No. 786,922. PATENTED APR. 11, 1905.

E. L. SMITH & J. M. SHERRERD.

CENTRIFUGAL PUMP.

APPLICATION FILED MAR. 21, 1904.

3 SHEETS—SHEET 1.

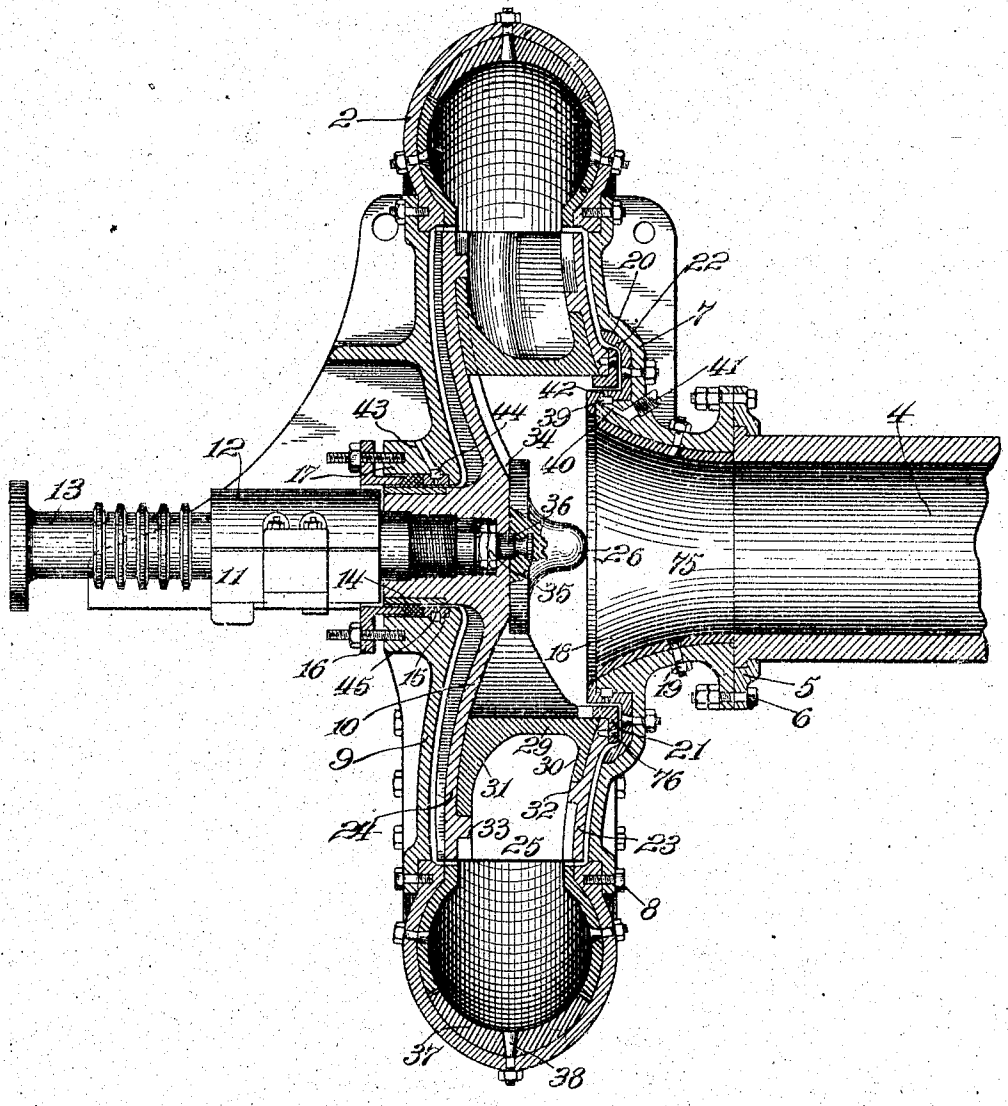


Fig. 1.

