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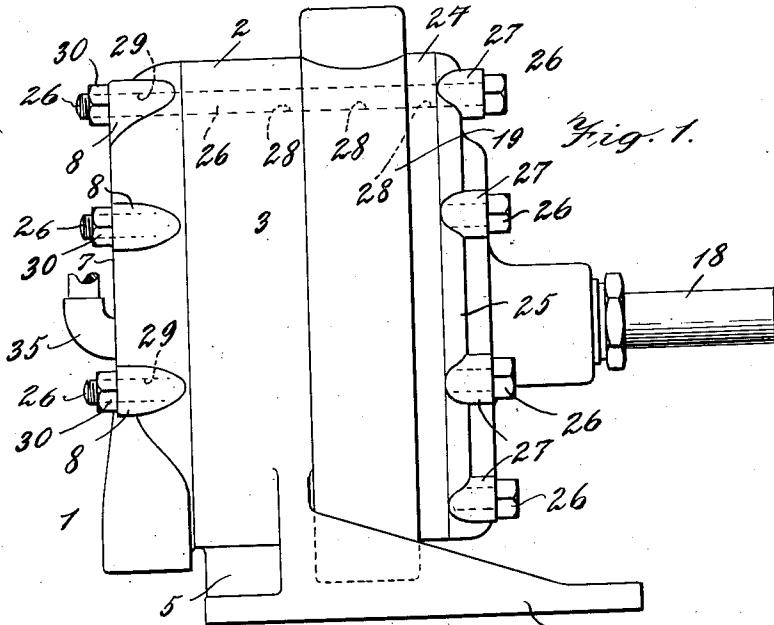
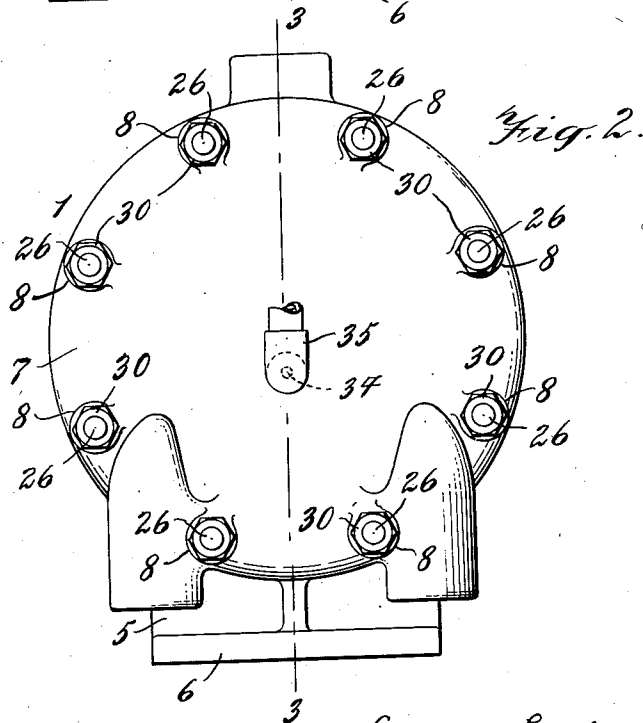
1,607,383

E. L. AURAND

PUMP OR COMPRESSOR

Filed May 25, 1923

6 Sheets-Sheet 1



INVENTOR.

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Nov. 16, 1926.

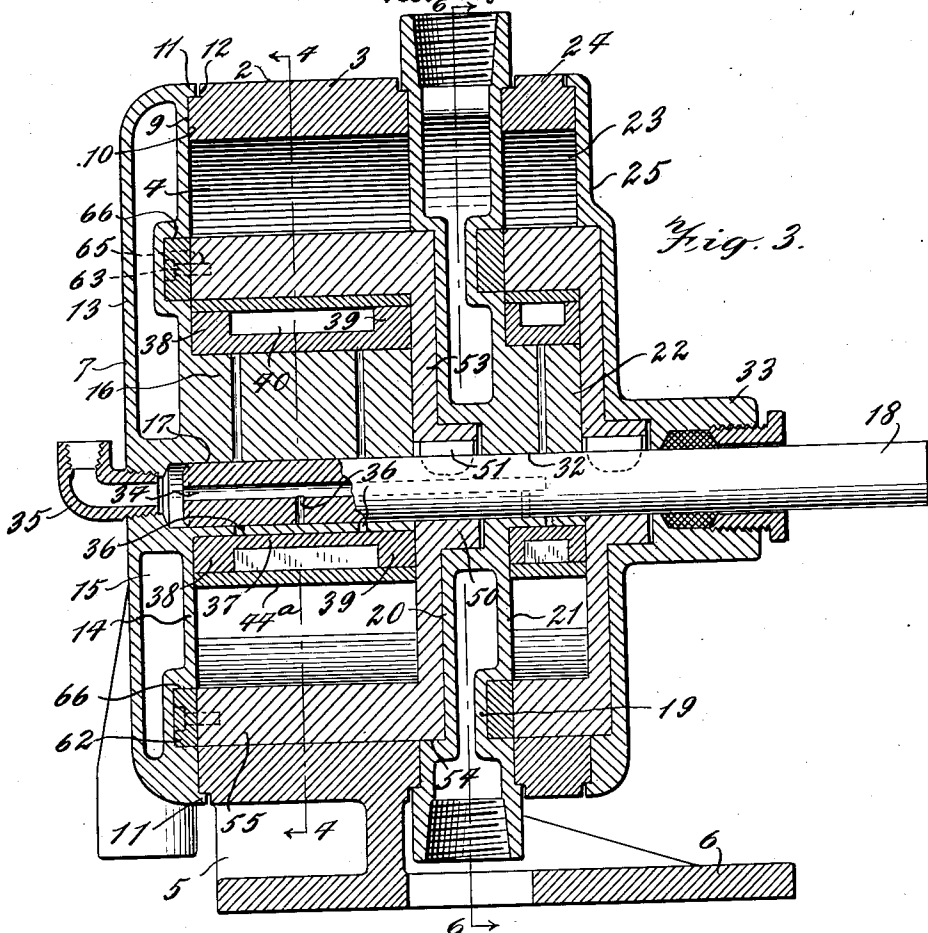
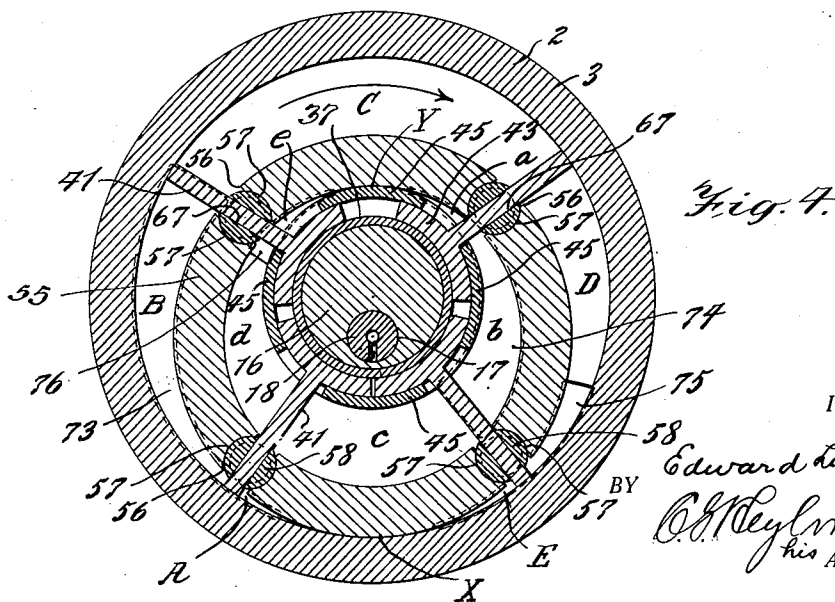
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PUMP OR COMPRESSOR

