Aug. 23, 1960 A. J. GRANBERG 2,949,859

SELF-PRIMING CENTRIFUGAL PUMP ASSEMBLY

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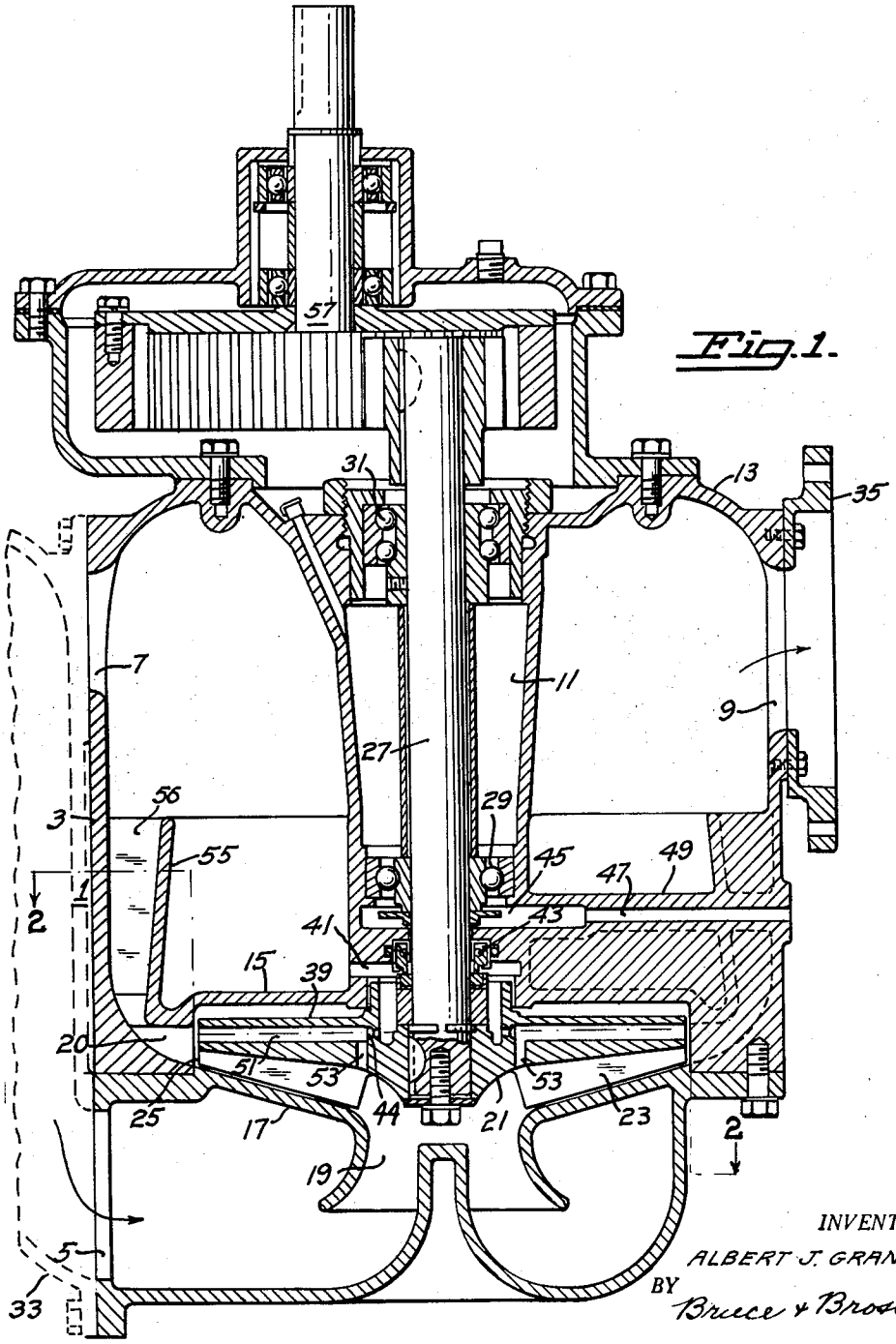


Fig. 1.

INVENTOR.
ALBERT J. GRANBERG
BY
Bruce & Broaler
HIS ATTORNEYS

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Fig. 2.