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R. W. Pittman

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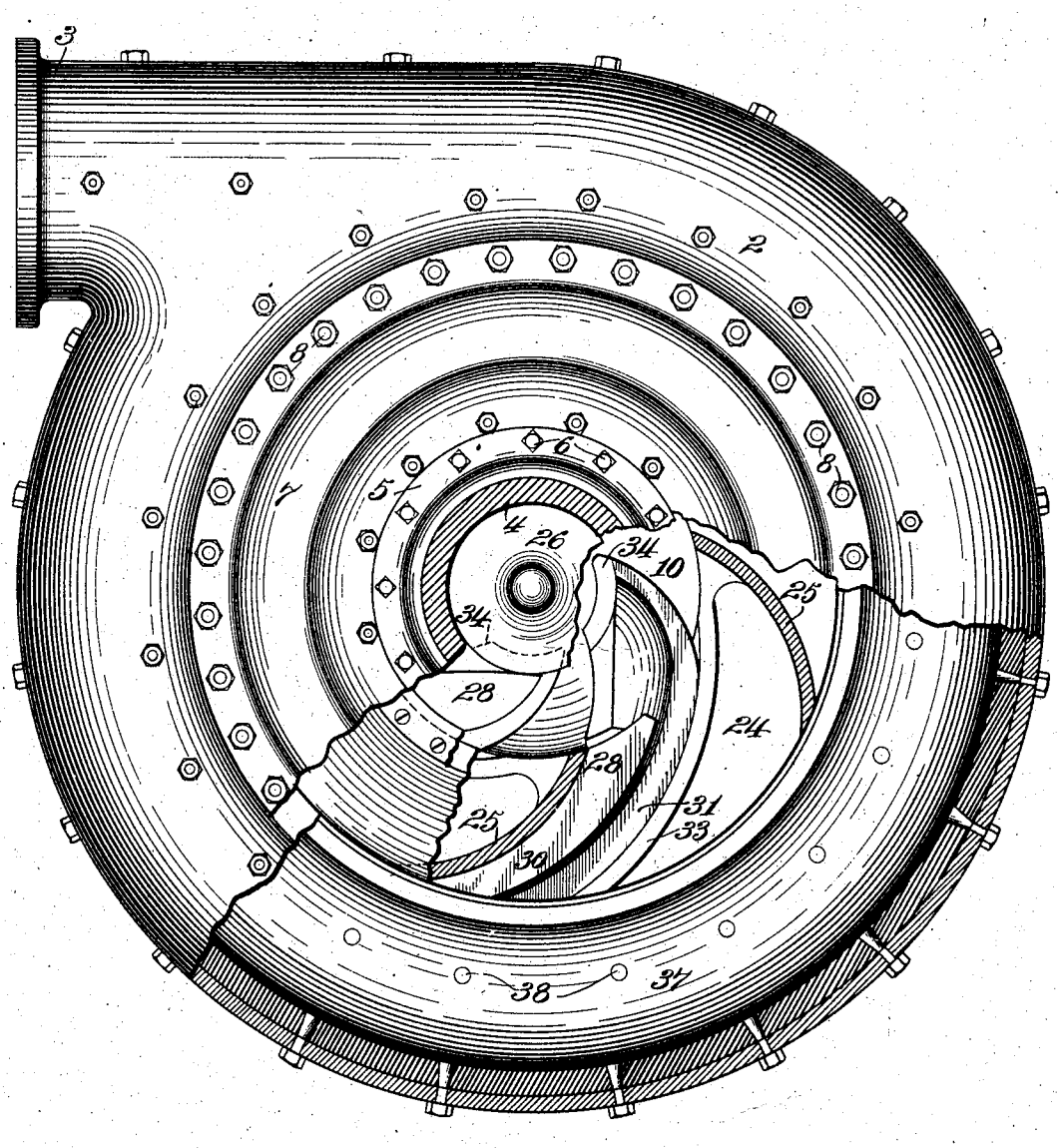


Fig. 2.