Filed May 25, 1923

6 Sheets-Sheet 2



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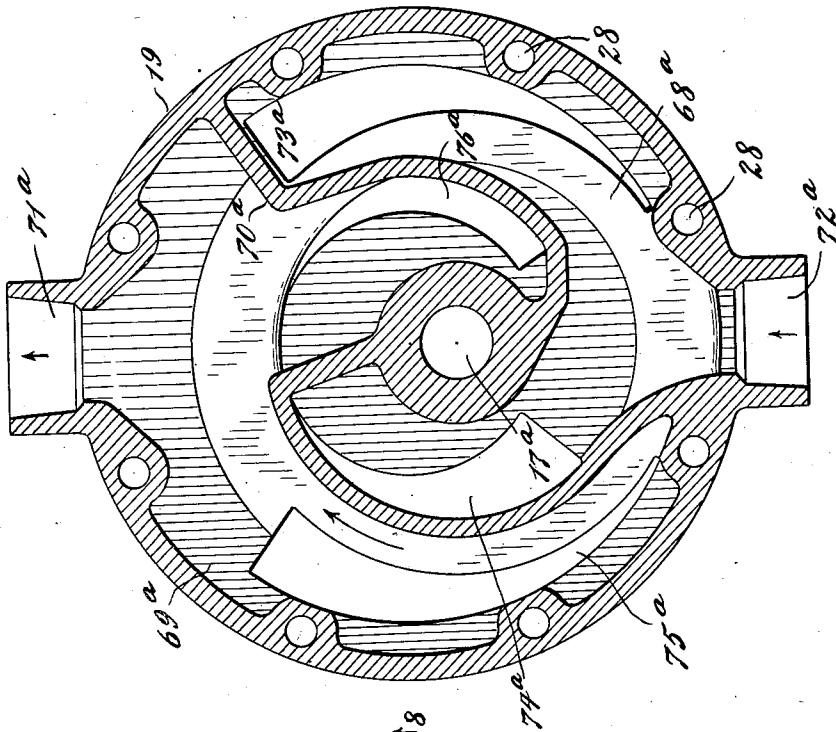


Fig. 6.

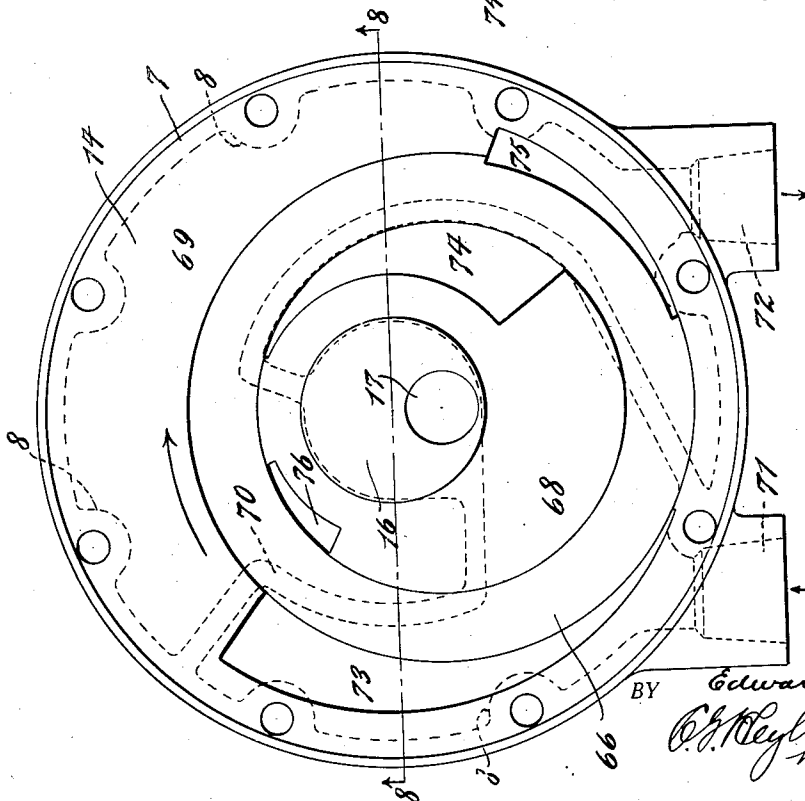


Fig. 5.

