June 29, 1948. S. O. STAGEBERG 2,444,234

ROTARY CYLINDER PUMP

Filed June 28, 1943 2 Sheets-Sheet 1

Fig. 3

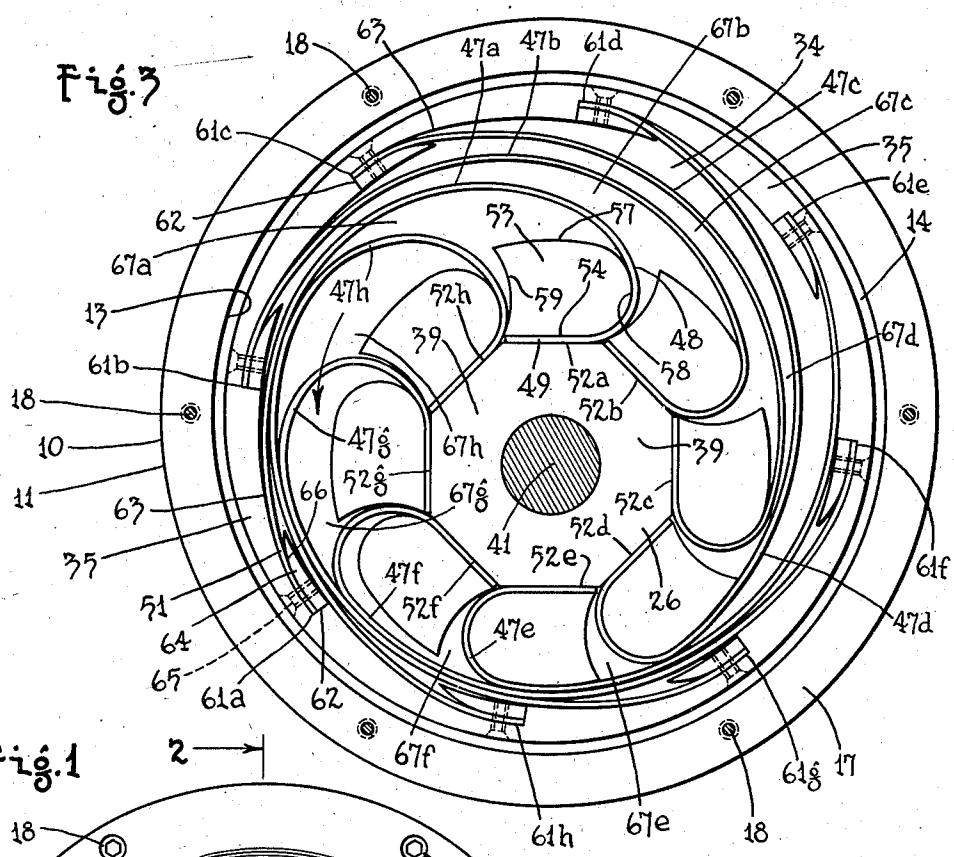
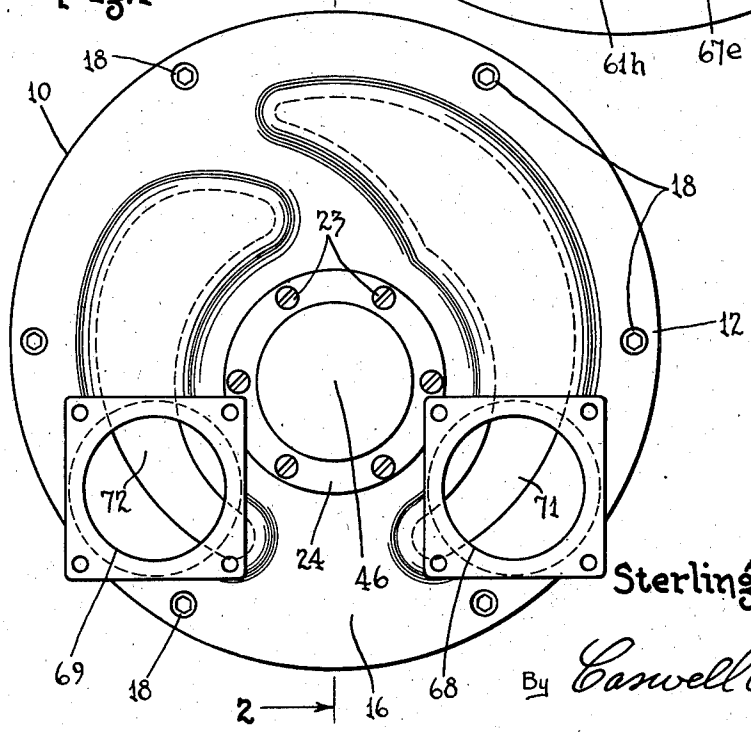



