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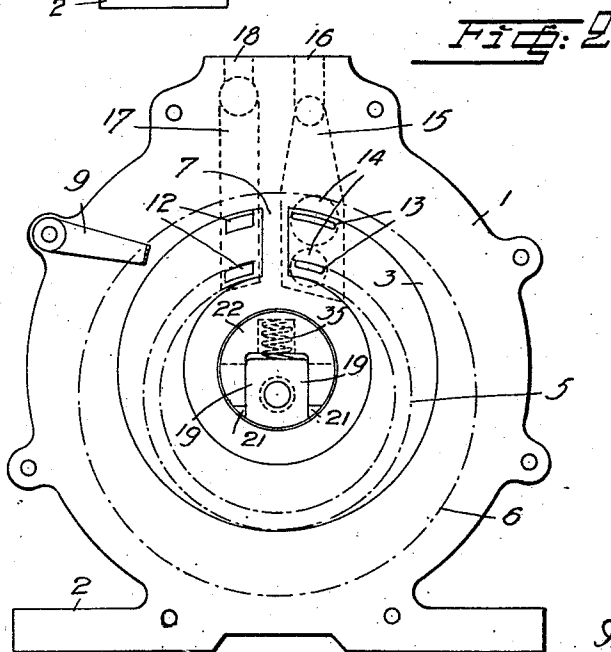
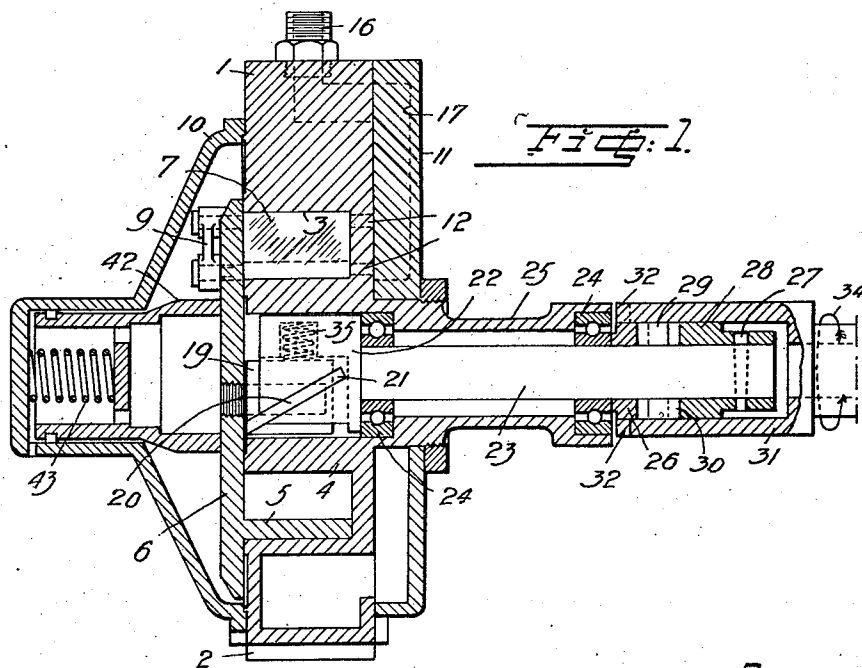
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ROTARY MACHINE.

