

Oct. 2, 1951

L. B. GRANTHAM
CENTRIFUGAL PUMP

2,569,563

Filed June 10, 1946

2 Sheets-Sheet 1

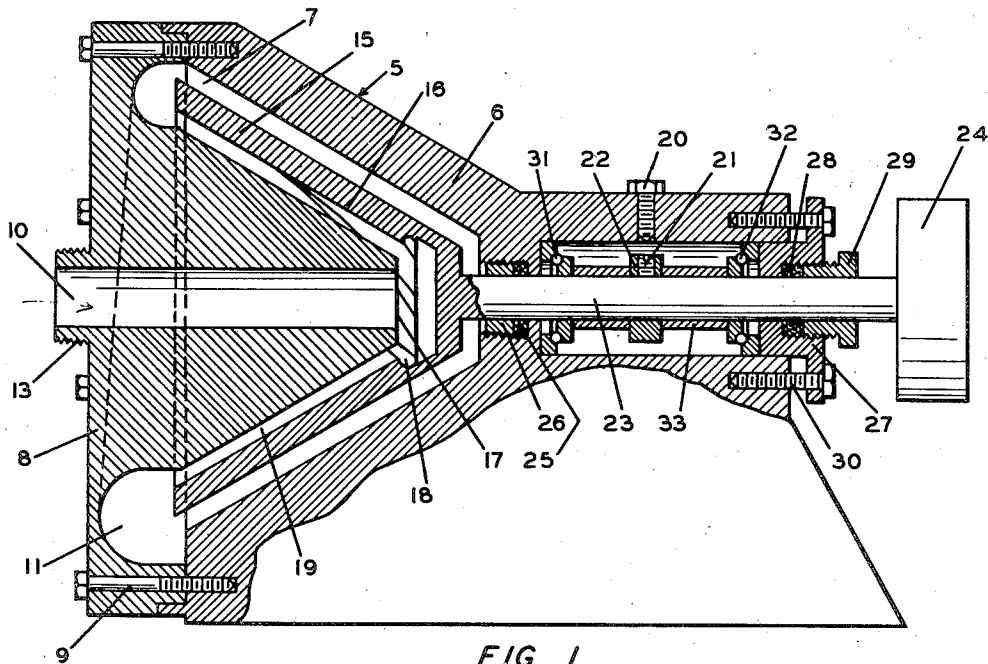


FIG. 1

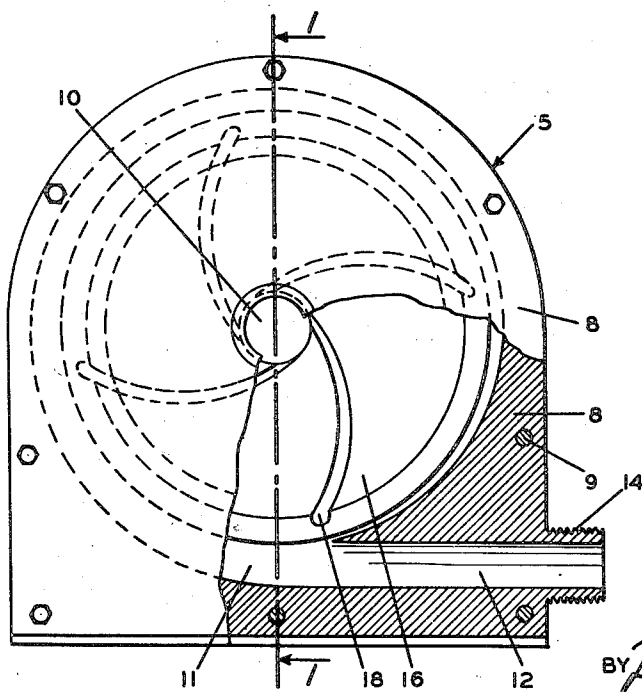


FIG. 2

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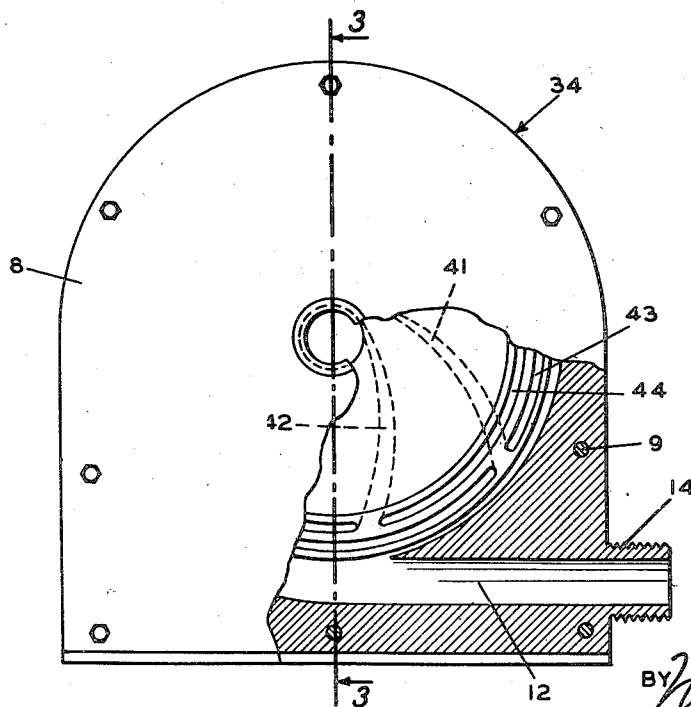
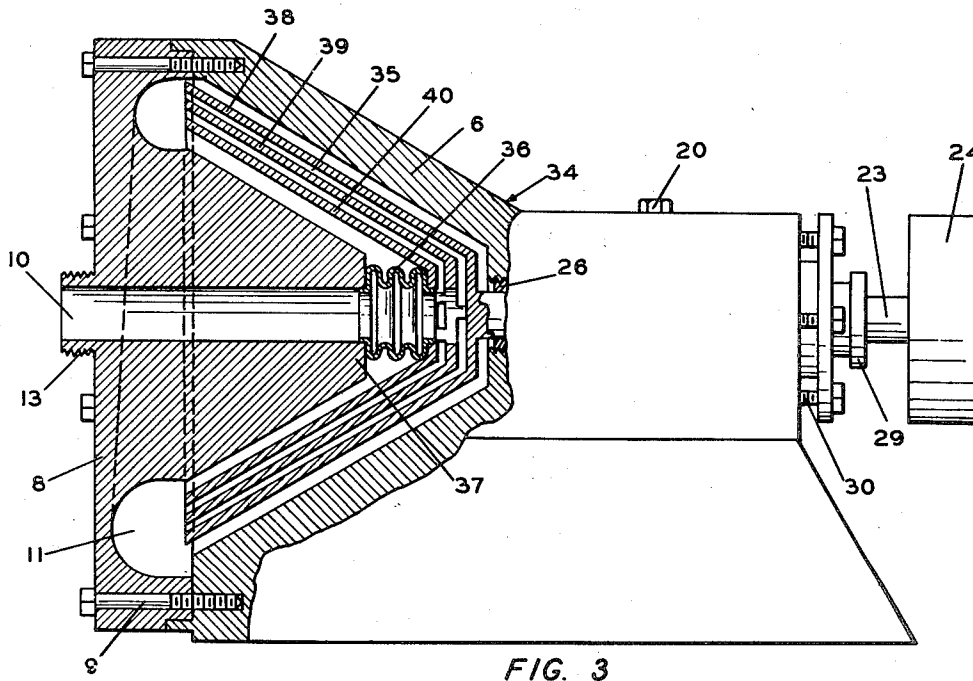
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UNITED STATES PATENT OFFICE

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CENTRIFUGAL PUMP

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of Delaware

Application June 10, 1946, Serial No. 675,609

5 Claims. (Cl. 103—88)

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This invention relates to centrifugal pumps. In one specific aspect it relates to centrifugal pumps for pumping liquids with high vapor pressure such as propane or butane. In another specific aspect it relates to a centrifugal pump having desired characteristics in which the volume of liquid pumped is variable by a manual adjustment.

