

July 4, 1939.

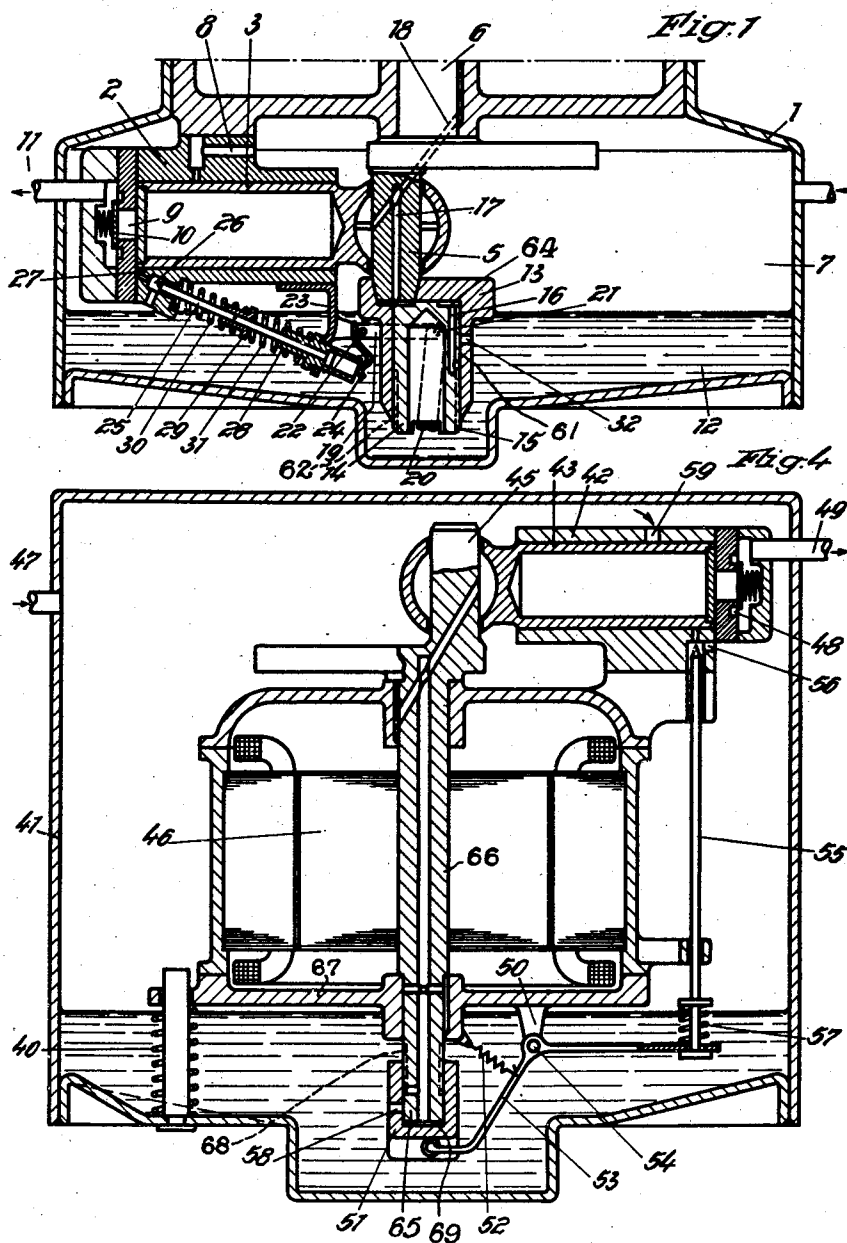
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DEVICE FOR FACILITATING THE STARTING OF REFRIGERATING
APPARATUS OF THE COMPRESSOR TYPE