Filed April 27, 1928

3 Sheets-Sheet. 1



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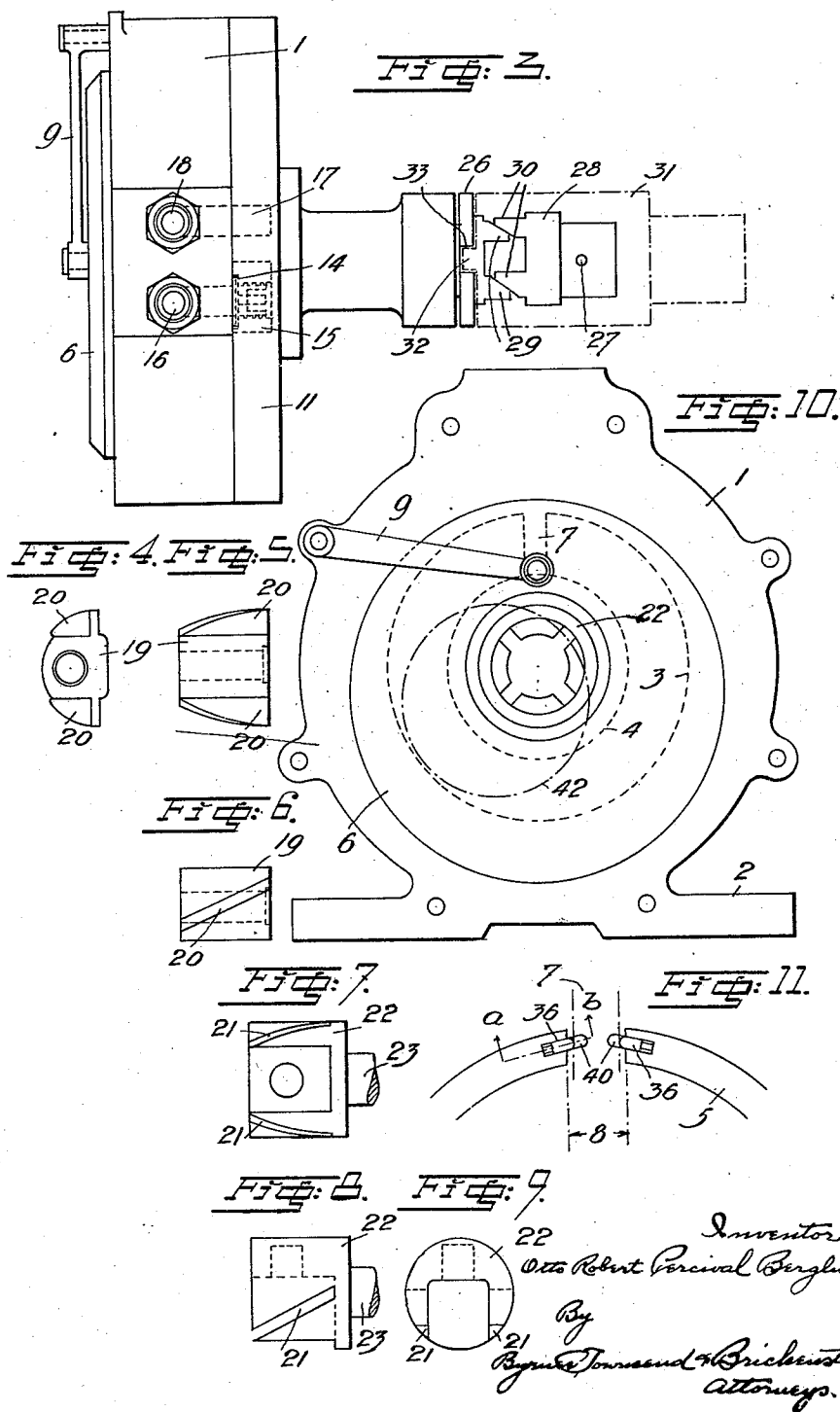
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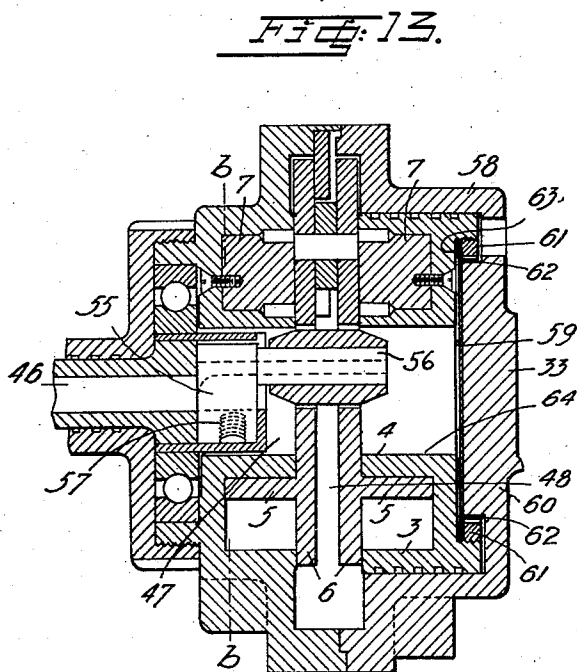
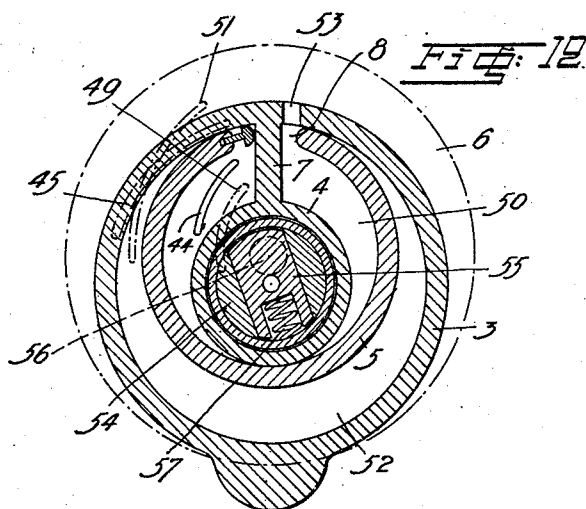
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ROTARY MACHINE

