May 13, 1947. A. V. MUELLER 2,420,556

PUMP

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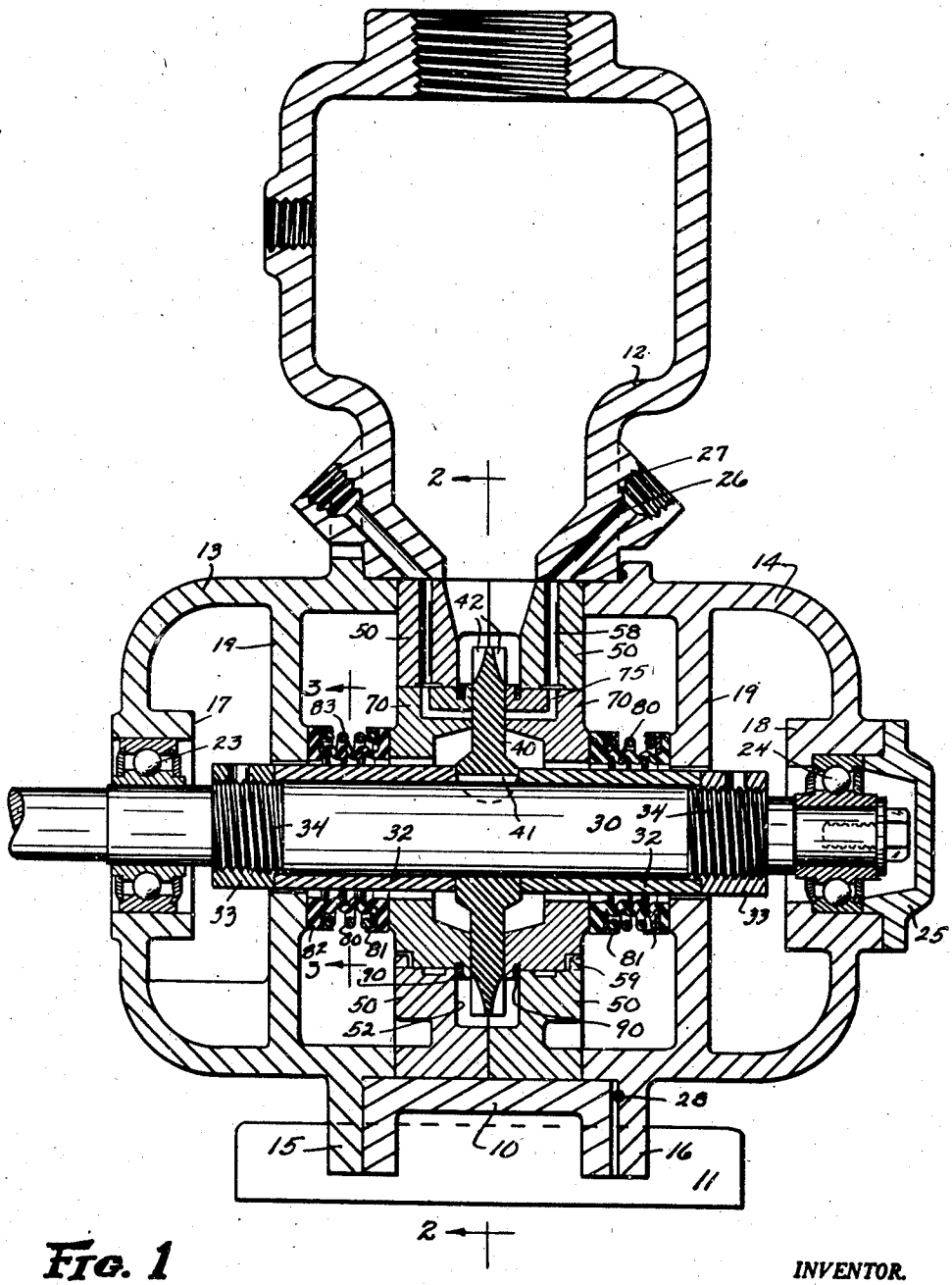

FIG. 1

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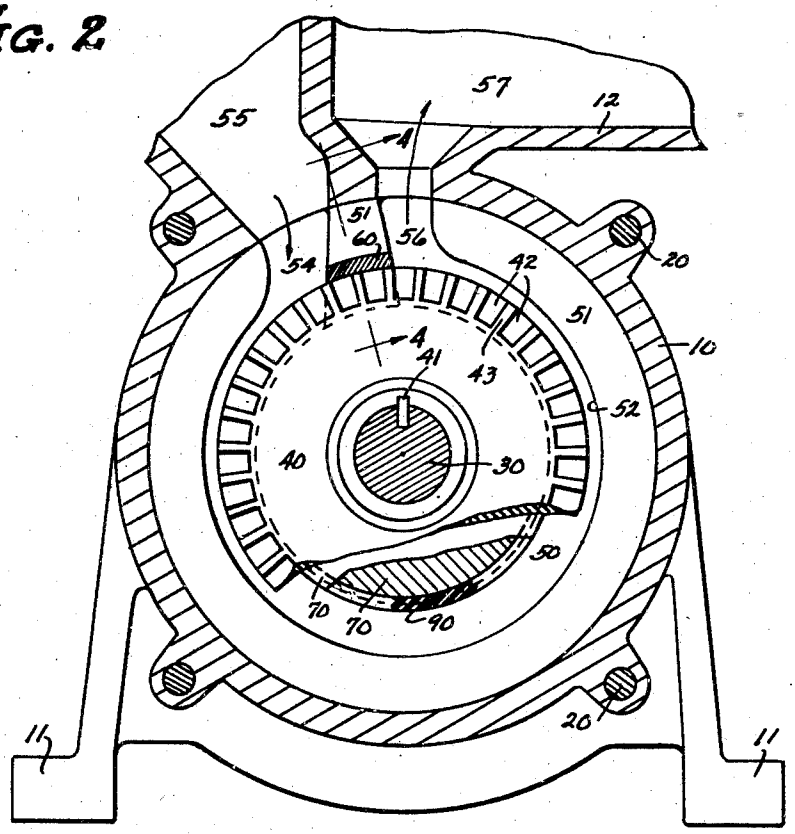
FIG. 2.



