June 25, 1968 W. R. DIRK 3,389,853

REFRIGERANT COMPRESSOR WITH OIL TRAP IN DISCHARGE GAS CAVITY

Filed Feb. 14, 1967

Fig. 1

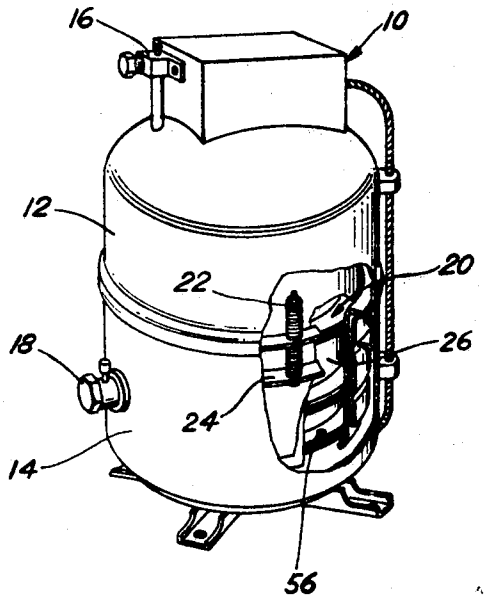


Fig. 2

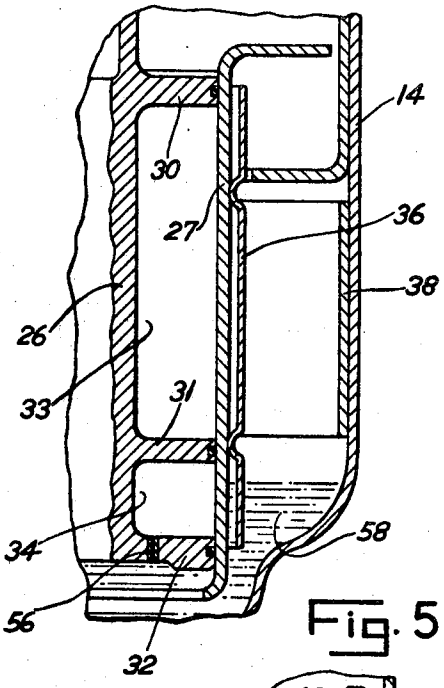


Fig. 3

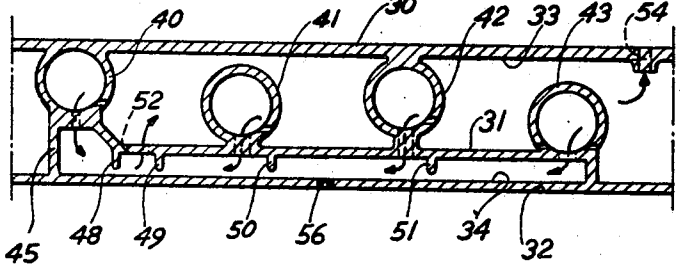


Fig. 4

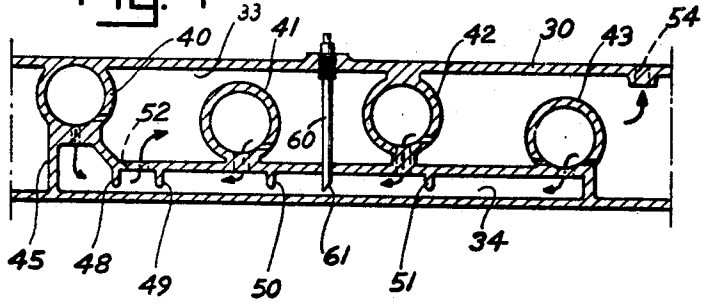
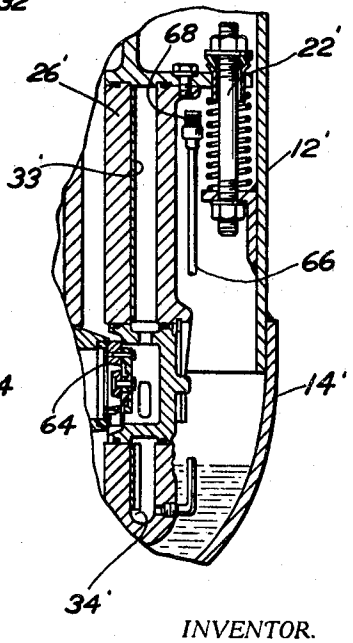


Fig. 5



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REFRIGERANT COMPRESSOR WITH OIL TRAP IN DISCHARGE GAS CAVITY

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9 Claims. (Cl. 230—206)

ABSTRACT OF THE DISCLOSURE

A refrigerant compressor having an annular discharge gas manifold provided in the lower portion of the compression mechanism, with means for trapping oil carried with the refrigerant in the lower portion of the discharge gas manifold, and with conduit means for effecting return of the trapped oil from the discharge manifold to the sump defined in the compressor between the compression mechanism and the outer housing during operation of the compressor.

