May 27, 1958 O. H. SCHELDORF 2,836,349

COMPRESSION ARRANGEMENT

Filed July 13, 1953

Fig. 1.

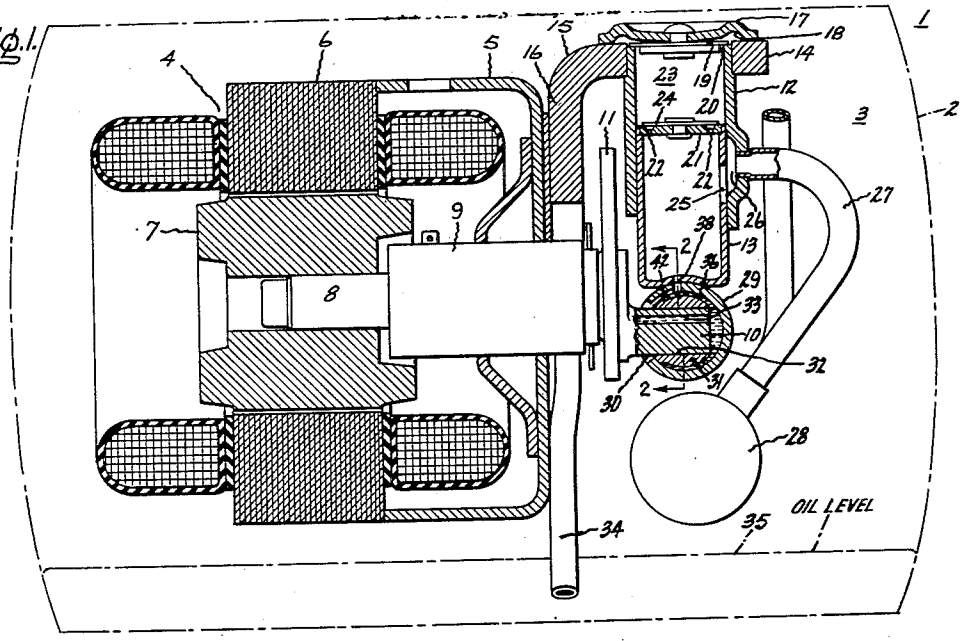


Fig. 4.

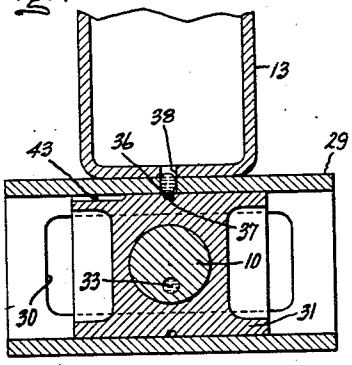


Fig. 5.

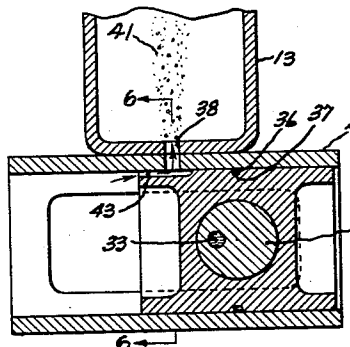


Fig. 6.

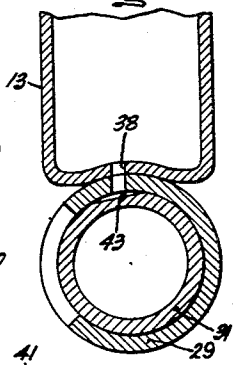


Fig. 7.

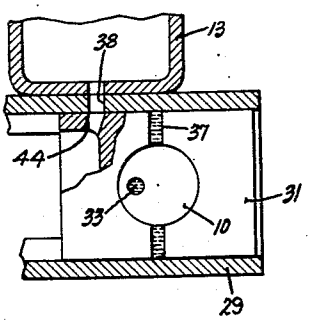


Fig. 3.

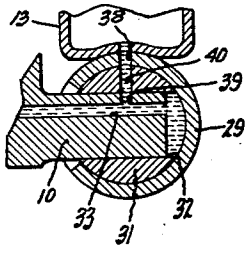
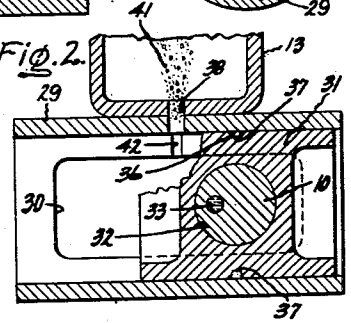


Fig. 2.



