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MEANS FOR CONVERTING A REFRIGERATION COMPRESSOR FOR USE IN A PLURAL COMPRESSOR REFRIGERATION INSTALLATION

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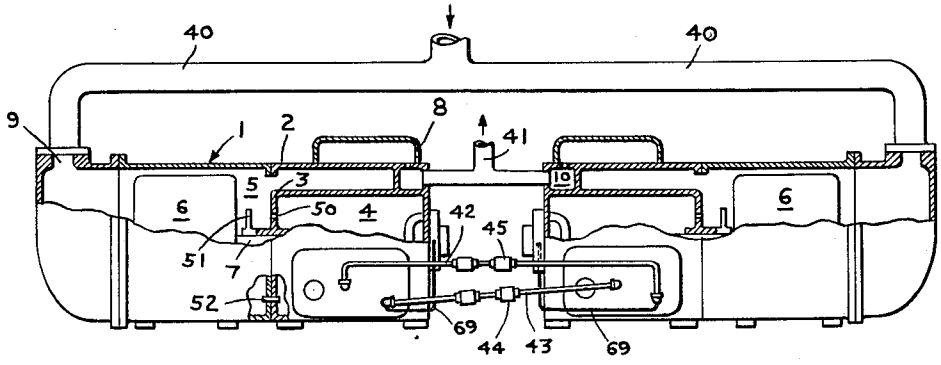


FIG. 1

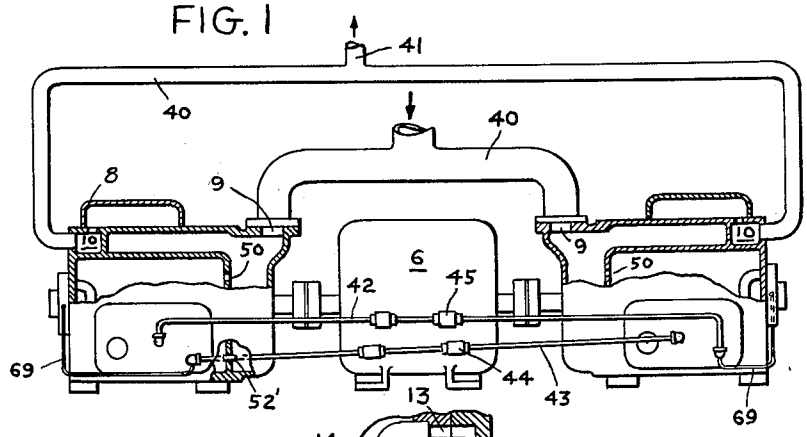


FIG. 2

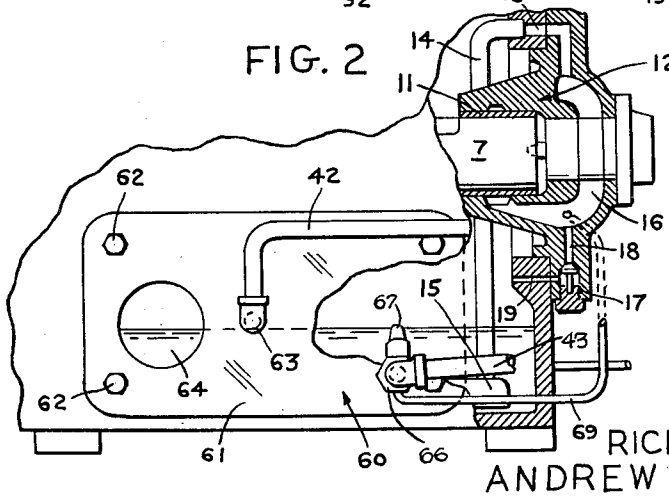


FIG. 3

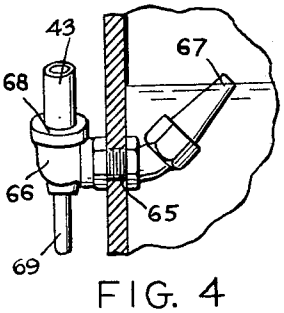


FIG. 4

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MEANS FOR CONVERTING A REFRIGERATION COMPRESSOR FOR USE IN A PLURAL COMPRESSOR REFRIGERATION INSTALLATION

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9 Claims. (Cl. 230—206)

This invention relates to plural compressor refrigeration installations and more particularly to means for converting an individual compressor so that it may be used in such installations.

