March 2, 1943. R. M. SMITH 2,312,596

REFRIGERATING APPARATUS

Filed Feb. 27, 1940 2 Sheets-Sheet 1

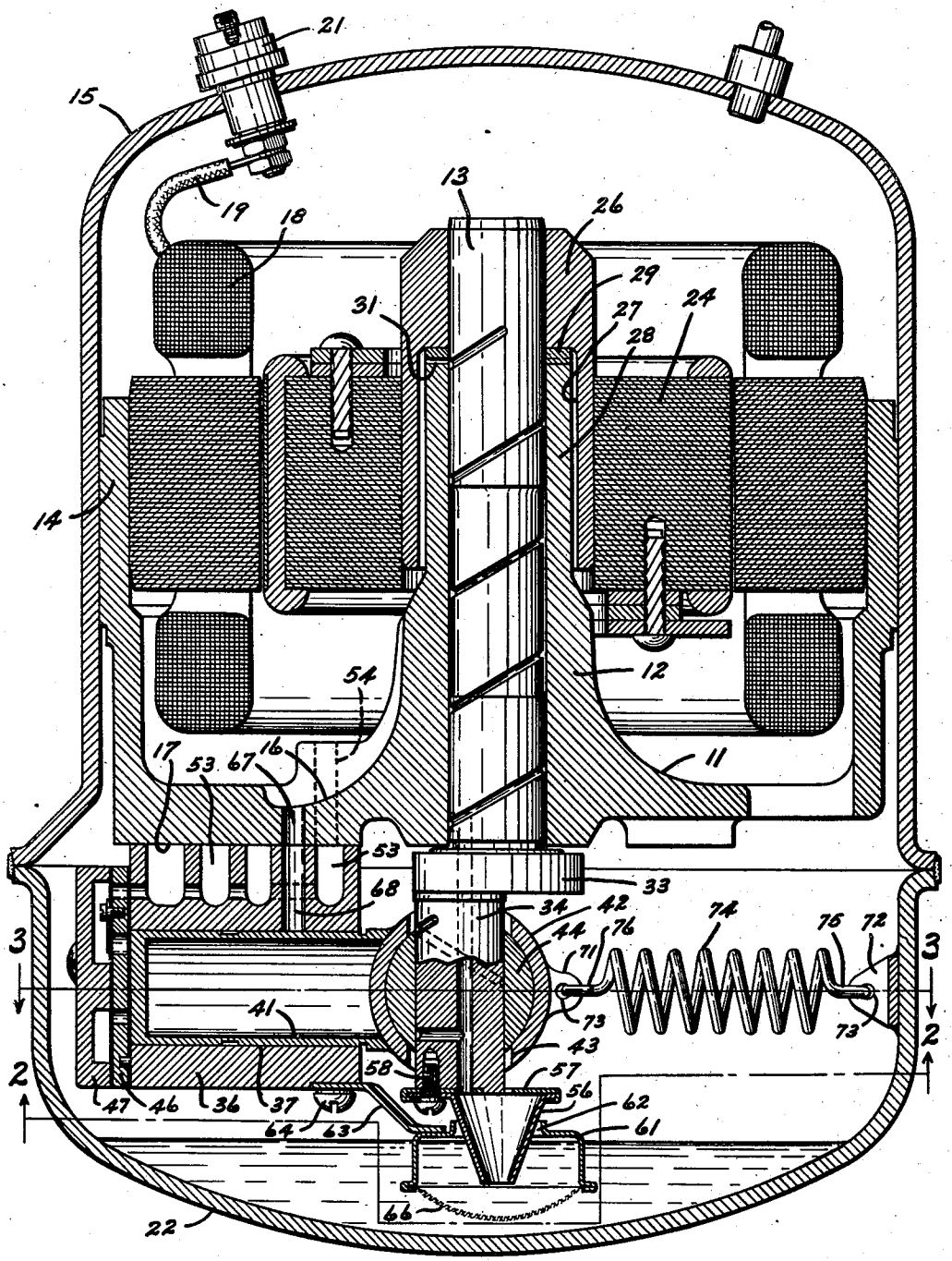

Fig. 1

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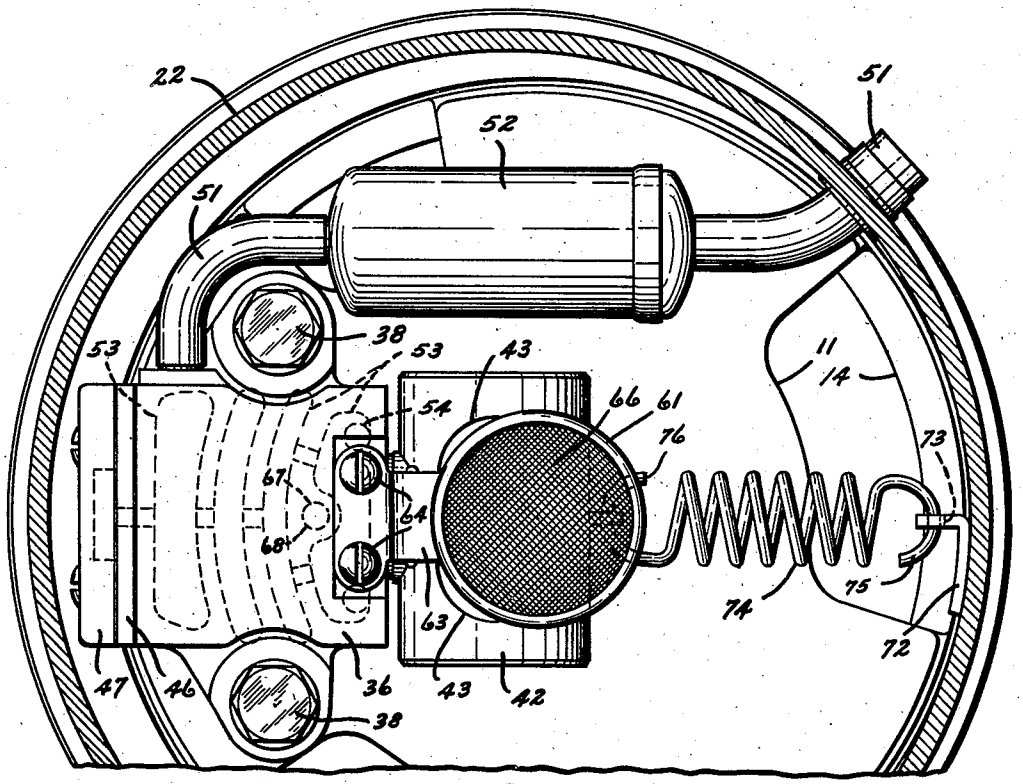

Fig. 2

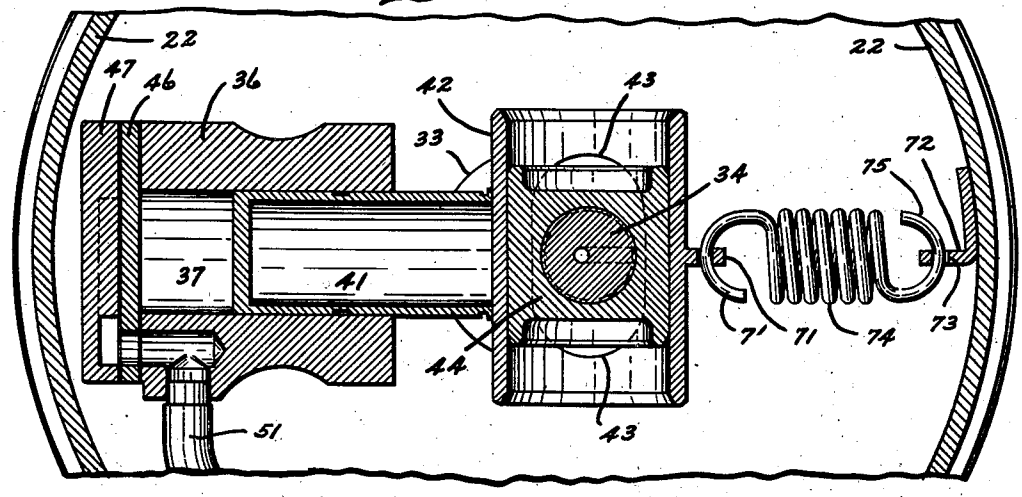

Fig. 3

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UNITED STATES PATENT OFFICE

2,312,596

REFRIGERATING APPARATUS

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Application February 27, 1940, Serial No. 321,078

6 Claims. (Cl. 230—58)

This invention relates to refrigerating apparatus and particularly to a motor-compressor unit for refrigerating systems.