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3 Sheets-Sheet. 3



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UNITED STATES PATENT OFFICE

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ROTARY MACHINE

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The present invention comprises a rotary machine serviceable as a motor, pump or compressor, of the type where the principal active members consist of two concentric parts fixedly arranged relatively to each other, and of an annular piston which is movable eccentrically relatively to the concentric parts and tightens against the latter, said piston being provided with a cover plate bearing tightly against the edges of the concentric parts cooperating with the piston, said cover plate having such an extension that the plate will be constantly situated with its circumference outside the inner side of the outer one of the two concentric members.

In this kind of machine, as in rotary machines generally, the main condition for obtaining a calculated efficiency is, that effective tightening shall prevail between the parts movable relatively to each other. Thus, a tight fit should be effected in the machine in question, not only between the eccentrically movable piston and the concentric members in the places where the latter are in contact with each other, but the cover plate carried with the piston should also be tightly connected to its bearing surfaces.

Measures should also be taken to the effect that the high pressure acting on the high pressure side of the piston, that is to say on the one side of the center, will be counteracted in its tendency to bend the cover plate sideways, so that it will not, on the high pressure side, be removed from its bearing position in contact with the concentric members, as otherwise leakage could occur between said members and the plate.

The conditions for a tight fit as set forth above are fulfilled in a simple and entirely satisfactory manner through the arrangement according to the present invention which, throughout, aims at bringing about a really effective tightening of the motor, to obtain an efficiency as high as possible.

Primarily, the invention relates to an arrangement whereby safe tightening is effected, first, in a radial direction between the eccentrically movable piston and the concentric parts in contact therewith, and, second, in an axial direction between the cover plate

of the piston and the concentric parts. This arrangement is principally characterized by the fact that there is provided between the piston and the member on which it exerts a driving action, or by which it is driven, a movable connection of such a nature that, when a turning moment is produced between the piston and the driven or the driving member, the said connection will have a displacing action on the piston, so that it is caused to bear tightly against the tightening surfaces or places. This displacement may be effected axially or radially to effect tightening in one of these directions, or, it may take place both axially and radially to effect tightening in both directions.

The arrangement will be described more fully with reference to the accompanying drawings, which illustrate a few embodiments of the invention by way of example.

Fig. 1 shows a longitudinal section of a rotary machine arranged as a compressor.

Fig. 2 is an endwise view of the machine, one side of the casing and the piston being removed.

Fig. 3 is an upper plan view of the machine, the one side of the casing being removed.

Figs. 4-9 represent details of the connection effecting displacement of the piston into a tightening position, such connection being situated between the piston and the driving or the driven member.

Fig. 10 is an endwise view of the machine, the plate of the casing covering the piston being removed.

Fig. 11 shows the slot provided in the piston, provided with tightening strips inserted into the edges of the slot and viewed in an axial direction.

Fig. 12 is a cross-section on line *b-b* in Fig. 13 of the machine with means to bring about an expansion or compound action, when the machine is working as a motor.

Fig. 13 shows an axial section of the machine arranged according to Fig. 12 and provided with two eccentrically movable pistons.

1 designates the frame of the machine, carried by the base plate 2 and made integral with the concentric parts 3 and 4. 5 is the eccentrically movable piston cooperating with

