May 23, 1939. R. K. MILLER ET AL 2,159,748

REFRIGERATING APPARATUS

Original Filed Dec. 29, 1928 2 Sheets-Sheet 1

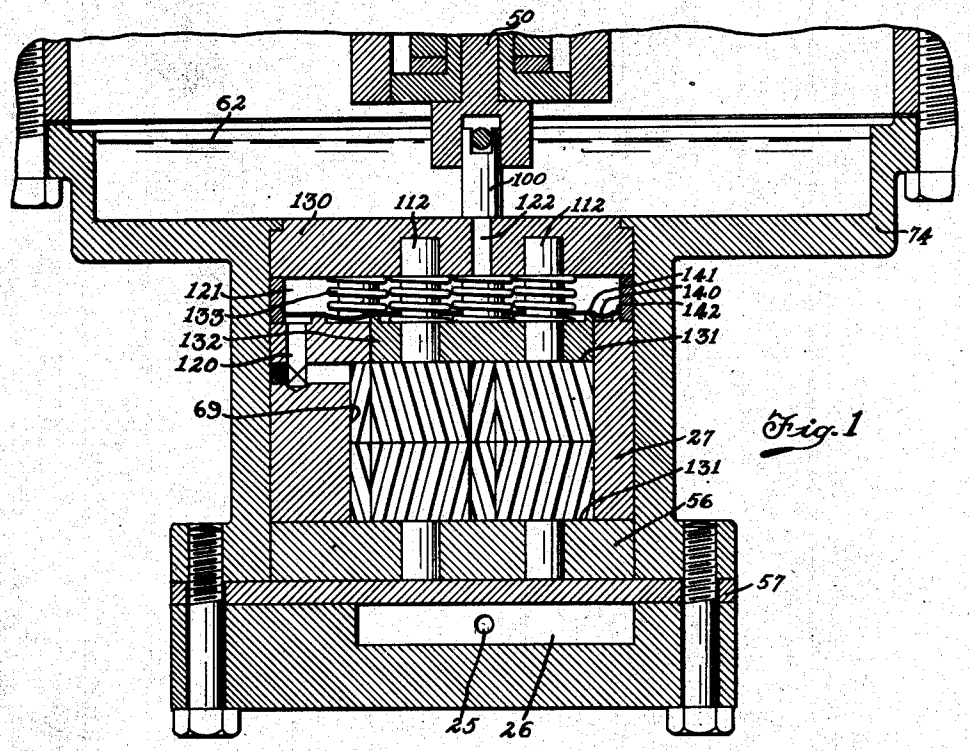

Fig. 1

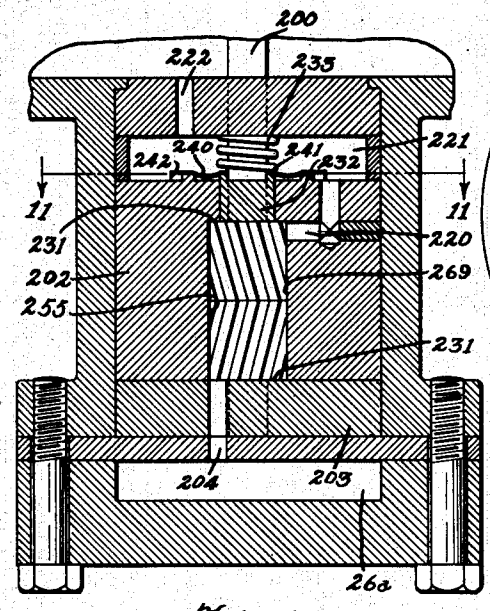

Fig. 10

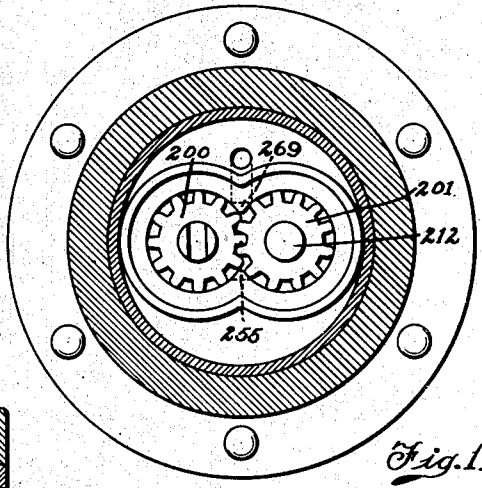

Fig. 11

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REFRIGERATING APPARATUS

Original Filed Dec. 29, 1928 2 Sheets-Sheet 2

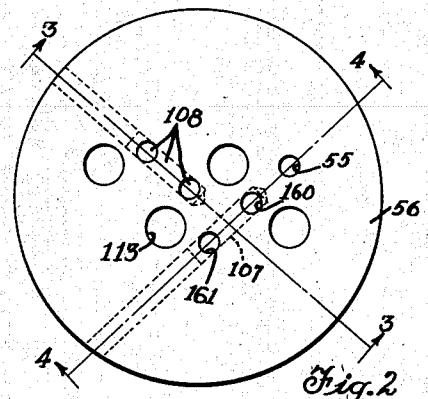

Fig. 2

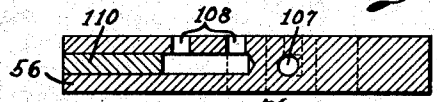

Fig. 3

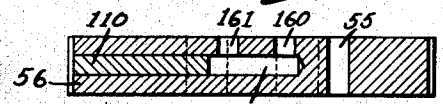

Fig. 4

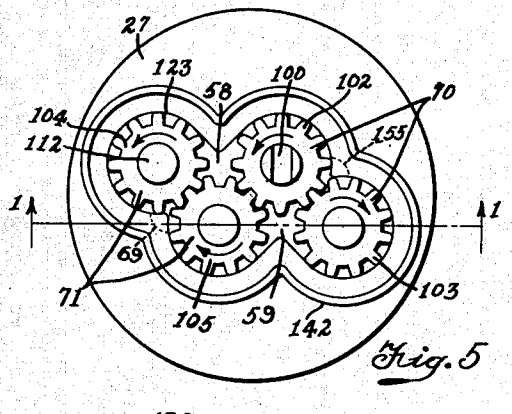

Fig. 5

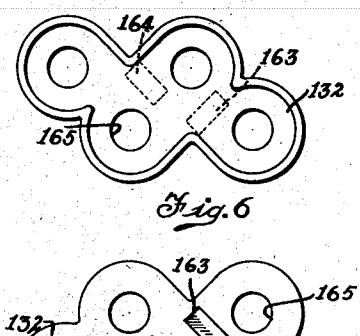

Fig. 6

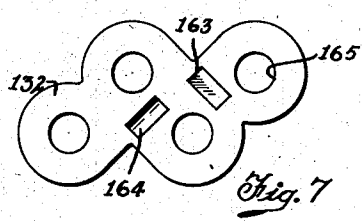

Fig. 7

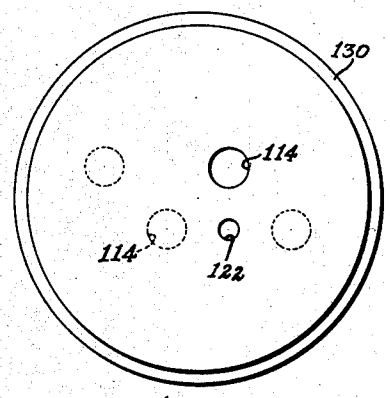

Fig. 8

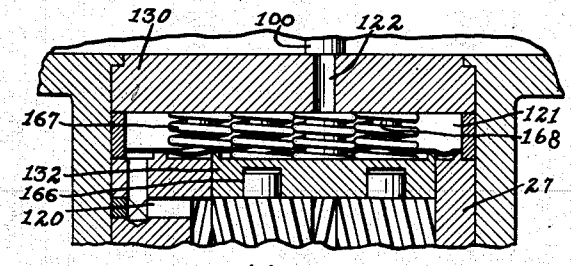

Fig. 9

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REFRIGERATING APPARATUS

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Refiled for abandoned application Serial No. 329,156, December 29, 1928. This application January 19, 1934, Serial No. 707,394. Renewed March 17, 1937

3 Claims. (Cl. 230—141)

This invention relates to refrigerating apparatus and more particularly to that portion of the refrigerating apparatus wherein the refrigerant and the lubricant have their pressure changed from the low pressure side to the high pressure side of the system.

An object of this invention is to improve the efficiency of refrigerant compressors of the gear type in general as used in refrigerating systems, and also to improve in certain respects the apparatus shown in the application of Ralph K. Miller, Serial No. 316,173, filed October 31, 1928, now Patent No. 1,950,510, issued March 13, 1934, to which reference is made, if necessary, for a more detailed description of certain unmodified parts of the apparatus.

