

May 22, 1934.

A. C. DURDIN, JR

1,959,710

PUMP

Filed Sept. 21, 1931

2 Sheets-Sheet 1

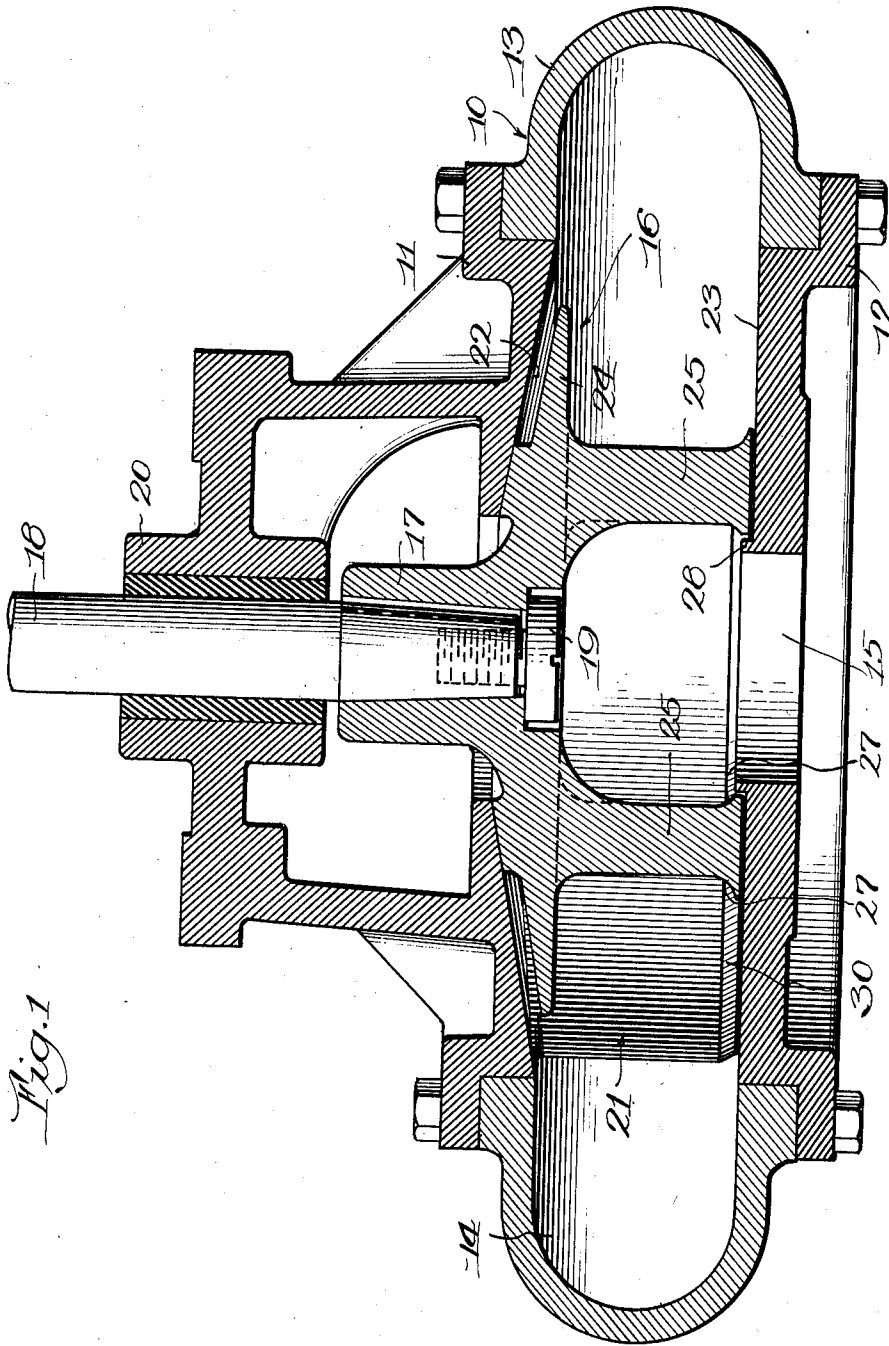


Fig. 1

Witness:
Chas. L. Gourshe

Inventor,
Augustus C. Durdin, Jr.,
by Charles Shewey Atty.