Considerable difficulty has been encountered in the prior art in pumping highly volatile liquids by centrifugal pumps due to the liquid being vaporized by the reaction of the pump so that the pump becomes filled with vapor which is unpumpable. Another disadvantage of centrifugal pumps of the prior art is that the volume of liquid pumped at a given rate of rotation is not variable. Another disadvantage is caused by leakage of liquid, which has been pumped, back into the intake of the pump.

In the present invention, I have overcome the above mentioned disadvantages and have provided a centrifugal pump having numerous objects and advantages which will now be set forth.

One object of the present invention is to produce a new and useful centrifugal pump.

Another object is to provide a centrifugal pump in which the impeller clearance may be varied so that the volume of liquid pumped at a given rate of rotation may be varied at will.

Another object is to provide means to seal the impeller to the inlet passage so that the liquid pumped can not re-enter the inlet.

Another object is to provide a pump in which by reversal of flow, the pump will have little tendency to cause vaporization of the liquid in the pump.

Another object is to provide a suitable centrifugal pump having a minimum of moving parts, the parts being easily manufactured in integral or separable assemblies if desired, in which there is no metal to metal contact except in proper bearings, the pump thereby having a minimum of friction, and in which the parts are accessible, and which pump is efficient and quiet in operation in any position from horizontal to vertical.

Numerous other objects and advantages will be apparent to those skilled in the art upon reading the accompanying specification, claims and drawings.

In the drawings:

Figure 1 is an elevational view of a pump embodying the present invention with parts broken away in section along a central vertical plane to show details of construction. It will be noted that the broken away portion of Figure 1 has

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been taken along the plane indicated by the line 1—1 of Figure 2 looking in the direction indicated.

Figure 2 is an elevational view of the left side of the device shown in Figure 1 with parts broken away to show details of construction.

Figure 3 is an elevational view of a second embodiment of the present invention with parts broken away along a central vertical plane indicated by the line 3—3 in Figure 4 to show details of construction.

Figure 4 is an elevational view of the left side of Figure 3 with parts broken away to show details of construction.

In Figure 1, a centrifugal pump generally designated as 5 comprises in combination a housing 6 having a chamber 7. Chamber 7 for purpose of easy assembly is provided with a cover plate 8 which in assembled relation may be regarded as a portion of housing 6. Cover 8 may be secured by any suitable means such as bolts 9 to housing 6.

Cover 8 is shown containing an inlet conduit 10 for liquid to be pumped (not shown) the inlet conduit leading to a central portion of chamber 7. Cover 8 also contains a volute liquid collection chamber 11 which is a portion of chamber 7 and an outlet conduit 12 is provided in cover 8 for discharge of liquid from the pump. Obviously conduits 10 and 12 may be provided with any suitable connection means such as screw threads 13 and 14 respectively for connection to suitable intake and discharge lines leading from pump 5 to other apparatus.

Rotatably mounted in chamber 7 is a frusto-conical impeller 15 having a conical liquid engaging surface 16 disposed around the end 17 of inlet conduit 10.

Surface 16 may engage the liquid coming out of end 17 by means of surface friction, but in most instances I prefer to cut, or form grooves 18 in surface 16. While radial or other shaped grooves may be employed, I prefer spiral grooves of substantially the shape shown in the drawings because they provide more uniform pressure against the liquid at all points.

Between conduit 10 and surface 16 is a lumen or pumping space 19 and between the limits of adjustment shown in Figure 1, the width of space 19 has a definite effect on the volume of liquid pumped at a given speed of revolution. By removing plug 20 and loosening set screw 21 in collar 22, the width of space 19 may be varied by moving shaft 23 and drive pulley 24 axially of the shaft. When the adjusted position is

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reached set screw 21 is retightened and plug 20 replaced.

