

June 29, 1926.

1,590,384

A. A. KUCHER
REFRIGERATING APPARATUS

Filed Nov. 4, 1922

5 Sheets-Sheet 1

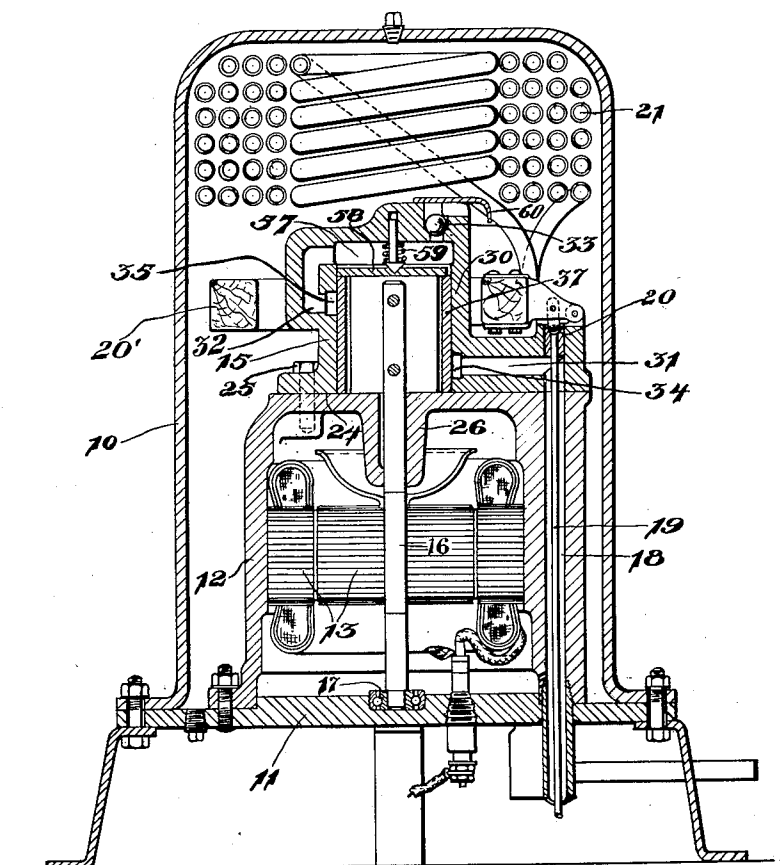


Fig. 1.

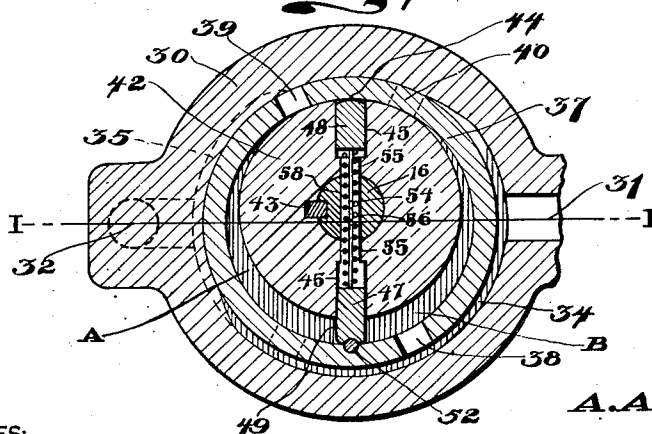


Fig. 2.

WITNESSES:

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5 Sheets-Sheet 2

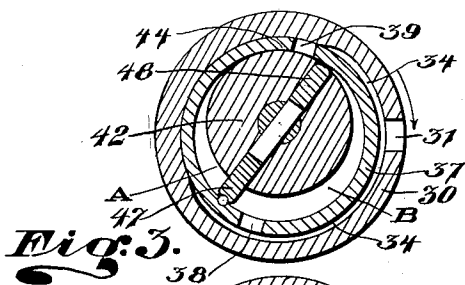


Fig. 3.

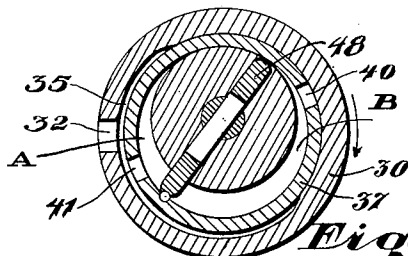


Fig. 8.

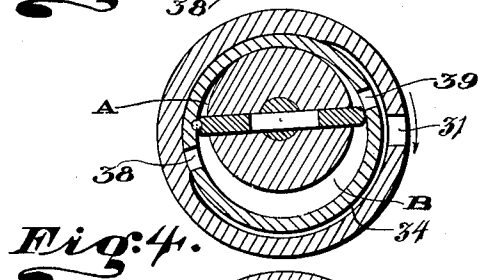


Fig. 4.