Filed Aug. 20, 1937

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Fig. 2

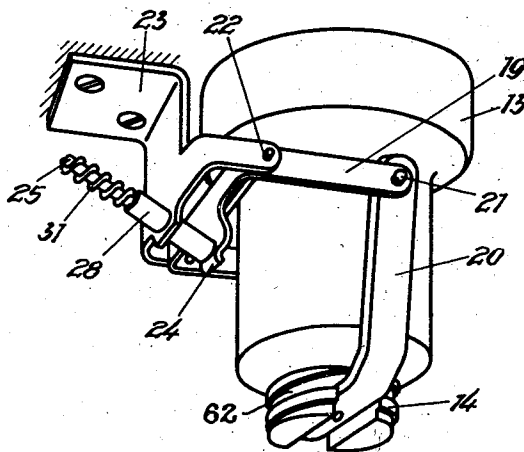
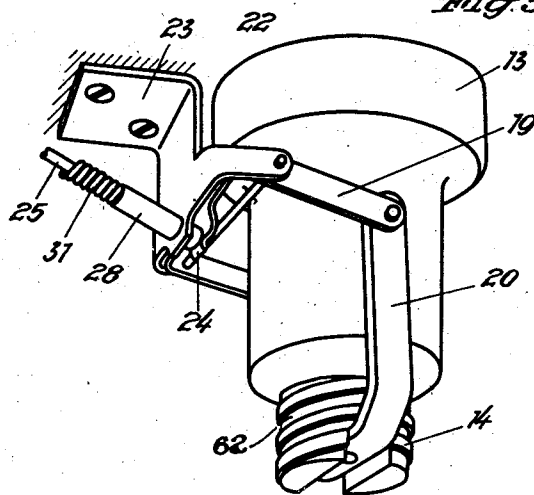


Fig. 3



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DEVICE FOR FACILITATING THE STARTING
OF REFRIGERATING APPARATUS OF THE
COMPRESSOR TYPE

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My invention relates to compressors, and more particularly to compressors in refrigerating systems.

In refrigerating apparatus of the compressor type, particularly electrically-operated units, it is known to provide means for unloading the motor when starting and when operating it at low speeds. To this end, in general, a conduit connecting the suction side of the compressor with the pressure side is opened when the unit is at rest or is operated at low speeds, and this conduit is closed by a valve only upon the attainment of higher speeds. For controlling this valve, means have hitherto been employed which are dependent upon the centrifugal force. Furthermore, it is known to operate such valves electromagnetically or in accordance with the pressure of the refrigerant or of the lubricating oil contained in the apparatus. My invention concerns devices of the last-mentioned type in which a valve is employed which operates in response to the oil pressure and upon exceeding a given pressure closes a conduit connecting the suction side with the pressure side of the compressor.

An object of my invention is to improve the construction of devices of the above-mentioned kind by closely associating the lubricating pump with the means for operating the unloading valve of the compressor. More particularly, while in the controls hitherto known, operating in response to the oil pressure, two very accurate running fits are necessary, i. e., one for the oil pump and the other for the valve, an object of the invention is to necessitate only one running fit.

Other objects of my invention concern an improved operation of the compressor arrangements above referred to. In this respect, more particularly an object is to obtain a reliable response of the unloader device even if the forces available for operating the unloader are relatively small. An object in this line, further, is to diminish the impeding influence of foreign substances in the lubricant on the accuracy and reliability of operation.

A further object is the simplification and spacial contraction of the compressor pump, and unloader arrangement, as well as a space-saving adaptation of such arrangements to a refrigerating system in which the entire arrangement is sealed in a common container which is connected in the circulating system of the refrigerant.

An object, particularly in connection with one

or more of the preceding objects, is to provide means for preventing an increase in the pressure of the lubricant above a certain maximum value.

According to my invention the lubricating pump of a compressor arrangement of the above-mentioned type is kinematically associated with the unloader device of the compressor so that the unloader is directly actuated by means of a mechanical connection with the pump. In carrying the invention into practice a rotary oil pump is preferably employed which has one of the cooperating pumping members arranged so as to be shiftable in the axial direction responsive to the oil pressure, the axial movement being employed to operate the unloader. Since the active pumping members of the pump revolve relatively to each other when the shiftable member is axially displaced, the two members perform spiral movements with respect to each other so that a very fine regulation is attained even if the controlling forces are comparatively small. In contradistinction thereto, the actuating member of the known valve controls, which are displaced responsive to the oil pressure, effect only a straight relative motion so that considerably greater controlling forces must be produced, especially in the event of slight amounts of foreign substances, such as dirt, being present between the movable parts.

Further objects and details of the invention will become apparent from the following description of the two embodiments illustrated in the drawings in diagrammatic form.

Fig. 1 shows a sectional view of the lower part of the compressor casing of a motor-driven refrigerating apparatus of the compressor type.

Fig. 2 is a perspective view of the novel oil pump at rest shown in Fig. 1.

Fig. 3 is a perspective view of the oil pump in operating position.

Fig. 4 shows a modified form of the invention.

Referring to Fig. 1, 1 denotes the lower portion of the compressor casing. Within the cylinder 2 connected to the casing 1 is mounted a piston 3. The crank shaft 6 with the crank 5 serves to drive the piston. The refrigerant passes from the evaporator, not shown, through conduit 4 into the gas chamber 7 of the compressor and, by the action of the piston, is sucked into the cylinder 2 through the passage 8. After being compressed, the refrigerant passes through the opening 9 of the spring-biased valve 10 into the pressure conduit 11 of the refrigerating apparatus. The lubricant 12 is collected in the

lower part of the compressor casing 1 and is supplied by an oil pump secured to the lower end of the crank 5 to the points of the apparatus to be lubricated.

