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ROTARY PUMP

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Fig. 1.

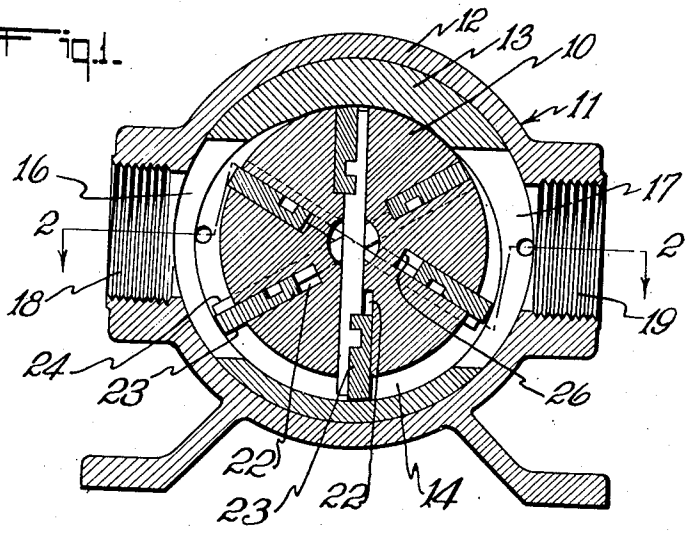
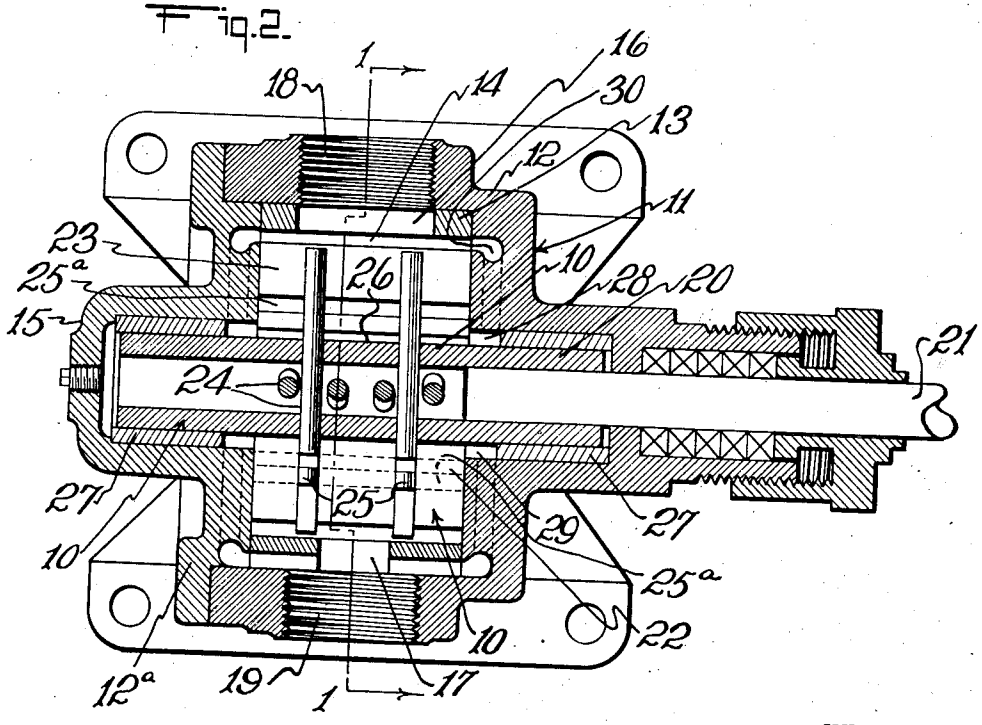


Fig. 2.



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Fig. 3.

