

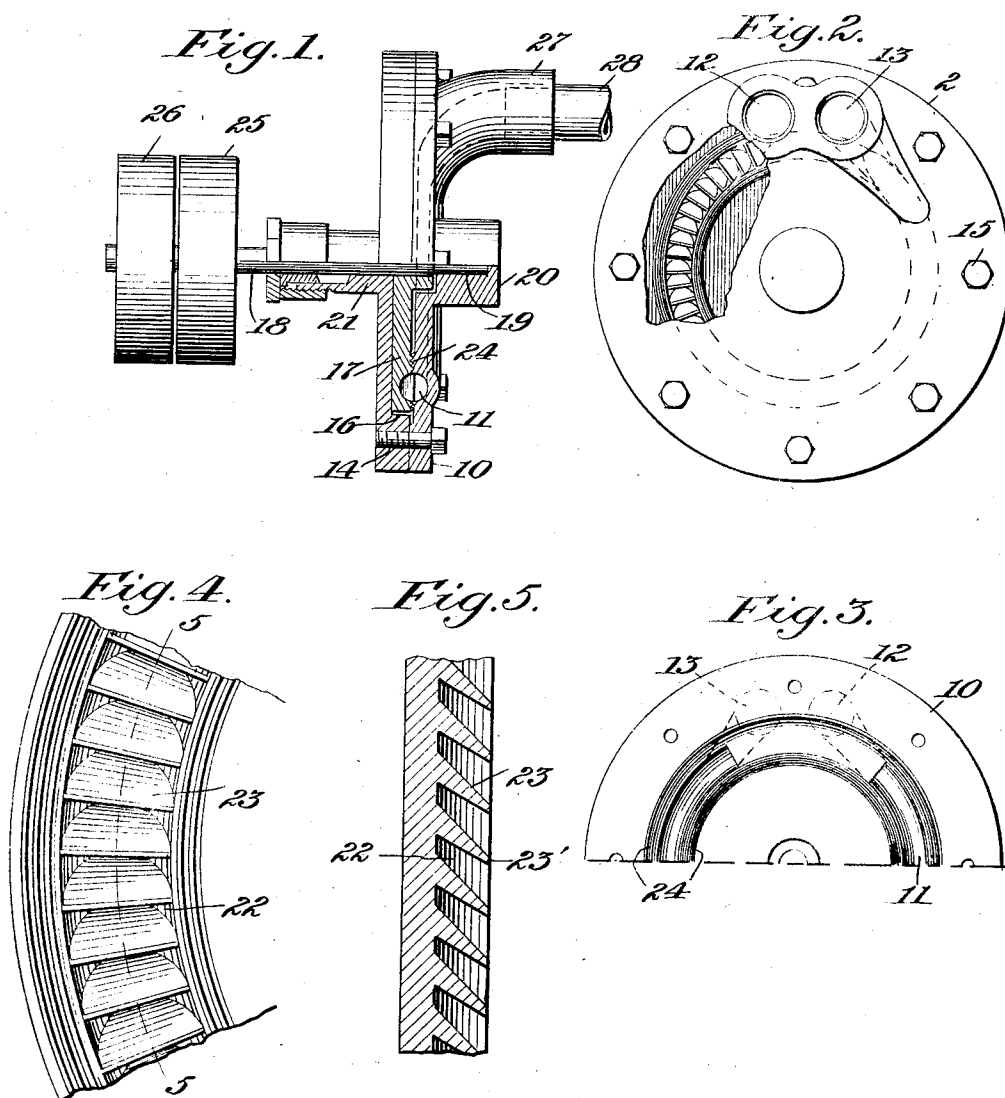
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PUMP

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PUMP.

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This invention relates to pumps, and more particularly to pumps of the centrifugal type which comprise a rotor having fluid impelling means, such as a series of blades, disposed remote from its axis and operating upon fluid within a raceway, the rotor being disposed within a casing which makes a sealing fit with the same to prevent movement of the fluid radially inwardly from the raceway.

An object of this invention is to provide a pump in which the rotor has located thereon impelling blades of improved and more efficient construction.

