June 5, 1951 R. E. CORNWELL 2,555,679

FLUID DISPLACEMENT ROTARY MACHINE

Filed June 9, 1949 3 Sheets-Sheet 1

Fig. 1.

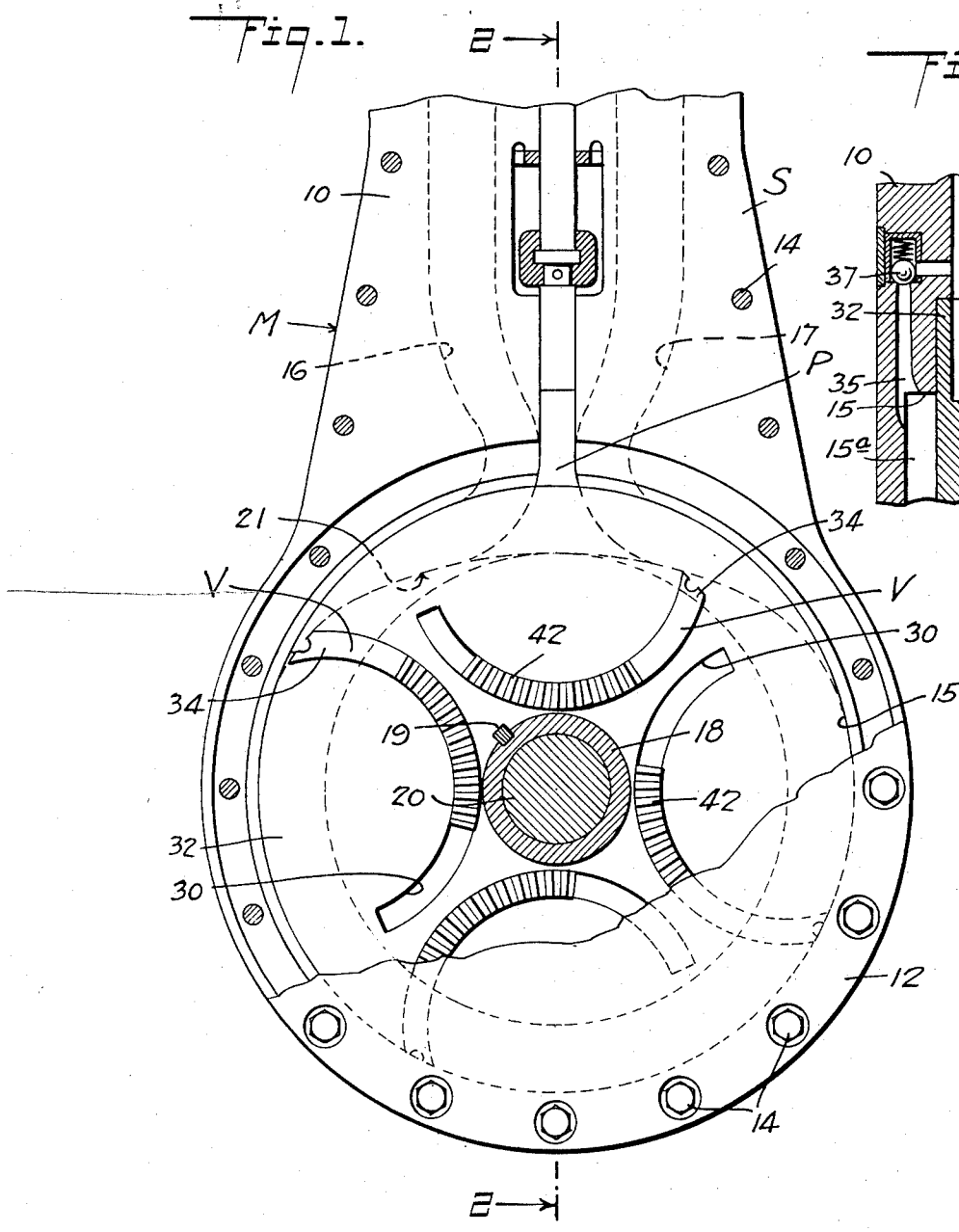
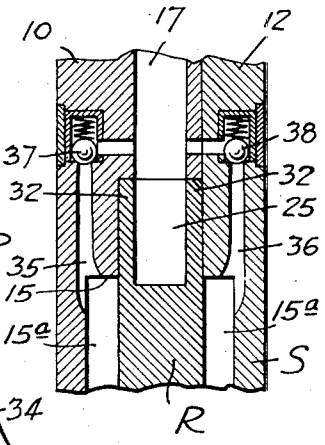


Fig. 6.