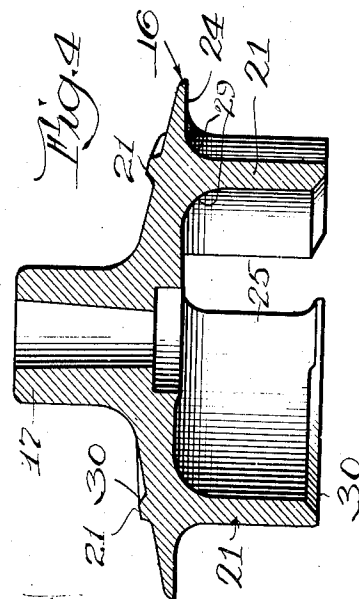
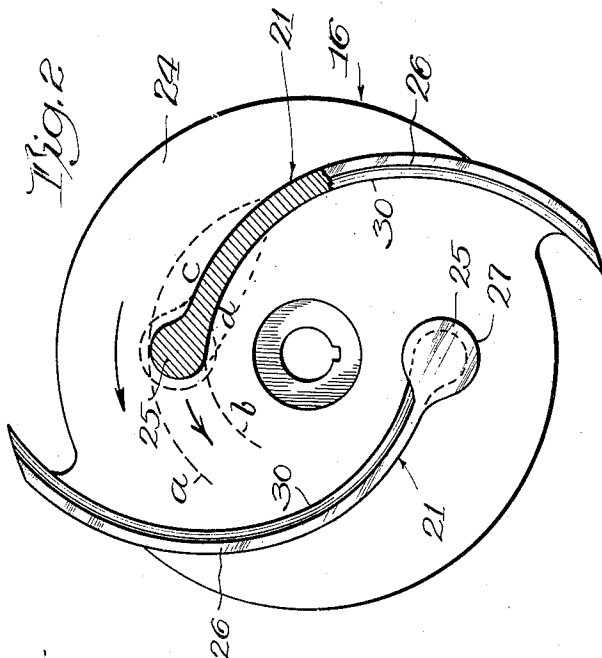
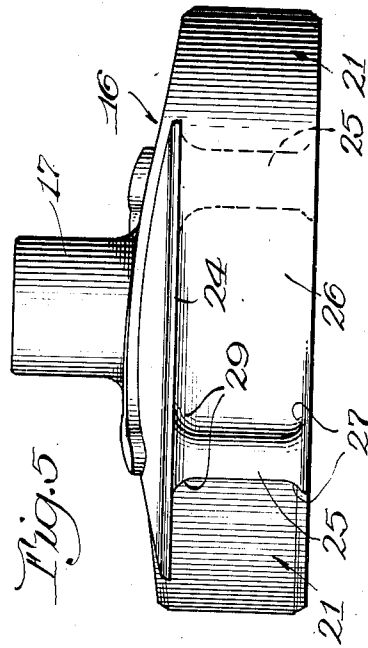
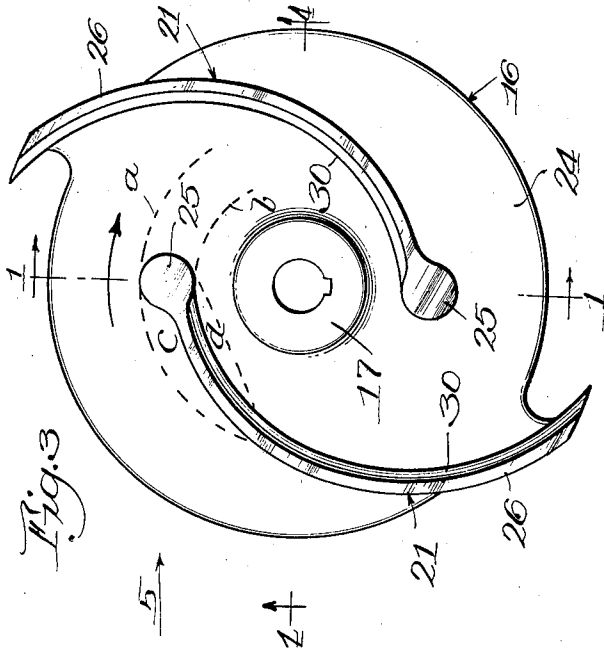
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Filed Sept. 21, 1931

