Sept. 3, 1935. S. E. SLOCUM 2,013,079

MECHANISM FOR BALANCING IMPELLERS

Filed March 16, 1933

Fig. 1

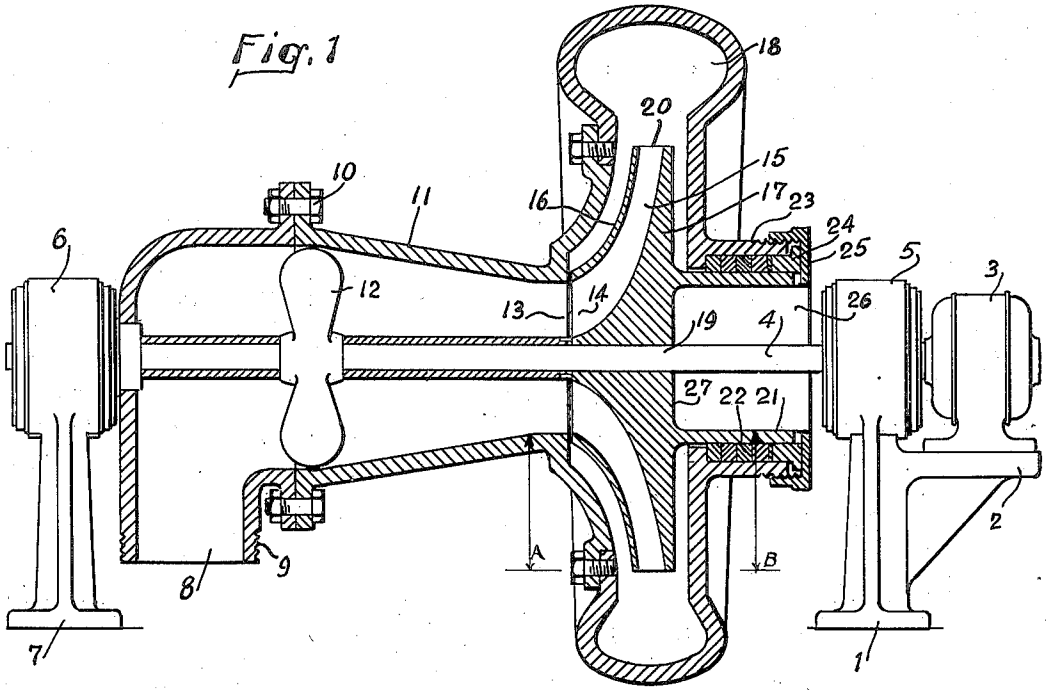
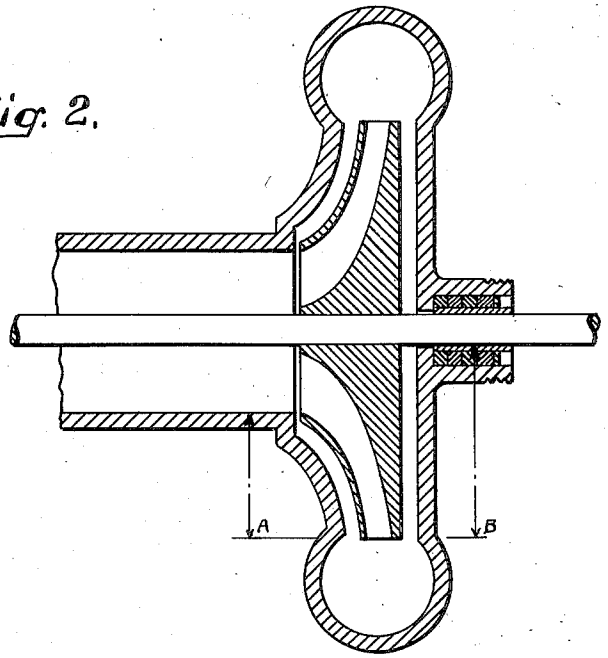


Fig. 2.



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MECHANISM FOR BALANCING IMPELLERS

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Application March 16, 1933, Serial No. 661,055

2 Claims. (Cl. 103—112)

My invention relates to hydraulic pumps.

It is my particular object to provide a means and method of securing a hydraulic balance in centrifugal pumps and of preventing the pressure set up by the action of the centrifugal pump from causing hydraulic unbalance which produces axial thrust on the impeller and shaft.

In particular it is my object to overcome this condition in a two stage or multiple stage pump.

It is a further object to secure automatic balancing without the use of balancing pistons or similar supplementary devices.

It is a further object of my invention to secure automatic balancing without the necessity of ventilating the impeller by drilling holes in the web.

It is a further object to secure a combination packing gland and impeller in a unitary assembly.

It is my object to provide a packing gland with a unitary surface exposed to the air for cooling it. I eliminate leakage joints at the back of the last impeller as in the case of a single suction, multiple stage pump where the leakage being led off is taken to the suction side.

Heretofore in the art in the construction of both single stage and multiple stage centrifugal pumps, except those having an even number of runners grouped in pairs back to back, their action has been such as to produce an unbalanced axial thrust, which is usually compensated for by some form of balancing piston or auxiliary balancing device.

This unbalance is due to the fact that in centrifugal pumps as heretofore constructed, the annular area of the impeller on the suction side, or shroud, is less than the annular area exposed to pressure on the opposite side, the difference being equal to the area of the annular inlet space called the eye of the impeller.

The unit pressure on these two opposed areas being substantially the same, the consequence is that the total thrust on the web of the impeller is greater than the total thrust on the shroud, causing an unbalanced axial thrust, tending to move the impeller shaft lengthwise in its bearings.