- 5 The oil pump has two cooperating pumping members 13 and 14 arranged coaxially to the crank shaft 6. Member 13 is revolvable and connected with crank 5 so as to be operated simultaneously with the operation of the compressor. The second pumping member 14 is arranged within the member 13 and is axially displaceable against member 13. A lever 20 passing through a recess in the lower end of member 14 prevents this member from revolving.
- 10 The non-revolvable inner member 14 which fits accurately into the cylindrical boring 61 of the rotary member 13 has helical threads 62 the lower end of which forms an entrance opening 15 for the lubricant to be impelled by the pump.
- 20 The upper end of the thread opens into a passage 16 which is connected with an annular space 64. Ducts 17 and 18 in the crank connect the space 64 with the places of the apparatus to be lubricated.
- 25 The lever 20 securing the member 13 against rotation is linked to a U-shaped lever 19 as indicated at 21. The lever 19 is pivoted at 22 on an arm 23 which is secured to the stationary cylinder. The stationary member 14 of the oil pump may carry out an axial movement in the vertical direction while moving the levers 20 and 19 downward. 25 denotes the needle of a valve which in the position shown is moved away from the valve seat 26 and which, therefore, opens a conduit 27 connecting the suction side and the pressure side of the compressor when the apparatus is at rest and at low speeds. The valve needle 25 is slidably arranged in a sleeve 28. One end of the sleeve 28 contacts with a nose 24 of the lever 19. To the valve needle 25 is firmly secured a holder 29, a controlling spring 30 engaging one side of the holder 29 and a second spring 31 engaging the other side thereof. These springs tend to hold through levers 19 and 20 the pumping member 14 in raised position.

The oil pump and the valve combined therewith operate as follows:—

- When starting the compressor, the outer pumping member 13 is rotated against the inner member 14. The oil near the cylindrical boring 61 of member 13, impelled by this rotation, is pressed upward through the thread windings 62 into the duct 16 and the annular space 64 whence it reaches the different points to be lubricated. At the beginning of this operation, the springs 30 and 31 are in expanded condition and the levers 19 and 20, as well as the member 14, are in the raised position shown in the figure. The valve needle 25, therefore, also assumes the position illustrated in which the compressor is unloaded. However, the pumping effect produced by members 13 and 14 causes an increase of pressure in the annular space 64. This increasing pressure now forces the member 14 downward, thereby rotating the lever 19 in clockwise direction so that the nose 24 of lever 19 presses against the sleeve 28 thus moving the needle 25 in the closing direction of the valve against the force of spring 30. When the oil pressure becomes great enough to overcome this counter-force, the valve is closed and the compressor fully loaded. The force of the spring 30 is so rated that the valve is closed only after the starting period of the refrigerating apparatus

is finished so that normal operating conditions prevail.

In order to prevent an unduly high pressure, a relief port 32 is provided in the revolving member 13 of the pump. As soon as the oil pressure has increased to such an extent as to cause the valve seat 26 to be closed, the axially displaceable member 14 of the pump may continue its movement in the downward direction, since then the lever 19 displaces the sleeve 29 relatively to the valve needle 25 against the force of the spring 31. Upon further displacement of member 14 relatively to member 13 of the pump, the port 32 is uncovered so that part of the oil in space 64 is discharged through the port.

In the modified form of the invention illustrated in Fig. 4, 41 denotes the compressor casing of the refrigerating apparatus, 42 is the cylinder and 43 the piston which is driven by the electric motor 46 through the crank 45. The motor 46 is resiliently supported on the compressor casing 41 through springs 40. The refrigerant is drawn in by the compressor through the conduit 47 and passes through the port 59 into the cylinder 42, whence the compressed refrigerant is supplied to the condenser (not shown) through the valve 48 and the conduit 49. The lower end 65 of the shaft 66 of the driving motor 46 extending through the casing 67 thereof is designed as one of the two pumping members of an oil pump of the same type as described in the foregoing with reference to Figs. 1, 2 and 3. To this end, the lower end 65 of the shaft is threaded, as indicated by 68, and is enclosed by a sleeve 51 which forms the second member of the pump. A lever 53 pivoted at 54 to a stationary arm 50 secures the pumping member 51 against rotation but allows the member to be displaced in the downward direction against the force of a spring 52 upon an increase of the oil pressure acting in the space 69. The lever 53 is coupled through a spring 57 with a valve rod 55 controlling a relief valve 56.

