May 18, 1943 L. B. HARRINGTON 2,319,230

CENTRIFUGAL PUMP

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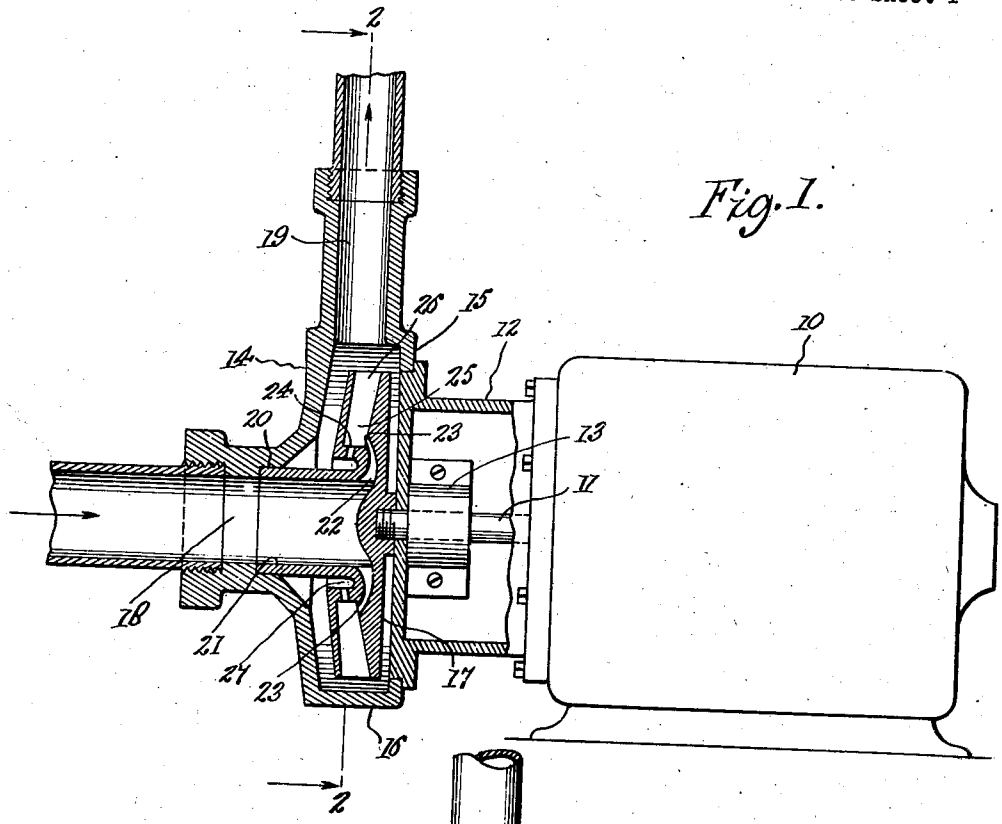


Fig. 1.

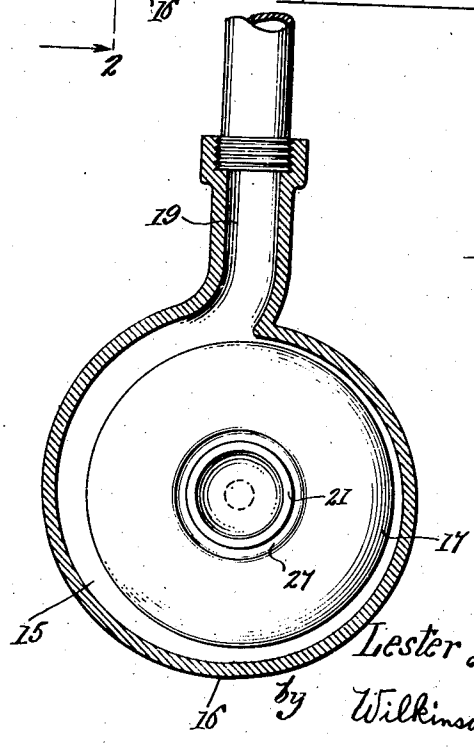


Fig. 2.

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Fig. 3.