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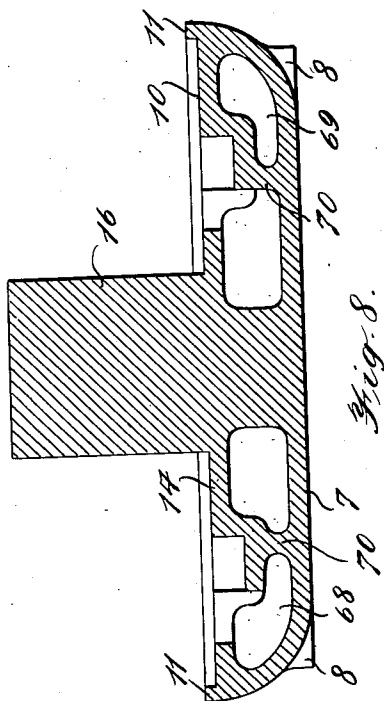
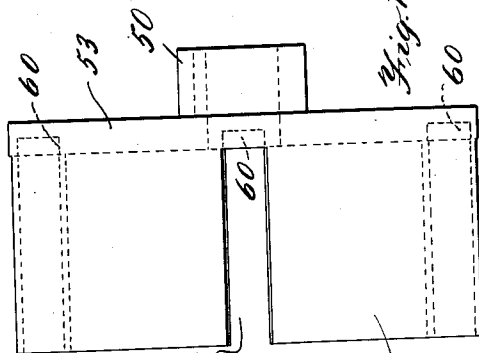
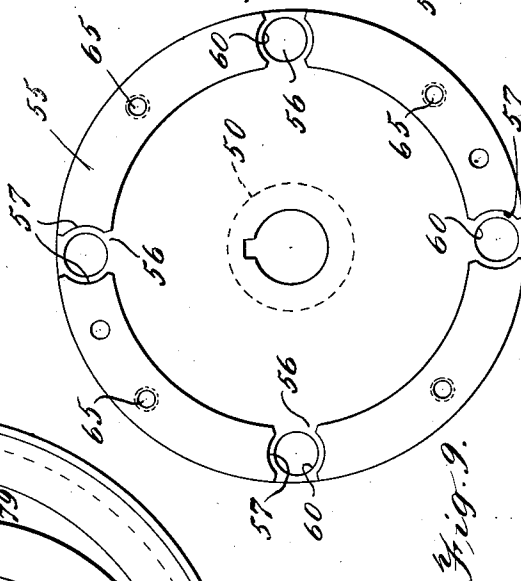
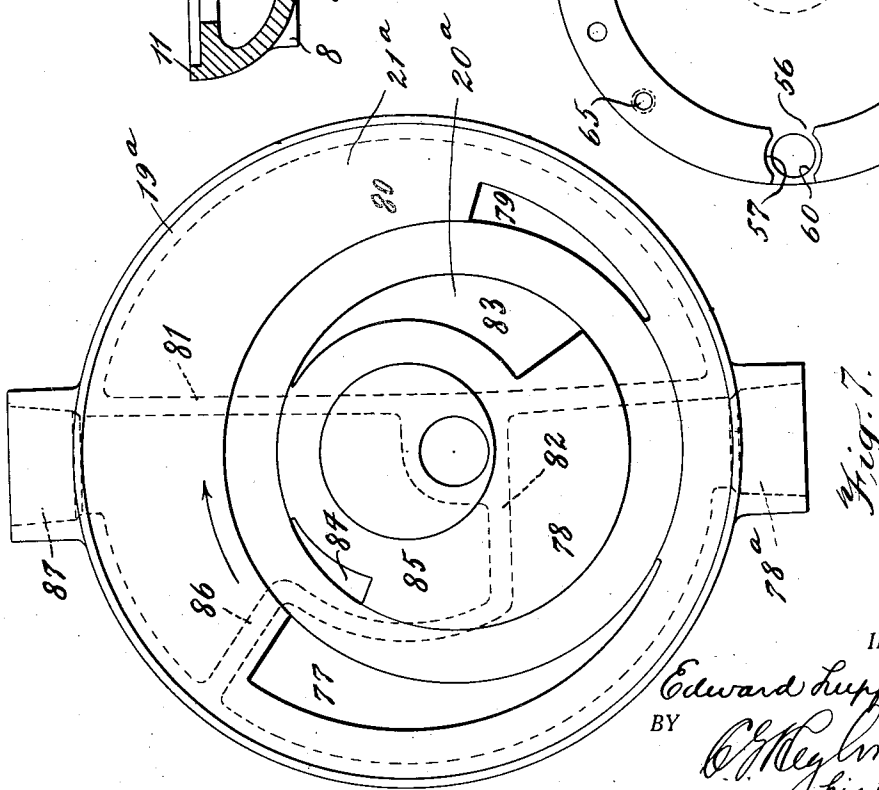
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1,607,383

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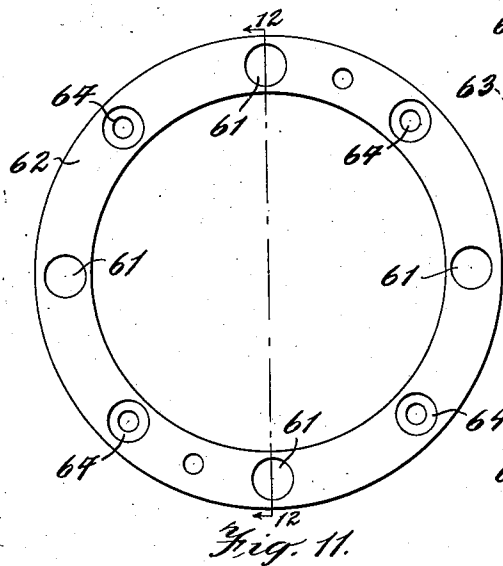
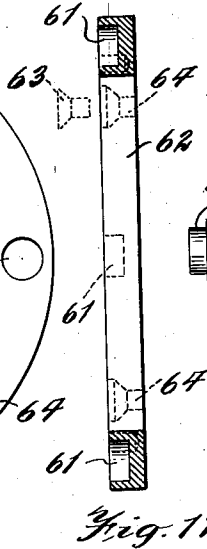
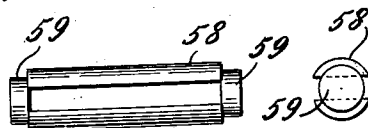
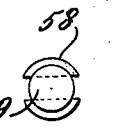
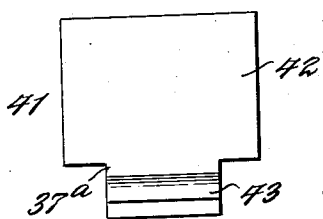
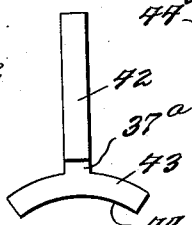
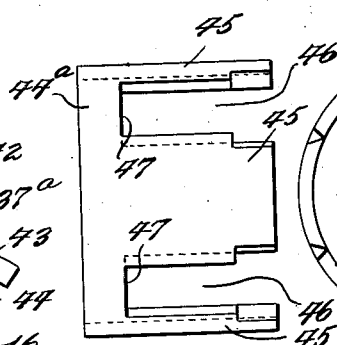
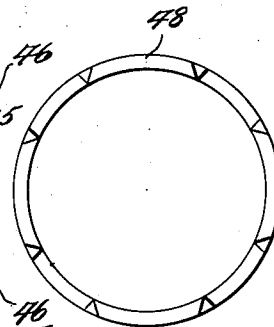
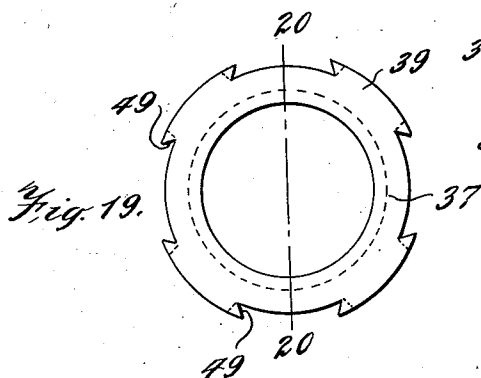
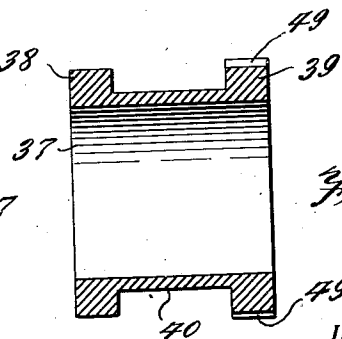
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E. L. AURAND
PUMP OR COMPRESSOR