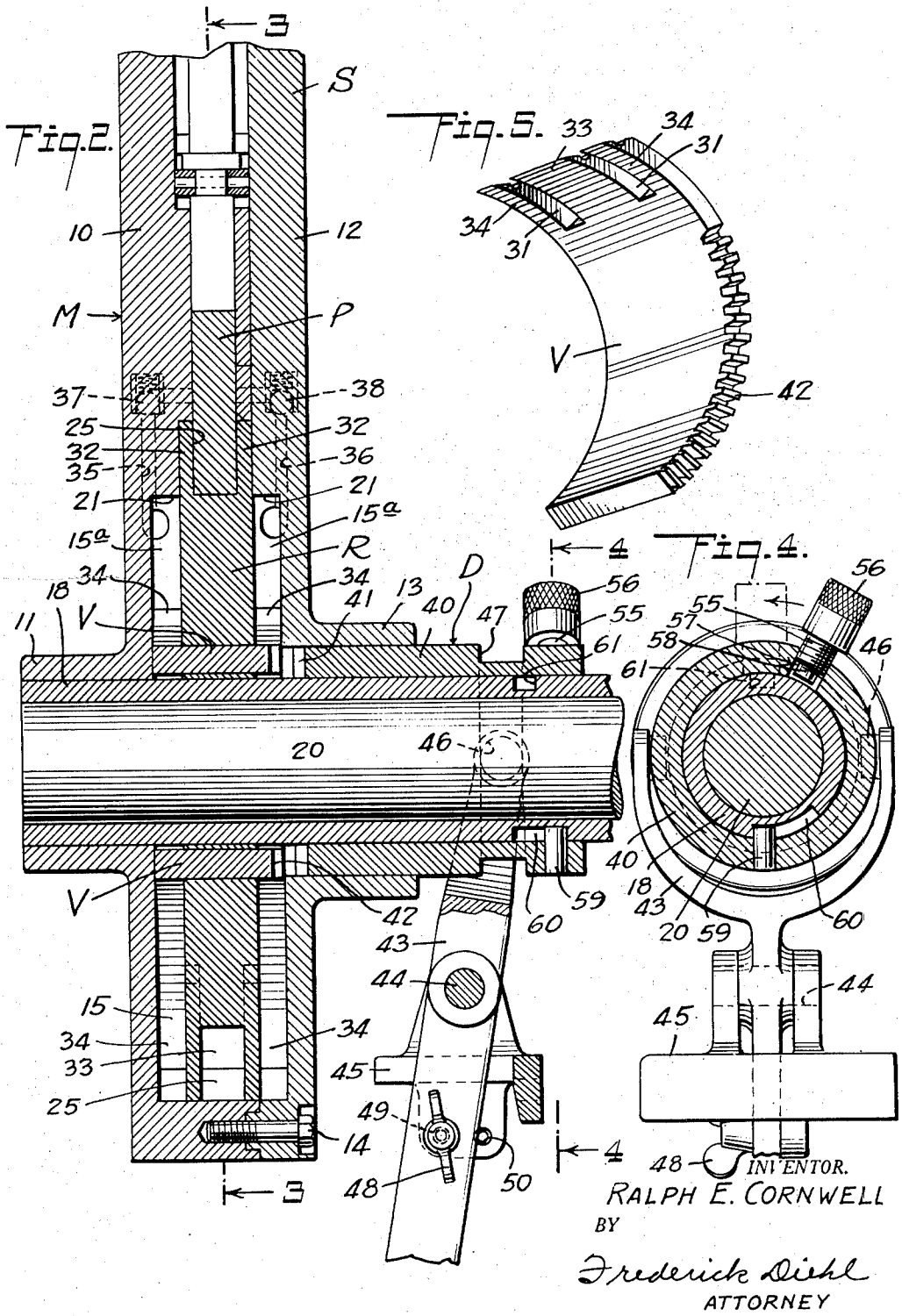


INVENTOR.
RALPH E. CORNWELL
BY
Frederick Diehl
ATTORNEY

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FLUID DISPLACEMENT ROTARY MACHINE