Fig. 1




Inventor

Sterling O. Stageberg

By Caswell & Lagaard

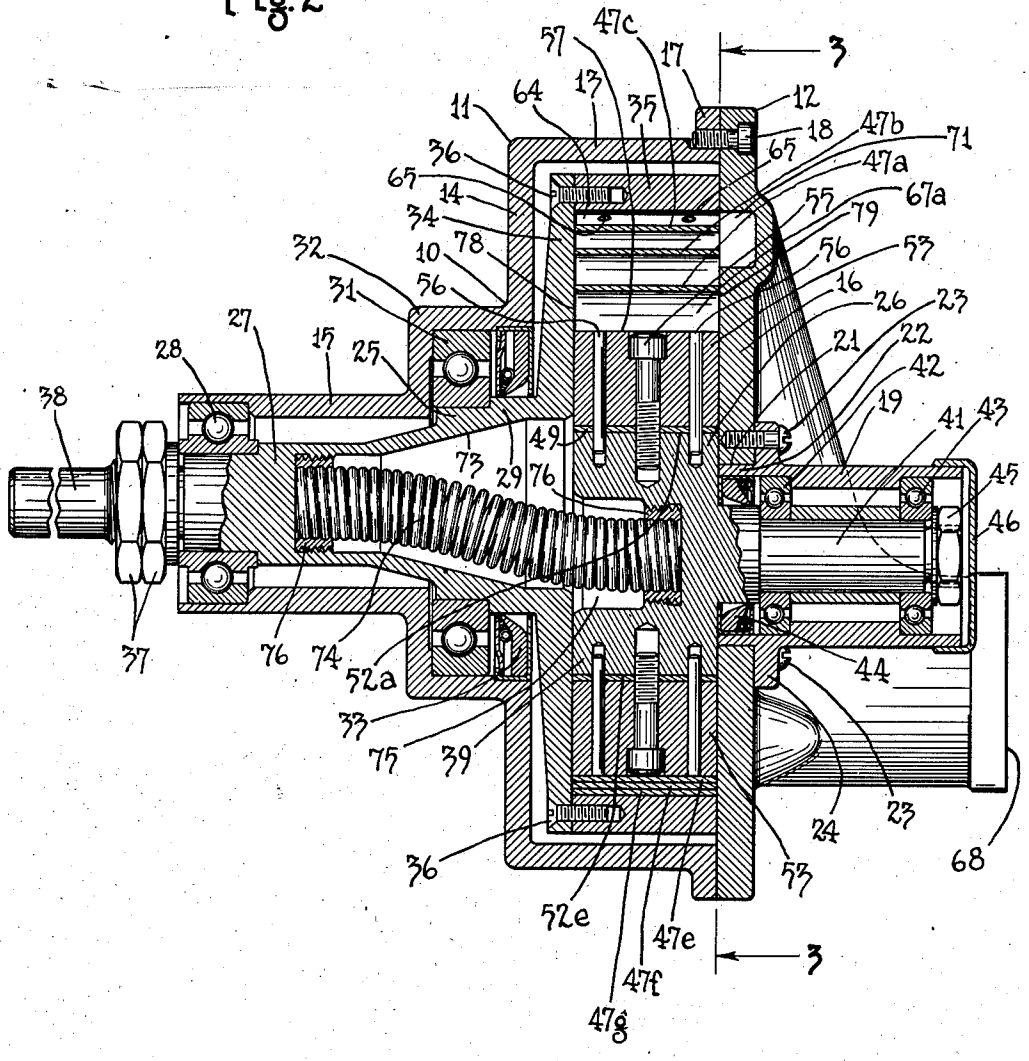
Attorneys

June 29, 1948. S. O. STAGEBERG 2,444,234

ROTARY CYLINDER PUMP

Filed June 28, 1943 2 Sheets-Sheet 2

Fig. 2




Inventor

Sterling O. Stageberg

By Caswell & Lagaard

Attorneys

Patented June 29, 1948

2,444,234

# UNITED STATES PATENT OFFICE

2,444,234

## ROTARY CYLINDER PUMP

Sterling O. Stageberg, Minneapolis, Minn.

Application June 28, 1943, Serial No. 492,505

10 Claims. (Cl. 103—121)

1

My invention relates to pumps and particularly to pumps of the vane type and has for an object to provide a pump in which the vanes and other parts forming the expansible chambers require no lubrication.

An object of the invention resides in providing a pump having two relatively movable displacement members with facing surfaces, portions of said surfaces being adapted to approach and recede from one another upon relative movement of said members and in providing vanes rigidly attached at their extremities to said members at said surfaces.

Another object of the invention resides in constructing the vanes from resilient material.

An object of the invention resides in arranging the vanes in the form of a loop.

A feature of the invention resides in utilizing a clamp member for securing the extremities of the vanes to the displacement members.

Another object of the invention resides in constructing the clamp members with backing surfaces attached to engage the vanes and to limit the flexure of the vanes adjacent the localities of attachment of the vanes to the displacement members.

A still further object of the invention resides in constructing the pump with an inlet and an outlet and with ports communicating therewith and shaped to conform to the shape of the expansible chambers between the vanes.

Another object of the invention resides in providing a pump having two rotatable displacement members, each rotating in balanced relation about its own axis, the axis of said displacement members being non-coincidental.

