Sept. 16, 1924. 1,508,805

A. D. SHAW ET AL

COMPRESSOR

Filed April 14, 1922 2 Sheets-Sheet 1

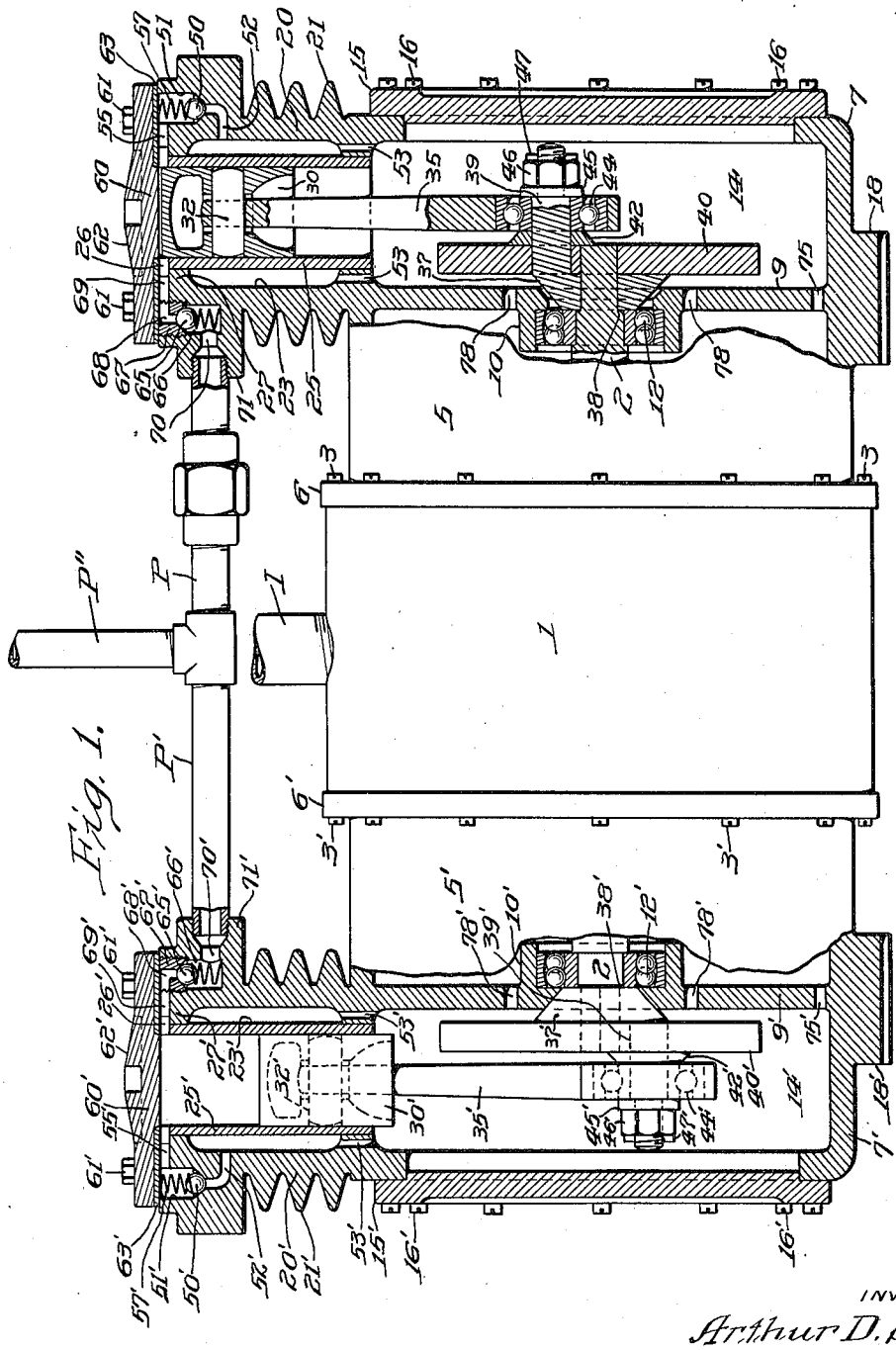


Fig. 1.

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Fig. 2.

