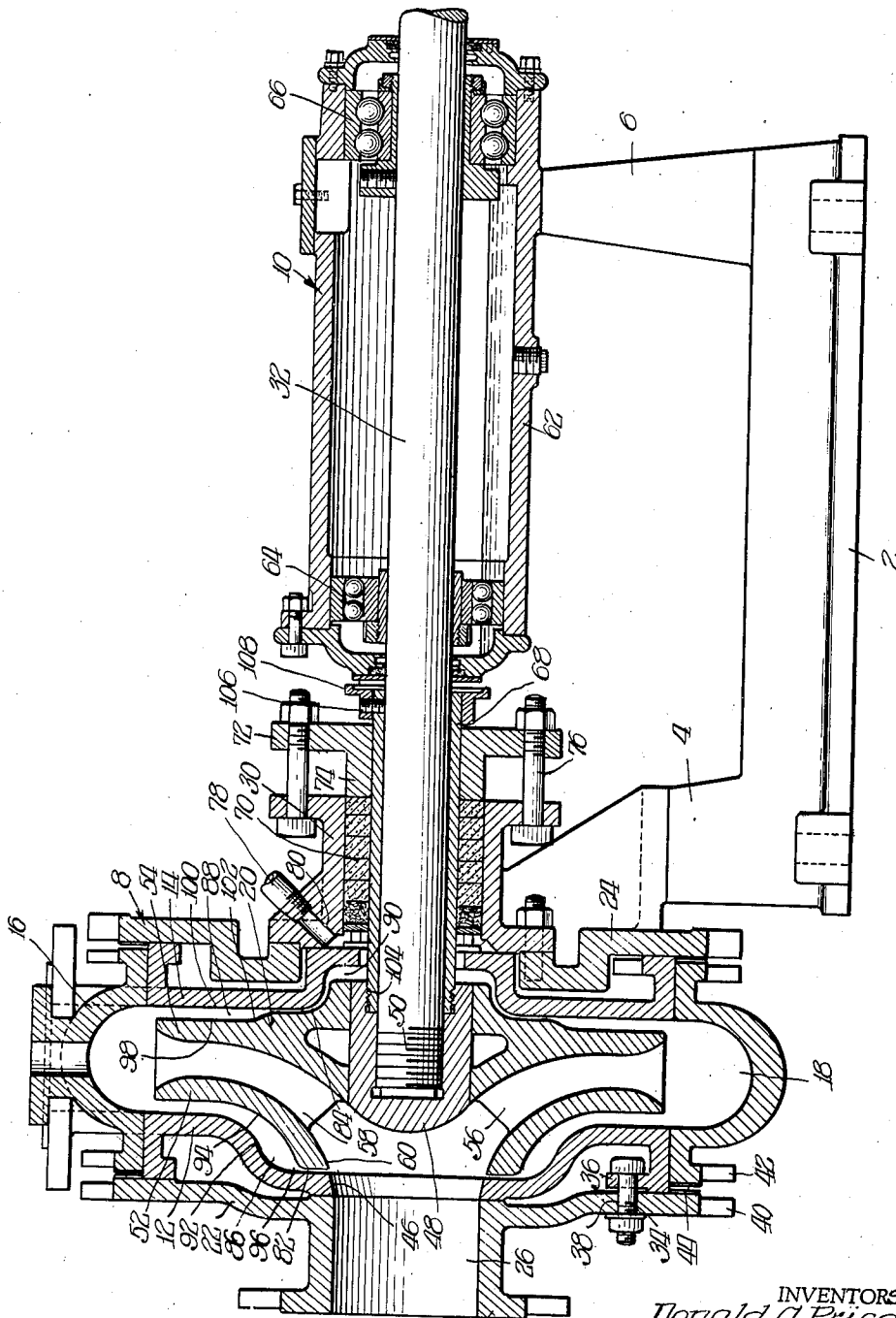


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FLUID ACTUATING DEVICE

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FLUID ACTUATING DEVICE

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The present invention relates to improvements in fluid actuating devices; and more in particular to improvements in centrifugal pumps.

One of the objects of the present invention is to provide a novel arrangement for certain operating elements of a centrifugal pump or the like to substantially eliminate eddy currents in the fluid disposed within the pump and in contiguous relation with the said operating elements whereby wear on said elements is greatly decreased and the efficiency of the device is increased.

