March 26, 1935. J. H. SHEATS 1,995,438

REFRIGERATING APPARATUS

Filed June 29, 1929 3 Sheets-Sheet 1

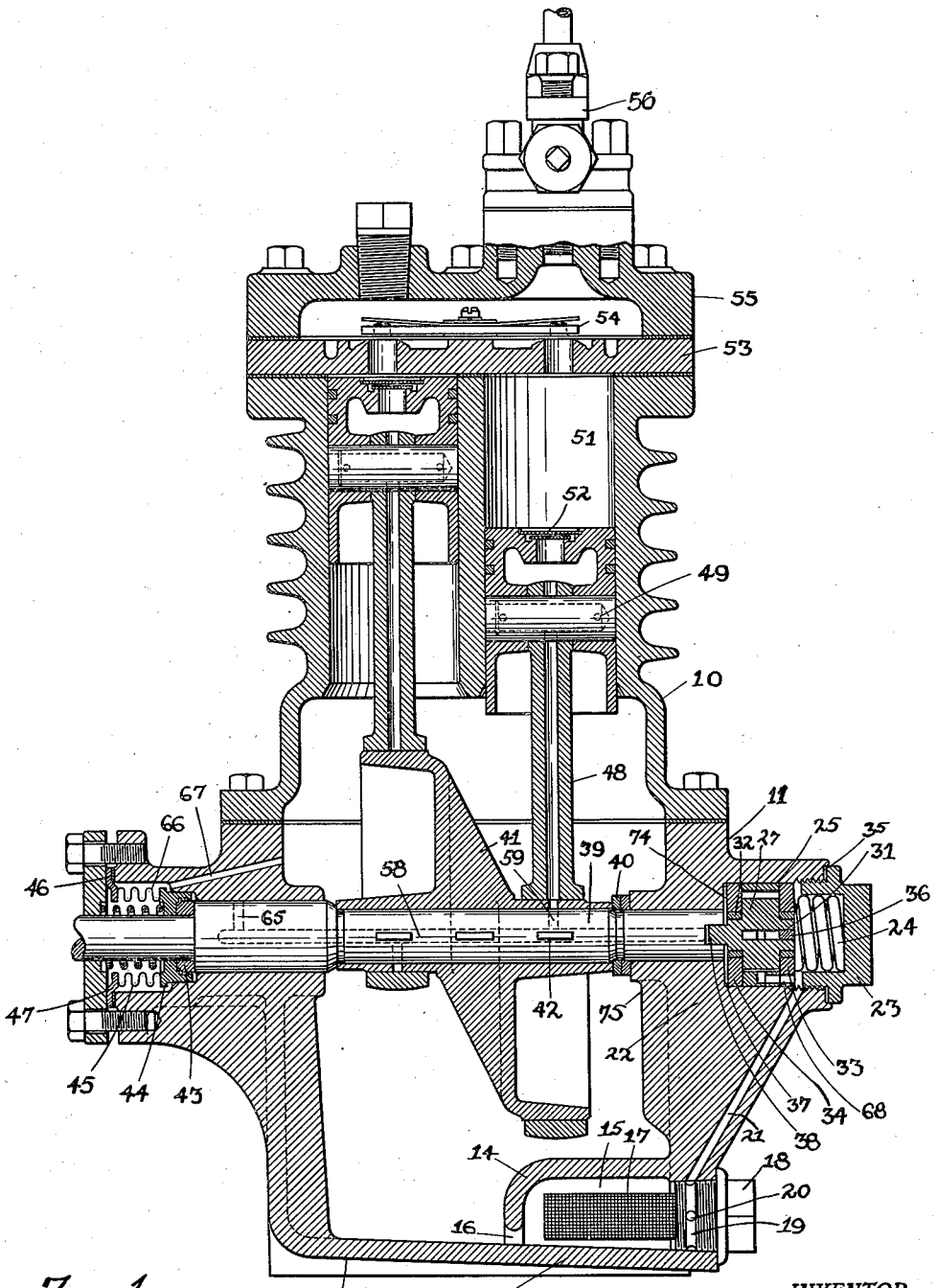


Fig. 1

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REFRIGERATING APPARATUS

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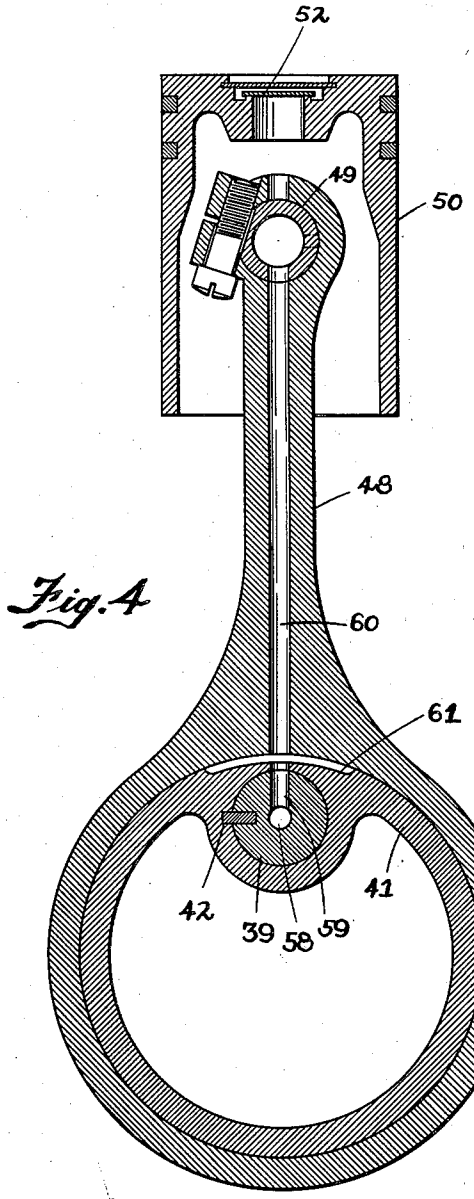


