March 3, 1931. P. B. RENFREW 1,795,040

ROTARY MACHINE

Filed July 21, 1927 5 Sheets-Sheet 1

Fig. 1.

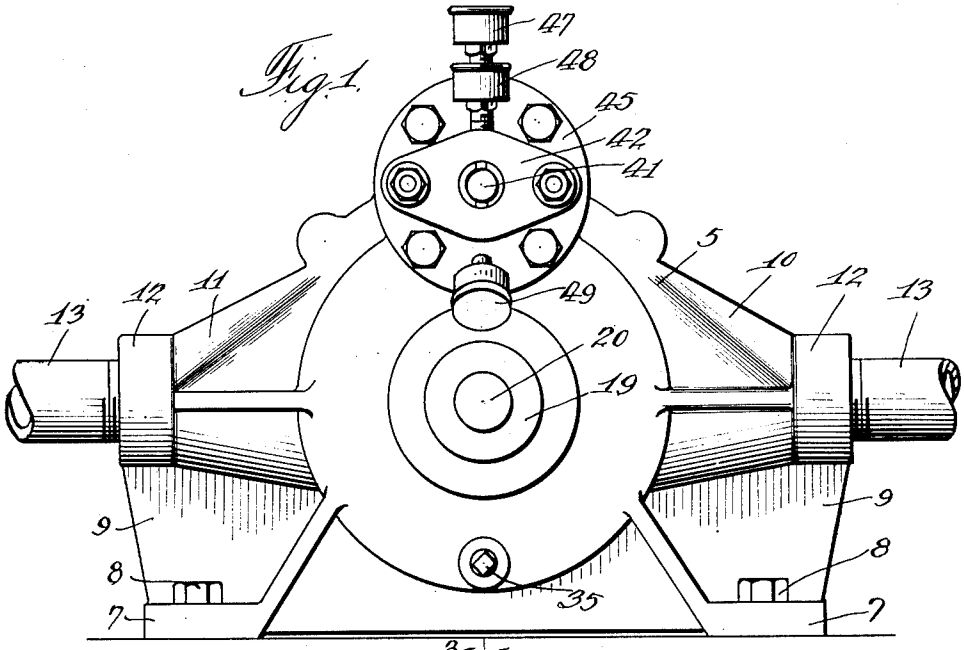
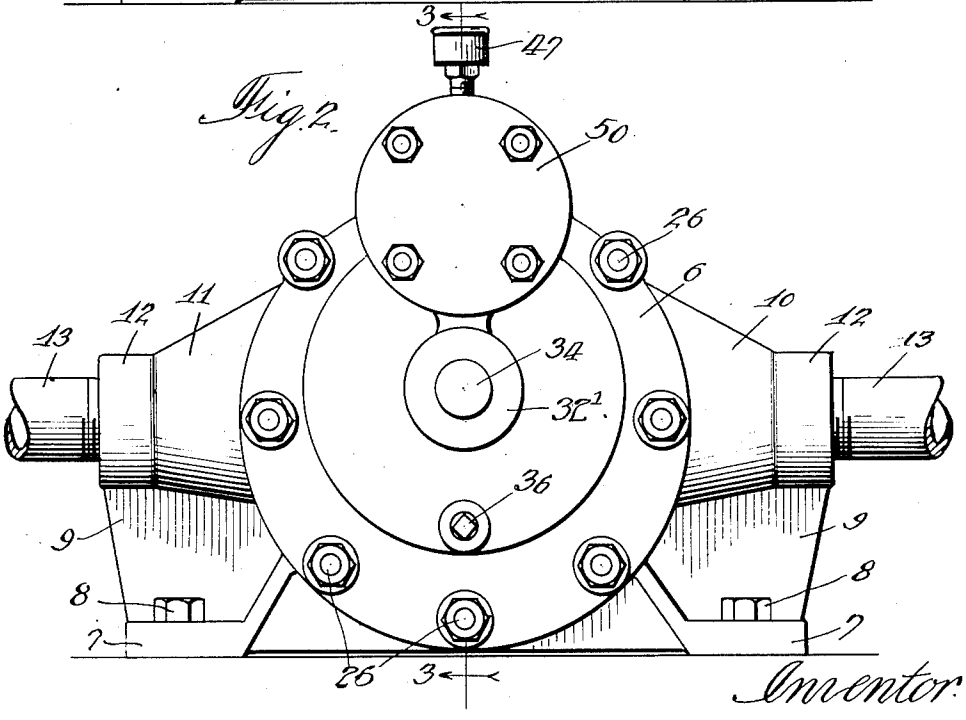


Fig. 2.