Another object of this invention is to prevent the backward leakage of the refrigerant at the shoulders of the gears of a gear compressor of any general type.

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.

This application is a refiling of applicants' abandoned application Serial No. 329,156, filed December 29, 1928.

In the drawings:

Fig. 1 is a vertical cross-sectional view, taken along the line 1—1 of Fig. 5, of a portion of the mechanism disclosed in the said application of Ralph K. Miller with certain features changed in accordance with this invention;

Fig. 2 is a top plan view of the bottom bearing plate of the compressor;

Fig. 3 is a vertical cross-sectional view taken along the line 3—3 of Fig. 2;

Fig. 4 is a vertical cross-sectional view taken along the line 4—4 of Fig. 2;

Fig. 5 is a top plan view of a portion of the mechanism shown in Fig. 1 with certain parts removed;

Fig. 6 is a top plan view of the relatively movable plate at the ends of the gears;

Fig. 7 is a bottom view of the plate shown in Fig. 6;

Fig. 8 is a top plan view of the plate which is placed on top of the structure shown in Fig. 5;

Fig. 9 is a vertical cross-sectional view of a slightly modified form of apparatus shown in Fig. 1;

Fig. 10 is a vertical cross-sectional view of a further modification of the apparatus shown in Fig. 1, and

Fig. 11 is a horizontal cross-sectional view taken along the line 11—11 of Fig. 10.

Parts designated in this application with the same numerals used in the said application of Ralph K. Miller, where they obviously can be the same in structure or function, are intended to perform substantially the same functions, or have substantially the same structure as such similarly numbered parts in the application of Ralph K. Miller.

In the application of Ralph K. Miller, heretofore referred to, there is disclosed a refrigerating system wherein the refrigerant is liquefied in a unit and the refrigerant is returned in an evaporated condition to the unit. The lubricant also is adapted to travel in a closed cycle of which the refrigerant liquefying unit is a part. The refrigerant liquefying unit includes a rotary gear compressor, of any suitable construction, and, under certain conditions, a more specific type of gear compressor having two pairs of gears. The gear compressor discharges the refrigerant and the lubricant into a funnel-shaped member or reservoir 74. The lubricant is maintained in this reservoir at any convenient height as indicated at 62. The refrigerant from this member or reservoir 74 passes on to a condenser, a receiver and an evaporator and from thence it is discharged in an evaporated condition to a sealed chamber from whence it returns by suitable connections to the inlet chamber 26, for instance through the pipe 25. The compressor may be driven through the shaft 50 by means of a motor, not shown, and the shaft 50 may in turn drive a shaft 100 which passes into the compressor casing 27 and is preferably attached to one of the gears, for instance the gear 102. The general construction of the refrigerating system as a whole is more specifically described in the said application of Ralph K. Miller, to which reference may be had, if necessary, for a further description.

The refrigerant and the lubricant are adapted to pass from the inlet chamber 26 through an opening, not shown, in the plate 57 and through the opening 55 in the lower bearing plate 56 into the gear chamber. The opening in the plate 57 may be in alignment with the opening 55. After passing through the opening 55 the refrigerant and the lubricant are conveyed between the teeth of the gears 102 and 103 comprising the pair of gears 70 to intermediate compression chambers 58 and 59. From thence the lubricant and the refrigerant are conveyed by the pair of gears 71, which comprises gears 104 and 105, to

a channel 69 shown dotted in Fig. 5 and which is formed vertically along the casing 27 from the passage 120 to the plate 56. The refrigerant and lubricant pass from the channel 69 through the outlet passage 120 into the chamber 121 and from thence through the passage 122 into the funnel-shaped reservoir 74, from whence the refrigerant passes to the condenser as heretofore described.