Another object of the invention resides in providing driving means for driving one of said displacement members to cause operation of the other displacement member through the vanes connected to the displacement members and in further providing transmission means for preventing reverse relative movement between said displacement members to prevent buckling of the vanes.

A feature of the invention resides in utilizing as said transmission a torsional coil spring connected to said displacement member and twisted to maintain certain of said vanes in tension.

Other objects of the invention reside in the novel combination and arrangement of parts and in the details of construction hereinafter illustrated and/or described.

In the drawings:

Fig. 1 is an elevational view of a pump illustrating an embodiment of my invention.

2

Fig. 2 is an elevational sectional view taken on line 2—2 of Fig. 1 and drawn to a somewhat larger scale.

Fig. 3 is an enlarged sectional view taken on line 3—3 of Fig. 2 and drawn to the same scale as Fig. 2.

While I have described my invention as a pump, it is to be understood that the invention may be embodied in any type of device having expansible chambers, such as a pump, compressor, motor or similar structure and that the word "pump," when used in the specification, should be so interpreted.

My invention comprises a case 10 constructed with two sections 11 and 12. The section 11 has a circumferential wall 13 and a radial wall 14 connected therewith. Issuing from the radial wall 14 and concentric with the circumferential wall 13 is a tubular boss 15. The section 12 comprises a radial wall or end plate 16 which overlies a flange 17 formed on the circumferential wall 13 of section 11 and which is secured thereto by means of cap screws 18. The wall 16 has issuing from it a tubular boss 19 similar to the boss 15. This boss may be integral with the plate 16 or the same may be detachable therefrom as shown in the drawings. In such case, the wall 16 is constructed with a bore 21 which receives the end 22 of the boss 19. A number of screws 23 extend through a flange 24 on the boss 19 and are screwed into the plate 16 for holding the said boss attached thereto.

Within the interior of the case 10 are mounted two displacement members 25 and 26 which are mounted for relative movement and constructed in the following manner.