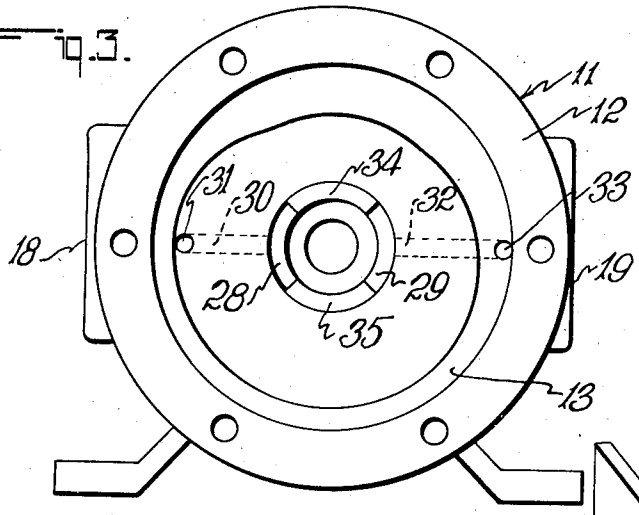


Fig. 5.

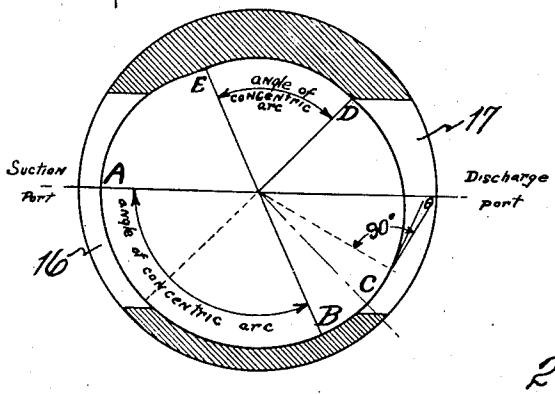


Fig. 4.

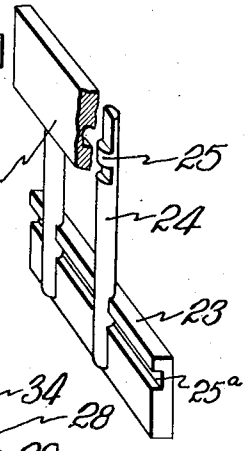


Fig. 7.

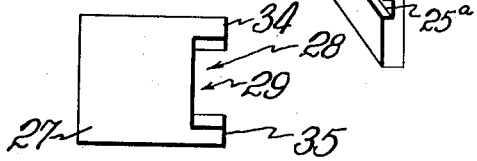
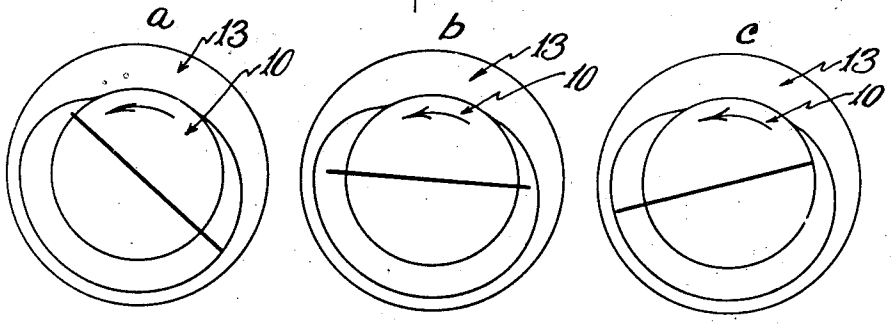


Fig. 6.



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Fig. 8.

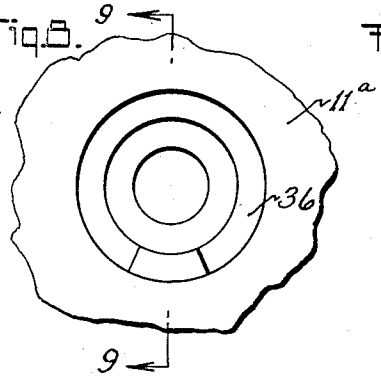


Fig. 9.

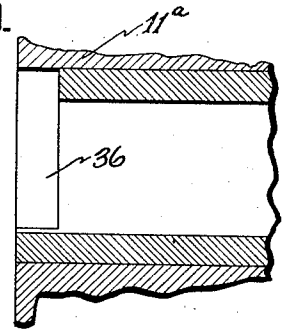


Fig. 10.