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ROTARY MACHINE

Filed July 21, 1927 5 Sheets-Sheet 2

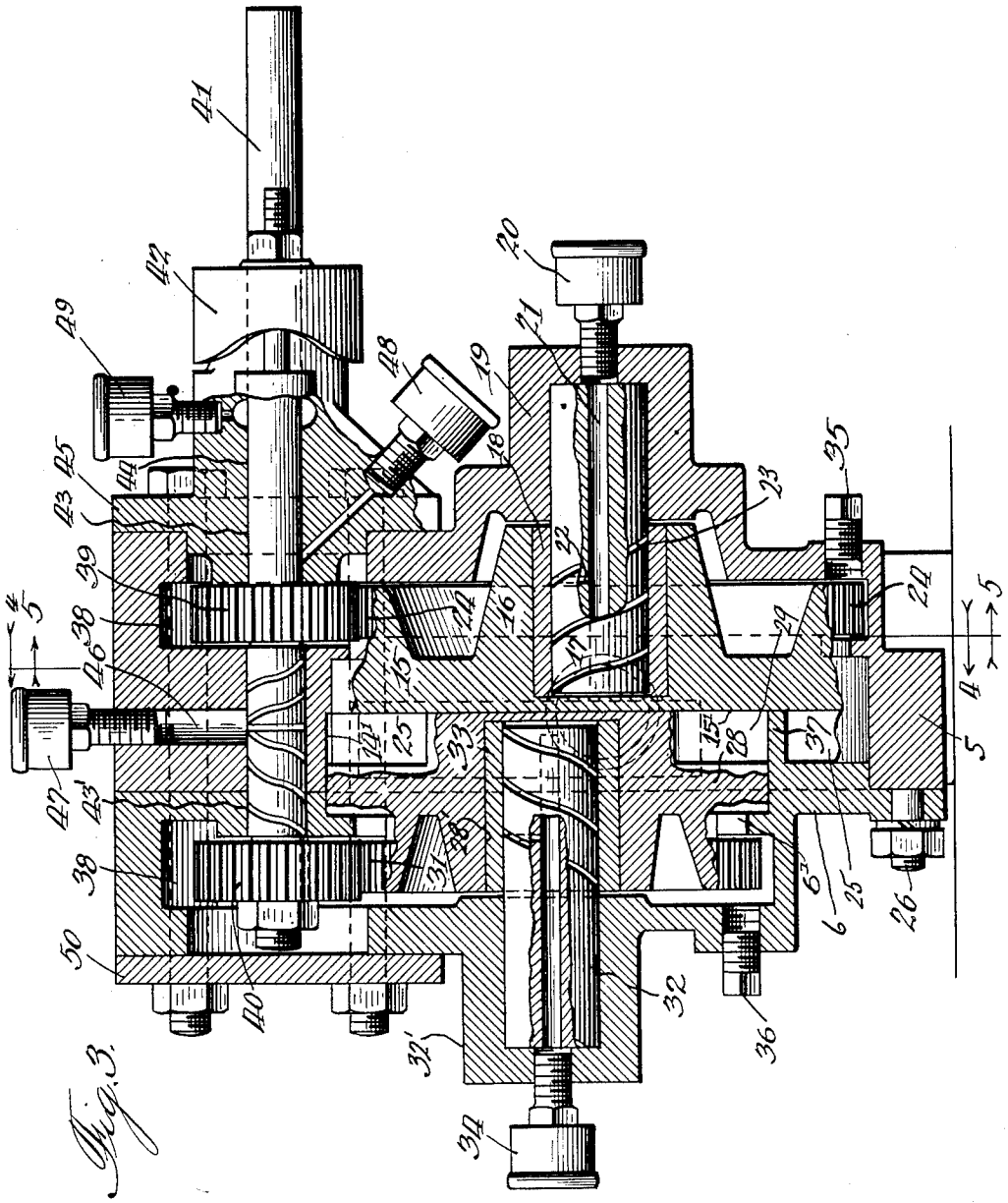


Fig. 3.

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ROTARY MACHINE

Filed July 21, 1927 5 Sheets-Sheet 3

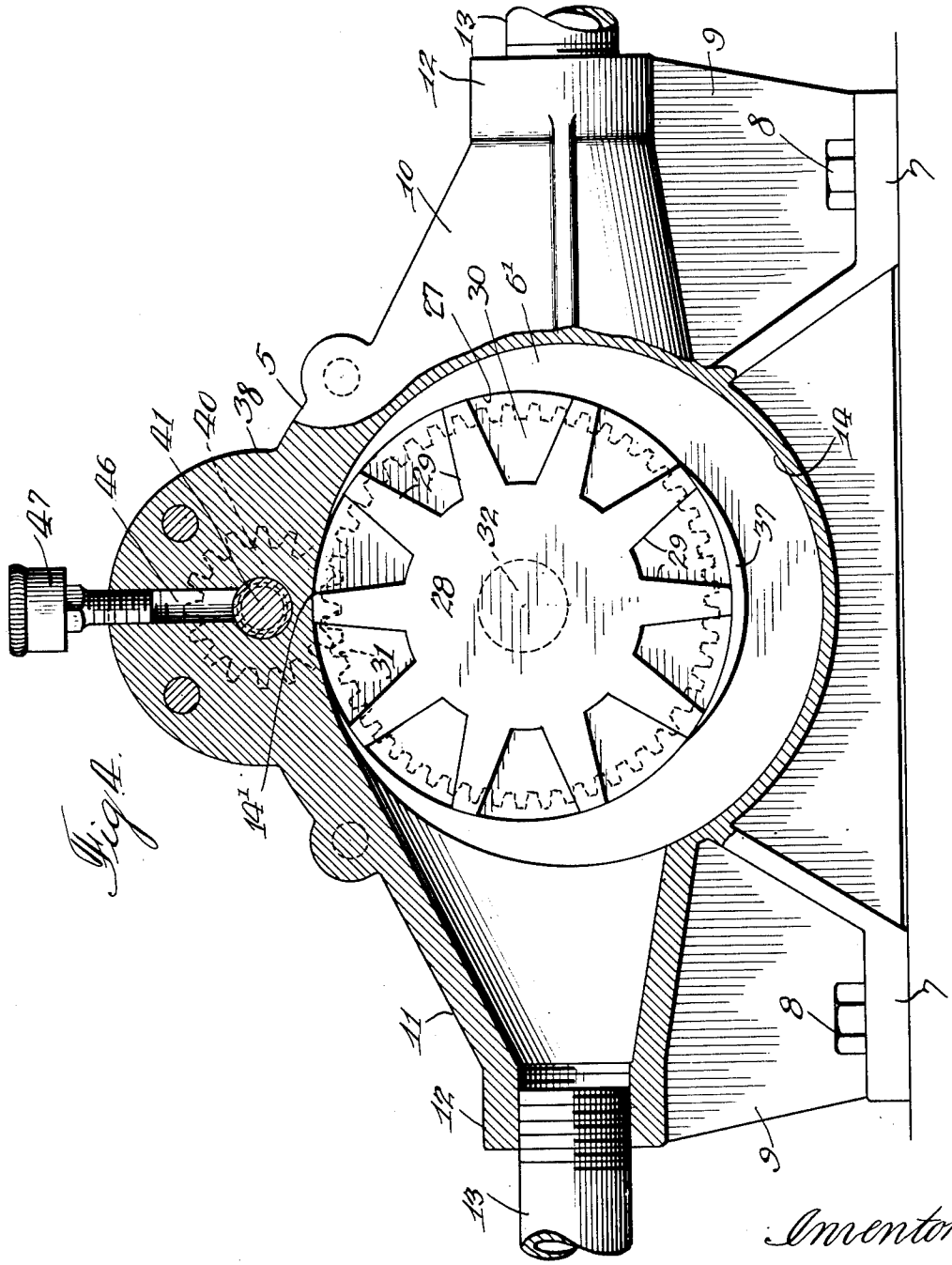


Fig. 4.