Filed May 25, 1923

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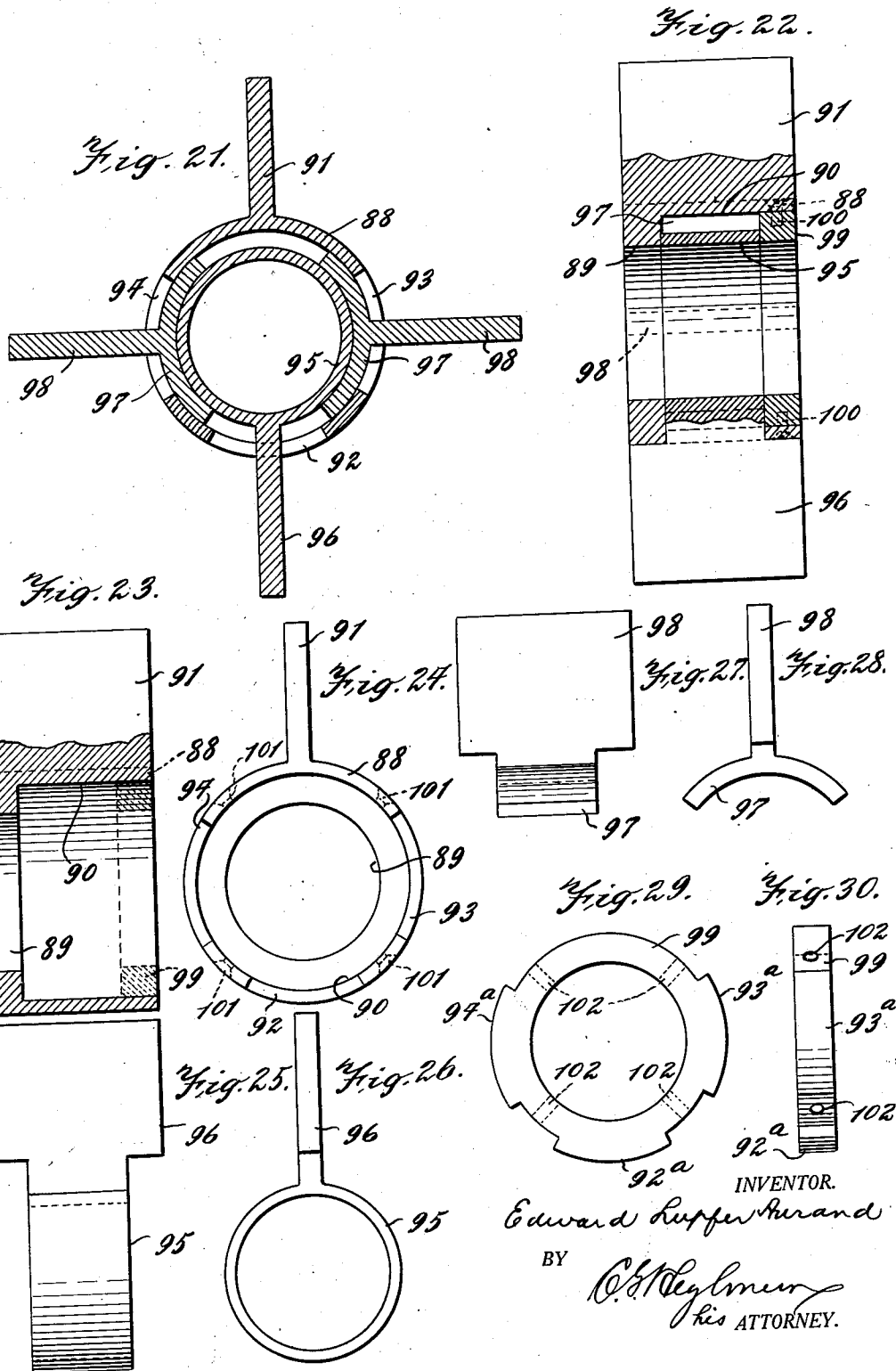
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E. L. AURAND
PUMP OR COMPRESSOR
Filed May 25, 1923

6 Sheets-Sheet 6



UNITED STATES PATENT OFFICE.

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PUMP OR COMPRESSOR.

Application filed May 25, 1923. Serial No. 641,331.

My invention relates broadly and generally to new and useful improvements in pumps or compressors, the object being to provide a device of the character stated, which will be efficient and simple in construction, and which will have great displacing capacity in proportion to its size. Of course the principle involved is not limited in its application to an embodiment in a structure of small size, but it will be found particularly useful when a small structure of relatively great capacity is desired or required.

The invention consists in the improved construction and combination of parts to be more fully described hereinafter, and the novelty of which will be particularly pointed out and distinctly claimed.

In the accompanying drawings, to be taken as a part of these specifications, I have illustrated preferred embodiments of my invention, in which—

Figure 1 is a view in side elevation of one embodiment of my invention, embodying a duplex pump adapted, for example, to act as an exhaustor for the purpose of creating a vacuum or rarefied atmosphere, and also as a pump for propelling or displacing liquid;

Fig. 2 is a view in end elevation looking from the left of Fig. 1;

Fig. 3 is a central vertical section on the line 3—3 of Fig. 2;

Fig. 4 is a section on the line 4—4 of Fig. 3;

Fig. 5 is a view in front elevation of the interior face of one head or cover of a casing, and showing the arrangement of ports therein;

Fig. 6 is a sectional view on the line 6—6 of Fig. 3;

Fig. 7 is a view in front elevation of the face of the cylinder head modified in order to provide for a two-stage operation;

Fig. 8 is a section on the line 8—8 of Fig. 5;

Fig. 9 is a detail view in end elevation of a rotatable member, in the present embodiment constituting a driving element;

Fig. 10 is a view in side elevation of the element shown in Fig. 9;

Fig. 11 is a view in front elevation of a retaining member in the form of a ring, adapted to retain certain pistons or vane-

bearings in place on the rotatable element shown in Figs. 9 and 10;

Fig. 12 is a section on the line 12—12 of Fig. 11;

Fig. 13 is a plan view of a bearing for piston blades or vanes;

Fig. 14 is an end view of the bearing shown in Fig. 13;

Fig. 15 is a view in front elevation of a piston blade or vane;

Fig. 16 is an end view of the piston blade or vane shown in Fig. 15;

Fig. 17 is a side view of a retaining member in the form of a sleeve for retaining the piston blades or vanes, such as shown in Figs. 15 and 16, in position on a rotor;

Fig. 18 is an end view of the construction shown in Fig. 17;

Fig. 19 is an end view of a rotor for supporting the piston blades or vanes shown in Figs. 15 and 16;

Fig. 20 is a longitudinal section on the line 20—20 of Fig. 19.