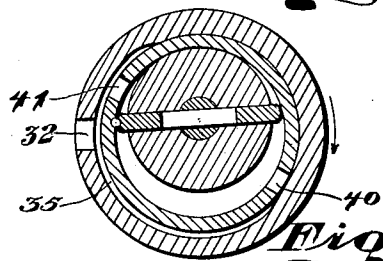


Fig. 9.

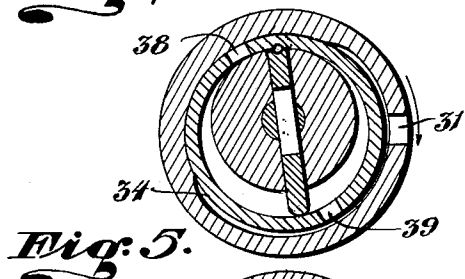


Fig. 5.

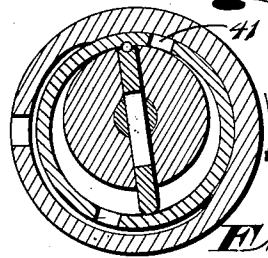


Fig. 10.

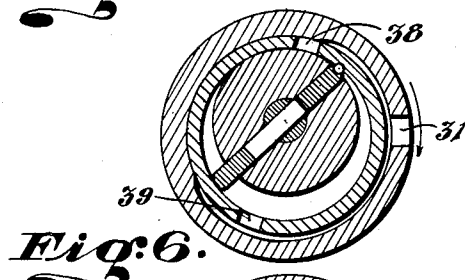


Fig. 6.

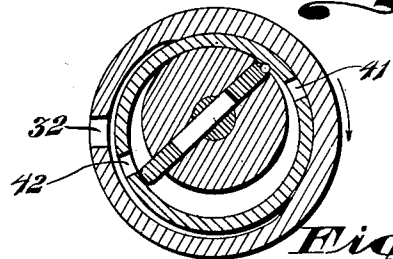


Fig. 11.

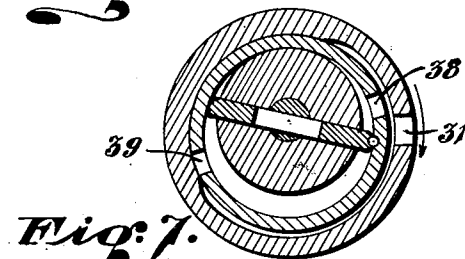


Fig. 7.

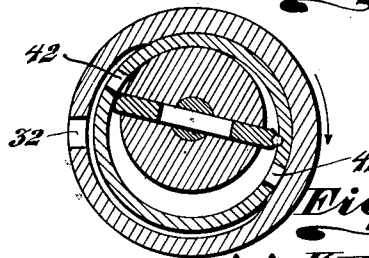


Fig. 12.

WITNESSES:
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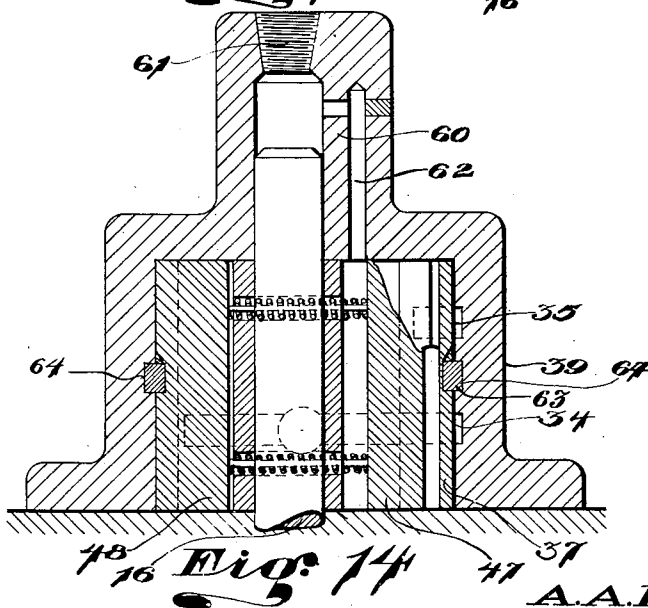
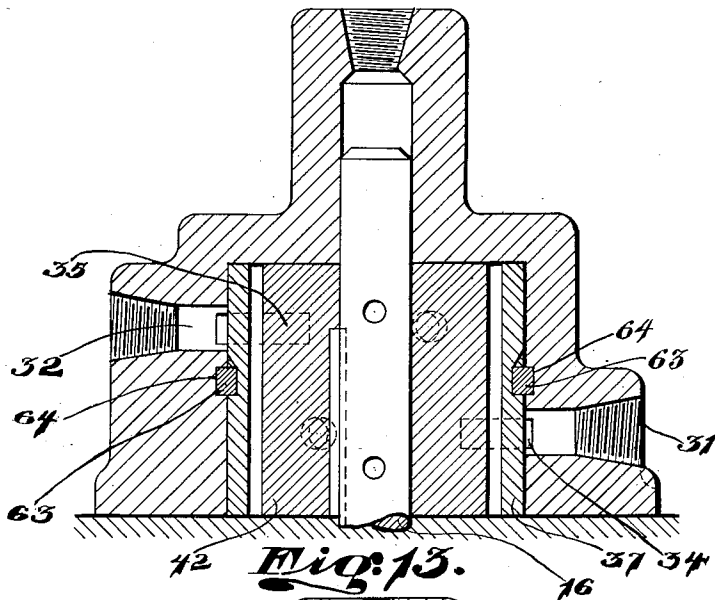
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REFRIGERATING APPARATUS

