March 8, 1949. W. H. WELSH 2,463,581

IMPELLER

Filed Feb. 5, 1947 2 Sheets-Sheet 1

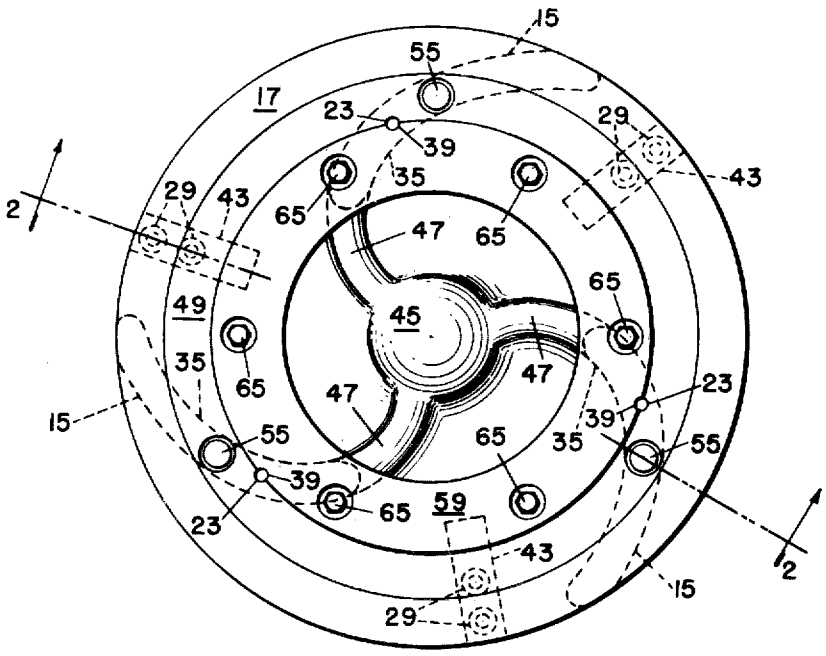



FIG. 1

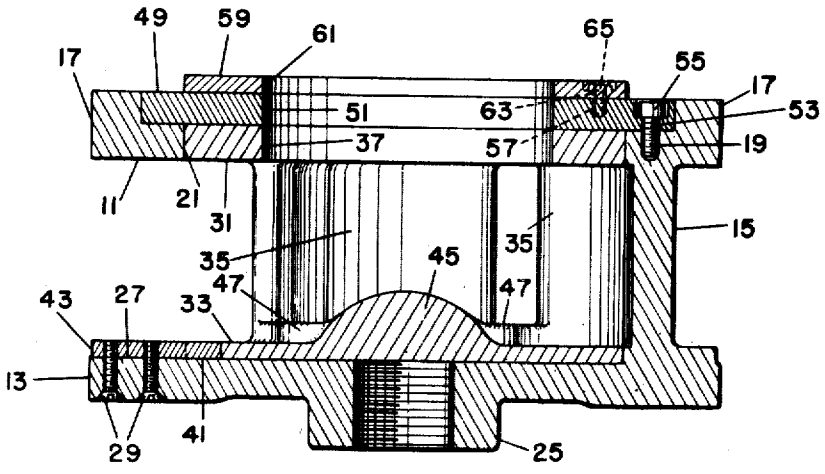



FIG. 2

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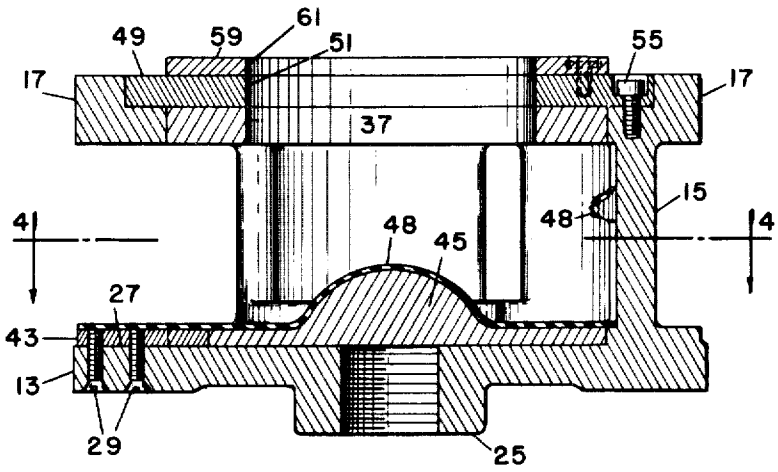