Fig. 21 is a transverse sectional view through another form of rotor adapted to be employed in my pump;

Fig. 22 is a view in side elevation, partly in section, of the structure shown in Fig. 21;

Fig. 23 is a view in side elevation, partly in section, of one of the elements shown in Figs. 21 and 22;

Fig. 24 is a view in end elevation of the element shown in Fig. 23;

Fig. 25 is a side elevation of one of the elements shown in Figs. 21 and 22;

Fig. 26 is a view in end elevation of the element shown in Fig. 25;

Fig. 27 is a side view of a blade element shown in Figs. 21 and 22;

Fig. 28 is an end view of the blade element shown in Fig. 21, and

Figs. 29 and 30 are, respectively, front and edge views of a retaining member or ring employed in the form of a rotor, shown in Figs. 21 and 22.

Referring to the drawings by characters of reference, 1 designates generally a casing which may be of any suitable external structure and form adapted for the purpose for which it is employed. In the preferred embodiment shown, this casing includes an intermediate member 2, comprising a cylindrical wall 3, said member having a cylindrical bore or chamber 4 adapted to contain

a gas or liquid-displacing means to be presently described.

The casing member 2 is mounted on a suitable standard 5 rising from a base-plate 6 of any suitable construction, said member, standard and base-plate, if desired, being made in an integral structure.

One end of the member 2 is closed by a head or end-plate 7 provided with annularly arranged bosses 8, for a purpose to be presently described.

It will be understood that the meeting faces 9 and 10 between the end of the cylinder 2 and the head 7 are formed, for example, by a ground joint, so that a gas and liquid-tight joint is provided. If desired, the head may be provided with an overhanging flange 11 adapted to set into a recess 12 on the end of the element 2, so as to provide an additional seal at this point.

The head or cover-plate 7 is formed hollow, being made of outer and inner walls 13, 14, which, in general, are substantially parallel to each other providing a chamber 15, said inner wall forming the end wall of the casing chamber 4 and carrying a cylindrical bearing member 16, preferably integral with said wall 14, said bearing member being concentric with the chamber 4 and provided with a longitudinal bore 17 eccentric to the chamber 4 and constituting a bearing for a power-shaft 18 which is eccentric to the said chamber 4. It is to be noted that the bearing 17 and shaft 18 are located at a point below the center of the member 16 and the chamber 4.

The opposite end of the casing element 2 from that closed by the head or cover-plate 7 is closed by a head or wall, indicated, generally, at 19 in the present embodiment, that is, a duplex structure to which, of course, the invention is not limited, said head 19 comprising spaced walls 20, 21, the former of which faces the chamber 4. The wall 21, or that one on the opposite side of the head 19 from the chamber 4, is provided with a cylindrical bearing member 22 similar to the member 16 heretofore described, and arranged concentric with a cylindrical pump chamber 23 formed, preferably, of a cylindrical ring 24, one end of said chamber being closed against the wall 21, and the other end being closed by an end cover-plate 25. The head 7, casing member 2, head 19, ring 24 and cover-plate 25, are held in assembled relation by means of headed bolts 26 passed through bosses 27 on the cover-plate 25, alining openings 28 in the ring 24, head 19 and openings 29 in said bosses 8 on the head 7, the elements being clamped together by means of nuts 30 on the ends of said bolts projecting beyond the outer faces of the said bosses on the plate 7. These bolts are commonly known as "through-going" bolts in the art, and merely constitute one means by

which the casing element may be assembled, as is obvious.

The bearing member 22 is provided with a bearing opening 32, and the outer face of the head 25 with a stuffing-box 33, said opening 32 and box 33 being in alinement with the bearing 17 heretofore described, and together therewith constituting bearings for said shaft 18. Said shaft 18 may be provided with a longitudinal bore 34 adapted to communicate with any suitable lubricant receptacle 35 attached to the head 7, and said bore having outlet ports 36 by which lubricant may pass from said bore to surfaces in the elements 16 and 22 against which the shaft turns.

I will now proceed to describe the displacing means located in the chamber 4 for displacing or propelling gas or liquid, whether the principle involved be embodied in a structure for exhausting, for example, a vacuum pump, or in a pump for compressing or propelling gas or liquids.

On the bearing member 16 is rotatably mounted a rotor, preferably in the form of a cylindrical sleeve 37, the same being concentric with said member and adapted to rotate freely thereon. This rotor is provided at its opposite ends with radial circumferential flanges 38, 39, thereby providing the rotor with a circumferential recess or slot 40 between said flanges. 41 designates generally each of a plurality of blades or vanes, preferably in the form of rectangular plates 42 (see Fig. 15), the outer ends of which are arranged to travel at all times closely adjacent to the cylindrical inner surface of the chamber 4—say, for example, one one-thousandth to two one-thousandths of an inch distant from said surface, so that lubricant can fill and seal the intervening space. The inner ends of the vanes are connected to supports, in the form of arcuate shoes 43, located in the recess or slot 40, and the under faces 44 of which shoes conform in curvature to the circumference of the sleeve 37, and are slidably disposed thereon circumferentially thereof. The shoes are preferably of a width substantially equal to but slightly less than the distance between the flanges 38, 39, and of a thickness slightly less than the depth of said flanges. Each vane is preferably connected rigidly and integrally to the transverse center of its shoe, as indicated in Fig. 16, and in such manner that said vane or blade lies in a plane at a right angle to the chord of the arc of the shoe, so that when the vanes are in operative arrangement on the rotor 37, they extend radially from the latter and at all times are maintained in this relation. It is to be noted that each vane is connected to its shoe or retainer by a reduced portion 37^a of less width than the body of the vane, for a purpose to be presently described. Ducts 16^a through the member 16

are provided to feed lubricant from the bore 17 to the outer face of the said member 16 and the inner face of the rotor 37.

The vanes 41 are held in assembled relation on the rotor by any suitable means, but I prefer to accomplish this result by means of a retaining-sleeve 44^a adapted to be slipped over the rotor body, and embodying longitudinally-extending portions 45 and intervening equally spaced slots 46 closed at one end, as at 47, and at their opposite ends opening through the end of the retaining-sleeve (see Figs. 17 and 18). The retaining-sleeve when in operative position, is so arranged that the longitudinal side edge portions of the parts 45 overlie the outer ends of the shoes 43, whereby the shoes and the vanes carried thereby are held on the rotor. The blades 42 project outward through the slots 46, which are wide enough to permit the sliding movement of the shoes on the rotor in the manner heretofore described. In order that the retaining sleeve will be held in proper position, the ends of the parts 45 are formed inwardly flaring, wedge-shaped in cross-section, as at 48 (see Figs. 17 and 18), and are adapted to be inserted endwise or longitudinally into companion slots 49 formed in the flange 39 of the rotor 37 (see Figs. 19 and 20). By this construction the shoes of the vanes are held against endwise displacement by the flanges 38, 39, and from outward displacement by the sleeve 44^a. The sleeve 44^a, by its cooperation with the ends of the shoes, aids in equally distributing the load between the inner and outer surface of the shoe caused by any moment applied along the vane, and thereby prevents binding of the shoe against the bearing surfaces.