In order to prevent leakage, I may provide customary and suitable packing 25 secured by gland 26. If it is desired to insert lubricant through plug 20 a lubricant sealing gland 27 may be provided with packing 28 and follower 29 screw threaded to gland 27 and the gland may be secured to housing 6 by suitable means such as bolts 30.

Shaft 23 may be supported by suitable anti-friction bearings such as ball thrust bearings 31 and 32 consisting of the usual balls and races and the bearings may be spaced by such means as sleeves 33. By proper adjustment of bolts 30 the entire bearing assembly may be held in proper relationship.

Obviously a motor or other prime mover and suitable drive means is provided to drive element 24. While 24 is shown as a belt pulley obviously it could be a gear or other known drive means or the motor could be mounted in place of 24 to drive the pump directly. Obviously impeller 15 may be integral with or separable with shaft 23 and similar changes in details of construction may be made without departing from the present invention.

In Figure 3 a pump generally designated as 34 is provided having the same housing 6, cover 8 and other details of construction as indicated by the use of similar reference numerals in Figures 1 and 3. However, the impeller 35 is considerably different than impeller 15 of Figure 1 and a flexible Sylphon bellows sealing means 36 has been provided between impeller 35 and the end portion 37 of the inlet conduit 10.

Impeller 35 as shown in Figures 3 and 4 comprises a plurality of concentric cones 38, 39 and 40 which are spaced apart by spiral ribs 41 and 42 to provide lumens or passages 43 and 44 for imparting pumping force to the liquid.

While ribs 41 and 42 might be made radial or some other shape than shown it is preferred to have the ribs substantially of the shape shown in Figure 4 in order to equalize the pressure at all points.

While a specific bellows type seal has been indicated at 36 for illustrative purposes it should be understood that any usual type bellows seal may be employed at this point. A similar bellows type seal may be substituted for stuffing box 25 and gland 26 if desired.

While the shape of cone in Figures 1 and 3 may vary considerably as to diameter and angle of the cone, it is preferred to have the proportions substantially as shown in order to obtain the maximum efficiency and utility. While this pump is especially adapted to pump high vapor pressure liquids such as propane or butane numerous other liquids may obviously be pumped with considerable advantage including liquids containing a high percentage of sediment, such as gravel, and when made of suitable materials this pump may be used for pumping various chemicals and it may be employed as a combination pump separator, or for any other pumping installation for which its characteristics are suitable.

Operation

The operation of Figures 1 and 2 are as follows:

Pump 5 is connected into the desired pumping circuit by means of connectors 13 and 14 and drive means 24 rotates impeller 15. Liquid 10 entering through orifice 17 passes into space 19 and due to skin friction on 16 and/or grooves 18

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the liquid is carried out across impeller 15. Due to inertia or centrifugal forces the liquid travels through space 19 into volute 11. The pressure is increasing at all times and the liquid is discharged through outlet 12. Because of the reversal of direction from inlet 10 through space 19 and because of the steady increase of pressure caused by the rotation of impeller 15 there is no tendency to vaporize the liquid, which is of importance in pumping propane or butane.

Centrifugal pumps of the prior art have a fixed volume at a given speed of rotation. The pump shown in Figure 1, however, may be varied in volume by adjustment of impeller 15 axially of shaft 23 so that space 19 may be of any desired width (within the limits shown in Figure 1) by a simple adjustment of collar 22 and set screw 21 with a simple tool such as a screw driver through the opening closed by cover screw 20.

The operation of Figures 3 and 4 is similar to the operation of Figure 1, except that the liquid coming in passage 10 is confined by bellows 36 to pass into lumens 43 and 44. The rotation of impeller 35 carries around the liquid in lumens 43 and 44 respectively and through inertia or centrifugal force the liquid moves through lumens 43 and 44 at ever increasing pressure into volute 11 from which it passes out through passage 12.

The reversal of fluid flow from passage 10 into lumens 43 and 44 and the steady increase in pressure effectively prevents vaporization of such liquids as propane or butane which would otherwise cause vapor lock of the pump 34.

The bellows seal 36 prevents liquid from volute 11 returning inside of cone 40 to the intake 10.

