

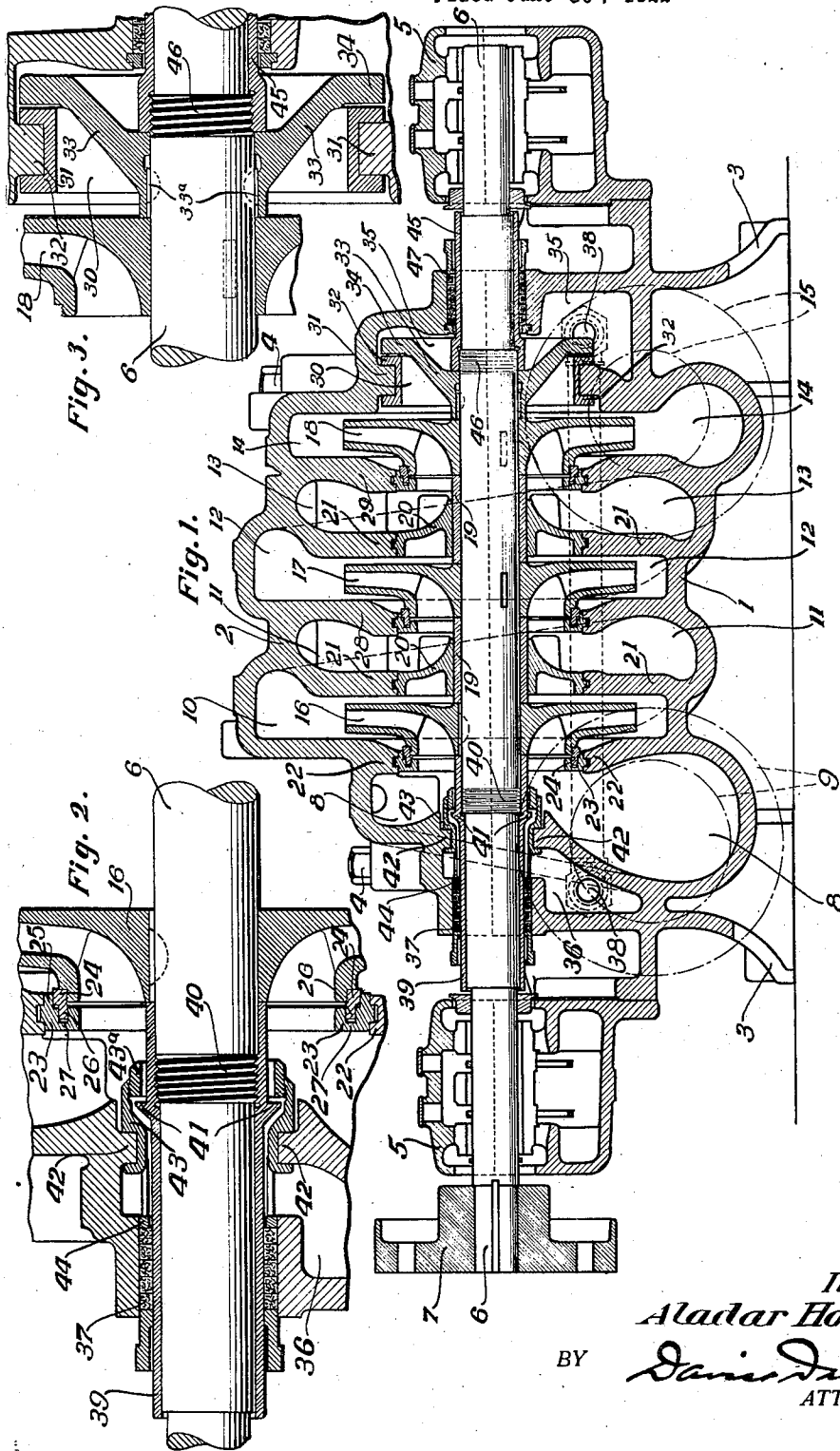
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CENTRIFUGAL PUMP

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CENTRIFUGAL PUMP.

