

[54] **ROTARY COMPRESSOR**

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[58] Field of Search..... 417/410, 902, 372,
417/204; 418/83, 85, 87, 88, 91, 92, 93, 99,
125, 129, 32

[56] **References Cited**

UNITED STATES PATENTS

2,225,228 12/1940 Neeson 184/6.28

3,003,684	10/1961	Tarleton	417/410
3,111,820	11/1963	Atchison.....	418/99
3,513,476	5/1970	Monden.....	417/902
2,134,936	11/1938	Getchell et al.	417/902
2,669,384	2/1954	Dills.....	418/88
2,623,365	12/1952	Daniel.....	418/85

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[57]

ABSTRACT

A rotary compressor comprising a lubricant reservoir placed in the lower part of a compressor body; and a lubricant circulating mechanism for cooling lubricant received in said reservoir by conducting it through a tubing provided with a heat exchanger and supplying the lubricant thus cooled to the compressing unit of said body and those sections of said body through which there slides a blade.

8 Claims, 4 Drawing Figures

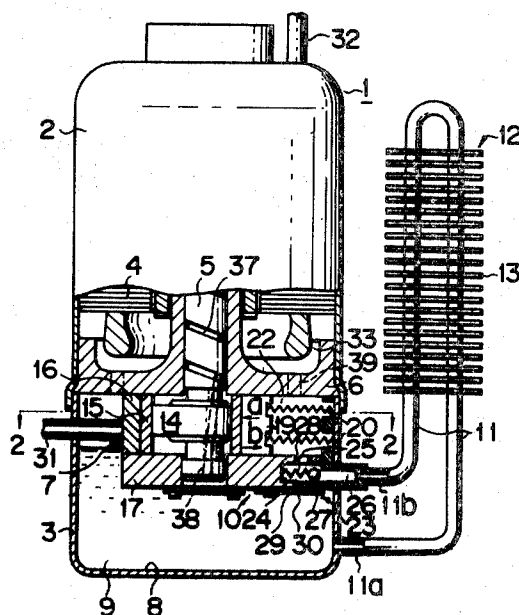


FIG. 1

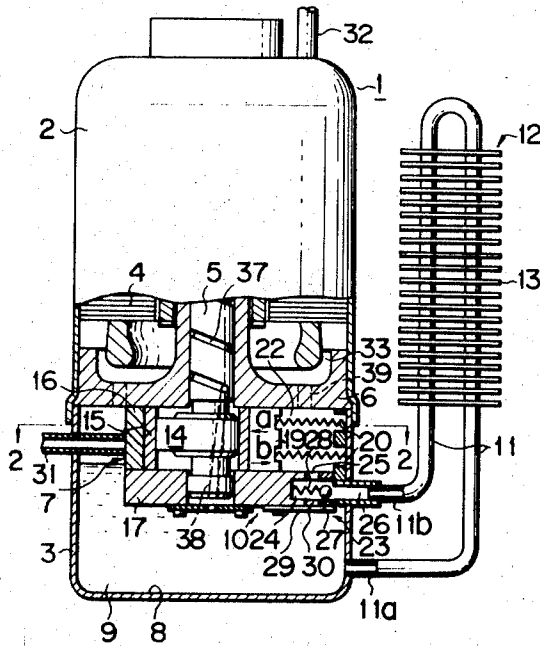


FIG. 2

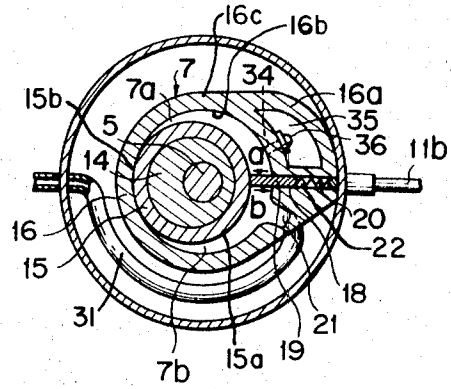


FIG. 3

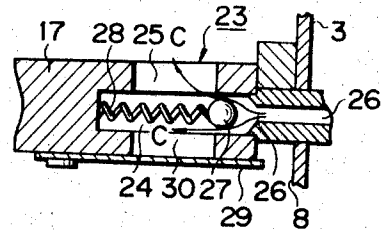
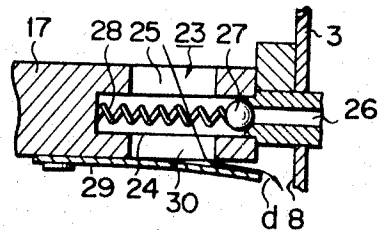


FIG. 4



ROTARY COMPRESSOR

BACKGROUND OF THE INVENTION

This invention relates to a rotary compressor provided with a lubricant circulating mechanism to cool lubricant.