The function of this modification is in principle the same as that of the preceding embodiment. Upon an increase of the oil pressure, the member 51 of the pump is forced downward against the action of spring 52 and causes the rod 55 to close the valve 56 so that the compressor is fully loaded only after a certain starting period. When the valve 56 has been closed, the sleeve 51 may continue to move in the downward direction while compressing the spring 57. In this manner an oil relief port 58 is opened upon the attainment of a given oil pressure.

I claim as my invention:

1. In a compressor arrangement, in particular for refrigerating systems, having a lubrication pump coupled with the compressor and a device for unloading said compressor in dependence upon the pressure of the lubricant produced by said pump, said pump having two cooperative pumping members arranged movably with relation to each other and designed to impel said lubricant by said relative movement, one of said pumping members being arranged so as to be additionally movable in a direction differing from that of said first movement in response to the increase in the pressure of said lubricant caused by said pump, and a mechanical connection between said additionally movable pumping member and said unloading device for operating said device by said additional movements of said latter member.

2. In a compressor arrangement, in particular

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for refrigerating systems, having a lubrication pump coupled with the compressor and a device for unloading said compressor in dependence upon the pressure of the lubricant produced by
 5 said pump, said pump having a revolvable pumping member for impelling said lubricant, said member being arranged to be displaceable in axial direction responsive to the pressure of said lubricant, and a mechanical connection be-
 10 tween said member and said unloading device for operating said device by said axial displacements of said member.

3. In a compressor arrangement, in particular for refrigerating systems, having a lubrication
 15 pump coupled with the compressor and a valve for unloading said compressor at low operating speeds, arranged between the pressure side and the suction side of said compressor, said pump having two cooperative pumping members re-
 20 volvable with relation to each other and designed to impel the lubricant by said revolution, one of said pumping members being arranged so as to be displaceable in axial direction responsive to the pressure of said lubricant produced by said
 25 pump, and a mechanical connection between said displaceable member and said valve for operating said valve by said displacements of said latter member.

4. In a compressor arrangement, in particular for refrigerating systems, having a lubrication
 30 pump coupled with the compressor and a device for unloading said compressor in dependence upon the pressure of the lubricant produced by said pump, said pump having two cooperative
 35 pumping members, one of said members being revolvable for impelling said lubricant, the other of said members being displaceable in axial direction responsive to the pressure of said lubri-
 40 cant, and a mechanical connection between said displaceable member and said unloading device for operating said device by the displacements of said latter member.

5. In a compressor arrangement, in particular for refrigerating systems, having a lubrication
 45 pump coupled with the compressor and a valve for unloading said compressor at low operating speeds, arranged between the pressure side and the suction side of said compressor, said pump having two cooperative pumping members re-
 50 volvable with relation to each other and designed to impel the lubricant by said revolution, one of said pumping members being arranged so as to be displaceable in axial direction responsive to the pressure of said lubricant produced by said
 55 pump, a mechanical connection between said displaceable member and said valve for operating said valve by said displacements of said latter member, and spring means tending to maintain said displaceable member in valve opening posi-
 60 tion.

6. In a compressor arrangement, in particular for refrigerating systems, comprising a lubrica-
 65 tion pump coupled with the compressor and having a pressure relief port designed to be normally closed, said pump having two cooperative pumping members revolvable with relation to each other and designed to impel the lubricant by said revolution, one of said pumping members being arranged so as to be displaceable in axial
 70 direction responsive to the pressure of said lubricant and designed to open said pressure relief port of said pump upon reaching a given maximum displacement, a valve for unloading said compressor at low pressure of said lubricant, a
 75 mechanical connection between said displace-

able member and said valve for closing said valve by displacements smaller than said maximum displacement, a spring associated with said connection and tending to maintain said displace-
 5 able member in valve opening position, and a second spring arranged so as to impede the further displacement of said latter member when said valve is in closed position.

7. In a compressor arrangement, in particular for refrigerating systems, comprising a lubrica-
 10 tion pump coupled with the compressor and having relief means for limiting the pressure of the lubricant, and a valve for unloading said compressor at low pressure of said lubricant, said pump having two cooperative pumping members
 15 revolvable with relation to each other and designed to impel said lubricant by said revolution, one of said pumping members being arranged so as to be displaceable in axial direction responsive to the pressure of said lubricant and designed
 20 to be integral with said relief means, and a mechanical connection between said displaceable member and said valve for operating said valve by said displacements of said latter member.