In well-built centrifugal pumps as heretofore constructed it has been customary to compensate the axial thrust due to such hydraulic unbalance by means of a balancing piston mounted on the pump shaft and forming a separate element. In small and inexpensive pumps where a balancing piston is not included in the construction, a partial balance is often secured by drilling one or more holes in the web of the impeller, called ventilating holes, thereby providing a vent by which the excess pressure on the web is bypassed into the suction of the impeller.

In the invention here described, hydraulic balance is secured by the simple and novel means of providing a packing gland of the same, or approximately the same, diameter as that of the eye of the impeller, thereby making the annular areas of web and shroud, subjected to pressure, of equal amount, thus eliminating the cause of hydraulic unbalance, namely unequal areas of web and shroud subjected to the same unit pressure.

Another unique and distinctive feature of the invention herein described is that in centrifugal pumps as heretofore constructed, the packing gland on high pressure side of impeller is a separate and distinct element, mounted directly on the shaft, whereas in this invention, the packing gland forms a unit with the impeller.

A practical advantage of this feature is that the gland takes the form of a cylindrical drum of larger inside diameter than the shaft diameter, thereby providing a large interior surface exposed to circulation of air for cooling the gland, which is impossible with a gland assembled solidly on the shaft.

This unbalance is accentuated in a multiple stage pump such as shown in my co-pending application Ser. No. 661,054, where I use a propeller as a primary water moving means while the centrifugal pump is used as a secondary water moving means.

Referring to the drawing, Figure 1 is a section through my improved pump showing diagrammatically the relationship of the pumps.

Figure 2 is a similar diagrammatic view showing the prior art construction, which has been found disadvantageous by reason of the hydraulic unbalance.

Referring to the drawing in detail, 1 is a standard having the bracket 2 supporting a driving motor 3 connected to a shaft 4 supported at one end by the bearing 5 and at the other end by the bearing 6 which is mounted upon a standard 7. The pump inlet is designated 8 and may be of any desired character. This inlet is formed in the inlet casing 9, bolted at 10 to a tapered converging casing acting as a propeller Venturi tube 11 at the mouth of which is located the nonhelical propeller 12 which delivers the fluid axially in a converging spiral path through the Venturi opening 13 into the eye of the impeller at 14, whence the fluid passes into the impeller of the centrifugal pump having the blades 15 be-

tween the shroud 16 and the web 17. The rotor is balanced because the pressure on the web at the back of the rotor is equal to the pressure on the shroud 16. While the whole area of the shroud, on account of its curvature, may be greater than the back area of the web, its area for effective pressure is equal to that of the web.

The fluid is discharged centrifugally into the fluid casing 18 from which it is discharged tangentially. The web 17 is provided between its center where it is mounted on the shaft 4 at 19 and its periphery at 20 with a horizontally disposed bearing collar 21 which is mounted within the packing 22 of the bearing sleeve 23 of the volute casing 18. This packing is held in position by the packing gland 24 and nut 25.

This forms a large interior ventilation space 26 around the shaft 4 and adjacent the interior portion 27 of the web 17.

In the conventional form shown in Figure 2 of the prior art, the distance B being greater than the distance A, caused an axial thrust due to the hydraulic unbalance. In my invention as shown in Figure 1, the distance A and B is the same. The distance B can be adjusted by the construction of my design in any manner so far as proportions are concerned so as to preserve this balance irrespective of the proportions of the design of the pump.

It will be understood that the use of the propeller 12 is optional and in the event it is not used or in the event the connecting casing 11 is cylindrical and has a constant diameter, the distance A at any point throughout its length will equal the distance B.

It will be appreciated that my principle of preserving hydraulic balance is applicable to varying types and designs of pumps, as well as varying sizes of pumps.

It also has the marked advantage of providing a cool, ventilated bearing, reduces the necessity for a bearing 5 in some types of pumps, or reduces the size and expensiveness of the bearing 5. It eliminates the tendency to gyratory action of the shaft with consequent wear and inefficient operation.

It will be noted that in principle I make the outer diameter of the sleeve 21 equal to the diameter of the eye of the impeller of the centrifugal pump.

My principle is also adaptable to mechanisms handling not only hot and cold fluids but also hot and cold gases. In any event the features of internal cooling of the bearing 21 plus its large size, and the cooling of the face 27 of the impeller either by air or by any other means desired makes possible a pump construction not secured in the art.

It will be understood that I desire to comprehend within my invention all the modifications necessary to adapt it to varying conditions and uses.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a centrifugal pump, a casing, a centrifugal impeller, and means for preventing unbalanced axial thrust comprising an extension on said casing including a bearing surface, said impeller having a longitudinally extending bearing sleeve in contact with said aforementioned bearing surface, the outer diameter of said bearing sleeve being substantially that of the diameter of the eye of said impeller member, said longitudinally extending sleeve on said impeller having one surface open and in direct communication with the outside air whereby said sleeve assists in the cooling of the bearing as well as serving to approximately balance the internal hydraulic thrust.

2. In combination, a casing, an impeller in said casing, said impeller having a web and a shroud, said casing having an extension forming a bearing surface, and said impeller having a longitudinally extending bearing sleeve in contact with said bearing surface, the exterior diameter of said bearing sleeve being substantially that of the eye of said impeller, said longitudinally extending sleeve having its inner surface open and in direct communication with the outside air whereby said sleeve assists in the cooling of the bearing as well as serving to approximately balance the internal hydraulic thrust of said impeller.

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