The displacement member 25 comprises a shaft 27 which extends through the boss 15 and is journaled at its outer end in a ball bearing 28 mounted at the outer end of said boss. This shaft has an enlarged portion 29 extending inwardly from the bearing 28 which, in turn, is journaled in a ball bearing 31 mounted in an offset 32 in the boss 15. An oil seal 33 retains the lubrication within the bearing 31 and prevents the same from flowing into the operating mechanism of the device. The displacement member 25 further includes an end plate 34 which has an annulus or ring 35 secured thereto by means of screws 36 which extend through the plate 34 and are threaded into the ring 35. The ring 35 is concentric with the axis of the shaft 27. The shaft 27, through the action of the ball bearing 28 and 31, is guided for rotational movement about an axis concentric with that of the ring 35. Axial movement of the said shaft may be eliminated by means of nuts

37 which take up the play in the bearings 28 and 31 in the customary manner. The extreme end 38 of shaft 37 projects outwardly beyond the case 10 and has a pulley, gear or other driving member attached thereto and by means of which the pump may be driven.

The displacement member 26 consists of a hub 39 which has issuing from it shaft 41. Shaft 41 is journaled in two ball bearings 42 and 43 mounted in the boss 19. An oil seal 44 retains the lubricant within the two bearings 42 and 43. Play in the bearings 42 and 43 is taken up by means of a nut 45 screwed upon the end of shaft 41. The shaft 41 terminates at the end of the boss 19 which is closed by means of a cap 46 secured to the extreme end thereof. As will be noted in Fig. 2, the axis of the shaft 41 is eccentric with reference to the axis of the shaft 27 but parallel thereto.

Between the hub 39 and the ring 35 are mounted a number of flexible vanes 47*a*, 47*b*, 47*c*, etc. Inasmuch as these vanes are identical in construction, and attached to the two displacement members in identically the same manner, only the vane 47*a* and its mode of attachment will be described in detail. The vanes are constructed from flexible material such as rubber impregnated fabric, leather, flexible metals, or any of the rubber substitutes now well known in the art. Applicant has found that ordinary rubber belting of suitable thickness and rigidity will serve the purpose. The vane 47*a* is constructed as a ribbon and extends spirally between the hub 39 and the ring 35. The said vane is looped as designated at 48 and the two extremities 49 and 51 of said vane extend in the same rotational direction, namely, counter-clockwise, as viewed in Fig. 3. The hub 39 is polygonal in form, having a number of flat sides 52*a*, 52*b*, 52*c*, etc., one for each of the vanes 47*a*, 47*b*, 47*c*, etc. In the instant exemplification of the invention, there are eight vanes and, accordingly, the hub 39 is constructed with eight sides 52*a*, 52*b*, 52*c*, etc. The extremity 49 of the vane 47*a* overlies the surface 52*a* of hub 39 and is secured thereto by means of a clamp member 53. This member has a flat surface 54 overlying the extremity 49 of vane 47*a* and is bolted to the hub 39 by means of a bolt 55 shown in Fig. 2. Dowel pins 56 which extend through said clamp member and into the hub 39 retain the clamp member in proper position upon the hub. The clamp member 53 is constructed with a slightly convex curved outer surface 57, a highly convex curved surface 58 at one end thereof merged into the surface 57 and a concave surface 59 at the other end thereof. The clamp member 53, in addition to holding the end of the vane 47 in position, serves as a backing member and the surfaces 57 and 58 form backing surfaces for the portion of the vane 47 adjacent the extremity 49, so that when the vane 47*a* is in the position of the vane 47*e*, said portions of the vane extend along said surfaces and are restrained from further flexure thereby.

The opposite extremity 51 of the vane 47*a* is attached to the ring 35. For this purpose, the said ring is constructed with a number of recesses 61*a*, 61*b*, 61*c*, etc., which have radial ends 62 and spiraling surfaces 63 connected therewith. The extremity 51 of the vane 47*a* lies in the recess 61*a* and is attached to the ring 35 at such locality by means of a clamp member 64. A number of screws 65 extend through the ring 35 and are threaded into said clamp member, thus securely attaching the extremity 51 of the vane 47*a* to the said ring. The clamp member 64 has a spiraling surface 66 which recedes from the spiraling surface 63 and which forms a backing surface similar to the backing surfaces 57 and 58 of the clamp member 53. These surfaces limit flexing of the vanes at the localities of attachment to the displacement members and thereby increase the life of the vanes.

