July 23, 1957 C. A. BUTLER 2,800,084

CENTRIFUGAL SAND PUMP

Filed Jan. 10, 1955 2 Sheets-Sheet 1

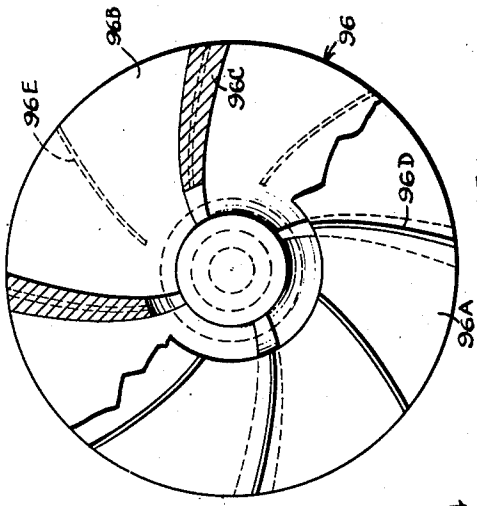


Fig. 3

Fig. 1

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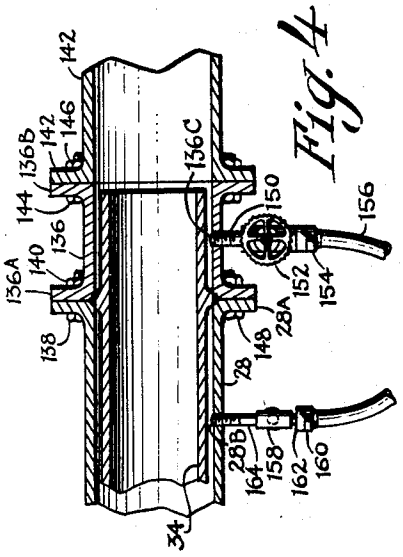


Fig. 4

Fig. 2

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United States Patent Office 2,800,084 Patented July 23, 1957

2,800,084

CENTRIFUGAL SAND PUMP

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Application January 10, 1955, Serial No. 480,715

3 Claims. (Cl. 103—103)

This invention relates to motor driven pumps, and more specifically to a sand and gravel pump.

One of the primary objects of this invention is to provide a centrifugal type sand pump with means for detecting leakage of the pumped material through an inner shell liner, whereby the pump may be shut down immediately to prevent serious damage thereto.

Another object of this invention is to provide means for detecting leakage of the pumped material through the suction side face plate liner or through the shaft side face plate liner.

A further object of this invention is to provide means for effectively maintaining the space between the suction and shaft face plates and the impeller free of sand and gravel during the operation of the pump.

A still further object of this invention is to provide a sand and gravel pump of the type described with a split outer housing and wherein the line of separation between the housing sections falls in a plane parallel to the axis of its rotor.

Other and further objects and advantages of the present invention will become more evident from a consideration of the following specification when read in conjunction with the annexed drawings, in which:

Figure 1 is a side elevational view of a centrifugal sand pump constructed in accordance with the present invention.

Figure 2 is a cross-sectional view taken on the vertical plane of line 2—2 of Figure 1, looking in the direction of the arrows.

Figure 3 is a side elevational view of the rotor, a portion thereof being broken away to illustrate its inner construction.

Figure 4 is a detail cross-sectional view taken on the horizontal plane of line 4—4 of Figure 1, looking in the direction of the arrows.

Referring now more specifically to the drawings, reference numeral 10 designates, in general, a centrifugal sand pump constructed in accordance with the teachings of this invention. The pump 10 is seen to comprise a pair of outer shell members 12 and 14. The members 12 and 14 are provided with a semi-circular side elevational configuration and are substantially U-shaped in transverse cross-section. The adjacent ends of the shell members 12 and 14 terminate in outwardly directed laterally extending flanges 16, 18 and 20, 22, respectively, which are rigidly secured together by a plurality of bolts 24 and nuts 26. The shell member 14 is also provided with an involuted portion 28 substantially circular in transverse cross-section, and a pair of base supports 30.