In motor-compressor units for refrigerating systems and particularly compressors of the single-cylinder reciprocating type, enclosed within a sealed casing the interior of which is exposed to or forms a part of the high pressure portion of a refrigerating system, an extremely high load is placed on the eccentric member during the suction stroke of the compressor piston. This high or peak load condition is created by movement of the compressor piston outwardly of its cylinder into the area occupied by high pressure refrigerant within the sealed casing. Due to the unbalanced pressure condition between the interior of the sealed casing and the cylinder and the projected area of the piston head upon which the pressure within the casing can work, a temporary increase in wattage of the motor occurs during its rotation to actuate the compressor piston through its suction stroke. Thus, my invention is directed generally to balancing the load condition of a compressor on its operating motor to thereby render a motor of a sealed motor-compressor unit more efficient.

An object of my invention is to provide an improved sealed motor-compressor unit for use in refrigerating systems.

Another object of my invention is to provide a sealed motor-compressor unit of the type wherein a piston reciprocates within a cylinder located within a sealed casing which casing is under compressor discharge pressure or forms a part of the high pressure side of a refrigerating system with means for balancing the load thereof placed upon the motor.

In carrying out the foregoing objects it is a further object of my invention to provide a sealed motor-compressor unit of the type wherein a motor is directly connected with the compressor by an eccentric and Scotch yoke forming elements for reciprocating a piston in a cylinder with means which aids the motor in moving the piston outwardly relative to the cylinder into the area within the sealed casing occupied by high pressure refrigerant.

More specifically, it is an object of my invention to provide a spring having one of its ends connected to the casing of a sealed motor-compressor unit and its other end connected to a member of a Scotch yoke connection between an eccentric formed on the motor shaft and a reciprocating piston which spring exerts a force tending to aid movement of the piston in a direction outwardly of its cylinder and into the confines of a sealed high pressure chamber.

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 transverse vertical sectional view of a sealed motor-compressor unit having my invention embodied therein;

Fig. 2 is a horizontal section of the unit shown in Fig. 1 and is taken on the line 2—2 thereof; and

Fig. 3 is a horizontal sectional view taken on the line 3—3 of Fig. 1 illustrating the connection of the motor with the compressor of the unit and showing the compressor piston at the end of its suction stroke.

Referring to the drawings, for illustrating my invention, I have shown in Fig. 1 thereof a sealed motor-compressor unit adapted to form a part of a closed refrigerating system (not shown) and the interior of which unit is subjected to compressor discharge pressure or forms a part of the high pressure side of the system. The unit includes a cast metal spider-like main frame 11 provided with a central vertical bore, the wall of which forms a bearing 12 for a shaft 13 disposed therein. Frame 11 is also provided with an upstanding wall 14 concentric with the shaft bore (see Fig. 2) and which wall is adapted to be secured in any suitable or conventional manner to a dome 15. The top surface of the perforated horizontal bottom portion of frame 11 is undercut as at 16 to provide a trough-like depression therein for a purpose to be hereinafter described. A portion of the bottom of frame 11 is provided with a flat plane surface 17 disposed perpendicularly to the shaft bore. The upright wall 14 of frame 11 receives and supports a motor stator generally represented by the reference character 18 and having windings connected by a lead or leads 19 to a terminal or terminals 21 sealed to the wall of dome 15. A lower casing 22 is welded or otherwise suitably sealed to dome 15. Terminals 21 provide connections exteriorly of the unit for the sealed motor stator windings with a suitable source of electric current. A motor rotor, generally represented by the reference character 24 and located within the motor stator 18, is rigidly secured to a metal member 26 such as by being tightly pressed thereon. Metal member 26 has a central bore which receives the upper end of shaft 13 and is