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3 SHEETS—SHEET 3.

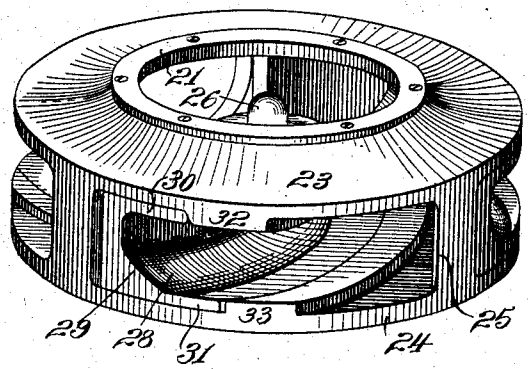


Fig. 3.

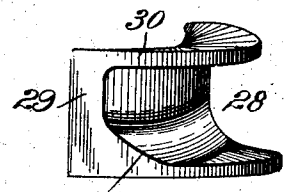


Fig. 4.

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No. 786,922. Patented April 11, 1905.

UNITED STATES PATENT OFFICE.

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CENTRIFUGAL PUMP.

SPECIFICATION forming part of Letters Patent No. 786,922, dated April 11, 1905.

Application filed March 21, 1904. Serial No. 199,173.

To all whom it may concern:

Be it known that we, EDWARD L. SMITH, residing at Breckenridge, in the county of Summit and State of Colorado, and JOHN M. SHERRERD, residing at Easton, in the county of Northampton and State of Pennsylvania, citizens of the United States, have invented certain new and useful Improvements in Centrifugal Pumps, of which the following is a specification.

The present invention relates to that class of apparatus in whose construction are embraced moving parts designed to be faced to a greater or less extent with a wear-resisting lining, and it is especially directed to the provision of those surfaces of a centrifugal pump exposed to the pressure of the material passing through the pump with durable wear-resisting bodies of a high or relatively great resistance to the abrasive action of the liquid and any matter which may be carried along thereby.

Difficulty is experienced in respect to the lining of the runner or rotary part of the above class of pumps, especially if bolts or like fastenings devices are used for retaining the wear-resisting bodies in place. Not only does the vibration and jar of the working pump tend to loosen the wear-resisting bodies from their proper positions, but also the continued attrition of the sand, grit, or pebbles in the water discharged tends to wear away the bolt heads or nuts, eventually permitting the wear-resisting body or bodies constituting the lining to become loose and dislodged from position. While, therefore, fastening-bolts may be used for retaining the lining of the stationary pump parts in place, the use of such fastening devices is objectionable for the above reasons when applied to the retention of the wear-resisting bodies on the runner.

The present invention is designed to obviate the use on the runner of the pump of any fastening means liable to work loose during the operation of the pump or whose function is destroyed or affected by the continued wear of the pump-discharge. In a general way these results are accomplished according to our present invention by so forming the runner and the bodies constituting the wear-resisting lining thereof as to enable the bodies to be readily fitted to the runner without the employment of fastening-bolts, &c., these bodies being so related to the runner as to tend to be the more firmly held in place by the centrifugal action of the rotating runner.

Another important feature of the invention relates to the introduction into the clearance-spaces of a pump of a counter-current tending to prevent the ingress of sand, pebbles, &c., in the liquid into such spaces and consequent rapid wear of the parts.

In the drawings accompanying the present specification, Figure 1 is a tranverse longitudinal section of a pump embodying our present improvements, the plane of the section corresponding with the axis of the pump-suction. Fig. 2 is an elevational view looking from the right in Fig. 1, part being broken away to show parts lying beyond. Fig. 3 is a perspective view of the runner of the pump, the wear-resisting bodies constituting the lining of this runner being shown in their assembled position. Fig. 4 is a similar view of one of the wear-resisting bodies, the same being adapted to be engaged with its corresponding opening or recess in the runner.