With conventional compressors, lubricant is cooled by conducting part of a gaseous refrigerant previously cooled in a condenser through a piping disposed in a lubricant reservoir. Since, however, a gaseous refrigerant has a far smaller heat transfer coefficient and specific heat at constant pressure than lubricant, this cooling method is extremely inefficient. There are disadvantages that the unavoidable shaking of the piping decreases the efficiency of a compressor and the additional installation of the piping leads to the complicated construction of a compressor and increased manufacturing cost.

The prior art compressor of the aforementioned type does not permit any ejecting action following the principle of the Venturi meter to be utilized in circulating cooled lubricant through a heat exchanger, presenting the drawback that there must be provided bulky circulation means outside of the compressor.

SUMMARY OF THE INVENTION

A rotary compressor according to this invention comprises a motor fitted with a main shaft; a refrigerant compressing unit actuated by an eccentric attached to the main shaft and provided with a blade chamber; and a lubricant circulating mechanism including a lubricant tubing passing through a heat exchanger, open at one end to the lubricant in the reservoir and communicating at the other end with at least a compressing unit and those sections of a compressor body through which there slides a blade in the blade chamber, thereby cooling lubricant by conducting it through said tubing according to the rotation of the main shaft and supplying the lubricant thus cooled to said blade sliding sections.

According to a feature of this invention a rotary compressor is provided with a lubricant circulating mechanism for conducting lubricant only in one direction through a tubing penetrating a heat exchanger for cooling the lubricant in the tubing while an electric motor is driven to operate a refrigerant compressing unit.

According to a further feature of the invention a rotary compressor is provided with a valve unit co-operating with a blade chamber so as to cool lubricant by circulating it through a tubing penetrating a heat exchanger.

A still further feature of the invention is to provide a rotary compressor which is little subject to failure and which is formed of a small number of easily assembled parts and adapted for miniaturization and quantity production with reduced cost.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partially exploded side view of a rotary compressor according to an embodiment of this invention;

FIG. 2 is a sectional view along line 2—2 of FIG. 1;

FIG. 3 illustrates the operating condition of a valve unit where there is sucked lubricant into a blade chamber; and

FIG. 4 illustrates the operating condition of a valve unit where there is discharged lubricant from the blade chamber into its reservoir.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1, numeral 1 represents a compressor body tightly closed by upper and lower casings 2 and 3. In the upper casing 2, there is fixedly received an electric motor 4 in such a manner that a main shaft 5 thereof projects downwardly therefrom. In the lower casing 3 is disposed a refrigerant compressing unit 7 and a reservoir 8 filled with lubricant 9. The inner walls of the lower casing 3 define a lubricant reservoir 8 in which lubricant 9 is contained. However, the lubricant reservoir may be separately provided in the lower casing.

Numeral 10 denotes a lubricant circulating mechanism actuated by the rotation of the main shaft 5, the lower part of said mechanism being immersed in the lubricant 9. To the lower side wall of the lower casing 3 is connected one end 11a of a lubricant tubing 11 so as to communicate with the reservoir 8. The other end 11b of the lubricant tubing 11 is connected to the lubricant circulating mechanism 10. The greater part of said lubricant tubing 11 passes through a radiator, for example, a heat exchanger 12 provided with fins 13.

To that portion of the main shaft 5 which projects downward of the electric motor 4 is eccentrically fixed an eccentric or an eccentric disk member 14 which is fitted into a portion 15. Concentrically with the main shaft 5 is disposed a cylinder 16, the cylindrically inner surface 16b of which contacts that portion 15b of the outer periphery 15b of the rotor 15 which is remotest from the axis of the main shaft 5. The top and bottom surfaces of the cylinder 16 contact airtight with an upper frame 6 and a lower frame 17 which support the main shaft 5 respectively. The rotor 15 slides airtight on the lower surface of the upper frame 6 and the upper surface of the lower frame 17.

Referring to FIGS. 1 and 2, the side wall of the cylinder 16 is perforated with a slit 18 for guiding a blade 19. The blade 19 is urged by springs 20 so as always to have an the inner end surface thereof brought into contact with the outer periphery of the rotor 15. Thus, said blade 19 reciprocates in the radial direction of the cylinder 16 (in the directions of the arrows a and b of FIGS. 1 and 2) in a state always pressed thereby as the rotor 15 rotates. A blade chamber 22 is provided in the swollen portion 16a of the wall 16c of the cylinder 16. Below the blade chamber 22 is provided a lubricant valve unit 23 constructed substantially in integral relationship with the lower frame 17. A valve chamber 24 of the valve unit 23 communicates with the blade chamber 22 through a lubricant passage 25. The end of the lubricant tubing 11b communicates with the chamber 24 through a suction port 26 connected to the lower casing 3 and extending in the chamber 24. In the valve chamber 24, there is so disposed a ball 27 as to be urged by a spring 28, thereby normally closing the suction port 26. To the lower end of the valve unit 23 is fitted a plate 29 made of elastic material normally to close a discharge port 30. When the port 30 is opened, the valve cavity 24 to communicate with the lubricant reservoir 8. The lubricant circulating mechanism 10 comprises the blade chamber 22 and valve unit 23.