The eccentricity of the two shafts 27 and 41 is such that the various vanes 47*a*, 47*b*, 47*c*, etc., between the ring 35 and the lowermost clamp member 53 just fill such space. The other portions of said vanes loop outwardly from the clamp member 53 and form more or less crescent shaped chambers indicated at 67*a*, 67*b*, 67*c*, etc. The surfaces 59 of the clamp members 53 conform to the form of the loops 48 of the adjacent vanes 47*a*, 47*b*, etc., when in their most extended positions and help reduce the volume of the chambers 67*a*, 67*b*, etc., to a minimum when the vanes are collapsed.

Communicating with the various chambers 67*a*, 67*b*, 67*c*, etc., is an inlet 68 and an outlet 69. Crescent shaped ports 71 and 72 in the end plate 16 directly communicate with these chambers and also with said inlet and outlet.

In the shaft 27 and in the enlarged portion 29 thereof is formed a conical bore 73 shown in Fig. 2. A torsional coil spring 74 is disposed within this bore and within another bore 75 in the facing portion of the hub 39. This spring has secured to the ends of it bushings 76 which are screwed into the shaft 27 and the hub 39 at the ends of the bores 73 and 75, respectively. Prior to the assembly of the vanes 47*a*, 47*b*, 47*c*, etc., the spring 74 is tensioned by rotating the two displacement members 25 and 26 relative to one another and twisting said spring. The said members are then so hold during assembly. After assembly, said members are released and the spring 74 acts to tension the vanes and prevent buckling thereof during operation of the pump.

The operation of the invention is as follows: The hub 39 of displacement member 26 and the vanes 47*a*, 47*b*, 47*c*, etc., fit snugly between the facing surfaces 78 and 79 of the two plates or walls 34 and 16. A slight amount of clearance is provided, so that friction is minimized and the necessity for lubrication at these localities is eliminated. In Fig. 3, it will be noted that the chambers 67*a*, 67*b*, 67*c*, etc., while at the uppermost portion of the device, have a greater capacity than at the lowermost portion of the device and that the capacity increases from the bottom to the top and decreases from the top to the bottom. The port 72 communicates with said chambers while the same decrease in volume and receives the contents of said chambers. The port 71 communicates with said chambers while the same are increasing in volume and directs the fluid to be pumped into the same. In this manner, the rotation of the two displacement members 25 and 26 causes pumping action, drawing the fluid into inlet 68 and discharging it from outlet 69. In the operation of the pump, the displacement member 26 is driven by the displacement member 25 through the various vanes 47*a*, 47*b*, 47*c*, etc. It will be noted that the driving is effected through the vanes when they occupy positions similar to that of the vane 47*d* in the drawings. When the pump is in operation, the pressure within the various chambers and the tension on the vanes exerted through the driving of the member 26 by the member 25 causes the vanes to assume positions similar to those shown in Fig. 3,

During operation of the pump, the vanes follow along the surfaces 58 and 57 of the clamp members 53, along the surface 66 of clamp members 64 and along the surfaces 63 of the ring 35 which prevent undue flexing of the vanes at their localities of attachment and give long life to the vanes. The spring 74 restrains reverse relative movement of the displacement members relative to one another and prevents buckling of the vanes.

The advantages of the invention are manifest. No lubrication is needed for the movable parts forming the expansible chambers. The bearings for the shafts can be packed with lubricant and will not need attention. The pump has no valves. A great capacity for the size of the pump can be procured. By rotating both displacement members, each are rotated about its own axis and balanced so that undue vibration is eliminated. Due to the backing surfaces at the locality of attachment of the vanes to the displacement members, undue bending is prevented and long life is the result. The pump is quiet in operation and does not get noisy in use. There is a minimum amount of friction in the pump, so that for the particular type of pump, a maximum efficiency is procured.

Changes in the specific form of my invention, as herein described, may be made within the scope of what is claimed without departing from the spirit of my invention.

