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W. E. JOHNSON

2,233,168

COMPRESSOR

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Fig. 2.

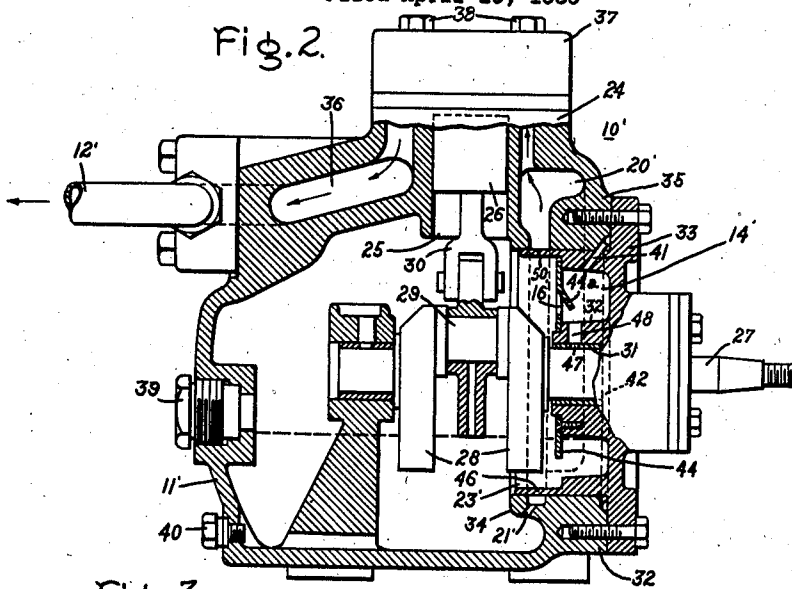


Fig. 3.

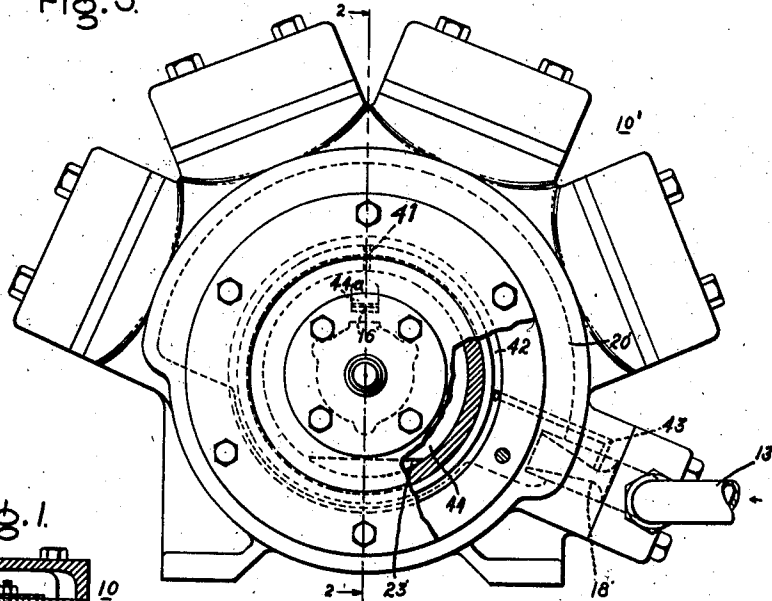
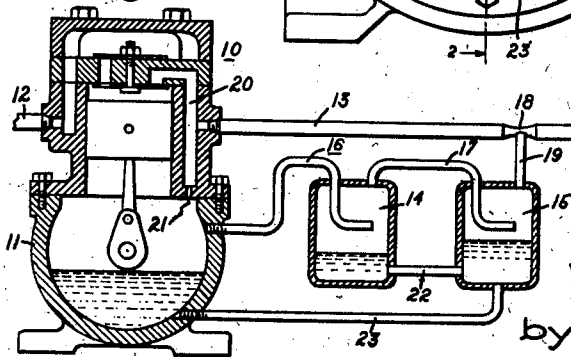


Fig. 1.



Inventor:
Wilfrid E. Johnson,
by *Harry C. Dunham*
His Attorney.

UNITED STATES PATENT OFFICE

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COMPRESSOR

Wilfrid E. Johnson, Fort Wayne, Ind., assignor to
General Electric Company, a corporation of
New York

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14 Claims. (Cl. 230—187)

My invention relates to fluid compressors and the like and more particularly to fluid compressors employing a splash feed lubricating system.