FIG. 3

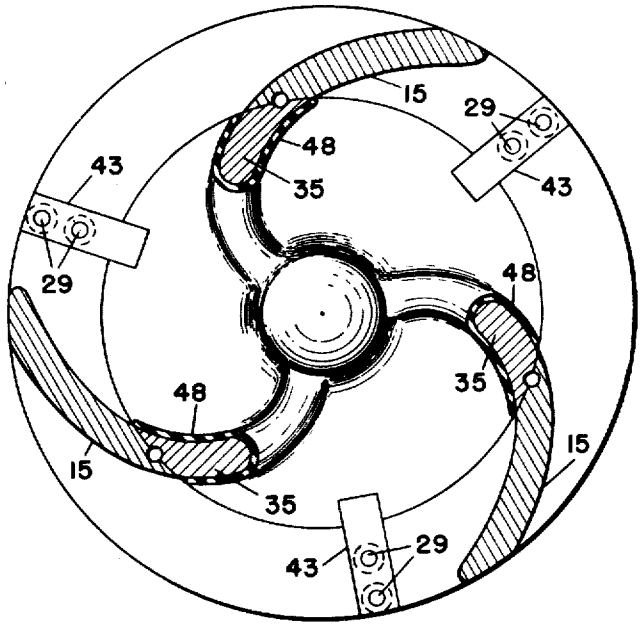



FIG. 4

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# UNITED STATES PATENT OFFICE

2,463,581

## IMPELLER

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Application February 5, 1947, Serial No. 726,505

7 Claims. (Cl. 103—115)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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This invention relates to improvements in impellers, and more particularly to improvements in impellers adapted for use on centrifugal pumps.

In pumping corrosive fluids or slurries of either corrosive or non-corrosive abrasive material, cast-iron impellers are worn speedily, requiring replacement in a relatively short time. Slurries of sand or of ore and ashes, for example, are commonly handled by volute centrifugal pumps. The impellers of such pumps wear, erode and corrode rapidly with corresponding decrease in efficiency resulting in reduction of exit velocities from the pump to the level at which suspended solids settle out of the slurry and clog the system. Shutdowns of pumping operations that result are long and costly, since pump runners and conveyor-line piping must be separated and cleaned, and worn impellers replaced.

The industrial life of a pump impeller can be lengthened by fabricating the entire impeller of a material more resistant to wear and corrosion than cast iron. Such a practice, however, involves the use of a large quantity of relatively expensive material, all of which must be replaced by reason of only localized wear. In addition, since the impeller must operate at relatively high speeds, at which balance against torsional vibration is a significant factor, it is virtually impossible to machine such an impeller so as to attain such balance.

Alternatively, in order to attain more efficient performance for longer periods of time, only portions of the impeller subjected to great wear, erosion and corrosion can be fabricated of a material more resistant to wear and corrosion than cast iron. While such a practice requires use of a minimum quantity of relatively expensive material, it involves construction of a multiplicity of members, increasing tooling costs.

The primary object of this invention is to provide a pump impeller of simple and durable construction in which the portions thereof that are subjected to maximum wear, erosion and corrosion are constructed as a unitary replaceable member.

Another object is to provide a pump impeller in which the member thereof most liable to wear is made of material having a high resistance to corrosion and abrasion, the remainder of the impeller being made of common and inexpensive material that can be machined easily and accurately at comparatively low cost.

A further object is to provide a pump impeller of a construction that is adapted to retain the impeller assembly in balance.