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COMPRESSION ARRANGEMENT

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4 Claims. (Cl. 230—206)

My invention relates to refrigeration apparatus and pertains more particularly to the compressors in refrigerating units.

In constructing a refrigerating unit it is desirable to provide means for insuring satisfactory lubrication of the compressor thereof and minimizing compressor operating noise. Accordingly, the primary object of my invention is to provide in a refrigerating unit new and improved means for lubricating the compressor thereof and minimizing compressor operating noise.

Another object of my invention is to provide in a refrigerating unit new and improved means for metering oil into the compressor thereof.

Another object of my invention is to provide in a refrigerating unit new and improved means for admitting oil into the compressor thereof in such a state as to facilitate the distribution of the oil in the compressor.

Further objects and advantages of my invention will become apparent as the following description proceeds and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming part of this specification.

In carrying out the objects of my invention, I provide a refrigerating unit comprising a gas containing case and a compressor adapted for being operated in the case. Provided in the compressor is means for metering oil into an orifice for admission into and distribution in the compressor. Also provided is means for admitting gas into the orifice from the case when during operation of the compressor the pressure of the gas beyond the orifice is less than in the case thereby to effect spraying of the oil metered into the orifice, into the compressor mechanism.

For a better understanding of my invention, reference may be had to the accompanying drawing in which:

Fig. 1 is a fragmentary sectional and partially schematic view of a refrigerating unit including a Scotch yoke compressor;

Fig. 2 is an enlarged fragmentary sectional view taken along the line 2—2 in Fig. 1 and looking in the direction of the arrows;

Fig. 3 is an enlarged fragmentary sectional view of a modified form of my invention;

Fig. 4 is an enlarged fragmentary sectional view of another modified form of my invention;

Fig. 5 is a fragmentary sectional view of the modification of Fig. 4 in which the cross slide is shown in a particular operating position;

Fig. 6 is a sectional view taken along the line 6—6 in Fig. 5 and looking in the direction of the arrows; and

Fig. 7 is an enlarged fragmentary sectional view illustrating still another modification of my invention.

Referring to Fig. 1, I have shown a refrigerating unit generally designated 1. The refrigerating unit 1 comprises a case shown in outline and indicated by 2. The case 2 is adapted for having the suction line of a refrigerating system (not shown) connected thereto whereby

the case is filled with vaporous refrigerant or gas at suction pressure. Enclosed in the case 2 is a compressor generally designated 3 and a motor for driving the compressor generally designated 4.

Provided for supporting the compressor 3 and the motor 4 and suitably supported in the case is a frame 5. The frame 5 is cup-like in configuration and is secured at its edge to the stator laminations 6 of the motor 4. Included in the motor and adapted for rotating in the stator laminations 6 is a rotor 7. Suitably fitted in the rotor for being rotated thereby is a drive shaft 8. The drive shaft 8 is suitably supported for rotation in a bearing sleeve 9 which extends through and is secured, as by welding, to the frame 5. On its outer extremity the drive shaft 8 is formed to include a shoulder. Formed on the shoulder and eccentrically disposed relative to the axis of the drive shaft 8 is a crank pin 10. Also carried on the shoulder for balancing the shaft is a counterweight 11. During rotation of the drive shaft 8 the crank pin 10 rotates in a circular path for operating the compressor 3 which is of the Scotch yoke type.

The compressor 3 comprises a cylinder 12 and a piston 13 adapted for being operated in the cylinder by the crank pin 10. The cylinder 12 is secured, as by welding and brazing, to the edge of a suitable aperture formed in the horizontal leg 14 of an inverted L-shaped bracket 15. The vertical leg 16 of the bracket 15 is secured, also as by welding and brazing, to the frame 5. Thus the cylinder is suitably supported for having the piston 13 operated therein.

Closing the upper end of the cylinder 12 and suitably secured to the upper side of the horizontal leg 14 of the bracket 15 is a cylinder head 17. The cylinder head 17 is formed to include an annular exhaust chamber 18. Carried by the cylinder head 17 is an exhaust valve 19. The exhaust valve 19 is a flexible disk which is centrally secured to the cylinder head and adapted for cooperating at its outer edge with the upper edge of the cylinder 12 which in effect is a valve seat and is designated 20. This arrangement controls communication between the cylinder and the exhaust passage 18 in accordance with the pressure in the cylinder 12.

The piston 13 is cup-like or hollow and includes a head element 21 formed to include a plurality of intake passages or apertures 22. Carried on the head 21 and adapted for controlling communication between the cylinder 12 and the piston 13, or in other words between the interior of the piston and a compression chamber 23 formed through the cooperation of the piston and the cylinder, is an intake valve 24. The intake valve 24 is a flexible disk which is centrally secured to the element 21 and adapted for cooperating at its outer edge with the apertures 22 to control flow of gas from the piston into the compression chamber 23 in accordance with the pressure difference therebetween.