Filed Nov. 4, 1922

5 Sheets-Sheet 3



WITNESSES:

W. S. Beckley
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A. A. KUCHER
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5 Sheets-Sheet 4

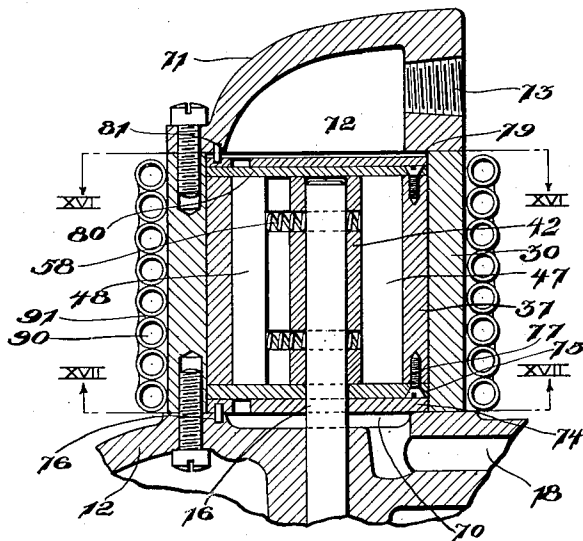


Fig. 15.

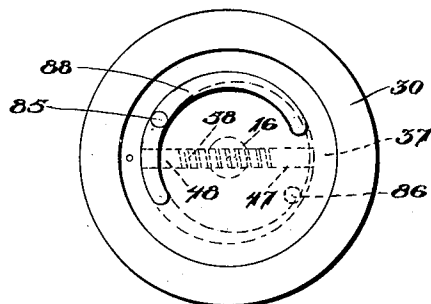


Fig. 16.

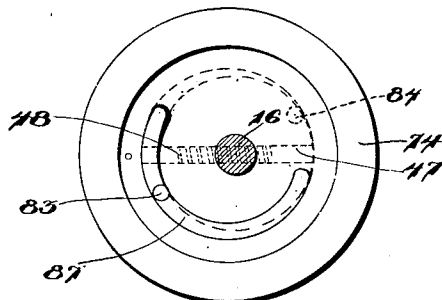


Fig. 17.

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REFRIGERATING APPARATUS

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5 Sheets-Sheet 5

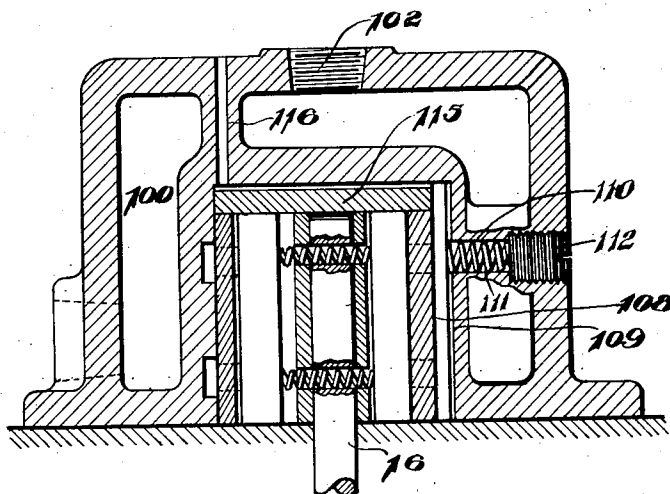


Fig. 18.