Filed June 9, 1949 3 Sheets-Sheet 2



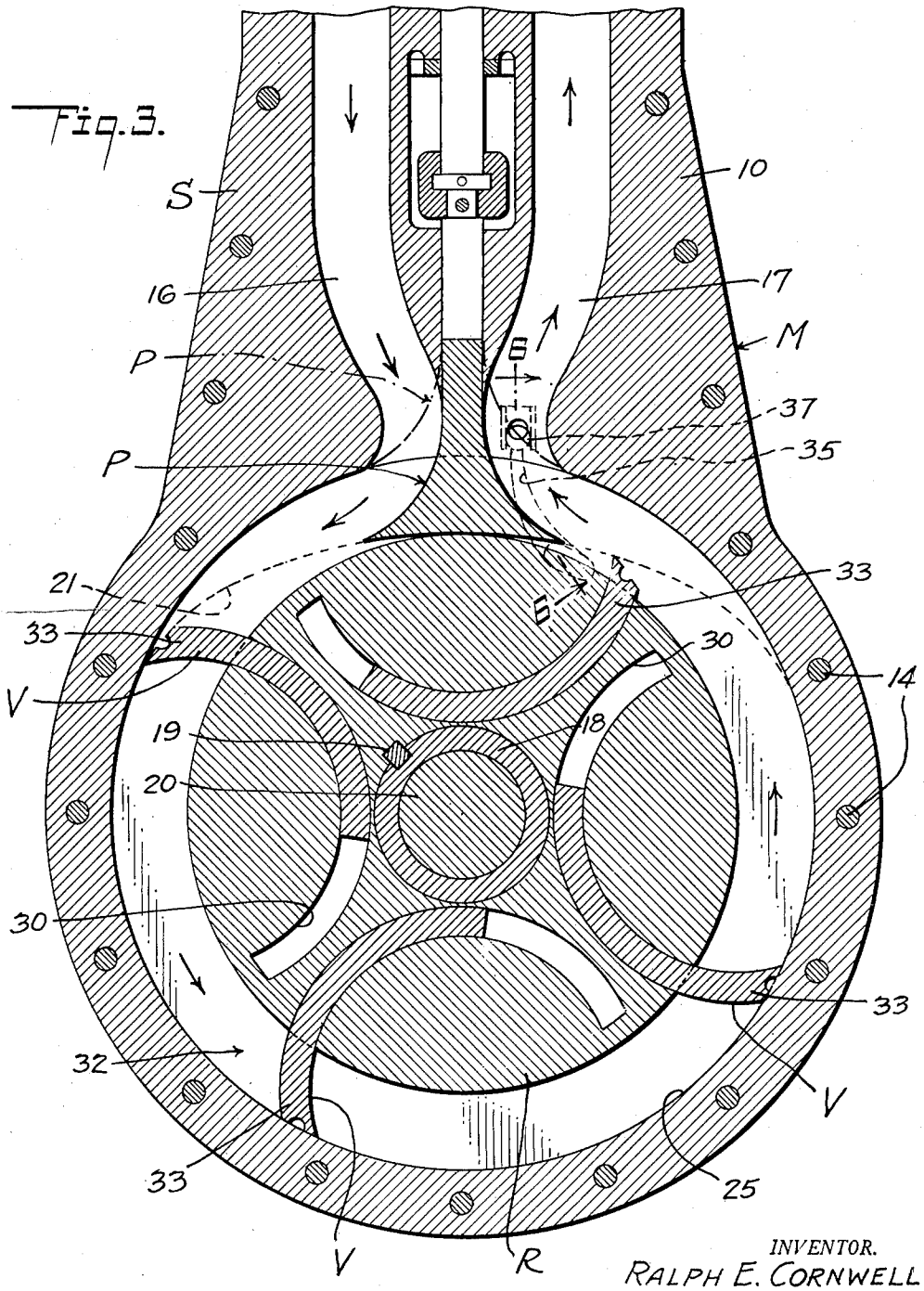
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RALPH E. CORNWELL
BY
Frederick Diehl
ATTORNEY

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Filed June 9, 1949 3 Sheets-Sheet 3

Fig. 3.



INVENTOR.
RALPH E. CORNWELL
BY
Frederick Diehl
ATTORNEY

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FLUID DISPLACEMENT ROTARY MACHINE

Ralph E. Cornwell, La Canada, Calif.