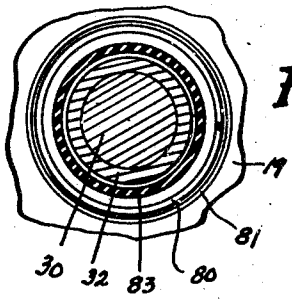


FIG. 3

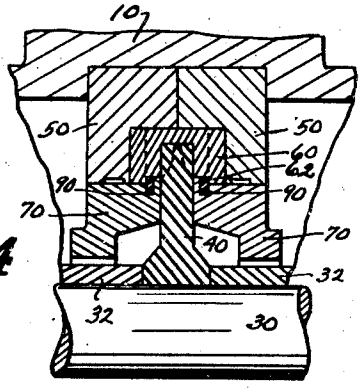


FIG. 4

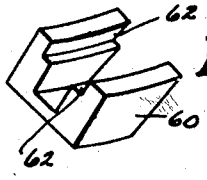


FIG. 5

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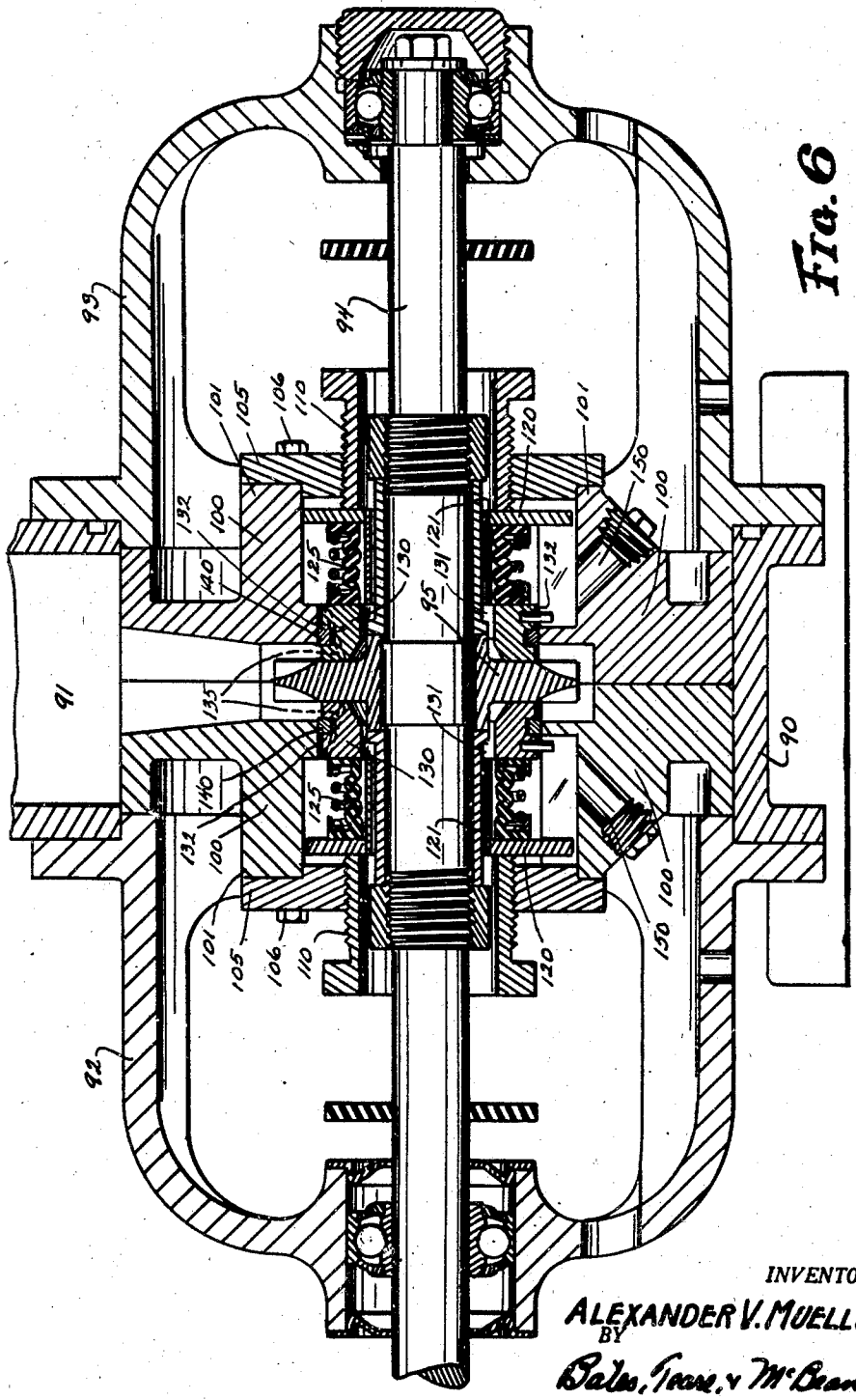