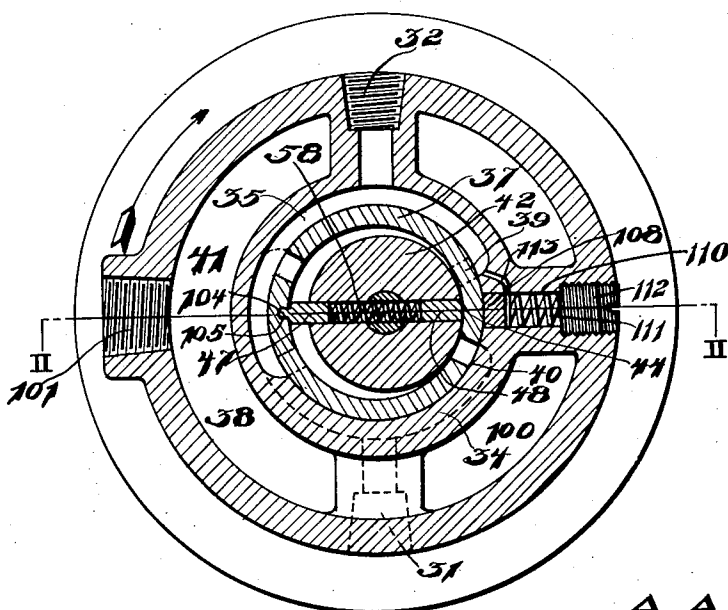


Fig. 19.

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UNITED STATES PATENT OFFICE.

ANDREW A. KUCHER, OF CHESTER, PENNSYLVANIA.

REFRIGERATING APPARATUS.

Application filed November 4, 1922. Serial No. 599,019.

This invention relates to refrigerating apparatus of the so-called compression type and more particularly to mechanism for effecting compression of the refrigerant fluid in such apparatus. It has for an object to provide a compression mechanism of the character designated which shall be compact, efficient and adapted for operation at high speeds. It has for a further object to provide for a complete sealing of the relatively moving parts of the pump against leakage of gaseous fluids being compressed and further to provide an arrangement of expansible chambers, together with ports, inlet and outlet passages therefor, which shall permit the full volumetric capacity of said chambers to be utilized in translating the refrigerant fluid.

These and other objects of my invention, which are made more manifest in the further description thereof, may be attained by the employment of apparatus illustrated in the accompanying drawing in which: Fig. 1 is a view in section of a refrigerating machine equipped with a compressor constructed in accordance with the present invention; Fig. 2 is a sectional view through the pump; Figs. 3 to 7, inclusive, are diagrammatic views showing successive operative positions of the working parts through one section of the compressor, illustrating the intake or suction operation thereof; Figs. 8 to 12, inclusive, are diagrammatic views showing successive operative positions of the working parts through another section of the compressor, illustrating the exhaust or compression operation thereof, Figs. 13 and 14 are views in longitudinal section illustrating modifications of the compressor shown in Fig. 1; Fig. 15 is a view in longitudinal section of a further modification of the compressor mechanism; Figs. 16 and 17 are views taken on lines XVI—XVI and XVII—XVII, respectively of Fig. 15, illustrating discharge and intake ports in the end plates of the compressor rotor; Fig. 18 is a view in longitudinal section showing still another modification of the compressor; and Fig. 19 is a view in transverse section of the compressor illustrated in Fig. 18.

Referring to the drawings, I show in Fig. 1 refrigerating apparatus comprising a compression chamber 10 having a base plate 11,

upon which is supported a motor casing 12 housing a motor 13, and a compression mechanism 15 mounted upon the motor casing. A shaft 16 common to the motor and compressor extends axially of the motor and compressor housings and is supported from the base plate 11 by means of a ball bearing 17. The compression chamber 10 is provided with an inlet passage 18 in the motor housing 12 and an outlet pipe 19 for the refrigerant fluid. As shown, the outlet pipe 19 is disposed within the inlet passage 18, the latter communicating with the compressor 15. The outlet pipe has at its inner end a reducing valve 20, controlled by a float 20'. Suitable condensing coils 21 are also provided within the compression chamber. The above organization involving the refrigeration apparatus is disclosed in my copending application, Serial No. 509,672, filed October 22, 1921, of which the present application is a division in part, and since the present case is limited to the specific characteristics of the compressor, a fuller description of the associated apparatus is deemed to be unnecessary in the present specification.

The top wall of the motor casing 12 is provided with a plane face 24 upon which the compressor rests and to which it is secured as by bolts 25. A downwardly projecting bearing portion 26 depends from the top of the motor casing and serves as a guide and a bearing for the shaft 16.