According to present constructions, considerable attention has been given to the construction and arrangement of the elements on the discharge side of fluid actuating or impelling devices for increasing the hydraulic efficiency thereof. On the other hand, these devices are subjected to criticism on the score that although the efficiency in many cases has been increased by incorporating such improvements, nevertheless no attention whatsoever has been given to other parts of the device to decrease wear on the operating elements thereof, with corresponding increase in the life of the said device.

As is well understood in the art, such fluid actuating or impelling devices as herein contemplated operate on the principle of imparting centrifugal motion to the incoming fluid and discharging the said fluid at the periphery of the fluid impeller at increased pressure over the pressure maintained on the intake side of the said device. As a matter of fact, the pressure at the discharge end of the device may be as much as 100 pounds to the square inch or more, whereas the pressure of the fluid on the intake side of the device may be a negative pressure, the relation of the two depending, of course, upon the design of the particular device and its speed of operation. Nevertheless there is always a pressure differential between the discharge and intake sides of the said device.

As a further factor in a consideration of this type of device, a clearance space is necessarily present between the fluid actuating or impelling device and the adjacent side wall or walls of the casing. Because of the pressure differential between the discharge and intake for the said device on the one side and between the discharge and the stuffing box on the other side, flow of fluid takes place therebetween in the direction of the said intake and the stuffing box and through the restricted clearance spaces formed between the impeller and the side walls of the casing. Accordingly, because of the particular disposition of the impeller with respect to the contiguous

parts of the casing therefor resulting in these restricted clearance spaces through which flow of fluid necessarily takes place, and further, because of the action of the impeller or fluid actuating element operating at high speeds, violent whirls and eddy currents are produced between the said impeller and the side walls of the casing, which fluid disturbances cause considerable wear on the surfaces of the impeller and casing subjected thereto, and particularly at and adjacent the restricted spaces between the impeller and the contiguous stationary casing. This condition is aggravated when the fluid being discharged through the device contains sediment or other foreign substances, and particularly when impelled at high speeds which cause rapid deterioration of the parts, requiring frequent replacement or repair thereof to condition the device for maximum and efficient performance.

Another factor particularly relating to the excessive wear which is experienced under the operating conditions alluded to above at the restricted spaces between the impeller and casing is the abrupt change in velocity or direction of the fluid at the said restricted clearance spaces because of the fluid seal provided thereby. That is to say, because of the abrupt changes in cross-sectional area of the passages between the impeller and casing due to the restricted clearance spaces, the velocity of the fluid passing through said passages is abruptly changed, thus intensifying the eddy currents and whirls within said passages, which condition further amplifies the eroding characteristics of the material-laden fluid being impelled and accordingly causing excessive wear at and adjacent the said restricted spaces. All of said detrimental factors are more pronounced at the restricted clearance space between the discharge and intake than between the discharge and the stuffing box.

The present invention has proceeded with these inherent defects of present constructions in mind and on the theory that although flow of fluid from the discharge to the intake and stuffing box side of the unit could not be dispensed with and completely eliminated, nevertheless adjacent and contiguous surfaces of co-operating elements of the device could be so constructed and arranged as to practically eliminate eddy pockets and abrupt changes which would lead to eddy currents and violent whirling of the fluid in the passageways between the operating elements, and to provide for the flow which necessarily takes place in the direction of the intake and stuffing box for the device in such a

way as to cause a more uniform flow of fluid, with gradual changes in velocity and direction at the restricted spaces, thus eliminating all causes for excessive wear which has taken place heretofore at and adjacent the restricted spaces on the cooperating elements of the device at those points.

It is therefore an object of the present invention to provide improvements in fluid actuating devices of the type herein disclosed whereby eddy currents and violent whirls of fluid are substantially eliminated during operation of the device at and adjacent the said restricted spaces, thus resulting in practically eliminating the wear which has taken place heretofore at those points.

More particularly, the present invention contemplates an arrangement of the contiguous surfaces of the impeller and the stationary casing in which the same operates whereby said surfaces are of streamlined formation, gradually merging into the surfaces defining the restricted space or spaces at the clearance between the said impeller and said casing. As a further object of the present invention, the flow line contours of the said impeller and contiguous casing at and adjacent the said restricted spaces are such as to provide for gradual changes in the velocity and direction of fluid flow from one part of the device to the other, as hereinbefore referred to.