Witness
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ROTARY MACHINE

Filed July 21, 1927 5 Sheets-Sheet 4

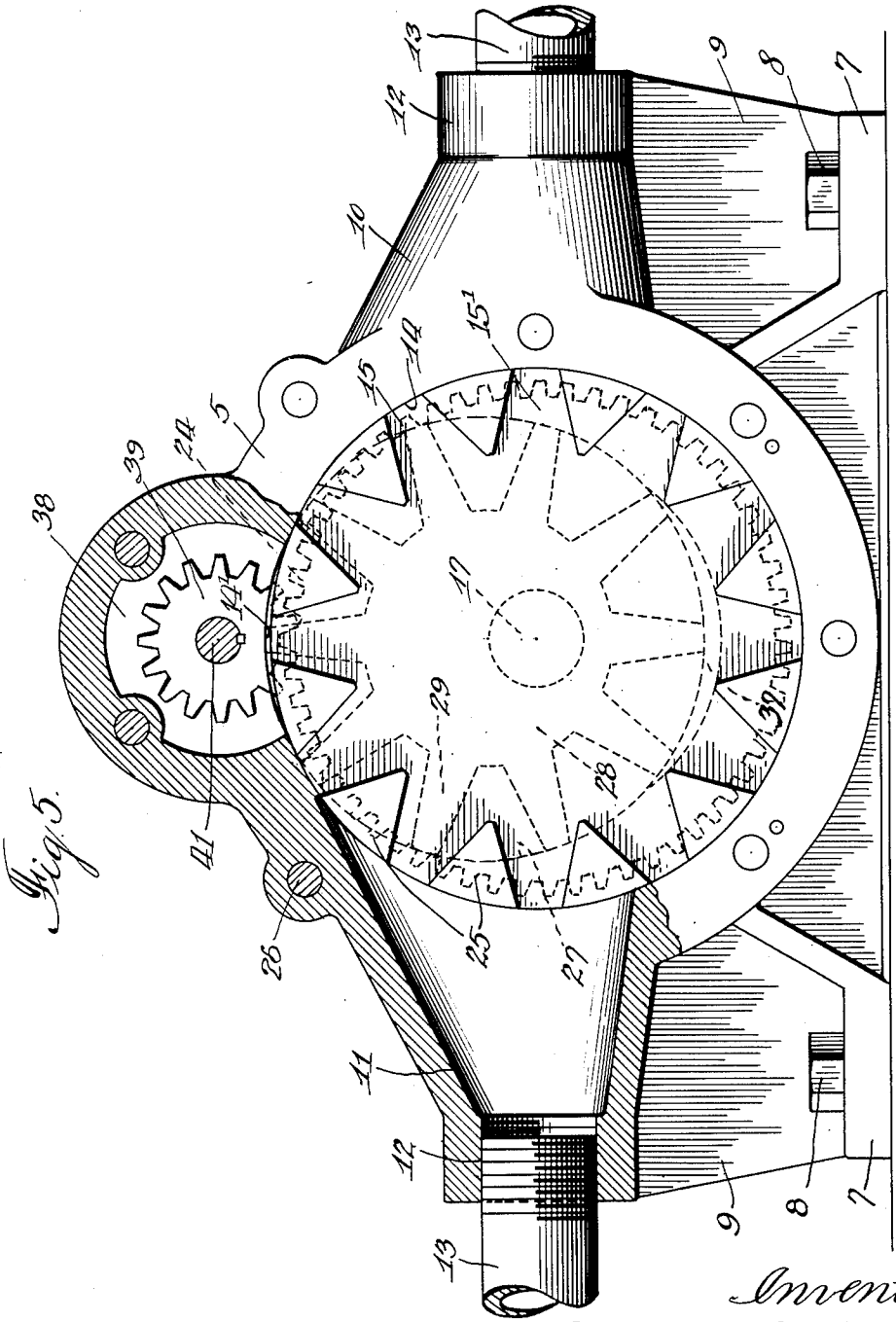


Fig. 5.

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March 3, 1931. P. B. RENFREW 1,795,040