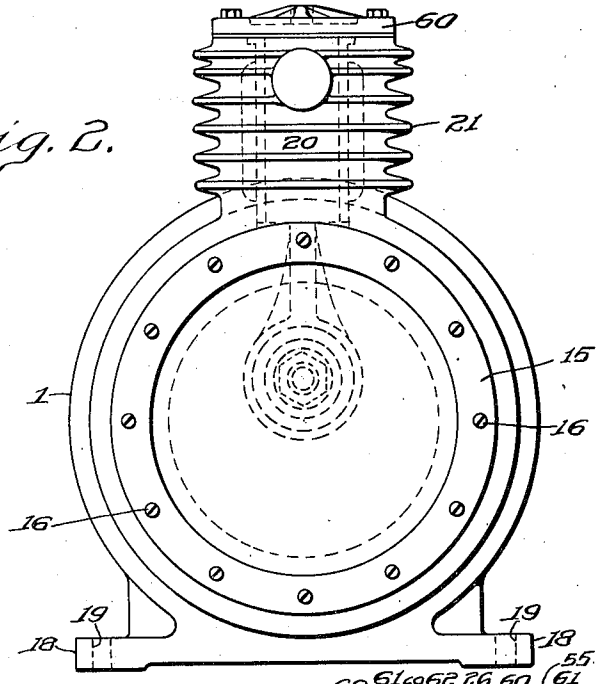
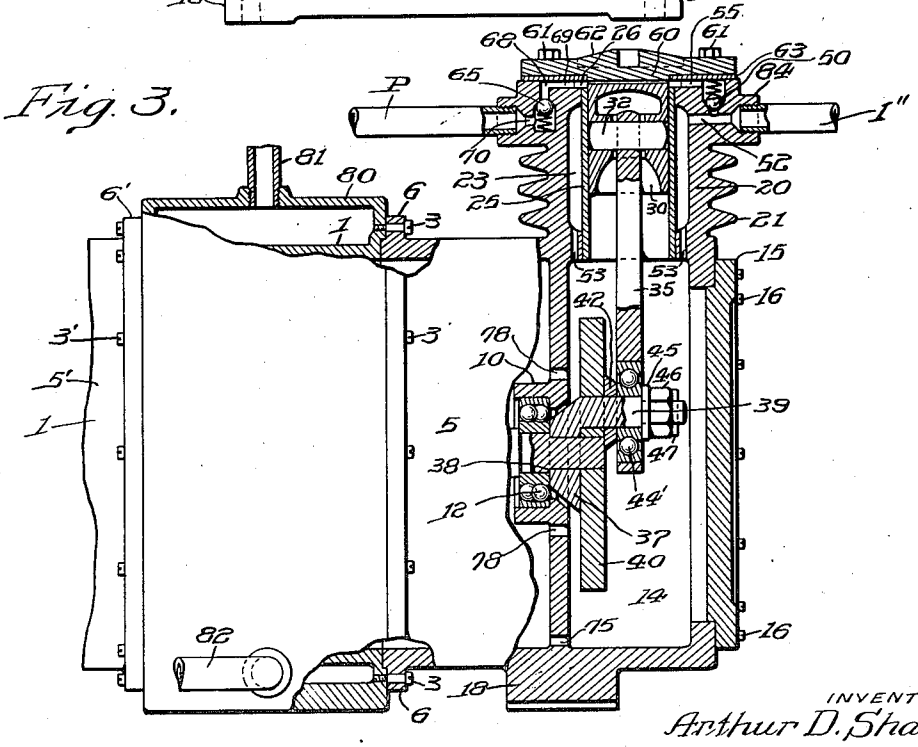


Fig. 3.



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Patented Sept. 16, 1924. 1,508,805

UNITED STATES PATENT OFFICE.

ARTHUR D. SHAW AND JOSEPH R. THOMAS, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNORS, BY MESNE ASSIGNMENTS, TO WIDMER COMPRESSOR, INC., OF PHILADELPHIA, PENNSYLVANIA, A CORPORATION OF DELAWARE.

COMPRESSOR.

Application filed April 14, 1922. Serial No. 552,511.