It is an object of my invention to provide a new and improved compressor construction which is rugged in construction and efficient in operation.

Compressors designed to operate at high speeds and to use a splash feed lubrication system encounter conditions under which it is difficult to provide for the return of lubricating oil to the crankcase of the compressor after it has once passed the pistons. Because of the extremely vigorous splash occurring in the crankcase there is a tendency to throw oil out of the crankcase and prevent its return from the inlet or suction side of the compressor. This difficulty is intensified in the event of even a small leakage of the working fluid past the pistons into the crankcase. Whenever this fluid leakage occurs the leakage fluid will flow out from the crankcase into the suction line through any orifice or passage that is provided for the purpose of returning lubricant from the suction line to the crankcase and carry entrained lubricant therewith. Hence, it is a further object of my invention to minimize the accumulation of lubricant in the external part of the refrigerant system including the condenser, evaporator and liquid receiver, for example, by returning to the crankcase any excess lubricant accumulating in the external part of the refrigerant circuit.

It is also an object of my invention to provide means for returning any of the working fluid which has leaked past the piston into the crankcase to the suction side of the system without hindering the return of lubricant to the crankcase.

Further objects and advantages of my invention will become apparent as the following description proceeds and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of my invention reference may be had to the accompanying drawing in which Fig. 1 is a schematic diagram illustrating the operation of apparatus embodying my invention; Fig. 2 is a side elevational view, partly in section, illustrating a compressor embodying the principles of my invention; and Fig. 3 is an end view, partly broken away, of the compressor shown in Fig. 2.

As shown in Fig. 1, I have provided a com-

pressor 10 having a crankcase 11, an exhaust line 12 and an inlet or suction line 13. Oil separating chambers 14 and 15 are also provided. A conduit 16 communicates between crankcase 11 and the separating chamber 14 above the lubricant levels therein and I provide a second conduit 17 communicating between separating chambers 14 and 15 above the lubricant levels therein. In the suction line 13 there is provided a pressure reducing means 18, such as a Venturi contracta. A conduit 19 communicates between the low pressure region of the pressure reducing means 18 and the upper portion of lubricant separating chamber 15 above the lubricant level therein. The inlet conduit 13 terminates in an inlet chamber or manifold 20, a restricted passage 21 being provided between the inlet chamber 20 and the crankcase 11 for returning any lubricant deposited in the inlet chamber 20. The restriction in passage 21 should have a smaller cross-sectional area than any portion of the path of flow through chambers 14 and 15 and passages 16, 17 and 19. Separating chambers 14 and 15 have a connecting passage or conduit 22 below the lubricant level in the chambers 14 and 15 and the lower portion of chamber 15 is connected to the crankcase 11 below the lubricant level therein by means of a lubricant return conduit 23.

The operation of the system is as follows: Because of the presence of passage 21, working fluid as well as lubricant may pass from the inlet chamber 20 to the crankcase 11. The flow of gas through the venturi 18 in the suction line 13 causes a reduction of pressure at the throat of the venturi 18 which tends to siphon the working fluid from the crankcase 11 through the passages 16, 17 and 19 and chambers 14 and 15 into the throat of the venturi 18 and the suction line 13. Consequently, there is a constant circulation of working fluid through the above described circuit during normal operation of the system. If sufficient injector capacity is provided at the venturi and if the passages 16, 17 and 19 are sufficiently large and the leakage past the piston is not excessive, there will be a reduction of pressure in the crankcase below that existing in the suction manifold 20. Note that the pressure in the suction manifold 20 will be equal to that in the suction line at the mouth of the venturi 18 except for losses due to friction and to the injector loss. Because the pressure is higher in the inlet chamber than in the crankcase, any oil deposited in the inlet chamber will be returned to the crankcase through the restricted passage 21.