Similar characters of reference designate corresponding parts in all figures.

The pump which we have chosen for the illustration of our invention is of the ordinary type of centrifugal pump provided with the usual annular body 2, from which extends a discharge 3, suitably formed for the connection of the delivery-pipe, while a section of the suction-pipe is designated by 4, the same being in this instance secured by a coupling-piece 5 and bolts 6 to the flanged end of the pump-suction or throat-plate 7. This latter is of sufficient diameter to enable its shouldered outer edge to be connected by bolts, such as 8, with the annular edge of the annular body 2. At the opposite side of the pump is a closure-disk 9, through the central opening of which extends the hub of the rotary element or pump runner or impeller 10. Of

course both the throat-plate and the closure may be ribbed in any desired manner for the purpose of strengthening the same, and they, with the other parts of the pump, may, if desired, be provided with suitable bosses or projections to constitute a supporting-base or to enable the pump to be attached in the desired position for working. In this instance the said closure 9 supports a journal-box 11 (provided with a removable cap 12) for the support of the runner-shaft 13, which may also have associated with it a thrust-bearing. Further specific features of the construction illustrated comprise a journal-ring 14 on the hub of the runner and a wear-ring 15 within the bore of the shaft-opening in the said closure, while a stuffing-box 16 surrounds the hub of the runner, being adjustably secured to an annular extension 17 of the said closure.

The inlet 75 in the throat-plate 7 has an annular wear-resisting lining-piece 18, flaring outwardly in the direction of flow and secured by countersunk bolts 19. It will be noticed that the throat-plate is provided with an annular channel formed within the curved portion 20 between the inlet 75 and the peripheral portion of the throat-plate. This channel provides a space for an L-shaped ring 21 on the runner of wear-resisting material and the function of which will be hereinafter referred to. The annular channel is of sufficient depth, moreover, not only to permit of the free working of this ring on the runner, but also to receive a ring 22 of like material, and which has the general cross-sectional conformation of the channel-wall. This ring, it is apparent from the drawing in Fig. 1, partially encircles the ring 21 on the runner and extends at its edges in both directions a distance sufficient to connect at one edge with the lining of the throat-plate, while at the other edge it extends somewhat beyond the over-all diameter of the ring 21.

The runner of the pump may be of the general configuration usually adopted in apparatus of this character, in that it is formed with radial front and rear plates 23 and 24, respectively, each of which is adapted to work close to the face at the corresponding side of the fixed pump part, and with curved radial vanes or blades 25, of which latter a suitable number are employed. The inner faces of the plates 23 and 24 are somewhat curved, as seen in the sectional view Fig. 1, the more gradually to deflect the moving liquid from its axial direction of flow to a radial direction, (given to it by the rotating runner,) while the central or axial portion of the incoming liquid striking against the surface of a deflector 26, rigid with the runner and having a curved deflecting-surface of revolution, has its direction of flow gradually changed to an outward or radial movement.

One of the most important features of the present invention relates to means for engaging wear-resisting bodies with the runner of the pump to thereby constitute a resistant lining for the protection of those portions liable to be worn by the abrasive action of the solid particles with which the liquid may be charged. In accordance therewith those surfaces of the runner which are instrumental in deflecting the liquid from an axial to a radial flow, and which are subject to the pressure arising from throwing the mass outward, are fitted with lining-pieces, which are engaged with seats formed by the recesses receiving them by an assembling movement in a direction in which these developed forces tend to move them when in place. During the operation of the pump, therefore, these lining-pieces are subject to a pressure urging them to a more intimate engagement with the surfaces of the receiving-recesses.

Referring to the specific construction whereby the results aforesaid are attained, it is apparent at the outset that the convex face of each vane or wing 25 is the surface against which the greatest pressure occurs, while the opposite or concave faces of the vanes are subject to comparatively little or none, and hence to a minimum of abrasive action. We do not, therefore, deem it necessary to line these concave faces or the portions of the inner faces of the plates 23 and 24 contiguous to them.