To all whom it may concern:

Be it known that we, ARTHUR D. SHAW and JOSEPH R. THOMAS, citizens of the United States, and residents of the city and county of Philadelphia, State of Pennsylvania, have invented certain new and useful Improvements in Compressors, of which the following is a specification, reference being had to the accompanying drawings.

Our invention relates more particularly to electrically driven compressors adapted for effecting compression of the refrigerant in refrigerating units intended for household and other similar uses as distinguished from large refrigerating installations employed in commercial refrigeration or in the manufacture of artificial ice, a principal object of the invention being to provide an entirely self-contained compressor which is capable of being driven at high speeds and in which the moving parts are suitably disposed and balanced in such manner as to avoid excessive vibration when so driven.

A further object of our invention is to provide a compressor adapted for the aforesaid purposes which is entirely devoid of stuffing boxes, glands, or other devices for preventing leakage of the refrigerant gas from the interior of the compressor adjacent shafts or other moving parts extending through the casing or other portion of the machine, as it has been found in practice that compressors embodying such devices require constant care, expense and attention in an effort to make them perform their intended function of preventing leakage of the refrigerant; a condition which is extremely undesirable in the class of refrigerating installations in which these small compressors are employed. As all of the moving parts are entirely self-contained within the casing of our improved compressor, however, no devices for preventing refrigerant leakage adjacent any moving part are necessary and none are employed.

A still further object of the invention is to provide a compressor in which all of the rotating parts are supported on ball bearings and of such design and construction that adequate and thorough lubrication of all the moving parts is constantly effected during operation, a condition which is extremely important in prolonging the life of the machine.

A still further object of the invention is to utilize in the construction of the compressor a suitable electric motor of standard design as a source of motive power and to arrange substantially similar compressing mechanism at opposite ends of the field ring thereof in place of the ordinary bells customarily utilized at the ends of the field ring, and to provide means for effecting adequate cooling of the motor armature and windings; in the preferred form of the invention by introducing the expanded low pressure refrigerant directly into the interior of the motor from whence it is drawn over and through the coils to the compressing mechanisms disposed laterally of the ring at each end thereof in which it is compressed and from thence discharged to the desired part of the refrigerating system, and in a modified construction by utilizing a suitable water jacketed field ring.

The foregoing, as well as other novel objects and features of construction and arrangement comprehended by our invention will appear more clearly from the following description taken in connection with the drawings forming a part hereof.

In effecting the objects of our invention we preferably utilize a suitable electric motor of direct or alternating current or induction type, such motors normally comprising a central field ring having a bell removably attached to each end thereof which serves to support the armature shaft in suitable bearings as well as the cages in which the brushes are disposed if the same are employed, the armature being, of course, positioned within the ring. When employing a motor of this general character we remove the bells from the ends of the field ring and substitute for each bell a suitable crank case which is effective to support a cylinder in which the compression is effected by a reciprocating piston and to house the mechanism through which the piston is actuated from the rotatable armature shaft, as well as to provide a support for the bearings on which the latter rotates and for the brush cages if employed.

In the accompanying drawings we have

illustrated in Figs. 1 and 2 a preferred embodiment of our invention, Fig. 1 being a view partially in central vertical section and partially in side elevation and Fig. 2 being an end elevation on a slightly reduced scale. In Fig. 3 we have illustrated a slightly modified form of the invention, the said figure being a fragmentary view partially in central vertical section and partially in side elevation of the motor and one of the compressing mechanisms. Like numerals are utilized to indicate the same parts in the different figures, and as the mechanism at both ends of the field ring is the same in all substantial respects, we have designated the parts at the left hand end of the machine, viewed as in Fig. 1, by the same numerals as those at the right hand end but with the addition of a prime (′), thereby avoiding needless repetition in the following description which will thus be understood as equally applicable to the mechanism at each end of the motor.