21. Because of the vigorous splashing of the lubricant in the crankcase 11, a considerable quantity of lubricant will pass through the conduit passage 16 into the chamber 14 together with any vapor that is flowing. Due to the change in direction of flow in chamber 14 and the reduced velocity of flow caused by the sudden increase in volume of chamber 14 compared to conduit 16, the lubricant is to a large extent separated from the fluid and falls to the bottom of the chamber 14. Because of the flow of lubricant and fluid from the crankcase into the chamber 14, there will exist a pressure drop and the pressure in the chamber 14 will be lower than that in the crankcase resulting in the lubricant level being higher than the lubricant level in the crankcase as illustrated. Because of the action of the lubricant separator 14, there will be mainly a flow of gas without lubricant through conduit 17 into the separator chamber 15 but any oil that is still entrained is separated in the chamber 15. Again, due to the pressure drop between chambers 14 and 15, there will be a higher lubricant level in chamber 15 than in chamber 14 as indicated in the drawing. Whenever the amount of lubricant collecting within the chambers 14 and 15 is sufficient to overcome the pressure in the crankcase 11, any excess lubricant will be returned to the crankcase by way of conduit 23. While the schematic arrangement illustrated in Fig. 1 illustrates a system using two separating chambers in series, one or more separators may be used depending upon the degree of separation required.

Describing my invention in greater detail and referring to Figs. 2 and 3, I have illustrated a compressor embodying the features of my invention. Primed numerals will be used in Figs. 2 and 3 to indicate corresponding parts of Fig. 1. A compressor 10' having a plurality of cylinders radially arranged is illustrated having a cylinder block 24 provided with cylinders 25 adapted to receive a movable element for displacing the working fluid as, for example, reciprocable pistons 26. In order to reciprocate the pistons 26 within the cylinders 25, I have provided a shaft 27 suitably secured to an eccentric comprising crank arms 28 and crank pin 29, and a connecting rod 30. The shaft 27 is arranged to rotate in a bearing 31 suitably supported in the hub 32 of the end plate 33. The shaft 27 may be driven directly by a motor, not shown, or if desired a pulley, not shown, may be secured to the shaft 27 whereby the compressor may be belt-driven. The lubricant level within the crankcase 11' of the compressor 10' is indicated by the dotted line. As shown in Fig. 2, the counterweight portions of the crank arms 28 are arranged to dip into the lubricant in order to provide a splash feed lubrication system.

The inlet chamber or suction manifold 20' is illustrated as generally annular in shape and having an enlarged cross-section around most of its circumference. In order to permit easy cleaning of the inlet chamber 20', I have illustrated the inlet chamber 20' with a side open to the crankcase 11 as indicated at 50. The open side of inlet chamber 20' is closed by the flange 46 of the removable end plate or wall 33. The inlet chamber 20' is connected with the suction line or inlet conduit 13' through a venturi 18'. In order to permit lubricant collecting within the inlet chamber 20' to be returned to the crankcase 11', a passage 21' is provided through the flange 34

of the wall 35 of crankcase 11' communicating between the lower portion of chamber 20' and the crankcase 11'. In most cases, it may be desired to place the passage 21' in the lower portion of the crankcase 11 at a height approximately equal to that of the lubricant level in order to prevent rapid loss of lubricant from the crankcase into the inlet chamber 20' under transient conditions in which the inlet chamber pressure may be appreciably lower than that prevailing in the crankcase 11'. In such instances, the siphon operation caused by the venturi 18' will not relieve the crankcase pressure rapidly enough to prevent the pressure difference from forcing the lubricant out of the crankcase 11' very rapidly. It is desirable to shield the opening of passage 21' from any direct splash or impingement of lubricant which would tend to reverse the flow of lubricant.

Exhaust conduit 12' communicates with an exhaust manifold 36. A valve assembly, not shown, is enclosed in a cylinder head 37 which is suitably secured to the cylinder block 24 as by bolts 38. A sight glass 39 is provided in the wall of crankcase 11' to permit the determination of the lubricant level within the crankcase and a drain plug 40 is provided near the bottom of the crankcase 11' to permit draining of the crankcase.

I have found that while any number of lubricant separating chambers may be used, in most cases one such chamber is sufficient. Therefore, in the embodiment of my invention illustrated in Figs. 2 and 3 I have shown but one such chamber 14' which communicates directly with the venturi 18' through bleeder passages 41, 42 and 43 instead of communicating with the venturi through passages 17 and 19 and chamber 15 as illustrated in Fig. 1. In the illustrated form of my invention passage 42 comprises a substantially annular groove formed in the outer face of wall 35. The groove is closed by the inner face of end plate 33 as shown in Fig. 2. Passage 41 may be simply a bore extending through the upper part of the laterally extending flange 46 of end plate 33 and through a portion of wall 35.

