MULTIPLE COMPRESSOR REFRIGERATION SYSTEM


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References Cited

UNITED STATES PATENTS

2,175,913 10/1939 Philipp ........................................ 62/468
2,294,552 9/1942 Gypax ........................................ 62/510
2,253,623 8/1941 Jordan ........................................ 62/192
2,663,164 12/1953 Kurtz ........................................ 62/468

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ABSTRACT

A multiple compressor refrigeration system having at least first and second hermetic shell compressors with the suction line of the system connected into the upper portion of the first compressor shell and a suction line extending from within the upper portion of the first compressor shell to within the upper portion of the shell of the second compressor and with the discharge lines of the first and second compressors connected in parallel to the high pressure line of the system. An oil equalizing conduit is connected between the crankcase portions of the shells of the first and second compressors at the height of the minimum desired oil level to be maintained in the first compressor when both compressors are running with normal quantities of oil in the system.

4 Claims, 3 Drawing Figures
FIG. 1

FIG. 2

FIG. 3
MULTIPLE COMPRESSOR REFRIGERATION SYSTEM

BACKGROUND OF THE INVENTION

It is well known to provide a refrigeration system with multiple compressors, various ones of which may be cycled off and on to vary the capacity of the system. In the most common arrangement, the suction lines of the multiple compressors are connected in parallel and their discharge lines are connected in parallel to the system but in addition, both suction pressure and oil level equalizing lines must be connected between the parallel connected compressors to obtain satisfactory operation under all conditions either when all compressors are running or when a compressor in the system is not running to reduce the capacity. It is desirable to reduce the complexity of such systems by reducing or eliminating the number of various equalizing lines and or parallel connections between the multiple compressor shells not only for the obvious reasons of economy and serviceability but to eliminate the parallel suction path present for a running compressor through a non-running compressor in the previous system. At the same time, it is also desirable to assure adequate lubrication for the compressors whether or not they are running or are just being started to run. Therefore, in accordance with this invention, it has been found that the respective suction lines to each of the multiple compressors should not be connected in parallel to the system suction line but should be connected serially from the first compressor to the second compressor thus avoiding the need for a parallel suction equalizer line. However, with such an arrangement it has been found to be also necessary to provide an oil equalizer line between the crankcases of multiple compressors and connected at a predetermined height to the compressor that is always running when the system is in operation such that at least a minimum oil level at that height is maintained in that compressor when both compressors are running and that a suitable level of oil is maintained in the not running compressor when only one compressor is running.

PRIOR ART

U. S. Pat. No. 2,663,164 discloses a so-called parallel compressor arrangement in which the suction line of the system is connected to the first compressor and the suction line to the upper portion of the second compressor extends from within the lower portion of the first compressor at a height equal to the desired oil level in the first compressor. There is no oil equalizing line provided in the patented arrangement and therefore, oil can be deposited in the second compressor only when it is running to suck oil over from the crankcase of the first compressor or to deposit entrained oil from the gaseous refrigerant during the operation of the second compressor.

SUMMARY OF THE INVENTION

In accordance with this invention, a multiple compressor refrigeration system is provided with at least first and second hermetic shell compressors, the first of which is intended to be always running when the system operates on the second which may be cycled off and on to vary the capacity of the system during its running. The first compressor is provided with a suction gas conduit extending into the upper part of its shell and the second compressor is provided with a suction gas conduit extending from within the upper part of the first compressor shell to within the upper part of the second compressor shell. Thus, when only the first compressor is running, the suction gas is delivered directly thereto from the system and does not pass through the second compressor. In order to maintain a desired oil level in both compressors when only the first compressor is running, an oil equalizing conduit extends from the shell of the first compressor of the second compressor and is located at a position above the crankcase bottom of the first compressor equivalent to the minimum desired oil level in the first compressor whether or not one or both compressors are running. Since, when the second compressor is not running, the oil in the second compressor tends to be cooler, an oil crankcase heater is provided in the second compressor to be energized when the second compressor is cycled off to be not running. Since the system of this invention avoids the parallel suction path of the prior systems the operation of the crankcase heater is most effective because there is no cooling of the oil by circulating refrigerant in the not running compressor.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a top plan diagrammatic view showing the connections of two compressors in a multiple compressor refrigeration system in accordance with the invention;

FIG. 2 is a side elevation diagrammatic view similar to FIG. 1 and showing the oil levels in both compressors when only the first compressor is running; and

FIG. 3 is a view similar to FIG. 2 but showing the oil levels in both compressors when both compressors are running.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A multiple compressor refrigeration system, the coil and expansion valve parts of which are not shown, is provided with at least two compressors such as shown at 1 and 2. Both compressors are of the hermetic shell type as well known in the art. The first compressor 1 is provided with a suction line conduit 12 adapted to be connected to the suction line of the refrigerant system (not shown) and extending to a flare and strainer 13 within the upper portion of compressor shell 14. The second compressor 2 is provided with a suction gas conduit 15 extending from within the upper portion of shell 14 to a flare and strainer 16 within the upper portion of the compressor shell 17. The discharge line 18 of compressor 1 is connected by a conduit 19 in parallel with the discharge line 20 of compressor 2 to the high pressure line 21 to be connected to the refrigeration system.