Referring more particularly to the form of the invention shown in Figs. 1 and 2, the same comprises a motor of any suitable construction and having a field ring 1. As the motor employed is of standard type no attempt has been made in the drawings to illustrate any of the parts thereof save the field ring and portions of the armature shaft 2, but it will of course be understood that the armature and field windings are disposed in the customary manner within the ring and that provision is made for attachment of the wires through which the current is led in. Removably secured to the ends of the field ring, as by the screws 3, are cylindrical housings 5, 5′ which may be provided with flanges 6, 6′ for the reception of the screws and which abut the end faces of the ring. These housings in effect replace the ordinary bells employed in motors of this type and are operative, among other things, to support the crank cases 7, 7′ which are preferably formed integrally with their respective housings. Each crank case is substantially cylindrical in form and divided from its adjacent housing by a partition 9 provided with a preferably integral,. inwardly directed annular cup 10, the interior of which is machined to receive an annular ball bearing, generally designated as 12 and preferably of a well known self-aligning type, this bearing serving to rotatably support one end of the armature shaft 2 which extends entirely through the bearing, through a suitable opening in the partition and into the chamber 14 formed within the crank case. Preferably the extreme outer end of the crank case is initially left open and adapted to be operatively closed by a cover 15 held in position by screws 16, so that by removing the cover convenient access may be had to the interior of the case. The case is also provided with a suitable integral base 18 having bolt holes 19 for the reception of bolts by means of which the machine may be attached to a supporting surface.

Formed integrally with the crank case and extending radially upward and outward therefrom is a cylinder block 20 preferably provided with a plurality of horizontally disposed outwardly directed radiating flanges 21. This block is preferably cored out between its upper and lower extremities thereby providing an annular chamber 23 within which is rigidly disposed a sleeve 25 having an overhanging flange 26 at its upper end which rests in a chamfer in the end of the block, the sleeve being laterally supported by inwardly directed annular flanges 27 at the extremities of the cored out space, the interior of the sleeve thus forming the compression cylinder in which a piston 30 of any suitable type and arranged to form a good sliding fit in the sleeve is disposed for reciprocation. If desired, the piston may be provided with one or more piston rings (not shown) for preventing leakage between the piston and the sleeve in the well known manner, while a wrist pin 32 is arranged to extend transversely of the piston to receive the upper end of the connecting rod 35 in the usual manner, the pin being either secured to the rod and arranged to oscillate in the piston or secured to the piston to provide a surface on which the rod may oscillate.

The opposite or lower end of the connecting rod is arranged to be driven from the armature shaft through the medium of a suitable crank pin and while the connection between these parts may be made in any suitable or convenient manner we prefer and as shown, to dispose a relatively thick washer 37, having its outer surface inwardly beveled, on the outer squared end of the armature shaft so that the inner end of the washer abuts a shoulder 38 formed on the shaft in the plane of the outer face of bearing 12. Formed integrally with this washer and projecting outwardly from its outer face is a crank pin 39, the distance between the axis of this pin and the shaft being equal to one-half of the desired stroke of the piston, and the pin being arranged to extend through an eccentrically positioned hole formed in a fly wheel 40 conveniently in the form of a solid disk supported on the extreme outer end of the armature shaft. Disposed on the crank pin in abutting relation with the outer face of the fly wheel is a washer 42 which limits the inward movement of an annular ball bearing, generally designated as 44, disposed in the lower or large end of the connecting rod 35 and against the outer face of which a flat washer 45 is drawn up by a

nut 46 positioned on the extreme outer end of the crank pin; the nut which may be castellated being preferably locked in position by a cotter pin 47, and that portion of the pin on which the nut and washer are located being reduced in diameter so as to form a shoulder in the plane of the outer bearing 44.

For effecting the admission and exhaust of the gas into and from the cylinder, suitable inlet and exhaust valves are provided and arranged to alternately open and close in correspondence with the movements of the piston. Conveniently the inlet valve may comprise a ball 50 disposed in a chamber 51 formed in the upper end of the cylinder block and cooperative with a downwardly inclined conical seat at the lower end of the chamber to control a port 52 extending into the cored space or chamber 23, which latter is connected by a plurality of ports 53 with the crank chamber 14. A transversely extending port 55 leads from the upper end of the chamber 51 to the interior of the cylinder sleeve, and a light spring 57 is preferably interposed in the chamber between the ball and the under side of the cylinder head 60 which extends over the upper end of the block to close the cylinder and is retained in position by bolts 61. Preferably the upper face of the center of the head is provided with a plurality of radiating flanges 62 and a gasket 63 is ordinarily disposed between the other end of the cylinder head block and the cylinder head to form a tight joint at this point.