The oil separating chamber 14' is defined by the substantially annular space or recess between the substantially annular flange 46 and the hub 32. In order more nearly to isolate the separating chamber 14' from the crankcase 11', I have provided a closure member in the form of a splash plate 44 suitably secured. In order to permit gas and lubricant to be drawn into the chamber 14' I have provided an opening or passage 16' in the plate 43 above the lubricant level in crankcase 11'. It is desirable to locate the passage 16' in such a place that oil is fed directly to the bearing without creating excessive splashing within the chamber 14'. In order to accomplish this purpose, the plate 44 is provided with a baffle portion 44a which tends to direct the lubricant downwardly into the chamber 14'. By reason of the several successive changes in direction of flow, the lubricant is separated from the gas and drops downwardly onto and around the hub or boss 32. A bore 47 is provided in the boss 32 and an opening 48 is provided in the bearing 31 in order to provide lubrication for the shaft 27. In order to provide a return passage 23' between the separating chamber 14' and the crankcase 11' the plate 43 is flattened at the lower portion, as shown in Fig. 3, to provide a space between the bottom edge of plate 44 and

the flange 46 of end plate 33. The gas, freed of the lubricant, is drawn from chamber 14' through bleeder passages 41, 42 and 43 into the suction line 13' at the venturi 18'.

Many modifications of my invention may be made. As illustrated in the drawing, the separating chamber or chambers may be incorporated integrally in the compressor block and end plate design so as not to be externally apparent, or the separating chambers may be separated from the compressor. The chambers and passages described above may be formed in any desired way in the compressor block and end plate. A splash plate is not essential to the invention as any desired separation between the chamber 14' and the crankcase 11' may be provided as long as suitably positioned passages are arranged between the crankcase 11' and chamber 14' above and below the lubricant levels. Furthermore, my invention is not limited to the use of a Venturi contracta as a pressure reducing means but any sort of pressure reducing means may be employed to perform the siphon function.

While I have shown a particular embodiment of my invention, I do not desire my invention to be limited to the particular construction shown and described and I intend in the appended claims to cover all modifications within the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A compressor having a crankcase, a cylinder, a movable element in said cylinder for displacing a working fluid, an inlet chamber communicating with said cylinder and receiving lubricant from the external part of the refrigerant circuit, a suction line communicating with said inlet chamber and means for returning the lubricant entering said inlet chamber to said crankcase, said means including a pressure reducing portion in said suction line for establishing a lower pressure in said crankcase than in said inlet chamber.

2. A compressor having a crankcase, a cylinder, a movable element in said cylinder for displacing a working fluid, an inlet chamber communicating with said cylinder, a suction line and means for returning any working fluid entering said crankcase to said inlet chamber, said means including a pressure reducing portion in said suction line for establishing a lower pressure in said crankcase than in said inlet chamber.

3. A compressor having a crankcase, a cylinder, a movable element in said cylinder for displacing a working fluid, an inlet chamber communicating with said cylinder and receiving excess lubricant from the refrigerant circuit, a suction line communicating with said inlet chamber and means for returning the lubricant entering said inlet chamber to said crankcase and for returning any working fluid from said crankcase to said inlet chamber, said means including a pressure reducing portion in said suction line for establishing a lower pressure in said crankcase than in said intake chamber.

4. A compressor having a crankcase chamber, a cylinder, a movable element in said cylinder for displacing a working fluid, an inlet chamber communicating with said cylinder, a suction line, and means for maintaining a lower pressure in said crankcase than in said inlet chamber, said means including a pressure reducing portion in said suction line, a lubricant separating chamber, means including a first passage communicating between said pressure reducing portion and said separating chamber, additional means including

a second passage communicating between said crankcase above the lubricant level therein and said separating chamber and further additional means including a third passage communicating between said inlet chamber below the lubricant level therein and said crankcase.

5. In a compressor having a crankcase, a cylinder, an element in said cylinder for displacing a working fluid, an inlet chamber communicating with said cylinder and means including a passage for returning lubricant entering said inlet chamber to said crankcase, a wall of said compressor being provided with a lubricant separating chamber, said wall having a first passage communicating between said separating chamber and said crankcase above the lubricant level in said crankcase, said wall having a second passage communicating between the lower portion of said separating chamber and said crankcase, said wall having a third passage therein communicating with said inlet chamber, pressure reducing means in said third passage, said wall having a fourth passage therein communicating between said separating chamber and said pressure reducing means and said wall having a fifth passage therein communicating between the lower portion of said inlet chamber and said crankcase.