Fig. 4

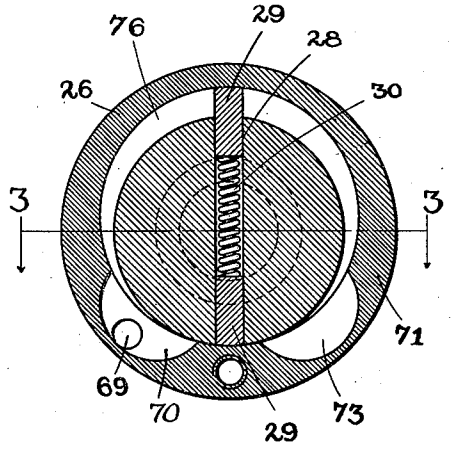


Fig. 2

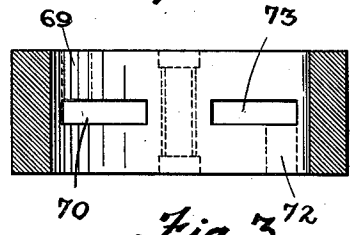


Fig. 3

Fig. 5

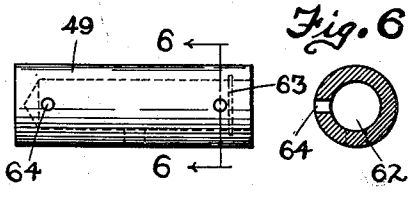


Fig. 6

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Filed June 29, 1923 3 Sheets-Sheet 3