The exhaust valve for the cylinder may be substantially similar to the inlet valve and preferably comprises a ball 65 disposed in a chamber 66 formed in the cylinder block diametrically opposite the chamber 51 and into the upper end of which is threaded a bushing 67 having its lower face beveled to form a seat for the ball and through which a port 68 communicates with a horizontally disposed port 69 in the upper end of the cylinder block and extending into the cylinder. From the lower end of the chamber a port 70 leads through a boss 71 formed on the block and into which is threaded one end of a pipe P which unites with a similar pipe P′ extending from the boss 71′, a single pipe P″ leading from these pipes to the high pressure side of the refrigerating system.

It will be observed that the crank pins 39, 39′ are diametrically disposed with respect to the axis of the armature shaft so that when one piston is at the end of its down or suction stroke the other piston is at the end of its up or compression stroke and as the moving parts on opposite ends of the machine are preferably made similar in all respects a very smooth running and well balanced machine results.

Under operative conditions a body of lubricating oil is preferably maintained in each crank case at a height sufficient to permit the lower parts of the fly wheels to dip thereinto to effect constant lubrication of all of the working parts by splashing the oil thereover, and we prefer to provide the partitions 9 with one or more oil ports 75 through which the oil can flow from the cases into the housings and interior of the motor to maintain a constant oil level throughout the machine. Of course if it be found that owing to the construction of the motor it is undesirable to permit the introduction of oil thereto, the ports 75 may be omitted or a pipe extending from one crank case to the other and by-passing the motor may be employed instead. Furthermore, it will be understood that in case it is requisite to utilize cages or other devices for supporting the motor brushes, the same may be readily mounted on the exterior of the cups 10 which for this purpose may be extended inwardly sufficiently far to afford the requisite support, as will be readily apparent to those familiar with the art.

In the preferred embodiment of the invention, in order to effect the cooling of the motor windings and other parts, we connect the inlet pipe I through which the gas which is to be compressed is brought to the machine directly with the interior of the field ring by drilling and tapping the latter and screwing the pipe thereinto so that the gas is free to flow into the space within the field ring in which the armature is positioned. For permitting the passage of the gas from this point to the crank cases, the partitions 9 may be provided with a plurality of suitably disposed ports 78 so that as a suction is created in either cylinder during the down stroke of the piston therein, the gas which fills the armature space, crank cases and chambers 23 surrounding the cylinder sleeves is drawn past the inlet valve and into that cylinder, in which, on the ensuing upstroke of the piston, it is compressed and forced out past the exhaust valve to the pipe P″. It will be apparent that the drawing of the gas through the ports 78 creates a substantially constant flow or current of the gas toward each end of the armature and over the windings thereof thus serving to keep the latter, as well as the field coils, in suitably cooled condition.

In the form of the invention shown in Fig. 3 the cooling of these parts is accomplished in a slightly different manner, namely, by providing the field ring with a suitable surrounding water jacket 80 into which cooling water is introduced through a pipe 81 and from which it is discharged through a pipe 82. Preferably under these conditions the jacket is constructed, as clearly shown in Fig. 3, so that a somewhat greater body or

depth of water will be maintained near the upper part of the field ring than near the lower part thereof so as to compensate for the greater heat adjacent the former point. Additionally, under these circumstances the ports 52 through which the gas passes to the inlet valves are each arranged to communicate with an inlet pipe I'' which is threaded into a boss 84 formed on the cylinder block adjacent the inlet valve and through which the gas to be compressed is conducted to the machine. Preferably, however, the port 52 is also arranged to communicate with the chamber 23 and adjacent crank case in the manner already described in order that a balanced pressure may at all times be maintained in the interior of the machine.

It will thus be observed that we have provided a compressor in which all of the moving parts are entirely enclosed and thoroughly lubricated, which is simple in construction and design and capable of being driven at high speeds without injury to the parts or excessive vibration and which is capable of use over long periods of time without any attention or adjustment whatsover.