FIG. 6

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UNITED STATES PATENT OFFICE

2,420,556

PUMP

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Application November 24, 1943, Serial No. 511,577

31 Claims. (Cl. 103—96)

1

This invention relates to a rotary pump of the type having an impeller between two heads which are in close proximity to the faces of the impeller, and an object of the invention is to provide means for increasing the efficiency of such a pump by preventing or greatly reducing leakage between the heads and impeller.

More particularly, the invention relates to an impeller pump having a rotary impeller with an annular row of vanes or buckets adjacent its periphery, such impeller being mounted between two frame members which stand adjacent the impeller and one or both of which cooperate with the buckets and extend across the periphery of the impeller and carry an annular water passageway with which spaced intake and discharge passages communicate. In pumps of this type it has been customary to make the frame members or stationary heads stand very close to the face of the impeller, while out of contact therewith, and hence there has been always some leakage between the faces of the impeller and the heads, reducing the efficiency of the pump. Furthermore, this leakage water frequently carries grit with it which scores the faces of the impeller and progressively diminishes its effective operation.

My invention provides pressure seals having annular faces which are maintained in actual contact with the faces of the impeller by continuous pressure, with the result that the leakage and consequent scoring is practically eliminated.

My invention provides also means to prevent leakage between the pressure seals and the stationary frame members in which they are mounted. Accordingly, leakage is prevented around the exterior of the seals, as well as between them and the impeller. These features have a further advantage of avoiding the requirement for stuffing boxes about the shaft to prevent leakage from the pump.

My invention is hereinafter more fully explained in connection with preferred embodiments thereof, illustrated in the drawings, and the essential novel features are summarized in the claims.

In the drawings, Fig. 1 is a vertical axial section through one embodiment of my impeller pump; Fig. 2 is a central vertical cross section at right angles to Fig. 1, as indicated by the line 2—2 on Fig. 1; Fig. 3 is a vertical cross section through one of the pressure seals for the impeller, the plane of the section being indicated by the line 3—3 on Fig. 1; Fig. 4 is a fragmentary radial section through a portion of the impeller

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and the cut-water or stop-block between the intake and exit passages, as indicated by the line 4—4 on Fig. 2; Fig. 5 is a perspective of the cut-water block detached and inverted; Fig. 6 is a vertical axial section (partly broken away) through a modified form of pump having my invention.

It will be convenient to describe first the general construction of the pump illustrated in Figs. 1 and 2, before taking up the features constituting my invention. It should be understood, however, that the invention is not confined to the pump construction illustrated.

In the form shown in Fig. 1, the frame of the pump comprises a vertical ring-like member 10 having a suitable base portion 11 and carrying at the top a hollow discharge chamber 12, which may be integral with the ring of the frame or attached thereto. This view shows two end members 13 and 14 which abut the sides of the frame ring 10 and are secured thereto, cap screws 20, passing through flanges 15 and 16 on the end members, being shown for this purpose. Each of the frame members 13 and 14 is shown as cup-shaped and formed at its central region into a sleeve portion 17 and 18 carrying a bearing for the shaft, suitable ball bearings 23 and 24 being shown in the drawing.

30 indicates the driving shaft of the pump which is mounted in the two bearings 23 and 24. This shaft carries the impeller 40 which coacts with members to be described. The impeller is shown as keyed at 41 to the shaft and longitudinally positioned by being mounted between a pair of sleeves 32 on the shaft which are forced against the impeller by nuts 33 screwing onto threaded portions 34 on the shaft. This makes a simple construction rigidly securing the impeller to the shaft in the desired position while enabling ready installation of the impeller on the shaft or its removal therefrom, if required.

As shown, the shaft extends only in one direction to its driving means, not shown. With such construction I mount a closure cap 25 on the frame portion 18 across the other end of the shaft.

The impeller 40 is of a general disc form, and carries an annular row of buckets adjacent its periphery. The actual form or direction of the buckets may vary and they may be on one or both sides of the impeller, as desired. I have shown buckets made by radial notches 42 in opposite sides of the impeller, the notches on either side leaving between radial vanes 43. These vanes operate in an annular passageway provided by two stationary heads or frame mem-

bers 50. These heads are mounted within the frame ring 10 and abut each other at their inner faces. They are shown as abutted at their outer faces by the ends of the frame members 13 and 14. These heads therefor when the pump is assembled constitute part of the stationary frame of the pump.

The frame member 13 may be bolted snug without gaskets against the ring 10, but I prefer to employ a gasket (indicated at 28 in Fig. 1) between the flange of the frame member 14 and the central ring member, as that is the frame member which would be removed to obtain access to the pump.