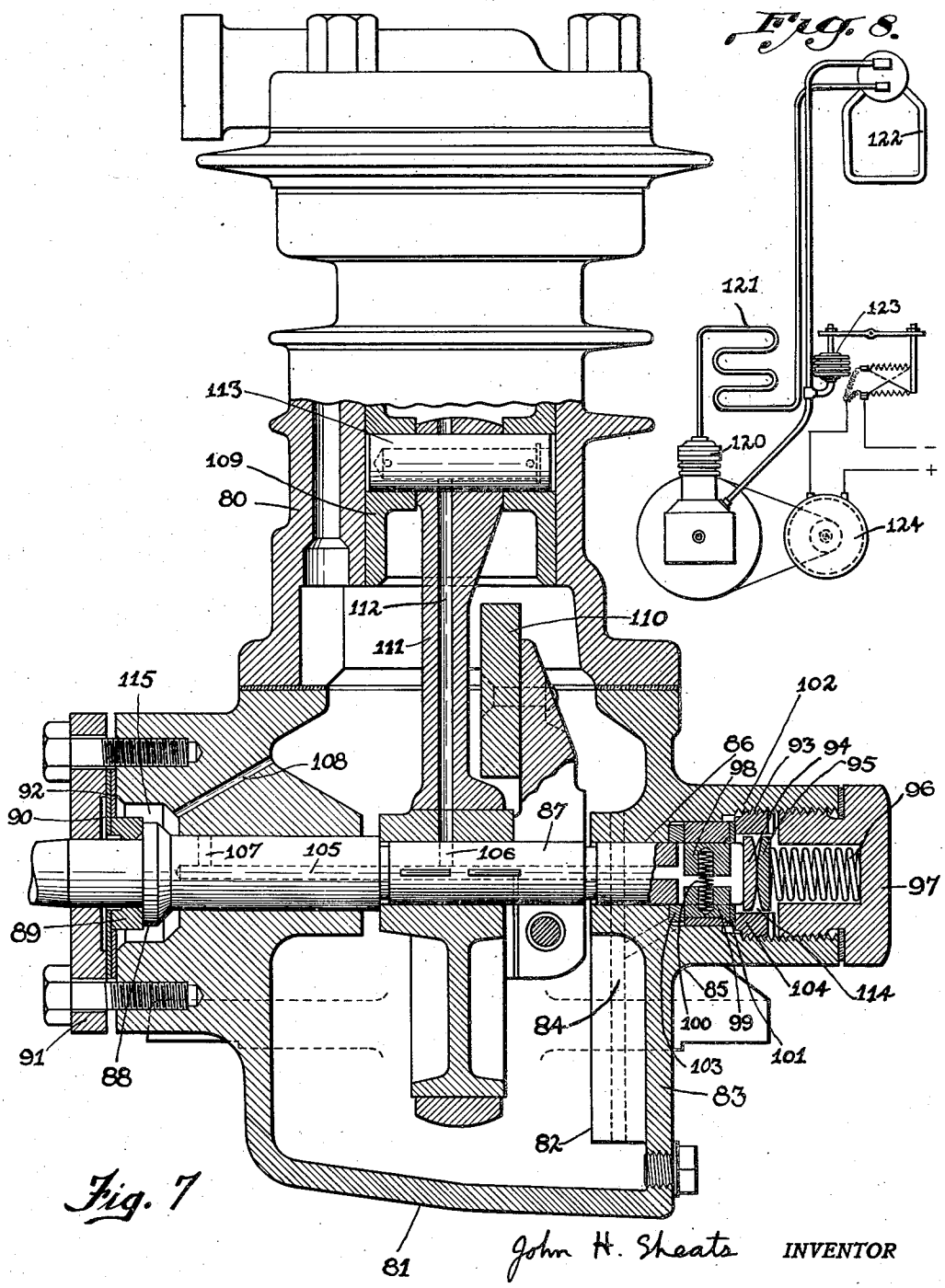


Fig. 8.

Fig. 7

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Patented Mar. 26, 1935

1,995,438

UNITED STATES PATENT OFFICE

1,995,438

REFRIGERATING APPARATUS

John H. Sheats, Dayton, Ohio, assignor, by mesne assignments, to General Motors Corporation, a corporation of Delaware

Application June 29, 1929, Serial No. 374,685

5 Claims. (Cl. 184—6)

This invention relates to refrigerating apparatus and especially to the lubrication of the moving parts of certain elements of said refrigerating apparatus.