The piston 13 is adapted for receiving gas to be compressed through a lateral aperture 25. The aperture 25 is adapted for registering with a gas inlet chamber 26 formed in the side of the cylinder 12 and to which is connected an inlet tube 27. The tube 27 connects with muffler 28 which is in open communication with the interior of the case 2 for receiving gas from the case and supplying it to the inlet chamber 26.

In the arrangement described to this point, reciprocation of the piston 13 in the cylinder 12 results at a predetermined point of reciprocation or on the downstroke in a reduction of pressure in the compression chamber 23 and the piston 13. At this point the valve 24 opens the apertures 22 in the element 21 and the aperture 25 moves into register with the inlet chamber 26. Thus, vaporous refrigerant from the case is admitted into the compression chamber for being compressed.

On the upstroke of the piston the gas in the compression chamber 23 is compressed whereby it is effective for maintaining the valve 24 seated for closing the passages 22. Subsequently, and at a predetermined degree of compression the gas in the compression chamber 23 is effective for raising the exhaust valve 19 from the edge of the cylinder or valve seat 20 thereby to permit the compressed gas to exit into the annular chamber 18. By a connection, not shown, the compressed gas is conducted from the annular chamber 18 to a portion of the muffler 28 adapted for muffling exhaust noises. Means, also not shown, is provided for conducting the exhaust gas from the muffler to the exterior of the case 2 for delivery to condensing means in the system employing the refrigerating unit 1.

In addition to the drive shaft 8 and the eccentrically disposed crank pin 10, the means for reciprocating the piston 13 in the cylinder 12 includes a cylindrical yoke 29 connected or secured, as by welding, to the bottom of the piston 13. Formed in the side of the yoke 29 adjacent the shoulder of the drive shaft and better seen in Fig. 2 is a horizontally elongated aperture 30. The aperture 30 permits extension into the yoke of the crank pin 10 and horizontal movement of the crank pin in the yoke. Provided for reciprocating in the yoke 29 is a cross slide 31. The cross slide 31 is formed to include a transverse bore 32 adapted for having the crank pin 10 rotatably fitted therein. In this arrangement circular travel or rotation of the crank pin 10 as effected by rotation of the drive shaft 8 results in reciprocation of the cross slide 31 in the yoke 29 and reciprocation or operation of the piston 13 in the cylinder 12.

Formed in the crank pin 10 is a passage 33. By pumping means, not shown, the passage 33 is adapted for being maintained supplied with oil drawn through a tube 34 from a reserve 35 thereof in the sump of the case 2. Communicating with the passage 33 and also adapted for being maintained supplied with oil is a passage 36. In the preferred form of my invention, the passage 36 is formed by a portion of the bore 32 and surface grooves 37 formed in the cross slide and cooperating with the inner or bearing surface of the yoke 29. The grooves 37 extend transversely from the bore 32 and terminate short of the aperture 30. This arrangement provides for lubrication of the bearing surfaces of the cross slide and yoke. Additionally, in a manner about to be described it assists in metering oil into the compressor for lubrication and noise damping purposes.

Providing communication between the interiors of the piston 13 and the yoke 29 is means in the form of an orifice 38. By this arrangement the oil supply passage 36 is moved into and out of register with the orifice 38 during reciprocation of the cross slide in the yoke for operating the piston in the cylinder. Thus oil is metered into the orifice for being conveyed into the compression chamber by gas flowing through the piston into the compression chamber. It has been my finding that by metering oil into the piston and having it conveyed into the compression chamber by gas admitted thereinto for compression, I am able to obtain satisfactory distribution of oil in the compression chamber for lubrication and oil damping of the valves 19 and 24 to minimize valve operating noise.

In Fig. 3 is illustrated a modified form of my invention which is identical to the above-described embodiment except that an alternative arrangement for metering oil into the compressor is provided. In this alternative oil metering arrangement a bore 39 extends from the oil passage 33 in the crank pin 10 to the bearing surface of the crank pin. Additionally, a similar bore 40 extends radially from the transverse bore 32 in the cross slide 31 to the bearing surface of the cross slide. In this arrangement the bores 39 and 40 and the orifice 38 are aligned or registered for metering oil into the orifice for conduction into the compressor once each cycle or revolution of the drive shaft, and specifically at bottom dead center of the piston. It will be seen that, if desired, metering could take place twice or at both top and bottom dead center simply by extending the bore 39 completely through the crank pin 10.

