Nov. 6, 1934. A. HOLLANDER 1,979,621

BALANCED TURBULENCE PUMP

Filed Jan. 20, 1933

Fig. 1.

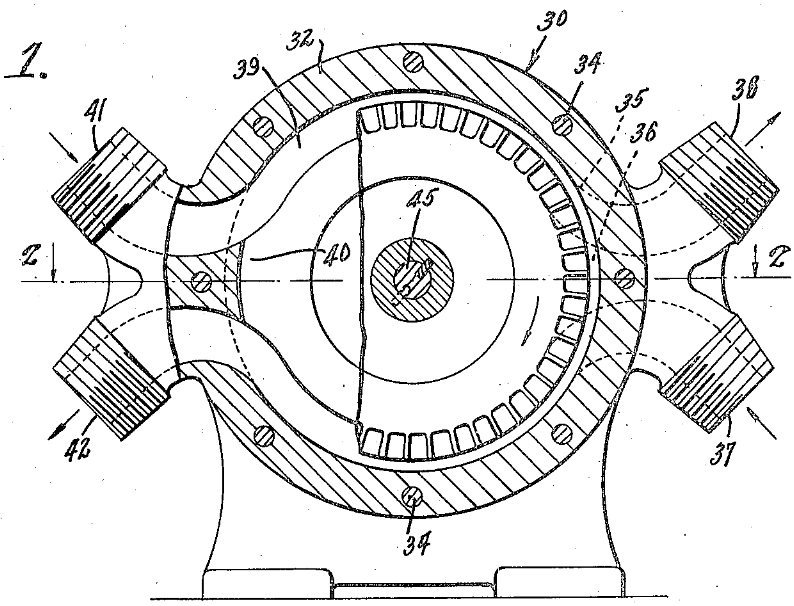


Fig. 3.

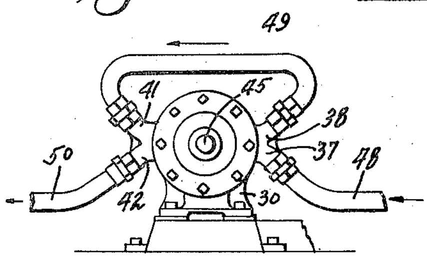
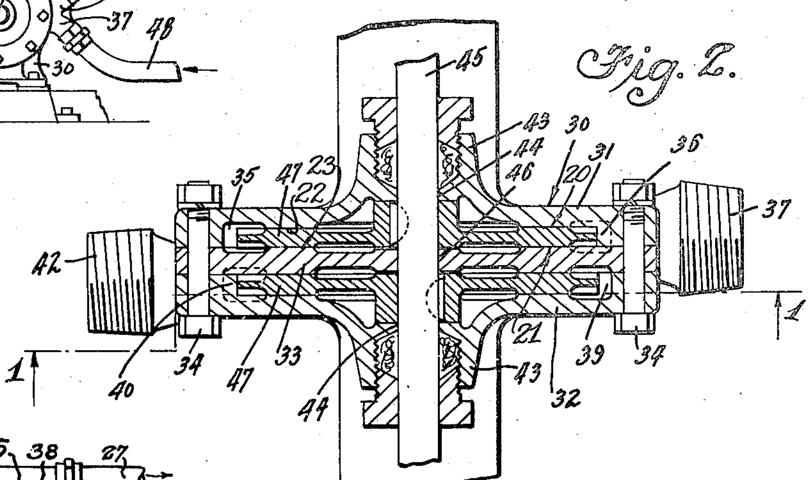


Fig. 2.



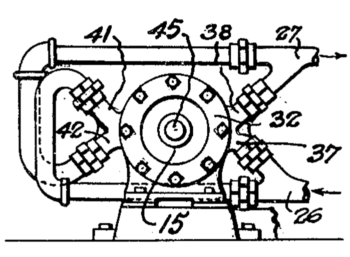


Fig. 4.

Inventor

Aladar Hollander

By Lyon & Lyon

Attorneys

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BALANCED TURBULENCE PUMP

Aladar Hollander, Berkeley, Calif.

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5 Claims. (Cl. 103—96)

This invention relates to a turbulence pump in which the unbalanced forces acting upon the impeller to set up a bending moment in the impeller shaft, are counterbalanced or neutralized.