As illustrated in Figs. 1 and 2, the compressor 15 comprises an outer cylindrical member or casing 30, having an inlet port 31 communicating with the inlet passage 18, and an outlet port 32 longitudinally offset with respect to the inlet port 31. The inner cylindrical surface or bore of the casing 30 is provided with longitudinally offset peripheral or arcuate grooves 34 and 35, which communicate with the inlet port 31 and the outlet port 32, respectively, the length of the grooves being such as to permit the compressor to be operated at maximum capacity, as hereinafter appears.

A cylindrical sleeve member or shell 37, closely fitting the bore of the casing 30, is provided with oppositely disposed inlet ports 38 and 39 and longitudinally offset discharge ports 40 and 41 which communi-

cate at their outer ends with the grooves 34 and 35, respectively, and at their inner ends with the interior of the sleeve 37.

A drum or rotor 42 is mounted concentrically on the shaft 16, as by key 43, and with the latter is disposed in eccentric relation to the sleeve 37, the drum engaging the sleeve in sealing relation, as at 44. The rotor may then be said to be tangent internally to the sleeve 37. Radial slots 45 in the rotor 42 are adapted to receive radially slidable vanes or blades 47 and 48, which serve to divide the space 49 caused by the eccentricity of the rotor 42 and the sleeve 37, into chambers A and B. The blade 47 is pivotally keyed to the sleeve 37 in any suitable manner as by a pin 52. Rods 54, extending through openings 55, at the bottom of slots 45, and through openings 56 in the shaft 16, into proximate relation to the inner edges of blades 47 and 48, prevent the disengagement of the blade 47 and pin 52. Springs 58 surround the rods 54 and exert outward pressure against the blades 47 and 48, the latter blade being rounded at its outer edge to slidably engage the inner surface of the sleeve 37.

The cylindrical sleeve 37, the rotor 42 and the blades 47 and 48 are made of equal lengths to facilitate end sealing of the compression chambers. Preferably these members rest upon the face 24 of the motor casing 12, which may be machined to form a sealing surface. As shown in Fig. 1, the housing 30 has a bore greater in depth than the length of the rotating moving parts, which provides in one end thereof, a chamber 57. A plate 58 loosely fits in the bore of the housing 30 and is held in engagement with the sleeve 37, rotor 42 and blades 47 and 48 by means of a weak spring 59, the pressure of which is preferably transmitted to the plate in order to permit the latter to rotate freely with the other rotating members.

The outlet passage 32 leads into the chamber 57 and exerts a pressure on the plate 58, sufficient to secure effective sealing of the compression chambers. Moreover, the fluids passing through the pump have suspended therein some lubricant which may collect upon the plate 58 and assist in sealing the compression chamber and in lubricating the pump parts. The ball check valve 33 permits the discharge of the compressed fluids from an upper portion of chamber 57, the downwardly flanged plate 60 serving to deflect the discharged fluids into the lower portion of the chamber 10.

The disposition of the inlet ports 38 and 39, the discharge ports 40 and 41, and the grooves 34 and 35 may be more readily understood by a consideration of the diagrammatic views of Figs. 3 to 12. As

shown, the blade 47 is keyed to the sleeve 37 and hence there is no relative movement of the contacting portions of these members. The blade 48, however, has a slight movement relative to the sleeve, due to the eccentricity of the rotary movement of these members. There results a relative to-and-fro sliding or toddle of the blade 48 upon the sleeve 37. The extent of this movement varies with the distance between the eccentric axes and for a practically operative structure should not be large. The extent of the toddle is shown in the several views designated as Figs. 3 to 12. Having determined the extent of toddle in any compressor, the inlet port 39 and the outlet port 40 are placed in such position that the blade 48 at its extreme positions of toddle does not permit the port 39 or the port 40 to communicate simultaneously with both chambers A and B. The ports 39 and 41 are placed diametrically opposite the ports 38 and 40, respectively, in order to give a uniform compressing action. In either direction of rotation, the outlet ports are in advance of the blades and the inlet ports are behind the blades.

It is obvious that the rotor 42 contacts with the sleeve 37 in all positions of rotation in a line 44 determined by the intersection of the plane of the parallel axes of the rotor and sleeve with the inner cylindrical surface of the sleeve.

The grooves 34 and 35 are preferably disposed in substantially symmetrical relation with respect to this plane of the axes. The overlapping ends of the grooves disposed opposite to the line 44, should be placed so that each compression chamber may receive fluids to its full capacity. The maximum volumetric capacity of a compression chamber occurs when the blades are at right angles to the plane of the axes. Thus as shown in Figs. 4 and 9, the inlet groove 34 should terminate at such position as to fully cut off communication with the inlet port 38 when the blades are at or near their normal position with respect to the plane of the axes. Similarly, the outlet groove 35 should terminate at such position as to begin to open communication with the discharge port 40 at or about the same position of the blades. The other extremities of the grooves 34 and 35 should approach the contact line 44 with sufficient nearness to permit a complete discharge of the fluids as the chamber approaches a zero capacity and to supply fluid to the chamber during its initial stages of expansion.