It has been my further finding that by injecting or spraying the oil metered into the orifice into the piston it is introduced into the piston in a state which facilitates its satisfactory conveyance into the compression chamber by gas flowing through the piston and its more equal distribution on the walls of the chamber and the valves resulting in more satisfactory lubrication and greater noise reduction. To accomplish this spraying of the metered oil into the piston, I provide means for providing communication between the piston and the case through the orifice during that time in the operation of the compressor when the pressure in the piston is less than the pressure of gas in the case. This, it will be seen, results in admission of gas into the piston directly from the case and through the oil-filled orifice whereby the oil in the orifice is injected or sprayed into the piston in the manner indicated by 41 in Fig. 2.

In the preferred form of my invention, the communication between the piston and the case through the orifice is provided by a passage formed by the cooperation of the cross slide and a groove 42 formed in the inner periphery of the yoke and extending from the orifice 38 to the edge of the elongated aperture 30 in the yoke. As pointed out above, the groove 37 is so disposed in the cross slide 31 as to move into register with the orifice 38 for metering oil into the orifice at both the top and bottom dead centers of the piston stroke. And in the modified form of Fig. 3 oil is metered into the orifice at bottom dead center. At approximately 90° of rotation of the drive shaft, regardless of which of the described metering arrangements is employed, the pressure in the piston 13 is reduced sufficiently for resulting in a flow of gas from the case into the piston through the passage 42 and the orifice 38 for injecting or spraying the oil metered into the orifice into the piston. In its sprayed state as indicated by 41 the oil is more easily conveyed into the compression chamber by gas passing through the piston. Additionally, in this state the oil is more equally distributable on the walls of the compression chamber 23 and the valves 19 and 24, resulting in more satisfactory lubrication and noise reduction.

In Figs. 4–6 is illustrated another modified form of my invention. This modification is identical to the preferred form to the extent that it includes the passage 36 formed by the groove 37 which is adapted for being maintained supplied with oil and moving into and out of register with the orifice 38 for metering oil thereinto. This modification differs from the first described form in that the injecting or spraying of the oil metered into the piston is accomplished by forming a flat 43 on the cross slide at one end thereof. In this arrangement, the oil is metered into the orifice at both top and bottom dead centers of the piston stroke also. Additionally, and as perhaps best seen in Figs. 5 and 6 at approximately 90° past top dead center the flat 43 moves into register with the orifice 38. Thus communication is provided between the case 2 and the interior of the piston 13 through the orifice 38. At this point in the operation of the piston in the cylinder the pressure in the piston is less than that in the case resulting in a flow of gas from the case into the piston through the passage afforded by the flat 43 and the orifice 38 for effecting injection or spraying of the oil previously metered into the orifice into the piston in the manner indicated by 41. In this sprayed or injected state the conveyance of the oil into the compression chamber 23 is facilitated in the manner and for the purpose brought out above. It will be seen that while I have employed in the modification of Figs. 4–6 the means employed in the embodiment of Figs.

1 and 2 for metering oil into the orifice 38 the metering arrangement of Fig. 3 is alternatively employable.

In Fig. 7 is illustrated still another modification of my invention. It, like the modification just described, is similar to the first described embodiment in all respects with the exception of the means for spraying the oil into the piston 13. In this arrangement the cross slide 31 is formed to include a bore 44 extending from an end of the cross slide to the periphery or bearing surface thereof. The extremity of the bore at the bearing surface of the cross slide is adapted for moving into and out of register with the orifice 38. At approximately 90° past top dead center and at which point in the operation of the piston the pressure therein is less than the pressure in the case 2, the bore 44 moves into register with the orifice 38. When the orifice 38 and bore 44 are in register in this manner, communication is provided between the interior of the piston and the case through the orifice and gas is admitted thereby into the case for injecting or spraying into the piston oil previously metered into the orifice 38 by movement of the oil passage 36 into and out of register with the orifice 38. Again it will be seen that the oil metering arrangement of Fig. 3 is alternatively employable for depositing metered quantities of oil into the orifice 38 for being sprayed into the piston.

It will be seen that the flat 43 in the modification of Figs. 4–6 and the bore 44 in the modification of Fig. 7 are each replaceable by a groove (not shown) which can be formed in the cross slide 31 for admitting gas into the orifice for spraying oil therein into the piston 13. The groove can be similar to the upper one of the grooves 37 and can extend beyond the edge of the aperture 30 and be so located on the cross slide as to move into register with the orifice 38 at approximately 90° past top dead center for thereby providing communication between the case and piston to spray the metered oil into the piston.