preferably rigidly secured to the shaft by being tightly pressed thereon. Rotation of motor rotor 24, therefore, rotates member 26 and shaft 13 due to the rigid connection of member 26 with rotor 24 and with shaft 13. Metal member 26 is hollowed out as at 27 to loosely fit over and surround the upper wall portion 28 of the shaft bearing 12. A thrust washer 29 is disposed between the top end of bearing portion 28 and the inner horizontal surface of the hollowed out part 27 of member 26. Washer 29 is provided with a groove or a plurality of grooves 31 in its face which engages the top of bearing portion 28 for a purpose to be hereinafter described. Shaft 13 has an integral enlarged lower portion 33 provided with an integral round shaft extension 34 which has its vertical axis offset horizontally relative to the vertical axis of shaft 13 so as to serve as an eccentric portion which rotates around the vertical axis of the shaft bore.

The eccentric portion or shaft extension 34 is adapted to operate parts of a compressor located below the motor of the unit. The compressor portion of the unit is contained within the lower casing 22 and includes a housing 36 having a horizontally disposed cylinder 37 formed therein. Housing 36 is provided with a flat or plane top surface that registers with and is secured in sealing engagement to the plane bottom surface 17 of the main or spider-like frame 11 by bolts or the like 38 (see Fig. 2). A piston 41 located within cylinder 37 of housing 36 is welded or otherwise suitably secured to a horizontally disposed collar-like element 42 provided with aligned elongated openings 43 for receiving the eccentric or shaft extension 34. A horizontally disposed slider 44 fits within collar 42 and is provided with a round vertical opening which receives the eccentric shaft extension 34. The outer wall of slider 44 is cylindrical in cross-sectional contour and forms a bearing for the inner cylindrical surface of collar 42. The construction and arrangement of the elements of the connection between the eccentric or shaft extension 34 and the piston 41 form a Scotch yoke connection. The elements of the Scotch yoke connection are held in place relative to the eccentric or shaft extension 34 by virtue of the piston 41 fitting within cylinder 37 of housing 36. The head of the compressor comprises a plate 46 having suitable or conventional inlet and outlet valves carried thereby and a head plate 47 secured to the housing 36 over valve plate 46 by bolts or the like. A conduit 51 having its one end sealed to the wall of casing 22 and its other end sealed to housing 36 has a muffler device 52 interposed between its ends and is utilized for drawing gaseous refrigerant into the compressor cylinder 37. Refrigerant compressed by the piston 41 in cylinder 37 is discharged through the suitable check valve in or on valve plate 46 into the head plate 47 where it is caused to flow through a series of elongated communicating passages 53 provided in the housing 36. The compressed refrigerant is directed from the innermost passage 53 through a porthole 54 registering therewith and extending through the bottom wall portion of frame 11 and is discharged into the sealed casing at a point above the bottom of the frame. Passages 53 serve to muffle the discharge of compressed refrigerant from cylinder 37 and the compressed refrigerant contained in the sealed enclosure may be directed to a point exteriorly thereof, to permit cooling and liquefying of same, by a connection extending through dome 15 near the top thereof.

A hollow inverted cone-shaped element 56 having a cover 57 is secured to the bottom of eccentric or shaft extension 34 of shaft 13 by a screw 58. It will be noted that the cone-shaped element 56 has its vertical axis disposed in alignment with the axis of the central bore in frame 11 or with the axis of shaft 13. Since the interior of the unit forms a part of the high pressure portion of a refrigerating system a body of lubricant will, as is conventional, be contained in the bottom of the sealed enclosure. The lower portion of inverted cone-shaped element 56 is adapted to project into the body of lubricant and this cone-shaped element is therefore utilized for circulating the lubricant to operate parts of the unit as is fully disclosed and described in my copending application Serial No. 297,148 filed September 29, 1939. A box 61, having an opening 62 in its top wall for receiving a portion of the element 56, is mounted below the element 56 in the body of oil in the sealed unit and is secured to housing 36 by a bracket 63 and a screw 64. The bottom of box 61 is in the form of a screen 66 which serves to strain foreign matter out of the oil to be picked up by element 56 for circulation to operating parts of the unit. Oil circulated upwardly through suitable openings in and grooves around shaft 13 by element 56 is circulated outwardly from the top of bearing 12 through the groove or grooves 31 in washer 29 and thereafter flows downwardly around bearing 12. Some of this oil finds its way into the trough or depression 16 in the top surface of the bottom of frame 11. A hole 67 provided in frame 11 and extending from the trough 16 communicates with a hole 68 provided in housing 36. The registering holes 67 and 68 lead to the cylinder 37 and these holes direct oil from the trough 16 onto the piston 41 and thereby lubricates the wall of cylinder 37 during reciprocation of the piston therein.

