This invention relates to centrifugal pumps and comprises a new and improved pump of that type adapted by the provision of a ceramic lining and impeller for pumping fluid mixtures containing abrasive solids in suspension, such as cement slurry, tailings in ore reduction plants, grinding and cutting sand in quarries, acid slurries, soda ash and the like. While centrifugal pumps have heretofore been provided with linings and impellers of hard metal and rubber, the results have not been entirely satisfactory from the standpoint of expense of manufacture and wear in use. The present invention eliminates these difficulties and presents additional advantages.

Going more into detail, the pump of my invention comprises all or several of the following elements, viz. an outer metal casing or shell lined on the inside with a ceramic liner, a metal suction disk lined on the inside with a ceramic liner, a metal hub disk lined on the inside with a ceramic liner, a ceramic impeller fitted with a metal bushing in the hub for securing it on the shaft and conventional shaft, bearings and base.

These and other features of the invention will be best understood and appreciated from the following description of a preferred embodiment thereof selected for purposes of illustration and shown in the accompanying drawings, in which:

FIG. 1 is a view of the pump unit, the bearing frame being shown in elevation and the pump in longitudinal section,

FIG. 2 is a view of the pump in cross section,

FIG. 3 is a diagrammatic view of the ceramic impeller and adjacent ceramic disk liners, and

FIG. 4 is a view in perspective of the ceramic shell liner.

As shown in FIG. 1, the bearing frame 11 and pump 13 are mounted on a common base 10, the shaft 12 carrying a ceramic impeller 23. The outer casing of the pump is supported from the base 10 by legs or brackets 14 and comprises a fixed bottom section 15 and a detachable upper section 16. These members form a substantially volute metal casing having a tangential outlet 17. The removable section 16 is secured to the fixed section 15 by bolts 17 as shown in FIG. 2.

The metal casing also includes an inner or hub disk 18 having a tubular hub 19 containing a stuffing box and gland for the shaft 12 and a peripheral flange, also an outer or suction disk 26 having a flanged inlet passage 27 and an outwardly directed peripheral flange. The metal disk 18 also includes a bracket 20 connecting the bearing frame 11 to the casing of the pump.

The inboard end 21 of the shaft 12 is shouldered, reduced in diameter and threaded. A flanged sleeve 22 surrounds the shaft and engages its shoulder.

The outboard end of the shaft may be fitted either with flexible coupling for direct connection to motor or engine or with pulley for belt drive.

The impeller 23 is formed as a single ceramic unit having a tubular hub formed with an internal thread and in this is fitted a metal bushing 24 externally threaded for connection with the hub of the impeller and having a flange for engaging the end of its hub. In addition to the threaded connection between the bushing and the hub of the impeller, epoxy cement is applied to the contacting surfaces for the purpose of making a permanent union between the bushing and the impeller. Epoxy cement has been found particularly effective in maintaining a permanent bond at this point. The bushing 24 is also internally threaded to take the thread of the reduced end 21 of the driving shaft. The impeller is also formed with several threaded recesses for the reception of metal plugs 25. These may be inserted or removed or varied in weight in order to secure a static and dynamic balance of the impeller.

The impeller 23 may be of conventional design including circular side walls and a series of interposed vanes 28 symmetrically located to produce a balanced rotating unit. The vanes form peripheral outlets for fluid entering by the inlet opening opposite the center of the rotating impeller.

The ceramic shell liner 25 which is in one piece is held in place within the outer metal casing 15 and 16 by projecting circumferential flanges as shown in FIG. 1.

The space between shell liner 32 and outer shell 15 and 16 is allowed to fill with the liquid being pumped through various clearances so that the internal and external pressure on the shell liner is equalized and it is not subjected to any bursting pressure.

It will be apparent that in assembling the pump the lower half of the outer casing 15 will first be put in place and then the shell liner 32 will be inserted inside and then the upper half 16 inserted over the liner. The two halves will then be bolted together with bolts 17.