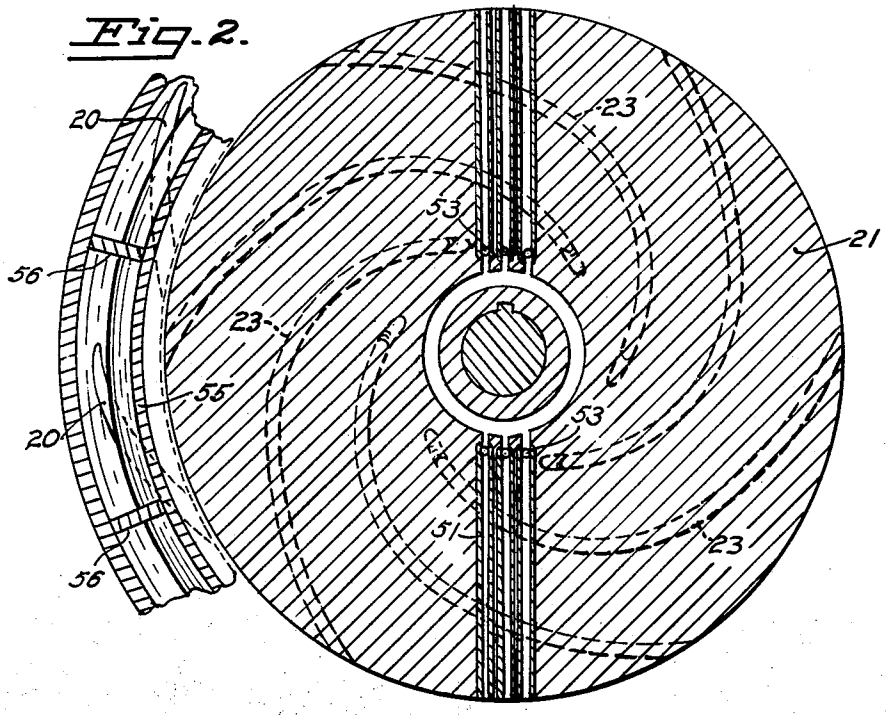
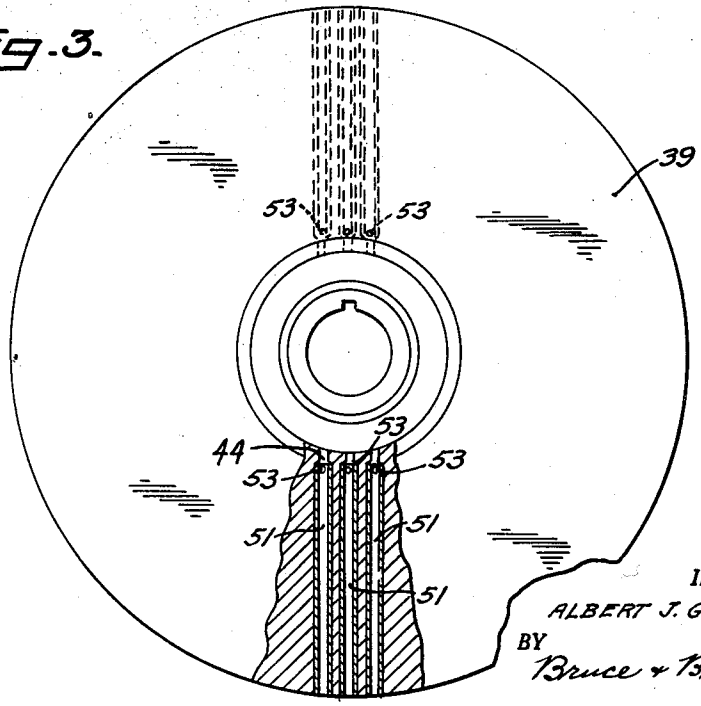


Fig. 3.



INVENTOR.
ALBERT J. GRANBERG
BY
Bruce & Brosler
HIS ATTORNEYS

United States Patent Office 2,949,859 Patented Aug. 23, 1960

2,949,859

SELF-PRIMING CENTRIFUGAL PUMP ASSEMBLY

Albert J. Granberg, 6001 Rockwell St., Oakland, Calif.

Filed Feb. 3, 1955, Ser. No. 485,863

5 Claims. (Cl. 103—113)

It is a well known characteristic of centrifugal pumps that the presence of substantial amounts of air or gas with the liquid being pumped, can result in the collection of air bubbles along the surfaces of the impeller components, particularly in the entrance or eye thereof, ultimately to cause the pump to become air bound and cease to function in the pumping of liquid while under such condition.

Among the objects of the present invention are,

(1) To provide a novel and improved centrifugal pump assembly;

(2) To provide a novel and improved centrifugal pump assembly of the self-priming type;

(3) To provide a novel and improved centrifugal pump assembly of the self-priming type capable of functioning in a variety of positions;

(4) To provide a novel and improved centrifugal pump assembly which is incapable of becoming air bound;

(5) To provide a novel and improved pump assembly of the impeller type, which is capable of functioning in a variety of positions and without becoming air bound; and

(6) To provide a novel and improved centrifugal pump assembly having shaft bearings protected against flooding from liquid leaking by the pump shaft seals.

