May 9, 1967 H. G. PALMBERG ETAL 3,318,254

CENTRIFUGAL DREDGE PUMP

Filed May 28, 1965 2 Sheets-Sheet 1

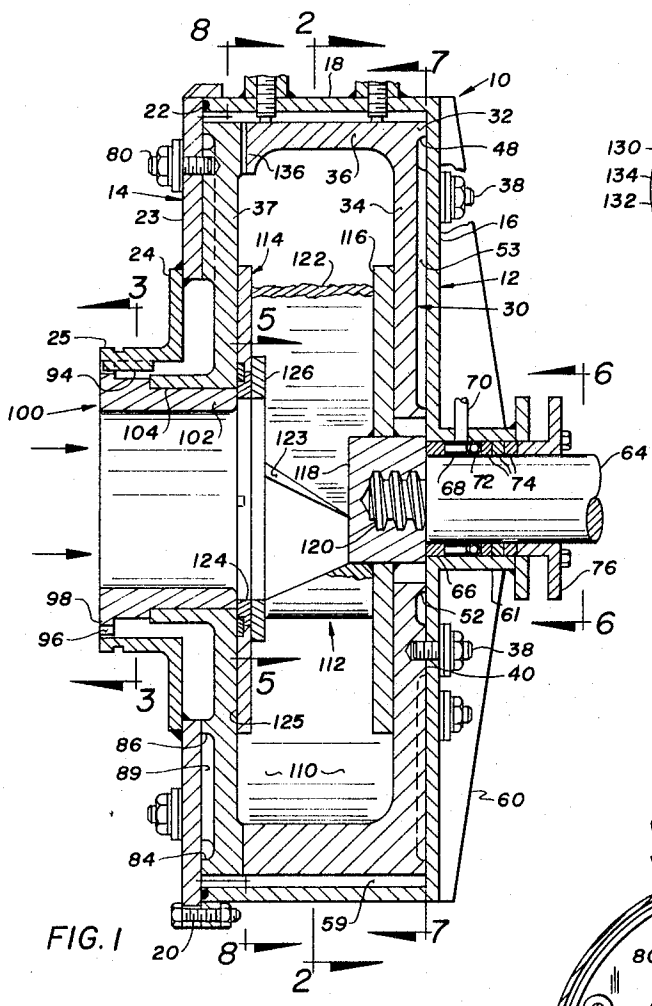

FIG. 1

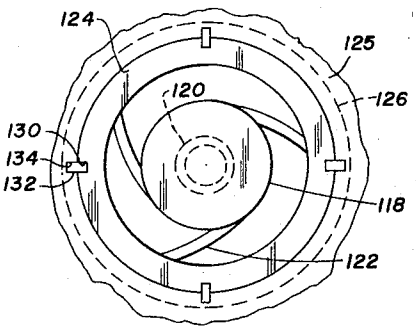

FIG. 5

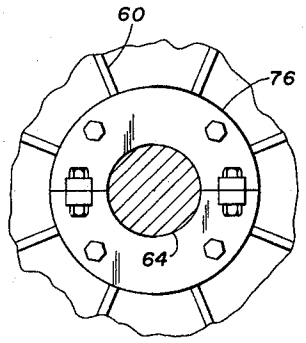

FIG. 6

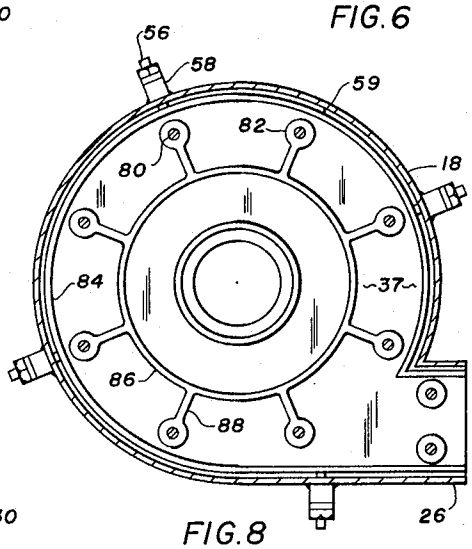

FIG. 8

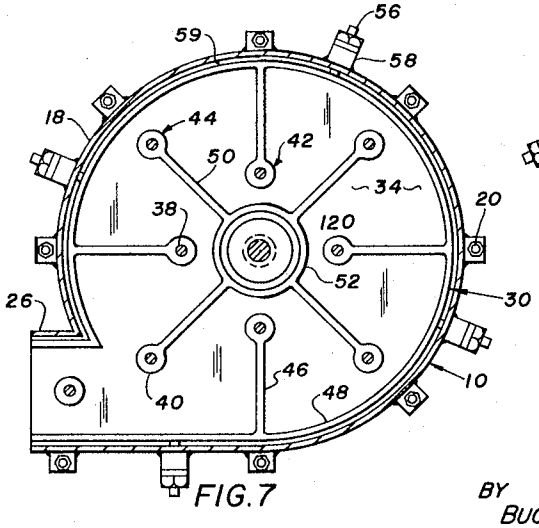

FIG. 7

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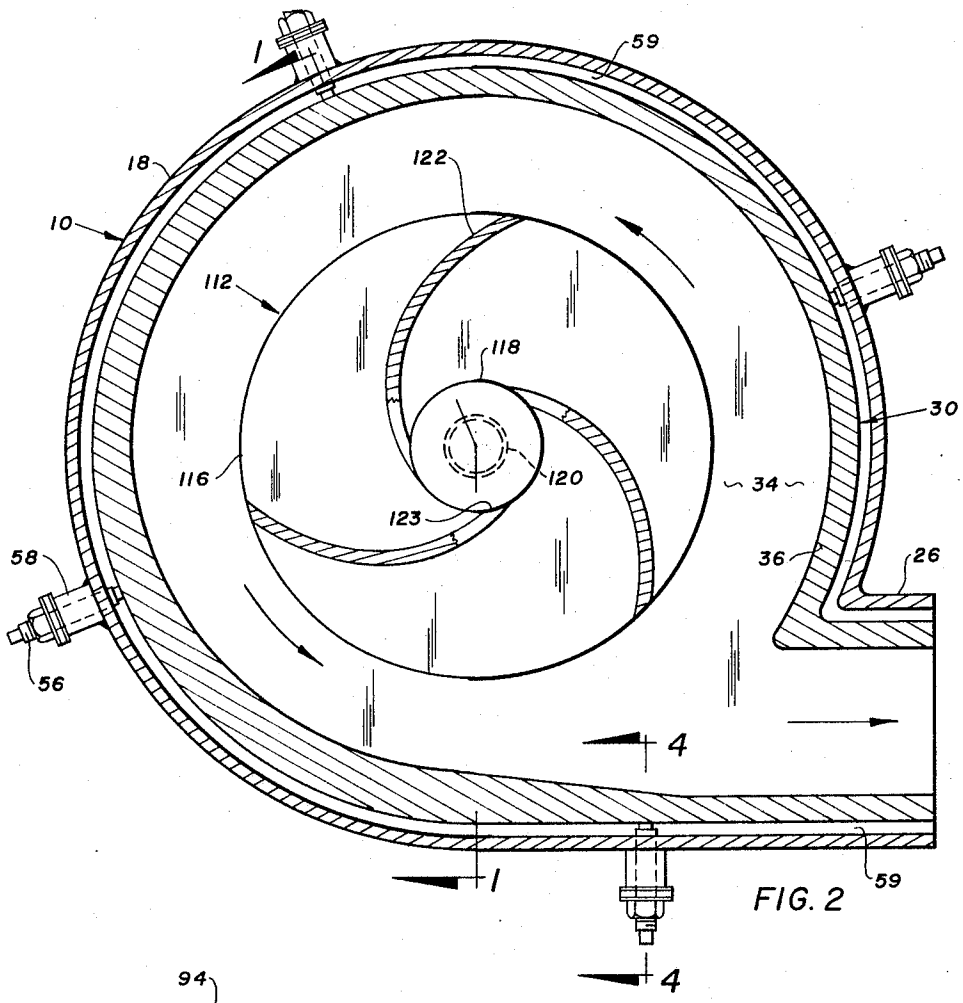

FIG. 2

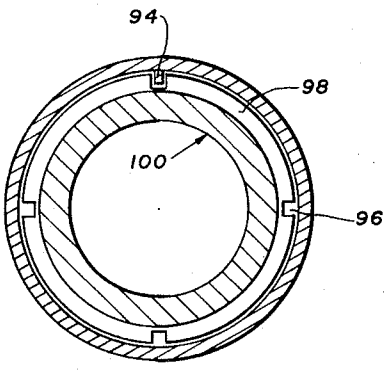

FIG. 3

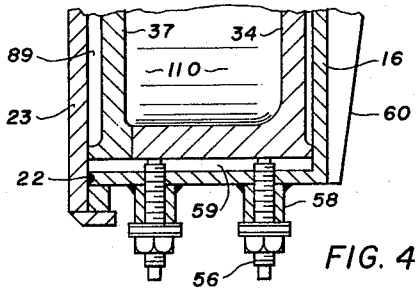

FIG. 4

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CENTRIFUGAL DREDGE PUMP

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6 Claims. (Cl. 103—114)

The present invention relates to centrifugal pumps and more particularly to a centrifugal pump for use on marine suction dredges.