The ceramic hub disk liner 31 has a tubular hub which encloses the hub on the impeller 23 and is cemented to the metal disk 18 with epoxy cement with its circumferential edge in flush relation with the peripheral flange of the metal hub disk.

The ceramic hub disk liner 31 has a tubular hub which encloses the hub on the impeller 23 and is cemented to the metal disk 18 with epoxy cement with its circumferential edge in flush relation with the peripheral flange of the hub disk.

The cementing of liners to disks with epoxy cement reinforces the liners and has been found particularly effective in maintaining a bond between the disks and the liners. It also permits of renewing the liners readily by application of heat which releases the bond.

Shaft 12 is supported by ball or roller bearings within the bearing frame 11, the bearings being lubricated either with grease or oil.

The pump 13 and bearing frame 11 are mounted on suitable base 10 for maintaining alignment.

In assembling the pump, the outer casing with liner is first assembled and secured in place as described above. After that, hub disk 18 with liner 31 is secured to the outer casing with suitable studs. Then the impeller 23 is mounted on the threaded end of the shaft. Then the suction disk 26 with liner 30 of the inlet opening is secured to the outer casing with suitable studs.

In disassembling, a reversed process will be followed. The ceramic impeller and the parts of the ceramic lining may be formed of porcelain or other abrasion resistant ceramics such as "Refrax" which is a dense bonded silicon carbide especially hard, practically impervious to oxidation or other chemical attack.

The four ceramic members 23, 30, 31 and 32 as shown in FIGS. 3 and 4 may be formed or cast as separate integral units capable of manufacture at moderate cost and inherently rugged in their construction.

No bolts or studs are used for holding the ceramic lining in place which is particularly advantageous because of the fragile character of ceramic materials.

It is also contemplated as part of this invention to utilize these features in different combinations with metal parts such as metal impeller with ceramic lined casing and disks, metal impeller and metal outer casing with ceramic lined disks, etc.

Having thus disclosed my invention and described in
detail an illustrative embodiment thereof, what I claim as new and desire to secure by Letters Patent is:

1. In a ceramic lined pump for handling abrasive mixtures, a ceramic impeller having circular side disks and curved intermediate vanes forming peripheral discharge openings in the impeller, the said side disks having smooth inner faces and recesses in their outer faces containing balancing plugs.

2. A ceramic lined pump for handling abrasive mixtures, comprising an outer end disk of metal having an outwardly directed flanged inlet opening and an inwardly directed peripheral shoulder, a corresponding hub disk of metal having a flanged opening for a driving shaft and a peripheral shoulder, flanged ceramic liners for said metal outer end disk and hub disk coinciding in diameter with the peripheral shoulder of its adjacent disk and adhesively secured to the disk with its circumferential edge in flush relation therewith, the flanges on said liners fitting within said openings, an integral ceramic liner of volute shape having flanges that rest directly upon the peripheral shoulders of the end disks and upon the flush circumferential edge of the ceramic liners of the end disks, thus supporting the ceramic volute liner as a unit, and a sectional metal casing of volute form having flanges fitting upon the flanges of the ceramic volute liner, and engaging the peripheral shoulders of said end disc.

References Cited in the file of this patent

UNITED STATES PATENTS

304,809    Esplin ------------------ Sept. 19, 1884
914,283    Jackson ------------------ Mar. 2, 1909
1,172,947    Coppage ------------------ Feb. 22, 1916
1,897,947    Howell ------------------ Feb. 14, 1933
1,952,488    Blunt ------------------ Mar. 27, 1934
1,958,108    Milkowski ------------------ May 8, 1934
1,970,435    Sharp ------------------ Aug. 14, 1934
2,029,333    Miller ------------------ Feb. 14, 1936
2,107,260    Ibara ------------------ Feb. 1, 1938
2,433,589    Adams ------------------ Dec. 30, 1947
2,658,454    Greene ------------------ Nov. 10, 1953
2,868,441    Reutt ------------------ Jan. 13, 1959