Another object of the invention is to afford a pump in which the fluid raceway is tightly sealed to prevent leakage.

A still further object of the invention is to provide a pump of extremely simple construction, and which may, as a result, be manufactured with considerable economy.

The above mentioned and other objects of the invention of a character which are more intimately connected with the details of the illustrated embodiment of the invention, will become more obvious as the description proceeds.

The invention consists, broadly, of a pump having a disc type rotor provided on one face with an annular marginal series of blades which, preferably, are inclined in the direction of rotation of the rotor for the purpose, among others, of increasing the force of the tangential impulse given the particles of fluid by the rotor. More specifically the blades are located in an annular marginal groove in a lateral face of the rotor with their ends substantially flush with the surface of the rotor on each side of the groove. Although the blades are preferably arranged on a lateral face of the rotor, it is to be understood that this lateral disposition of the same is not essential; for this reason it will be stated throughout the description and claims that the blades are marginally disposed, or, in other words, are remote from the axis of the rotor and at or adjacent the rotor periphery or margin.

The rotor is enclosed in a casing having a section which faces the surface of the rotor having the series of blades therein, and which is formed with an annular channel opposite the series of blades to afford a raceway. This casing section closely receives the rotor on each side of the channel and the

series of blades in order to close the raceway, and both the casing section and the rotor are formed with annular co-acting ribs in order to minimize leakage from the raceway.

In the accompanying drawings there is illustrated one form of a device embodying the features which have above been generally described, and in these drawings

Fig. 1 is a side view of the pump with a portion of the same shown in section,

Fig. 2 is a front elevational view with a portion of the casing broken away,

Fig. 3 is a fragmentary view of the interior of one of the sections of the rotor casing,

Fig. 4 is a fragmentary elevational view of the impelling blades, and

Fig. 5 is a sectional view on the line 5-5 of Fig. 4.

Referring to the drawings for a more detailed description, like numerals representing the same parts throughout the several views, 10 indicates a casing section having, upon its inner face, an annular channel 11 provided with an inlet 12 and an outlet 13 extending through the web of the casing section. The section 10 is secured adjacent its periphery to a rear casing section 14, as by bolts 15 extending through the two sections. The section 14, upon its inner face, is formed with a marginal shoulder or flange 16 to provide a central recess or cavity for the reception of a rotor 17 fixedly secured to a shaft 18, having a bearing 19 in a boss 20 in the casing section 10, and a bearing 21 in the section 14. The rotor is of the disc-type, and is provided remote from its axis with a groove having therein a series of blades with the walls of the groove substantially closing the spaces between the blades at the sides thereof to form buckets. This groove is marginally disposed, or, in other words, is remote from the axis and at or adjacent the rotor periphery; further, the groove is, although not necessarily, arranged on a lateral face of the disk as indicated by the reference character 22. The blades 23 are arranged in the groove, which, it will be observed, is of curved or semi-circular formation in cross section. Since the channel 11, forming the raceway is also of curved or semi-circular cross section, there is thus provided, as illustrated clearly in Figure 1, a fluid passage, which, in cross sectional shape,

is continuously curved, without sharp ends or angles. In other words, the walls of the raceway and buckets merge, and are substantially continuous at the lines of junction; and the cross sectional shape of each bucket is such that in association with the adjacent cross section of the raceway, the entire wall of the bucket and raceway is of curved or circular form. This construction avoids sharp corners or bends for the water, and when the same is thrown outwardly by centrifugal action of the rotating disk, a whirling effect is imparted thereto by the raceway, and it returns to the buckets at a point further on in the raceway without loss of friction or the creation of eddy currents as would occur if the raceway and buckets were not of this curved formation and did not merge.

As will be noted from an inspection of Fig. 5, the blades are slightly inclined in an anti-clockwise direction, which is the direction of movement of the rotor, and have their ends 23' substantially flush with the face of the rotor at each side of the groove 22. It is, of course, understood by one skilled in the art that in pumps of this type the blades impart to the particles of water entering through the inlet opening into the raceway two impulses, one in a direction radially of the rotor, which is the action of the centrifugal force, and another impulse in a direction at a tangent to the rotor, which is, of course, the result of the tangential force. As is understood, the centrifugal force and the tangential forces created by the revolution of the rotor modify each other so that the path actually taken by the particles of fluid is one which is a component of these two influences. It has been found that by forwardly inclining the blades 23 in the manner shown in the drawings the influence of the tangential force is materially increased, which is highly desirable in this type of pump.