Background of the invention

This invention relates to a hermetic refrigerant compressor and more particularly, to an improved arrangement for assuring adequate supply of oil within the compressor at all times during operation.

One troublesome problem with refrigeration systems is that lubricant or oil is often carried with refrigerant from the compressor into the refrigeration system. Any oil in the condenser and the evaporator would tend to coat the interior surfaces and reduce the heat transfer efficiency. Furthermore, if the lubricant level within the compressor is too low, then there may be inadequate lubricant available during critical periods of operation to lubricate the crankshaft bearing surfaces and the connecting rod bearing surfaces. Inadequate bearing lubrication would cause bearing failure and ultimately might damage the compression mechanism and possibly the electric motor for driving the compression mechanism.

Summary of the invention

The present invention pertains to a hermetic refrigerant compressor having an annular discharge gas manifold in the compression mechanism and provides an oil trap within the discharge gas manifold to trap lubricant in the discharge gas manifold and minimize carryover of lubricant into the refrigeration system. The compressor includes conduit means for returning the lubricant to the sump defined in the lower portion of the compressor between the compression mechanism and the outer casing.

The present invention has particular utility with a reciprocating compressor of the type including an outer casing, compression mechanism including a compressor block supported in the outer casing and providing a space between the compressor block and the outer casing, cylinder means formed in the compressor block and piston means slidable in the cylinder means. A vertically-disposed crank shaft in the compressor block is operatively connected to the piston means and is driven by an electric motor to actuate the pistons. The compressor block is provided with an annular discharge gas muffling chamber and the lower portion of the compressor between the outer casing and the compressor block defines a sump for lubricant.

It is a feature of this invention to provide wall means in discharge gas manifold in the comrpessor block for trapping lubricant carried with refrigerant in the lower portion of the discharge gas manifold. Conduit means are provided for communicating the lower portion of the discharge gas manifold with the space between the compressor block and the outer casing for returning lubricant trapped in the lower portion of the discharge gas manifold to the sump during operation of the compressor. In one

form of the invention the conduit means comprises a small bore directly connecting the discharge gas manifold to the lubricant sump. In another form of the invention a conduit communicates the lower portion of the discharge gas manifold with the space above the lubricant level in the sump so as to prevent return of lubricant and refrigerant to the discharge gas manifold during the off cycle.

An object of the present invention is to provide a hermetic refrigerant compressor having an annular discharge gas cavity with means for trapping lubricant carried with the refrigerant and with conduit means for returning trapped lubricant to the lubricant sump in the compressor for minimizing carryover of lubricant to the refrigeration system and for assuring that there is an adequate supply of lubricant in the compressor during operation. Other objects and advantages of this invention will be made more apparent hereafter.

Brief description of the drawing

For a better understanding of the invention, reference may be had to the accompanying drawing in which like numerals refer to like parts, and in which:

FIG. 1 is a perspective view of a hermetic refrigerant reciprocating compressor, with parts broken away to show one form of the present invention;

FIG. 2 is a detail cross-sectional view of a hermetic refrigerant compressor further illustrating the form of invention shown in FIG. 1;

FIG. 3 is a lay-out of the compressor block illustrating the cylinders and showing generally the location of the conduit means of the present invention for returning trapped lubricant from the lower portion of the discharge gas manifold to the sump.

FIG. 4 is a view similar to FIG. 3, but illustrating a modification of the present invention; and

FIG. 5 is a detail cross-sectional view illustrating the application of a further modification of the present invention to a modified form of compressor.

Description of preferred embodiments

Referring to FIG. 1 there is illustrated a hermetic refrigerant compressor **10** which comprises an outer casing enclosing both a compression mechanism and a compressor drive motor. The outer casing comprises an upper shell **12** and a lower shell **14** suitably joined together to form a hermetic outer casing. The compressor is adapted to be connected to a refrigerant system by means of the discharge gas fitting **16** and the suction gas fitting **18**.

The compression mechanism **20** is resiliently supported within the outer casing by means of a plurality of spring means **22** which function between a flange on the annular sleeve of the compression mechanism and a coacting flange on a mounting ring **24** mounted on the interior of the outer casing. Reference may be made to the patent of Sidney A. Parker, Patent 3,250,461 granted May 10, 1966, for a more detailed explanation of the compression mechanism and the mounting means therefor.

Briefly, the compression mechanism **20** includes a compressor block having a plurality of cylinders defined therein. Slidable within the cylinders are radially-disposed pistons. The pistons are connected to a crank shaft operatively driven by an electric motor.