2 Sheets-Sheet 2



Witness:
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UNITED STATES PATENT OFFICE

1,959,710

PUMP

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Chicago Pump Company, Chicago, Ill., a corporation of Illinois

Application September 21, 1931, Serial No. 563,988

3 Claims. (Cl. 103—115)

This invention relates to rotary and centrifugal pumps, and more particularly to the impellers of pumps of that type. The invention is especially concerned with centrifugal pumps of the type used for ejecting sewage or drainage water and for handling liquids which contain solid and semi-solid substances, such as trash and other litter, which cannot be handled by the ordinary centrifugal pump because of the danger of injury to the parts thereof and because of the likelihood of the pump becoming clogged. One difficulty which has heretofore been encountered with pumps of this character is the likelihood of small solid particles becoming wedged between the adjacent faces of the impeller and the casing of the pump and thereby creating enough friction to stop the rotation of the impeller.

The principal object of this invention is the provision of an impeller wherein the impeller vanes are so shaped as to eliminate the possibility of solid or semi-solid articles being wedged between the adjacent faces of the impeller and pump casing. This I have accomplished by shaping the parts of the impeller vanes adjacent their entering edges so as to maintain little or no pressure at one or both sides of the impeller vanes at places adjacent the entering edges thereof. When suitably shaped, a balanced or substantially balanced vacuum zone is created on the two sides of each impeller vane adjacent its entering edge. In actual practice, I have found that with the provision of means for creating a vacuum zone in the region of the vane immediately following its entering edge there is no tendency for the liquid to be drawn through the clearance space between the adjacent faces of the impeller vanes and the pump casing, and, as a result, there is no tendency for the solid or semi-solid matter to enter such space, but, on the contrary, the solid and semi-solid matter are carried away from said vacuum zone by the flowing water and ejected from the pump.

This invention consists, therefore, in a pump having an impeller containing impeller vanes shaped to create and maintain a partial vacuum on one or both sides thereof in zones adjacent their entering edges. It further consists in a pump impeller having vanes provided with entering edges of greater cross section than the parts of the vanes directly following said entering edges. It further consists in a pump impeller in which the entering edges are formed with fillets at the ends thereof which run adjacent the wall of the pump casing, whereby incoming solid or semi-solid matter is prevented from entering the clear-

ance spaces immediately at the front of the entering edge portions of the impeller vanes.

The invention further consists in the several novel features hereinafter fully set forth and claimed.

The invention is clearly illustrated in the drawings accompanying this specification, in which—

Figure 1 is a central vertical cross section of a pump embodying a simple form of the present invention, the line of section through the impeller being indicated at the line 1—1 in Fig. 3;

Fig. 2 is an inverted plan of the impeller with one of its vanes partly broken out;

Fig. 3 is a plan of said impeller;

Fig. 4 is a detail vertical cross section of the impeller taken on the line 4—4 of Fig. 3; and

Fig. 5 is a side elevation of the impeller looking in the direction of the arrow 5 in Fig. 3.

Referring to said drawings, which illustrate one embodiment of the present invention, the reference character 10 designates a pump casing of a centrifugal pump, which casing, as here shown, is composed of end casing members 11 and 12 and a middle casing member 13 bolted thereto and formed with the usual volute 14, as is customary. A centrally disposed inlet opening 15 is provided in the casing member 12 through which the liquid and the solid and semi-solid matter enter the pump and the volute terminates in a discharge opening through which the liquid and other matter are discharged.