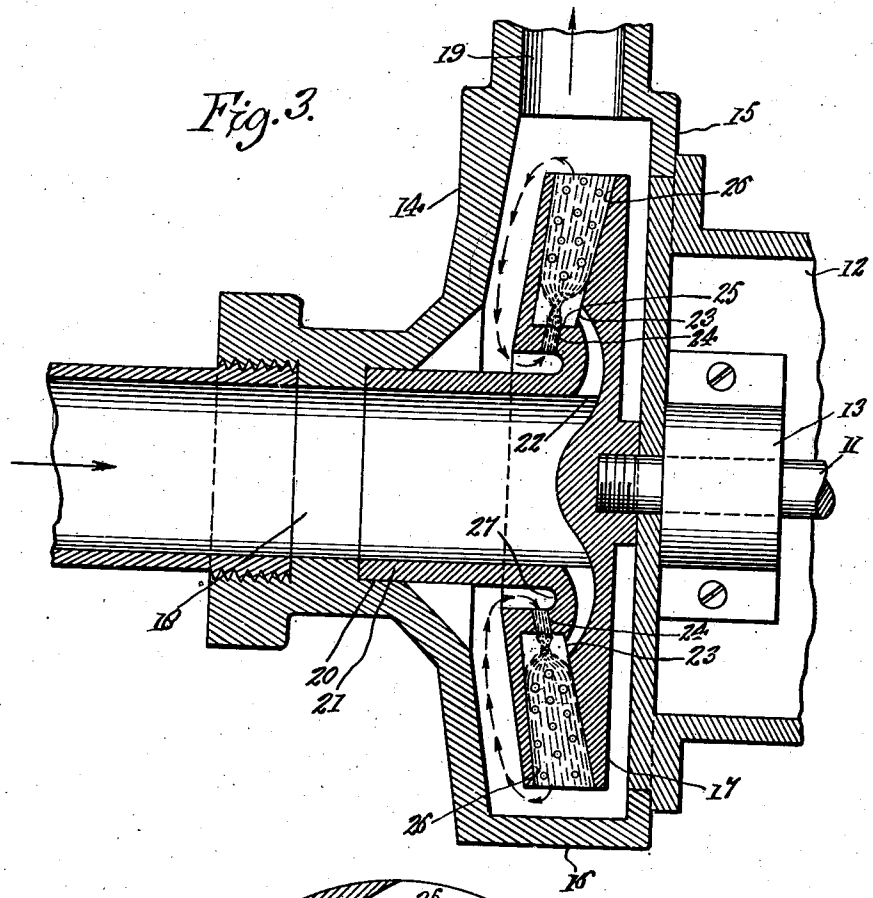
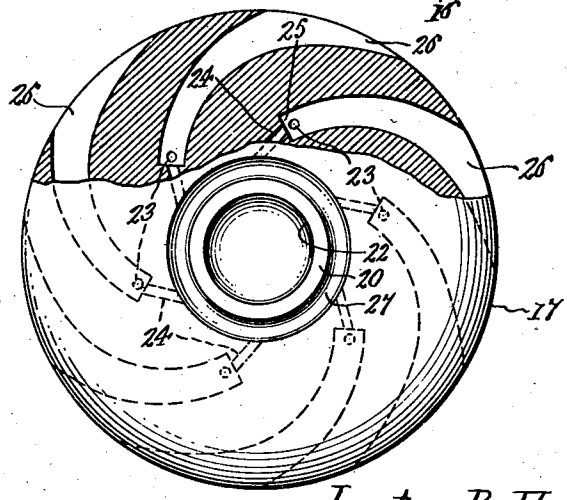


Fig. 4.



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UNITED STATES PATENT OFFICE

2,319,230

CENTRIFUGAL PUMP

Lester B. Harrington, Salem, Oreg., assignor of forty per cent to Reynolds Allen, Salem, and fifteen per cent to Clay A. Racely, Portland, Oreg.

Application August 25, 1941, Serial No. 408,258

6 Claims. (Cl. 103—262)

The present invention relates to improvements in centrifugal pumps, and has for an object to provide an improved pump of this class suitable for use as a water pump, or for pumping chemicals or generally as a liquid supply pump.

The present application is a continuation in part of my prior co-pending application Serial No. 334,433, filed May 10, 1940.

Another object of the invention is to adapt the type of vacuum pump disclosed in my prior co-pending application aforesaid for use as a water pump in which certain difficulties are encountered in introducing water at the inlet side of the pump, inasmuch as the pump shaft was utilized in the prior construction, the passages being necessarily small for water so that an object of the present invention is to redesign the pump construction with the water intake at the so-called "bottom" of the pump, namely at the side of the pump opposite the motor or impeller shaft.

A further object of the present invention flows directly from the objects stated in the immediately preceding paragraph in that the "bottom" intake is unimpeded and uninterrupted from any shaft structure and is thus of larger cross-sectional area accommodating the water in greater volume, contributing to the capacity of the pump.

