrigerant is forced to circulate in a circulating system, and some of the oil is drawn into the refrigerating cycle and mixes with the refrigerant. Thus, the content of the lubricant contained in the refrigerant-lubricant mixture tends to increase cumulatively, with a resultant decrease in the refrigerating capacity of the compressor, and also a decrease in the amount of oil in the compressor lubrication system, thereby causing insufficient lubrication, and burning or damaging of frictional elements in the compressor.

Furthermore, during operation of the compressor, blow-by gas leaks through the gap between the piston and the cylinder of the compressor, thus causing the pressure in the oil reservoir chamber to increase. In order to balance this pressure build-up with the pressure of the suction chamber, a balancing hole is conventionally provided between the oil reservoir chamber and the suction chamber. When the compressor is starting, or when its operation is fluctuating abruptly, a sudden pressure difference is created between the oil reservoir chamber and the suction chamber, and this produces foam in the mixture of the refrigerant gas and the liquid within the oil reservoir chamber, with the result that the foamed mixture tends to flow to the suction chamber through the balancing hole. Thus, the refrigerating efficiency of the compressor decreases, and also the amount of the lubricant oil in the compressor lubrication system decreases, causing insufficient lubrication of the compressor as previously described.

The compressor for an automobile air conditioner is required to be compact so as to fit in the small space under the hood of the automobile, particularly in the case of a compact car, and in the modern automobile designs which tend to have low profiles. Accordingly it is difficult to provide the aforementioned balancing hole at a substantially elevated position from the oil surface, and when the automobile runs on steep grades, or starts or stops pro-

ably, the surface of the lubricant in the oil forms ripples which causes an oil flow back into the suction chamber through the balancing hole.

It is an object of this invention to eliminate these and other disadvantages of such a conventional compressor, and to provide a system for separating lubricant from a refrigerant-lubricant mixture.

One advantage of the present invention is that a plate is provided in the suction passage of the compressor for providing spaced passages for the lubricant and refrigerant. This plate has a hole or causing an accelerated flow of the mixture to be ejected therethrough at high speed, and to collide on a corrugated wall formed on the inner wall of the suction passage for further separating the lubricant from the mixture. This separation of the lubricant by means of the corrugated wall is caused by the differences in the specific gravity and adhesion between the refrigerant and the lubricant, whereby the lubricant flows downward on the corrugated wall.

Another advantage of the present invention is that the thus separated lubricant is fed to the oil reservoir of the compressor through a check valve or a device having a tapered expanding portion and an expanded passage provided with a ball so as to prevent the counterflow of lubricant to the suction portion of the compressor. This arrangement allows a counterflow feed of the refrigerant to the cylinder of the compressor, but prevents the counterflow of the lubricant from the oil reservoir to the suction chamber as otherwise would be caused by the blow-by gas pressure inside the casing.

The features and advantages of the present invention will become apparent from the following description when read in conjunction with the accompanying drawings, in which:

FIG. 1 is a sectional view of the suction portion of a compressor for an automobile air conditioner constructed in accordance with the present invention;

FIG. 2 is a sectional view similar to FIG. 1 but taken in a different section;

FIG. 3 is a sectional view taken along the line III—III of FIG. 2; and

FIG. 4 is a sectional view similar to FIG. 1 but showing the suction portion of the compressor having means for preventing the counterflow of the lubricant from the oil reservoir to the suction portion of the compressor.

Reference is now made to FIGS. 1 and 2, which show the suction portion of a reciprocating type compressor for an automobile air conditioner constructed according to the present invention, and including apparatus 10 for separating lubricant from a refrigerant-lubricant mixture in the compressor. The compressor and apparatus include a casing 11; a cylinder 12; a valve plate 13; a cylinder head 14 disposed in sealed contact with the valve plate 13 and inserted into the end of the casing 11, and including a suction chamber 15, a discharge chamber 16, and a suction port 15'; a head cover 17; a head cover gasket 18; and a cover gasket 19, for sealing the cylinder head 14; a suction connector 18; a retaining 19; a suction connector 19; a packing 20; a plurality of bolts 20' for connecting the suction connector 19 to the head cover 17; a check joint 21 for supplying a refrigerant or for checking the pressure of the refrigerant gas in the suction chamber
Reference is now made to FIG. 4, which shows different means 40 for preventing the counterflow of oil. The device 40 is composed in the oil separating chamber 23. A strainer 22 disposed in the oil separating chamber 23 for providing upper and lower passages for the refrigerant and lubricant respectively, said plate being formed with a hole 25 for providing an accelerated flow of the mixture toward the cylinder head 14; a partition 26 provided in the head cover 17 for providing a recess 27 for keeping the separated oil isolated from the mixture flow in the oil separating chamber 23 means providing a passage between the oil separating chamber 23 and the recess 27 such as, for example, a gap 28 provided between the head cover 17 and the cylinder head 14, or a hole (not shown) formed in the partition 26; and a lubricant passage 29 for passing the lubricant from the recess 17 to the oil reservoir 30 of the compressor. Preferably, the section area of the strainer 22 is larger than the area of the suction connector 18; and the hole 25 in the plate 24 is bored in the opposite corner from the strainer 22 at the lowest part of the plate 24, as best seen in FIG. 3.