In order to minimize leakage from the raceway the casing section 10 forms a substantially water-tight joint with the rotor at each side of the channel 11 and the series of blades, as will be clear from an inspection of Fig. 1. Both the face of the rotor and the inner face of the casing section are formed at the sides of the channel and the series of blades with co-acting and interlocking annular ribs 24, which tend to seal the raceway.

The rotor shaft 18 may be driven through the pulley 25 adjacent a loose pulley 26, to which the driving belt is transferred when operation of the pump is to be stopped. As is customary, the inlet and outlet openings may be provided with the usual nipples 27 which receive the ends of fluid supply and exhaust pipes 28.

In operating this pump, power is applied

to the rotor shaft 18 and the rotor is revolved in a counter clockwise direction, as viewed in Fig. 2. Fluid entering through the inlet opening 12 is engaged by the blades, generally upon the inner side of the blades, and the centrifugal force immediately results in a tendency to throw the water against the outer wall of the raceway, the centrifugal force being modified by a forward or tangential force created by the revolution of the rotor. The path actually taken by the fluid is a resultant of these two forces. Each amount of fluid operated upon in this manner, of course, obtains a great increase in velocity. This increase in velocity head of the fluid is immediately imparted in the form of pressure head to the fluid immediately ahead in the raceway, and the impartation of power results in an immediate decrease in head on the part of the amount of fluid which again is actuated by the rotor. In passing through the raceway the fluid follows the helical course until it reaches the outlet opening, where its very high velocity head is changed to pressure head. The frequency with which the fluid is actuated by the rotor during its passage through the raceway will vary in accordance with the back pressure at the outlet, high back pressure at the outlet tending to lengthen the path of the fluid by increasing the number of times it is subjected to the action of the rotor.

In other words, as the back pressure increases, the curves of the line of travel of the fluid back and forth or into and out of the rotor will multiply and become sharper, since the high back pressure prevents the fluid from passing onwardly within the raceway for any considerable distance before it imparts its velocity head to the preceding fluid and then returns to the rotor for impulsion.

In addition to the action of the rotor, the form of the raceway changes the direction of the water and causes it to take the helical path, and if no other force acted to change its course or reduce its velocity, it would again enter the impeller at a point farther ahead in the direction of its rotation, when it would again receive kinetic energy from the action of the impeller. Due to the small friction of the discharge and the friction of the passage through the raceway, in addition to the head, the pump may be acting against, the water leaving the impeller will encounter a back pressure or pressure head acting in a direction opposite rotation of the impeller. This force tends to change the course of the water counter to the direction in which it is traveling. The water in thus changing its direction gives up its velocity head to the water just ahead of it in the form of the pressure head. As the water gives up its velocity head to the water in advance,

it is caused, by the several forces mentioned, to return to the impeller to obtain additional velocity, and the path it takes is a helical one.

5 The water does not in any substantial or considerable amount pass through the narrow portion of the raceway. Small amounts of the same may return to the inlet opening, but not in degrees sufficient to affect the
10 operation of the pump.

Furthermore, it will be understood that the close fit of the rotor within the casing assists the action of centrifugal force in maintaining the fluid within the raceway,
15 and although small amounts of the fluid may work inwardly toward the axis due to the fact that there is too great a clearance between the rotor and raceway, the construction is such that in ordinarily operation this will not occur to an extent sufficient to affect the operation of the pump.

It should be borne in mind that while I have described in detail my invention as embodied in a working device, the disclosure, in its details, is illustrative merely, and in no sense restrictive of the invention, such modifications being covered by the invention as come within the scope of the following claims. For instance, although the casing channel 11 is shown as positioned in a
20 plane paralleling a lateral face of the rotor on which the blades are located, the invention is not limited to this precise location for either the channel or the blades.