A still further difficulty encountered with a pump such as that disclosed in my prior co-pending application aforesaid when put to water pumping uses is the matter of lubrication, inasmuch as water is a poor lubricant, it is an object of the invention to maintain the pump and motor shaft of as small a diameter as possible, which also contributes to the graphite seal at this side of the pump and prevents scoring of the bearing and other disadvantages which would be encountered if the shaft and its bearing were of a large diameter necessitated by the water intake at the shaft side of the pump; these difficulties being eliminated by the water intake at the "bottom" of the pump namely at the side opposite the shaft.

A still further object of the invention is to provide a centrifugal pump in which the propelling liquid circulates substantially radially through the rotary impeller passages in an annular chamber outside, and preferably concentric with the eye or central enlarged water intake of the pump to form a compact and efficient structure and one that will produce a high degree of vacuum.

With the foregoing and other objects in view, the invention will be more fully described hereinafter, and will be more particularly pointed out in the claims appended hereto.

In the drawings, wherein like symbols refer to like or corresponding parts throughout the several views,

Figure 1 is a side elevational view, with parts broken away and parts shown in section, of an improved centrifugal pump constructed in accordance with the present invention.

Figure 2 is a vertical section taken on the line 2—2 in Figure 1.

Figure 3 is an enlarged vertical section through the pump casing and rotor illustrating the method of liquid operation, and

Figure 4 is a top plan view, with parts broken away, of the rotor.

Referring more particularly to the drawings, 10 designates an electric or other motor suitable for driving the pump through the armature shaft 11 which may also be the impeller shaft of the pump.

A housing 12 may be used to connect the casing of the pump to the housing of the motor 10, although the pump may be supported in relation to the motor by any other suitable means. At 13 is shown the packing gland or shaft seal which may contain graphite or other mechanical means for preventing the escape of the water at the motor side of the pump. In this instance this packing gland 13 and the seal may be of normal size and diameter in comparison to a standard size diameter of shaft 11; whereas these parts would have to be greatly magnified in diameter, with consequent greater frictional losses, were the water intake to be provided at this side of the pump inasmuch as the intake passage is of necessity very large in cross-section in dealing with water.

The pump casing is generally formed of side walls 14 and 15, and an end wall 16 which is of volute form and extends concentrically with the rotary impeller or rotor 17. The rotor or impeller 17 is connected to be driven by the shaft 11 which projects through the end wall 15. The intake of the pump is represented at 18 and is of enlarged cross-section suitable for the intake of a water pump to accommodate the water in sufficient volume. The intake 18 is connected to any suitable source of water or liquid supply.

The outlet of the pump is shown at 19 and it comes off the casing at the largest radius of the volute end wall 16.

In the intake 18 is a bearing 20 for the hollow neck 21 which is a part of the impeller, rotates therewith and forms a continuation of the intake of the pump. This hollow neck 21 communicates interiorly with a hollow annular chamber 22 at substantially the center of the impeller body. Leading from this chamber 22 are the inlet ports 23. Such inlet ports may be provided in any suitable number in accordance with the number of the pump passages in the impeller. Six such passages are shown in connection with the embodiment of the invention illustrated but any number of such passages might be used.

Each passage is formed of three components,

namely a central orifice 24, an abruptly enlarged chamber 25 and a long distal portion 26. The inner end of the orifice 24 is spaced away from the outer part of the neck 21 and communicates with an annular internal space 27. This internal space 27 extends out radially in all directions between the pump wall 14 and the adjacent side of the impeller which is spaced from said pump wall 14. The space 27 opens at its outer circumferential portion directly into the volute chamber defined within the end wall 16, such opening being in a plane beside the plane of the impeller disc 17. In other words the circumferential mouth of the annular space 27 opens into the casing alongside the discharge mouths of the impeller passages.

In operation the motor 10 through shaft 11 drives impeller 17 at a suitable speed, for instance, 3600 R. P. M. The rotary motion of the pump sets up centrifugal action which moves liquid through the impeller passages. The propelling liquid moves in a closed cycle through the impeller passages, being recirculated from the outer part of the pump casing when discharged from the impeller back through the internal space 27 to the inner ends of orifices 24.

The propelling liquid entering an orifice 24 is moved outwardly therein. The orifice will be so restricted as to cross-sectional area as to form a vena contracta in the liquid. This vena contracta will be projected outwardly beyond the outer end of the orifice 24 and into the chamber 25. The vena contracta thus forms a low pressure annular space within the chamber 25 at a point where the inlet port 23 communicates with the chamber 25. Thus the vena contracta will act to draw in water, gasoline or other liquid through the intake 18, hollow neck 21, central chamber 22, port 23 and into the space within the chamber surrounding the vena contracta. The intake liquid will thus be entrained with the propelling liquid moving outwardly in the impeller passage.