The heads 50 are symmetrical, each formed with smooth nearly annular faces 51 adjacent its periphery, which faces abut each other tightly. Within the nearly annular regions 51, and opposite the buckets 42 and beyond the periphery of the impeller, in the form shown, are formed grooves 52 which coact to make the annular passageway in which the buckets travel. This annular passageway leads from an intake passage 54 communicating with the suction or supply chamber 55 of the pump. Another nearly radial passageway 56 leads from the annular raceway 52 to the discharge port 57 in the frame ring and thence to the discharge chamber 12.

Between the intake or suction passage 54 and the discharge passage 57 is mounted the so-called "cut-water" separating these passages. This may comprise a bifurcated block 60 (Figs. 2, 4 and 5) occupying the raceway in this location and straddling the impeller and thus blocking the passage of liquid about the impeller buckets from the discharge passage to the intake passage, except such small amount as may be carried by the buckets 42 themselves moving past the block.

I have given above a description of the particular pump illustrated in Figs. 1 and 2 of the drawings in order that the application and function of the sealing means constituting my invention about to be described may be better understood. Such sealing means, however, is capable of a wide variety of applications to impeller pumps differing materially from that above specifically described.

Heretofore in impeller pumps such as above described it has been customary to extend the stationary heads 50 inwardly close to the face of the impeller and continue them into a region near the shaft, where they have been provided with external stuffing boxes preventing discharge of the water which necessarily leaked inward between the impeller and such stationary heads. In my invention, however, I eliminate the leakage and the necessity of the stuffing boxes by a novel construction at the sides of the impeller, which I will now describe.

I provide each frame head 50 with a cylindrical bore, which may be of substantially the same diameter as that of the impeller body between diametrically opposite vanes, and in these two circular openings I mount two annular pressure heads or seals 70 which fit slidably in the bores and have smooth inner faces contacting with the faces of the impeller. Each of these heads is pressed into actual contact with the impeller and constantly maintained in such contact.

To effect the pressure of the heads or seals 70 against the impeller, I provide a pair of yielding pressure devices acting against the outer faces of the seals. I have shown, for this purpose, a pair of helical compression springs 80 which bear at their inner ends against the respective pressure heads and at their outer ends against abutments carried by the frame, for instance, webs 19 on the frame members 13 and 14.

As shown, these helical springs seated at their ends in flanged washers 81, each of which seats against a flange 82 of an elastic spool or bellows 83. Such bellows preferably has a corrugated body to allow its longitudinal contraction or expansion. The bellows body surrounds the corresponding sleeve 32 on the shaft and the flanges contact with the seal ring and the abutment and are maintained in that position by the tendency of the coil spring to expand.

The two pressure heads may be of hardened metal or other wear resisting material and have their inner faces polished or lapped in so as to be very smooth and in contact directly with the smooth face of the impeller, which is preferably of bronze. In such construction there is no annular space between the inner faces of these pressure seals and the faces of the impeller and, hence, no leakage about the impeller face from a region of higher pressure to a region of lower pressure.

To prevent leakage of the pumped liquid from the annular raceway across the outer perimeter of the pressure heads I provide suitable packing rings 90 which seat in grooves in the respective seal rings and coact with the frame heads 50. The packing rings may be of any suitable material. If of rubber, they may well extend radially beyond the bore of the frame members 50 and coact with the inner faces thereof, as shown in Fig. 1. Where the packing rings cross the cut-water block 60 they occupy rabbets 62 formed in the block, as illustrated in Figs. 4 and 5.

The sealing rings may be of such material, or have such inner faces, that no lubrication between them and the impeller is necessary. However, I have made provision for supplying lubricant to these faces. Thus, as shown in Fig. 1, I have provided oil passages 75 in the pressure heads, shown as communicating with passages 58 in the frame heads, which latter communicate with oil passages 26 in the central frame member at the base of the discharge chamber 12. The latter passages preferably extend inwardly diagonally and carry internal threads 27 for the application of ny suitable oiling coupling. By this means, I can readily supply lubricant to the faces of the impeller in the region of its engagement with the pressure heads.

The heads 50 in one region may have lugs 59 occupying recesses in the pressure heads to prevent any circumferential displacement of the heads, so that communication of the lubricating passages 75 and 58 is assured.

In Fig. 6, I have illustrated another embodiment of my invention wherein the pump casing, the shaft carried thereby and the impeller and liquid passageways are similar to those already described, but wherein the stationary frame heads and sealing means they carry are specifically different through operating in the same general manner as in the first embodiment.

In Fig. 6, 90 indicates the ring-like central frame with its discharge chamber 91; 92 and 93 indicate the side frame members; 94, the shaft carried thereby; 95, the impeller on the shaft having the two annular rows of buckets at its periphery. In this view the stationary frame heads 100 seat within the ring opening of the frame 90 and abut each other on their inner faces and are held in place by the side members

92 and 93. The stationary frame members 100, however, specifically differ from the corresponding members 50 of the first embodiment, as will now be described.