An object of the invention is to provide adequate lubrication for the moving parts in a refrigerating apparatus.

Another object is to provide lubrication for the compressor in a manner that will not readily distribute oil to other parts of the refrigerator system.

Another object of the invention is to still provide efficient circulation of oil when the oil in the reservoir is very low.

Another object of the invention is to provide an easily accessible and removable actuating means for circulating the lubricant.

More specifically it is an object of the invention to provide an easily accessible and removable oil pump on the end of the shaft of a compressor and actuated by the same to draw oil from a specially constructed oil pocket in the oil reservoir and to distribute the oil through passageways to the various places where friction might occur with the moving parts of the compressor without prior exposure to the suction of the gas passing through the compressor casing.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a cross-section through a compressor illustrating an application of the invention;

Fig. 2 is a cross-section through the casing of the oil pump of Fig. 1;

Fig. 3 is a cross-section on line 3—3 of Fig. 2;

Fig. 4 is a cross-section through the shaft, eccentric, connecting rod and piston disclosing the oil passages;

Fig. 5 is an elevation of the piston pin;

Fig. 6 is a cross-section on line 6—6 of Fig. 5;

Fig. 7 is an application of the invention to a slightly different form of compressor; and

Fig. 8 is a diagrammatic view of a closed refrigerator system.

One of the problems in connection with refrigerating apparatus is the efficient lubrication of the moving parts especially the compressor. This problem differs from the problem of lubricating the moving parts of other apparatus due to the fact that the interior of the compressor is part of a closed gas-tight circuit. Due to this closed gas-tight circuit and the fact that suction and pressure are generally depended upon to keep the refrigerant circulating properly a certain amount of oil is generally carried along with the refrigerant in passing around this closed system. This is especially true where the oil is churned into a foam and splashed about the casing by one or more revolving elements. As the refrigerant gas is sucked through the casing, the foaming oil is in a state best adapted to be carried to other parts of the system where it is not desired. While the apparatus generally is of course designed to have this oil returned to the place where it is needed conditions may arise under which there may be a very small amount of oil at the particular place where lubrication is needed and this amount may be below the minimum required by the lubricating system of the compressor. Although sufficient oil would eventually be returned to the oil reservoir from the other parts of the system the apparatus is likely to be damaged by running during even this short time with insufficient oil in the place where it is needed. Accordingly it is one of the objects of this invention to provide a lubricating system for a refrigerating compressor that will direct the lubricant to the bearings and other moving parts from the oil reservoir without exposing such lubricant to the possibility of being sucked up with the refrigerant gas prior to reaching the bearings. It is also another object of the invention to provide an oil pump that will continue to efficiently direct such oil even though the oil is almost exhausted from the oil reservoir. Furthermore, the oil reaches the bearings with a more solid body than it would be if it were first churned up by a splasher.

Another problem in connection with supplying a lubricating system is to be able to easily and quickly examine the actuating parts of the lubricant supply means. As before stated the system through which the refrigerant circulates is a closed one such as illustrated in Fig. 8 and if the oil circulation means is incorporated within the place where the gas circulates, it requires a dismantling of the apparatus to obtain the oil circulating means in order to examine it for any defects. Accordingly it is another object of this invention to provide an easily removed oil pump that may be quickly and easily removed as a unit and also to provide an easily removed screen for the oil. By this means the apparatus will not have to be dismantled in order to repair or replace the oil circulating means of the apparatus.