As shown in FIG. 2, the refrigerant compressing unit 7 is formed of the rotor 15 rotatably engaging the eccentric 14, the cylinder 16 whose inner wall always contacts the remotest portion 15b of the outer periphery 15a of the rotor 15 and the blade 19 always pressed

against the periphery of the rotor 15 so as to divide the space between the rotor 15 and cylinder 16 into a high pressure side 7a and low pressure side 7b. Said refrigerant compressing unit 7 is constructed in the same manner as an ordinary rotary pump, compressing gaseous refrigerant sucked in from a suction line 31 for refrigerant and delivering it from its discharge line 32 through the space 33 of the upper casing 2. It will be noted at this point that a refrigerant tubing comprises the suction and discharge lines 31 and 32. It is assumed for convenience of description that the main shaft 5 rotates clockwise as viewed from FIG. 2.

In FIG. 2 numeral 34 denotes a discharge port open to a high pressure side 7a and a discharge chamber 35 defined by the upper and lower frames 6 and 17 and the swollen portion 16a of the wall 16c of the cylinder 16. To that opening of the discharge port 34 which faces the discharge chamber 35 there is fitted a check valve 36 for conducting gaseous refrigerant from the high pressure 7a only to the discharge chamber 35. In the upper frame 6 is disposed a passage 39 (FIG. 1) for allowing the discharge chamber 35 to communicate with a space 33 defined by the inner walls of the upper casing 2. The high pressure side 7a may directly communicate with said space 33 without providing the discharge chamber 35. In that part of the swollen portion 16a of the cylinder 16 which is opposite to the discharge chambers 35 with respect to the blade chamber 22 is provided a suction chamber 21 communicating with the low pressure side 7b. The suction line 31 is connected to said suction chamber 21.

In the peripheral surface of the main shaft 5 is formed a spiral groove 37 communicating with a lubricant passage 38 bored in the main shaft 5 and open to the lubricant 9 at the lower end of the main shaft 5.

There will now be described by reference to FIGS. 1 and 2 the operation of a rotary compressor according to an embodiment of this invention. When the eccentric 14 rotates with the main shaft 5 by the electric motor 4, the blade 19 is made to slide back and forth in the radial direction of the cylinder 16 while abutting against the periphery of the rotor 15. Now let it be assumed that the eccentric 14 is rotating so as to decrease the distance between its contact with the blade 19 and the axis of the main shaft 5. Then the blade 19 slides by the force of the springs 20 in the direction of the arrow a shown in FIGS. 1 and 2 to increase the volume of the blade chamber with the resultant generation of suction pressure therein. As a result, the ball 27 is detached from the suction port 26 against the force of the spring 28, allowing the lubricant in the tubing 11 to pass through the tube end 11b and suction port 26 and be sucked into the blade chamber 22 through the valve chamber 24 as indicated by the arrow c of FIG. 3. During this time the elastic plate 29 closes the discharge port 30. When the disk member 14 further rotates so as to broaden the distance between its contact with the blade 19 and the axis of the main shaft, then the blade 19 slides against the force of the springs 20 in the direction of the arrow b of FIGS. 1 and 2 to reduce the volume of the blade chamber 22 with the resultant generation of compressive pressure therein. At this time the ball 27 closes the suction port 26 by said compressive pressure as well as by the force of the springs 20. On the other hand, said compressive pressure causes the elastic plate 29 to be forced open, so that the lubricant in the blade chamber 22 is forced out into the lubricant

reservoir 8 as indicated by the arrow d of FIG. 4 through the valve cavity 24 and discharge port 30. The aforementioned cycles of operation are repeated according to the rotation of the eccentric 14. Thus the lubricant 9 is forcefully circulated through the following route:

Reservoir 8 → tube end 11a → tube 11 → tube end 11b → valve cavity 24 → blade chamber 22 → valve cavity 24 → reservoir 8. The lubricant 9 is cooled by being conducted through that part of the lubricant tube 11 which penetrates the heat exchanger 12.

This permits the circulation and cooling of lubricant without particularly providing a pump for its circulation, thereby enabling a rotary compressor to be built of a small number of easily assembled parts in compact form adapted for quantity production and reduced cost with least possibility of failure.