In order to carry out the objects of the present invention I provide an integral projection or ear 71 on the side of collar-like element 42 opposite the side thereof to which piston 41 is secured. A similar projection or ear 72 is formed on a metal piece which is welded or otherwise suitably secured to the inner vertical side wall surface of the lower casing 22. The projections or ears 71 and 72 are each apertured as at 73. A coil spring 74 has its one end 75 received in the aperture 73 of ear 72 and has its other end 76 received in the aperture of ear 71. This spring 74 exerts a pulling force upon the collar 42 and consequently upon the piston 41 secured thereto. In the operation of the compressor portion of the unit by the motor thereof the eccentric or extension 34 of shaft 13 revolves in a circle around the vertical axis of shaft 13. This rotation of eccentric 34 causes reciprocation of slider 44 within collar-like element 42 during movement of element 42 in a direction to and from housing 36 to reciprocate the piston 41 within the cylinder 37. As before stated, reciprocation of piston 41 and particularly movement thereof in a direction outwardly of cylinder 37 causes evaporated or gaseous refrigerant from an evaporator of a refrigerating system to be conveyed through pipe 51 and muffler 52 through a suitable or conventional suction inlet valve into the cylinder 37. Movement of piston 41 in a direction into the cylinder 37 compresses the refrigerant previously drawn into the cylinder and forces the compressed refrigerant through plate 46 and past a suitable or

conventional outlet valve associated with the plate into the passage provided therefor in head 47. The passage in head 47 communicates with the series of passages or passageways 53 and hole 54 to direct the compressed refrigerant into the sealed enclosure formed by the dome 15 and lower casing 22. The reduced pressure within cylinder 37, created by movement of piston 41 in a direction outwardly thereof, together with the high pressure existing in the sealed unit and acting on the relatively large area of the piston usually offers a great amount of resistance to movement of the piston 41 outwardly of cylinder 37. It has been found that this resistance is of such intensity as to ordinarily create the maximum load condition on the motor, and this load condition is greater during the suction stroke than during the compression stroke of piston 41. Although this high load condition occurs during only a short period of a complete revolution o the motor rotor, it is, nevertheless, detrimental to efficient operation of the motor in that the wattage of the electric current required for the motor at this period is increased. The short period of high load condition creates an unbalanced condition of operation of the unit and, furthermore, places an abnormal load in one direction on the bearings or operating parts of the Scotch yoke connection between the motor shaft and the piston. These defects in a unit of the type disclosed are eliminated by the incorporation in the unit of my improvement which consists of the spring 74. Spring 74 is stretched when the piston moves into cylinder 37 and therefore exerts a pulling force on collar-like member 42 and piston 41 when the piston moves in a direction outwardly of cylinder 37 and into the confines of the high pressure within the sealed chamber. This pulling force of spring 74 overcomes the pressure of the high pressure refrigerant in the unit acting upon the piston 41 and thereby minimizes or destroys the resistance to movement of the piston 41 into the confines of the high pressure chamber during its suction or intake stroke. The spring 74 balances the load on the bearings of the Scotch yoke connection and eliminates the short period high or peak load condition described to thereby reduce the high wattage required by the motor of the unit.

It will be seen from the foregoing that I have provided an improved sealed motor-compressor unit and that I have eliminated certain defects existing in sealed units of the type wherein the sealed enclosure is subjected to or forms a part of the high pressure side of a closed cycle refrigerating system. My improvement tends to balance the operation of moving parts of the unit to thereby reduce wear on bearings thereof, minimizes vibration of the unit and reduces the total wattage required by the motor to operate the compressor. The present improvement is simple in nature and is of infinitesimal expense to thus permit its incorporation in a sealed unit without complicating the structure and without materially increasing the cost thereof.