In a turbulence pump of the type in which the outer casing is provided with a smooth fluid channel within which the blades of the impeller travel, a fluid pressure increasing in magnitude from the fluid inlet passage to the fluid discharge passage will be created, as for example, at the entrance of the fluid inlet passage into the fluid channel, the fluid pressure may be zero, while at the discharge outlet the fluid pressure may be 100 lbs. Thus the fluid pressures exert unequal forces against substantially the entire periphery of the impeller. The greatest force exerted against the impeller by the fluid pressure, is in the vicinity of the discharge passage, which force acts to displace the impeller toward the opposite or inlet side of the pump casing, as in this vicinity the fluid pressure may be considerably below zero or at best, very little above zero, and thus is powerless to counteract the far greater force acting upon the opposite side of the impeller, and therefore, the impeller is continuously displaced. The displacement of the impeller causes a relatively severe bending moment to be placed in the impeller shaft, which in turn causes undue wear in the shaft bearings, but even more serious, makes it practically impossible to maintain the stuffing boxes fluid tight. This is especially serious when the pump is to be used as a vacuum pump, as unless the stuffing boxes are maintained fluid and vapor tight, air will filter in through the stuffing boxes and cause vapor binding of the pump, and even though the pump should not lose its prime, the infiltration of air through the stuffing boxes, will materially reduce the operating efficiency thereof.

It is an object of this invention to overcome the above set forth inherent defects of a turbulence pump, by providing means for counterbalancing or neutralizing the unbalanced forces of the impeller.

A further object is to provide a balanced two-stage turbulence pump with two fluid channels, each having a single separator member formed therein, and for arranging the separator of one channel at 180° from the separator of the other channel, whereby the unbalanced forces acting against one impeller, will act to counterbalance the unbalanced forces acting against the other impeller.

A further object is to provide a balanced turbulence pump with a plurality of fluid channels, each having a single separator member formed therein, and for angularly spacing each of the separators an equal amount with relation to the other separators, and for providing appropriate duct means communicating all of the fluid channels in parallel, or for providing an appropriate duct means for serially communicating the fluid channels.

Other objects and advantages of the invention will become apparent as the nature of the same is more fully understood from the following description and accompanying drawing wherein is set forth what is now considered to be a preferred embodiment. It should be understood, however, that this particular embodiment of the invention is chosen principally for the purpose of exemplification, and that variations therefrom in details of construction or arrangement of parts may accordingly be effected and yet remain within the spirit and scope of the invention as the same is set forth in the appended claims.

In the drawing:

Figure 1 illustrates a sectional view taken substantially in the plane of line 1—1 of Fig. 2, of a two stage balanced turbulence pump and in which view a portion of the impeller has been broken away so as to more clearly show the fluid channel.

Figure 2 illustrates a sectional view taken substantially in the plane of line 2—2 of Fig. 1.

Figure 3 illustrates a side elevation of the pump together with the arrangement of the system of ducts for serially communicating the two stages.

Figure 4 illustrates a side elevation of the pump showing the arrangement of ducts or manifolds for connecting the two channels in parallel.

The fluid pressure or head generated by a turbulence pump is proportional to the length of the fluid channel, and as one of the important features of this type of pump is its ability to generate relatively high pressures, it is desirable to make the fluid channel as long as possible. The maximum length of fluid channel may be obtained by providing a single channel having a length equal to its circumference, less the length necessary for the separator, but a turbulence pump having a single fluid channel and separator is undesirable due to the unbalanced forces acting against the impeller. However, by arranging two single channel turbulence pumps so that their separators are located diametrically opposite, and their impellers mounted in relatively close relation upon a single shaft, then such a pump will be substantially balanced.

In Figures 1, 2, 3 and 4, such a double turbulence pump is illustrated and may briefly include a casing 30 formed of covers 31 and 32, and a diaphragm 33 suitably fastened together as by means of bolts 34. The cover 31 may be provided with a single fluid channel 35, a separator 36, an appropriate inlet passage 37, and an appropriate discharge passage 38, while the cover 32 may likewise be provided with a single fluid channel 39, a separator 40, an appropriate inlet passage 41, and an appropriate discharge passage 42. Each cover may be provided with a suitable stuffing box 43, and a bore 44 through which the shaft 45 may be operatively mounted. The separators 36 and 40 are provided to form an effective fluid seal with the periphery and side blades of their respective rotors and to thus partition the inlet end of the channel from the discharge end thereof. It will be understood that the separators do not form such a close fit with the rotors as to prevent the free rotation thereof but are sufficiently close to effectively seal the inlet from the discharge passages between which the separators are mounted.

The diaphragm may be provided with a bore 46 which may act as a bearing for the shaft 45, and also to prevent leakage between the two stages of the pump. In each side face of the diaphragm a portion of each fluid channel and its separator may be formed for its respective cover member.

A rotor or impeller 47 may be operatively mounted in each cover member, and each impeller may be suitably mounted upon shaft 45.

Each side face of the impeller adjacent the periphery thereof may be provided with grooves so as to form fluid impelling blades and contiguous therewith fluid sealing surfaces 20 and 21. When the impellers are mounted in the casing, the impeller fluid sealing surfaces may form close working fits with corresponding fluid sealing faces 22 and 23 formed in the casing.