An integrally formed shell liner 32 having a substantially circular configuration in side elevation and having an involuted portion 34 is disposed within the shell members 12 and 14 and the involuted portion 28 thereof. As is seen in Figure 2, the liner 32 is substantially U-shaped in transverse cross-section and has an outside diameter less than the inside diameter of the shell members 12, 14, and each of the shell members is constructed with a pair of inwardly projecting semi-circular and laterally extending ribs 12A, 12B and 14A, 14B at the marginal edges adjacent the free ends thereof which engage tightly against the opposed sides of the liner 32 and defines a closed substantially U-shaped chamber 36 thereabout. As is seen in Figure 2, the annular arms 32A, 32B project inwardly beyond the terminal ends of the ribs 14A and 14B.

A liner plate 38, substantially circular in configuration, closes the suction side of the pump liner 32 and is integrally formed with an outwardly extending laterally projecting, and substantially hollow hub portion 38A. The plate 38 is constructed with a circumferential and lateral extension 38B which seats against and seals the confronting sides of the ribs 12A and 14A. A rubber O ring seal 40 is positioned at the juncture of the plate 38 with the arm 32A and ribs 12A, 14A.

A substantially circular face plate 42 having a laterally depressed portion 42A and a laterally extending hollow circular boss 42B which terminates in inwardly and outwardly extending radial flanges 42C and 42D, respectively, is secured adjacent its circumferential marginal edge to the shell ribs 12A and 14A by a plurality of bolts 44 and nuts 46. As is seen in Figure 2, the depressed portion 42A is juxtaposed but spaced from the plate 38 and that the radial flange 42C serves as a spacer to hold the boss 42B from the hub 38A. The spacing between these elements forms a pair of horizontally and vertically extending connected chambers 48 and 50, respectively.

A collar 52 having radial flanges 52A and 52B at its ends is telescoped over the outer end of the boss 38A. Bolts 54 and nuts 56 connect the flange 42D with the flange 52A, and identical connector means secure the flange 52B with a radial flange 58A at one end of a tubular conduit 58. Adjacent the last-mentioned connection a vacuum pressure gauge 60 is connected with the conduit 58.

The shell member 12 includes an internally threaded opening 12C, positioned adjacent the upper end thereof, in which is threaded one end of a short length of an externally threaded pipe 62. The other end of the pipe is provided with a fitting 64 in which is connected a pressure gauge 66. A conduit 68 connects with one side of a manually operated valve 70 having its other side connected by pipe 72 with one end of a connector 74. The other end of the connector 74 is attached to one end of a flexible conduit 76 which has its other end affixed to one end of a second connector 78. A pipe 80 connects the other end of the connector 78 with one end of a fitting 82, and the other end thereof is connected to one end of an externally threaded pipe 83 having its other end threaded into an internally threaded opening 42E formed in the face plate 42 adjacent the lower end thereof.

The shaft side of the pump liners 12, 14 is provided with a circular liner plate 84 having a hub 84A projecting laterally from a side thereof and a laterally extended circumferential flange 84B. The plate 84 seats within the annular arm 32B and the flange 84B thereof seats against the rib 14B. At the junction of the plate 84 with the shell liner 32 and the shell members 12 and 14, a waterproof element such as an O type sealing member 86 is inserted.

A circular face plate 90 having a depressed central portion 90A extends across the liner plate 84 and is secured to the shells 12, 14 by the bolts and nuts 44, 46, respectively. As is seen in Figure 2 of the drawings, the circular face or cover plate 90 is in juxtaposed relation relative to the liner plate 84, and the hub 90B is concentrically positioned with respect to the hub 84A thereby

forming a substantially vertically extending chamber 92 which is in open communication with a horizontal chamber 94.