The application of multiple compressors as the circulating means in a refrigeration system as is shown in U.S. Patent 2,076,332 has certain advantages, both from the standpoint of manufacture and operational effectiveness, over single units having the capabilities of the multiple units.

For example, shutting down a unit in the multiple system is a more efficient way of regulating the capacity of the system than can be accomplished with unloaders on a single unit.

Furthermore, individual units can be added to the refrigeration installation along with normal plant growth or expansion.

But inherent defects in the construction of the components of the system and their adaptation to multiple compressor operation have created serious operational difficulties which have limited the application of these systems in refrigeration installations.

One such difficulty is presented in prior art duplex systems. For example, during operation with one unit the pressure in the crankcase of the operating compressor is usually greater than that in the suction compartment. As a consequence oil that collects in the suction compartment due to reasons well known in the art, will not return to the crankcase where it is needed in proper quantity as lubricant.

Another operational limitation is presented in systems using more than two compressors, wherein one or more may be idle, as follows: the system pressure drop during foregoing operation may prevent the equalization of oil levels in the crankcases of the individual units. As a consequence one or more of the running units may become oil starved.

Various methods have been developed for multiple compressor systems to relieve the arresting influence that the higher gas pressure in the crankcase compartment has on lubricant collected in the suction compartment.

One such system is disclosed in U.S. Patent 2,869,775 and provides a compressor including check valves which prevent the buildup of abnormal pressures in the crankcase compartment, as described above, which arrests lubricant return thereto.

An analysis of the foregoing patent indicates that the problem relative lubricant return from suction to crankcase compartment is solved but that in providing means for destroying the system pressure to maintain substantially equal levels of lubricant in all of the crankcase compartments other difficulties are presented and particularly in installations including more than two compressors. In order to provide a system of three or more units wherein the system pressure does not interfere with the equalization of oil levels in the crankcases, it is necessary, according to the teachings of the foregoing patent, to maintain definite relationship between the conduits interconnecting the suction, discharge and crankcase compartments and between check valves mounted in the partitions of the individual compressors. Said

another way the system contemplated by Patent 2,869,775 solves the problem relative oil return from the suction to crankcase compartment in an individual unit but in attempting to provide for equalization of oil levels in all units of the system, presents complex technical requirements which increase the overall cost thereof.

In addition to insure proper operation the system contemplated in the above patent must be operated in accordance with predetermined operational instructions which at times may be difficult to meet.

The system contemplated in application Serial No. 1,300 of Richard K. Berger et al. filed January 8, 1960 and assigned to Worthington Corporation solves both the problem of oil return from suction compartment to crankcase compartment and equalization of oil level in all crankcases in such manner so as not to require complex technical considerations in the design or operation of the overall system.

However, in solving these prior art deficiencies another disadvantage is presented, namely maintaining the dimension of the leveling conduit in a definite relation relative the equalizing orifice, adds to the cost of the system. Said another way the conduit and valves associated therewith due to the above requirement are overly large and thusly add appreciably to the manufacturing costs of the system.

In addition high oil temperatures at low pressure operating conditions are presented in the above systems including simply an equalizing conduit to provide for equal lubricant levels in the crankcase.

The above enumerated difficulties were substantially eliminated with the advent of the system disclosed in application Serial No. 52,633 of Richard K. Berger et al. filed August 29, 1960. More particularly equalization of lubricant level is accomplished by pumping lubricant from one unit to the other through the pump associated with the lubrication system of the compressor.

In practice while the system disclosed in the above application solved the operational difficulties of the prior art, other problems presented themselves. In particular since the connecting means comprises drilled openings in the crankcase of the compressor and in the discharge compartment of the pump sealing problems were presented. Such arrangements also presented more complex assembly problems to the workmen in the art at hand.