It will also be apparent that connected as shown in the piping of a circulating system such as is commonly employed in effecting refrigeration, the compressor may broadly be considered as comprising a closed casing forming an integral part of the means through which the circulation of the refrigerant fluid is effected and operative to enclose the moving parts through the medium of which the expanded fluid is drawn from the low pressure side of the system into one part of the casing and discharged in compressed condition from another part thereof into the high pressure side. So far as we are aware, irrespective of the particular type or kind of compressing or circulating means employed, we believe it to be broadly new to utilize the casing of the compressor as an integral part of the means in which the fluid is circulated and to entirely dispose the moving parts of the compressing mechanism therein, the results effected by such an arrangement being of great utility in that the necessity of employing glands, stuffing boxes or the like, with their attendant disadvantages, in an effort to prevent fluid leakage adjacent drive shafts or other moving parts extending outside or through the walls of the means in which the circulation of the fluid carried on is entirely avoided, and we therefore claim this feature in its broadest aspect.

Moreover, while we have more especially referred to the use of the invention in the compression of refrigerant gas in small refrigerating systems, it will be understood that the same may be employed with equal facility as a pump, or for other purposes, and that while we have illustrated and described with considerable particularity certain embodiments thereof for the purpose of enabling those skilled in the art to comprehend and practice the invention, we do not thereby desire or intend to in any manner limit ourselves to any precise details of construction and arrangement of the several elements, as our invention includes such modifications in the form, construction and arrangement thereof and the utilization of such equivalent means therefor as are comprehended by and fall within the scope of the appended claims.

Having thus described our invention, we claim and desire to protect by Letters Patent of the United States:—

1. In a compressor, the combination with a motor having a field ring, of a closed crank case supported at each side of the ring, a partition provided with ports between each crank case and the ring, a cylinder supported on each crank case and having inlet and exhaust valves, a piston in each cylinder, means for actuating the piston from the motor, and an inlet connection communicating with the interior of the motor whereby the gases to be compressed in the cylinders are first directed into the motor and thence led through said ports and the respective inlet valves of the cylinders.

2. In a compressor, the combination with a motor having a field ring, of an inlet connection to the interior of the ring, a closed crank case supported at each end of the ring and communicating with the interior thereof, a cylinder supported on each crank case, a piston adapted to reciprocate in the cylinder, means for actuating the piston from the motor, and an inlet valve disposed to control communication between the interior of each crank case and the interior of each cylinder whereby on the suction stroke of each piston a charge of the gas to be compressed will be drawn from said inlet through said motor and crank case and into said cylinder.

3. A compressor comprising a centrally disposed motor having a field ring and an inlet connection thereto through which the gas to be compressed may pass to the interior of the motor, a closed crank case disposed at each end of the motor, ports connecting the interior of the motor with the interior of the crank case, compressing means adjacent each case including a cylinder and a piston actuated from the motor, a passage between each crank case and its adjacent cylinder, and an inlet valve disposed to control said passage, whereby when a suction is formed in each cylinder the gas to be compressed is drawn through said motor and the adjacent crank case into said cylinder.

4. In a compressor, the combination with a motor, of a closed crank case disposed at

each end of the motor, a partition separating the interior of each crank case from the interior of the ring, a ball bearing for the armature shaft of the motor supported from each partition, a cylinder supported on each crank case, an inlet valve controlling the admission of gas to each cylinder, and means comprising a plurality of ports for insuring a balanced pressure in said motor and said crank case and in said cylinder when said inlet valve is open.

5. In a compressor, the combination of a centrally disposed motor having an inlet through which the gas to be compressed is admitted to its interior, a closed crank case disposed at each end of the motor, a cylinder supported on each crank case, a reciprocating piston in each cylinder actuated from the motor, and means including a plurality of ports and an inlet valve adjacent each cylinder whereby on the suction stroke of the piston the gas will be drawn from said inlet through said motor, the adjacent crank case and past said inlet valve into said cylinder, and an exhaust valve controlling a part leading from each cylinder and adapted to open on the compression stroke of the piston therein.

In witness whereof, we have hereunto set our hands this 13th day of April, 1922.

ARTHUR D. SHAW.
JOSEPH R. THOMAS.