Preferred applications of the invention are disclosed in the drawings. In Fig. 1 is disclosed a

compressor 10 adapted to draw evaporated refrigerant gas from any suitable cooling unit through any convenient opening in its body. This compressor has a lower portion 11 generally referred to as a crankcase portion or as an oil reservoir or oil sump. This crankcase portion has a bottom wall 12 and it is preferred to have a certain portion 13 of this bottom wall below the rest of the bottom wall. Although this may be done in various ways it is most convenient from a manufacturing standpoint to have the bottom wall slanted towards one end. It is also desirable to enclose this lowermost portion to form an oil pocket therein such as by a partition 14 extending over the major portion of this lower part. A small opening 16 is provided for the entrance of the oil into the oil pocket 15. A screen 17 is preferably secured to a plug 18 which is screwed into the casing of the crankcase and has the screen extending in the oil pocket. This plug preferably has a hollow shank and has its screw-threads grooved out at a certain place 19 in a plane where the hole or passageway 21 contacts with the plug. A series of holes 20 are drilled through the periphery of this groove to the hollow center of the plug. This passageway 21 preferably extends upward to a projecting part 22 of the crankcase. A plug 23 is preferably screwed into this projecting part and preferably bears against a spring 24 bearing in turn upon the oil pump 25.

This oil pump, as disclosed also in Figs. 2 and 3, is composed preferably of a pump body 26 having an eccentric bore enclosing a rotor 27. The center part of this rotor is slotted as at 28 and receives in this slot two vanes 29 separated by a spring 30. These vanes will rotate with the rotor but will be maintained in constant contact with the interior of the pump body 26 due to the pressure exerted by the spring 30 as disclosed in Fig. 2. A bushing 31 projects from the outside end of this rotor and has the continuation of the slot 28 plugged up by any convenient material such as 36. A collar 35 surrounds this bushing 31 and is in turn enclosed by an end piece 33. This end piece has a perforation 68 therethrough placed adjacent the opening of the passageway 21 into the space between this end piece and the inner end of the plug 23. This hole through the end piece communicates directly in turn with a hole 69 through the pump body and then to a gouged-out portion 70 opening over a small area to the eccentric bore 71 of the pump body. The other end of the rotor 27 has a bushing 32 surrounded by a collar similar to the collar 35. This collar is in turn surrounded by another end piece 34 similar to the end piece 33 and having an opening therethrough connected with the opening 72 in the rotor and opening to a gouged-out place 73 opening to the eccentric bore 71 in a similar manner to the holes 69 and 70. The gouged-out places 70 and 73 in the pump body are preferably located within a semi-circle of the pump body and preferably the semi-circle that has the greatest thickness of the pump body such as the semi-circle below the line 3—3 in Fig. 2. This pumping device is preferably located in the hole 74 in this projection 22 of this crankcase portion. A spacer 37 maintains the inner end piece slightly away from the inner surface of this hole. The rotor 27 has a projection 38 extending within a slot 75 in the end of the shaft 39. This shaft 39 is the actuating shaft for the pistons of the compressor. A shoulder on the shaft preferably bears against the washer 40 to prevent its extending into a hole 74. An eccentric 41 is preferably secured to the shaft by the keys 42. At the other end of the shaft where it begins to project out of the casing of the compressor, is a Durex bearing metal ring 43 made in the manner similar to that disclosed in the patents to Williams et al., 1,642,347 and 1,642,348. The mounting 44 surrounds this bearing metal ring and has attached thereto a flexible wall or metal bellows 45 attached to a ring 46 compressed between the end plate 47 and the portion of this compressor wall surrounding this opening for the compressor shaft. These parts 43, 44, 45 and 46 provide a seal for the shaft so that refrigerant will not leak through and escape about this opening. A hollow connecting rod 48 surrounds at one end the eccentric and is clamped at the other end to a piston or wrist pin 49 more fully disclosed in Figs. 5 and 6. This piston pin is journaled in the piston 50. The piston preferably has an inlet valve 52 for the passage of the refrigerant gas therethrough from the main body of the compressor. On top of the cylinder is the valve plate 53 having an outlet valve 54 on one side thereof which may be of any suitable structure but is preferably of a structure such as disclosed in the copending application of George M. Troup 27,373, filed May 2, 1925 now Patent No. 1,748,531. The compressed gas passing through the valve structure 54 is discharged from the head 55 into a connection 56 leading to a condenser.