When the system is operating with both compressors 1 and 2 running the suction gas for compressor 1 is drawn through conduit 12 while the suction gas for compressor 2 is drawn through both conduits 12 and 15. When only compressor 1 is running, its suction gas is drawn through conduit 12 only and there is no flow of suction gas through conduit 15 with compressor 2 not running. Since the flow of gas through conduit 15 will always be less than through conduit 12, its diame-
3,785,169

3. The diameter of conduit 12 may be smaller than the diameter of conduit 12. Stated another way, if both compressors 1 and 2 are of the same capacity, then the suction conduit 15 need be sized only for one-half the capacity for which suction conduit 12 is sized.

In order to assure an adequate amount of oil in the crankcase of both compressors 1 and 2 under all conditions of system operation, an oil equalizing conduit 30 is provided to extend from within the compressor shell 14 in the crankcase of compressor 1 to within the shell 17 in the crankcase of compressor 2. The point of connection 31 into compressor 1 is at a height that will provide a first minimum oil level in compressor 1 when both compressors are running as shown by FIG. 3 of the drawing and second oil levels in both compressors somewhat above the first level in the first compressor when only the first compressor is running as shown by FIG. 2 of the drawing. Thus, when only the first compressor is running and the suction pressures in both compressors are equalized through suction conduit 15, the oil level in both compressors 1 and 2 would be the same, assuming both compressors to be on the same level and sufficient oil to be present in the system. Therefore, there will always be oil in the not-running compressor 2 for its subsequent start-up operation.

When both compressors 1 and 2 are running, there will be a slightly lower suction pressure in shell 17 of compressor 2 due to the added restriction of suction line 15 and strainer 16 to thus cause the oil level in compressor 2 to be higher than the oil level in compressor 1 as shown by FIG. 3 of the drawing. However, as previously mentioned, the minimum oil level for compressor 1 as shown by FIG. 3 would be determined by the height of the connection 31 of the oil equalizing line 30 since the oil in compressor 2 is sucked through connection 31 from compressor 1 to compressor 2, assuming that the system has sufficient oil for which it is designed and that is of course more than enough to fill the crankcase of compressor 1 to the level of the oil equalizer line connection 31.

When the system is operating at reduced capacity with compressor 1 running and compressor 2 cycled to be not running, there is no circulation of refrigerant gas from compressor 1 to compressor 2 to tend to cool the oil in the not-running compressor 2. However, this oil will be cool because compressor 2 is not running. As is well known, it is undesirable to cool the lubricating oil because of the tendency for cold oil to absorb more refrigerant gas than warm oil. Therefore, it is desirable to position a crankcase oil heater within the crankcase of compressor 2 beneath the normal level of crankcase oil when compressor 2 is not running so that the heater may be energized to heat the oil when compressor 2 is not running, thus effectively driving off any entrained refrigerant in the oil in the crankcase of compressor 2.

With the system of this invention, having no parallel suction path through compressor 2 when only compressor 1 is running, the operation of the heater 40 is most effective to heat the oil in compressor 2 at that time and remove entrained refrigerant.

It will be noted that in the preferred form of the invention, the suction conduit 15 extends into the shell 14 of compressor 1 beyond the inner surface of the shell as shown at 45. This arrangement provides an effective labyrinth for the flow of oil wiped on the inner surface of shell 14 to prevent its induction into the suction conduit 15 and assuring its return to the crankcase of the always running compressor 1.

Various modifications will occur to those skilled in the art.

What we claim is:

1. A multiple compressor refrigeration system arrangement comprising, a first hermetic shell compressor intended to be always running when the system is operating, a second hermetic shell compressor that may be cycled on and off when the system is running, a first suction gas conduit adapted to be connected to the suction line of the system and extending into the upper portion of the shell of said first compressor, a second suction line extending from within the upper portion of said first compressor shell to within the upper portion of said second compressor shell, a first high pressure discharge line extending from said first compressor and connected in parallel to a second high pressure discharge line extending from said second compressor and adapted to be connected to the high pressure line of said system, and an oil equalizing conduit, connected between the shells of said first and second compressors and connected to open into said first compressor at the height of minimum desired oil level to be maintained in said first compressor when said first and second compressors are both running with normal oil supply in the system and connected to open in said second compressor at substantially the same height.

2. The system of claim 1 in which the second suction line is of less diameter than said first suction line.

3. The system of claim 1 in which the second suction line extends into the shell of said first compressor beyond the inner surface thereof.

4. The invention of claim 1 in which a crankcase heater is disposed in the shell of said second compressor beneath the level of oil to be normally maintained when said second compressor is cycled to be not running, said heater being adapted to be energized when said second compressor is not running.

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