While I have shown in the drawings, several particular illustrative forms of my invention, various modifications may be made in the same and in the various features of construction, without materially changing the invention therein, and formal changes may be made in the specific embodiment of the invention described without departing from the spirit or substance of the broad invention, the scope of which is commensurate with the appended claims.

Having described my invention, I claim:

1. A centrifugal pump comprising, in combination, a housing including a pair of spaced frusto-conical members defining a chamber therebetween, an inlet conduit extending axially through the inner frusto-conical member, an outlet conduit communicating with the enlarged end portion of said chamber, and an impeller of generally frusto-conical configuration in said chamber, said impeller including at least two frusto-conical shells, the inner and outer shells cooperating, respectively, with said housing to form an inner zone between the inner shell and the housing and to form an outer zone between the outer shell and the housing, means connecting said shells together to form a unitary structure, the outer end of each zone communicating with said enlarged end portion, means for sealing the inner end of each zone, means for establishing communication between said inlet conduit and the region between said inner and outer shells, means for driving said impeller, and means for sealing said driving means.

2. A centrifugal pump comprising, in combination, a housing including a pair of spaced frusto-conical members defining a chamber therebetween, an inlet conduit extending axially through the inner frusto-conical member, an outlet conduit communicating with the enlarged end portion of said chamber, and an impeller of

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generally frusto-conical configuration in said chamber, said impeller including at least two concentric frusto-conical shells, means connecting said shells together to form a unitary structure, the inner shell defining an inner zone with said housing and having an opening at its reduced end, the outer shell defining an outer zone with said housing, the outer ends of both zones communicating with said enlarged end portion, a shaft for rotating said impeller, said shaft being fixed to said outer shell, means for sealing said shaft and said housing to close off the reduced end of said outer zone, and a tubular resilient sealing member positioned between said housing and said inner shell to close off the reduced end of said inner zone, said resilient member establishing communication between the inlet conduit and the region between said shells.

3. A pump constructed in accordance with claim 2 wherein the resilient sealing member is a bellows.

4. A centrifugal pump comprising, in combination, a housing including a pair of spaced frusto-conical members defining a chamber therebetween, an inlet conduit extending axially through the inner frusto-conical member, an outlet conduit communicating with the enlarged end portion of said chamber, and an impeller of generally frusto-conical configuration in said chamber, said impeller including inner and outer frusto-conical shells and a third frusto-conical shell positioned between said inner and outer shells, all of said shells being concentrically mounted, means connecting said shells together to form a unitary structure, means for sealing the region between said housing and the reduced end of said inner shell, means for sealing the region between said housing and the reduced end of said outer shell, means for admitting liquid from said inlet conduit to the region between said inner and outer shells, means for rotating said impeller, and means for sealing said rotating means.

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5. A centrifugal pump comprising, in combination, a housing including a pair of spaced frusto-conical members defining a chamber therebetween, an inlet conduit extending axially through the inner frusto-conical member, an outlet conduit communicating with the enlarged end portion of said chamber, and an impeller of generally frusto-conical configuration in said chamber, said impeller including an inner frusto-conical shell having an opening at the reduced end thereof, a bellows mounted between said reduced inner end and said housing to seal the region therebetween and to admit liquid through said inlet conduit to said impeller, an outer frusto-conical shell, a shaft secured to the reduced end of said outer shell, means for sealing the region between said housing and said shaft, a frusto-conical shell mounted between said inner and outer shells, and means mounting all of said shells in concentric relation and connecting said shells together so as to form a unitary impeller structure, said mounting means permitting passage of liquid from said bellows into the volume between said inner shell and said outer shell.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
100,838	Andrews	Mar. 15, 1870
718,557	Wenzel	Jan. 13, 1903
860,668	Jaeger	July 23, 1907
2,060,899	Russell	Nov. 17, 1936
2,091,492	Russell	Aug. 31, 1937

FOREIGN PATENTS

Number	Country	Date
388,267	France	Aug. 7, 1908