The casing 27 is provided with a cavity which, in general, has the same periphery as the composite periphery of the gears of the compressor. Thus the casing 27 in this particular embodiment has a cavity which follows the line 123, indicated in Fig. 5, with the exception that there are two vertical channels 155 and 69, which comprise, respectively, the inlet feeder and the outlet receiver of the teeth of the gears. The vertical channel 155 is in alignment with the opening 55 in the plate 56. The gears within the cavity are provided with shafts such as 112 and the shaft 100. In one embodiment, these shafts have bearings 113 in the plate 56 at the bottom, and have bearings 114 in the plate 130 at the top. The gears also are provided with shoulders 131 at each of their ends. These shoulders 131 are adapted to be placed in two parallel planes. The lower set of shoulders are adapted to bear against the plate 56. The upper set of shoulders 131 are adapted to have bear against them a relatively movable plate 132. The outer periphery of the plate 132 may be substantially co-extensive with the composite periphery of the gears, thus following in general the line 123 shown in Fig. 5, when the gears comprise two pairs, as shown in this embodiment. The plate 132 may be resiliently movable against the gears, or it may be pneumatically movable against the gears, or it may be both resiliently and pneumatically movable against the gears. In this particular embodiment the plate is both resiliently and pneumatically movable. Thus springs 133 are adapted to be interposed between the plate 132 and 130, thus resiliently moving the plate 132 against the shoulders 131 of the gears. If desired, the springs 133 may be placed around the shafts 100 and 112. The plate 132 may also be pneumatically moved against the shoulders 131. Thus the compressed refrigerant and lubricant passing through the passage 120 and into the chamber 121 exert their pressure on top of the plate 132 and move it against the shoulders 131.

If desired, a flexible hermetic seal may be placed between the plate 132 and the casing 27 or any other stationary part which may be either an integral or a separate extension of the casing 27. The flexible hermetic seal may comprise a metal plate 140 secured to the plate 132 and the casing 127. If desired, both the plate 132 and the casing 27 may be provided with protruding continuous ridges 141 and 142 respectively. The flexible hermetic seal may join these ridges, and, preferably, it is hermetically attached to the ridges. Thus a certain amount of relative axial movement is provided for the plate 132 without distorting or breaking the flexible hermetic seal 140. The seal may have a contour somewhat similar to the composite periphery of the gears, or it may have any other suitable contour.

The intermediate compression chambers 58 and 59 are adapted to receive the lubricant which is entrapped between the intermeshing teeth of the gears. Thus in the lower plate 56 a passage 107 is provided so that the lubricant may be discharged from between the intermeshing teeth of the gears 102 and 103 through an opening 160 and the passage 107 and thence up through an opening 161. A convenient way of forming this passage may be by boring the passages 107, 160 and 161 and by inserting a plug 110 in order to seal the end of the passage 107. Likewise the lubricant entrapped between the intermeshing teeth of the gears 102 and 105 may be relieved at the lower end through a passage 108 formed similarly to the last described passage 107, 160 and 161. The upper end of these intermeshing teeth may also be provided with relief means. Thus teeth of the gears 102 and 103 may be relieved by a semi-cylindrical passage 163 formed or cut by a rotary tool in the plate 132 and the teeth of the gears 102 and 105 may be relieved by a similar semi-cylindrical passage 164 in the plate 132.

The plate 132 may have the shafts 112 and 100 pass through it as shown in Fig. 1, in which case the plate may be provided with openings or recesses 165. However, under certain conditions, the shafts 112 need not pass through the plate 132. As shown in Fig. 9 the plate 132 may be provided with recesses 166 which extend only part of the distance through the plate. The shaft 100, however, may pass through the plate 132 as shown in Fig. 9. The spring 133 may, if desired, be placed around the shaft 100, and if necessary additional springs 167 may be interposed between the plate 130 and the plate 132. These springs 167 may be positioned by any suitable means such as cylindrical lugs 168 formed in the bottom of the plate 130. In this modification there is only one passage through which the refrigerant and the lubricant may pass from the chamber 121 back into the gear chamber. This passage is around the shaft 100. If desired, a flexible seal, not shown, may be placed between the shaft 100 and the plate 132. This seal may be of any suitable construction, for instance of the type shown in the patent to McCuen 1,491,992, wherein the McCuen shaft 17 corresponds to shaft 100 herein, and where McCuen plate 26 corresponds to plate 132 herein, and where the shaft 100 herein may be axially movable and radially keyed to its gear 102.

In the operation of the device, the coil springs 133 resiliently at all times exert a pressure on the movable plate 132 so as to urge it at all times into contact with the shoulders or sides of the gears 70 and 71. The springs exert this pressure regardless of the presence of any high pressure or compressed gas behind the movable plate 132. This force is sufficient where moderate compression pressures are used. However, where high compression pressures occur, it is desirable to provide an additional force according to the pressure of the compressed gas. This is done in applicants' construction by conducting the discharged gas through the passage 120 to the opposite side of the movable plate so that the pressure of the compressed gas is exerted upon the movable plate in addition to the coil springs 133 so that an additional force is supplied to hold the movable plate tightly against the shoulders or sides of the gears. Thus, by using both the springs and the pressure of the compressed gas, a constant force provided by the springs is always available while a variable force provided by the compressed gas is available whenever compressed gas is present and varies according to the discharge pressure. In this way, the pressure which holds the movable plate against the shoulders or sides of the gears is properly governed and regulated.