Arranged within the chamber 4 is a rotatable member, which, in the present preferred embodiment, constitutes a driver or means for transmitting motion from a suitable power means, for example, the shaft 18, to the elements constituting the gas or liquid-displacing means heretofore described. This driver preferably comprises a hub member 50 keyed, as at 51, to the shaft 18, and turning within an annular bearing seat 52 formed in the head 19. Extending outwardly from the hub 50 is a flange 53 arranged to rotate in a circular recess 54 in said head-wall 20, said recess and the periphery of the said plate 53 being concentric to said shaft, and eccentric to the inner periphery of the chamber 4. It is to be noted that in the preferred embodiment, the flange 53 is located between the transverse end of the bearing member 16 and said end head-wall 20. At its outer or peripheral portion, the plate 53 carries a cylinder 55 concentric with the shaft 18 and eccentric to the inner periphery of the chamber 4.

The cylinder 55 is provided with a plu-

ality of equally spaced longitudinal slots 56, corresponding in number to the number of vanes employed, in the present example there being four, although it will be understood that a less or greater number may be employed within the scope of my invention. The opposite longitudinal walls of the slots 56 are circular, as at 57, to receive cylindrical vane slide-bearings 58 adapted to oscillate between the walls 57. The bearings 58 are formed with end journals 59, one of which is seated in a bearing socket 60 in the flange 53 at the end of the slot 56, and the other of which has bearing in a bearing socket 61 in a retaining-ring 62, 80 abutting the end of the cylinder 55 and secured thereto by means of screws 63 passing through openings 64 in said ring, and threaded into holes 65 in the end of the cylinder 55 (see dotted lines, Fig. 3). The retaining-ring 62 rides in an annular groove 66 in the inner face of the head 7, whereby this end of the rotatable member is supported properly. Each of the cylindrical bearings 58 is formed with a longitudinal 90 rectangular slot 67 registering with the opening 56 in cylinder 55, and adapted to slidably receive one of the blades or vanes 42 (see Fig. 4).

As heretofore stated, the head 7 is hollow, being formed of the inner and outer walls 13, 14, forming the chamber 15. The chamber 15 is divided into two portions 68, 69, by means of a continuous wall 70 joining the walls 13, 14, as shown in Fig. 5. The chamber 68 constitutes a receiver supplied through an inlet opening 71, and from which the pump withdraws gas or liquid during the normal operation thereof. The chamber 69 constitutes a receiver into which 105 the pump discharges gas or liquid during the normal operation thereof, said gas or liquid being expelled from the chamber 69 through the outlet opening 72. Referring particularly to Fig. 4, it will be seen that 110 the rotatable member makes a line contact at one point on its outer periphery with the inner periphery of casing chamber 4, as at X, thereby, together with the vanes, forming chambers A, B, C, D and E. It will 115 also be seen that the periphery of the rotor 37 makes line contact at one point on the inner periphery of the rotatable member 55, as at Y, thereby, together with the vanes, forming chambers a, b, c, d, and e. Con- 120 nection between the chambers A, B, C, D and E, and also the chambers a, b, c, d and e, with the chambers 68 and 69 (Fig. 5), is made by suitable inlet and outlet means, preferably in the form of ports, which will 125 now be described:

Considering the chamber 68, a port 73 in the wall 14 constitutes an inlet for gas or liquid passing into the chambers about the outer periphery of the rotatable member 55, 130

for example, the chambers A and B, this port being formed in this instance as a truncated crescent, conforming preferably, but not necessarily, in area and shape substantially to that of the chambers A and B. The port 74 constitutes an inlet for gas or liquid passing into the chambers lying within the inner periphery of the rotatable member 55, as, for example, the chambers *a* and *b*, this port being also formed as a truncated crescent, conforming preferably, but not necessarily, in area and shape substantially to that of the chambers *a* and *b*.

Considering the chamber 69, a port 75 in the said wall 14 constitutes an outlet or exhaust for gas or liquid displaced by the displacing means heretofore described, said port 75 being in communication with the chambers D and E about the outer periphery of the rotatable member 55. This port 75 is preferably, but not necessarily, in the form of a truncated crescent, covering the chamber E and a portion of the chamber D.

76 designates an outlet or exhaust port for the chambers lying within the inner periphery of the member 55, said port opening through the wall 14 into the chamber 69 and establishing communication between the same and the chambers *d* and *e* preferably. This port 76, in its preferred form, is also of truncated crescent shape. It is to be noted that in the preferred embodiment described, the inlet port 73 begins at a point just after the point of contact X, and the port 75 ends just in advance of said point of contact. It is also to be noted that the port 74 begins just after the point of contact Y, and the port 76 terminates just in advance of the point of contact Y. It is also to be noted that the side edges of the vanes 42 uncover and cover all said ports during rotation of the rotor.

The invention as so far described is applicable to a single cylinder construction, in which it may find many useful applications, but the invention may, if desired, be embodied in a multiple cylinder structure in the manner I have illustrated herein; for example, one of the cylinders being designed to act as a vacuum pump or exhaustor, and the other as a pump for pumping any desired liquid. In this embodiment, the pump for pumping liquid is constituted by the structure including the casing built up of the elements 19, 24 and 25, heretofore described. This liquid pump contains a vane-carrying rotor and a rotatable member constituting a driver, which are preferably of the same general construction and arrangement as the corresponding elements already described embodied in the pump for pumping gas. This construction is shown in section at the right-hand of Fig. 3, the rotor and rotatable elements and parts carried thereby being referred to by reference numerals correspond-

ing to those previously employed. The arrangement of chambers and ports in the head 19, may be, and preferably is, the same as that in the head 7, corresponding elements in Fig. 6 to those in previous figures being designated by corresponding numerals provided with the exponent "a".

In the embodiment shown wherein the pump is provided with two cylinders, for the purpose heretofore mentioned, said cylinders are separated by the element 19, which constitutes a partition between the cylinders. In this arrangement, as heretofore stated, the element 53 turns in the space between the end of the element 16 and the wall 20 of the partition 19, the outer face of the element 53 bearing against the adjacent face of the wall 20, as will be clear from Fig. 3, and thus serving to effectually seal communication between the two pump cylinders, although it will be understood that any suitable form of packing may be used at this point.