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Still another object is to provide a pump impeller in which the member subjected to maximum wear is replaceable facilely.

Further objects and advantages of this invention, as well as its construction, arrangement and operation, will be apparent from the following description and claims in connection with the accompanying drawings, in which

Fig. 1 is a plan view of an assembled pump impeller, showing a preferred embodiment of the invention;

Fig. 2 is a section thereof taken on the line 2—2 of Fig. 1;

Fig. 3 is a central vertical section of a modified embodiment of the invention; and

Fig. 4 is a section thereof taken on the line 4—4 of Fig. 3.

Similar numerals refer to similar parts throughout the several views.

The pump impeller body is of conventional design, such as that used in single-inlet, backward-discharge volute pumps. Said body comprises two discs 11 and 13, spaced in parallel planes and joined by a plurality of spaced arcuate vanes 15, cast integrally with said discs to form the sides of the impeller body. (For the purposes of illustration, the number of vanes 15 is shown as 3, it being understood that a greater or lesser number can be utilized, as desired.) The disc 11 is provided with a peripheral flange 17 on the face thereof distal the disc 13, said flange being adapted to seat the cover plate hereinafter described, and a plurality of spaced tapped holes 19 adapted to secure said cover plate to said face by means of bolts hereinafter described. An inlet opening 21 is provided in said disc 11, the vanes 15 above referred to bridging said discs 11 and 13 between the periphery of said inlet opening and the outer peripheries of said discs. Said vanes 15 are provided with a plurality of key slots 23 positioned to abut corresponding key slots of the insert hereinafter described.

Centrally located on the face of the disc 13 distal the disc 11 is hub 25, which is threaded internally to receive and engage a power shaft (not shown) by means of which rotary motion is imparted to the pump impeller. Spaced recesses 27 in the face of said disc 13 internal the impeller body are adapted to retain keys hereinafter described, said keys being adapted to secure said insert against rotation relative said impeller body and being fastened in said recesses by a plurality of bolts 29.

The insert is an integrally formed body constructed of a material characterized by great re-

sistance to corrosion and wear. Said insert comprises disc portions 31 and 33, spaced in parallel planes and joined by a plurality of spaced arcuate vane portions 35 to form said insert, said vane portions 35 defining confluent arcs with their corresponding vanes 15 to present conterminous ends; an inlet opening 37 in the disc portion 31; a plurality of key slots 39 in said vane portions 35 adapted to abut corresponding key slots 23, said key slots 23 and 39 carrying suitable keys (not shown); spaced notches 41 in the periphery of the disc portion 33 disposed to correspond with the recesses 27, said recesses 27 and notches 41 carrying keys 43, which are provided with the bolts 29 and are thus adapted to secure the said insert against rotation relative the said impeller body; a protuberant boss 45, medially disposed on the internal face of the disc portion 33; and a plurality of fin portions 47 flaring into said boss, the disc portion 33 and the vane portions 35, said fin portions defining confluent arcs to present conterminous ends with their corresponding vane portions.

Said insert is seated in the impeller body above described, the face of the face portion 31 distal the boss 45 being disposed flush with the external face of the disc 11.

An inner cover comprises an annular plate 49 provided with an inlet opening 51, a plurality of spaced bores 53 adapted to carry bolts 55 that secure said cover to the impeller body by engagement of the tapped holes 19, and a plurality of spaced tapped holes 57 adapted to receive bolts of the outer cover hereinafter described.

An outer cover comprises an annular plate 59 provided with an inlet opening 61 and a plurality of spaced bores 63 adapted to carry bolts 65, which secure said outer cover to the inner cover by engagement of the tapped holes 57.

In utilizing the pump impeller, the impeller body, the inner cover plate and the outer cover plate can be constructed of cast iron, or similar inexpensive material. The insert can can be made of material highly resistant to corrosion and wear, the choice of material therefor depending on the type of fluid or slurry the impeller is designed to pump. For example, in pumping a slurry of power-plant ashes in salt water, ordinary cast iron impellers wear to the point of uselessness in a relatively short time. It has been found that sand-cast white iron or chilled cast iron carrying 4.00% to 6.00% nickel and 1.25% to 2.25% chromium will withstand the destructive action of such a slurry for a relatively long time. Such material, vulcanized rubber, cast iron provided with a rubber casing or jacket, or similar material, is adapted for use in constructing the insert.