A still further object of the present invention is to provide flow line contours for adjacent surfaces of operating elements of a centrifugal pump which gradually merge with the surfaces defining restricted clearance spaces which may exist in the device.

The present invention further comprehends a novel arrangement in a fluid actuating device for the impelling or actuating element and its power-driven shaft, which assembly embodies as an improvement a protecting sleeve, the said shaft and sleeve being connected to the impeller or actuating element by way of opposed cooperating threads whereby the impeller and protecting sleeve may be removed from the shaft without affecting or disturbing in any way the operative position of the said shaft. More particularly, the said assembly comprising the impeller, its driving shaft and the protecting sleeve is embodied in a device wherein a stuffing box is used in cooperative association with the said sleeve to prevent leakage between the casing in which the impeller operates and the said shaft, the particular connection between the impeller and its shaft and protecting sleeve likewise comprising the opposed cooperating threads to facilitate the removal of the impeller and the said sleeve from the assembly without disturbing or affecting the operative position of the said shaft.

Other objects, features, capabilities and advantages are comprehended by the invention, as will later appear and as are inherently possessed thereby.

Referring to the drawing:

The figure is a view partly in elevation and partly in cross section disclosing a centrifugal pump embodying improvements in accordance with the present invention.

Referring now more in detail to the drawing, the improvements constituting the present invention are disclosed as being incorporated in a centrifugal pump comprising a base 2 having pedestals or standards 4 and 6 adapted to support an impeller housing 8 and associated mechanism and a bearing stand 10, respectively. The

housing 8 is of multi-part construction, including opposed side walls 12 and 14 to which is attached an outer peripheral housing part 16 connected in any desired manner thereto and forming a fluid compartment 18 in which operates an impeller or fluid actuating element 20. The housing assembly further includes the intake element 22 and the plate element 24, the former being provided with an intake passageway 26 and being provided with securing means 28 to be secured to an intake conduit or duct for delivering fluid to the device, and the latter of which is connected to sealing mechanism or stuffing box 30 for a shaft 32 which is power-driven and connected to the impeller 20. The parts of the pump housing, as explained above, may be connected by way of a plurality of bolts, such as 34, cooperating with the various elements through spaced lugs such as 36 and openings such as 38, or by way of spaced and opposed lugs such as 40 and 42, suitable gaskets, indicated as 44, being provided as needed to secure water-tight joints between the various elements. The duct 26 communicates with an opening 46 formed in the side wall 12 to form an intake leading axially into the impeller 20. This impeller 20 is of the shrouded or closed type, including a hub 48 having a threaded bore threadedly engaging the shaft 32 as at 50, upon which hub is mounted the impeller constituted by opposed walls 52 and 54 between which are provided a plurality of curved blades such as 56 and 58. These blades form radially extending passageways therebetween which merge at one end into the opening 60 which communicates with the opening 46, and at the other end communicate with chamber 18 whereby fluid impelled by said impeller is discharged tangentially therefrom at its periphery into the said chamber and outwardly through a discharge conduit communicating therewith.

The shaft 32 threadedly connected to the hub 48 at one end thereof extends outwardly from the housing assembly and is mounted for rotation within the bearing stand 10 comprising the housing 62 which completely encloses spaced anti-friction bearing units 64 and 66 for supporting and positioning the shaft during its operation and for maintaining its proper alignment whereby the said impeller will be properly operated within the housing assembly.

The shaft 32 is embraced adjacent its threaded end 50 by a sleeve 68 which extends through the sealing device 30 and is in sealing engagement with a plurality of compressible washers such as 70 of the said device for maintaining a tight joint between the shaft 32 and the housing assembly 8. This sealing device further includes a gland follower 72 having an annular part 74 disposed to compress the washers 70, and is adjusted into any desired position by means of a plurality of bolts or the like 76. The sealing device is further provided with a pipe 78 communicating with the interior thereof by way of duct 80 whereby water may be introduced to provide a water seal for said device.