Having described my invention, what I claim as new and desire to protect by Letters Patent is:

1. In combination, two relatively movable displacement members, said members having facing surfaces, portions of said surfaces being adapted to approach and recede from one another upon relative movement of said members, a plurality of flexible vanes extending between said surfaces, clamp members engaging said vanes at their extremities and each secured to one of said displacement members for rigidly attaching said vanes to said displacement members, said clamp members having surfaces receding from the surfaces of the adjoining structure to form flaring recesses for the reception of said vanes, said vanes having free edges intermediate the localities of attachment to said members, walls having surfaces along which the free edges of said vanes move, said walls and vanes forming a plurality of expansible chambers and an inlet and an outlet successively communicating with said chambers upon relative movement of said displacement members.

2. In combination, two relatively movable displacement members, said members having facing surfaces, portions of said surfaces being adapted to approach and recede from one another upon relative movement of said members, a plurality of vanes, means for immovably attaching at definite localities an extremity of each of said vanes to one of said members at its denoted surface and the opposite extremities to the other of said members at its denoted surface, said vanes being formed with free edges intermediate the localities of attachment to said members, said vanes being flexible throughout their extent and bending in a direction extending from one locality of attachment to the other, means at the localities of attachment of the vanes to one of said displacement members and having surfaces extending up to the localities of attachment for limiting the degree of curvature of said vanes beyond such localities, walls having surfaces along which the free edges of said vanes move, said walls and vanes forming a plurality of expansible chambers and an inlet and an outlet successively communicating with said chambers upon relative movement of said displacement members.



3. In combination, two relatively movable displacement members, said members having facing surfaces, portions of said surfaces being adapted to approach and recede from one another upon relative movement of said members, a plurality of vanes, means for immovably attaching at definite localities an extremity of each of said vanes to one of said members at its denoted surface and the opposite extremities of said vanes to the other of said members at said surfaces and being formed with free edges intermediate the localities of attachment to said members, said vanes being flexible throughout their extent and bending in a direction extending from one locality of attachment to the other, and means providing backing surfaces extending to the localities of attachment of the vanes to one of said displacement members to prevent abrupt bending of the vanes at such localities, walls having surfaces along which the free edges of said vanes move, said walls and vanes forming a plurality of expansible chambers and an inlet and an outlet successively communicating with said chambers upon relative movement of said displacement members.

4. In combination, two displacement members having facing surfaces, means for guiding said members for rotation about different axes, to cause portions of said surfaces to approach and recede from one another, means for driving one of said members, a plurality of flexible vanes rigidly attached at opposite extremities to said members at said surfaces, said vanes serving to drive the second displacement member from the driven displacement member in the same direction of rotation, yieldable means for restraining reverse relative rotational movement between said displacement members, said vanes having free edges intermediate the localities of attachment to said members, walls having surfaces along which the free edges of said vanes move, said walls and vanes forming a plurality of expansible chambers and an inlet and an outlet successively communicating with said chambers upon relative movement of said displacement members.

5. In combination, two displacement members having facing surfaces, means for guiding said members for rotation about different axes, to cause portions of said surfaces to approach and recede from one another, means for driving one of said members, a plurality of flexible vanes rigidly attached at opposite extremities to said members at said surfaces, said vanes serving to drive the second displacement member from the driven displacement member in the same direction of rotation, a torsional coil spring acting between said members for restraining reverse relative rotational movement between said displacement members, said vanes having free edges intermediate the localities of attachment to said members, walls having surfaces along which the free edges of said vanes move, said walls and vanes forming a plurality of expansible chambers and an inlet and an outlet successively communicating with said chambers upon relative movement of said displacement members.

6. In combination, a displacement member having a cylinder, a second displacement member having a hub received within said cylinder, means for guiding said members for rotation about spaced axes, each concentric with one of said members, a plurality of looped flexible vanes rigidly attached at opposite extremities to said hub upon the exterior surface thereof and to said

cylinder upon the inner surface thereof, one of said members having a conical bore, a torsional coil spring disposed within said bore and connected to both said members for restraining reverse relative rotational movement between said displacement members, said vanes having free edges intermediate the localities of attachment to said members, walls having surfaces along which the free edges of said vanes move, said walls and vanes forming a plurality of expansible chambers and an inlet and an outlet successively communicating with said chambers upon relative movement of said displacement members.