When it is stated in the specification and claims that the series of blades is marginally disposed, it is simply meant that the blades are remote from the axis of the disk, and are either at or adjacent the margin of the rotor disk. The statement that the blades are marginally disposed does not limit the invention to the positioning of the blades on a lateral face. Moreover, when the series of blades and raceway are defined as annular, it is to be understood that the invention is not to be restricted to either a raceway or a series of blades which constitutes a complete annulus or ring, and the term is used in a generic sense to cover a curved or arcuate formation of the series of blades or raceway.

I claim:

1. A pump comprising a rotor having an annular marginal groove, a plurality of
25 blades in said groove, the walls of the groove closing the spaces between said blades at the sides of the blades, and a plurality of sealing ribs adjacent the groove adapted to co-operate with complementary ribs on a rotor casing.

2. A pump comprising a disk rotor having an annular groove remote from its axis, and a plurality of blades in said groove bodily inclined outwardly from said surface in
30 the direction of rotation of the rotor, the

walls of the groove closing the spaces between said blades at the sides thereof.

3. A pump comprising a rotor having an annular groove adjacent its margin, a plurality of blades in said groove having their
70 ends substantially flush with the surface of the rotor on each side of the groove, the walls of the groove closing the spaces between said blades at the sides of the blades, and a plurality of sealing ribs adjacent the
75 groove adapted to co-operate with complementary ribs on a rotor casing.

4. A pump comprising a rotor having an annular groove remote from its axis, and a plurality of blades in said groove bodily inclined outwardly from said surface in the
80 direction of rotation of the rotor, the walls of the groove closing the spaces between said blades at the sides thereof, and the ends of the blades being substantially flush with the
85 surface of the rotor at each side of the groove.

5. A pump comprising a rotor having an annular marginal series of blades and a casing having an annular channel therein,
90 said casing on each side of said channel forming a substantially water-tight joint with the face of said rotor on each side of said blades to form a closed fluid raceway.

6. A pump comprising a rotor having an annular marginal series of blades inclined in the direction of rotation of the rotor and a casing having an annular channel therein,
95 said casing on each side of said channel forming a substantially water-tight joint with the face of said rotor on each side of said blades to form a closed fluid raceway.

7. A pump comprising a rotor having an annular marginal series of blades and a casing having an annular channel therein,
100 said casing on each side of the channel forming a substantially water-tight joint with the rotor on each side of the blades to form a closed fluid raceway, the casing and rotor being provided at the sides of the blades
105 with a plurality of annular co-acting ribs to prevent leakage.

8. A pump comprising a rotor having an annular marginal series of blades and a casing having an annular channel therein,
110 said casing on each side of the channel forming a substantially water-tight joint with the said face of the rotor on each side of the blades to form a closed fluid raceway, the casing and rotor being provided at the sides of the blades with a plurality of annular co-acting ribs to prevent leakage.

9. A pump comprising a rotor having an annular marginal groove, a series of blades in said groove having their ends substantially flush with the surface of the rotor on each side of the groove, and a casing having an annular channel therein, said casing on each side of the channel forming a substantially water-tight joint with the said face of
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the rotor on each side of the blades to form a closed fluid raceway, the casing and rotor being provided at the sides of the blades with a plurality of annular co-acting ribs to prevent leakage.

10. A pump comprising a rotor having an annular marginal series of blades, a shaft for said rotor and a casing having bearings for said shaft and comprising a section facing said rotor and having an annular channel therein opposite the series of blades, the said casing section forming a substantially water-tight joint with the said face of the rotor on each side of the series of blades to form a closed fluid raceway, said casing section having a fluid inlet and outlet.

11. A pump comprising a rotor having an annular marginal series of blades, a shaft for said rotor and a casing having bearings for said shaft and comprising a section facing said rotor and having an annular channel therein opposite the series of blades, the said casing section forming a substantially water-tight joint with the said face of the rotor on each side of the series of blades to form a closed fluid raceway, the casing section and rotor being provided at the sides of the blades and channel with a series of annular co-acting ribs to prevent leakage, said casing section having a fluid inlet and outlet.