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To all whom it may concern:

Be it known that I, ALADAR HOLLANDER, a citizen of the United States, and resident of the town of Belleville, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Centrifugal Pumps, of which the following is a specification.

The main object of the invention is to provide a simple and effective hydraulic thrust balancing mechanism adapted for use in centrifugal pumps and for other purposes wherein a packed shaft is employed.

A further object of the invention is to direct the fluid which escapes from the thrust balancing mechanism at the high-pressure side thereof back to said mechanism at the low-pressure side thereof and to utilize this leakage fluid for sealing one or both ends of the mechanism.

The invention as applied to a centrifugal pump, consists in providing means whereby the thrust on the impellers tending to move the supporting shaft and the impellers toward the intake or suction side of the pump is slightly overbalanced by a thrust in the opposite direction on a balancing disk carried by the shaft at the discharge end of the pump and subject to the high-pressure water at that point. The invention further consists in providing means whereby the excess pressure on the balancing disk in one direction will be balanced by counter-pressure, said counter-pressure being throttled and controlled by the axial movements of the impeller shaft with the result that the impeller shaft will be nicely balanced and will be held practically in a neutral position between the counter-balancing thrusts, thereby relieving the shaft and the thrust disk of undue lateral pressure. The invention further consists in utilizing the counter-pressure water for sealing the stuffing boxes of the impeller shaft at both the high-pressure and intake sides of the pump. A great advantage of this arrangement is that short low-pressure stuffing boxes may be used, these stuffing boxes being sealed with comparatively low-pressure water. The waste of water through the stuffing boxes will be comparatively small and of no consequence.

Another important object of the invention is to discharge the excess water from the balancing pressure chamber axially into the suction side or intake of the pump so that the energy of the water so discharged will

be exerted at the low-pressure side of the pump to assist in directing the inflowing water through the low-pressure impeller.

In the drawing Fig. 1 is a longitudinal vertical sectional view of a tandem-balanced multi-stage centrifugal pump embodying the invention;

Fig. 2 a detail vertical sectional view of the intake or suction side of the pump; and

Fig. 3 is a similar view of the discharge or outlet side of the pump showing the thrust balancing disk and the balancing pressure chamber.

Referring to the various parts by numerals, 1 designates the lower half of the pump casing and 2 the upper half thereof. The lower half of the casing is formed with supporting standards 3; and the upper half is bolted to the lower half by means of bolts 4, the two parts of the casing forming the several impeller chambers and the intake and discharge chambers which will be more fully hereinafter described. Extending through the casing and journaled in suitable bearings 5 at each end thereof is the impeller shaft 6. To one end of this shaft is rigidly connected a coupling disk 7 by means of which the pump shaft may be connected to any suitable driving motor.

The pump casing is formed with the intake chamber 8 near the left hand end thereof, said chamber being annular and extending around the shaft and in direct open communication with the intake pipe 9 shown in dotted lines in Fig. 1. This intake chamber is connected with an annular pressure chamber 10 and this pressure chamber is connected with an annular intake chamber 11 of the second stage, that is to say, of the second impeller. This intake chamber 11 is in communication with a pressure chamber 12 of the second stage, said pressure chamber receiving the water from the second impeller. The pressure chamber 12 is connected to an intake chamber 13 of the third stage. This intake chamber 13 delivers the water to the third impeller and is in communication with the high-pressure chamber 14 of the third stage. The high-pressure chamber 14 is in communication with the discharge 15 of the pump which is indicated by dotted lines in Fig. 1.