ROTARY MACHINE

Filed July 21. 1927 5 Sheets-Sheet 5

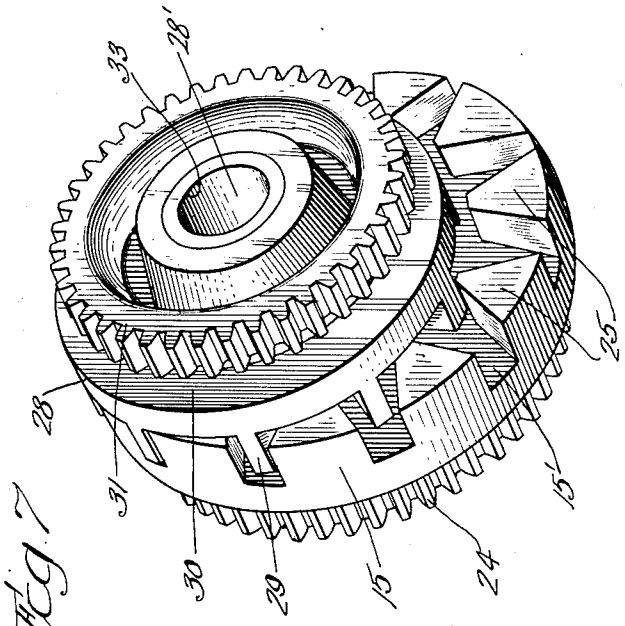


Fig. 7

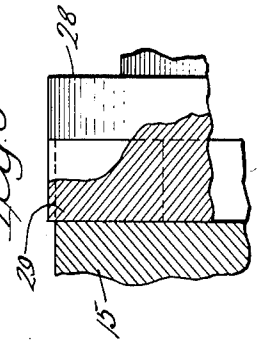


Fig. 8

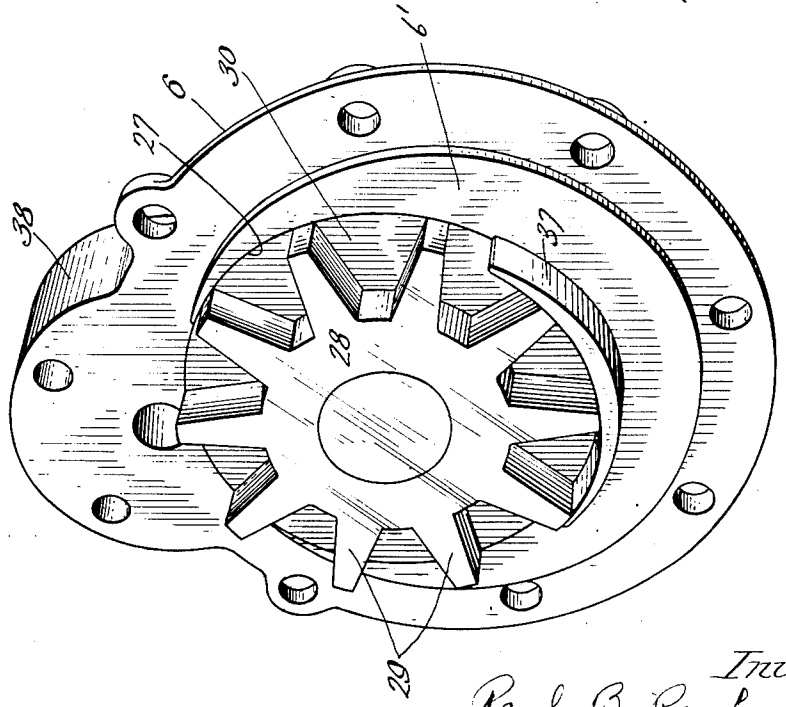


Fig. 6

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Patented Mar. 3, 1931 1,795,040

UNITED STATES PATENT OFFICE

PAUL B. RENFREW, OF FORT WAYNE, INDIANA, ASSIGNOR TO S. F. BOWSER & COMPANY, INC., OF FORT WAYNE, INDIANA, A CORPORATION OF INDIANA

ROTARY MACHINE

Application filed July 21, 1927. Serial No. 207,381.

My invention relates to a rotary apparatus which may be operated as a pump for effecting the movement of fluids, liquids and the like, or it may be driven by steam, air, water or other fluid as an engine or motor.

In either instance, the general assembly and cooperative relationship of the parts will embrace the same principle of operation so far as it applies to the salient features of the invention.

The primary object of the invention is to provide an apparatus of the class described which may be produced at a reasonable manufacturing cost taking into account quiet operation, wear resisting qualities, high efficiency, and a wide range of application.

With these and other objects in view, the description will now proceed with reference to the accompanying drawings in which I have illustrated a practical embodiment of my invention.

In said drawings:—

Fig. 1 is a view in elevation of the apparatus from one side;

Fig. 2 is a similar view from the opposite side;

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

Fig. 4 is a vertical section on the line 4—4 of Fig. 3, looking in the direction of the arrows;

Fig. 5 is a similar view on the same line, looking in the direction of the arrows 5—5;

Fig. 6 is a detail perspective view looking at the inside of the cover and showing the inner rotor carried thereby;

Fig. 7 is a detail perspective view of the two rotors fitted together but removed from their respective housings; and

Fig. 8 is a detail view of a portion of the top edge of the two rotors with parts thereof broken away.

Referring now to the drawings in detail, the casing for the apparatus is preferably made in two main parts 5 and 6. The part 6 is hardly more than a cover although as will hereinafter appear, it not only co-operates with the part 5 to enclose some of the operating parts but it also mounts and houses other of the parts. The casing will usually be made from a casting suitable for the purpose and having a supporting base, such as the feet 7, with openings for accommodating bolts or the like 8, so as to enable the apparatus to be securely anchored upon a supporting structure. Web portions 9 of the casting are provided between the base and the intake 10 and the outlet 11. Both the intake and outlet may have internally threaded necks 12 for the reception of delivery and discharge pipes 13. Arranged centrally of the casing in the part 5 thereof is a rotor housing 14 for the outer rotor 15 which preferably comprises a solid machined steel disc-like member having on one side an axial extension 16 providing a journal bearing. The outer rotor may thus be journaled for rotation in its housing upon the non-rotating bearing stud 17. The extension 16 is equipped with a bushing 18 which is secured to such extension 16 and rotates therewith. The stud 17 terminates in the base of the extension 16 against the closed inner end thereof with its opposite end fixed against rotation in the bore of the side extension 19 on the part 5 of the casing. A suitable grease cup 20 communicates with the axial duct 21 in the stud so that the lubricant may be supplied to the stud bearing throughout the length of the bushing 18 by the radial branching duct 22. In this respect, the stud is also provided with a circumferential spiral groove 23 for directing the lubricant toward the inner end of the stud as it is supplied through the radial duct 22.

Formed preferably as an integral part of the outer rotor 15 is a driving gear 24, the driving means for which will be presently described. The disc-face 15′ of this rotor 15 on the side opposite the gear 24 is equipped with relatively short peripheral vanes 25 which are spaced around the periphery of the rotor face so that the interdental spaces between them provide a multiplicity of openings communicating with the intake 10 and outlet 11 of the casing.

The inside dimension of the intake and outlet is flared inwardly with a decided upward slant so that there is a longer seal between the suction and discharge at the bottom of the rotor housing than at the top.

The part 6 of the casing has a machined fit with part 5 around the rotor housing 14 and bolts 26 may be employed to secure the parts together. This part 6 is further made with a central opening 27 for mounting the inner rotor 28 in co-operating relation with the outer rotor 15 but eccentric therewith, as shown in Fig. 6. The inner rotor 28 preferably comprises a steel machined wheel which projects from the face of the part 6 and has relatively long radial vanes 29 occupying the interdental spaces between the vanes 25 of the outer rotor 15 but not in contact therewith. The rotor 28 is permanently fixed to the face of a steel disc 30 concentric therewith and the opposite side of the disc is equipped with a driving gear 31, the drive for which will be presently described. The journal bearing for the inner rotor 28 comprises a non-rotating stud 32 one end of which is fixed in the bore of a side extension 32′ on the part 6 of the casing with its opposite end projecting into a closed bore 28′ arranged co-axial with the rotor 28. A bushing 33 is provided in the bore of the rotor 28 and rotates therewith on the stud 32. A grease cup 34 is provided for this bearing with a duct arranged as described with reference to the bearing for the outer rotor.

Both of the housings for the gears 24 and 31 may be equipped with plugged openings as at 35 and 36 for packing the driving gears with lubricant. The same plugs may be used for draining the gear housings if desirable.