The closed system of the remaining apparatus may be of any suitable arrangement such as that disclosed in Fig. 8. In Fig. 8 the refrigerant is forwarded from the compressor 120 to the condenser 121 where it is liquefied as required. It is then forwarded to the cooling unit 122 preferably of the flooded float control type disclosed in the patent to R. G. Osborn 1,556,708. The evaporated refrigerant is then drawn back to the compressor. The pressure-temperature controlled snap switch 123 automatically controls the running of the motor 124 operating the compressor.

It will be noted that the oil in the crankcase will cover the bottom wall to a depth depending upon the amount of oil in the crankcase and that being spread over the other parts of the compressor. It has hitherto been the custom to depend on the oil being of such a depth that it will be gathered up by the descending part of the eccentric and lower end of the connecting rod 48 and then distributed to the bearings as the eccentric revolves about the part above the shaft. The oil is thus apt to be churned into a foam, thus making it of less body and also making it more easy for the gas to suck it through the outlet valves. It sometimes happens, however, that the oil has been drawn along with the refrigerant to the other parts of the system disclosed in Fig. 8 to such an extent that the oil level falls below the eccentric and lower end of the connecting rod. In such a case the lubricating system will fail although there is still a considerable amount of oil in the crankcase.

By the construction of applicant's crankcase however, there will be always oil in the oil pocket 15 while the oil remains above the level of the upper portion of the hole 16. When the crankcase is first filled up with oil the pocket 15 will of course be filled with oil. Thereafter although the oil level might fall below the upper part of the partition 14 oil will still be flowing into the pocket and the pocket will be filled with oil until

the oil level falls down below the hole 16. At this point the oil is practically exhausted. Accordingly by the arrangement of the oil pocket 15 oil will be utilized as long as there is practically any oil left in the crankcase or oil reservoir. The oil is drawn through the screen 17 to the hollow shank or plug 18 and passes out the holes 20 and up the passageway 21 to the holes 68 in the end piece 33 where it passes through the holes 69 and gouged-out place 70 in the pump body 26. The actuating means in circulating this oil are the rotating vanes 29 in the rotor 27 eccentrically connected with the shaft 39.

Referring to Fig. 2 in which the rotor is revolved in clockwise direction it will be noted that the upper vane 29 has just passed through a 180° arc including the gouged-out portion 70. As the spring 30 kept the vane tightly against the periphery of the eccentric bore 71 a suction was created behind this moving vane due to the fact that at its lowermost point the rotor is also tight against the space between the two gouged-out portions 70 and 73. Accordingly as the upper vane 29 left substantially a vacuum in the space as it passed over the gouged-out portion 70 the oil is drawn up through the passageway 21 and into the gouged-out portion 70 and into the space 76 beyond the vane 29. The lower vane 29 had previously drawn oil into the space 77 between it and the upper vane 29. Hence the upper vane 29 having drawn the oil behind it into the space 76 now has the additional duty of pushing the oil in the space 77 out through the gouged-out portion 73. In other words the oil is drawn up by the vacuum behind one of the revolving vanes and is then pushed out in front of the other vane under pressure. As the oil leaves the opening 72 through the pump body and end plate 34 it passes through the corners between the end plate and the shoulder created by the space 74 and passes into the hole 58 in the shaft 39. This hole 58 has another hole 59 at right angles to it communicating as disclosed in Fig. 4 with the hole 60 in the connecting rod 48. These two holes 59 and 60 will only be in alignment at one point in the revolution of the eccentric and sometimes this is sufficient. However, it is preferred to have a groove 61 in the circumference of the eccentric communicating with the hole 59 so that the oil will have more chance to pass up into the hole 60 in the connecting rod. This groove may be of any length desired and may even extend completely around the surface of the eccentric. The oil passes from the hole or passageway 60 into the hollow central portion 62 of the piston pin as disclosed in Figs. 4, 5 and 6. This piston pin is preferably made by boring a hole in one end and then stopping up this end with any convenient material 63. The oil then flows from the central part 62 out through the holes 64 and lubricates the surface where the pin is journaled in the piston and also spreads from there over the cylindrical surface of the piston where it moves up and down the cylinder 51. A similar construction of passageways is also made for other parts of the compressor if more than one cylinder is in the compressor. At the far end of the shaft 39 another bore 65 is made at right angles at approximately the end of the hole 58. The purpose of this is to direct the oil towards the other end of the shaft so that it will leak out around the bearing 43 and mounting 44 below the space 66 about the seal. In this manner the seal is efficiently lubricated. A hole 67 allows the return of gas and surplus oil to the crankcase portion so that the space 66 is at all times filled with oil.