The operation of the compressor is apparent from the above description. Assume that the shaft 16, rotor 42, the blades 47 and 48, and the sleeve 37 are rotating in a clockwise direction, as indicated by the arrows. In the position shown in Figs. 3 and

8, the fluid to be compressed is passing through the port 31, groove 34 and port 38 into the chamber B. The inlet port 39 is about to arrive at a position in which it will communicate with the groove 34. The fluids in the chamber A are being discharged through the port 41, groove 35 and port 32.

As the rotating members approach the position shown in Figs. 4 and 9, the chamber A may be considered to be divided into two sections by reason of the contacting of the rotor 42 with the sleeve 37 at line 44. The right-hand section is receiving fluid through the inlet passage and the left-hand section is discharging fluid through the outlet passages. Upon reaching its full volumetric capacity (Figs. 4 and 9) the chamber B ceases to receive fluid through port 38 and begins to discharge fluid through port 40.

Upon a continued rotation to the position indicated in Figs. 5 and 10, the capacity of the left-hand section of the chamber A is reduced to zero, the right-hand portion now representing the whole of chamber A, which is receiving, but not discharging fluid. The above described action continues, as shown in Figs. 6 and 11 and Figs. 7 and 12, through recurring cycles. It will be noted that the period of intake for any chamber is measured by the time required for the parts to rotate through an angle considerably in excess of 180° , and the period of discharge is of equal length. It follows that there are intervals in the cycle when both chambers are receiving and one discharging, and when both are discharging and one receiving. This results in increased periods of intake and discharge, when compared to pumps of the rotary type commonly in use, reduces the velocity of fluids passing through the ports, cuts down fluid resistance, and greatly adds to the efficiency of the compressor.

The compressor of the present application is designed for the compression of gaseous fluids, and it is necessary, consequently, to supply lubricant to the contacting parts to secure an effective sealing thereof. This may be accomplished in any manner as by introducing lubricant in form of a spray into the inlet passage 18. However, should excess quantities of the lubricant be drawn into the compression chambers, as these chambers approach a zero capacity, the excess lubricant, being non-compressible, might cause a jamming of the pump. This is obviated in the present construction, since the plate 58 will yield to a superior pressure and pass the lubricant directly into the chamber 57.

The gases, including entrained lubricant, discharged from the port 32 pass into the chamber 57, where some of the lubricant is separated out and, by seeping down passed the plate 58 into the clearances between the moving parts of the pump, is available for

again lubricating the pump. The gases are discharged from the chamber 57 into the compression chamber 10 through the check valve 33, the deflector 60 serving to cause any liquids to fall into the bottom of the chamber 10. In Figs. 13 and 14, I show a modified construction of my pump. In this embodiment, the casing 30 is bored to a predetermined depth sufficient to accommodate the rotor 42, blades 47 and 48, and sleeve 37, the casing wall at the end of the bore serving as an end sealing means for the compression chambers. The shaft 16 extends through the rotor 42 into a reamed opening 60 which serves as a bearing for the end of the shaft. Lubricant is supplied to the bearing and to the pump through a port 61 and a passage 62. A sealing ring 63 is set in a cut 64 in the outer face of the sleeve 37 midway between the grooves 34 and 35 for the purpose of preventing objectionable leakage of fluid between the grooves 34 and 35. In other respects, the compressor is alike in structure and operation to that described in relation to Figs. 1 and 2.

In Figs. 15, 16 and 17, I show a further modification of compressor. The casing 30, sleeve 37, rotor 42, blades 47 and 48 and shaft 16 are disposed in the same general relation as described with regard to Figs. 1 and 2. The grooves 34 and 35 in the casings 30 and the ports 38 and 41 in the sleeve 37 are, however, omitted, the inlet and discharge of the fluids being effected through end plates of special construction. As shown, an inlet chamber 70 is formed in the supporting casing 12 and is connected to an inlet passage 18. A cap fixed to the opposite end of the casing 30 serves to form an outlet chamber 72, having an outlet port 73. Two circular plates 74 and 75 are disposed with the cylindrical bore of casing 30, contiguous to the inlet chamber 70. The plate 74 rests upon the casing 12, defining the top wall of the chamber 70, and is prevented from rotation by a dowel pin 76. The plate 75 is secured to the sleeve 37, as by bolts 77. Similarly at the outlet end of the compressor, two plates 79 and 80 are provided, the plate 79 being held against rotation by a dowel pin 81 and the plate 80 being secured to the sleeve 37 by bolts 82. Diametrically opposite ports 83 and 84 are provided in the plate 75 and similar ports 85 and 86 in the plate 80. The plates 74 and 79 have arcuate slots 87 and 88, registering with the ports 83 and 84 and the ports 85 and 86, respectively.