Each of the frame members 100, while having the same inner face as hereafter described, has on its outer side an annular projecting portion 101 to the outer face of which is secured a stationary frame ring 105. This may be attached to the annular extension by cap screws 106. Threaded within the plate 105 is an externally threaded sleeve 110. The inner end of this sleeve abuts a ring 120 which has a cylindrical flange 121 loosely surrounding the shaft. The spring bellows 125 constructed as heretofore described, surrounds this flange 121 and bears at its outer end against the threaded sleeve 110, indirectly through the ring 120, and at its inner end against the annular sealing head 130, the inner face of which coacts with the side of the impeller after the manner of the ring 70 in the first embodiment.

The threaded abutment sleeve 110 and the ring 120 furnish means for adjusting the compression of the spring bellows 125 to adjust the pressure of the seal against the impeller. The flange 121 on the ring 120 does away with the possibility of the rubber spool of the spring bellows contacting with the rotating shaft and being worn thereby.

The spring sleeve 110 is intended to have its threads fit with sufficient snugness so that it will remain in place without the necessity of a jam nut, and this sleeve nut accordingly furnishes effective means for adjusting and maintaining the desired pressure of the sealing ring against the impeller. There is a clearance space 131 at the inner periphery of the seal ring sufficient to receive the cylindrical flange 121, so that a considerable adjustment of the spring bellows is permissible.

The packing between the seal rings and the frame rings, the bores of which are occupied by the seal rings, is specifically different in Fig. 6 from that shown in Fig. 1. The packing in Fig. 6 may, for instance, readily be a split piston ring of metal or other material having the usual overlapping ends. These packing rings are shown at 140 as occuping grooves in the outer faces of the seal rings 130 and bearing outwardly against the wall of the bore of the frame member 100 which is occupied by the sealing ring, after the manner of a piston in a cylinder. However, I prefer to allow clearance, indicated at 132 about the seal-head periphery, so that the face of the seal head may automatically adapt itself to that of the impeller without requiring the maximum accuracy in the bore of the frame head.

The lubricating means illustrated in Fig. 6 is also specifically different from that heretofore described. These comprise merely diagonal passageways 150 through the annular extensions 101 on the frame members 100. Such passageways may terminate at their outer ends in internally threaded portions for the application of suitable nipples. Lubricant inserted through these passageways may if desired fill the annular spaces about the exterior of the spring seals. Suitable passageways 135 through the seal heads themselves may convey lubricant from such annular spaces to the faces of the seal rings. For convenience of illustration diagonal passageways 150 are shown in the plane in which the section of Fig. 6 is taken, though such openings may be in any other location about the axis of the shaft, as will be readily understood.

In either embodiment illustrated, due to the smooth engaging surfaces of the impeller and the sealing pressure heads, and the lubricant if employed, there is very little actual friction between the rubbing surfaces, and the wear is negligible, though the heads are constantly maintained in liquid tight engagement with the impeller. As the pressure heads are self sealing, there is practically no leakage along the face of the impeller from any region of higher pressure to one of lower pressure and the efficiency is thus increased, and the troublesome scoring which has taken place in the past is eliminated. The efficiency is further increased by the annular packing, preventing leakage about the exterior of the seals. As the leakage is prevented both along the impeller face and also along the outer periphery of the pressure heads, I do away with the necessity of stuffing boxes coacting with the shaft.

That the prevention of leakage from a region of higher pressure to a region of lower pressure, as above referred to, is particularly important in a pump of this type will be seen from the following consideration and will be more apparent when one considers the conditions in the usual pump having an impeller with the row of buckets around its periphery and radial intake and discharge ports. In such a pump the pressure is practically zero at the intake and the pressure builds up gradually around the periphery of the impeller, reaching a maximum at the discharge. Hence, at every region of the periphery of the propeller, there is a tendency of liquid to pass via the flat side of the impeller from every region about the impeller (except the region which happens to be at the intake opening) to other regions where the pressure is lower. In the ordinary pump of this type, the heads are made to stand as close as practicable to the sides of the impeller and still leave sufficient clearance to prevent contact, and hence, all around the impeller liquid will be forced by the built-up pressure into the annular space at the sides of the impeller and thence into the intake passageway where the pressure is lowest. This loss materially reduces the efficiency of the pump.

Of course, there is necessarily some leakage from the discharge port to the intake port, by the buckets themselves as they pass through the separator, from the high pressure region to the low pressure region. This loss cannot be avoided, but by itself is not troublesome. It is when there is added to this loss, the loss all around the impeller through the clearance spaces at the sides thereof, that the aggregate loss materially reduces the efficiency. My invention of the pressure seals in actual contact with the sides of the impeller, and with provision for preventing leakage at the outer periphery of the seals, eliminates all of this additional loss.

I claim:

1. In a pump, the combination of a rotary shaft, an impeller thereon having an annular row of vanes adjacent its periphery, means defining a passageway in which the vanes travel, a movable sealing ring surrounding the shaft, means for yieldingly pressing such sealing ring into contact with the side of the impeller, and an annular member coacting with the ring preventing leakage from said passageway across the periphery of said ring.

2. In a pump, the combination of a rotary im-

peller having an annular row of vanes and having smooth faces on its opposite sides between the vanes and the axis, means defining a passageway in which the vanes travel with intake and exit passages to and from said passageway, a pair of movable pressure heads engaging said smooth faces of the impeller, and means for maintaining said heads in such engagement.