The compression mechanism includes wall means defined by an annular sleeve which cooperates with flanges on the compressor block to define an annular discharge gas muffling chamber or manifold about the compressor block.

Referring now to FIGS. 2 and 3, there is shown a detail of the refrigerant compressor illustrating the present invention.

The compressor block **26** includes a plurality of flanges

30, 31 and 32 that cooperate with the sleeve or wall portion 27 to define the annular discharge gas muffling chamber comprised of an upper portion 33 and a lower portion 34. A heat shield 36 is provided about the annular sleeve 27 to insulate the suction gas entering the compressor 10 through the suction gas fitting 18 from the discharge gas muffling chamber 33, 34. This arrangement prevents an undesirable rise in suction gas temperature. A sound deadening ring 38 may be affixed internally to the lower portion 14 of the outer casing in order to reduce the vibrations emanating from the compressor.

In FIG. 3, there is shown a layout of the compressor block 26. In the illustrated arrangement shown, there are four cylinders 40, 41, 42 and 43 provided in the compressor block. It will be understood that the invention is usable with a compressor having more or less than four cylinders. During operation of the compressor, compressed discharge gas is discharged from each of the cylinders into the lower chamber 34 within the compression mechanism. The chamber 34 is defined between the flanges 31, 32 and the wall means 45 and 46 of the compressor block. Baffles 48, 49, 50 and 51 are provided within the chamber 34 to further assist in muffling of the discharge gases. The discharge gases pass through the opening 52 in the flange 31 that communicates the lower portion 34 of the discharge gas muffling chamber with the upper portion 33. The entrance to opening 52 is well above the lowest level in the discharge gas cavity to further minimize carryover of lubricant to the refrigeration system. The discharge gases pass from the upper chamber 33 through an opening 54 which comunicates with the discharge gas conduit.

In operation lubricant carried with the refrigerant from the cylinders is trapped within the chamber 34, since the lubricant is generally heavier than the refrigerant. In some cases there may be considerable build-up of lubricant and accordingly conduit means are provided for communicating the discharge gas muffling chamber with the space defined between the compression mechanism and the outer casing for returning trapped lubricant to the lubricant sump in the outer casing. As shown in FIGS. 2 and 3, the conduit means comprises a restricted orifice or opening 56 in the flange 32 which directly communicates the lowermost portion of the discharge gas muffling chamber with the sump 58 defined in the lower portion of the outer casing between the outer casing and the compression mechanism. In order to prevent clogging of the restricted orifice 56, shown in FIG. 2, a filter may be disposed ahead of the orifice to prevent clogging. A filter element such as a screen may be utilized at the entrance to the orifice. If desired, an integral filter and orifice may be utilized comprised of a powdered metal such as sintered bronze. The integral filter and orifice would be constructed and arranged so as to be equivalent to the desired restricted orifice for the particular application.

Tests to date have indicated that the largest orifice that might be satisfactorily utilized is a 1/64-inch diameter bleed orifice. Thus, an integral filter and orifice arrangement must be equivalent to no more than a 1/64-inch bleed orifice.

It has been found that an orifice as large as 1/64-inch can function without losing capacity in a compressor having extremely low oil carryover, for example, a 7½ ton compressor having an oil pump arrangement capable of pumping 8.7 pounds of lubricant per hour. The restricted orifice also functions equally well in a compressor having a relatively higher oil carryover such as an 11 ton compressor with an oil pumping rate of 32.3 pounds of lubricant per hour. The above described oil pumping rates from 0.5% to 1.5%, which is a normal variance. The amount of oil circulation is normally held below 3% by weight. See 1965 ASHRAE Guide and Data Book, p. 634. The quantity of oil that a particular orifice can handle is a function of its size and compressor conditions and the refrigerant flow rate does not affect the orifice capacity.

In the arrangement of FIGS. 2 and 3, should the compressor be idle for some time, lubricant (oil) and refrigerant could pass from the sump back into the lower portion 34 of the discharge gas muffling chamber in a design where the compression mechanism is at least partially immersed in the sump. Passage of lubricant and refrigerant into the discharge gas muffling chamber would be undesirable.

In FIG. 4 there is shown an arrangement whereby the aforenoted problem can be obviated. In this arrangement like parts are designated by the like numerals and the major difference is that instead of communicating the lower portion 34 of the discharge gas muffling chamber directly with the sump as in the embodiments of FIGS. 2 and 3, a pick-up tube 60 is secured to the upper flange 30 on the compressor block, with the lower end of the pick-up tube being disposed adjacent to the bottom of the chamber 34. In operation, any lubricant in the refrigerant would be trapped in the lower portion of the chamber 34 as indicated above. Due to the pressure differential between the chamber 34 and the space above the compression mechanism between the compression mechanism and the outer casing, lubricant will be picked up by the pick-up tube 60 and discharged from the upper end of the pick-up tube for return to the sump. Preferably, the lower end of the pick-up tube 60 is cut at an angle is indicated at 61 to facilitate pick-up of as much lubricant as possible from the lowermost portion of the chamber 34. The entrance to the discharge gas conduit through the opening 54 is well above the lower level of the discharge muffling chamber. Thus, it will be apparent that utilizing the arrangement of FIG. 4, there can be no return of lubricant from the sump to the lower portion of the discharge gas muffling chamber during the off cycle, as the lubricant level is at all times below the top of the pick-up tube 60.