the last-mentioned parts, said piston being made integral with the cover plate 6 bearing with the inside tightly against the edges of the parts 3 and 4 and covering the annular working space between said parts, no matter what position the piston 5 may assume. 7 is a rigid partition provided between the two parts 3 and 4, said partition entering a corresponding axial opening 8 (Fig. 11) in the piston 5. 9 is a guiding link movably arranged between the frame 1 and the piston 5 or the plate 6 respectively, said link guiding the piston during its movement and preventing the edges of the piston opening 8 with its tightening strips from being firmly pressed against the partition 7. The side of the frame 1 corresponding to the piston plate 6 is covered by the cover 10, while the opposite side is covered by the cover 11. Provided on the one side of the wall of the partition 7, in the bottom of the annular working space, are openings 12 (Fig. 2) which, when the machine is arranged as a compressor, form inlets for the air. On the opposite side of the partition 7 there are provided outlet openings 13 closed by spring actuated valves 14 which prevent entrance of air from the outside into the working space. Provided in the cover 11 is a space 15 extending over the two valves 14 and the openings 13, said space 15 communicating with the outlet 16. The inlet openings 12 are covered by a space 17 which, likewise, is arranged in the cover 11, and communicates with the inlet 18. It is previously known and need not here be described in detail how the two pairs of inlet and outlet openings 12 and 13 respectively cooperate alternately with the piston 5, so that the supply and the discharge take place into and out of the separated compartments of the working space respectively.

The mechanism forming the principal feature of the invention and which in the embodiment according to the drawing actuates the piston 5 so as to cause it to bear tightly both in the axial and in the radial direction, is arranged in the following manner. A square-head 19 is centrally connected with the piston and its plate 6 in such a manner as to be uniformly carried with the piston in the movement of the latter. From the opposite sides of the head 19, guide-wings 20 project obliquely with respect to the axis of rotation. Said guide-wings 20 enter into correspondingly shaped oblique slots 21 (Figs. 7 and 8) in a preferably cylindrical part 22 in such a manner as to be displaceable therein, said part 22 being rigidly connected with the shaft 23, which latter is carried by bearings 24 attached in the part 25 integral with the frame 1. Threaded onto shaft 23 is a member 26 which is rotatable and displaceable on the shaft and abuts against the outside of the outer bearing 24. Outside the part 26, a member 28 is threaded onto the

shaft 23 and secured by means of a cotter 27. The ends of the parts 28 and 26 directed towards one another are provided with oblique teeth 29 and 30 respectively cooperating in the manner disclosed in Fig. 3. Threaded onto the outside of the part 28 is a member 31 engaging by means of two diametrically opposed abutments 32 at the inner end of said member into corresponding recesses 33 provided in the member 26, which is rotatable and displaceable on shaft 23. Attached to the member 31 is a belt pulley, a toothed wheel or the like, or, the member may be directly coupled to a motor.

The arrangements last described operate in the following manner:

Under the condition set forth above, i. e. the machine operating as a compressor or, if desired, as a pump, motive power is transmitted through the belt pulley, toothed wheel or the like connected with the member 31, or from the motor coupled to said member. The member 31 will then rotate in the direction of the arrow 34 in Fig. 1. The member 26 is then entrained in the rotation of member 31. The oblique teeth 29 of the member 26 then actuate the oblique teeth 30 of the member 28 attached to the shaft 23, whereby the latter is displaced longitudinally to the right according to Fig. 1. The member 22 is brought along in the displacement. The engagement between the slots 21 of the member 22 and the guide-wings 20 of the head 19 entering therein, in the first place results in that the piston 5 with its plate 6 is carried along in the displacement, so that the plate 6 is caused to bear tightly against the corresponding tightening surfaces of the concentric parts 3 and 4. The friction then required between the slot 21 and the guide-wings 20 is ensured by a spring 35 inserted into the member 22 and bearing against the head 19. After the cover plate 6 has been brought into rigid engagement in the manner described, displacement of the shaft 23 continues consequent to the engagement between the oblique teeth 29 and 30, and inasmuch as the piston 5, with the plate 6 bearing tightly against its tightening surfaces, cannot take part in the displacement any longer, this results in that the member 22, while overcoming the friction between its slots 21 and the guide-wings 20, actuates the latter so that the same will, through the medium of the head 19, displace the piston 5 radially, that is to say downwards into the position occupied by the piston in Fig. 1, whereby the piston is caused to bear tightly against the concentric parts 3 and 4 at the bearing points on the latter. Thus the piston 5 and the cover plate 6 have been brought to bear tightly in an axial as well as in a radial direction by means of the movable connection between the piston and the member driving the same. This tight fit is of course maintained con-

stantly during the movements of the piston and the piston plate, irrespective of the positions occupied by them during these movements.

5 The arrangement above described may also be devised in another way. Thus, in place of the members 29 and 30 effecting the displacement of the shaft 23, there may be provided in the shaft, one or more threads or
10 one or more helical slots engaging the driven or the driving member in such a manner that the shaft will, on a turning moment being produced, be actuated for displacement through the medium of the helical slots.