3. In a pump, the combination of a rotary impeller having parallel flat faces on its opposite sides and carrying a row of laterally open buckets beyond said faces, means defining an annular passageway in which said buckets travel, intake and exit passages communicating with said annular passageway, a pair of sealing rings having flat inner surfaces contacting with the sides of the impeller, and a pair of pressure devices acting on the respective rings to maintain said rings in contact under pressure against the opposite faces of the impeller.

4. In a pump, the combination of a rotary impeller having faces on its opposite sides and carrying a row of buckets beyond said faces, means defining an annular passageway in which said buckets travel, intake and exit passages communicating with said annular passageway, a pair of heads having smooth inner surfaces automatically pressed into contact with the sides of the impeller, and a pair of yielding annular members preventing leakage across the perimeter of the respective heads.

5. In a pump, the combination of a rotary drive shaft and an impeller thereon having a smooth side face and an annular row of buckets entirely beyond said face, stationary means defining an annular passageway in which the buckets travel, intake and exit passages communicating directly with said passageway, a sealing ring engaging said smooth face of the impeller close to the inner periphery of the buckets, and a spring surrounding the shaft and compressed respectively between said ring and a stationary abutment, whereby said ring is maintained in snug engagement with the side face of the impeller.

6. In a pump, the combination of a rotary drive shaft and an impeller thereon having smooth faces on its opposite sides and an annular row of buckets beyond said faces, stationary means defining an annular passageway in which the vanes travel, intake and exit passages communicating directly with said passageway, means for blocking the space between the intake and exit passages beyond the periphery and at the sides of the impeller buckets, and a pair of movably mounted heads engaging opposite faces of the impeller, and a pair of springs surrounding the shaft and compressed respectively between one of said heads and stationary abutments, whereby said heads are maintained in snug engagement with the sides of the impeller.

7. In a pump, the combination of a pair of frame members in face abutment providing an annular passageway with intake and exit ports, a rotary impeller mounted at the axis of said annular passageway and having an annular row of buckets in said passageway and a smooth face between the buckets and axis, a pressure head slidably mounted within one of said frame members and having a smooth inner face engaging said smooth face of the impeller, and yielding means acting on the pressure head to maintain such engagement.

8. In a pump of the character described, the combination of a shaft, an impeller thereon having smooth opposite side faces and an annular row of buckets beyond said faces, a pair of stationary heads of annular form having mating grooves to provide a passageway about said buckets and intake and exit passages to and from said passageway, and a pair of movable pressure heads mounted within the stationary heads and surrounding the shaft and contacting with the opposite faces of the impeller, and yielding means for maintaining the movable heads pressed against the impeller.

9. In a pump, the combination with a frame, a shaft carried thereby, an impeller on the shaft having flat sides with an annular row of buckets beyond said flat sides, a pair of stationary abutting heads in annular form on opposite sides of the impeller, said heads being recessed to define a passageway extending about the impeller buckets and on each side thereof and beyond the periphery of the impeller, said heads having also outwardly extending notches to define intake and discharge passages, there being means separating said passages beyond the periphery of the impeller, a pair of annular pressure heads surrounding the shaft and mounted within openings in the stationary heads and engaging opposite sides of the impeller, and spring means acting on said pressure heads to maintain the heads in snug engagement with the sides of the impeller.

10. In a pump, the combination of an impeller having an annular row of buckets adjacent its periphery and having smooth faces between the buckets and axis, stationary means defining a passageway occupied by the buckets with intake and discharge passages to and from said passageway, said means having openings about the axis of the impeller, a pair of pressure heads mounted in said openings on opposite sides of the impeller, spring means for maintaining the pressure heads in contact with the smooth faces of the impeller, and annular yielding members closing the spaces between the perimeter of the pressure heads and the openings in the stationary means which they occupy.

11. In a pump, the combination of a frame, a pair of coacting stationary heads carried thereby having aligned cylindrical openings, said heads providing an annular passageway beyond said openings with intake and discharge passages leading to the exterior, a shaft coaxial with said cylindrical openings, an impeller on said shaft having an annular row of laterally open buckets in said annular passageway, said annular passageway being interrupted beyond the periphery of the impeller and at the sides of the buckets between the intake and discharge passages, a pair of pressure heads slidably mounted in the cylindrical openings of said stationary heads and abutting the opposite faces of the impeller, springs for maintaining the pressure heads in snug contact with the impeller, and an annular packing between the pressure rings and said stationary heads to prevent leakage from the annular passageway across the outer perimeter of the pressure heads.

12. In a pump, the combination of a rotary shaft, an impeller mounted thereon and having smooth opposite faces and an annular row of buckets beyond the faces, a pair of annular frame members on opposite sides of the impeller having mating annular grooves to provide a raceway for the impeller buckets, admission and discharge passages leading from said raceway to the region beyond the perimeter of said annular frame members, means carried by the latter separating the admission and discharge passages, a pair of an-

nular pressure heads slidably mounted within said annular frame members and engaging the opposite faces of the impeller, a pair of rings slidably mounted in said annular frame members, and a pair of compression springs surrounding the shaft and compressed between the outer faces of the movable rings and abutments carried by the frame, whereby the movable rings are maintained in snug contact with the impeller.