While the form of embodiment of the invention as herein disclosed, constitutes a preferre 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. A sealed unit comprising, a casing having a motor and a compressor directly connected to said motor mounted therein, said casing being under compressor discharge pressure, said motor including a shaft having an eccentric portion, said compressor including a cylinder and a piston disposed therein, means connecting said piston to said eccentric portion of said shaft for reciprocating the piston within said cylinder when said motor is operated, and means having a part attached to said connecting means and another part thereof attached to said casing for applying force to said piston at least in the direction of movement of the piston outwardly relative to its cylinder.

2. A sealed unit comprising, a casing having a motor and a compressor directly connected to said motor mounted therein, said casing being under compressor discharge pressure, said motor including a shaft having an eccentric portion, said compressor including a cylinder and a piston disposed therein, means connecting said piston to said eccentric portion of said shaft for reciprocating the piston within said cylinder when said motor is operated, and a coil spring having one of its ends attached to said connecting means and having its other end attached to said casing for applying force to said piston at least in the direction of movement of the piston outwardly relative to its cylinder.

3. A sealed motor-compressor unit including a casing, said casing being under compressor discharge pressure, a main frame within said casing and supported therefrom, said main frame having a vertical bore forming an elongated bearing, a shaft within said bore, a motor stator supported upon said main frame in the upper part of said sealed casing, a motor rotor secured to the upper end of said shaft for rotating same, said shaft having an eccentric portion below said main frame, a compressor secured to and depending from said main frame, said compressor including a cylinder extending perpendicularly to said motor shaft and in horizontal alignment with said eccentric portion thereof, a piston disposed within said cylinder, means connecting said piston to said shaft eccentric portion for reciprocating the piston within said cylinder when the motor is operated, and means applying force to said piston at least in the direction of movement thereof outwardly relative to its cylinder.

4. A sealed motor-compressor unit including a casing, said casing being under compressor discharge pressure, a main frame within said casing and supported therefrom, said main frame having a vertical bore forming an elongated bearing, a shaft within said bore, a motor stator supported upon said main frame in the upper part of said sealed casing, a motor rotor secured to the upper end of said shaft for rotating same, said shaft having an eccentric portion below said main frame, a compressor secured to and depending from said main frame, said compressor including a cylinder extending perpendicularly to said motor shaft and in horizontal alignment with said eccentric portion thereof, a piston disposed within said cylinder, means connecting said piston to said shaft eccentric portion for reciprocating the piston within said cylinder when the motor is operated, and means having a part attached to said connecting means and another part thereof attached to said casing for applying force to said piston at least in the direction of movement thereof outwardly relative to its cylinder.

5. A sealed motor-compressor unit including a casing, said casing being under compressor discharge pressure, a main frame within said

casing and supported therefrom, said main frame having a vertical bore forming an elongated bearing, a shaft within said bore, a motor stator supported upon said main frame in the upper part of said sealed casing, a motor rotor secured to the upper end of said shaft for rotating same, said shaft having an eccentric portion below said main frame, a compressor secured to and depending from said main frame, said compressor including a cylinder extending perpendicularly to said motor shaft and in horizontal alignment with said eccentric portion thereof, a piston disposed within said cylinder, means connecting said piston to said shaft eccentric portion for reciprocating the piston within said cylinder when the motor is operated, and a coil spring having one of its ends attached to said connecting means and having its other end attached to said casing for applying force to said piston at least in the direction of movement thereof outwardly relative to its cylinder.

6. A sealed unit comprising, a casing having a motor and a compressor directly connected to said motor mounted therein, said casing being under compressor discharge pressure, said motor including a shaft having an eccentric portion, said compressor including a cylinder and a piston disposed therein, means connecting said piston to said eccentric portion of said shaft for reciprocating the piston within said cylinder when said motor is operated, a coil spring disposed within said casing with its one end attached to said connecting means and its other end attached to said casing, and said spring applying force to said piston at least in the direction of movement thereof outwardly of its cylinder into said casing for overcoming high pressure within the casing acting on the projected area of the piston head.

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