In Fig. 7 is disclosed the application of the invention to a refrigerating compressor of slightly different construction. The compressor 80 has a depressed part 81 in its bottom wall and forms a reservoir for the oil. If desired, a projecting part similar to the partition 14 in Fig. 1 could enclose this part. As disclosed, however, an integral boss 82 is cast with the adjacent side 83 of the compressor and a passageway 84 is drilled therethrough reaching down to the depressed part 81 and an oblique pasageway 85 may be drilled from the end of the compressor shaft hole 86 to connect with this passageway 84. The compressor has the shaft 87 journaled in the compressor casing. At the farther end of the shaft a shoulder 88 bears upon a collar 89 of Durex metal similar in material to element 43 in Fig. 1. This Durex metal is preferably brazed to a gasket 90 secured between this end of the casing and the end plate 91. A compressible gasket 92 provides an effective seal between the washer 90 and the end of the casing. The opposite end of the shaft 93 bears against two thrust buttons or washers 94 and 95 under pressure from the spring 96 to maintain the shaft as far advanced to the left as possible. A removable cap 97 is screwed into the compressor casing and suitably compresses the spring 96. The end of the shaft 93 is slotted for a short distance in the direction of its axis and two vanes 98 and 99 separated by the spring 100 are placed therein. These vanes and spring are similar to the elements 29 and 30 in Fig. 2 except that the vanes do not have the integral bosses 32, 33, 38 and the far end of the vanes has a slight flange 101 to prevent any leftward movement of the upper vane when it is aligned at the top with the hole for the shaft of the compressor. An oil pump body 102 similar to the oil pump body 26 surrounds and encloses the vanes and shaft. This pump body has the passageways therein corresponding to the elements 69, 70, 73 and 72. End plates 103 and 104 have passageways therethrough in alignment with the passageways 69 and 72 in the pump body 102. The shaft 87 has a central passageway 105 bored therethrough to the further side of the compressor casing. This passageway 105 has branch passageways 106 and 107 leading off therefrom similar to the passageways 59 and 65 in Fig. 1. A vent 108 is also similar to the vent 67. Where only one piston 109 is used a suitable counter balance 110 for the eccentric is attached to the shaft. The connecting rod 111 has a central passage 112 therethrough similar to the passageway 60 in Fig. 4. The piston pin 113 is constructed similar to the piston pin described in Figs. 5 and 6. It will be noted that the oil pump in this figure has its moving parts inserted in the shaft instead of having these moving parts connected thereto by the projection 38 disclosed in Fig. 1. Furthermore, the oil pump abuts the spring 96 for taking the end thrust of the shaft. The spring 96 maintains the shoulder 86 tightly against the collar 89 and thus maintains a tight seal at the left hand side of the shaft.

The oil is drawn up by the suction created by the oil pump through the passageways 84 and 85 and through the passageways in the end plate 103 to the pump body 102 and is then pushed out under pressure through the end plate 101 to the open space 114 at this end of the shaft. A continued pressure pushes this oil through the slotted end of the shaft to the central passageway 105

and distributes it through the passageways 106 and 112 to the piston as described in connection with Fig. 1. Oil also flows out through the passageway 107 and suitably encloses the space 115 about the end seal. When the pressure in the opening 115 becomes sufficiently high the oil returns to the crankcase through the vent 108.