12. A pump comprising a rotor having an annular marginal series of blades having their ends substantially flush with the face of the rotor, a shaft for said rotor and a casing having bearings for said shaft and comprising a section facing said rotor and having an annular channel therein opposite the series of blades, the said casing section forming a substantially water-tight joint with the said face of the rotor on each side of the series of blades to form a closed fluid raceway, the casing section and rotor being provided at the sides of the blades and channel with a series of annular co-acting ribs to prevent leakage, said casing section having a fluid inlet and outlet.

13. A pump comprising a rotor having an annular marginal series of blades inclined in the direction of rotation of the rotor and having their ends substantially flush with the face of the rotor, a shaft for said rotor and a casing having bearings for said shaft and comprising a section facing said rotor and having an annular channel therein opposite the series of blades, the said casing section forming a substantially water-tight joint with the said face of the rotor on each side of the series of blades to form a closed fluid raceway, the casing section and rotor being provided at the sides of the blades and channel with a series of annular co-acting ribs to prevent leakage, said casing section having a fluid inlet and outlet.

14. A pump comprising a rotor having an

annular groove remote from its axis, a plurality of blades in said groove, the walls of the groove closing the spaces between the blades at the sides of the blades, and a plurality of sealing ribs adjacent the groove adapted to co-operate with complementary ribs on a rotor casing to form a fluid raceway.

15. A pump comprising a rotor having an annular groove disposed on a lateral face and remote from its axis, a plurality of blades in said groove, the walls of the groove closing the spaces between said blades at the sides of the blades, and a plurality of sealing ribs on opposite sides of the groove adapted to co-operate with complementary ribs on a rotor casing.

16. A pump comprising a rotor having an annular groove, a plurality of blades in said groove forming a series of buckets, the walls of the groove closing the spaces between the blades at the sides thereof, and a casing having a channel facing said groove, the casing making substantially water-tight joints with the surface of the rotor on the opposite sides of the groove to form a closed fluid raceway.

17. A pump comprising a rotor having an annular groove, a plurality of blades in said groove forming a series of buckets and having their ends substantially flush with the surface of the rotor at the sides of the groove, and a casing having a channel facing said rotor and making substantially water-tight joints with the surface of the rotor on opposite sides of the groove to form a closed fluid raceway.

18. A pump comprising a rotor having an annular groove, a series of blades in said groove having their ends substantially flush with the surface of the rotor on opposite sides of the groove, the walls of the groove closing the spaces between the blades at the sides thereof, a casing having an annular channel facing said series of blades, the casing on each side of the channel making a substantially water-tight joint with the surface of the rotor at the sides of the blades to form a substantially closed fluid raceway, and a plurality of annular co-acting ribs on the casing and rotor at the sides of the blades serving to prevent leakage from said raceway.

19. A pump comprising a rotor having an annular series of blades, a casing surrounding said rotor and having a channel co-operating with said blades to form a raceway, and a plurality of annular co-acting ribs on the rotor and casing at each side of the series of blades to seal the raceway.

20. A pump comprising a rotor having formed on a lateral face an annular groove, and a plurality of blades in said groove bodily inclined outwardly from said lateral

face in the direction of rotation of the rotor, the walls of the groove closing the spaces between the blades at the sides thereof.

21. A pump comprising a rotor having on
5 a lateral face an annular groove and a plurality of blades in said groove, the walls of the groove closing the spaces between the blades at the sides thereof, and a casing having an annular channel therein facing
10 said groove and blades and making a substantially water-tight joint with the face of the rotor on opposite sides of the groove to form a substantially closed fluid raceway.

22. A pump comprising a rotor having on
15 a lateral face an annular groove and a plurality of blades in said groove, the walls of the groove closing the spaces between the blades at the sides thereof, a casing having an annular channel therein facing said
20 groove and blades and making a substantially water-tight joint with the face of the rotor on opposite sides of the groove to form a substantially closed fluid raceway, and a plurality of cooperating sealing ribs upon
25 the casing and rotor at opposite sides of the said groove to prevent leakage from the raceway.