A corrugated wall 31, formed for example by zigzag or horizontal ridges on the inner wall of the oil separating chamber 23, separates the lubricant from the mixture ejected through the hole 25 of the plate 24, due to the adverse pressure acting on the corrugated wall 31. This system further comprises a check valve 32 provided at the outlet 33 of the passage 29 for preventing the counterflow of the oil and blow-by gas from the oil reservoir 30 to the oil separating chamber 23. Also, a rigid tubular member 33 in the lubricant passage 29 positions the cylinder head 14 with respect to the cylinder 12; and, packing 34 sealingly connects the tube 33 with the cylinder head 14 and the valve plate 13, a packing 35 sealingly connects the cylinder head 14 with the end of the casing 11, and a packing 36 sealingly connects the head cover 17 with the cylinder head 14.

In the operation of the system thus constructed in accordance with the present invention, the refrigerant-lubricant mixture gas is taken in through the suction connector 18, and then expanded while passing through the strainer 22 to cause the flow rate of the mixture to decrease, so that the lubricant is separated from the mixture through the screen of the strainer 22 due to the difference in the specific gravity between the two components of the mixture. The thus separated refrigerant gas then flows through the gap 28 between the top wall of the oil separating chamber 23 and the plate 24, while the thus separated lubricant flows through the gap 38 between the bottom wall of the oil separating chamber 23 and the plate 24, whereas the remaining unseparated portion of the mixture is ejected through the hole 25 and impinges on the corrugated wall 31 formed on the inner wall of the oil separating chamber 23, to cause the lubricant contained in the mixture to be separated therefrom due to its difference in specific gravity and viscosity with respect to the refrigerant, with the result that the lubricant adheres to the corrugated wall 31 of the oil separating chamber 23 and then flows down the wall. The separated refrigerant gas flows upward in the oil separating chamber 23, continuing to expand therein to slow down its flow rate, so that the separated lubricant flows downward to the partition 26. Thus the separated refrigerant flows into the suction chamber 15 of the compressor, while the lubricated lubricant, which has dropped on the partition 26, flows through the gap 28 between the partition 26 and the wall of the cylinder head 14 to the recess 27 and further through the lubricant passage 29, the tube 33, and the check valve 32 to the oil reservoir 30 when the check valve 32 opens due to a pressure drop in the oil reservoir chamber. When the pressure in the oil reservoir chamber 22 due to the blow-by gas entrained therein by the abrupt change of the operation of the compressor, the check valve 32 closes to prevent the counterflow of the lubricant oil.
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5 a gap therebetween to permit the flow of said separated lubricant from said one section to said other section; and a lubricant passageway provided in said rear cylinder head and extending in communication between said other section and said lubricant reservoir for passing the lubricant separated from said mixture in said sections into said lubricant reservoir, whereby the lubricant separated from said mixture in said separating chamber is drawn into said reservoir and the rest of said mixture is drawn into said suction chamber through said suction port.

2. Improved lubricant separating apparatus as set forth in claim 1, in which said cylinder head is provided with a corrugated surface portion within said other section, and said plate means opening is aligned with said corrugated surface to discharge said mixture from said first section at right angles against said corrugated surface.

3. Improved lubricant separating apparatus as set forth in claim 1, in which the uppermost edge of said plate means is spaced from an upper wall of said lubricant separating chamber to permit the flow of refrigerant over said uppermost plate edge from said one section to said other section.

4. Improved lubricant separating apparatus as set forth in claim 1, in which the upper surface of said partition slants downwardly toward said cylinder head.

5. Improved lubricant separating apparatus as set forth in claim 1, in which said lubricant passageway slants downwardly in said rear cylinder head.

6. Improved lubricant separating apparatus as set forth in claim 1, further comprising valve means connected to said lubricant passageway to permit the passage of lubricant into said reservoir from said other section, and to block the flow of lubricant from said reservoir toward said other section.

7. Improved lubricant separating apparatus as set forth in claim 1, in which said lubricant passageway has an expanded portion spaced from said other section and a tapered portion at the upstream end of said expanded portion, and further comprising valve means including a ball disposed within said expanded portion for movement therein, said ball when spaced from said tapered portion and thereby permitting the flow of gaseous fluid through said passageway, and being movable into said tapered portion to block the flow of lubricant from said reservoir toward said other section.

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