Rotatably mounted in the pump casing is the impeller 16 which forms the subject matter of this specification, said impeller being here shown as formed with a hub 17 on one end for mounting the impeller upon the pump shaft 18. The pump shaft is usually keyed to the hub and secured therein by a screw 19. The casing member 11 may be provided with a bearing bracket or other housing 20 in which the pump shaft 18 is journaled.

The impeller is here shown as formed with two oppositely disposed vanes or blades 21 which extend between the opposing faces 22 and 23 of the pump casing, but do not necessarily contact therewith, it being preferable to leave slight clearance spaces between the upper and lower edges of the vanes and the adjacent faces 22 and 23 of the pump casing. A disk-like plate 24 connects the vanes 21 with the hub 17, and, as a preference, said plate is located adjacent the face 22 of the pump casing, although it is spaced considerably therefrom, as is clearly shown in Fig. 1 of the drawings.

The entering edges 25 of the vanes 21 are dis-

posed adjacent but outside the margin of the inlet opening 15 of the pump casing and the trailing portions 26 of the vanes extend in curvilinear lines entirely outside the margin of the inlet opening toward the periphery of the impeller, as is clearly illustrated in Figs. 2 and 3 of the drawings. The entering edges 25 may be rounded off as indicated, and the trailing portions 26 are preferably made somewhat thinner in cross sections than the entering edges, the inner faces of said trailing portions 26 extending back from the inner faces of the entering edges or edge portions, whereas the outer faces of the vanes adjacent the entering edges are set back closer to the axis of the impeller than the outer faces of the entering edges or edge portions. The outer faces of the impeller vanes adjacent the entering edges merge into the outer faces of the entering edges through reverse curved portions, thus providing immediately behind each entering edge a re-entrant portion in each vane or at least a surface which lies within a path traveled by the entering edge of the vane.

To obtain the balanced vacuum effect, the thickness or diameter of the enlarged entering edges must be properly proportioned relative to the excentricity of the vanes to obtain the desired result. If the laterally projecting part of the enlargement is too narrow, the vacuum on the two sides of the vane will not be balanced, but a lower pressure will be produced on the inner face of the vane, with the result that small particles will enter and become wedged in the clearance space between the edge of the vane and the adjacent face of the pump casing. If the enlargement is too wide it will interfere with the efficient operation of the pump.

To obtain the balanced vacuum effect, a low pressure zone must be established on the outside or pressure face of each vane, through an arc of approximately 70° extending from the enlarged entering edge. I have found that when an enlarged entering edge of sufficient thickness or diameter is used to create a low pressure zone of such extent it also creates a pressure, sufficiently low to counterbalance the low pressure on the inner or suction side of the vane immediately following its enlarged entering edge.

To determine the thickness or diameter of the enlarged entering edge, the desired size of impeller, size of inlet opening, curvature, excentricity and thickness of the vanes are established as is usual. From a point on the pressure face of the impeller 70° distant from a radial line extending through the center of the enlargement (to be made) an arc of a circle is struck from the axis of the impeller as the center. The point of intersection between the arc and said radial line and the point of intersection between the inner face of the vane and said radial line gives the diameter and location of the enlarged entering edge. From experiments, I have found that an angle of 70° is best fitted for the largest number of conditions for the impeller for all practical purposes. An arc of approximately 65° for the low pressure zone has been found satisfactory for maximum water flows and an arc of 75° for minimum water flows.

The entering edges 25 of the vanes are formed with fillets 27 at the ends thereof which run adjacent the face 23 of the pump casing, and said casing is extended into the space between the entering edges 25 of the vanes to provide an annular rib 28 around which the filleted ends of the entering edges 25 travel. The other ends of the

entering edges 25 are also formed with fillets 29 at the places where they join with the disk-like plate 24. The opposite edges of the impeller blades are chamfered, as seen at 30, to reduce the width of the edges of the vanes that run along the faces 22 and 23 of the pump casing.