Pumps used for dredging purposes are subject to much abuse because of the abrasive quality of the sand and gravel which frequently are carried in the material pumped and also because of the occasion of relatively large rocks and debris that may enter the pump, and maintenance of dredge pumps has always been a problem. To lengthen the operating life of a pump, efforts have been made heretofore to construct a pump, including an outer casing with a liner of a wear resisting material and which liner can be replaced.

It is an object of the present invention to provide a new and improved arrangement of casing and liner for a dredge pump which facilitates the quick and ready replacement of a liner.

Still another object of the invention is to provide an arrangement of liner and casing in which the liner is effectively supported to minimize breakage of the liner because of impact thereupon of foreign objects in the pumping medium.

Still another object of the invention is to provide an arrangement to minimize recirculation within a pump chamber.

A still further object is to provide a new and improved arrangement of an inlet orifice which permits ready compensation for wear of the orifice defining member.

Still other objects and advantages of the invention will become more apparent hereinafter.

In accordance with an illustrated embodiment, the dredge pump of the present invention includes an outer casing of two parts one of which parts comprises a side wall and a cylindrical end wall of the casing, and the other part of which comprises a further side wall that is adapted to be clamped against the free edge of such casing end wall. Mounted within the casing is a two part pump liner formed of a hard, wear-resistant metal and defining the pump chamber and which liner also comprises two portions, one portion fitting within the aforementioned first part of the casing and including a side wall and a cylindrical end wall. The other portion of the liner comprises an opposed side wall that is secured to the flat removable side wall of the casing. The liner and casing are arranged so as to define cavities therebetween including an annular cavity and cavities between the liner and casing side walls. Means are provided in the liner for permitting the inflow of silt from the water being pumped into such cavities and which silt will pack therein to lend support to the liner.

The pump is provided with a unique arrangement of inlet orifice which permits the member defining such orifice to be rotated so as to compensate for wear and erosion of the same.

Other details and advantages of the pump will become more apparent from the following detailed description thereof taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a vertical section through a pump constructed in accordance with the invention taken substantially along line 1—1 of FIG. 2;

FIG. 2 is a vertical section taken substantially along line 2—2 of FIG. 1;

FIG. 3 is a sectional view of the inlet orifice construction taken substantially along line 3—3 of FIG. 1;

FIG. 4 is a sectional view taken substantially along line 4—4 of FIG. 2;

FIG. 5 is a sectional view taken substantially along line 5—5 of FIG. 1 showing detail of the impeller construction;

FIG. 6 is a view taken substantially along line 6—6 of FIG. 1;

FIG. 7 is a section on a reduced scale taken along line 7—7 of FIG. 1 showing the outer face of one of the liner side walls; and

FIG. 8 is a section on a reduced scale taken along line 8—8 and showing the face of the opposite liner side wall.

As shown in the drawings, the illustrated embodiment of the invention comprises a pump casing 10 including a cup shaped member 12 and a cooperating side wall member 14. The member 12 includes a side wall defining portion 16 and a substantially cylindrical end wall defining portion 18 which is integral along one edge with the side wall portion 16. The member 14 is adapted to be clamped against the free edge of the end wall 18 by suitable means such as bolts 20. A gasket 22 is provided between the end wall 18 and the side wall 14. The casing side wall 14 includes a flat outer portion 23 and a flat inner portion 24 defining a flange for a tubular projection 25 coaxial with the axis of rotation of the pump impeller to be hereinafter described. The projection 25 defines an inlet neck for the pump. The casing portions also form an outlet neck 26 through which the pump discharges. The casing 10 is preferably formed of conventional structural steel.