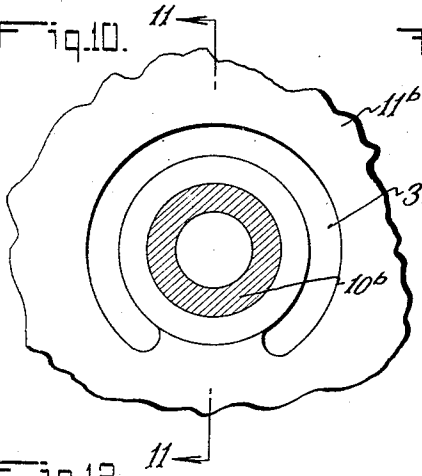


Fig. 11.

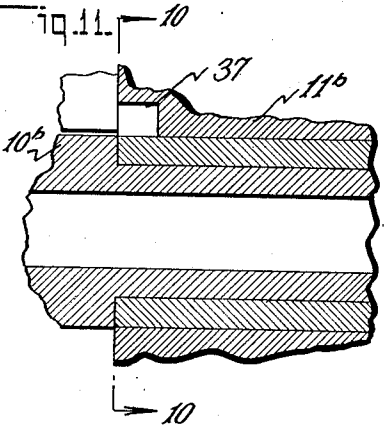


Fig. 12.

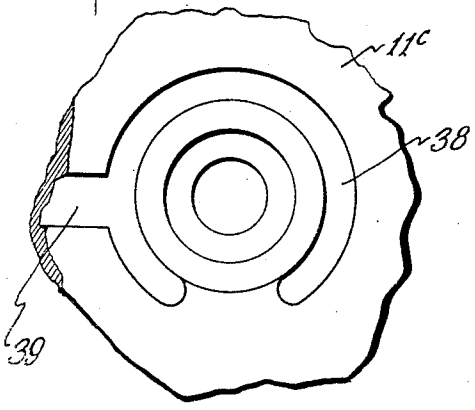
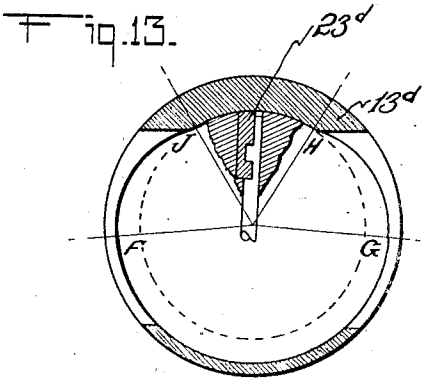


Fig. 13.



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UNITED STATES PATENT OFFICE

2,073,215

ROTARY PUMP

John Mann, Seneca Falls, N. Y., assignor to Goulds Pumps, Inc., Seneca Falls, N. Y., a corporation of New York

Application January 23, 1934, Serial No. 707,884

5 Claims. (Cl. 103—138)

This invention relates to rotary pumps and the like.

An object of the invention is to provide a rotary pump or the like which is simple and permanent of construction and which will efficiently and effectively perform the purposes for which it is intended.

A further object is to provide a rotary pump or the like wherein the vanes are subjected to a minimum of wear.

A still further object is to provide a rotary pump or the like which will operate smoothly and efficiently for a long time.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the features of construction, combination of elements, and arrangement of parts, which will be exemplified in the construction hereinafter set forth and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

Figure 1 is a vertical sectional view taken along the line 1—1 of Fig. 2, illustrating one type of rotary pump embodying the invention;

Fig. 2 is a horizontal sectional view taken along the line 2—2 of Fig. 1;

Fig. 3 is an end view taken from the left of Fig. 2 with the casing head and rotor removed;

Fig. 4 is a detail perspective view of one pair of vanes with their connecting pins;

Fig. 5 is a view similar to Fig. 1 showing the casing liner alone;

Fig. 6 is a diagrammatic showing of a manner in which a pump embodying the invention may operate;

Fig. 7 is a side view of the bushing shown in Figs. 2 and 3;

Fig. 8 is a view similar to the interior of Fig. 3 somewhat enlarged, showing a modified form of bushing and casing construction;

Fig. 9 is a sectional view along the lines 9—9 of Fig. 8;

Fig. 10 is a view similar to Fig. 8 with the rotor in place shown in section along the lines 10—10 of Fig. 11 showing another modified form of construction;

Fig. 11 is a transverse sectional view along the line 11—11 of Fig. 10;

Fig. 12 is a view similar to Fig. 8, showing still another modified form of construction; and

Fig. 13 is a detail view of the casing liner and a portion of the rotor showing a modified form of construction adapted for two-way operation.