The present invention solves the prior art problems mentioned above and in addition provides adaptor means which can be readily machined at the factory in accordance with the job specifications to permit the rapid conversion of a standard compressor to plural compressor refrigeration service.

Accordingly it is an object of this invention to provide means for converting a standard compressor to use in a plural compressor system whereby the problems mentioned above are overcome.

It is another object of this invention to provide a less costly multiple compressor system by providing standardized components which are manufactured according to assembly line techniques.

With the foregoing objectives in view, and others as may appear from the accompanying specification, the invention consists of various features of construction and combination of parts, which will be first described in connection with the accompanying drawings, in which like parts have the same reference characters, showing the multiple compressor system contemplated herein, and the features of the invention will be specifically pointed out in the claims.

In the drawings:

FIGURE 1 is a fragmentary longitudinal view in part section showing one form of multiple compressor system.

FIGURE 2 is a schematic view in part section showing a further form of multiple compressor system.

FIGURE 3 is a fragmentary section of a compressor utilized in the system.

FIGURE 4 is an enlarged side view in part section showing the ejector portion of the adapter means and the manner of mounting the ejector means.

Referring to the drawings, FIGURE 1 shows a hermetic type compressor designated **1** and generally adapted for use in the multiple compressor systems shown herein and embodying the novel components which provide for the return of lubricant from the suction to crankcase compartment and in addition maintain substantially equal lubricant levels in all crankcase compartments when applied in a multiple type system as hereinafter described.

While FIGURE 1 shows a hermetic type compressor, it will be understood by those familiar with this art that the concepts outlined herein may be applied to compressors of the open type as shown in FIGURE 2 and that reference to open units hereinafter is solely for purposes of illustration.

The compressor **1** basically comprises a casing **2** including a partition **3** which divides same into a crankcase compartment **4** and a suction compartment **5**. In the case of a hermetic type unit the motor means **6** is mounted in the suction compartment and is connected to the compression means (not shown) disposed in the crankcase compartment by a shaft designated **7**.

Means such as is shown in U.S. Patent 2,926,840 are included in the compressor **1** for equalizing pressures between the suction compartment and crankcase compartment to permit lubricant collected in the suction compartment to return to the crankcase compartment.

The foregoing means as shown in FIGURE 1 comprise a port **50** communicating the compartments **4** and **5** and an ejector or blower means **51** shown as mounted on the shaft whereby gases collected in compartment **4** are drawn therefrom and passed to the suction compartment **5**. Such an arrangement as is described in detail permits return of lubricant to the crankcase through check valve **52** shown as disposed in the lower portion of the partition **3**.

A similar arrangement is shown in FIGURE 2. However, it has been found that the compression means provide enough of a pressure differential to permit return of lubricant through the valve means **52'**.

As will be understood in the art all of the elements, such as cylinders, pistons and the like, of a conventional compressor are associated with the units contemplated herein and the compressor may be of one cylinder or multi-cylinder type without departing from the scope of the present invention. For the sake of clarity parts having like functions will be designated by the same reference characters.

The compressor is provided with the usual head **8** including the usual valves (not shown) to control fluid flow through the cylinder. As is customary fluid from the low side of the refrigeration installation is passed to suction compartment **5** through opening **9** and to the high side of the installation from the discharge chamber **10**.

The bearing **11** (FIGURE 3) and shaft **7** serving to drive the moving parts of the compressor are lubricated by any suitable lubrication system.

Thus, in the present form of the invention as is shown in FIGURE 3 the crankcase compartment **4** as is well known serves to collect lubricant in a reservoir generally designated **60** and formed in the lower portion of the crankcase compartment. This lubricant is supplied at a predetermined pressure to the moving parts by any suitable type pump generally designated **12**, connected to shaft **7**, which takes its suction through inlet **13** and suction pipe **14**, which is connected to strainer **15** shown as disposed in the lower portion of reservoir **60**.