7. In combination, two displacement members having facing surfaces, means for guiding said members for rotation about different axes, to cause portions of said surfaces to approach and recede from one another, means for driving one of said members, a plurality of flexible vanes rigidly attached at opposite extremities to said members at said surfaces, said vanes serving to drive the second displacement member from the driven displacement member in the same direction of rotation, a spring acting between said displacement members for restraining reverse relative rotational movement between said displacement members, said vanes having free edges intermediate the localities of attachment to said members, walls having surfaces along which the free edges of said vanes move, said walls and vanes forming a plurality of expansible chambers and an inlet and an outlet successively communicating with said chambers upon relative movement of said displacement members.

8. In combination, two displacement members having facing surfaces, means for guiding said members for rotation about different axes, to cause portions of said surfaces to approach and recede from one another, means for driving one of said members, a plurality of flexible vanes rigidly attached at opposite extremities to said members at said surfaces, said vanes serving to drive the second displacement member from the driven displacement member in the same direction of rotation, resilient torsional means acting between said members for restraining reverse relative rotational movement between said displacement members, said vanes having free edges intermediate the localities of attachment to said members, walls having surfaces along which the free edges of said vanes move, said walls and vanes forming a plurality of expansible chambers and an inlet and an outlet successively communicating with said chambers upon relative movement of said displacement members.

9. In combination, two relatively movable displacement members, said members having facing surfaces, portions of said surfaces being adapted to approach and recede from one another upon relative movement of said members, a plurality of flexible vanes extending between said surfaces and overlying portions of the same, said vanes being curved in their direction of extent between said surfaces, clamp members overlying said vanes



at their extremities and clamping said vanes to said members, said clamp members having curved surfaces diverging from the denoted surfaces of said displacement members, the curvature of said surfaces of said clamp members extending in the same general direction as the curvature of said vanes, said curved surfaces of the clamp members limiting the flexing of the vanes at their locality of attachment to the displacement members, said vanes having free edges intermediate the localities of attachment to said members, walls having surfaces along which the free edges of said vanes move, said walls and vanes forming a plurality of expansible chambers and an inlet and an outlet successively communicating with said chambers upon relative movement of said displacement members.

10. In combination, two relatively movable displacement members, said members having facing surfaces, portions of said surfaces being adapted to approach and recede from one another upon relative movement of said members, rotary means for procuring such movement between said members, a plurality of flexible vanes extending between said surfaces, said vanes being curved intermediate the localities at which said vanes leave said members, the curvature of said vanes varying during movement of said displacement members, clamps for attaching the ends of said vanes to said surfaces of said displacement members, said clamps being disposed upon the concave surfaces of said vanes and having convex surfaces for engagement with said vanes, said convex surfaces being continuous up to the locality at which said vanes leave the displacement members and diverging outwardly therefrom, said vanes having free edges intermediate the localities of attachment to said members, walls having surfaces along which the free edges of said vanes move, said walls and vanes forming a plurality of expansible chambers and an inlet and an outlet successively communicating with said chambers upon relative movement of said displacement members.

STERLING O. STAGEBERG.


## REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

| Number | Name | Date |
|---|---|---|
| 1,086,488 | Wachter | Feb. 10, 1914 |
| 1,818,430 | Ricardo | Aug. 11, 1931 |
| 2,064,635 | Stern | Dec. 15, 1936 |
| 2,122,352 | Rummel | June 28, 1938 |
| 2,241,824 | Meyerhoefer | May 13, 1941 |
| 2,336,344 | Bullard | Dec. 7, 1943 |

FOREIGN PATENTS

| Number | Country | Date |
|---|---|---|
| 249,587 | Great Britain | Mar. 29, 1926 |
| 448,903 | Great Britain | June 17, 1936 |