Figs. 3 and 4 show an embodiment of a modified form of the invention wherein an impeller constructed generally in the manner hereinabove described is provided with a rubber casing or jacket 48 on the wear surfaces of the insert element.

In assembling the pump impeller, the unitary insert is seated in the impeller body, being secured therein by means of the bolts and keys above described, and the inner cover and outer cover mounted on said impeller body. The pump casing (not shown) is then assembled about the impeller body and the power shaft is inserted through the pump casing into hub 25. After a period of operation, the impeller can be inspected by removing the runner or line (not shown) leading



to inlet opening 37 and the condition of the inert can be observed through said inlet opening.

When required, inserts can be removed and replaced easily and quickly through the aperture in the pump casing made by removing the inlet runner or line. This is accomplished by removing plates 59 and 49 from the impeller body, withdrawing the worn insert, replacing it with a new one, and then replacing the plates 49 and 59 and the inlet runner or line.

It is apparent that a pump impeller constructed as herein described will operate without servicing or replacement for as long a period of time as would an impeller made entirely of the resistant material above described. Further, it is apparent that a great saving in time and labor in construction of the insert and replacement thereof is effected.

Various modifications and changes can be made in the subject device without departing from the scope of the invention.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

I claim:

1. A pump impeller comprising an impeller body provided with an inlet opening and a plurality of vanes, and a unitary replaceable insert constructed of a material having relatively high resistance to wear and erosion, said insert having vane portions disposed conterminous with said vanes.

2. A pump impeller comprising an impeller body provided with an inlet opening and a plurality of vanes, a unitary replaceable insert constructed of a material having relatively high resistance to wear and erosion, said insert having vane portions disposed conterminous with said vanes, and means to secure said insert within said impeller body.

3. A pump impeller comprising an impeller body provided with an inlet opening and a plurality of vanes, a unitary replaceable insert constructed of a material having relatively high resistance to wear and erosion, said insert having vane portions disposed conterminous with said vanes, means to secure said insert within said impeller body, and means to prevent rotation of said insert relative said impeller body.

4. A pump impeller comprising an impeller body provided with an inlet opening and a plurality of vanes, a unitary replaceable insert constructed of a material having relatively high resistance to wear and erosion, said insert having vane portions disposed conterminous with said vanes and being removable axially of said impeller body, means to secure said insert within said impeller body, and means to prevent rotation of said insert relative said impeller body.

5. A pump impeller comprising an impeller body provided with an inlet opening and a plurality of spaced vanes, a unitary replaceable insert consisting of sand-cast white iron containing 4.00 to 6.00% nickel and 1.25 to 2.25% chromium, said insert having vane portions disposed confluent with said vanes and being removable axially of said impeller body, a cover plate adapted to retain said insert within said impeller body, and a plurality of key slots and associated keys adapted to prevent rotation of said insert relative said impeller body.

6. A pump impeller comprising an impeller body provided with an inlet opening and a plu-

rality of spaced vanes, a unitary replaceable insert consisting of vulcanized rubber, said insert having vane portions disposed conterminous with said vanes and being removable axially of said impeller body, a cover plate adapted to retain said insert within said impeller body, and a plurality of key slots and associated keys adapted to prevent rotation of said insert relative said impeller body.

7. A pump impeller comprising an impeller body provided with an inlet opening and a plurality of spaced vanes, a unitary replaceable insert consisting of cast iron provided with a rubber casing or jacket, said insert having vane portions disposed confluent with said vanes and being removable axially of said impeller body, a cover plate adapted to retain said insert within said impeller body, and a plurality of key slots and



associated keys adapted to prevent rotation of said insert relative said impeller body.

WILLIAM H. WELSH.


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