Additional objects of my invention will be brought out in the following description of a preferred embodiment of the same, taken in conjunction with the accompanying drawings, wherein,

Figure 1 is a longitudinal view, in section, through a pump assembly of the present invention;

Figure 2 is a view of an impeller assembly of the present invention and associated structure, as viewed in the planes 2—2 of Figure 1; and

Figure 3 is a plan view, partly in section, of such impeller assembly as viewed top side.

Referring to the drawings for details of my invention in its preferred form, the pump assembly illustrated, involves a pump casing 1 including an outer wall 3 having an input opening 5 adjacent one end for effecting a connection to said casing from the suction line of a pump system, and a pair of selective discharge openings 7 and 9 adjacent the other end.

Axially of the casing is a tubular wall 11 connected at one end by an end wall 13 with the outer wall to close that end of the casing, and terminating interiorly of the casing, in a floor 15 forming one side of an impeller housing. Completing the impeller housing is an opposing side 17 having an entrance 19 in communication with the input opening 5 of the casing, and a plurality of diffustion vanes 20 within the outer periphery or collecting wing of the housing.

Within the impeller housing is an impeller disc having on one side thereof a main impeller 21 of conventional design in the provision of volutes 23 which define flow passages through the impeller, within which the pressure against the liquid is increased as it flows from the entrance or eye 19 of the impeller to the discharge periphery 25 thereof. From the periphery, the liquid under the higher pressure, will be directed toward the selected discharge opening of the casing.

This main impeller is mounted for rotation within the impeller housing, by affixing it to the end of a pump shaft 27 carried in spaced bearings 29, 31 of the ball bearing type, which are mounted on the inner side of the tubular wall 11.

To render the pump assembly as thus far described, self-priming in its vertical position, a coupling connection 33 affixed to the input side of the casing, defines a flow passage to the input opening 5 and at the same time covers the discharge opening 7 in the casing, leaving that opening 9 on the opposite side of the casing, available for the discharge from the pump. A coupling flange 35 affixed to the casing at discharge opening permits of the coupling to the pump of any discharge line.

With the input passage provided by the coupling connection, rising to an elevation above the impeller housing of the pump, it will be apparent, upon cessation of operation of such pump, a supply of liquid will remain within the pump casing sufficien to maintain the impeller submerged and therefor primed at all times.

When the pump assembly is to be utilized in a horizontal position, the input coupling connection may be removed, thus leaving the input opening 5 and discharge opening 7 on the same side of the pump, which now represents the upper side of the pump casing, available for use in the operation of the pump. Under these conditions, the discharge opening 9 appearing at the bottom of the pump, in its horizontal position, may be blocked off by a suitable plate, which may at the same time function as a supporting base for the pump.

When in such horizontal position, it will also be apparent that the casing will remain substantially full of liquid upon cessation of operation of the pump, thus to maintain the impeller completely submerged at all times.

To render the present pump free of the drawback of becoming air bound in the presence of substantial quantities of air or other gases in the liquid being pumped, I provide means in the form of an air release impeller 39, on the other side of the impeller disc designed to function in conjunction with the main impeller, for removing such air or gas as it accumulates in the entrance or eye of the main impeller, thus to maintain the same substantially free of accumulation of such air or gas, whereby the main impeller may continue to pump liquid.

This air release impeller is fed from the interior of the pump casing through a passage 41 in the tubular wall 11 at a point sufficiently below the proximate shaft bearing 29, as to provide room for a mechanical seal 43 as a protection for such bearing. This passage connects to the air release impeller through a plurality of restricted openings each constituting a venturi. Such venturi is designated by the reference numeral 44. Each venturi 44 is formed in the usual manner by a restriction between enlarged portions of the passage. This construction defines a converging and diverging passage section which may include, at the ends of the restriction, wall portions at right angles to the axis of the restriction as well as wall portions that extend at an acute angle and form tapering passage sections.

However, as a precautionary measure in the event such mechanical seal should fail, the space or chamber 45 intervening between the mechanical seal and the proximate bearing, is exposed exteriorly of the pump casing, by a passage 47 provided in a radial wall 49 connecting the tubular wall to the outer wall of the casing. It will be apparent from this arrangement that regardless from which position the pump is functioning, whether vertical or horizontal, any liquid leaking past the mechanical seal, will drain out of the pump casing before it reaches the proximate bearing.

The air release impeller is one capable of developing a higher pressure than that developed by the main impeller. This may be accomplished in a variety of ways,

as by making this impeller of greater diameter than the main impeller, or by designing the volutes or their equivalent to approach a radial direction. In the preferred form, the air release impeller is formed with straight substantially radial slots or passages 51, and these are preferably arranged in groups of the order of three or so at locations which may be 180 degrees apart or at some other arbitrary locations.