Each wear-resisting member or plate (the several members being located in the several spaces or chambers between adjacent vanes 25 25) is so formed as to lie in close contact with the convex face of the vane, forming one wall of the space in which the plate fits. These plates or members (designated in a general way by 28) are substantial duplicates of each other, and each comprises a portion 29, fitting against the said convex face and integral laterally-extending portion or wall 30, adapted to fit against the inner face of the runner part 23, and a laterally-extending portion or wall 31, adapted to fit against the inner face of the runner part 24. Each said member presents in general appearance a screw-like form to enable it to be inserted first axially into its proper recess in the runner from the suction side thereof and then by a screw-like motion to be engaged with the said convex surface of the vane and with ribs 32 and 33, projecting inwardly from the runner parts 23 24, respectively. In other words, each lining member of the runner resembles a part or section of the blade or thread of the screw—that is to say, a horizontal straight line touching one end of the lining member (see Fig. 4) would be parallel to, instead of in alinement with, a similar line touching the other end of said member, and as such ends are united by a curved wall that wall has to the extent thereof the form of a spiral, so that if such lining member was prolonged it would have substantially the shape of a complete spiral, or,

in other words, the thread of a screw, and is therefore designated herein as screw-like, since to the extent thereof it is substantially similar to a part of a screw thread or blade.

The proportions between the dimensions of each wear-resisting member and the dimensions of the recess in which it is seated are such that when the member has reached its assembled position the coöperation between the faces of the runner and the faces of the member which engage serve to lock or hold the member against further outward or radial movement.

It will be noticed that the width of the laterally-extending portion 30 of the wearing member is somewhat greater than the corresponding dimension of the portion 30, (the respective ribs 32 and 33 being correspondingly placed to engage with the outer edges of these portions.) This difference designedly exists by reason of the fact that the most of the wear, a wear continuing for a greater radial distance, takes place on the portion 31. For the same reason the portion 31 is connected to the portion 29, preferably by a substantial fillet, such as shown.

It should be mentioned that the assembling of the wear-resisting member or plates and the runner is made before the deflector 26 is placed in position and that each such member is provided with a lip 34, adapted to lie under the deflector when the said members are in their assembled positions. When thereafter the deflector is secured in place, as by nuts 35 engaged from the hub end of the runner with the stem 36 of the deflector, accidental dislodgment of the wear-resisting members will be prevented. When the pump is in operation, however, and the runner rotating, it is obvious that the centrifugal force generated tends to firmly hold the wear-resisting members in place.

The axial extending ends of the runner part 23 are protected by the L-shaped wear-resisting piece 21, already mentioned, which may be secured by countersunk screws 76 in position to lap over the said wear-resisting pieces carried by the runner, as indicated. The body 2 of the pump is likewise protected by a suitable lining, designated as a whole by 37 and here shown to be of a built-up or sectional construction, the different sections of which are secured against the inner surface of the body part by suitable countersunk screws 38.

The tendency of the conditions prevailing in the working pump is to force the liquid out through all joints and by reason of the internal pressure to force pebbles, sand, and grit entering the pump into the clearance-spaces between the outer surfaces of the runner and the sides of the throat-plate 7 and the closure-plate 9. In order to obviate the ill effects due to the abrasive action which would occur should such solid matter get into the aforesaid spaces, we contemplate the connection of a suitable delivery-pipe at one or more points through which water under pressure may be passed in a direction to overcome the internal pressure existing within the pump, and thereby prevent the entrance of the sand, &c., laden water into spaces whose sides are in general unprotected by any high-resistant lining. In this instance an annular groove 39 is formed along the joint between the piece 22 and the throat-piece, and to this channel a port 40 leads. With this port a delivery-pipe 41 for fluid under pressure connects, while from the opposite side of the channel ports 42 lead outward to the space between the clearance-face of the part 21 and the L-shaped liner 22. The clearance-space at the opposite side of the pump receives an inward-pressure delivery through a port 43, to which a delivery-pipe (not shown) may be connected, this port connecting with an annular groove 44, which in turn is open to the clearance-space between the runner and its hub and the closure-plate of the pump by means of ports 45.