Turning now to FIG. 5, there is illustrated a modified compressor arranged to trap lubricant in the discharge gas muffling chamber and utilizing conduit means embodying the principle of the present invention for removing any lubricant trapped in the lower portion of the discharge gas chamber or manifold and returning same to the lubricant sump. Broadly, the compressor shown in FIG. 5 includes a compressor block 26' having a discharge gas manifold 33', 34' provided therein. Discharge gases compressed by the pistons 64 of the compressor will be discharged into the discharge gas manifold 33', 34' and any lubricant carried with the refrigerant will be accumulated in the lowermost portion 34' of the discharge gas manifold. The conduit means that communicate the lowermost portions 34' of the discharge gas manifold with the space between the compression mechanism and outer casing above the lubricant level in the sump includes a conduit 66 having a filter element 68 in the upper end thereof. The conduit 66 will function in the same manner as the pick-up tube 60 in the embodiment of FIG. 4 to remove lubricant trapped in the lowermost portion 34' of the discharge gas manifold and return it to the space between the outer casing (defined by the shell 12' and 14') and the compression mechanism 26'. Since the outlet from the conduit means 66 is above the highest level of lubricant within the sump, during the off cycle, lubricant will not be returned to the discharge gas manifold.

By the present invention oil pumped with refrigerant into the annular discharge gas muffling chamber defined in the compression mechanism will be trapped and accumulated in the lowermost portion of the discharge gas muffling chamber. Conduit means communicating the lowermost portion of the discharge gas muffling chamber with the space defined between compression mechanism and the outer casing provide for return of such trapped lubricant to the sump. In this manner, the flow of oil into the refrigeration system is substantially obviated and the danger

of adversely effecting the heat transfer efficiency of the condenser and the evaporator is minimized. Furthermore, in the event that too much oil is lost from the compressor by virtue of its flowing into the refrigeration system, there may not be available within the compressor sufficient oil during critical periods of operation to adequately lubricate the connecting rod-bearing surfaces and the crankshaft bearing surfaces. Thus, by trapping lubricant in the discharge gas muffling chamber and providing for its speedy return to the sump, optimum operation of the compressor is assured.

While I have described presently preferred embodiments of my invention, it will be understood that my invention is not limited thereto, since it may be otherwise embodied in the scope of the following claims.

I claim:

1. In a reciprocating compressor of the type including an outer casing, a compressor block supported in said outer casing and providing a space between the compressor block and the outer casing, cylinder means formed in said compressor block, piston means movable in said cylinder means, a vertically disposed crankshaft in said compressor block, drive means operatively connected to said crankshaft, said crankshaft being operative to drive said piston means, said compressor block having annular discharge gas muffling chamber means provided therein, and a sump for lubricant defined in the lower portion of the outer casing between the compressor block and the outer casing, the improvement comprising wall means in the compressor block for trapping lubricant carried with refrigerant in the lower portion of the discharge gas muffling chamber means, conduit means communicating the lower portion of said discharge gas muffling chamber means with said space for returning lubricant trapped in said lower portion of the discharge gas muffling chamber means to said sump during operation of said compressor.

2. A compressor as in claim 1 wherein said conduit means comprises a small bore in said compressor block connecting the discharge gas muffling chamber means directly to the lubricant sump.

3. A compressor as in claim 2 wherein said bore is no large than 1/64-inch diameter.

4. A compressor as in claim 2 wherein a filter is disposed in said bore.

5. A compressor as in claim 4 wherein said filter is made from powdered bronze.

6. A compressor as in claim 1 wherein said conduit means comprises a conduit communicating the lower portion of said discharge gas muffling chamber means with said space and above the lubricant level in the sump.

7. A compressor as in claim 6 wherein said conduit is a pick-up tube secured to the compressor block and having the lower end portion thereof adjacent the lowest point in the discharge gas muffling chamber means.

8. A compressor as in claim 6 wherein the conduit is secured to the compressor block at one end adjacent the lowest point in the discharge gas muffling chamber means and the other end extends and opens into the space between the compressor block and the outer casing above the lubricant level in the sump.

9. A compressor as in claim 8 wherein a powdered metal filter is disposed in said conduit.

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