Rigidly secured to the impeller shaft and arranged to rotate in chambers 10, 12 and 14 are the impellers 16, 17 and 18. These impellers are provided with rigidly ar-

ranged discharge nozzles, said nozzles opening at their inner ends on the intake side of the impeller and receiving water from the intake chambers adjacent thereto. The intake side of the impeller 16 opens directly into the intake or suction chamber 8; the intake side of the impeller 17 opens directly into the intake chamber 11 and the intake side of the impeller 18 opens directly into the intake chamber 13. The impellers are spaced apart and rigidly held in their spaced relation by sleeves 19 interposed between them and mounted on the impeller shaft. Each impeller is keyed directly to the shaft, as indicated in the drawing. To complete the walls between the chambers 10 and 11 and between the chambers 12 and 13 non-rotating annular partition plates 20 are mounted around the sleeves 19, said partition plates being formed with annular ribs which fit corresponding grooves in the contacting edges of the partition walls 21 of the casing when the two casing sections are assembled. Communication between the chambers 10 and 11 and between 12 and 13 is through the annular peripheral channels indicated by dotted lines in Fig. 1.

In the division wall 22, between the intake chamber 8 and the first pressure chamber 10 and extending around the impeller shaft, is a bearing ring 23, said ring being formed on its exterior annular surface with a rib which fits a corresponding groove in the contacting surface of the division wall 22. The impeller 16 carries an impeller wearing ring 24, said wearing ring extending around the eye of the impeller at the left hand edge thereof. This wearing ring fits within an annular flange 25 formed on the bearing ring 23, and is formed with an annular flange 26 which fits within a corresponding groove 27 formed in the adjoining face of the bearing ring. The purpose of this ring 24 is to seal the connection between the intake chamber 8 and the first pressure chamber 10 so that water from the intake chamber must pass through the impeller nozzles into the pressure chamber and cannot pass around the impeller and back into the intake chamber. The wearing ring has a slight sliding movement in the bearing ring due to the slight axial movement of the impeller shafts, as will be hereinafter described, while at the same time maintaining the seal between the chambers 8 and 10. The impellers 17 and 18 each carry a wearing ring 24 which engages a bearing ring 23 mounted in the partition wall 28 between chambers 11 and 12 and in wall 29 between chambers 13 and 14 so that communication between these chambers, except through the impeller nozzle, will be sealed at all times, notwithstanding the slight axial movement of the impeller shaft and the impellers carried thereby.

In the operation of pumps of this construction there is a certain amount of excess pressure on the high-pressure side of the impellers due to the fact that there is a larger area exposed to the high-pressure water. This excess pressure results in a thrust on the impellers and on the impeller shaft directed toward the suction or intake side of the pump. It is desirable to counter-balance or neutralize this thrust.

In the pump casing, at the discharge end thereof, is formed a pressure balancing chamber 30. This chamber is annular, extending around the impeller shaft, and is in open communication with the high-pressure discharge chamber 14 so that the high-pressure water will freely enter the chamber 30. The annular wall of the chamber 30 is formed with an inwardly extending annular rib 31 which is engaged by an annular seat or thrust ring 32, said seat being grooved on its exterior surface to receive the rib on the wall of the pump casing. Rigidly secured to the impeller shaft by keys 33^a, or otherwise, is a thrust balancing disk 33, said disk forming one wall of the balancing pressure chamber 30 so that the water pressure in said chamber 30 will be exerted directly against said disk and tend to move the impeller shaft and the impellers carried thereby toward the discharge end of the pump and in opposition to the excess pressure exerted on the high-pressure sides of the impellers. The thrust balancing disk 33 is formed with an annular bearing portion 34 which is adapted to engage the outer or right hand side of the thrust ring 32 and thereby close the pressure balancing chamber 30. A counter-balancing pressure chamber 35 is formed between the outer or right hand side of the thrust balancing disk 33 and the outer wall of the pump casing. This counter-balancing pressure chamber is sealed from the chamber 30 when the thrust disk flange 34 is in contact with the thrust ring, and is in communication with said chamber 30 when the thrust disk is moved to the right away from the thrust ring, as will be hereinafter described.