The ports 83, 84, 85 and 86 correspond in function and position with respect to each other and to the plane of the axes of the rotor and sleeve to that of the ports 38, 39, 40, and 41, of Figs. 1 and 2, and the slots 87 and 88 have the same function and relative position with respect to the blades 47

and 48, as do the grooves 34 and 35 of Figs. 1 and 2. These cooperating ports and passages having been fully described in a preceding portion of this specification, a further description thereof is deemed to be unnecessary. A coil 90 for the circulation of a cooling fluid may, if desired, be wound about the compressor casing, the spaces between the coils and between the coils and the casing being filled with a heat conducting metal 91.

In Figs. 18 and 19, I show a further modification of the structure illustrated in Figs. 1 and 2. The casing 30 is of double wall construction to provide a space 100 for cooling fluid, suitable inlet and discharge ports 101 and 102 being also provided. The grooves 34, 35 in the casing 30, and ports 38, 39, 40, and 41 in the sleeve 37 are the same as in Figs. 1 and 2. The blade 47 has at its outer edge a circular tenon 104 which fits into a cooperating mortise or groove 105, in the sleeve 37. This construction provided a positive driving connection between the shaft 16 and the sleeve 37 and eliminates the necessity for the rods 34 of Figs. 1 and 2. It has been found desirable, where the compressor is subject to hard service, to provide a means for taking up the wear of the relatively moving parts so as to provide an efficient seal between the rotor and sleeve at the line of the contact 44. This is accomplished by providing a bearing strip 108 set in a slot 109 in the casing 30 centrally of the plane of the axes of the rotor and sleeve. A passage 110 threaded at its outer end encases a light spring 111, the tension of which may be regulated by a nut 112. A passage 113 connects the discharge groove 35 with the back of the slot 109, so that the pressure of the compressed fluid is transmitted uniformly the length of the bearing strip 108 to hold the strip in contact with the sleeve 37. This structure ensures not only a close contact of the rotor and sleeve but also serves to seal against leakage of fluids between the grooves 34 and 35. The operation of the pump hereinabove described is in all respects similar to that of Figs. 1 and 2. A plate 115, in all respects similar to the plate 58 of Figs. 1 and 2, forms an end seal for the operating chambers of the pump. The plate is held in place by the pressure of the fluid within the condensing chamber, which is communicated to the upper side of the plate through the duct 116.

While I have shown my invention in several forms, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereon as are imposed by the prior art or

as are specifically set forth in the appended claims.

What I claim is:

1. The combination with a cylinder member having inlet and outlet ports, of a second cylinder member mounted to be relatively rotatable therein, an eccentrically mounted member disposed within said second member and having radial openings, a pair of members movable inwardly and outwardly with respect to said eccentric member and engaging said second member to effect alternately expanding and contracting chambers communicating with the ports, helical springs disposed in said radial openings and engaging said pair of members for biasing the latter outwardly, and rods surrounded by said helical springs.

2. The combination with a tubular cylindrical member having longitudinally spaced transverse openings therethrough, of an eccentrically mounted rotatable cylindrical member therein having radial longitudinal slots, a member slidably mounted in one of said slots and pivoted to said tubular member, a second member slidably mounted in one of said slots and resiliently biased toward said tubular member, and a casing fitting said tubular member having inner peripheral grooves opposite said transverse openings and ports communicating with said grooves.

3. In a pump, in combination, a hollow cylindrical member having inlet and outlet ports, a second hollow cylindrical member mounted therein with a running clearance, said members being so constructed as to form therebetween circumferential channels, each channel communicating with one of said ports, and a relatively rotatable structure eccentrically mounted within said second cylindrical member and constructed to provide alternately expanding and contracting chambers, said second cylindrical member having ports forming communication between each of said chambers and the said circumferential channels.

4. In a pump, in combination, a hollow cylindrical member having inlet and outlet ports, a second hollow cylindrical member mounted therein with a running clearance, one of said members having grooves therein so disposed as to form with the other member circumferential channels, each channel communicating with one of said ports, a second hollow cylindrical member mounted therein with a running clearance, and a relatively rotatable structure eccentrically mounted within said second cylindrical member and constructed to provide alternately expanding and contracting chambers, said second cylindrical member having ports forming communications between each of said chambers and the said circumferential channels.