Mounted within the casing 10 is a liner 30 including a first portion 32, including a side wall 34 and an integral end wall 36 and a second portion 37 defining the opposite side wall. The liner portions extend into the outlet neck 26 as shown in FIG. 2. The liner 30 is preferably formed of a hard, wear-resistant metal alloy such as the high nickel alloy sold under the trademark "Ni-hard" and which has a hardness of about 550 Brinnell. While wear-resistant, such alloy is at the same time somewhat brittle and is subject to fracture if subjected to shock and not properly protected. The pump design herein described lends maximum protection against shock injury to the liner. The side wall 34 is adjacent and substantially parallel to the casing side wall 16, and the liner portion 32 is secured to the casing member 12 by a plurality of studs 38 extending through the casing side wall 16 and threaded into bosses 40 formed on the side wall 34. As shown in FIG. 7, the bosses 40 are arranged in two circular rows including an inner row 42 and an outer row 44. Radial ribs 46 extend from the inner bosses 42 to a peripheral rib 48 and ribs 50 extend from the outer bosses 44 to an inner rib 52 so as to provide substantial bracing between the liner side wall 34 and the casing side wall 16 but leaving a cavity 53 between such side walls. Alignment of the casing 10 and liner 30 coaxially with one another is obtained by means of a plurality of jackscrews 56 threaded through bosses 58 welded to the casing. As is shown in FIGS. 1 and 2, the liner 30 is of lesser diameter than the casing 10 so that a substantially annular cavity 59 is formed between the end walls 18, 36.

The casing side wall 16 is formed to define a hub 61 which is braced by radially extending flanges 60 and is adapted to support the shaft 64 for the pump impeller to be described. Packing is provided to prevent the infiltration of silt and sand laden water into the bearing structure and which packing comprises a replaceable steel ring 66 and a lantern ring 68 opposite which is a water inlet 70 in the hub 61 through which water may be fed

to flush any silt or sand back into the pump chamber. Adjacent the lantern ring **68** is a ring seal **72** and adjacent that is a plurality of rings **74** of packing material such as flax. The packing is held in place by means of a split gland **76**. The water entering the inlet **70** flushes the silt and sand back into the pump chamber at the same time providing lubrication for the shaft **64**.

The side wall **37** of the liner is securely clamped to the casing side wall **14** by a plurality of stud bolts **80** extending through the casing side wall **14** and threaded into bosses **82** formed on the outer surface of the liner portion (see FIG. 8). The outer surface of the side wall **37** is provided with a peripheral rib **84** and with an inner circular rib **86** both of which are adapted to engage the casing side wall **14**. Additional bracing between the casing and the liner side walls is provided by means of a plurality of radially extending ribs **88** extending from the bosses **82** to the rib **86**, as best shown in FIG. 8. As shown in FIG. 1, a cavity **89** is formed between the liner side wall **37** and the casing side wall **14**.

Fixed to the inner surface of the housing inlet projection **25** is a slide bar **94** which is adapted to engage in one of a plurality of grooves **96** (see FIG. 3) formed in the peripheral flange **98** of a nose piece **100** slidably inserted within the projection **25**. The inner portion **102** of the nose piece **100** is of reduced outer diameter and is adapted slidably to fit within a hub-like projection **104** extending outwardly from the liner portion **37**, as best shown in FIG. 1. The inner end surface of the nose piece **100** is coplanar with the inner surface of the liner side wall **37**.

The liner **30** defines a pump chamber **110** having opposite, parallel, planar side walls and within which chamber is mounted a pump runner or impeller **112**. The impeller **112** comprises a pair of flat surfaced side plates **114, 116** the latter of which is secured to a hub **118** threaded to receive a threaded projection **120** of the shaft **64**. Extending between and secured to the side plates **114, 116** are vanes **122** the inner edges **123** of which diverge angularly from the hub **118** to define a wide-mouth entrance to the center portion of the impeller.

The inner peripheral edge of the side plate **114** is ordinarily subjected to much wear and abrasion and to improve the wear resistance of such portion of the side plate the same is preferably formed of a ring **124** of a hard, wear-resistant alloy such as "Ni-hard." The ring **124** is not fixedly secured to the outer portion **125** of the impeller side plate **114** but is effectively clamped in position between the side wall **37** of the liner, the inner end of the nose piece **100** and an annular back-up plate **126**, welded to the impeller side plate portion **125**. The wear ring **124** is provided with a plurality of peripheral notches **130** (see FIG. 5) for receiving positioning dogs or bars **132** which fit within recesses **134** provided in the side plate **114** and within which recesses the bars **132** are welded.