A sealing chamber 36 is formed in the pump casing between the intake chamber 8 and the stuffing box 37 on the suction side of the pump. This sealing chamber extends around the impeller shaft and is in communication with the intake chamber 8 through an annular throttling means. The sealing chamber is in open communication with the counter-balancing chamber 35 through a pipe 38 so that water from the counter-balancing chamber will flow directly into the sealing chamber and from this latter chamber through the throttling device into the intake chamber and around the impeller shaft. Rigidly se-

cured to the impeller shaft on the suction side of the pump is a sleeve 39, said sleeve extending through the stuffing box 37 and through the sealing chamber 36. The inner end of this sleeve is enlarged slightly and is internally threaded to engage threads 40 formed on the adjacent end of the enlarged central portion of the impeller shaft. The inner end of the enlarged portion of the sleeve 39 abuts against the hub of the impeller 16 and serves as a spacing means therefor to prevent any axial movement of the impeller on the shaft. The sleeve 39, at a point within the intake or suction chamber 8, is formed with an annular radial flange or throttling shoulder 41. The partition wall between the intake or suction chamber 8 and the sealing chamber 36 is formed with an annular rib 42 which surrounds the impeller shaft. A throttling sleeve 43 surrounds the impeller shaft and projects into the intake chamber 8, said sleeve being formed with an annular exterior groove which receives the rib 42, said rib serving as means to lock the throttle sleeve against axial movement. The interior diameter of the throttling sleeve is greater than the exterior of the sleeve 39 in order to provide an annular water passage of the desired capacity around the shaft and connecting the sealing chamber with the intake or suction chamber 8. The inner end of the throttling sleeve extends into the intake chamber and is internally threaded to receive a correspondingly threaded throttle ring or nozzle 43^a. This throttle ring or nozzle is adjustable in the throttle sleeve in order to properly position it with respect to the throttling shoulder on the sleeve 39. As hereinbefore pointed out, the impeller shaft and the impellers will have a slight axial movement due to the water thrusts on the impellers, and as the throttling shoulder 41 will move with the impeller shaft it is manifest that this axial movement will result in variations in the gap or space between the throttling shoulder and the adjacent end of the throttling nozzle. This throttling action will serve to control the discharge of water from the sealing chamber 36 into the intake or suction chamber. By properly adjusting the nozzle 43^a the throttling action may be regulated and the desired results secured. The throttling sleeve carries at its outer end an annular abutment or ring 44 which serves as a stop for the packing rings of the stuffing box 37 on the suction side of the pump. The inner end of the stuffing box 37 is open to the water of the sealing chamber 36 so that said stuffing box will be sealed by the comparatively low-pressure water in the sealing chamber. By reason of this arrangement the stuffing box 37 may be made short and need only be kept under a slight compression, or low pressure.

Rigidly secured to the impeller shaft, at the discharge end of the pump, is a sleeve 45, the inner end of said sleeve being enlarged and internally threaded to engage the threads 46 on the adjacent end of the enlarged central portion of the impeller shaft. The inner end of the sleeve 45 abuts against the adjacent outer surface of the thrust disk and serves as a means to prevent axial movement of said disk on the impeller shaft. It is manifest that the impeller sleeves 19 and the thrust balancing disk 33 are all locked to the impeller shaft against axial movement by the sleeves 39 and 45. The sleeve 45 extends through the stuffing box 47 on the discharge end of the pump, and the inner end of this stuffing box is open to the counter-balancing pressure chamber 35 and is sealed by the comparatively low-pressure water in said chamber. By reason of this arrangement the stuffing box 45 may be short and may be maintained under a comparatively low pressure or compression.

In the operation of pumps of this type the excess pressure on the high-pressure sides of the impellers will force the impellers and the impeller shaft toward the suction side of the pump. In the arrangement shown in the drawings and described herein this movement of the impeller shaft will cause the thrust balancing disk 33 to engage the thrust ring 32 and close communication between the balancing chamber 30 and the counter-balancing chamber 35. This movement of the impeller shaft will also open wide the throttling means between the sealing chamber and the intake or suction chamber 8. As the pressure builds up in the chamber 30 the force exerted on the thrust balancing disk 33 will tend to move the impeller shaft and the impellers toward the discharge end of the pump and in opposition to the excessive pressure on the impellers. The thrust balancing disk is so proportioned in size and area to the impellers that at any speed of the pump, the force exerted on said thrust balancing disk will be slightly in excess of the contrary excessive thrust on the impellers so that the thrust disk will be moved away from the thrust ring and thereby open communication between the chamber 30 and the counter-balancing pressure chamber 35 and permit high-pressure water to escape from chamber 30 around the thrust balancing disk 33 into the counter-balancing chamber 35. The movement of the impeller shaft toward the discharge end of the pump will cause the throttling shoulder 41 to approach the nozzle 43^a thereby throttling or reducing the discharge passage from the sealing chamber into the intake chamber. This will permit pressure to build up in the chamber 35 and in the chamber 36. It is manifest that when the balancing pressure in chamber 30 is sufficient to open up com-