In the operation of a pump containing an impeller constructed in accordance with the one shown and described herein, water and solid or semi-solid matter carried in suspension therein enter through the inlet opening 15 and are carried around through the volute 14 by the impeller vanes and are discharged therefrom in the usual manner. By reason of the annular rib 28 which projects beyond the filleted ends of the entering edges of the vanes, the entering liquid and solid and semi-solid matter are caused to travel over the fillets 27 on the entering edges and are, therefore, carried out beyond the marginal edges thereof, thereby eliminating any tendency for solid matter to enter the clearance spaces at the front of the entering edges of the vanes.

The entering edges 25 pass through the liquid and travel a circular path defined by the dotted lines *a* and *b* in Figs. 2 and 3, thus dividing the liquid, and causing zones *c* and *d* free from liquid between the faces of the divided liquid and the outer and inner faces of the impeller vanes immediately following the entering edges thereof. Vacuum zones are thus produced and maintained at both sides of the impeller vanes directly behind the entering edges thereof, which vacuum zones substantially balance the pressure on both sides of the vanes at places immediately following the entering edges thereof, so that the usual tendency for small pieces of trash, paper, rubber, and the like, to enter the clearance spaces between the impeller vanes and the casing walls is practically eliminated. Instead of entering said vacuum zones and becoming wedged in the clearance spaces between the vanes and casing, the solid and semi-solid matter travel with the moving liquid and are thrown outward into the volute and discharged therefrom.

By providing the vacuum zones at the forward or leading ends of the vanes, the tendency for the solid matter to become wedged between the impeller and the casing is eliminated. From actual experience, I have found that the tendency for the solid or semi-solid substance to become wedged under the trailing portions of the vanes is very slight owing to the fact that the vanes approach the periphery of the impeller at a greater angle to the line of travel than at the entering edge, so that the foreign matter freely rolls out from beneath the impeller vanes if caught in the clearance spaces near the outer ends thereof.

I claim as new, and desire to secure by Letters Patent:

1. The combination with a pump casing having an inlet opening in one wall, of an impeller having an impeller vane extending in a non-concentric curvilinear line from the inlet opening toward the periphery of the impeller with one edge held in close proximity to the face of the casing wall containing the inlet opening, said vane being provided with an enlarged convexly curved entering edge protruding laterally outward from the outer face of the vane a distance sufficient to create a low pressure area on the pressure face of the vane through an extent of from 65° to 75° from the enlarged entering edge, whereby a vacuum zone is produced on the outer face of that part of the vane immediately following its enlarged entering edge which sub-

stantially balances the vacuum zone produced, thereat on the inner face of the vane.

2. The combination with a pump casing having an inlet opening in one wall, of an impeller having an impeller vane provided with vacuum producing means on its outer face comprising an enlarged convexly curved entering edge and an inset trailing portion extending therefrom toward the periphery of the impeller in a non-concentric curvilinear line, approximately 70° of the outer face of the part of the trailing portion immediately following the center of the enlarged entering edge being disposed entirely in the path traveled by said entering edge and the inner face of the vane being tangent to the face of the entering edge whereby substantially balanced vacuum zones are produced on the two sides of that part of the trailing portion of the vane immediately following its entering edge.

3. The combination with a pump casing having an inlet opening in one wall, of an impeller comprising a disk-like plate and impeller vanes projecting therefrom, with one edge of each held in close proximity to the face of the casing wall containing the inlet opening, each vane having an enlarged convexly curved entering edge and a trailing part extending therefrom in a non-concentric curvilinear line toward the periphery of the impeller, and each vane having an inset portion on its outer face immediately following its entering edge, disposed in the path of travel of the enlarged entering edge for a distance of approximately 70° from the center of the enlarged entering edge.

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