Application June 9, 1949, Serial No. 97,956

2 Claims. (Cl. 103—120)

1

My present invention relates to hydraulic driving, braking and free wheeling mechanisms of the general character embodied in my United States Letters Patent No. 2,421,013, issued to me on May 27, 1947.

In my patent above identified, the mechanism includes hydraulic pumps operatively connected to wheel motors and to the prime mover of the vehicle to deliver power to the wheel motors with a minimum of hydraulic friction losses; to impose any degree of braking action upon the wheels through the medium of the wheel motors; to enable free wheel operation of the vehicle to be effected with a minimum of fluid drag; and to control the flow of hydraulic energy by valving partitions of the pumps and wheel motors in a manner to vary the volume of fluid circulated therebetween, to accordingly vary the hydraulic energy at the wheel motors for driving and braking purposes, or to cause the circulation of the fluid idly within the pumps and wheel motors for free wheeling operation of the latter.

An object of my present invention is to provide a fluid displacement mechanism having the aforestated advantages of my patented mechanism, and structurally characterized by novel stator and rotor structures co-acting to define a highly efficient fluid-sealed annular working chamber which is relatively deep in a direction radially of the rotor, for co-action with vanes of longitudinally curved contour, to minimize mechanical and fluid friction and to obtain a smoother fluid flow for maximum hydraulic efficiency, with the vanes being slidably mounted in the rotor in a manner to materially reduce the centrifugally caused mechanical friction of the vanes against the wall of the stator, to thereby reduce the adverse effect of centrifugal force acting upon the vanes to retard rotation of the rotor, whereby to increase the efficiency of the mechanism as compared to mechanisms heretofore proposed and embodying flat vanes of the type which are slidably mounted in the rotor for movement radially thereof.

Another object of this invention is to provide a fluid displacement mechanism of the above described character in which the vanes embody means to deliver to the discharge side of the machine, such fluid as might leak from the working chamber into stator spaces or chambers at opposite sides of the rotor, to thereby maintain maximum volumetric efficiency.

A further object of this invention is to provide means by which the vanes can be moved to an idle position clear of the working chamber for

2

free wheeling or idling operation, as well as for testing purposes.

With these and other objects in view, my invention resides in the combinations, arrangements and functional relationships of elements as set forth in the following and particularly pointed out in the appended claims.

In the accompanying drawings,

Figure 1 is a view in side elevation, of one form of fluid displacement rotary machine embodying my present invention, with a portion of one stator section broken away to disclose rotor and vane structure;

Figure 2 is an enlarged axial sectional view taken on the line 2—2 of Figure 1;

Figure 3 is a transverse sectional view taken on the line 3—3 of Figure 2;

Figure 4 is a detail sectional view taken on the line 4—4 of Figure 2;

Figure 5 is a perspective view of one of the vanes embodied in the invention; and

Figure 6 is a fragmentary sectional view taken on the line 6—6 of Figure 3.

Referring specifically to the drawings, my invention in its illustrated embodiment will be described as a wheel motor, although its use as a pump or as either in other environments is to be considered as within the scope of this disclosure. The hydraulic motor designated generally by M is broadly composed of a fixed casing or stator S, a disk rotor R, vanes V, a valving partition P, and a control device D for the vanes.

The stator S comprises a body section 10 having a bearing 11, and a cover section 12 having a bearing 13 and being secured to the body section by bolts 14, to define within the sections a cylindrical space or chamber 15 communicating at adjacent locations on its periphery with an inlet conduit 16 and an outlet conduit 17 controlled by the interposed valving partition P.

The rotor R has a running fit circumferentially in the stator chamber 15, and is fixed to a wheel hub or other driven element 18 by a key 19, which hub is rotatably mounted on the wheel spindle or axle 20. The axial dimension of the rotor R is considerably less than that of the stator chamber 15, and is located medially of the latter so as to leave on the outer sides of the rotor, cylindrical lateral portions 15a of the chamber 15. The circular continuity of the chamber portions 15a is interrupted symmetrically of the valving partition P by identical cams 21, 21, whose ends merge smoothly into the peripheries

of the respective portions 15a as shown in broken lines in Figures 1 and 3.