Having described our invention, we claim—

1. In combination with the casing and runner of a centrifugal pump, of a wear-resisting lining for said casing and runner, the lining for the runner comprising a plurality of screw-like-formed members.

2. A lining for a runner, the same comprising a member adapted to engage with said runner by a screw-like motion, in combination with means for limiting the outward or radial movement of the lining member relatively to said runner.

3. A boltless lining for a runner, the same comprising a member adapted to engage with the runner, in combination with means for stopping the outward movement of such member, and toward which means said member is urged by the forces generated by the rotation of such runner.

4. A lining for a runner, the same comprising a member adapted to engage with the runner by a screw-like motion, in combination with means for limiting the outward or radial movement of the member relatively to said runner, and a keeper for precluding the accidental dislodgment of the member.

5. A boltless lining for a runner, the same comprising a member adapted to engage with the runner, in combination with means for stopping the outward movement of the member and toward which means said piece is urged by the forces generated by the rotation of the runner, and a keeper for precluding the accidental dislodgment of the member.

6. In a rotary pump, the combination with an impeller containing an internal space adapted to receive a lining, and having walls inclined to the direction of the pressure generated in the impeller when in service, of a lining shaped to fit said space and adapted to be inserted in the general direction of said pressure and to engage said walls, the engaging

surfaces of the walls and lining being in position to limit the motion of the lining.

7. In a rotary pump, the combination with an impeller containing an internal space adapted to receive a lining member and having a wall inclined to the direction of pressure generated in the impeller when in service, of a wear-resisting lining member shaped to fit said space and adapted to be inserted in the general direction of said pressure and to engage said wall.

8. In a rotary pump, the combination with an impeller containing an internal space adapted to receive a lining member and having a wall inclined to the direction of pressure generated in the impeller when in service, of a lining member shaped to fit said space and adapted to be inserted in the general direction of said pressure and to engage said wall, and means for limiting outward movement of the lining member.

9. In a rotary pump, the combination with an impeller containing an internal space adapted to receive a lining member and having a wall inclined to the direction of pressure generated in the impeller when in service, of a lining member shaped to fit said space and adapted to be inserted in the general direction of said pressure and to engage said wall, means for limiting outward movement of the lining member, and means for preventing the dislodgment of said member.

10. In a rotary pump, the combination with an impeller containing an internal space adapted to receive a lining member and having a wall inclined to the direction of pressure generated in the impeller when in service, of a lining member shaped to fit said space and adapted to be inserted in the general direction of said pressure and to engage said wall, the engaging surfaces of such wall and the lining member being in position to limit the outward movement of such lining member, and a plurality of keepers effective to maintain the lining member in its proper position.

11. In a rotary pump, the combination with an impeller having vane-formed chambers adapted to receive a lining, the walls of which vanes are inclined to the direction of the pressure generated in the impeller when in service, of a wear-resisting lining member shaped to fit each such wall and adapted to be inserted in the general direction of said pressure and to engage said wall, the engaging surfaces of such walls and the lining members being in position to limit the outward movement of such lining members.

12. In a rotary pump, the combination with an impeller having vane-formed chambers adapted to receive a lining, the walls of which vanes are inclined to the direction of the pressure generated in the impeller when in service, of a wear-resisting lining member shaped to fit each such wall and adapted to be inserted in the general direction of said pressure and to engage said wall, the engaging surfaces of such walls and the lining members being in position to limit the outward movement of such lining members, and a deflector projecting axially from the impeller and engaging with the inner edges of said lining members.