23. A pump comprising a rotor having on
30 a lateral face an annular groove adjacent its margin, a plurality of blades in said groove, the ends of which are substantially flush with the ends of the rotor at opposite
35 sides of the groove, the walls of the groove closing the spaces between the blades at the sides thereof, and annular ribs on the surface of the rotor at opposite sides of the groove.

24. A pump comprising a rotor having
40 an annular groove remote from its axis, a plurality of blades in said groove extending entirely thereacross to form a series of buckets, the walls of the groove closing the spaces between the blades at the sides thereof, and a casing surrounding said rotor having
45 a channel facing the groove and blades, the casing making a substantially water-tight joint with the surface of the rotor at the sides of the said groove to form a substantially closed fluid raceway.

25. A pump comprising a rotor having on
50 a side surface an annular series of blades, a casing for said rotor having a raceway for fluid impelled by said blade and interfitting ribs and grooves on said casing and rotor
55 at each side of said series of blades to seal said raceway.

26. A pump comprising a rotor having an annular series of blades, and annular rib
60 and groove means at each side of said series adapted to interfit with complementary rib and groove means on a rotor casing.

27. A pump comprising a rotor having on
65 a lateral surface an annular series of blades, and annular rib and groove means at each side of said series adapted to interfit with

complementary rib and groove means on a rotor casing.

28. A pump comprising a rotor having an annular series of blades, a casing for said rotor, the rotor having a relatively close fit in said casing on each side of said series of
70 blades to provide a substantially fluidtight raceway and interfitting ribs and grooves formed in said casing and rotor to seal said raceway.

29. A pump comprising a rotor having on a lateral surface an annular series of blades, a casing for said rotor, the rotor having a relatively close fit in said casing on each side of said series of blades to provide
75 a substantially fluidtight raceway and interfitting ribs and grooves formed in said casing and rotor to seal said raceway.

30. A pump comprising a rotor having an annular groove adjacent its margin, a plurality of blades in said groove bodily inclined
80 outwardly from said surface in the direction of rotation of the rotor, the walls of the groove closing the spaces between said blades at the sides thereof, and a casing for said rotor having a raceway, the casing and rotor making a substantially fluidtight joint at the sides of the raceway and said groove, and the casing being provided with inlet
85 and outlet openings leading to said raceway.

31. A pump comprising a rotor having formed on a lateral face an annular groove, a plurality of blades in said groove bodily inclined outwardly from said lateral face
90 in the direction of rotation of the rotor, the walls of the groove closing the spaces between the blades at the sides thereof, and a casing for said rotor having a raceway, the casing and rotor making a substantially fluidtight joint at each side of said groove and the casing having inlet and outlet openings communicating with said raceway.

32. A rotor for a pump comprising a
95 metallic disc having an annular series of radially disposed blades, pockets formed in the disc between said blades, said blades being disposed inwardly from the peripheral edge of the disc and remote from its axis whereby a continuous annular face lies
100 immediately adjacent said peripheral edge.

33. A pump comprising a casing, a rotatable disc in said casing having an annular series of blades disposed adjacent but inwardly from the peripheral edge of the disc whereby a continuous annular face lies immediately adjacent said peripheral edge, said casing and disc making a substantially water-tight fit along said face, and a groove in said casing forming a fluid passage therein
105 opposite the blades.

34. A pump comprising a casing, a rotatable disc in said casing, said casing having an annular passage formed therein opposite a lateral face of the disc and adjacent
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its margin, an annular series of blades on said disc spaced from its periphery to engage liquid in said passage, said disc and casing having a substantially tight fit on the inner side of the series of said blades whereby movement of liquid radially inwardly is resisted, and supply and discharge ducts co-operating with said passage.

35. A pump comprising a casing, a rotatable disc in said casing, the casing having an annular passage formed therein opposite a lateral face of the disc and adjacent its margin, a series of blades on said disc spaced from its periphery to engage liquid in said passage, pockets in said disc between the blades, said disc and casing having a substantially tight fit on the inner side of said series of blades whereby movement of liquid radially inwardly is resisted, and supply and discharge ducts co-operating with said passage.