The sides of the rotor R have a running fit between the confronting sides of the cams 21, 21, and the rotor is provided with a peripheral, annular recess relatively deep in a direction radially of the rotor and opening to the internal annular surface of the stator chamber 15 for co-action with same in defining a working chamber 25 which slidably receives the valving partition P in the extreme position shown in Figures 2 and 3, wherein the partition is completely effective to interrupt the working chamber 25 between the inlet conduit 16 and the outlet conduit 17, for driving of the rotor, and as clearly shown in full lines in Figure 3.

By means (not shown) forming no part per se of the present invention, the valving partition P can be moved to its other extreme position shown in broken lines in Figure 3, to completely close off the conduits 16 and 17 from the working chamber 25 and clear the latter for free wheeling operation. In various intermediate positions of the partition P, the conduits 16 and 17 will be restricted to a greater or lesser extent according as more or less braking operation is to be effected.

The vanes V, of which four are shown for the purpose of illustration, are curved or segmental in longitudinal contour, and are of such width or dimension axially of the rotor as to have a running fit against the sides of the stator chamber 15. These vanes are slidably mounted in correspondingly curved slots 30 formed in the rotor R at equally spaced locations circumferentially thereof. The outer ends of the vanes are provided with slots 31, 31, (Figure 5) of such width as to slidably receive the flanges 32, 32 of the rotor which form the sides of the working chamber 25. Thus, the central tip portion 33 of each vane will operate in the working chamber, whereas the lateral portions 34 of the vane will operate in the lateral portions 15a of the stator chamber 15, for engagement with the cams 21 in moving the respective vanes inwardly of the working chamber 25 to an extreme retracted position wherein the vanes will clear the valving partition P when the latter occupies its extreme position spanning the working chamber, as clearly shown in Figures 2 and 3.

Ducts 35 and 36 in the stator sections 10 and 12, respectively, place the portions 15a of the stator chamber 15 in communication with the outlet conduit 17, so that any fluid which may leak from the working chamber 25 into the stator chamber 15 will be discharged from the latter into the ducts 35 and 36 and thence into the outlet conduit 17 by the lateral tip portions 34 of the vanes V during rotation of the rotor R in the direction of the arrows in Figure 3. Spring-urged check valves 37 and 38 are mounted in the respective ducts 35 and 36 and operate to prevent any reverse flow of liquid from the outlet conduit 17 into the stator chamber 15.

The control device D comprises a sleeve 40 rotatable and axially shiftable on the hub 18 and having teeth on its forward or inner end to provide a crown gear 41. Each of the vanes V is provided along one side edge with teeth to form a segmental gear 42 with which the crown gear 41 is adapted to be meshed. A shifting fork 43 pivoted at 44 on a fixed bracket 45, is provided with pins 46 working in an annular groove 47 in the sleeve 40, for co-action with such groove in axially shifting the sleeve 40 from one extreme position to another according as the crown gear 41 is to be meshed with or unmeshed from the segmental gears 42 of the vanes V. A thumb screw 48 passing freely through an opening in the fork 43, is adapted to be screwed into either of two threaded bores 49 and 50 in the bracket 45 to accordingly lock the fork in one or the other of its aforesaid extreme positions.

The sleeve 40 is provided with an actuating and locking screw 55 having a head 56 and being threaded into a radial bore 57 in the sleeve. The inner end of the screw 55 is reduced in diameter to form a locking pin 58. With the sleeve 40 shifted on the hub 18 to its advanced position wherein the gear 41 will be meshed with the segmental gears 42 of the vanes V, rotation of the sleeve in a counterclockwise direction as viewed in Figure 4, by using the screw head 56 as an actuator for the sleeve, will cause the gears 41 and 42 to co-act in retracting the vanes V to clear their outer ends from the working chamber 25 for free wheeling and testing operations.

The maximum amount of rotational movement of the sleeve 40 necessary to thus retract the vanes, is positively limited by a pin 59 in the sleeve, working in an arcuate slot 60 in the hub 18. In this rotationally adjusted position of the sleeve 40 on the hub 18, the locking screw 55 will be co-axially related to a recess 61 in the hub, so that by now further screwing the screw 55 into the sleeve 40, the pin 58 of the screw will enter the recess 61 to lock the sleeve to the hub against rotation thereon, and thus lock the vanes in retracted position.

The operation of the invention is as follows:

Let it be assumed that the outlet conduit 17 and the inlet conduit 16 are respectively connected to the intake and discharge sides of a pump (not shown) such as is disclosed in my patent above referred to, and that the fluid circuit between such pump and motor M is completely filled with liquid.