As explained heretofore, operating conditions require certain clearance spaces between the impeller 20 and the side walls 12 and 14 of the housing assembly. In the herein illustrated example of a device embodying improvements constituting the present invention, such clearance spaces are shown on one side of the impeller 20 as at 82 between side wall 12 of the housing and the side wall 52 of the impeller, and as at

84 between the side wall 54 of the impeller and the side wall 14 of the housing assembly. Here-
 tofore, in structures of the type herein disclosed,
 considerable difficulty has been experienced in the
 excessive wear and erosion which takes place
 adjacent such clearance spaces as 82 and 84. 5
 This wear and erosion are due primarily to the
 formation of eddy currents and violent whirls in
 the passageways between the impeller and the
 contiguous stationary casing, as for example at 10
 86, 88 and 90, due in part to the rapid movement
 imparted to the fluid in such passageways by the
 rapidly rotating impeller 20, and in part to the
 flow of fluid from the discharge end of the hous-
 ing toward the intake part on one side of the 15
 housing due to the pressure differential at these
 points and to flow to the stuffing box on the
 other side of the housing, it being recognized
 that a large positive pressure is present at the
 discharge end of the housing, and atmosphere 20
 or sub-normal or other pressures of less intensity
 on the intake and stuffing box sides of the said
 device. This situation is aggravated, particularly
 on the intake side, to a large degree by the pres-
 ence of foreign material in the fluid being im-
 pelled, such as is present under most conditions
 where a device of this kind is used, and particu-
 larly in the pumping of sludge and the like which
 includes a large amount of solid particles which,
 at high velocities, cause considerable damage to
 the parts of the pump where abrupt changes in
 velocity take place, as would be experienced at
 and adjacent the said clearance spaces 82 and 84.

In order to greatly decrease this wear and
 erosion at the points indicated, the opposed wall 35
 surfaces 92 and 94 of side walls 12 and 52, re-
 spectively, and defining the passageway 86, are
 formed with flow line curvatures without abrupt
 changes whereby uniform flow of fluid may take
 place thereover, the said surfaces merging gradu-
 ally as at 96 into the surfaces of the side walls 12
 and 52 defining the clearance space 82. This
 streamlined formation for the said surfaces and
 their gradual merging into the surfaces defining
 the restricted clearance space 82 between the 40
 impeller and contiguous side wall of the casing
 substantially eliminates any tendency for whirls
 and eddy currents to be created which would
 otherwise cause excessive wear and erosion of the
 material for the side walls 12 and 52 adjacent
 said clearance spaces.

On the other side of the impeller the passage-
 way 88 is defined by opposed surfaces 98 and 100
 formed on the side walls 54 and 14 of the im-
 peller and housing, respectively, the said surface
 98 in this particular instance being curved as at
 102 to gradually decrease the sectional area of
 the passageway 88 to merge with the clearance
 space 84 for the same purposes which have been
 above explained in respect of the structure on
 the other side of the impeller. In respect of the
 assembled relation of the impeller and the side
 plate 14, however, it will be noted that the
 clearance space 84 is formed in spaced relation
 to the shaft 32, and that another passageway 90
 of relatively large cross-sectional area is pro-
 vided between the impeller and the side wall 14.
 Because of the relatively large cross-sectional
 area of passageway 90 which permits a decrease
 in the velocity of fluid passing toward the stuff-
 ing box 30 through the restricted clearance space
 84, the said surfaces 98 and 100 of the said side
 walls 54 and 14, respectively, are of streamlined
 contour or formation whereby the said passage-
 way 90 has its cross-sectional area gradually in-

creased from the restricted clearance space 84
 inwardly and radially toward shaft 32, thus
 eliminating all abrupt changes which might cause
 eddy currents or whirls in the said passageway,
 resulting in excessive wear to the adjacent parts
 upon operation of the impeller at high speeds.
 A gradual divergence of the wall surfaces 98 and
 100 prevents abrupt changes in the velocity of
 the fluid passing through restricted clearance
 space 84, which abrupt changes are in part the
 cause for the excessive wear and erosion which
 have been referred to hereinbefore.

With the flow line contours above described,
 eddy currents and violent whirling motions are
 substantially eliminated within the fluid in the
 passageways designated upon rotation of the im-
 peller. Thus a large part of the excessive wear
 heretofore experienced has been eliminated,
 which results in more efficient operation of the
 device over extended periods of time without re-
 quiring replacement or repair of the various
 operating elements of the unit.