In the construction of rotary pumps and other fluid handling devices the effectiveness and efficiency of operation are important considerations. In commercial practise, moreover, a consideration of outstanding importance is the provision of a construction which will have a long effective life with a minimum of repair or replacement of the parts. In rotary pumps of the sliding vane type it is highly advantageous that the wear of the vanes against the periphery of the pump chamber, such as provided by the inner surface of the casing liner, be reduced to a minimum. It has been found that pressure contact of the vanes with the periphery results in a relatively high rate of wear, whereas an effective closure which may or may not involve actual contact causes a relatively low rate of wear. The present invention accordingly contemplates the provision of a construction wherein pressure contact of the vanes occurs only at certain portions of the periphery, and preferably only at a relatively small portion of the periphery.

Since surface contact of the vanes with the periphery results in less wear than does line contact, the invention in certain of its more specific aspects also contemplates the formation of a pump chamber having a periphery such that the portion at which the vanes are in pressure contact with the periphery will conform to a uniform curve. In this manner uneven wear and line contact of the vanes and the liner is avoided.

The invention in certain of its more specific aspects also contemplates the provision of features of construction whereby the efficiency, effectiveness, permanence and operating smoothness of a rotary pump and the like may be enhanced.

In accordance with the invention there may be provided a rotary pump fluid handling device of the sliding vane type wherein the periphery of the pump or working chamber comprises two portions which are arcuate and concentric with the axis of the rotor and at least part of which are preferably closed; wherein oppositely disposed vanes are fixedly connected; and wherein means are provided to limit the vane-movement so as to avoid pressure contact of the vanes with the periphery throughout a considerable portion of the vane movement. While oppositely disposed vanes may be provided by an integral piece of material, the construction, in effect, will comprise one or more pairs of fixedly-connected

vanes. Ordinarily a plurality of slidable pairs of fixedly-connected vanes will be utilized and the invention will be so exemplified. It will be understood, however, if the inlet and outlet ports are provided at the same side of the center line of the device that a single pair of vanes may be used.

By fixedly interconnecting the vanes, pressure contact of the vane which is nearer the axis of the rotor is eliminated, since the preponderant centrifugal force on the interconnected pair of vanes will be in the direction of the vane which is farthest from the axis. Accordingly, by the provision of means to limit the vane movement in the latter direction at a proper point, pressure contact of both vanes throughout the portions of their movement whereat both vanes are adjacent arcuate portions of the periphery will be eliminated. In accordance with the invention wear, due to pressure contact, may be still further eliminated by expanding the pump chamber rapidly over the portion of the periphery whereat outward movement of a vane will occur, and may still further be reduced by the provision of a construction wherein the vane movement will be accelerated by means other than contact with the periphery of the pump chamber. With a view to preventing impact of the vanes with the limiting means and to eliminating shocks and noise, means may be provided for cushioning the vane movement as the vanes approach the limiting means. To this end passageways may be provided for admitting the liquid to the space just exterior of the limiting means under conditions such that the ejection of liquid will be retarded, or by the provision of other suitable types of cushioning means.

Fluid handling devices of a variety of different sizes and adapted for various ones of a number of different uses may be provided in accordance with the invention, and it is to be understood that the type of construction and the extent of various parts may be widely varied in accordance with the use to which the pump is to be put.

It is also to be understood that certain constructions embodying the invention are adapted for use as motors as well as pumps, and while pumps are referred to herein by way of exemplification it is to be understood that the invention contemplates the provision of constructions of the nature indicated whether used to propel a fluid or to be propelled by a fluid.