While I have shown and described a specific embodiment of my invention, I do not desire my invention to be limited to the particular form shown and described and I intend by the appended claims to cover all such modifications within the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a refrigerating unit, a gas containing case, a compressor disposed in said case for operating therein, said compressor comprising a cylinder, a hollow piston for cooperating with said cylinder to provide a compression chamber, means for operating said piston in said cylinder in a reciprocating motion to provide compression of said gas on the forward stroke of said piston and suction on the return stroke of said piston, means for admitting gas to be compressed into said piston during said suction stroke of said piston, means for admitting said gas into said compression chamber from said piston during said suction stroke of said piston, an orifice in said piston, means in said operating means for metering oil into said orifice, and means in said operating means providing communcation between said piston and said case through said orifice in said piston whereby during the suction stroke of said piston when the pressure therein is less than the pressure of said gas in said case said oil in said orifice is sprayed into said piston.

2. In a refrigerating unit, a gas containing case, a Scotch yoke compressor disposed in said case for operating therein, said compressor comprising a cylinder, a hollow piston for cooperating with said cylinder to provide a compression chamber, means for operating said piston in said cylinder in a reciprocating motion to provide compression of said gas on the forward stroke of said piston and suction on the return stroke of said piston, means for admitting gas to be compressed into said piston during said suction stroke of said piston, means for admitting said gas into said compression chamber from said piston during said suction stroke of said piston, said means for operating said piston including a yoke connected to said piston, a cross slide reciprocating in said yoke, a drive shaft having a crank pin journalled in said cross slide for rotational movement therein to cause reciprocation of said yoke and said piston, an orifice in said piston providing communication between the interiors of said piston and said yoke, a passage formed in said cross slide, means supplying oil to said passage, said passage moving into and out of register with said orifice during reciprocation of said cross slide in said yoke whereby oil is metered into said orifice, and means providing communication between said piston and said case through said orifice in said piston whereby during the suction stroke of said piston when the pressure therein is less than the pressure of said gas in said case said oil in said orifice is sprayed into said piston.

3. In a refrigerating unit, a gas containing case, a Scotch yoke compressor disposed in said case for operating therein, said compressor comprising a cylinder, a hollow piston for cooperating with said cylinder to provide a compression chamber, means for operating said piston in said cylinder in a reciprocating motion to provide compression of said gas on the forward stroke of said piston and suction on the return stroke of said piston, means for admitting gas to be compressed into said piston during the suction stroke of said piston, means for admitting said gas into said compression chamber from said piston during the suction stroke of said piston, said means for operating said piston including a cylindrical yoke connected to said piston, a cylindrical cross slide reciprocating in said yoke, a drive shaft having a crank pin journalled in said cross slide for rotation therein to cause reciprocation of said yoke and said piston, an orifice in said piston providing communication between the interiors of said piston and said yoke, a passage formed in said cross slide, means supplying oil to said passage, said passage moving into and out of register with said orifice during reciprocation of said cross slide in said yoke whereby oil is metered into said orifice, and a flat formed on said cross slide, said flat moving into register with said orifice and providing communication between said piston and said case through said orifice in said piston whereby during operation of said piston on said suction stroke when pressure therein is less than the pressure of said gas in said case said oil in said orifice is sprayed into said piston.

4. In a refrigerating unit, a gas containing case, a Scotch yoke compressor disposed in said case for operating therein, said compressor comprising a cylinder, a hollow piston for cooperating with said cylinder to provide a compression chamber, means for operating said piston in said cylinder in a reciprocating motion to provide compression of said gas on the forward stroke of said piston and suction on the return stroke of said piston, means for admitting gas to be compressed into said piston during the suction stroke of said piston, means for admitting said gas into said compression chamber from said piston during the suction stroke of said piston, said means for operating said piston including a yoke connected to said piston a cross slide reciprocating in said yoke, a drive shaft having a crank pin journalled in said cross slide for rotation therein to cause reciprocation of said yoke and said piston, an orifice providing communication between the interiors of said piston and said yoke, a groove formed on the surface of said cross slide, means supplying oil to said groove, said groove moving into and out of register with said orifice during reciprocation of said cross slide in said yoke whereby oil is metered into said orifice, and a passage formed on said cross slide, said passage communicating at one end thereof with said gas within said case, said passage moving into register with said orifice and providing com-

munication between said piston and said case through said orifice when during the suction stroke of said piston the pressure therein is less than the pressure of said gas in said case whereby said oil in said orifice is sprayed into said piston.

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