As a further improvement embodied in the
 centrifugal pump herein described, but equally
 adapted for other fluid impelling devices, such as
 reciprocating pumps or hydraulic presses, refer-
 ence is hereby made to the manner in which the
 protecting sleeve 68 and operating shaft 32 are
 connected to the impeller to expedite removal of
 the said protecting sleeve 68 and impeller 20
 without disturbing the adjustment or position of
 the said shaft 32. This removal is necessitated
 because of the need of repairs or replacements to
 the various elements, and particularly the pro-
 tecting sleeve 68, as well as the impeller or other
 parts of the housing, and it is highly desirable to
 provide a construction which can be disassembled
 with ease and facility and the parts repaired or
 replaced without loss of time. In order to ac-
 40 complish this result, the various parts of the
 housing are readily disconnected to secure ad-
 mittance to the fluid chamber 18 and to gain
 access to the impeller 20.

The impeller 20 is connected to the protecting
 sleeve 68 by way of cooperating threads as at 104,
 the threads 104 being opposed to the threads 50
 by which the shaft 32 is likewise connected to the
 impeller. That is to say, the threads 50 may be
 cut as left-hand threads, whereas the threads at
 50 104 are cut as right-hand threads, or vice versa,
 and with equal pitches whereby, when the im-
 peller 20 is removed from shaft 32, the sleeve 68
 will be removed simultaneously without distur-
 bing in any way the alignment or mounting for
 the shaft 32. The protecting sleeve 68 normally
 rotates with the shaft 32 and is held in associa-
 tion therewith by way of a set screw 106, which
 further connects a water finger 108 to the said
 sleeve 68. Because of the opposed threads at 50
 and 104, a further advantage is secured in that
 when the sleeve 68 is rotating, the frictional drag
 of the washers 70 on the sleeve tends to screw
 the sleeve more tightly into the impeller, secur-
 ing it in operation against relative motion of the
 shaft. While we have herein described and upon
 the drawing shown an illustrative embodiment of
 the invention, it is to be understood that the in-
 vention is not limited thereto but may compre-
 hend other constructions, arrangements of parts,
 70 details and features without departing from the
 spirit of the invention.

We claim:

1. In a centrifugal pump, the combination of
 an impeller, a casing having intake and dis-
 75 charge means, said impeller being mounted for

rotation in said casing and having a substantially sealing relation with said casing adjacent said intake means through the medium of a restricted clearance space, and said impeller and the adjacent casing having flow line contours gradually merging toward and into said clearance space.

2. In a centrifugal pump, the combination of an impeller, a casing having intake and discharge means, said impeller being mounted for rotation in said casing and having a substantially sealing relation with said casing adjacent said intake means through the medium of a restricted clearance space, and said impeller and the side wall of said casing adjacent thereto having substantially radially extending flow line contours converging gradually toward and into said clearance space to provide for gradual change in velocity of fluid within said pump.

3. In a centrifugal pump, the combination of an impeller, a casing therefor having intake and discharge means, a stuffing box in association with said discharge means, said impeller being mounted for rotation in said casing and having a substantially sealing relation with said casing adjacent said intake means and stuffing box through the medium of restricted clearance spaces, and said impeller inwardly of the periphery thereof and the opposed walls of said casing having flow line surfaces free from abrupt changes gradually merging with said restricted clearance spaces to eliminate the formation of eddy currents in the fluid within the said pump upon operation of said impeller.

4. In a centrifugal pump, the combination of an impeller, a casing having intake and discharge means, a stuffing box in association with said discharge means, said impeller being mounted for rotation in said casing and having a substantially sealing relation with said casing adjacent said intake means and stuffing box through the medium of restricted clearance spaces, the impeller and said casing having flow line contours gradually merging into the restricted space adjacent said intake means, and the surfaces of said impeller and said casing having flow line contours on opposite sides of the restricted clearance space adjacent said stuffing box disposed in gradual converging relation to one another and extending toward said clearance space whereby said passages gradually merge into said clearance space.

5. In a fluid actuating device, the combination of a fluid actuating element, a housing therefor, a power-driven shaft extending into said housing and being connected to said element, means for operatively positioning said shaft with respect to said element, a stuffing box for said shaft, a sleeve for protecting said shaft against wear connected at one end to said element and extending through said stuffing box, said connections comprising interengaging right and left handed threads whereby removal of said element and sleeve from said shaft can be effected without disturbing the operative position of said shaft.

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