Further, part of the lubricant in the reservoir 8 is supplied to the spiral groove 37 formed in the main shaft 5 through the lubricant passage 38 disposed therein mainly to lubricate the slide sections of the main shaft 5 and upper frame 6 and those of the eccentric 14 and rotor 15. Part of the lubricant 9 sucked into the blade chamber 22 lubricates the slide sections of the blade 19, upper and lower frames 6 and 17, rotor 15 and cylinder 16 and those of said rotor 15, upper and lower frames 6 and 17 and cylinder 16.

We claim:

1. A rotary compressor comprising:

tightly closed upper and lower casings, said lower casing defining a lubricant reservoir containing a lubricant;

a motor provided with a main shaft and firmly mounted in the upper casing;

a refrigerant compressing unit actuated by an eccentric fixed to the main shaft;

a blade chamber with a blade reciprocating radially therethrough, said blade dividing the compressing unit into high and low pressure sides;

a refrigerant tubing comprising a suction line for leading gaseous refrigerant into the refrigerant compressing unit and a discharge line for delivering the refrigerant;

a lubricant tubing provided with a heat exchanger and having a first end thereof opened to the lubricant in said lubricant reservoir; and

a mechanism for circulating the lubricant, said lubricant circulating mechanism comprising a valve unit including a valve chamber which communicates with said blade chamber, and suction port means connecting the other end of the lubricant tubing with said valve chamber, said valve unit selectively causing lubricant to be introduced from said other end of the lubricant tubing to said valve chamber and to said blade chamber.

2. The rotary compressor according to claim 1 wherein said motor is an electric motor.

3. The rotary compressor according to claim 1 wherein said valve unit includes: a first check valve between the blade chamber and the other end of the lubricant tubing for conducting the lubricant from said tubing to said chamber, and a second check valve between the blade chamber and the lubricant reservoir for discharging the lubricant from the chamber to the reservoir.

4. The rotary compressor according to claim 1 wherein said suction port connects the valve cavity with said other end of the lubricant tubing for introducing the lubricant to the lubricant tubing into said blade chamber through the valve cavity while said blade is advancing outwardly of said blade chamber; and

a discharge port connects the valve cavity with the lubricant reservoir for conducting the lubricant in the blade chamber into said reservoir while the blade is receding inwardly of said blade chamber.

5. The rotary compressor according to claim 4 wherein said lubricant circulating mechanism further comprises:

a ball in the valve cavity for closing the suction port except while said blade is advancing;

a spring in the valve cavity for urging the ball toward the suction port; and

an elastic plate for closing the discharge port except while said blade is receding.

6. The rotary compressor according to claim 5 wherein said elastic plate is mounted exterior of said valve unit.

7. A rotary compressor including:

a. tightly closed upper and lower casings, said lower casing defining a lubricant reservoir containing lubricant;

b. a motor provided with a main shaft and firmly received in the upper casing;

c. a refrigerant compressing unit comprising a cylinder disposed below the motor, an eccentric fixed to the main shaft in the cylinder, a rotor having the eccentric fitted therein and contacting the cylindrical inner surface at that portion of the outer periphery of the eccentric which is remotest from the main shaft;

d. a lubricant tubing having one end connected to the lower casing so as to communicate with the lubricant reservoir;

e. a heat exchanger for cooling the lubricant in the

tubing, through which the tubing passes; and
f. a mechanism for circulating the lubricant comprising

a blade chamber provided in the wall of the cylinder, a blade reciprocating radially of the cylinder through the blade chamber and biased so as to always contact the outer periphery of the rotor, and

a lubricant valve unit provided under the blade chamber, said valve unit comprising a valve chamber formed therein, a passage formed between the valve chamber and the blade chamber for mutual communication of the chambers, a suction port provided on the lower casing, said suction port having one end connected to the valve chamber and the other end to the other end of the lubricant tubing, a ball disposed in the valve chamber so as to normally close the suction port by a spring in the valve chamber, a discharge port formed between the valve chamber and the lubricant reservoir, and a plate of elastic material mounted on the lower end of the valve unit so as to normally close the discharge port, wherein, when the blade is moved toward the main shaft by the rotation thereof, suction pressure is generated in the blade chamber for disengagement of the ball from the suction port with the discharge port closed, thereby causing the lubricant in the valve chamber and the cooled lubricant in the tubing to be introduced into the blade chamber through the passage and, when the movement of the blade is reversed by further rotation of the main shaft, compressive pressure is generated in the blade chamber to make the ball close the suction port and the elastic plate forced open, thereby causing the lubricant in the blade chamber to be forced out in the lubricant reservoir through the passage, valve chamber and discharge port.

8. The rotary compressor according to claim 7 wherein said motor is an electric motor.

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