Each such passage at its inner end, is placed in communication with the eye of the main impeller by a communicating passage 53, where air bubbles are most apt to collect and cause cessation of operation. In the preferred embodiment of the invention, the air release impeller and main impeller are formed as a unit, or in other words, one integral with the other.

The communicating passages 53 coupling the inner ends of the air release impeller passages with the entrance or eye of the main impeller, and under the action of the liquid flowing through the air release impeller at the venturi discharge, air accumulating in the entrance or eye of the main impeller will be drawn through the communicating passages into the air release impeller. Under the higher pressures developed by the air release impeller, the air will be driven through the wall of liquid surrounding the main impeller, since the back pressure imposed by such wall will be less than that developed by the air release impeller.

To assure an adequate supply of liquid to the air release impeller, means is provided for separating from the main flow through the pump, a portion of such liquid and substantially immobilizing it within the pump casing. This is accomplished by the provision of a circular wall 55 rising from the periphery of the impeller housing.

This wall functions, both in the vertical and horizontal position of the pump assembly, to isolate a portion of the liquid discharge from the main impeller, for it will be apparent that the main impeller discharges at essentially all points about its periphery, which means that there will be a flow of liquid at substantially all points about the wall 55 regardless from which position the pump may be functioning.

It is quite desirable that that portion of the liquid which is supplied to the air release impeller for priming purposes, be essentially free of air or other gas. The substantial immobilization of liquid behind the wall 55 is a step in the realization of this.

A very important factor, however, in the removal of air or gas from the liquid, is attributed to the provision of a plurality of walls 56 extending between the circular wall 55 and the outer wall 3, to define longitudinal passages which receive the liquid from the diffusion vanes 20 and change its direction, so as to cause it to flow longitudinally of the pump casing along the outer wall thereof. The liquid is thus made to traverse a longer path before any of it becomes isolated within the region defined by the circular wall 55.

Where the motor driving the pump is of proper speed, a direct connection to the pump shaft may be used, otherwise speed compensation must be provided in the form of a step-up gear train or drive where the speed of the driving motor is of a value lower than required.

In the specific embodiment of the invention illustrated, I have depicted a step-up gear train 57 connected to the pump shaft, for enabling the pump to be driven from a driving motor of lower speed value, such an arrangement being quite essential where the pump is to be employed in pumping oil or gasoline from a tank truck, in which case, the pump would operate from the drive shaft of the truck.

From the foregoing description of my invention in its preferred form, it will be apparent that the same is susceptible to various alterations and modifications without departing from the underlying principles involved, and I accordingly do not desire to be limited in my protection to the details of the preferred embodiment illustrated and described except as may be necessitated by the appended claims.

I claim:

1. A centrifugal pump comprising: a casing having an inlet and a discharge outlet; wall means within said casing forming an impeller housing having a central entrance eye on each side and a peripheral collecting ring in direct communication with said outlet, one of said eyes being in direct communication with said inlet, said wall means together with said casing forming a centrally-arranged liquid-collecting chamber in direct communication with said ring and the other of said eyes for separating and substantially immobilizing within said casing a portion of the liquid flowing to said outlet from said ring; impeller disc means rotatably mounted in said housing; means on one side of said disc means forming main impeller passages communicating at their inner ends directly with said one eye and for discharging to said ring; means on the other side of said disc means forming air-release impeller passages of greater pressure rating than said main impeller passages, communicating at their inner ends with said other eye and for discharging to said ring, each of said air-release impeller passages having at its inner end an outwardly converging and diverging section defining a venturi; and passageways through said disc means providing communication between said one eye and each of said air-release passages immediately outwardly of the venturi therein, whereby pressurized liquid from said chamber flows through the venturis, entrains fluid from said passageways through said disc means, and discharges the entrained fluid through said air-release impeller passages.

2. The structure defined in claim 1, in which the main impeller passages are volute and the air-release impeller passages are generally radial.

3. The structure defined in claim 1, in which the casing is generally cylindrical and concentric with the disc means, and the wall means includes a generally circular portion extending in spaced, generally concentric relation with said casing from that side of the housing having the other eye, the end of said circular wall portion being spaced from the corresponding end of said casing, the annular space between said portion and said casing forming a portion of the ring, and the space within said portion forming the chamber.

4. A centrifugal pump impeller comprising: rotatable impeller disc means; means on one side of said disc means forming main impeller passages; means on the other side of said disc means forming air-release impeller passages of greater pressure rating than said main impeller passages, each of said air-release impeller passages having at its inner end an outwardly converging and diverging section defining a venturi; and passageways through said disc means providing communication between the inner ends of said main impeller passages and each of said air-release impeller passages immediately outwardly of the venturi therein.

5. The structure defined in claim 4, in which the main impeller passages are volute, and the air-release impeller passages are generally radial.

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