To permit the entrance of silt into the annular cavity **59** and into the side cavities **53, 89**, a small orifice **136** may be provided through the liner and preferably at the top portion of the pump as it is shown in the drawings, though in some instances silt may simply filter through between the mating surfaces of liner portions **36, 37**. The mating surfaces between the casing **10** and the liner **30** are preferably ground surfaces and accordingly fit together relatively snugly and with little clearance. Nevertheless, under the pressures of the operation of the pump, silt will gradually filter through the pump completely to fill the cavities around the periphery of the liner and along the side wall, thus providing effective bracing to the liner and protecting the same against damage from impact thereupon of any large foreign object entering the pump. It is to be appreciated that pumps of the type herein shown may have a diameter of 4 ft. to 5 ft. and an entrance orifice of 12 in. to 15 in. and rocks or boulders of 10 in. to 12 in. in diameter are occasionally passed into the pump. When objects of such size are impacted against the liner fracture of the liner may occur unless it is adequately braced and which bracing the silt packed in the cavities affords.

To assemble the pump the liner portion **30** is assembled within the casing member **12** and the position of the liner and casing adjusted with respect to one another by manipulation of the jack bolts **56**, which, it should be observed also function to reinforce and strengthen the liner against pressures and impact during pumping. The shaft **64** is then mounted in the hub **61** and the impeller thereafter mounted upon the shaft. The wear ring **124** is then placed in position in the impeller and after securing the casing member **14** to the liner portion **37**, the casing member **14** is clamped to the casing member **12** by means of bolts **20**. The interior side of the casings are machine finished and both sides of the liners ground finished such that when the casing side wall **14** is bolted to the casing portion **12** the ground surfaces of the liners come together simultaneously with full compression of the gasket **22** which effects the water tight closure of the pump. The final assembly of the pump is therefore accomplished with ease and is done automatically without possibility of error. Finally, the nose piece **100** is placed in position and the pump is then ready to be connected to a suitable inlet line and to a suitable outlet line.

If for some reason the pump must be dismantled for repair or replacement of any part it is apparent that this may be done quickly and rapidly with little shutdown time. The pump can be dismantled and the liner completely replaced without disturbing the main motor alignment and the casing member **12**.

The arrangement wherein the cavities between the liner and the casing are permitted to fill with silt eliminates the necessity of using pressure rings or of elaborate systems to pump water under pressure into such cavities as is used in some prior art systems. As is apparent, the noise piece **100** can easily be rotated to a new position in the event that one portion of the surface thereof is subjected to excessive wear. Furthermore, since the nose piece **100** and wear ring **124** are both made of hard, wear-resistant alloy there will be little wear therebetween and hence very little space for circulation of water. Recirculation of water between the impeller and entrance orifice is a universal problem and ordinarily causes substantial erosion and wear on the sides of the impeller and liner as well as causing excessive pumping head loss because of the circulation.

Having illustrated and described a preferred embodiment of the invention it should become apparent to those skilled in the art that the invention permits of modification in arrangement and detail. We claim all such modifications as come within the spirit and scope of the appended claims.

We claim:

1. A centrifugal dredge pump comprising:

a casing including a first portion having a substantially flat side wall and a substantially cylindrical end wall integral with said side wall along one edge of said end wall,

said casing including a second portion defining a second substantially flat wall portion,

means for releasably securing said second casing portion to the edge of said end wall opposite the said one edge thereof,

a liner in said casing defining a pump chamber and including a first portion having a side wall positioned adjacent and substantially parallel to said first casing portion side wall and a substantially cylindrical end wall positioned adjacent and substantially parallel to said first casing portion end wall,

a plurality of jack bolts threaded through said casing end wall for engaging said liner end wall and adjusting the position of said liner with respect to said casing,

said liner including a second portion defining a second

side wall adapted to engage the free edge of said first liner portion end wall and being positioned adjacent said second casing portion,

said liner portions being spaced at least in part from said casing to define cavities therebetween,

said liner portions defining passageway means from said pump chamber through said liner to permit the passage of fine silt and the like into said cavities,

an impeller rotatably mounted in said pump chamber including a pair of annular, plane surfaced side plates and a plurality of vanes supported between said side plates,

a shaft for said impeller removably secured at one end to the impeller side plate adjacent the side wall of said liner first portion and extending outwardly through said side walls of said casing and liner first portions,

said casing second portion having an axial opening and a tubular projection extending outwardly coaxially of said opening,

said liner second portion having an axial opening and a tubular projection extending outwardly coaxially of said opening and said casing projection but being of lesser outward projection than said casing projection,

an inlet defining tubular nose piece of hard, wear-resistant metal slidably mounted within said projections and snugly engaging the inner surface of said projections,

interengaging means on said nose piece and said casing projection for retaining said nose piece against rotation about its axis,

said means being engageable in a multiple number of rotative positions of said nose piece,

the inner surface of said second liner portion being substantially planar and the inner end of said nose piece being substantially coplanar with said liner inner surface,

the side plate of said impeller adjacent said liner inner surface comprising a ring of hard, wear-resistant metal alloy snugly engaging said nose piece inner end.