Lubricant flowing to pump **12** is discharged into outlet **16** and flows into the bearing areas and rotating portions of the unit. To preclude the build up of high pressures in the outlet portion **16** and in the lubricated areas of the compressor relief valve **17** is disposed in a passageway **18** connected to outlet **16** and through valve **17** with a passageway **19**. It will be clear that on the development of excess pressure valve **17** will open and permit lubricant to flow back to the reservoir **60** through passageway **19**.

In order to convert the standard unit for use in a plural system adaptor means shown as plate **61** is connected to the crankcase portion of the casing by a plurality of bolts **62**.

An opening or port **63** is drilled in plate **61** and at a desired level, preferably at a location maintaining the desired quantity of lubricant in reservoir **60**. The usual sight glass **64** or opening is formed to provide visual means for determining whether or not the unit is functioning properly.

A second port **65** clearly shown in FIGURE 4 is formed in the plate **61** to receive an ejector means **66**.

A portion of the ejector means **66** includes a discharge outlet **67** disposed within the crankcase of the compressor and another portion disposed outside of the unit comprises the suction inlet **68**. The ejector may be connected to the plate **61** by any well known manner.

Motive power for the ejector is supplied via pump **12** through conduit **69** connected at one end to discharge outlet **16** and at the other end to the portion of the ejector mounted on the outer portion of the compressor.

The apparatus described above thusly permits adaptation of compressor **1** into a multiple system without the necessity of incorporating complex design changes and at appreciably lower costs.

A multiple system including the above compressor is shown in FIGURES 1 and 2 can be readily assembled by interconnecting the suction compartment **5** through conduit means **40** with the low side of the refrigeration installation. In similar fashion the discharge compartments **10** are interconnected by conduit means **41** to the high side of the installation.

Conduit means **43** interconnects the ejector of the compressor on the left of the drawings with the port **63** of the compressor on the right side of the drawings.

Conduit means **42** serves the same function as conduit **43**. However, it connects the ejector of the right compressor to the port of the left compressor.

Motive power is supplied to the respective ejectors by the pump associated with the compressors including the ejector.

In this fashion it will be evident that the pump of the right compressor will cause the ejector associated therewith to draw lubricant from the left compressor through line **42** until the level is where desired. This is of course controlled by proper location of the port **63**.

To preclude flow of lubricant through lines **42** and **43** by pressure difference in the crankcase of a compressor check valves **44** and **45** are disposed therein. As a consequence lubricant circulation only occurs by operation of the ejector means **66**.

Thusly, in the above described fashion applicant provides means for maintaining equalization of lubricant level during the most adverse operating conditions.

It will be evident to those skilled in the art that many changes may be made without departing from the scope of the appended claims.

What is claimed is:

1. Means for converting a refrigeration compressor for use in a plural compressor refrigeration installation, each of the compressors comprising a casing having a partition therein for dividing the casing into a suction and crankcase compartment, means in each compressor forming a discharge compartment, a lubrication system disposed in each of said compressors and including a pump having an inlet and outlet, the inlet of said pump being connected to its respective crankcase compartment, vent

means in the partition of each compressor, port means in each compressor providing communication between the suction and crankcase compartments and said port means to maintain a pressure in said crankcase compartment to permit lubricant to flow from said suction compartment to said crankcase compartment, said means for converting said compressors for use in a plural compressor refrigeration installation comprising a suction conduit interconnecting each of the suction compartments and said suction conduit connected to the low side of the refrigeration installation, a discharge conduit interconnecting each of the discharge compartments and said discharge conduit connected to the high side of said refrigeration installation, an adaptor means connected to each of said compressors, an ejector means connected to each of said adapter means and a portion of each of the ejector means including a discharge outlet disposed within one of the compressors, another portion of both said ejector means including a suction inlet and disposed on the outer portion of said adapter means, each of the adapter means including a port, conduit means interconnecting the port of one adapter means to the suction inlet of the ejector means connected to the other adapter means, conduit means interconnecting the port of the other adapter means to the suction inlet of the ejector means connected to the other adapter means, a conduit means interconnecting the discharge outlet of the pump of one compressor to the ejector of the compressor including said pump, and a conduit means interconnecting the discharge outlet of the pump of the other compressor to the ejector of the compressor including said pump whereby said pump means operate to maintain an equal level of lubricant in both said compressors.