13. A centrifugal pump having a runner provided in each of its vane-formed chambers with a wear-resisting member, each member lying against the convex face of the vane forming one wall of the chamber and having laterally-extending flanges lying against the side walls of the runner, and each side wall having a rib with which the wear-resisting member engages, and which operate to lock the assembled wear-resisting member against undue outward movement.

14. In a centrifugal pump, the combination of a runner provided with curved vanes or blades and side walls, one of which walls is open for the inflow of liquid, and said side walls being provided with ribs forming with said vanes recesses for the reception of wear-resisting members, screw-like wear-resisting members located in the said recesses in the runner, and a combined keeper and deflector secured to the runner opposite the inflow-opening in the opposite wall.

15. In a centrifugal pump, the combination of a runner provided with curved vanes or blades and side walls, one of which is open for the inflow of liquid, and said side walls being provided with ribs forming with said vanes recesses for the reception of wear-resisting members, one of each pair of said ribs being situated at a greater distance from the convex face of the vane than the other rib, screw-like wear-resisting members located in the said recesses in the runner, and a combined keeper and deflector secured to the side wall of the runner opposite the inflow-opening in the opposite wall.

16. As an article of manufacture, a wear-resisting member for the runner of a centrifugal pump, the same comprising a trough-shaped piece having a screw-like form.

17. In a centrifugal pump, the combination of a runner provided with curved vanes or blades and sides walls, one of which is open for the inflow of liquid, said side walls being provided with ribs forming with said vanes openings for the reception of wear-resisting members, screw-like wear-resisting members adapted to be located in the receiving-openings in the runner, a combined keeper and deflector secured to the side wall of the runner opposite the inflow-opening in the opposite wall, and a lining for the fixed portions of the pump.

18. In a centrifugal pump, the combination of a runner provided with curved vanes or blades and side walls, one of which is open for the inflow of liquid, said side walls being provided with ribs forming with said vanes openings for the reception of wear-resisting

members, one rib being situated at a greater distance from the convex face of the vane than the other rib, screw-like wear-resisting members adapted to be located in the receiving-openings in the runner, a combined keeper and deflector secured to the side wall of the runner opposite the inflow-opening in the opposite wall, and a lining for the fixed portions of the pump.

19. A centrifugal pump having a runner provided with a wear-resisting lining comprising a plurality of sections, each having a curved vane-engaging wall, one end of which extends above the other.

20. A centrifugal pump having a runner provided with a wear-resisting lining comprising a plurality of sections, each having a curved vane-engaging wall, one end of which extends above the other, and one or more side walls.

21. A centrifugal pump having a runner provided with a wear-resisting lining comprising a plurality of sections, each having a curved vane-engaging wall, one end of which extends above the other, and a side wall connected with the curved wall by a reinforced portion.

22. A wear-resisting lining member for a centrifugal pump-runner comprising a curved wall provided with a pair of side walls integral therewith, one end of which structure extends above the other to give such curved wall a partly-spiral formation.

23. A wear-resisting lining member for a centrifugal pump-runner, comprising a screw-like-formed structure.

24. A wear-resisting member for a centrifugal pump-runner, comprising a screw-like-formed structure provided with side walls.

25. A wear-resisting lining member for a centrifugal pump-runner, comprising a screw-like-formed structure provided with side walls, one projecting beyond the other.

26. A wear-resisting lining member for a centrifugal pump-runner, comprising a structure having a curved wall, one end of which extends above the other.

27. A wear-resisting lining member for a centrifugal pump-runner, comprising a structure having a curved wall, one end of which extends above the other, and a side wall.

28. A wear-resisting lining member for a centrifugal pump-runner, comprising a structure having a curved wall, one end of which extends above the other, and a pair of side walls.

29. A wear-resisting lining member for a centrifugal pump-runner, comprising a structure having a curved wall, one end of which extends above the other, and a pair of side walls, one wall projecting beyond the other.

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