Projecting from the face of the central opening 27 at the lower edge thereof is a crescent-shaped brass partition 37. The outer end edges of the vanes 29 on the inner rotor 28 wipe against the concave side of this partition and the inner end edges of the vanes 25 on the outer rotor 15 wipe against the convex side thereof. Since the vanes are steel and the partition is brass or at least a softer metal than steel, any wear at this point will be reduced to a minimum. This also applies to the other points of contact between the vanes and casing. For instance, the outer rotor 15 rotates in its housing 14 and the outer edges of the vanes thereof, as well as the circumferential edge of the disc, have a wiping contact against the inside circumference of the housing but since this contact is steel against brass the wear on the vanes and disc is reduced to a minimum. It should also be pointed out that this inside circumference between the intake and outlet at the top of the housing is also ground out to leave a shallow depression 14′ on the radius of the inner rotor 28. The outer edges of the vanes 25 do not contact with the inner circumference of the housing at this space but since it is made on the radius of the inner rotor the outer edges of the vanes 29 thereof contact with the circumference at this space and seal the liquid between the vanes at this point. The outer edges of the vanes 25 and the edge of the disc thereof contact with the housing throughout the inner circumference thereof excepting this shallow depression, as explained. The only points of contact for the vanes of the inner rotor occur at the crescent partition 37 and the shallow depression 14′. The disc-like member to which the inner rotor is secured has a ground fit in the opening 27 in the part 6 of the casing but here again it is steel against brass.

At the top of each of the parts 5 and 6 of the casing is a housing 38 for the driving pinions 39 and 40, one of which is positioned to mesh with the driving gear 24 and the other with the gear 31. The drive shaft 41 on which the pinions are mounted enters the casing from the side 5 through a stuffing box 42 with the co-axial opening in the casing parts serving as suitable continuous bearing as at 43 and 44, the bearing 44 being made in the extension of the plate 45. An intermediate bearing 43′ is provided between the pinions 39 and 40 and a lubricating duct 46 from the cup 47 communicates with the shaft at this bearing. The shaft, as shown is provided with reversed spiral lubricant channels so as to distribute the lubricant from the duct 46 throughout the length of the bearing between the two pinions.

The bearings 43 and 44 are also equipped with lubricant cups 48 and 49 respectively. The side of the housing 38 for the pinion 40 is covered by a bolted plate 50. The liquid being pumped will occupy the spaces between the non-contacting vanes 25 and 29 as it is sucked therein at the intake 10 and will be trapped in these spaces until released at the outlet 11. The interdental spaces between the vanes of the inner and outer rotors are presented in confronting relation and the faces of the discs 15′ and 30 thereof lie flush with the sides of the vanes 25 and 29. The diameter of the disc 30 of the inner rotor is smaller than that of the outer rotor which leaves a crescent-shaped area on the outer rotor uncovered but this area is covered by the casing 6 which is formed, for this purpose, with a crescent-shaped flange 6′. As previously stated, the outer edges of the inner rotor contact with the inner circumference of the shallow depression 14′ between the ends of the crescent-shaped flange 6′ which effects a seal at this point.

It is a more or less common expedient to construct rotary pumps, motors or engines with co-operating rotors but in all of these prior devices the teeth, as they are called, of the rotors are interposed in contact with one another so that the wear on the same is one of the outstanding drawbacks. In my improved assembly the vanes on the respective rotors occupy the interdental spaces between the vanes so that they are interposed with re-

spect to one another but they do not contact at any point so that wear is eliminated from this cause.

The necessary suction in my assembly is produced from the outside of the outer rims of the rotors. The vanes thereon hold the liquid as well as expelling it at the proper time. The partitions in the two parts of the casing seal the housing 38 for the pinions 39 and 40 so that there is no circulation from the rotor housing into the same.

Another important difference in my assembly over the prior art is the direct drive for each rotor preferably from a shaft common to both. This enables the rotors to be driven in time and relieves the necessity of contact with one another.

In building an apparatus in accordance with my invention, relative diameters of the inner and outer rotors should be taken into account so as to provide for the rotation thereof in proper time. There is therefore considerable significance in the gear ratio used. As an example, with an inner rotor having 10 vanes the driving pinion for the drive gear thereof should have 16 teeth with the gear itself having 40 teeth. For an outer rotor with 12 vanes, the driving pinion should have 17 teeth with the drive gear having 51 teeth. This ratio would change, of course, when the 10 to 12 ratio of the vanes change. In other words, when the 10 to 12 ratio of the vanes change, the gear ratio should be changed in the same proportion.

A pump or engine constructed in accordance with my invention will be quiet in operation. There is no chance for the liquid to be trapped by the vanes and produce "hammering". It is unusually efficient in operation and may have a wide range of application. With the wear reduced to a minimum, it will have a long life and the construction is such as to enable the device to be produced at a reasonable manufacturing cost.

Obviously those skilled in the art may make various changes in the details and arrangement of parts without departing from the spirit and scope of the invention as defined by the claims hereto appended and I wish therefore not to be restricted to the precise construction herein described.

I claim:—

1. In a rotary machine of the class described, a casing having an intake and outlet, rotors journaled in said casing for rotation in the same direction and each having spaced radial vanes, the vanes on one rotor occupying the interdental spaces between the vanes of the other rotor and out of contact therewith.

2. A rotary machine of the class described embodying in its construction co-operating rotors mounted for rotation in the same direction with interposed vanes out of contact with one another.

3. A rotary machine of the class described embodying in its construction co-operating rotors mounted for rotation in the same direction with interposed vanes out of contact with one another, and a direct drive for each rotor.

4. A rotary machine of the class described embodying in its construction co-operating rotors mounted for rotation in the same direction with interposed vanes out of contact with one another, and a direct drive for each rotor from a drive shaft common to both.

5. A rotary machine of the class described embodying in its construction inner and outer eccentrically mounted rotors having interposed radial vanes out of contact with one another.

6. A rotary machine of the class described embodying in its construction inner and outer eccentrically mounted rotors having interposed radial vanes out of contact with one another, and a direct drive for each rotor.

7. A rotary machine of the class described embodying in its construction inner and outer eccentrically mounted rotors having interposed radial vanes out of contact with one another, and a direct drive for each rotor from a shaft common to both.

8. A rotary machine of the class described embodying in its construction co-operating rotors mounted for rotation in the same direction with interposed vanes out of contact with one another, and a direct drive for each rotor comprising a driving shaft, driving pinions on said shaft, and a gear for each rotor meshing with said pinions.

9. In a rotary machine of the class described, a casing, an outer rotor journaled therein, an intake and outlet in the casing on diametrically opposite sides of said rotor, relatively short radial vanes on the side of said rotor, an inner rotor eccentrically mounted with respect to the outer rotor, within the space defined by the radial vanes on the outer rotor, relatively long radial vanes on the inner rotor occupying the interdental spaces between the vanes on the outer rotor but not in contact therewith, a crescent-shaped partition for said rotors between the intake and outlet, and a direct drive for each of said rotors.