The liquid, both propelling and entrained, which meets in the vena contracta is moved out in the pump passage. Due to the enlarged diameter of the chamber 25 and distal end 26, the velocity of the liquid at the vena contracta is converted to pressure and the liquid expands outwardly against the wall of the distal portion 26 in all directions at right angles to the axis of the passage, or in other words radially of the passage. Such action creates a large volume of liquid in the distal portion 24 which seals such distal portion and prevents atmospheric or other higher pressure from moving backwardly through the distal portion 26 into the chamber 25 which constitutes the low pressure area. Consequently this low pressure area is sealed by the body of liquid in distal portion 26 from breaking the high degree of vacuum formed about the vena contracta.

Moreover this great body of liquid moving out the distal portion 26 under the influence of centrifugal force is accelerated. This acceleration will be felt in the low pressure space of chamber 25 about the vena contracta. In other words the pumped liquid will communicate directly and immediately with the low pressure space about the vena contracta without going directly through the liquid forming the vena contracta. Therefore the pulling effect produced in the distal portion 26 will contribute greatly to the production of low pressure and will act in addition to the suction created by the vena contracta.

The pulling effect in the distal portion 26 will thus act to pull the liquid, both propelling and intake, through the impeller passages from a point downstream of the vena contracta. Thus I am enabled to dispense with the use of pressure or head at the inner ends of the passages which would tend to push the liquid through such passages.

The orifice 24 will be of such length and cross-section comparatively to the cross-section of the distal portion 26 to feed sufficient liquid through the vena contracta to form a sealing volume of liquid in the distal portion 26 which will move outwardly with a suction action.

The propelling liquid in the pump is caused at the center to acquire a high velocity through the action of the orifice 24 in order to form a vena contracta. Thereupon by reason of the enlarged diameter of the chamber 25 and distal portion 26 the liquid is allowed to lose its velocity in favor of pressure which will have a sealing effect. After the liquid is discharged from the distal portions 26 of the passages it enters the casing which is of volute form toward the outlet 19, thus having a further tendency to convert velocity of the liquid into pressure and enabling the quiet discharge of the liquid from the pump casing.

The distal portion 26 is of the major length of the axis of the passage to emphasize the pulling effect of the liquid therein.

It will be appreciated that the intake 18 and its neck 21 may be constructed of large diameter without any modifications of the shaft 11 or its sealing member 13 and moreover the internal bores of such parts may be unimpeded and uninterrupted, thereby allowing a great capacity flow of intake water or other liquid to the pump. Due to the construction where the annular internal space 27 is at one side of the hollow neck 21 and the intake 18 at the other side, no particular packing will be needed at the bearing 20 because the pressure of the recirculated liquid in the annular internal space 27 will offset any pressure of the water or other liquid entering through the inlet 18.

The discharge of liquid at the periphery of the rotary impeller alongside space 27 makes for an easy cycling of the propelling liquid back through the space 27. At the central portion of this internal space 27 there will be low pressure due to the movement of the liquid centrifugally outward in the impeller. The reduction of velocity attributable to the volute casing enables this discharged liquid to more easily come under the influence of this low pressure and be drawn back into the central part of the annular internal space 27 to again feed the orifices 26.

It will also be appreciated that lubricant problems are not increased by a pump of this character but that the lubrication of the comparatively small diameter shaft 11 may be taken care of by a standard sealing member 13; this all being secured by the intake 18 being located at the opposite side of the pump.

It is obvious that various changes and modifications may be made in the details of construction and design of the above specifically described embodiment of this invention without departing from the spirit thereof, such changes and modifications being restricted only by the scope of the following claims:

What is claimed is:

1. In a centrifugal pump, an impeller having passages therein of generally radial disposition but curved at their outer ends to radii of the

impeller, said passages composed of inner orifices having restricted cross-sectional area, abruptly enlarged chambers outwardly of said orifices and distal portions of the passages outwardly of said chambers to the periphery of the impeller, said impeller having fluid inlet ports to said enlarged chambers, a hollow neck communicating internally with said inlet ports and extending off one side of said impeller and forming a journal therefor, a casing for the impeller having a liquid intake at one side in communication with the internal space of said hollow neck, a bearing in said casing for said hollow neck, said hollow neck spaced from the inner ends of said passages, said impeller being of a width substantially less than the width of the casing to provide an internal space within the casing beside said impeller communicating both with the inner and outer open ends of said passages, means for driving said impeller, said casing having a volute outer wall, and an outlet for the casing at substantially the largest radius of said volute outer wall.