15 According to Fig. 11, tightening strips 36 are inserted into the edges of the interstice 8 of the piston 5, said tightening strips 36 bearing, with their inner edges directed towards each other, against both sides of the partition 7 attached between the concentric
20 parts 3 and 4.

On the one side of the center (the right side according to Fig. 1), a high pressure prevails during the operation of the machine, which pressure is greater than that prevailing
25 on the opposite side. Therefore, the cover plate 6 will be actuated from within the working space on the high pressure side in such a manner as to be liable to be displaced on the high pressure side from the
30 tightening surface against which it is bearing. If this pressure is allowed to remain, that is to say, if it is not counteracted in some way or other, a leak will be produced at the high pressure side between the plate and its
35 bearing surface. To prevent this, there is provided a special balancing means according to the invention. This means may be devised by providing one or more openings at the side opposite to the high pressure side, in
40 or adjacent to the tightening surface provided there. Said openings communicate with the high pressure conduit of the machine in such manner that the pressure acting through the openings will actuate the
45 plate from the inside by the same amount as the previously mentioned pressure on the high pressure side, whereby, consequently, the plate will be balanced in its bearing so as to bear flush against the tightening surfaces
50 in the tightening position.

In the drawing, another arrangement is shown as effecting this balancing action. According to Fig. 1, the edge of a bell 42 bears
55 against the outside of the plate 6, said bell 42 being kept in tight contact with the plate by means of a spring 43. According to the position shown in chain-dotted lines in Fig. 10, the bell should be situated eccentrically
60 in relation to the plate 6, displaced over toward the side opposite to the high pressure side. Hereby the high pressure side will be uncovered to a greater extent than the opposite side, which latter is covered over a great
65 portion by the bell. The result of this is, that

if the cover plate 6, while yielding to the pressure on the high pressure side, is removed from its tightening position on the said side and the high pressure, by reason of leakage, consequently becomes active also on the out-
70 side of the plate, this pressure will act on the uncovered larger surface of the plate 6, which latter will thus be moved back into tightening position under the action of the pressure. In order to enable effecting a temporary in-
75 crease of the balancing action last described, the bell 42 may be movable in a suitable manner with respect to the center along the outside of the cover plate 6. The arrangement with the bell can also be utilized in other
80 ways, i. e. so that the bell is filled on the inside with a high pressure medium, or is evacuated as by a conventional duct leading to the discharge or intake of the pump, so that the pressure on the surface covered by the
85 bell can be greater or smaller than the pressure on the surface surrounding the bell. The position of the bell relative to the center must then obviously be adjusted in each particular case.

If desired, the bell may be replaced by a
90 diaphragm mounted on a ring or the like which is suitably connected with the casing.

According to Fig. 12, where the machine is arranged as a motor, the cover plate 6 is pro-
95 vided on the inside with two groove-shaped channels 44 and 45. Channel 44 is arcuate with the same radius of curvature as the part 4, and channel 45 has the same radius of curvature as the member 3. The driving medium, which according to Fig. 13 is supplied
100 through the tubular shaft 46, enters the central space 47 as well as the chamber 48 communicating therewith. According as the piston 5 moves together with the plate 6, the channels 44 and 45 provided in the latter alter
105 their position so as to be periodically covered by the members 4 and 3 respectively, with the edges of which they are then caused to coincide, and so as to periodically cross the said
110 edges or be brought into a position outside the same. In the position indicated by the chain-dotted lines 49 in Fig. 12, channel 44 crosses the edge of member 4 and is then situated with its one end within the central space 47
115 and with its other end within the working space 50. Channel 44 then mediates the flow of the driving medium from the central chamber 47 to the working space 50. On the same occasion, channel 45 crosses the edge of mem-
120 ber 3 and enters with its one end into the outer working space 52 and with its other end into the chamber 48, and mediates the transfer of the driving medium from the latter chamber into the working space 52. Both
125 working spaces 50 and 52 will thus be partly filled with driving medium under full pressure, such driving medium then expanding with the same effect in both spaces and escaping, on having performed the work, through
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the opening 8 between the end edge of the piston 5 and the wall 7 and, further, out through the opening 53 in the member 3.