13. In a pump, the combination of a shaft, an impeller thereon having flat opposite faces and an annular row of laterally open buckets beyond said flat faces, a pair of abutting stationary heads having mating grooves to provide a passageway about said buckets and intake and exit passages to and from said passageway, a pair of frame members abutting the outer sides of said heads and holding them against each other, bearings carried by said frame members in which said shaft is journalled, a pair of movable pressure heads of annular form surrounding the shaft and contacting with the opposite faces of the impeller close to the bases of the buckets, and a pair of compression springs surrounding the shaft and compressed between the outer faces of said movable heads and abutments carried by the two frame members respectively.

14. In a pump, the combination of a vertical frame member having a supporting base and carrying a discharge chamber at the top and having intermediately a horizontal opening, a pair of mating frame heads mounted in said opening and abutting each other, the opposed faces of the heads being grooved to provide an annular passageway with intake and discharge passages to the exterior of the heads, said discharge passage communicating with the discharge chamber and there being means separating the discharge passage from the intake passage, a pair of frame members of cup-shape facing inwardly and abutting the outer faces of said annular frame members, said cup-shaped frame members being bolted to said vertical frame member, the cup-shaped frame members carrying bearings for a drive shaft, a shaft mounted in said bearings, an impeller mounted on the shaft having an annular row of buckets, occupying the annular passageway of said annular frame heads, a pair of annular sealing rings freely surrounding said shaft and slidably mounted in said frame heads, a pair of compression springs surrounding the shaft and each compressed between the adjacent pressure ring and an inwardly extending web on the adjacent cup-shaped frame member.

15. In a pump, the combination of a rotary shaft, an impeller mounted thereon and having smooth opposite faces and an annular row of buckets beyond the faces, a pair of sleeves embracing the shaft and abutting opposite sides of the impeller, a pair of nuts on the shaft abutting the sleeves and locking them in position, a stationary means providing a raceway for the impeller buckets, admission and discharge passageways leading from said raceway outwardly to the region beyond the periphery of said impeller, there being means separating the admission and discharge passageways, a pair of annular pressure heads slidably mounted within said stationary means and engaging the opposite faces of the impeller, and means for causing said heads to be maintained in snug contact with the impeller.

16. In a pump, the combination of rotary impeller carrying an annular row of buckets, means defining a passageway for liquid in which said buckets travel, a pressure seal continuously pressed against the side of the impeller, and means for adjusting the pressure of said seal.

17. In a pump, the combination of a pair of frame members having bores and grooved inner faces and means for holding the members in face abutment to define an annular passageway, there being intake and exit passages communicating with the annular passageway, a shaft at the axis of said bores, an impeller on said shaft having an annular row of buckets adapted to travel in said annular passageway, pressure seals surrounding the shaft and each including a compression spring and a head bearing against a side of the impeller, said frame members carrying extensions internally threaded about the axis of the shaft and spaced therefrom, and externally threaded sleeves occupying such internally threaded openings and bearing against the outer ends of the pressure seals to force the same against the opposite sides of the impeller.

18. In a pump, the combination of means defining an annular passageway for liquid, an impeller having an annular row of buckets operating in said passageway, a shaft carrying the impeller, a pressure seal surrounding the shaft and comprising a spring-extended bellows terminating in an annular member having its outer periphery of no greater diameter than the inner periphery of the row of buckets and bearing against the impeller, a ring with a cylindrical flange, said flange surrounding the shaft and occupying the interior of the bellows and the ring extending across the outer end of the pressure seal, and adjustable means engaging said ring to apply a variable compression to the spring to adjust the pressure against the impeller.

19. In a pump, the combination of a rotary impeller having an annular row of buckets, a frame member having in one face an annular groove to form a wall for an annular passageway in which the buckets operate, said frame member having an opening, a sealing head slidably occupying said opening and engaging the side of the impeller, a yielding member between the outer perimeter of the seal head and the wall of said opening to prevent liquid passage between them, and means for maintaining the head in contact with the impeller while the latter is running.

20. In a pump, the combination of a rotary shaft, an impeller thereon having an annular row of buckets, a stationary frame member surrounding the shaft and having in one face an annular groove to form a wall for an annular passageway in which the buckets operate, said frame member having a bore concentric of the shaft, a sealing ring slidably occupying said bore and engaging the side of the impeller, there being clearance between the outer periphery of the sealing ring and the bore of the frame member, and a packing between the outer periphery of the seal head and the inner periphery of the frame member and engaging one of such peripheries whereby the seal head may tip slightly within the stationary member and maintain an accurate presentation to the face of the impeller, and a spring bearing against the outer face of the seal head to maintain such engagement.

21. In a pump, the combination of stationary frame member defining an annular passageway for liquid, a shaft, an impeller on the shaft having an annular row of buckets occupying said passageway, a seal head slidably occupying space about the shaft within said frame member, a

spring bellows surrounding the shaft and bearing against the seal head, a passageway through the stationary member for conveying lubricant to the space about the pressure seal back of the seal head and a passageway through the seal head for conducting such lubricant from such space to the face of the seal head engaging the impeller.