10. In a rotary machine of the class described, a casing, an outer rotor journaled therein, an intake and outlet in the casing on diametrically opposite sides of said rotor, relatively short radial vanes on the side of said rotor, an inner rotor eccentrically mounted with respect to the outer rotor, within the space defined by the radial vanes on the outer rotor, relatively long radial vanes on the inner rotor occupying the interdental spaces between the vanes on the outer rotor but not in contact therewith, a crescent-shaped partition for said rotors between the intake and outlet, and a direct drive for each of said

rotors comprising a driving shaft, driving pinions on said shaft, and a gear for each rotor meshing with said pinions.

11. In a rotary machine of the class described, a casing formed of two main parts, one of which having an intake and outlet, and a central rotor housing communicating therewith, a rotor concentrically journaled in said housing comprising a disc-like member having relatively short radial vanes on one side thereof, the other part of said casing comprising a cover for the central rotor housing in the first-named part, a rotor journaled in the said cover eccentric with said first-named rotor and having relatively long radial vanes occupying the interdental spaces between the vanes in said first-named rotor but not in contact with said vanes, a crescent-shaped partition for said rotors between the said intake and outlet, and a direct drive for each rotor, comprising a drive shaft, driving pinions on said shaft, and a gear for each rotor meshing with said pinions.

12. A rotary machine of the class described embodying in its construction a rotor comprising a disc-like member having spaced peripheral vanes on the side thereof, and a co-operating rotor mounted to rotate in the same direction as said first-named rotor and comprising a wheel-like member eccentrically mounted with respect to the first-named rotor and having spaced radial vanes occupying the interdental spaces between said peripheral vanes but out of contact therewith.

13. A rotary machine of the class described embodying in its construction a rotor comprising a disc-like member having spaced peripheral vanes on the side thereof, and a co-operating rotor mounted to rotate in the same direction as said first-named rotor and comprising a wheel-like member eccentrically mounted with respect to the first-named rotor and having spaced radial vanes occupying the interdental spaces between said peripheral vanes but out of contact therewith, and a direct drive for each of said rotors.

14. A rotary machine of the class described embodying in its construction a rotor comprising a disc-like member having spaced peripheral vanes on the side thereof, and a co-operating rotor mounted to rotate in the same direction as said first-named rotor and comprising a wheel-like member eccentrically mounted with respect to the first-named rotor and having spaced radial vanes occupying the interdental spaces between said peripheral vanes but out of contact therewith, and a direct drive for each of said rotors from a drive shaft common to both.

15. A rotary machine of the class described embodying in its construction a rotor comprising a disc-like member having spaced peripheral vanes on the side thereof, and a co-operating rotor mounted to rotate in the same direction as said first-named rotor and comprising a wheel-like member eccentrically mounted with respect to the first-named rotor and having spaced radial vanes occupying the interdental spaces between said peripheral vanes but out of contact therewith, and a direct drive for each of said rotors from a drive shaft common to both, comprising a pair of pinions on said drive shaft, and a gear for each rotor meshing with said pinions.

16. In a rotary machine of the class described, a casting formed of two main parts, rotors journaled in said casing, and a direct drive for each of said rotors comprising a drive shaft entering said casing parallel with the axis of rotation of the rotors, pinions on said shaft, one of said pinions being housed in one part of the casing and the other being housed in the other part, and a gear for each of said rotors entering each of the pinion housings and meshing with the pinions therein.

17. In a rotary machine of the class described, a casing, a rotor housing therein, a pair of co-operating rotors journaled in said housing, and a direct drive for each of said rotors comprising a shaft, pinions on the shaft, and a gear for each rotor meshing with said pinions, said pinions being each housed in the casing separate from each other, and the pinion housings being separated from the housing for the rotors.

18. A rotary machine of the class described embodying in its construction inner and outer eccentrically mounted rotors journaled to rotate in the same direction and having interposed radial vanes out of contact with one another.

19. A rotary machine of the class described embodying in its construction inner and outer eccentrically mounted rotors journaled to rotate in the same direction in timed relation to one another and having interposed radial vanes out of contact with one another.

20. In a rotary machine of the class described, the combination with a casing having an intake and an outlet, of rotors journaled in said casing each for rotation in the same direction, and a series of spaced-apart vanes on each of said rotors mounted to travel in coincident planes, the interdental spaces between the vanes of one of said rotors being wider and deeper than the vanes of the other rotor.

21. In a rotary machine of the class described, the combination with a casing having an inlet and an outlet, of rotors journaled in said casing each for rotation in the same direction, a series of spaced-apart vanes at the peripheral portions of each of said rotors, means for supporting said rotors with clearances between the vanes thereof throughout a complete cycle of rotation, and barriers for closing the clearance between the vanes.

22. A rotary machine of the class described comprising rotors mounted for ro-

tation in the same direction and having radial vanes interspaced with one another, the spaces between the vanes of one rotor which are occupied by the vanes of the other rotor being wider and deeper than the vanes which thus occupy them to leave clearances between the vanes of one rotor and the vanes of the other rotor, and means for closing such clearances at the opposite peripheral portions of said rotors.

23. A rotary machine of the class described comprising rotors each mounted for rotation in the same direction and each having a series of spaced-apart radial vanes interspaced with the vanes of the other rotor, the spaces between the vanes of one rotor which are occupied by the vanes of the other rotor being wider and deeper than the vanes which occupy them to leave a clearance between the vanes of one rotor and the vanes of the other rotor, and means for closing such clearances at opposite sides of the periphery of the rotors between the intake and outlet of the machine.

24. A rotary machine of the class described comprising an outer rotor and an inner rotor each having spaced-apart radial vanes with the vanes of the inner rotor projecting radially beyond the vanes of the outer rotor when occupying predetermined positions, and means comprising arcuate sealing seats for said vanes between the intake and outlet of the machine.

25. A rotary machine comprising a casing having inlet and exhaust ports, rotors journaled in said casing, a series of radial vanes on each of said rotors, each of said vanes having flat faces on the opposite surfaces thereof, and means for supporting said rotors with the vanes thereof out of contact with each other at all times.

26. A rotary machine comprising a casing, rotors therein each having spaced radial vanes, the vanes on one rotor occupying the interdental spaces between the vanes on the other rotor, said rotors being eccentrically mounted to rotate in the same direction, the vanes on one rotor moving into a projected position beyond the periphery of the other rotor at one stage in the cycle of rotation of the rotors.