With the valving partition P occupying the position shown in full lines in Figure 3; the vanes V advanced as also shown in this figure; and the pump in operation, liquid from the pump entering the working chamber 25 through the inlet conduit 16 will act upon the vanes V in successive order to rotate the rotor R in the counterclockwise direction shown by the arrows in this figure. It will be noted that in view of the longitudinally curved contour of the vanes V and the disposition of the rotor slots 30 in which the vanes are mounted, the centrifugally caused friction of the tips of the vanes against the wall of the stator chamber 15 and the cams 21 is materially reduced, as a portion of the centrifugal force acting upon the vanes, urges the vanes laterally against the walls of the rotor slots 30, thus reducing the wear upon the vane tips and stator wall surfaces as well as rendering the vanes easier to retract, all while insuring that a sufficient amount of the centrifugal force will effectively urge the vanes to their advanced positions in contact with the perimeter of the stator chamber 15 and with the surfaces of the cams 21, which latter retract the vanes sufficiently for them to clear the valving partition P during each rotation of the rotor.

By the provision of the longitudinally curved vanes V, the rotor speed may also be greatly increased without creating excessive wear upon the various working surfaces. Furthermore, the curved vanes have greater freedom of movement in the rotor slots than do straight vanes, and en-

able a radially deeper working chamber to be utilized in the rotor, with the attending advantages of smoother fluid flow and less fluid friction, so as to provide greater hydraulic efficiency. Also, the curved vanes, freely movable in the rotor slots **30** and retractable by the cams **21**, reduce to a minimum the number of parts required, and thus reduce the cost of manufacture while attaining more mechanical efficiency and higher rotor speeds.

I claim:

1. A fluid displacement rotary machine comprising: a stator; a rotor rotatably mounted in the stator and co-acting therewith to define an annular working chamber therebetween; said stator having juxtaposed inlet and outlet ports communicating with said working chamber at the periphery thereof; a valving element mounted in the stator between said ports for movement from a position in said working chamber to a position clear of the latter; a plurality of curved vanes; said rotor having curved slots in which said vanes are slidably mounted, so that when the rotor is rotating, the vanes will be urged at their ends against the perimeter of the working chamber by only a portion of the centrifugal force acting upon the vanes, whereas the remainder of the acting centrifugal force will urge the vanes laterally against the walls of said slots so as to minimize the mechanical friction between the vane ends and the stator; means co-acting with the vanes during rotation of the rotor, to retract the vanes at the location of said valving element so as to enable the vanes to pass said element when occupying a position in the working chamber; said vanes having gear teeth along a side edge thereof; a gear mounted co-axially of said rotor for rotation and axial movements; means by which said gear can be axially moved to engage said vane teeth; and means by which said gear can be rotated to co-act with said vane teeth in retracting the vanes clear of the working chamber for testing and idling operations.

2. A fluid displacement rotary machine comprising: a stator having a cylindrical chamber; a rotor rotatably mounted in said chamber coaxially thereof, with the sides of the rotor spaced from the sides of said chamber and the periphery of the rotor having a running fit in said stator chamber for co-action with the annular surface of the latter in defining an annular working chamber between stator and rotor; said stator having juxtaposed inlet and outlet ports communicating with said working chamber at the periphery thereof; a valving element mounted in the stator between said ports for movement from a position in said working chamber to a position clear of the latter; a plurality of curved vanes mounted in said rotor to project from opposite sides thereof into said stator chamber and adapted to be urged by centrifugal force into said working chamber and against said annular surface of said stator chamber when the rotor is rotating; means in said stator chamber at opposite sides of the rotor, co-acting with said projecting portions of the vanes during rotation of the rotor, to retract the vanes at the location of said valving element, so as to enable the vanes to pass said element when the latter occupy a position in the working chamber; said stator having check valve-controlled conduits in communication with said stator chamber and said outlet port, into which fluid leaking from the working chamber into said stator chamber will be discharged by said projecting portions of the vanes so as to be delivered to said outlet port; said vanes having gear teeth along a side edge thereof in said stator chamber; a gear mounted co-axially of said rotor for rotation and axial movements; means by which said gear can be axially moved into said stator chamber to engage said vane teeth; and means by which said gear can be rotated to co-act with said vane teeth in retracting the vanes clear of the working chamber for testing and idling operations.

RALPH E. CORNWELL.

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