Certain features of this invention may be em-

bodied in any type of rotary compressor. Thus in Figs. 10 and 11 is shown a single pair of gears 200 and 201. These gears may be placed in a casing 202, and a relatively movable plate 232 may be placed at one end of the gears and another plate 203, which may be stationary, may be placed at the other end of the gears. The compressor may be provided with an inlet chamber 26a somewhat similar to chamber 26 from which the lubricant and refrigerant may pass through a passage 204 to the gear chamber. The casing 202 may have a cavity with a periphery substantially co-extensive with the composite periphery of the gears. In addition it may be provided with vertical inlet and outlet channels 255 and 269, similar to passages 155 and 69, respectively, for feeding and receiving the refrigerant from the gears 200 and 201. The gears may be provided with shoulders 231 similar to shoulders 131 and the plates 203 and 232 may have an action similar to the action of plates 56 and 132. An outlet passage 220 leads into a chamber 221 and from thence the refrigerant and the lubricant may pass through a passage 222 into a reservoir similar to the reservoir 74. A hermetic seal 240 may be placed between the casing 202 and the plate 232. If desired this seal may be formed similar to that shown in Fig. 1, but adapted to the different type of compressor. Thus ridges 241 and 242 may be made in the plate 232 and the casing 202 respectively. Springs 233 may be provided. Thus the plate 232 may be made either resiliently movable or pneumatically movable or both resiliently and pneumatically movable in a manner somewhat similar to the device shown in Fig. 1. The other parts of the structure shown in Figs. 10 and 11 may be similar to that shown in the other modifications, with such changes as may be necessary to adapt them to the different form of compressors. Thus the drive shaft 200 may pass through the plate 232, and the shaft 212 may pass through the plate 232 similarly to the manner in which shafts 112 pass through the plate 131 in Fig. 1, or the shaft 212 may terminate within the plate 232 in a manner similar to shafts shown in Fig. 9, and shaft 200 may be provided with a seal similar to that described for shaft 100 in Fig. 9.

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 a refrigerating apparatus wherein lubricant and refrigerant are circulated in closed paths, a refrigerant compressor comprising a casing, pumping gears in said casing provided with shafts and end shoulders, plates at opposite ends of the gears having recesses receiving said shafts, one of said plates being relatively movable by pressure of the compressed refrigerant and by resilient means against at least one of said shoulders, said last named plate having a periphery substantially co-extensive with the composite periphery of said gears and fitting in a recess of substantially the same periphery formed in said casing, said movable plate incorporating pressure relief means for conducting away lubricant trapped in the intermeshing teeth of said gears.

2. A refrigerating apparatus, a portion of which includes a compressor through which the refrigerant and the lubricant are circulated in their closed cycles, said compressor including a casing and two pairs of gears within said casing, the gears of each pair intermeshing with each other and at least one gear of each pair intermeshing with at least one gear of the other pair, a single inlet for supplying refrigerant to one of said pairs, and a single outlet for discharging said refrigerant from the other of said pairs, said gears forming two chambers of intermediate compression between said gears and said casing, said gears being provided with shafts and end shoulders, plates at opposite ends of the gears having recesses receiving said shafts, one of said plates being relatively movable against at least one of said shoulders, said last named plate having a periphery substantially co-extensive with the composite periphery of said gears and fitting in a recess of substantially the same periphery formed in said casing, and a flexible web means hermetically secured to said last named plate and to said casing for providing a hermetic seal for said plate.

3. A refrigerating apparatus, a portion of which includes a compressor through which the refrigerant and the lubricant are circulated in their closed cycles, said compressor including a casing and two pairs of gears within said casing, the gears of each pair intermeshing with each other and at least one gear of each pair intermeshing with at least one gear of the other pair, a single inlet for supplying refrigerant to one of said pairs, and a single outlet for discharging said refrigerant from the other of said pairs, said gears forming two chambers of intermediate compression between said gears and said casing, said gears being provided with shafts and end shoulders, plates at opposite ends of the gears having recesses receiving said shafts, one of said plates being relatively movable against at least one of said shoulders, said last named plate having a periphery substantially co-extensive with the composite periphery of said gears and fitting in a recess of substantially the same periphery formed in said casing, protruding continuous ridges formed on said last named plate and on said casing adjacent said last named recess, and a flexible web means joining said ridges for providing a hermetic seal for said plate.

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