27. A rotary machine comprising a casing, rotors therein each having spaced radial vanes, the vanes on one rotor occupying the interdental spaces between the vanes on the other rotor, said rotors being eccentrically mounted to rotate in the same direction, the vanes on one rotor moving into a projected position beyond the periphery of the other rotor at one stage in the cycle of rotation of the rotors, and a crescent-shaped enlargement in the casing to accommodate the projected position of said vanes.

28. A rotary machine comprising a casing having inlet and outlet ports, a rotor journaled in said casing, a series of spaced-apart radial vanes on said rotor, another rotor journaled in said casing, and a series of spaced-apart vanes on said second-named rotor, said second-named vanes having opposite plane faces extending from the periphery of the second-named rotor to a narrow edge extending along lines parallel to the axes of rotation of said rotors.

29. A rotary machine comprising a casing, a rotor journaled for rotation therein, a series of spaced-apart vanes at the side of said rotor, each of said vanes being substantially triangular in shape with opposite plane faces extending to an inner edge parallel to the axis of rotation of said rotor, the interdental spaces between said vanes extending to the periphery of said rotor, another rotor journaled in said casing for rotation eccentrically of said first-named rotor, a series of spaced-apart flat sided radial vanes on said last-named rotor, the sides of said last-named vanes tapering toward the periphery of the second-named rotor, and means for supporting said rotors with the vanes of the second-named rotor occupying positions in the interdental spaces between the vanes of the first-named rotor but out of contact therewith.

30. A rotary machine comprising a casing, a rotor journaled therein, a series of substantially triangular vanes at the side of said rotor, the interdental spaces between said vanes extending to the periphery of said rotor and said vanes having flat sides extending to the periphery of said rotor and said vanes having flat sides extending inwardly from the periphery of the rotor, another rotor in said casing journaled for rotation eccentrically of said first-named rotor, flat-sided peripheral vanes on the side of said second-named rotor, and means for supporting said rotors with the vanes of the second-named rotor occupying positions in the interdental spaces between the vanes of the first-named rotor with the vanes of one rotor being out of contact with the vanes of the other rotor.

31. A rotary machine comprising a casing, a rotor journaled for rotation therein, a series of spaced-apart substantially triangular vanes at the peripheral portion of said rotor with the interdental spaces between said vanes extending to the periphery of said rotor and said vanes having flat opposite sides tapering inwardly, another rotor in said casing journaled eccentrically of said first-named rotor, a series of spaced-apart radial vanes on said second-named rotor with opposite flat faces on each tapering outwardly, the interdental spaces between the vanes of the second-named rotor being wider and deeper than the vanes on the first-named rotor, and means for supporting said rotors to keep the vanes of one

rotor out of contact with the vanes of the other rotor throughout a complete cycle of rotation of said rotors.

32. A rotary machine comprising a casing having an inlet and an outlet, inner and outer rotors journaled eccentrically of each other in said casing, a series of spaced-apart radial vanes on each of said rotors, the vanes of one rotor being adapted to occupy positions in the interdental spaces between the vanes of the other rotor, a seat in said casing having the form of a segment of a cylinder, and means for supporting said rotors in said casing with the vanes of one rotor projecting peripherally beyond the interdental spaces between the vanes of the other rotor to fit against said seat.

33. A rotary machine comprising a casing, a rotor journaled for rotation therein, a series of spaced-apart vanes on said rotor with the interdental spaces between said vanes extending to the periphery of the rotor, another rotor journaled in said casing, a series of spaced-apart vanes on said second-named rotor occupying positions in the interdental spaces between the vanes of the first-named rotor, and means for supporting said second-named rotor with the vanes thereon projecting beyond the periphery of the first-named rotor when the vanes of said second-named rotor occupy predetermined positions.

34. A rotary machine comprising a casing, a rotor journaled therein, a series of spaced-apart vanes on said rotor with the interdental spaces extending to the periphery of said rotor, another rotor in said casing journaled eccentrically of said first-named rotor, a series of spaced-apart vanes on said second-named rotor occupying positions in the interdental spaces between the vanes of the first-named rotor but out of contact with the latter throughout a complete cycle of rotation of the rotors, and means for supporting said rotors with the vanes on the second-named rotor projecting beyond the periphery of the first-named rotor when the vanes on the second-named rotor occupy predetermined positions in the cycle of rotation of the rotors.

35. In a rotary machine, the combination with a casing comprising a detachable cover, of a disc-shaped rotor journaled in said cover, a series of spaced-apart radial vanes on said rotor extending to the periphery of the latter, another rotor journaled in the casing, a series of inwardly extending radial vanes on the peripheral portion of said last-named rotor, a crescent-shaped seat on said cover for the vanes on the second-named rotor, the face of said crescent-shaped seat being flush with that side of said first-named rotor adjacent the radial vanes thereon, a crescent-shaped partition between the vanes of the two rotors, and a seat between the ends of said crescent-shaped seat for the outer ends of the radial vanes on the first-named rotor.

36. In a rotary machine of the class described, the combination with a casing having an intake and an outlet, of rotors journaled to rotate in said casing between said intake and said outlet, radial interposed vanes on said rotors, a crescent-shaped partition in said casing between the intake and outlet and having a curvature corresponding to the curvature of the periphery of said rotors, the vanes of one of said rotors projecting beyond the periphery of the other rotor when in predetermined positions in the cycle of rotation of the rotors, and means for supporting said rotors with the projecting vanes engaging a cut-away portion in the casing to serve as a seat diametrically opposite said crescent-shaped partition and also located between the intake and outlet.

37. In a rotary machine of the class described, a casing having an intake and outlet, rotors journaled in said casing between said intake and outlet, each having radial interposed vanes in spaced relation throughout a complete cycle of rotation to provide a clearance between said vanes, a crescent-shaped partition in said casing between said intake and outlet and having a curvature corresponding to the curvature of the periphery of the rotors to close the clearance space between the vanes at the periphery of the rotors at one stage in the cycle of rotation of the rotors, a crescent shaped enlargement in the casing having a curvature substantially corresponding to the curvature of the periphery of the rotors and positioned diametrically opposed to said crescent-shaped partition, the vanes on one of said rotors moving into a projected position beyond the periphery of the rotors at one stage in the cycle of rotation of the rotors and adapted to wipe across the surface of said crescent-shaped enlargement for closing the clearance between the vanes at another stage in the cycle of rotation of the rotors, said crescent-shaped enlargement also being located between said intake and outlet.