2. The apparatus claimed in claim 1 wherein the port in said adapter means is disposed at a desired level.

3. The apparatus claimed in claim 1 wherein the adapter means comprises a plate connected to the crankcase of each compressor and the port included therein is disposed at a desired level.

4. The apparatus claimed in claim 1 wherein flow control means are disposed in both conduits interconnecting the ejectors and ports in the adapter means.

5. Means for converting a refrigeration compressor for use in a plural compressor refrigeration installation, each of the compressors comprising a casing having a partition therein for dividing the casing into a suction and crankcase compartment, means in each compressor forming a discharge compartment, a lubrication system disposed in each of said casings, a lubrication system disposed in each of said compressors and including a pump having an inlet and outlet, the inlet of said pump being connected to its respective crankcase compartment, vent means in the partition of each compressor, port means in each compressor providing communication between the suction and crankcase compartments, a blower means in each compressor for flowing fluid from the crankcase compartment to the suction compartment through said port means so that lubricant is permitted to flow from said suction compartment to said crankcase compartment, said means for converting said compressors for use in a plural compressor refrigeration installation comprising a suction conduit interconnecting each of the suction compartments and said suction conduit connected to the low side of the refrigeration installation, a discharge conduit interconnecting each of the discharge compartments and said discharge conduit connected to the high side of said refrigeration installation, an adapter means connected to each of said compressors, an ejector means connected to each of said adapter means and a portion of each of the ejector means including a discharge outlet disposed within one of the compressors, another portion of both said ejector means including a suction inlet and disposed on the outer portion of said adapter means, each of the adapter means including a port, conduit means interconnecting the port of one adapter means to the suction inlet of the ejector means connected to the other adapter means, conduit means interconnecting the port of the other adapter means to the suction inlet of the ejector means connected to the other adapter means, a conduit means interconnecting the discharge outlet of the pump of one compressor to the ejector of the compressor including said pump, and a conduit means interconnecting the discharge outlet of the pump of the other compressor to the ejector of the compressor including said pump whereby said pump means operates to maintain an equal level of lubricant in both said compressors.

6. The apparatus claimed in claim 5 wherein the port in said adapter means is disposed at a desired level.

7. The apparatus claimed in claim 5 wherein the adapter means comprises a plate connected to the crankcase of each compressor and the port included therein is disposed at a desired level.

8. The apparatus claimed in claim 5 wherein flow control means are disposed in both conduits interconnecting the ejectors and ports in the adapter means.

9. Means for converting a refrigeration compressor for use in a plural compressor refrigeration installation, each of the compressors comprising a casing having a partition therein for dividing the casing into a suction and crankcase compartment, means in each compressor forming a discharge compartment, a lubrication system disposed in each of said compressors and including a pump having an inlet and outlet, the inlet of said pump being connected to its respective crankcase compartment, vent means in the partition of each compressor, port means in each compressor providing communication between the suction and crankcase compartments and said port means to maintain a pressure in said crankcase compartment to permit lubricant to flow from said suction compartment to said crankcase compartment, said means for converting said compressors for use in a plural compressor refrigeration installation comprising a suction conduit interconnecting each of the suction compartments and said suction conduit connected to the low side of the refrigeration installation, a discharge conduit interconnecting each of the discharge compartments and said discharge conduit connected to the high side of said refrigeration installation, an ejector means connected to the crankcase of each compressor and a portion of each of the ejector means including a discharge outlet disposed within each compressor, another portion of both of said ejector means including a suction inlet and disposed on the outer portion of the compressor, a port in the portion of the casing comprising the crankcase, conduit means interconnecting the port of one casing to the suction inlet of the ejector means connected to the other crankcase, conduit means interconnecting the port of the other casing to the suction inlet of the ejector means connected to the other crankcase, a conduit means interconnecting the discharge outlet of the pump of one compressor to the ejector of the compressor including said pump, and a conduit means interconnecting the discharge outlet of the pump of the other compressor to the ejector of the compressor including said pump whereby said pump means operate to maintain an equal level of lubricant in both said compressors.

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