5. In a pump, in combination, a hollow cylindrical member having inlet and outlet ports, a second hollow cylindrical member mounted therein with a running clearance, said members being so constructed as to form therebetween circumferential channels extending through an arc of approximately 180°, each of said channels communicating with one of said ports, and a relatively rotatable structure eccentrically mounted within said second cylindrical member and constructed to provide alternately expanding and contracting chambers, said second cylindrical member having ports forming communications between each of said chambers and the said circumferential channels.

6. In a pump, in combination, a hollow cylindrical member having inlet and outlet ports, a second hollow cylindrical member mounted therein with a running clearance, said members being so constructed as to form therebetween circumferential channels extending through an arc of at least 180°, each of said channels communicating with one of said ports, and a relatively rotatable structure eccentrically mounted within said second cylindrical member and constructed to provide alternately expanding and contracting chambers, said second cylindrical member having ports forming communications between each of said chambers and the said circumferential channels.

7. In a pump, in combination, a hollow cylindrical member having inlet and outlet ports, a second hollow cylindrical member mounted therein with a running clearance, an eccentrically mounted member disposed within said second member, and yieldable means for dividing the space caused by the eccentricity of said members into alternately expanding and contracting chambers including means for positively connecting the said eccentric members whereby they may be caused to rotate in synchronism.

8. In a pump, in combination, a hollow cylindrical member having inlet and outlet ports, a second hollow cylindrical member mounted therein with a running clearance, a pair of member movable inwardly and outwardly with respect to said eccentric member and engaging said second member to provide alternately expanding and contracting chambers communicating with the ports, one of said pairs of members being flexibly secured to said second member whereby they may be caused to rotate in synchronism.

9. In a pump, in combination, a hollow cylindrical member having inlet and outlet ports, spaced along the cylinder with respect to its longitudinal axis, a second hollow cylindrical member mounted therein with a running clearance, said members being so constructed as to form herebetween two circumferential channels extending through an arc of approximately 180°, each

of said channels communicating with one of said ports, and a relatively rotatable structure eccentrically mounted within said second cylindrical member and constructed to provide alternately expanding and contracting chambers, said second cylindrical member having ports forming communications between each of said chambers and the said circumferential channels.

10. In a rotary pump for handling vapors having lubricating properties, in combination, a base member, a casing having a cylindrical bore mounted thereon with an open end to said base member, a rotary vane pump of the eccentric expansible-chamber type disposed in said casing, the pump elements bearing at one end against the base member, a circular cover plate of substantially the diameter of the cylindrical bore resiliently held against the other end of the pump elements, a chamber in the casing between cover plate and the end of the cylinder, means for discharging the compressed vapors from the pump into said end chamber, said end chamber being adapted to partially condense vapor, whereby condensed vapors may pass to the pump to assist the lubrication thereof, and means for discharging the residue of vapors from the end chamber.

11. In a pump for handling vapors having lubricating qualities, in combination, a casing provided with inlet and outlet ports, a sleeve mounted therein with a running clearance, a relatively rotatable structure mounted within the sleeve and constructed to provide alternately expanding and contracting chambers communicating with the ports, a cover plate for sealing said chambers, a chamber having heat dissipating walls provided in the casing between the cover plate and the end of the cylinder, means for discharging the compressed vapors from the pump into said end chamber, whereby condensed vapors may pass to the pump to assist the lubrication thereof, and means for discharging the residue of vapors from the end chamber.

12. In a rotary pump for handling vapors having lubricating qualities, the combination of a casing having inlet and discharge ports, a rotating mechanism disposed within the casing for compressing the vapor, and a chamber having heat dissipating walls interposed between the rotating element and the discharge port, whereby the vapor is partially condensed in its passage through the pump and some liquid is produced for lubricating and sealing the pump.

13. In a pump for handling vapors having lubricating qualities, the combination of a casing having inlet and discharge ports, a rotating mechanism disposed within the casing for compressing the vapor, and a chamber having heat dissipating walls em-

bodied in the casing, whereby the vapor is partially condensed in its passage through the pump and some liquid is derived for sealing and lubricating the pump.

- 5 14. The combination with a tubular member having longitudinally spaced openings therethrough, of an eccentrically mounted rotatable cylindrical member therein having radial slots, a member slidably mounted in
10 one of said slots and pivoted to said tubular

member, a second member slidably mounted in one of said slots and biased toward said tubular member, and a casing fitting said tubular member having inner peripheral grooves opposite said transverse openings 15 and ports communicating with the grooves.

In testimony whereof, I have hereunto subscribed my name this 30th day of October, 1922.

ANDREW ALBERT KUCHER.