This invention relates to fluid pressurizing apparatus and more particularly to improvements in turbine pumps.

In a turbine pump provided with single suction and discharge ports, liquid flows from the suction port into a channel enveloping the vanes on each side of the impeller periphery. Under the action of the impeller wheel the liquid is pressurized at the same time it is circulated nearly a complete revolution in the channel, from which the fluid is then diverted out of the discharge port by a partition interposed between the suction and discharge ports. Pressure developed in the channel of the turbine-type pump is a variable being a minimum at the suction port and gradually increasing to a maximum at the discharge port. This unequal pressure distribution in the channel between the suction and discharge ports produces a large radial hydraulic unbalance on the impeller wheel, thus increasing the bearing loads.

Because of this characteristic, turbine pumps of a given capacity must be constructed with large bearings compared to other types of pumps having identical capacities. This adds to the cost and weight of construction, thus reducing the demand of this type pump where these factors are of primary importance.

It is, therefore, a purpose of this invention to overcome the aforesaid disadvantages by constructing a turbine pump having a hydraulically balanced impeller wheel.

An important object of the invention resides in the provision of a turbine pump equipped with two oppositely related pressurizing chambers wherein the pressures developed in the respective chambers are equal in magnitude and opposite in direction, thus providing a fluid pressure balanced impeller wheel.

It is an object of the invention to provide a pump that produces only a slight pressure rise for a given reduction in flow.

A further object of the invention resides in the provision of means for increasing the capacity of a turbine pump of a given size.

The above and other objects and features of the invention will be apparent from the following description of the device taken in connection with the accompanying drawings which form a part of this specification, and in which:

Figure 1 is a view in section taken on the line 1-1 of Figure 2;
Figure 2 is a view in section taken on the line 2-2 of Figure 1;
Figure 3 is a vector diagram of the fluid pressure distribution around the periphery of the impeller wheel; and
Figure 4 is a flow chart.

Referring now to Figure 1 of the drawings the reference numeral 10 designates a pump or motor housing having a main chamber or cavity 12 formed therein for the reception of a rotatably supported impeller wheel 14, equipped with transversely positioned blades or vanes 16, extending radially inwardly from the wheel periphery and down each side thereof. Access to the cavity 12 is obtained through an openings 18 in one end of the housing. The opening is normally closed by a cover 19 securely held in place by bolts 20 which pass through a flange 22 of the cover and threadedly engage holes 26 in the housing proper. A seal 27, located in a groove 23 of the cover, prevents the escape of fluid pressure from the cavity 12.

The impeller wheel 14 is splined to a shaft 28, one end of which is supported by a bearing assembly 30, located in a hub 32, integral with the housing, the other end of the shaft is carried in a longitudinal bore 34 of the cover 20. A needle bearing 35, in the bore 34, provides a relatively frictionless bearing for the said other end of the shaft. The bearing assembly 30 includes ball bearings 38 which furnish a relatively frictionless bearing for said one end of the shaft 28. The said one end of the shaft is formed with a radially extending flange 40, and the said other end of the shaft is threaded to receive a nut 42. Interposed between the flange 40 and the nut 42 are the following elements viz., an inner race 44 of the bearing assembly 38 abutting the flange 40, an oil slinger ring 46, a sealing ring 48, the impeller wheel 14, spacer washers 50 and 52, and a sleeve 55 inserted between the latter washers. Tightening the nut 42 applies an axial force to the aforesaid elements interposed between the nut and flange, thus holding said elements in fixed relationship to said shaft. A packing gland 56 encircles the oil slinger ring 46, and is interposed theretbetween and the housing 10, to thereby seal the cavity 12 from annulus 58.

The outer end of the hub 32 is counterbored at 52 to receive an L-shaped collar 64, one leg of which slides into the counterbore for engagement with outer race 66 of the bearing structure 35, for retaining the same in place. Machine bolts 68 pass through openings 70 in the other leg of the L-shaped collar for threadedly engaging the outer end of the hub 32.

The left end of the shaft 28 protrudes beyond
3 the end of the hub 32 for connecting said shaft to a prime mover, not shown, when the device is used as a pump.