In the form of construction illustrated in Figs. 1 to 7, inclusive, there is exemplified a pump including a rotor **10** and a casing **11**. The casing includes an outer portion **12** which includes a head **12***a*, and an inner portion **13**, which forms the casing liner and provides the periphery of a pump or working chamber **14**. The liner **13** is cut away between its ends as indicated at **16** and **17** to provide openings forming a part of inlet and outlet ports **18** and **19**, respectively. The rotor **10** in the present instance comprises laterally-extending sleeve portions **20** one of which is mounted on a driving shaft **21**. In the rotor body there is provided a plurality of pairs of inwardly-extending slots **22** for the reception of a suitable number of pairs of oppositely-disposed vanes **23**, three such pairs being provided in the present instance. The vanes of each pair are fixedly connected by pins **24** which extend slidably through the rotor. In the present instance the pins are cut away down to their center to receive the vanes on the sides thereof which are forward during normal rotation, but retain protuberances as shown at **25** which extend into grooves **25***a* in the vanes to prevent independent movement of the vanes. The particular construction exemplified holds the vanes firmly connected during rotation, but permits the vanes to be readily slid transversely of the rotor when the head **15** of the casing is removed, so that any individual vane may be repaired or replaced without disturbing the pins. Each slot **22** terminates at a point, such as indicated at **26**, so as to limit the sliding movement of the pairs of vanes to a given distance.

The periphery of the pump chamber is formed in the present instance to have a conformation in cross-section, such as illustrated particularly in Figs. 1 and 5. From the point A to the point B (Fig. 5) the periphery is arcuate and concentric with the axis of the rotor. The radius of the arc is just sufficient so that a vane will have a close clearance therewith when the opposite vane is in contact with the limiting means **26**. This close clearance may be an actual clearance small enough so as not to interfere with the effective operation of the pump, or may be a substantial contact without pressure contact. From the point D to the point E the periphery conforms to an arc which is concentric to the axis of the rotor and which has a radius smaller than the radius of the arc A—B. In the present instance the radius of the arc A—B may be 1⅞ inches and the radius of the arc D—E may be $1\frac{7}{8}$ inches. As exemplified, the limiting means **26** is so positioned that the vanes will entirely seat within the body of the rotor when moved inwardly, and when moved outwardly will have a close clearance without pressure contact with the arcuate portion A—B, of larger radius. As above indicated the uncompensated centrifugal force acting on the outer portion of the opposite vane will prevent any vane from being thrown against the arcuate portion D—E, of smaller radius. That portion of the periphery extending from a point C, in proximity to the point B, toward the arcuate portion D—E conforms to a uniform curve so as to present a constant conformation to the vane tip. Since it is this portion of the curve with which the vanes are in positive pressure contact, the provision of a curve of this nature assures that there will be a surface contact with the vanes rather than a line contact. The curve is formed so that its tangent at any point will be at a constant angle θ with a perpendicular to the radius. The angle θ in the present instance is 7°, but it will be apparent that the angle may be varied, depending upon the length of the curve C—D and the length of its radius, and other factors. It will be noted that this curve is not a circle with its center at the axis of the rotor. If desired, the small portion of the periphery between the point B and the point C may conform to a curve which smoothly merges the arc A—B with the eccentric arc C—D. The point C may approach the point B as closely as may be desired. From the point E to the point A the periphery in the present instance is expanded rapidly so as to permit each pair of vanes to move freely toward this portion under the influence of discharge pressure and/or centrifugal force. Proceeding along the curve E—A in a counter-clockwise direction, the successive points on the curve are farther and farther from the axis of rotation. Points on the curve C—D diagonally opposite the beforementioned points are suc-

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cessively nearer the axis of rotation. An arrangement such as provided in this instance permits the extent of pressure contact of the vanes with the periphery of the pump chamber to be reduced still further, since the movement of the vanes needs only to be initiated by the inwardly extending curve C—D, after which the vanes will be permitted to move without pressure contact with either side of the periphery of the casing liner until the limiting means is reached. In a construction such as exemplified the discharge pressure acts at a point intermediate the points C and D to reduce materially or eliminate pressure of the vanes on the periphery.

As will be seen, the portion **16** of the inlet port **18** in the casing liner **13** extends from a point a short distance beyond the point E to a point substantially opposite the point D, and the portion **17** of the outlet port **19** in the liner **13** extends substantially from the point C to the point D. The arc A—B subtends an angle of about 115° and the arc D—E subtends an angle of about 80° in the exemplified construction. As will be apparent, however, the dimensions and proportion of the parts may be widely varied without departing from the invention.