The ports controlling the inlet and outlet of liquid from the cylinder 23 are located in the wall 21 of the partition 19, and are substantially the same in construction and arrangement as the ports heretofore described located in the wall 14, except that the area thereof may be varied accordingly, as may be required by the density of the liquid to be pumped. It is believed that the construction and arrangement of the fluid pump embodying the invention will be clear without further detailed description.

The parts in the preferred embodiment being as heretofore described, the operation of the device is as follows, referring particularly to Figs. 3 and 4: Power from any suitable source is applied to the shaft 18, which serves to transmit rotary motion to the rotatable element 55, and turn the same in the direction of the arrow, shown in Fig. 4, that is, clockwise. By virtue of the connection afforded by the bearings 58 with the vanes 42, said vanes are caused to travel with the rotatable element and carry with them the rotor 37 to which they are connected. By virtue of the eccentric arrangement of the element 55 relative to the rotor 37 and the inner periphery of the casing 2, the vanes or blades 42 are progressively and successively projected through the openings in the bearings 58 carried in the slots 56 in the rotatable element, so as to generate chambers of increasing volume outside the rotary element during the rotation of the latter. Each chamber is defined by any two of the blades, the outer periphery of the rotatable element and the inner periphery of the chamber 2. This operation, so far as any chamber outside the rotatable element 55 is concerned, begins to take place at a desired point just after the contact point X. In the embodiment shown wherein four vanes or

blades are employed, the increase of volume of the chamber defined by any two blades, the outer periphery of the rotatable element and the inner periphery of the chamber 2, continues until the blades have reached a point of maximum divergence from each other, this occurring when a point on the rotatable member lying midway between the two bearing centers 56 comes substantially opposite the point Y. At this point the chamber has attained its maximum volume, and has operated to draw in the largest possible charge through the port 73. For example, during the operation just described, the chamber, as shown at B, is in communication with the chamber 68 of Fig. 5 through the port 73, and by virtue of the rotation of the mechanism, chamber B is ultimately translated to the position occupied by chamber C, at which point the leading edge of the trailing vane has crossed the edge of port 73, shown in dotted lines on the drawing, and has cut off chamber C from communication with chamber 68 of Fig. 5. It will be noted that the increase of volume takes place in both the cylinders A and B successively, so as to act by suction to draw the gas or liquid continuously from the chambers 68 through the port 73 into said chambers A and B. As heretofore stated, the exact form and area of the port 73 may be varied to suit desired conditions of operation, and that the point of cut-off may be varied to take place earlier or later during the rotation of the vanes. Continuing the working cycle from the point Y, the eccentric arrangement of the rotatable member relative to the rotor serves to generate a chamber of decreasing volume, that is, the latter half of the chamber C and the chambers D and E, whereby the gas or liquid is expelled through the port 75 into the chamber 69. During this operation, when the trailing edge of the leading vane of any chamber has passed the leading edge of the port 75, that chamber is placed in communication with chamber 69 of Fig. 5, and by virtue of the constantly decreasing volume of the chamber the contents thereof are expelled into chamber 69. Simultaneously, with the operation just described, the same operation takes place in the chambers *a, b, c, d, e*, located between the outer periphery of the rotor and the inner periphery of the rotatable member 55, the gas or liquid being drawn in from the chamber 68 through the port 75 and expelled through the port 76 into the chamber 69, in the same manner as heretofore described.

During the operation just described, the blades or vanes 42, while moving in the direction of rotation, move circumferentially on the rotor with relation to each other, so that they diverge until the position of maximum angularity or maximum volume is reached, as shown by chamber C. From this point on, the blades move circumferentially on the rotor relative to each other, and converge until a position of minimum angularity is reached, as shown in chamber *c*. This position constitutes the point of maximum volume for the chamber lying within the inner periphery of the rotatable member. This action of the blades is permitted, due to the fact that the arcuate shoes 43 are of such circumferential length as to leave clearance spaces between the ends of the shoes, and the slots 46 in the element 44 are of sufficient circumferential width to permit the desired relative movement of the shoes, and consequently the blades. It is also to be noted that during this operation, the change of angularity of the blades relative to each other is permitted, due to the pivotal movement of the blades in the rotatable member afforded by the bearings 58. The same operation takes place with respect to both the chambers lying outside the rotary member 55 and those located inside thereof, and also whether the device is employed as a pump for gas or liquid.

As heretofore stated, the shoes 43 are of such length as to permit them to move circumferentially on the rotor, there being clearance spaces provided between the ends of the adjacent shoes. During the rotation of the rotor and the circumferential movement of the shoes, the blades engage the forward walls of the slots 46 through which they extend, so that the sleeve 44^a is moved by the vanes circumferentially to rotate the rotor 37 to which it is connected, and the desired angular travel of the blades in forming the increasing and decreasing chambers is permitted.

In Fig. 7 I have shown a port arrangement by which the same principle heretofore described may be embodied in a two-stage pump, in which the exhaust from the chambers outside the rotatable member 55 is admitted to the chambers inside said rotatable member, and the exhaust from the inside chambers is delivered to any suitable point. In Fig. 7, the port 77 is an inlet port corresponding to the port 73 heretofore described, and communicates with a supply chamber 78 supplied with gas or liquid through an inlet 78^a, and the outlet port 79 opens into a receiving chamber 80, said ports 77 and 79 being located outside the periphery of the rotatable member 55. The chambers 78 and 80 are separated by partitions 81, 82, joining the walls 20^a, 21^a of the casing-head 19^a, which corresponds to the head 7 heretofore described. Leading from the chamber 80 into the chamber inside the rotatable member 55, is a port 83, preferably of truncated crescent shape, although it may take other shapes if desired. Leading from the chamber inside the rotatable

member 55 is an outlet port 84 opening into a chamber 85 in the head formed by the partitions 81, 82, a partition 86 joining the partition 82 with the peripheral wall of the head at a point beyond the cut-off end of the port 77. By this arrangement, during the rotation of the vanes, the gas or liquid is expelled through the port 79 into the chamber 80, whence it passes through the port 83 into the interior of the rotatable member 55, in which the charge is further compressed and expelled through the port 84 into the chamber 85, from which it passes through an outlet 87 to any desired point. In this form of the invention, the construction and operation of the displacing means may be, and preferably is, the same as heretofore described.