The main chamber or cavity 12 of the housing is enclosed by lateral walls 72 and 76 and a bridge portion 78 connecting the walls. The lateral wall 74 is formed in part by the cover 26. Channels 62 and 82 are formed partly in the bridge portion 78, and transverse partitions 84 and 85, formed in the bridge portion 78, separate respectively the inlet or suction end of channel 32 from the outlet or discharge end of channel 32, and the outlet or discharge end of channel 32 from the inlet or suction end of channel 32, thus providing two pressure chambers. The channels 28 and 62 envelop the vanes on each side of the impeller wheel periphery, and each channel extends around the inside of the cavity, a greater part of half the impeller periphery. The channels are of equal length, so that the pressure of fluid takes place throughout the same fractional part of a revolution of the impeller wheel, thereby insuring the production of equal pressures in the two channels or pressure chambers. The pressure developed in each of the chambers is a variable, being a minimum at the suction or inlet end and gradually increasing to a maximum at the discharge or outlet end, as illustrated in the schematic drawing, Figure 3, showing a vectorial fluid pressure distribution around the periphery of the impeller wheel, illustrated in the drawing by the arrows F1, F2, etc., the distribution of the internal pressure in this fashion providing a hydraulically balanced impeller wheel.

The housing 16 is formed with an inlet port or suction opening 88, adapted to be connected to a source of fluid, not shown, and an outlet port or discharge opening 58, adapted to be connected to an engine, not shown, which requires pressurized fuel. A pair of passages 82 and 84 communicate the suction opening 88 with the inlet ends of the channels 32 and 62 respectively. Passages 82 and 62 connect the discharge opening 58 with the outlet ends of the chambers 30 and 32 in that order.

Referring to the flow chart, Figure 4, curve A represents the flow in pounds per hour of fluid vs. the discharge pressure in pounds per square inch of a turbine pump having a single suction opening and single discharge opening. The suction pressure was held at 30'' Hg absolute and the temperature of the fluid was 110° Fahrenheit. Curve B shows the flow vs. discharge pressure under the identical conditions as above for a turbine pump having the same impeller wheel size but incorporating the invention hereinafter disclosed. With respect to curve B note the relatively small change in discharge pressure over the wide range of flow.

Although this invention has been described in connection with certain specific embodiments, the principles are susceptible of numerous other applications that will readily occur to persons skilled in the art.

Having thus described the various features of the invention, what I claim as new and desire to secure by Letters Patent is:

1. A turbine pump or motor comprising a housing, a channel formed in the housing, an impeller wheel rotatably carried within the housing and provided with vanes extending along each side of extending across said channel and dividing the same into two diametrically related portions, a bridge in said housing connecting the discharge port to each of said chambers and terminating in the respective chambers at points equidistant from the said suction passages, said chambers being so constructed and arranged that pressures developed therein are radially and axially balanced.

2. In a turbine pump or motor having a housing with an entrance port and a discharge port therein, a curved channel formed in the housing, a passage from the suction port to each of said chambers, a discharge port in the housing, and a passage in the same plane as said channel connecting the discharge port to each of said chambers and terminating in the respective chambers at points equidistant from the said suction passages, said chambers being so constructed and arranged that pressures developed therein are radially and axially balanced.

CHARLES O. WEISENBACH.
JOHN J. O'BELNIS.

References Cited in the file of this patent

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,689,979</td>
<td>Burks</td>
<td>Oct. 30, 1933</td>
</tr>
<tr>
<td>1,861,835</td>
<td>Burks</td>
<td>June 7, 1932</td>
</tr>
<tr>
<td>1,861,835</td>
<td>Burks</td>
<td>June 7, 1932</td>
</tr>
<tr>
<td>1,979,941</td>
<td>Hollander</td>
<td>Nov. 6, 1934</td>
</tr>
<tr>
<td>2,983,844</td>
<td>Brady</td>
<td>May 10, 1942</td>
</tr>
<tr>
<td>2,986,369</td>
<td>Edwards</td>
<td>Mar. 12, 1943</td>
</tr>
</tbody>
</table>