In Fig. 6 there is shown diagrammatically one manner in which a pair of vanes in a pump embodying the invention may shift under certain conditions. The vane pair, which is indicated by the straight line, may first be in contact with the periphery of the pump chamber at a point adjacent the beginning of the pressure port as shown in view *a*. Under the influence of the discharge pressure the vane pair tends to shift, in the present instance, to the left as it approaches the medial line so that it is out of contact with either side of the periphery of the chamber, as indicated in view *b*. Continuing this movement, the vane pair moves until its left-hand end approaches the periphery of the casing liner, as shown in view *c*. In this position the vane pair is prevented from movement away from the larger radius arcuate portion by overbalanced centrifugal force, and is prevented from moving into pressure contact with the periphery of the pump chamber by the limiting means.

As above indicated suitable means for cushioning the vanes as they move toward the limiting means may be provided. Desirably, such means comprise passageways whereby liquid is permitted to flow from and to the spaces between the inner edge of the vanes and the limiting means. The passageways may permit the flow of liquid between the various spaces, between each space and one or the other of the ports, between certain of the spaces and certain of the ports, or between all of the spaces and one of the ports, as desired; and the passageways may be formed in the casing or in the rotor, or both, as desired, several types of passageways being hereinafter exemplified.

In the construction exemplified in Figs. 1 through 7 the sleeve portions **20** rotate in bushings **27** forming part of the casing and the bushings are cut away as indicated at **28** and **29**. From the cut-away portions **28** passageways **30** lead through the casing to a channel **31** communicating with the inlet port **18**. From the cut-away portions **29** passageways **32** lead through the casing to a channel **33** communicating with the outlet port **19**. Since the portions **28** and **29** are separated by solid portions **34** and **35** of the bushing, (see Fig. 7) there is no communication from the outlet port to the inlet port. As will be seen, the bottom of the slots in which the vanes move is aligned with the bushings **27** so that communication from or to the spaces between the inner edge of each vane and the limiting means **26** to or from one or the other of the ports is obtained. The portions **28** and **29** are of sufficient extent so that the passageways will be open at all times when vane movements will tend to occur. It may be noted that in this construction the discharge pressure on the inner edge of the vanes will substantially balance the discharge pressure on the outer edge of the vanes except for the transverse area of the pins. The difference in pressure on the ends of the pins adjacent the inlet and outlet ports will however, be sufficient to materially reduce or to eliminate pressure contact of the vanes with the liner after the vanes reach a position considerably in advance of the point D. Some acceleration of this movement is obtained by the counter-balancing centrifugal force of the outwardly moving vane after the pair of vanes have passed center.

If it is desired to utilize the difference between discharge and suction pressure to a greater extent, or if for other reasons, it is not desired to connect the spaces interiorly of the vanes with the ports, an arrangement such as shown in Figs. 8 and 9 may be utilized, or these spaces may be suitably interconnected by passageways through the rotor.

In Figs. 8 and 9 the casing *11a* is formed without passageways and the bushing is cut away throughout the greater portion of its annular extent, as indicated at **36**.

Figs. 10 and 11 show a similar arrangement wherein the bushing is not cut away. In this instance the slots extend less deeply into the rotor *10b*, and the casing *11b* is formed with an annular or substantially annular passageway **37** interconnecting the spaces formed interiorly of the vanes as the vanes move away from the inner ends of the slots.

If desired, the spaces formed between the inner edges of the vanes and the inner ends of the slots may be all connected with the inlet port. One form of construction of this nature is shown in Fig. 12, wherein a rotor similar to the rotor *10b* is employed and the casing *11c* is formed with an annular or substantially annular passageway **38** interconnecting the spaces, and is also formed with a passageway **39** connecting the passageway **38** with the inlet port.