In Figs. 21 to 30, inclusive, I have shown another construction embodying my invention, in so far as the same relates to the rotor and blades carried thereby. In this construction, the rotor embodies an outer sleeve member 88 (see Figs. 21 to 24), having at one end a reduced cylindrical bore 89 adapted to set over and turn upon the cylindrical member 16 heretofore described. The said sleeve member 88 is also formed with an enlarged cylindrical bore 90 concentric with the bore 89, heretofore mentioned, and of sufficient diameter to afford an annular space between the circumference of the member 16 and the inner surface of the said bore 90. The sleeve 88 is provided with an integral blade 91 extending radially from the sleeve, and the latter is also formed with open-ended slots or clearance openings 92, 93, 94, the opening 92 being diametrically opposite to the blade 91, and the openings 93, 94 on opposite sides of the sleeve and equidistant between the said opening 92 and the blade 91, as will be apparent from Figs. 21 and 24. Adapted to be mounted on the member 16 and rotatable thereon, is an internal sleeve member 95 housed within the bore 90, heretofore described, and having an integral blade 96 extending radially therefrom and projecting outward through the opening 92 in the sleeve 88. The outer diameter of the sleeve 95 is such that an annular space is provided between the same and the inner surface of the bore 90, and in this annular space on opposite sides of the member 16 are arranged arcuate shoes 97, from each of which projects a blade 98, preferably integral with said shoes, said blades projecting in opposite directions from the center of the rotor and through the openings 93, 94. The sleeve 95 and the shoes 97 are of less width than the length of the bore 90, as shown in Fig. 22, and said sleeve and shoes are held in assembled relation in said bore by means of a retaining-ring 99 inserted within the bore 90, and having projections 92^a, 93^a and 94^a

adapted to be seated in the openings 92, 93 and 94, heretofore described. The retaining-ring is held in place by screws 100 let through openings 101 in the sleeve 88 and threaded into said ring, as at 102. In this arrangement the blades or vanes, during the rotation of the rotor, move and function in the same manner as heretofore described. It is to be understood that either rotor and blade construction above described, may be used, as may be desired, within the spirit and scope of my invention.

By the construction and arrangement heretofore described, I provide a pump which will have great capacity as to volume of gas or liquid handled during one revolution of the rotor and blades carried thereby. This is due to the fact that since the cylinders C, c, Fig. 4, reach their point of maximum displacement simultaneously, the total displacement of these two cylinders may represent approximately one-fifth to one-fourth of the gross volume enclosed within the casing 2, and since a point of maximum displacement is reached by the two opposing cylinders of the inner and outer group four times in each revolution of the shaft, in the case of a pump having four vanes, it will be noted that the total combined displacement of all the chambers of the pump during one revolution may well approximate the gross volume enclosed by the casing 2, regardless of the apparent loss due to the presence of the mechanism shown within said casing.

Another advantage of the pump embodying my invention is, that being rotary, it is capable of being operated at high speeds in contradistinction to a reciprocating pump, and thereby adding to its effectiveness and capacity. A further advantage is that the invention readily finds its embodiment in a structure employing simple ports, as distinguished from valve mechanisms and their attendant complications.

It will be evident that the dimensions of the various elements may be ascertained and fixed in order to best secure the desired pump capacity, that is, the internal diameter of the casing, the length thereof, the external and internal diameters of the rotatable element 55, and the diameter of the rotor 37, may be so determined and varied within wide limits as to produce a pump of the desired capacity.

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

1. In a structure of the character described, a cylinder, a cylindrical bearing member concentric with said cylinder, a cylindrical rotor sleeve mounted on said bearing member, vanes having their inner ends supported on said rotor sleeve for movement relative to each other and having their outer ends adjacent the cylinder wall, a rotatable driving member surrounding the rotor sleeve

and eccentric to said cylinder, said member internally making contact with the rotor sleeve and externally making contact with the inner peripheral wall of the cylinder
 5 and having openings through which said vanes extend, said rotatable driving member together with the rotor sleeve and cylinder forming chambers inside and outside of said member, each of said chambers having inlet
 10 and outlet ports located respectively on opposite sides of the point of contact of the driving member with the rotor sleeve and the cylinder, and a driving shaft having driving connection with said rotatable mem-
 15 ber.

2. In a structure of the character described, a cylinder, a rotor concentric with said cylinder, vanes carried on the rotor and having their outer ends adjacent the
 20 cylinder wall, a rotatable member surrounding the rotor and eccentric to the cylinder and together with the rotor forming chambers inside and outside said member, said member having openings therethrough, os-
 25 cillating slotted sleeves arranged in said openings, said vanes projecting through said sleeves, and inlet and outlet means communicating with said chambers.

3. In a structure of the character described, a cylinder, a cylindrical rotor in the cylinder, vanes having arc-shaped shoes seated on the periphery of the rotor, said
 30 shoes being movable circumferentially on the rotor and said vanes having their outer ends adjacent the cylinder wall, means for holding said vanes on the rotor, a rotatable member surrounding the rotor and eccentric
 35 to the cylinder and together with the rotor and the cylinder forming chambers inside and outside said member, said member having openings through which said vanes extend, and inlet and outlet means communicating with said chambers.
 40

4. In a structure of the character described, a cylinder, a cylindrical rotor in the cylinder, vanes having arc-shaped shoes seated on the periphery of the rotor, said
 45 shoes being movable circumferentially on the rotor, retaining means overlying said shoes to hold said shoes on the rotor, a rotatable member surrounding the rotor and eccentric to the cylinder and having openings
 50 through which said vanes extend, said mem-

ber, together with the rotor and the cylinder, forming chambers inside and outside said 55 member, and inlet and outlet means communicating with said chambers.

5. In a structure of the character described, a cylinder, a cylindrical rotor in the cylinder, vanes carried on and extending 60 radially of the rotor and having rigid arc-shaped shoes seated on the periphery of the rotor, said shoes being movable circumferentially on the rotor, means for holding said shoes on the rotor, a rotatable member sur- 65 rounding the rotor and eccentric to the cylinder and having openings through which said vanes extend, said member, together with said rotor and the cylinder, forming chambers inside and outside said member, 70 and inlet and outlet means communicating with said chambers.

6. In a structure of the character described, a cylinder, a cylindrical rotor in the cylinder, vanes having arc-shaped shoes seated 75 on the periphery of the rotor, said shoes being movable circumferentially on the rotor, a retaining sleeve surrounding the rotor and having members overlying said shoes, and a rotatable member surrounding the 80 rotor and eccentric to the cylinder and having openings through which said vanes extend, said member, together with said rotor and the cylinder, forming chambers inside and outside said member. 85

7. In a structure of the character described, a cylinder, a cylindrical rotor in the cylinder, vanes having arc-shaped shoes seated on the periphery of the rotor, said 90 shoes being movable circumferentially on the rotor, a retaining sleeve surrounding the rotor and having members overlying said shoes to hold the vanes in place on the rotor, said sleeve having slots through which the 95 vanes project, a retaining-ring closing the ends of the slots in said sleeve, a rotatable member surrounding the rotor and eccentric to the cylinder and having openings through which said vanes extend, said member, to- 100 gether with the rotor and the cylinder, forming chambers inside and outside said member, and inlet and outlet means communicating with said chambers.

In witness whereof, I have hereunto subscribed my name.

EDWARD LUPFER AURAND.