Accordingly there has been disclosed the application of an oil pump to a compressor casing that can be readily and easily removed from the casing as a unit without tearing down or disturbing other parts of the compressor. By means of this oil pump the oil is taken from the very lowest portion of the crankcase and distributed directly to the bearings that require lubrication. It will be apparent that in this operation there is not the splashing and churning of the oil inside the body of the compressor that would tend to have the oil in its foamy condition carried along to other parts of the refrigerator system where it is not desired. On the contrary the oil is applied to the moving parts with the same body consistency that it had in the reservoir. Furthermore, the oil pump is always in working order with a minimum of oil in the crankcase. Accordingly this oil pump provides means for lubricating the bearings with an amount by which the splashing lubricating means of the prior art would not work. Furthermore, this oil pump works in a manner that will not carry oil to the other parts of the refrigeration system and finally in case of any trouble the oil pump can be easily and quickly removed from the compressor casing for examination or repair without dismantling the compressor.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. In combination, a compressor having a casing forming a reservoir for lubricant, a drive shaft journaled in said casing, said casing being formed with a cavity adjacent an end of said shaft, a lubricant pump within said cavity spaced from the end of the shaft for providing a discharge chamber between the pump and the end of the shaft, a lubricant conduit extending from the lower portion of the reservoir to the inlet of said pump, said pump being driven by said shaft for drawing lubricant from said reservoir through said suction lubricant passage and pumping the lubricant into said discharge chamber, said shaft being provided with a passage communicating with said discharge chamber for conducting lubricant to the bearing surfaces of the compressor.

2. In combination, a compressor having a casing forming a reservoir for lubricant, a drive shaft journaled in said casing, said casing being formed with a cavity adjacent an end of said shaft, a lubricant pump located in said cavity at the end of said shaft and connected to be driven by said shaft, said pump being spaced from one wall of the cavity forming a discharge chamber at one side of the pump into which it discharges, a suction lubricant conduit extending from the lower portion of the reservoir to the inlet of said pump, said shaft having a lubricant passage therein communicating directly with the discharge chamber at one side of said pump for conducting lubricant to the bearing surfaces of the compressor.

3. In combination, a compressor having a casing forming a reservoir for lubricant, a drive shaft journaled in said casing, said casing being formed with a recess adjacent an end of said shaft, a closure member for enclosing said recess, a lubricant pump within said recess adjacent the end of said shaft dividing said recess into a discharge chamber located between the pump and the end of the shaft and a suction chamber located between the pump and the closure member, said pump being driven by said shaft and being removable by removing the closure member without disturbing the remainder of the compressor, a suction lubricant conduit extending from said suction chamber to the lower portion of said lubricant reservoir, said pump taking lubricant from said suction chamber and pumping the lubricant into the discharge chamber, said shaft having a drilled passage communicating with said discharge chamber for distributing the lubricant to the bearing surfaces.

4. In combination, a compressor having a casing forming a reservoir for lubricant, a drive shaft journaled in said casing, said casing being formed with a bearing and a cavity adjacent an end of said shaft, a lubricant pump within said cavity spaced from one wall thereof providing a discharge chamber communicating with said bearing, a lubricant conduit extending from the lower portion of said reservoir to the inlet of said pump, said pump being driven by said drive shaft for drawing lubricant from said reservoir through said suction lubricant passage and pumping the lubricant into said discharge chamber for supplying said bearing with lubricant.

5. In combination, a compressor having a casing forming a reservoir for lubricant, a drive shaft journaled in said casing, said casing being formed with a bearing and a cavity adjacent an end of said shaft, a lubricant pump within said cavity spaced from one wall thereof providing a discharge chamber communicating with said bearing, a lubricant conduit extending from the lower portion of said reservoir to the inlet of said pump, said pump being driven by said drive shaft for drawing lubricant from said reservoir through said suction lubricant passage and pumping the lubricant into said discharge chamber for supplying said bearing with lubricant, said shaft being provided with a passage communicating with said discharge chamber for conducting lubricant to bearing surfaces of the compressor.

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