While the constructions previously exemplified are adapted for normal rotation of the rotor in a single direction, it will be understood that the invention in its broader aspects is adapted for embodiment in a construction arranged for effective two-way operation. One such construction is exemplified in Fig. 13. In this construction the rotating parts are the same as those shown in Figs. 1 and 2, except that the outer edges of the vanes *23d* may conform with the periphery of the rotor. The casing liner *13d* has a modified interior periphery. This includes a portion extending from a point F near the center of one port to a point G near the center of the other port and conforming to an arc having a radius such that when the vanes are seated against the limiting means **26** they will have a close clearance with the periphery of the pump chamber. The periphery of the pump chamber also includes a portion extending from a point H to a point J and conforming to an arc such

that the vanes will just clear it when they are in seated position. In the present instance the entire arcuate portion from H to J is closed. The ports from F to J and from G to H conform, at their central portions, to arcs eccentric with the axis of the rotor and with each other, and at their end portions, to curves merging the various arcs.

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

1. A rotary fluid handling device comprising a rotor, a casing providing inlet and outlet openings and a working chamber, said working chamber having a periphery two portions of which are arcuate and concentric with the axis of the rotor, one of said portions having a greater radius than the other of said portions and at least part of each portion being closed, a plurality of pairs of oppositely-disposed fixedly-connected vanes slidably mounted in said rotor for unrestrained movement over a distance sufficient to enable two proximate vanes to be simultaneously adjacent to the arcuate portion of greater radius, means to limit the sliding movement of said vanes to prevent pressure contact thereof with said arcuate portion of greater radius, and means for admitting a liquid between each vane and its limiting means to provide a cushion when the limiting means is approached by the vane.

2. A rotary fluid handling device comprising a rotor, a casing providing inlet and outlet openings and a working chamber, said working chamber having a periphery two portions of which are arcuate and concentric with the axis of the rotor, one of said portions having a greater radius than the other of said portions and at least part of each portion being closed, a plurality of pairs of oppositely-disposed fixedly-connected vanes slidably mounted in said rotor for unrestrained movement over a distance sufficient to enable two proximate vanes to be simultaneously adjacent to the arcuate portion of greater radius, means to limit the sliding movement of said vanes to prevent pressure contact thereof with said arcuate portion of greater radius, means closing the interior of the rotor at said limiting means, and means providing passageways connecting the pump chamber adjacent the inlet and outlet ports with the space between each vane and its limiting means when the vane is subjected to tendencies causing outward or inward movement respectively.

3. A rotary fluid handling device comprising a rotor, a casing providing inlet and outlet openings and a working chamber, said working chamber having a periphery two portions of which are arcuate and concentric with the axis of the rotor, one of said portions having a greater radius than the other of said portions and at least part of each portion being closed, a plurality of pairs of oppositely-disposed fixedly-connected vanes slidably mounted in said rotor for unrestrained movement over a distance sufficient to enable two proximate vanes to be simultaneously adjacent to the arcuate portion of greater radius, means to limit the sliding movement of said vanes to prevent pressure contact thereof with said arcuate portion of greater radius, and means for interconnecting the spaces just outside said limiting means, said inter-connecting means being so arranged as to retain liquid interiorly of said vanes long enough to provide a cushioning effect.

4. A rotary fluid handling device comprising a rotor, a casing providing inlet and outlet openings and a working chamber, said working chamber having a periphery two portions of which are arcuate and concentric with the axis of the rotor, one of said portions having a greater radius than the other of said portions and at least part of each portion being closed, a plurality of pairs of oppositely-disposed fixedly-connected vanes slidably mounted in said rotor for unrestrained movement over a distance sufficient to enable two proximate vanes to be simultaneously adjacent to the arcuate portion of greater radius, means to limit the sliding movement of said vanes to prevent pressure contact thereof with said arcuate portion of greater radius, and means for interconnecting the spaces just outside said limiting means and for connecting said spaces with the inlet port.

5. A rotary fluid-handling device comprising a rotor, pins mounted for sliding movement transversely of said rotor, each of said pins being cut away at each end thereof on the side toward the direction of normal movement of the rotor, said rotor being formed with inwardly-extending slots embracing the cut-away portion of said pins, a vane in each slot, cooperating protuberances on said pins and longitudinal grooves on said vanes for preventing movement of said vanes longitudinally of said pins, and a casing providing inlet and outlet ports and a pump chamber having a periphery which is generally eccentric to the axis of the rotor, said casing being formed with a removable head whereby upon the removal of the head said vanes may be slid laterally out of said rotor along said grooves.

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