8. In a compressor arrangement, in particular for refrigerating systems, comprising a lubrica-
 25 tion pump coupled with the compressor and having a pressure relief port designed to be normally closed, and a valve for unloading said compressor at low pressure of the lubricant, said pump hav-
 30 ing two cooperative pumping members revolvable with relation to each other and designed to impel said lubricant by said revolution, one of said pumping members being arranged so as to be
 35 displaceable in axial direction responsive to the pressure of said lubricant and designed to open said pressure relief port of said pump upon reaching a given maximum displacement, and a mechanical connection between said displace-
 40 able member and said valve for closing said valve by displacements smaller than said maximum displacement.

9. With a compressor, in particular for refrigerating systems, in combination, means for un-
 45 loading said compressor, a lubrication pump having two cooperative cylindrical pumping members having the form of a bolt and of a cup surrounding said bolt, respectively, and being revolv-
 50 able and axially displaceable relatively to each other, one of said pumping members having helical threads forming a passage for the lubricant to be impelled through said threads by the relative revolution of said members, a duct for said
 55 lubricant connecting said passage with the end face of said bolt-shaped member in order to axially displace said members relatively to each other responsive to the pressure of the lubricant, a mechanical connection between said pump and
 60 said unloading means of said compressor for operating said unloading means by said axial displacements, and resilient means arranged to counteract said displacements and tending to maintain said members in a position wherein said compressor is unloaded.

10. With a compressor, in particular for re-
 65 frigerating systems, in combination, means for unloading said compressor, a lubrication pump having two cooperative cylindrical pumping members having the form of a bolt and of a cup surrounding said bolt, respectively, and being
 70 revolvable and axially displaceable relatively to each other, one of said pumping members having helical threads forming a passage for the lubricant to be impelled through said threads by the relative revolution of said members, a
 75

duct for said lubricant connecting said passage with the end face of said bolt-shaped member in order to axially displace said members relatively to each other responsive to the pressure of the lubricant, a mechanical connection between said pump and said unloading means of said compressor for operating said unloading means by said axial displacements, a pressure relief port arranged in said cup-shaped member spaced apart from the bottom face of said cup so as to vent said duct when said displacements exceed a maximum distance, and resilient means arranged to counteract said displacements and tending to maintain said members in a position wherein said compressor is unloaded and said relief port closed.

11. With a compressor, in particular in a refrigerating system, the combination of a rotatable driving element connected with said compressor, said driving element having a duct for passing a lubricant to said compressor, a lubricating pump connected with said driving element so as to communicate with said duct, said pump having two cooperative pumping members, one of said members being rotatable and connected with said driving element, the other of said pumping members being axially displaceable in response to the pressure of said lubricant in said pump, and a valve for unloading said compressor, said valve being mechanically connected with said displaceable member so as to be operated by the displacements of said latter member.

12. With a compressor, in particular in a refrigerating system, the combination of a crank for actuating said compressor having a crank arm provided with a duct for the passage of a lubricant, a rotary lubricating pump communicating with said duct and having two coaxial pumping members, the outer of said members forming a rotary sleeve and being coupled with said crank arm, the inner of said pumping members being axially displaceable responsive to the

pressure of said lubricant, a valve for unloading said compressor, a connection between said inner pumping member and said valve for operating said valve by the displacements of said latter member, and spring means tending to maintain said latter member and said connection in valve opening position.

13. With a compressor, in particular in a refrigerating system, the combination of a motor for driving said compressor, said motor having a shaft provided with a longitudinal duct for the passage of a lubricant, a lubricating pump coaxial to said shaft and communicating with said duct, said pump having two coaxial pumping members, one of said members being associated with said shaft, the other of said members being axially displaceable responsive to the pressure of said lubricant, a valve for unloading said compressor, a connection between said displaceable pumping member and said valve, and spring means tending to maintain said valve and said displaceable member in valve opening position.

14. With a compressor, in particular for refrigerators, having a horizontal cylinder and a reciprocatory piston disposed in said cylinder, and a crank mechanism having a vertical crank shaft and a crank pin for reciprocating said piston, in combination, a lubricating system comprising a container for collecting the lubricant, a lubrication pump comprising two cooperative pumping members, one of said pumping members consisting of a bolt arranged coaxially with respect to said crank shaft, said other pumping member consisting of a sleeve revolvable about said bolt, one of said pumping members having a helical thread in its surface contacting said other member so as to form a helical passage for the lubricant, the intake of said helical passage being submerged in said collected lubricant when in operation, and said crank pin being connected with said sleeve for revolving said sleeve.

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