22. The combination of a rotary impeller having a row of vanes at its periphery providing an annular row of buckets distant from the axis of the impeller and means preventing leakage along the face of the impeller from buckets containing fluid of lower pressure comprising a sleevelike member contacting the impeller adjacent the bases of the buckets, and means to prevent leakage between said sleevelike member and a member with which it frictionally coacts to prevent leakage between them while allowing relative rotary movement.

23. In a pump, the combination of a rotary impeller having an annular row of buckets, means defining a passageway in which the buckets travel and means preventing leakage from a bucket containing fluid under higher pressure to a bucket containing fluid of lower pressure via the face of the impeller, said means including a seal in contact with the face of the impeller adjacent the base of the buckets, there being a slipping engagement between the face of the seal and a member of the pump and yielding means comprising a spring for maintaining such slipping engagement snug during rotation of the impeller.

24. In a pump, the combination of a shaft, a rotary impeller thereon having a row of vanes at its periphery providing an annular row of buckets distant from the axis of the impeller, a device for preventing leakage from a peripheral region of higher pressure along the face of the impeller to a peripheral region of lower pressure comprising a sleevelike member surrounding the shaft and contacting the impeller adjacent the bases of the buckets, a compression spring surrounding the shaft, and an abutment surrounding the shaft and serving to compress the spring against said sleevelike member to maintain the latter member in slipping engagement with a member of the pump between which members there is relative rotary movement.

25. In a pump, the combination of a rotary shaft, an impeller thereon having an annular row of vanes adjacent its periphery providing buckets open at the side of the impeller, said impeller having a smooth side face between the buckets and axis, means defining a passageway in which the vanes travel, a movable sealing member having a smooth face engaging the side face of the impeller within the circle defining the bottom of the buckets, and a yielding pressure device maintaining such sealing member in contact with the impeller.

26. In a pump, the combination of a drive shaft, an impeller thereon having a smooth side face and carrying a row of buckets beyond said face open at their outer side, means defining an annular passageway in which said buckets travel, intake and exit passageways communicating with said annular passageway, a sealing ring contacting with the side face of the impeller within the circle defining the bases of the buckets close to the bases of the buckets, and a compression spring surrounding the shaft and maintaining said sealing ring in slipping contact under pressure with a member between which there is relative rotary movement.

27. In a pump, the combination of a rotary impeller having vanes providing an annular row of laterally open buckets, means defining a passageway in which the impeller vanes travel, a seal member engaging the face of the impeller between its axis and its vanes and having its outer periphery adjacent the inner periphery of the buckets, and means preventing leakage from said passageway across the perimeter of said seal member.

28. In a pump, the combination of means defining an annular passageway with intake and exit ports, said means including a frame member with a bore, a rotary impeller mounted coaxially with said bore and having an annular row of buckets in said annular passageway and a smooth face between the buckets and axis, a round sealing ring slidably mounted in said bore and having a smooth face, means for maintaining said smooth faces in actual contact while the impeller is rotating, and means preventing leakage across the periphery of the sealing ring.

29. In a pump, the combination of a frame member having an opening through it, one face of said member forming a wall for an annular raceway, a rotary impeller having an annular row of open-sided buckets traveling in said raceway, a pressure seal continuously pressed against the face of the impeller adjacent the bases of the buckets, a cross member carried by said frame member and means mounted in the cross member for adjusting the pressure of the seal against the impeller.

30. In a pump, the combination of a frame member having an opening through it, one face of said member forming a wall for an annular raceway, the other face of the member having a projecting annular flange, a rotary shaft, an impeller thereon having an annular row of buckets traveling in said raceway, a pressure seal surrounding the shaft within said annular flange and engaging the face of the impeller, a spring bearing against the pressure seal, a stationary cross member carried by the annular flange and surrounding the shaft, and means on the cross member for compressing the spring to maintain the seal continuously pressed against the impeller.

31. The combination of a shaft, an impeller thereon having an annular row of open-sided buckets adjacent its periphery, means defining an annular passageway for liquid in which said buckets travel, intake and discharge passages communicating with said annular passageway, a seal ring surrounding the shaft and engaging the face of the impeller adjacent the bases of the buckets, a screw-threaded member mounted in a stationary part of the pump and a compression spring compressed by said member to maintain in actual contact with the impeller under adjustable pressure.

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REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,580,032	Geiger	Apr. 6, 1926
1,884,974	Hurd	Oct. 25, 1932
2,245,094	Neibert	June 10, 1941
2,247,335	Neibert	June 24, 1941
1,768,313	Ferguson et al.	June 24, 1930
1,972,548	Brady, Jr.	Sept. 4, 1934

(Other references on following page)

13

Number	Name	Date
2,258,416	Leopold et al.	Oct. 7, 1941
2,051,080	Frederick	Aug. 18, 1936
2,021,346	Allen	Nov. 19, 1935
2,013,499	Meckenstock	Sept. 3, 1935
2,003,168	Allen	May 28, 1935
1,938,854	Moulet	Dec. 12, 1933
1,937,461	Mylting	Nov. 28, 1933
1,931,724	Fageol et al.	Oct. 24, 1933

14

Number	Name	Date
1,694,805	Wiltse	Dec. 11, 1928
1,635,522	Wilson	July 12, 1927
1,539,728	Ensign	May 26, 1925

FOREIGN PATENTS

Number	Country	Date
158,773	Great Britain	Feb. 17, 1921