6. In a compressor having a crankcase, a cylinder, an element in said cylinder for displacing a working fluid, an inlet chamber communicating with said cylinder, a wall of said crankcase being provided with a recess, a closure member arranged substantially to close the open side of said recess thereby providing a lubricant separating chamber, said member having a first opening above the lubricant level in said crankcase, said member having a second opening located below the lubricant level in said crankcase, said wall of said crankcase having an inlet passage therein communicating with said inlet chamber, a Venturi contracta in said inlet passage, said wall having a second passage therein communicating between said separating chamber above the lubricant level therein and the throat portion of said Venturi contracta, said wall having a third passage therein communicating between the lower portion of said separating chamber and said crankcase below the lubricant levels in said crankcase and means including a passage for returning lubricant entering said inlet chamber to said crankcase.

7. In a compressor having a crankcase, a cylinder, an element in said cylinder for displacing a working fluid, an inlet chamber communicating with said cylinder, said inlet chamber being open at one side, a removable end wall, a portion of said end wall closing said open side of said inlet chamber, said end wall having a recess, a closure member arranged substantially to close the open side of said recess thereby providing a lubricant separating chamber, said member having a first opening above the lubricant level in said crankcase, said member having a second opening located below the lubricant level in said crankcase, said wall of said crankcase having an inlet passage therein communicating with said inlet chamber, a Venturi contracta in said inlet passage, said wall having a second passage therein communicating between said separating chamber above the lubricant level therein and the throat portion of said Venturi contracta, said wall having a third passage therein communicating between the lower portion of said separating chamber and said crankcase below the lubricant

levels in said crankcase and means including a passage for returning lubricant entering said inlet chamber to said crankcase.

8. In a compressor apparatus including fluid compression means, a fluid supply line and a crankcase, the combination of means for creating within said fluid supply line an area in which the pressure is substantially lower than the suction pressure of said compression means, and means for providing communication between said area of low pressure and said crankcase at a point above the normal oil level therein.

9. In a compressor apparatus including fluid compression means, means for supplying fluid to be compressed to said compression means, and an oil reservoir having a normal oil level, the combination of means for creating within said fluid supply means an area in which the pressure is substantially lower than the suction pressure of said compression means, and means for providing communication between said area of low pressure and said oil reservoir at a point above the normal oil level therein.

10. In combination with a compressor apparatus having an oil reservoir formed in the crankcase thereof and means for supplying to said compressor fluid to be compressed, means operative responsive to the supply of fluid to said compressor for forming an area in which the pressure is substantially lower than the suction pressure of said compressor, and means providing communication between said area of low pressure and said crankcase at a point above the normal oil level therein.

11. In combination with a compressor apparatus having an oil reservoir formed in the crankcase thereof and means for supplying to said compressor fluid to be compressed, means operative responsive to the supply of fluid to said compressor for forming an area in which the pressure is substantially lower than the suction pressure of said compressor, and a conduit providing communication between said area of low pressure and said crankcase at a point above the normal oil level therein.

12. In combination with a compressor appara-

tus having an oil reservoir formed in the crankcase thereof and means for supplying to said compressor fluid to be compressed, means operative responsive to the supply of fluid to said compressor for forming an area of lower pressure than the suction pressure of said compressor apparatus, said last-mentioned means comprising a venturi forming a part of said fluid supply means, and a conduit providing communication between said area of low pressure and said crankcase at a point above the normal oil level therein.

13. In combination with a compressor apparatus having an oil reservoir formed in the crankcase thereof and means for supplying to said compressor fluid to be compressed, means operative responsive to the supply of fluid to said compressor for forming an area of lower pressure than the suction pressure of said compressor apparatus, said last-mentioned means comprising a venturi forming a part of said fluid supply means, and means forming a passageway providing communication between the crankcase of said compressor, at a point above the normal oil level therein, and the fluid supply means proximate the throat of said venturi.

14. In combination with a compressor apparatus having an oil reservoir formed in the crankcase thereof and means for supplying to said compressor fluid to be compressed, means operative responsive to the supply of fluid to said compressor for forming an area of lower pressure than the suction pressure of said compressor apparatus, said last-mentioned means including means for restricting communication between upstream and downstream portions of said fluid supply means, whereby fluid passing to the compressor will attain a relatively high velocity proximate said communication-restricting means and thus form an area of relatively low pressure proximate the downstream side of said communication-restricting means, and means forming a passageway providing communication between said area of relatively low pressure and the crankcase of said compressor above the normal oil level.

WILFRID E. JOHNSON.