2. In a centrifugal pump, an impeller having a passage therein constructed and arranged for producing a vena contracta with the inner and outer ends of the passage opening at the inner and outer edges of the impeller, a hollow neck on the impeller spaced from the inner end of the passage and communicating interiorly with the vena contracta, a pump casing having side and end walls with the end wall extending in a substantially volute curve concentrically outward of the impeller and having an outlet at its widest portion, a liquid intake through one side wall to the internal space of the hollow neck, said casing having a recirculating space beside the impeller communicating with both the inner and outer ends of said passage.

3. In a centrifugal pump, a pump casing having an intake at one side and a peripheral discharge, an impeller mounted to rotate in said casing, drive means for the impeller connected through the side of the casing opposite said intake, said impeller having a passage therethrough comprising orifices for forming a vena contracta at the inner portion of the passage, an abruptly-enlarged chamber surrounding said vena contracta, and a long distal portion leading from the chamber to the rim of the impeller, a fluid inlet communicating with the intake and with said enlarged chamber, said casing having an internal space beside the impeller provided with a portion lying radially within said orifices, through which space the propelling liquid may be recirculated from the discharge of the distal portions to said vena contracta, a hollow neck extending from the impeller oppositely from the drive shaft having a bearing in the casing at the intake side thereof, said neck lying within the portion of said space which lies inwardly of said vena contracta.

4. In a pump of the character described, a pump casing having spaced side walls and a peripheral end wall connecting said side walls, one of said side walls having a narrow-diameter opening, a drive shaft projecting through said opening into the interior of the pump casing, an impeller having a closed side wall with a bearing to receive said drive shaft, the other side wall of said casing having a large diameter fluid inlet opening at its central portion and a bearing in said inlet opening, a large diameter hollow neck projecting from the other side of said impeller and journaled in said bearing in position to receive fluid centrally through said intake, said neck forming an internal chamber substantially concentrically of said impeller, said impeller having a passage substantially concentric with said chamber and composed of an orifice at the inner portion of the passage, an abruptly enlarged chamber outwardly of the orifice and a distal portion extending from the enlarged chamber to the periphery of the impeller and being of progressively enlarging diameter outwardly, said impeller having ducts connecting the central neck chamber with the enlarged passage chamber, said impeller having an inner annular wall in which said orifice is formed, said annular wall being spaced concentrically outward of said neck to form an annular chamber within said annular wall and outwardly of said neck leaving the orifice open at its inner end to receive recycled fluid after passing through said passage.

5. In a centrifugal pump, a pump casing having spaced side walls and a peripheral wall connecting the side walls and provided with a discharge, said casing having at one side a large diameter substantially central fluid intake having a bearing therein, a large diameter hollow neck rotatably mounted in said bearing in alignment with said intake and having an internal fluid chamber therein, a drive shaft extended through the opposite side wall substantially coaxial with said neck, and an impeller supported at one side by said neck and at the other side by said drive shaft, the internal chamber in said neck extending concentrically into said impeller, said impeller having ducts radiating out from said neck chamber, said impeller having passages therein opening at the rim of the impeller and composed of orifices at the inner ends of the passages, distal portions of progressively increasing diameter outwardly and chambers between said orifices and distal portions which are abruptly enlarged with respect to said orifices, said ducts leading into said enlarged chambers, said impeller having an internal wall in which said orifices are made spaced from said neck and communicating at one side with the internal space within the casing alongside said impeller to receive and recycle the fluid discharged peripherally by the impeller.

6. In a centrifugal pump, a pump casing having a discharge and a large diameter fluid inlet having a bearing therein, an impeller in said casing of narrower width than the casing to provide a recycling passage for fluid in the casing at the side of said impeller, a hollow neck substantially carrying said impeller in open communication with the intake and journaled in said bearing, said impeller having an annular internal wall concentric with and outwardly spaced from the inner portion of said hollow neck and providing therewith an annular space communicating with the side space in said casing, orifices in said annular wall communicating with the annular space, abruptly enlarged chambers in said impeller communicating with and outwardly of said orifices, passages in the impeller leading outwardly from said chambers through the rim of the impeller and being of progressively increasing diameter outwardly, said impeller having ducts placing the interior space of the hollow neck in communication with said enlarged chambers.

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