A centrifugal impeller or rotor 96 is disposed within the pump 10, the impeller having a diameter slightly less than the diameter of the liner plates 42 and 84. The impeller 96 is provided with a centrally positioned laterally extending annular flange 98 to which is bolted at 100 a radial flange 102A integrally formed at one end of an elongated substantially cylindrical shaft 102. The shaft 102 rotates in the hub 84A of the liner plate 84 and projects outwardly from the pump 10 through the hub 90B and is rotatably journalled in a pair of spaced bearings 104, 106 of conventional design. The bearings are fixedly secured to base elements 108 and 110.

A plurality of sealing members 112 are mounted on the the shaft 102 and engage at their circumferences the inner circumference of the hub 90B. The radial flange 90C confronts a radial flange 114A of a closure member 114, the closure member 114 extending into the hub 90B and compressing the sealing members 112 between it and the outer end of the hub 84A. The flanges 90C and 114A are connected by means of the bolts 116 and nuts 118.

The shaft side of the shell member 12 is provided with an internally threaded opening 120 which is adapted to receive one end of a threaded pipe 122, the other end of the latter being connected to one end of a fitting 124. The other end of the fitting is connected with one side of a manually operated valve 126 by conventional means and the other side of the valve is connected to one end of a flexible tubular member 128. The other end of the member 128 is connected with one end of a fitting 130, the other end of which receives one end of an externally threaded pipe 132, and the other end of the latter is threadedly secured within an opening 134 which communicates with the chamber 92.

The involuted portions 28 and 34 of the pump 10 are maintained in spaced relationship as illustrated in Figure 4, and the involuted portion 34 extends beyond the extremity of the involuted portion 28. The latter terminates in a radial flange 28A which confronts a radial flange 136A of a collar 136 that surrounds the terminal end portion of the involuted member 34. The two flanges 28A and 136A are secured as by the bolts 138 and nuts 140. The other end of the collar 136 is provided with a radial flange 136B which confronts a radial flange 142A at one end of a discharge conduit 142. The flanges 136B and 142A are secured together by bolts 144 and nuts 146. Interposed between the flanges 28A and 136A and the involute 34 is an O type sealing element 148.

As is seen in Figure 4 of the drawings, the collar 136 is provided with an internally threaded opening 136C which is adapted to receive one end of an externally threaded pipe 150 having its other end connected with one side of a manually operated valve 152. The other side of the valve 152 is connected by conventional means to a connector 154, the latter having connection with one end of a conduit 156. The other end of the conduit 156 connects to one side of a T-connector 158 (see Figure 1) through the connector 160 and pipe 162. A second side of the T-connector 158 receives one end of an externally threaded pipe 164, the other end of which is secured in a internally threaded opening 28B which extends through the involute 28. The third side of the T-connector 158 is connected with a source of water under pressure through the conduit 166.

The impeller 96 is driven through a pulley 168 keyed at 170 to the shaft 102 intermediate the bearings 104 and 106. The pulley is connected through endless V-belts 172 with a driving motor.

The liner plates 42 and 84 are each provided with an opening 38C and 84C, respectively, which communicate on the one hand, between the chamber 50 and the interior of the pump 10, and on the other hand between the chamber 92 and the interior of the pump 10. The functions of these openings will be described in detail below.

Referring now to Figure 3 of the drawings, the impeller 96 is seen to comprise a pair of spaced circular discs 96A, 96B between which extend spiral impeller blades 96C. As is seen in this figure, the exterior sides of the discs 96A, 96B are provided with a plurality of spiral ribs 96D and 96E.

In sand and other similar types of pumps heretofore known in the art no means have been provided for determining precisely which of the pump liner elements had ruptured, given away, or had worn out. The present invention provides such means.

For example, and under actual running operation, water under pressure is supplied from the conduit 166 and passes through the T-connector 158 and into the space between the involuted portions 28 and 34, and then enters and fills the space 36 between the liner member 32 and the shell members 12 and 14. As this space or chamber is filling, water passes through the valves 70, the conduits 76 and 128, and completely fills the chambers 48, 50, and 92, 94.