36. A pump comprising a casing, a rotatable disc in said casing, said casing having an annular passage formed therein opposite a lateral face of the disc and adjacent its margin, an annular series of blades on said disc spaced from its periphery to engage liquid in said passage, said disc and casing having a substantially tight fit on the opposite sides of said series of blades whereby movement of liquid radially with respect to said passage is resisted, and supply and discharge ducts co-operating with said passage.

37. A pump comprising a casing, a rotatable disc in said casing, said casing having an annular passage therein opposite a lateral face of the disc and adjacent its margin, an annular series of blades on a lateral face of said disc to engage liquid in said passage, pockets on the disc between the blades closed from the periphery of the disc, said disc and casing making a substantially tight fit on the inner side of the series of blades whereby movement of liquid radially inwardly is resisted, and supply and discharge ducts co-operating with said passage.

38. A pump comprising a casing, a rotatable disc in said casing, said casing having an annular passage therein opposite a lateral face of the disc and adjacent its margin, an annular series of blades on a lateral face of said disc to engage liquid in said passage, pockets on the disc between the blades closed from the periphery of the disc, said disc and casing making a substantially tight fit on the inner side of the series of blades whereby movement of liquid radially inwardly is resisted, there being also a substantially tight fit between the casing and rotor outside the series of blades, and supply and discharge ducts co-operating with said passage.

39. A pump comprising a casing, a rotatable disc in said casing, said casing having an annular passage therein opposite a lateral

face of the disc and adjacent its margin, an annular series of blades on a lateral face of said disc to engage liquid in said passage, pockets on the disc between the blades, said disc and casing making a substantially tight fit on the inner side of the series of blades whereby movement of liquid radially inwardly is resisted, there being also a substantially tight fit between the casing and rotor outside the series of blades, and supply and discharge ducts co-operating with said passage.

40. In a pump of the class described, a casing having therein a substantially annular fluid raceway and an inlet and an outlet for said raceway, and a rotor having a marginal and laterally disposed series of blades forming buckets adjacent said raceway, the rotor and the casing making substantially fluid-tight points at the sides of the blades, said raceway and buckets forming a fluid passage which is substantially curved in cross section with the raceway and bucket walls substantially merging.

41. In a pump of the class described, a casing having therein a substantially annular fluid raceway and an inlet and an outlet for said raceway, and a rotor having a marginal series of blades forming buckets adjacent said raceway, the rotor and the casing making substantially fluid-tight joints at the sides of the blades, said raceway and bucket walls being substantially curved in cross section with the raceway and bucket walls substantially merging at opposite sides of the buckets.

42. In a pump of the class described, a casing having therein a substantially annular fluid raceway and an inlet and an outlet for said raceway, and a rotor having a marginal series of blades forming buckets adjacent said raceway, the spaces between said blades at the sides thereof being closed, and the rotor and the casing making substantially fluid-tight joints at the sides of the blades, said raceway and bucket walls being substantially curved in cross section with the raceway and bucket walls substantially merging at radially spaced points whereby to receive and direct fluid thrown outwardly back into the buckets at their opposite and radially inwardly disposed sides.

43. In a pump of the class described, a rotor having a marginal series of blades, a casing having therein a passage forming a raceway adapted to co-operate with said blades, the rotor and casing making substantially fluid tight joints at the sides of the blades, said raceway being curved substantially continuously in cross-section and merging with the buckets whereby to direct the fluid thrown radially outwardly by the buckets back into the same without the formation of eddy currents.

44. In a pump of the class described, a

casing having therein a substantially annular fluid raceway, an inlet and an outlet for the same, and a rotor having a marginal laterally disposed series of blades forming
5 buckets for propelling fluid through said raceway, the rotor and casing making a substantially fluid tight joint radially inwardly whereby to resist the flow of fluid from the
10 raceway, said raceway being curved substantially continuously in cross section and the walls thereof substantially merging with the buckets at their radially outer and radially inner sides whereby to continuously direct return to the buckets without the formation of eddy currents fluid thrown radially outwardly therefrom. 15

In testimony whereof I have hereunto set my hand.

ARTHUR W. BURKS.