38. In a rotary machine of the class described, a casing having an intake and outlet, rotors journaled in said casing between said intake and outlet, each having radial interposed vanes in spaced relation throughout a complete cycle of rotation to provide a clearance between said vanes, a crescent-shaped partition in said casing, between said intake and outlet and having a curvature corresponding to the curvature of the periphery of the rotors to close the clearance space between the vanes at the periphery of the rotors at one stage in the cycle of rotation of the rotors, a crescent-shaped enlargement in the casing having a curvature substantially corresponding to the curvature of the periphery of the rotors and positioned diametrically opposed to said crescent-shaped partition, the vanes

on one of said rotors moving into a projected position beyond the periphery of the rotors at one stage in the cycle of rotation of the rotors and adapted to wipe across the surface of said crescent-shaped enlargement for closing the clearance between the vanes at another stage in the cycle of rotation of the rotors, said crescent-shaped enlargement also being located between said intake and outlet, said rotors being eccentrically mounted, and a separate drive for each of said rotors.

39. In a rotary machine of the class described, a casing having an intake and outlet, rotors journaled in said casing between said intake and outlet, each having radial interposed vanes in spaced relation throughout a complete cycle of rotation to provide a clearance between said vanes, a crescent-shaped partition in said casing between said intake and outlet and having a curvature corresponding to the curvature of the periphery of the rotors to close the clearance space between the vanes at the periphery of the rotors at one stage in the cycle of rotation of the rotors, a crescent shaped enlargement in the casing having a curvature substantially corresponding to the curvature of the periphery of the rotors and positioned diametrically opposed to said crescent-shaped partition, the vanes on one of said rotors moving into a projected position beyond the periphery of the rotors at one stage in the cycle of rotation of the rotors and adapted to wipe across the surface of said crescent-shaped enlargement for closing the clearance between the vanes at another stage in the cycle of rotation of the rotors, said crescent shaped enlargement also being located between said intake and outlet, said rotors being eccentrically mounted, and a separate drive for each of said rotors comprising gear teeth on each of the rotors, a drive shaft having pinions thereon meshing with the teeth of the respective rotors.

40. In a rotary machine of the class described, a casing having an intake and outlet, rotors journaled in said casing between said intake and outlet, each having radial interposed vanes in spaced relation throughout a complete cycle of rotation to provide a clearance between said vanes, a crescent-shaped partition in said casing between said intake and outlet and having a curvature corresponding to the curvature of the periphery of the rotors to close the clearance space between the vanes at the periphery of the rotors at one stage in the cycle of rotation of the rotors, a crescent shaped enlargement in the casing having a curvature substantially corresponding to the curvature of the periphery of the rotors and positioned diametrically opposed to said crescent-shaped partition, the vanes on one of said rotors moving into a projected position beyond the periphery of the rotors at one stage in the cycle of rotation of the rotors and adapted to wipe across the surface of said crescent-shaped enlargement for closing the clearance between the vanes at another stage in the cycle of rotation of the rotors, said crescent shaped enlargement also being located between said intake and outlet, said rotors being eccentrically mounted, and a separate drive for each of said rotors comprising gear teeth on each of the rotors, a drive shaft having pinions thereon meshing with the teeth of the respective rotors, and means for selectively adjusting the drive for the rotors for changing their timed relation of rotation.

41. In a rotary machine, the combination with a casing, of a bearing secured to one of the inner walls of said casing, a rotor journaled on said bearing, another bearing secured to the opposite inner wall of said casing, another rotor journaled on said additional bearing, spaced-apart vanes extending from adjacent sides of said rotors and occupying positions in coincident planes, and means within said casing and associated with said vanes for controlling the flow of liquid through the machine.

42. In a rotary machine, the combination with a casing, of a fixed bearing secured to one inner wall of said casing, a rotor journaled on said bearing, another fixed bearing secured to the opposite inner wall of said casing, an additional rotor journaled on said second-named fixed bearing, spaced-apart vanes on adjacent faces of said rotors in co-operative relation to each other while the inner faces of said rotors are in abutting relation, and means associated with said vanes for controlling the flow of liquid through the machine.

43. In a rotary machine, the combination with a casing, of a rotor therein, an annular seat for said rotor, another rotor in said casing, an additional annular seat for said second-named rotor, spaced-apart vanes on said rotors arranged in co-operative relation and with their diametral flat faces in contact with the opposite adjacent diametral faces of said rotors, and means for directing the flow of fluid along predetermined paths within said casing.

44. In a rotary machine, the combination with a casing, of a rotor therein having a flat diametral face, spaced-apart vanes projecting from said flat face and having flat faces in a diametral plane spaced from the first-named flat face, an additional rotor in said casing having a flat diametral face, vanes extending laterally from said additional rotor and having flat faces in a diametral plane spaced from the flat face of said additional rotor, means for mounting said rotors with the flat faces of the vanes of each in engagement with the flat faces of the opposite rotor, and means for controlling the liquid flow through said casing.

45. In a rotary machine, the combination with a casing having detachable sections, of a rotor fitting in a circular recess in one section, another rotor fitting in a circular recess in the other section, spaced-apart vanes on each rotor with their flat diametral faces engaging the flat diametral faces of the opposite rotor when said sections are secured together, and means within said casing for controlling the flow of the liquid through the machine.

46. In a rotary pump, the combination with a casing, of two rotors within said casing, radial vanes on said rotors, gearing for positively driving both rotors with the vanes thereon, and annular seats for the rotors to seal the liquid from the gearing.

47. In a rotary pump, the combination with a casing, of rotors mounted therein, annular seats for said rotors, a series of vanes on each rotor, and gearing in enclosed lubricating compartments separated by said annular seats from the said vanes, said gearing being connected to said rotors to drive said vanes.

48. In a rotary pump, the combination with a casing having detachable sections, of a rotor fitting in a cylindrical recess in one section and journaled to said section, another rotor fitting in a cylindrical recess in the other section and journaled to said last-named section, spaced-apart radial vanes on each rotor in co-operative relation when said sections are secured together with the adjacent faces of the rotors in engagement, a gear on each rotor, and a pair of pinions respectively meshing with said gears to drive said rotors and said vanes.

In testimony whereof, I have signed my name to this specification on this 16th day of July, A. D. 1927.

PAUL B. RENFREW.