As the chambers 50 and 92 fill, water will pass through the openings 38C and 84C and enters a chamber 174 formed between the flange 102A and the hub portion 84A of the liner 84. From the chamber 174 the water is forced upwardly under pressure between the spiral ribs 96D and the adjacent sides of the liner plates 38 and 90.

Assuming that the pump 10 has been primed and is in operation, the gauge 60 will read, in the actual operation of the pump, twenty-five pounds vacuum pressure. The gauge 66 will stand at fifteen pounds pressure, and the gauge 176 connected in the discharge conduit 142 will stand at forty pounds.

Now let it be also assumed that after prolonged operation of the pump a fissure occurs in the shell liner 32. Water and sand under pressure will then enter the space 36 and cause the gauge 66 to show an increase thereof which will approximate the reading on the gauge 176. To determine accurately that the rupture occurred in the liner 32, the operator will close first one or the other of the manually controlled valves 70 or 126, and if no variation in pressure is noted on the gauge 66 the operator knows immediately that the break has occurred in the liner 32. If, however, upon closing the valve 70 and leaving the valve 126 in its open position a decrease in pressure is recorded by the gauge 66, the operator instantly knows that the plate 38 is defective. If, on the other hand, the valve 70 is in its open position and after closing the valve 126 a pressure drop is recorded on the gauge 66, the operator is informed that the fault is in the liner plate 84.

The provision of such testing means enables the operator to determine with precision the exact extent of the repairs which must be made to the pump without making an extensive, time consuming, dismantling thereof in order to determine which of the three elements has been damaged.

The openings 38C and 84C provide means whereby water is circulated between the spiral ribs 96D and maintains the space between the sides of the impeller and the adjacent sides of the liner plates 42 and 84 free and clear of all sand and other debris.

Having described and illustrated one embodiment of this invention in detail, it will be understood that the same is offered merely by way of example, and that the invention is to be limited only by the scope of the following claims.

What is claimed is:

1. A centrifugal pump comprising a pump casing having a vacuum intake and a high pressure discharge, an impeller rotatably journaled in said casing, liners on each side of said impeller defining a first and second separated chamber between the impeller and casing, a peripheral liner between the impeller periphery and casing defining

a third chamber between said peripheral liner and casing, means connected to said pump for pressurizing all of said chambers at a pressure lower than pump discharge pressure, a detecting means in communication with each of said chambers, means connected to the discharge of said pump for indicating pump discharge pressure, each of said first and second chambers having restricted communication with said impeller chamber, means carried by said impeller for inducing a reduction in pressure in said first and second chambers, and means in fluid communication with said detecting means for selectively placing said detecting means in communication exclusively with a desired chamber to test for a break in a liner wall.

2. A centrifugal pump comprising a pump casing having an intake and a discharge port, an impeller rotatably mounted in said casing, side liners in said casing to each side of said impeller defining a first and a second chamber between said impeller and casing on each side of said impeller, means on said impeller for inducing a reduction of pressure in said first and second chambers, a peripheral liner in said casing defining therewith a peripheral chamber separate from said side chambers, means connected to said pump for pressurizing said chambers, said side liners having a restricted opening into the impeller chamber at a low pressure area, pressure change

sensing means in communication with each of said chambers, pressure change sensing means in communication with the discharge of said pump, and means in fluid circuit with said sensing means for selectively placing said sensing means in circuit with any one chamber to the exclusion of the others to detect a break in any of said liners and through said selective means to determine exactly which liner has broken by a change in said pressure change sensing means.

3. A centrifugal pump as claimed in claim 2 wherein said means for pressurizing said chambers is a source of water under pressure which fills the chambers and passes through the openings through said side liners to force a cleansing stream between the liner walls and the impeller.

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