Turbulence pumps have been designed with a casing arranged to provide two fluid channels of substantially half a circle each and divided by oppositely disposed separators through which the bladed periphery of a single impeller travels. However in turbulence pumps, speeds and sizes being equal, the maximum pressure which this type of pump may deliver is proportioned to the length of its fluid channel, and it follows that for pumps of equal diameter the one having two oppositely disposed fluid channels will have a maximum effective fluid head of only one-half that of a turbulence pump having a single fluid channel which extends entirely around the casing excepting for the space occupied by the separator.

As the fluid channel of each stage is substantially twice as long as in the pump above referred to considering pumps of equal diameters, the fluid pressure created in the single channel will be substantially twice as great as in the double channel pump. However, substantially only one-half as much fluid will be pumped by each stage. By providing two impellers and two separate single channels, the same volume of fluid may be delivered at twice the pressure as would be the case with the single impeller double channel pump. As single channel turbulence pumps may operate to deliver the fluid at higher pressures, it is therefore, of greater importance to provide means for balancing the impeller against the forces acting thereupon, due to the pressure differences in the fluid channel.

The turbulence pump of Figures 1 and 2 is substantially balanced, because the separators of the two single channels are diametrically opposed, whereby the unbalanced forces acting upon one impeller are balanced by the unbalanced forces acting upon the other impeller. Likewise, a three stage turbulence pump may be balanced by spacing the separators 120° apart, and a four stage turbulence pump by spacing the separators 90° apart. In other words, a multistage turbulence pump may be balanced by angularly spacing the separators at equal distances around the pump structure.

The two pumping stages of the turbulence pump illustrated in Figures 1 and 2 may be connected in parallel as by an arrangement of ducts as illustrated in Fig. 4, or may be connected in series by the arrangement of ducts as illustrated in Fig. 3.

As may be observed in Fig. 4, the two stages may be communicated in parallel as, for example, by providing an inlet manifold 26 arranged to communicate the inlet passages 37 and 41 of the respective channels with a source of fluid supply and a discharge manifold 27 arranged to communicate the two discharge passages 38 and 42 with a discharge pipe, not shown.

The system of ducts as illustrated in Fig. 3, for connecting the two pumping stages in series, may include an inlet duct 48 for communicating the inlet passage 37 with a source of fluid supply, a transfer duct 49 for communicating the discharge passage 38 of the first stage with the inlet passage 41 of the second stage, while the discharge passage 42 may communicate with the final discharge duct 50.

When the two stage turbulence pump is connected in series as in Fig. 3, it will operate to deliver substantially one-half as much fluid at twice the pressure as when the two stages are connected in parallel, by the arrangement of ducts as illustrated in Fig. 4.

Having fully disclosed the invention, it is not to be limited to the details herein set forth, but the invention is of the full scope of the appended claims.

I claim:

1. In a balanced turbulence pump, casing means having a plurality of fluid channels arranged in different planes, a single separator for each channel positioned to separate the inlet from the outlet ends of their respective channels and arranged in equally spaced angular relation, an impeller for each fluid channel arranged to form an effective fluid seal with the separator thereof, and said casing having appropriate inlet and outlet passages for each channel.

2. In a balanced two stage turbulence pump, casing means having a first and second stage fluid channel arranged in different planes, a single separator for each channel located in said casing 180 degrees apart and each of said separators arranged to partition the inlet from the outlet ends of their respective channels, an impeller for each fluid channel, fluid impelling means carried by each impeller and arranged to form with its respective separator an effective fluid seal, said casing having appropriate inlet and outlet passages for each fluid channel, and duct means for serially communicating said casing inlet and outlet passages.

3. In a balanced multistage turbulence pump, casing means having a plurality of fluid channels arranged in different planes, a single separator for each channel positioned to separate the inlet from the outlet ends of their respective channels and arranged in equally spaced angular relation, an impeller for each fluid channel and each impeller having fluid impelling means arranged to

form with its respective separator an effective fluid seal, said casing having appropriate inlet and outlet passages for each fluid channel, and duct means for serially communicating said casing inlet and outlet passages.

4. In a balanced turbulence pump, casing means having a plurality of fluid channels arranged in different planes, a single separator for each channel positioned to separate the inlet from the outlet ends of their respective channels and arranged in equally spaced angular relation, an impeller for each fluid channel and each impeller having fluid impelling blades, arranged to form with its respective separator an effective fluid seal, said casing having appropriate inlet and outlet passages for each fluid channel, an inlet duct for communicating the casing inlet passages with a source of fluid supply, and a discharge duct arranged to communicate with the casing outlet passages.

5. In a balanced turbulence pump, casing means having two side by side fluid channels, a single separator for each channel positioned to separate the inlet from the outlet ends of their respective channels, said separators being arranged in diametrically opposed relation, an impeller for each fluid channel, fluid-impelling means carried by each impeller arranged to form an effective fluid seal with its respective separator and said casing having appropriate fluid inlet and outlet passages for each fluid channel.

ALADAR HOLLANDER.