2. A centrifugal dredge pump comprising:

a substantially cylindrical casing including a first portion having a substantially flat side wall and a substantially cylindrical end wall integral with said side wall along one edge of said end wall,

said casing including a second portion defining a second substantially flat wall portion,

means for releasably securing said second casing portion to the edge of said end wall opposite the said one edge thereof,

a liner in said casing defining a pump chamber and including a first portion having a side wall positioned adjacent and substantially parallel to said first casing portion side wall and a substantially cylindrical end wall positioned adjacent and substantially parallel to said first casing portion end wall,

said liner including a second portion defining a second side wall adapted to engage the free edge of said first liner portion end wall and being positioned adjacent and removably secured to said second casing portion,

said liner portions being spaced at least in part from said casing to define cavities therebetween,

said liner portions defining passageway means from said pump chamber through said liner to permit the passage of fine silt and the like into said cavities.

3. In a centrifugal dredge pump:

a casing including a side wall,

an impeller mounted in said casing,

a liner between said side wall and said impeller,

said casing side wall having an axial inlet opening and a tubular projection extending outwardly from about said opening,

said liner having an inlet opening coaxial with said casing side wall opening and a tubular projection extending outwardly from about said liner opening,

said liner projection being of lesser inner diameter than said casing projection and of lesser length,

a tubular nose piece of a hard, wear-resistant metal alloy fitting snugly within said projections,

and interengaging means on said nose piece and said tubular casing projection for retaining said nose piece in various selected rotative positions relative to said projections.

4. In a centrifugal dredge pump as set forth in claim 3 wherein said interengaging means comprises a lug on the inner surface of said casing projection with a plurality of slots in the periphery of said nose piece for selectively receiving said lug.

5. A centrifugal dredge pump comprising:

means including a pair of opposite, circular side walls defining a pump chamber and having planar inner surfaces,

an impeller including a pair of opposite side plates mounted in said chamber, said side plates being parallel to said side walls and closely adjacent thereto,

one of said side walls having an axial opening defining an inlet,

the said side plate adjacent said one side wall having an axial opening communicating with said side wall opening,

said last mentioned side plate including an annular outer portion and an inner ring portion nesting within said outer portion,

interengaging means on said ring portion and said one side plate outer portion for restraining said ring against rotation relative to said outer portion,

a backing plate fixedly secured to the inner surface of said side plate outer portion and overlapping said ring portion,

a tubular nose piece mounted in said inlet opening and having an inner end surface coplanar with said one side wall inner surface,

said nose piece overlapping said ring,

said nose piece and said ring being formed of a hard, wear-resistant alloy whereby erosion of said one impeller side plate is minimized.

6. A centrifugal dredge pump comprising:

means including a pair of opposite, circular side walls defining a pump chamber and having planar inner surfaces,

an impeller including a pair of opposite side plates mounted in said chamber, said side plates being parallel to said side walls and closely adjacent thereto,

one of said side walls having an axial opening defining an inlet,

the said side plate adjacent said one side wall having an axial opening communicating with said side wall opening,

said last mentioned side plate including an annular outer portion and an inner ring portion nesting within said outer portion,

said ring portion having a plurality of radial notches in the outer periphery thereof,

a plurality of dogs fixed to said side plate outer portion and engaging in said notches so as to retain said ring in radial alignment with said side plate outer portion,

a backing plate fixedly secured to the inner surface of said side plate outer portion and overlapping said ring portion,

a tubular nose piece mounted in said inlet opening and having an inner end surface coplanar with said one side wall inner surface,

said nose piece having an inner diameter less than the inner diameter of said ring and an outer diameter

intermediate the inner and outer diameter of said rings,

said nose piece and said ring being formed of a hard, wear-resistant alloy whereby erosion of said one impeller side plate is minimized.

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