Instead of admitting driving medium into the two working spaces under full pressure as described hereinabove, the work of the motor may be performed on the expansion- and compound principle. The inner working space 50 is then cut off outwardly, and the driving medium is admitted under full pressure in the manner previously described, by means of the channel 44, and expands to a certain extent within the space. An outlet opening provided in the plate 6 is then uncovered so as to allow the partly expanded driving medium to escape into a chamber outside the plate 6, whence it enters the outer working space 52, either through the medium of the channel 45 in the manner previously described, or, direct through an opening in the plate 6.

Diametrically movable in the crank disk 54 rigidly connected with the motor shaft is a slide 55 which is connected with the piston 5 by means of a crank pin 56. Inserted between the slide 55 and a part of the crank disk 54 is a spring 57 actuating the slide 55 and the crank pin connected therewith, in such a manner as to keep the piston pressed constantly, thus also during the movement of the piston, against the concentric members 3 and 4.

The direction of displacement of the slide 55 extends obliquely in relation to the straight line through the center of the crank disk 54 and the crank pin 56, whereby displacement of the piston is effected toward the points of contact between the same and members 3 and 4.

Fig. 13 discloses two motor aggregates arranged in the manner above described, said motor aggregates being situated beside each other in the axial direction. The one aggregate is adapted to be displaced axially within the casing 58, it being then possible to approach the two aggregates in the requisite manner toward each other in the direction of the motor shaft. To promote this adjustment, the displaceable aggregate is connected with a diaphragm 59 abutting against the part 33 connected with the casing 58. The support 33 does not extend as far out as to the edge attachment 61 of the diaphragm, the latter being free over a certain width inside said attachment 61. The pressure on this uncovered portion 62 and the equally great pressure on the opposite surface 63 of the motor aggregate situated on the inside balance each other and, consequently, do not bring about any deformation of the diaphragm. On the other hand, the pressure prevailing on the inside of said surfaces, which pressure acts upon the diaphragm and its rigid support on the one side, results in that the motor aggregate is displaced in-

wardly, the uncovered portion 62 of the diaphragm then yielding inwards. The drawing shows the support 60 as bearing flush against the diaphragm, but instead the bearing surface may be convex or concave, or have some other outline deviating from the plane shape.

What I claim is:—

1. A rotary machine comprising the combination with an annular casing, of a piston eccentrically movable therein and bearing against the inside surface thereof, a cover member carried by said piston and bearing against said casing, driving means, and mechanical means comprising a member carried by said driving means operative upon the actuation of said driving means to axially move said piston and cover to cause them to bear tightly against their respective bearing surfaces.

2. A rotary machine comprising the combination with an annular casing, of a piston eccentrically movable therein and bearing against the inside surface thereof, a cover member carried by said piston and bearing against said casing, driving means, and means operative upon the actuation of said driving means to axially move said piston and cover to cause them to bear tightly against their respective bearing surfaces, said last named being active upon a continued movement of said driving means to move said piston and cover radially.

3. A rotary machine comprising the combination with an annular casing of a piston eccentrically movable therein and disposed against the inner surface thereof, a cover carried by said piston and bearing against the edge of said casing, a drive shaft and mechanical means comprising a member carried by said shaft active upon a varying movement between said shaft and said cover for causing a correspondingly varying pressure on said disk to move the disk and piston axially to bear tightly against their respective bearing surfaces.

4. The invention as set forth in claim 3 wherein said means comprises a set of cooperating cam surfaces, an intermediate shaft and a pair of relatively movable guide surfaces disposed between said intermediate shaft and said cover.

5. The invention as set forth in claim 3 wherein is provided a cupped member cooperating with said casing to enclose said cover, a member disposed within said cupped member eccentrically with respect to said cover and coaxially with respect to said casing and having an annular surface contacting with said cover, and a single spring disposed between said member and coaxially with respect to said casing for pressing said cover against said casing.

6. In a rotary machine the combination with an annular casing of a piston movable

therein, and disposed to bear against the inner surfaces of said casing, a cover carried by said piston and disposed to bear against the casing, a drive shaft and means comprising a mechanical coupling between
5 said shaft and said piston for axially moving said piston and cover to cause them to bear tightly against their respective bearing surfaces.

10 7. In a rotary machine the combination with an annular casing of a piston movable therein, and disposed to bear against the inner surfaces of said casing, a cover carried by said piston and disposed to bear against
15 the casing, means for axially moving said piston and cover to cause them to bear tightly against their respective bearing surfaces, and means including a guide disposed obliquely with respect to the axis of said piston for causing it to move radially.

20 In testimony whereof I affix my signature.

OTTO ROBERT PERCIVAL BERGLUND.

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