munication between chambers 30 and 35 the throttling means will restrict the discharge from the sealing chamber into the intake chamber. This permits the building up of the necessary pressure in the counter-balancing pressure chamber 35. It is also clear that when the necessary counter-balancing pressure has been built up in chamber 35 the throttling means will be automatically operated to enlarge the discharge passage from the sealing chamber into the intake chamber thereby automatically preventing building up an excessive pressure in the counter-balancing chamber 35. In the normal operation of the pump, the impellers and the thrust balancing disk will be maintained, in what might be termed, a neutral position wherein the opposed thrusts will be completely neutralized and the impeller shaft and the impellers will be in, what might be termed, a floating condition, that is to say, the axial thrusts will be completely eliminated.

The counter-balancing water is returned to the intake or suction chamber along the impeller shaft co-axially therewith and in a stream parallel with the main suction water flow. This eliminates shocks and prevents vacuum disturbances. This inflowing water has an ejector effect and increases the water flow. The ejector action results in a part regeneration of the balance water energy.

While I have specifically described my invention as applied to centrifugal pumps it is manifest that it may be readily adapted for use with any mechanism in which the use of a hydraulic thrust balancing means is desirable, such as in a thrust bearing, or on a ship propeller shaft, or the like.

What I claim is:

1. A centrifugal pump comprising a casing, a rotary impeller shaft having a slight axial movement, an intake chamber at the suction end of the pump, a high-pressure discharge chamber at the discharge end of the pump, a series of rotary centrifugal impellers mounted on the impeller shaft and directing the water in successive pressure stages from the intake chamber to the high-pressure discharge chamber, a balancing pressure chamber at the discharge end of the pump and in communication with the high-pressure discharge chamber, a thrust balancing disk rigidly mounted on the shaft and subject to pressure in the pressure balancing chamber, a counter-balancing pressure chamber on the opposite side of said disk from the balancing pressure chamber, the thrust balancing disk controlling communication between said two chambers, a sealing chamber surrounding the impeller shaft at the suction side of the pump and in communication with the said intake chamber, means operated by the axial movement of the impeller shaft to control the flow of water from the sealing chamber into the intake chamber, means placing the counter-balancing pressure chamber in communication with the sealing chamber, a stuffing box for the impeller shaft at the suction end thereof and communicating with the seal-

ing chamber, and means placing the counter-balancing pressure chamber in communication with the sealing chamber.

2. A centrifugal pump comprising a casing, a rotary impeller shaft having a slight axial movement, an intake chamber at the suction end of the pump, a high-pressure discharge chamber at the discharge end of the pump, a series of rotary centrifugal impellers mounted on the impeller shaft and directing the water in successive pressure stages from the intake chamber to the high-pressure discharge chamber, a balancing pressure chamber at the discharge end of the pump and in communication with the high-pressure discharge chamber, a thrust balancing disk mounted on the shaft for axial movement therewith and subject to pressure in the pressure balancing chamber, a counter-balancing pressure chamber on the opposite side of said disk from the balancing pressure chamber, the thrust balancing disk controlling communication between said two chambers, a sealing chamber surrounding the impeller shaft at the suction side of the pump and in communication with the said intake chamber, means operated by the axial movement of the impeller shaft to control the flow of water from the sealing chamber into the intake chamber, and means placing the counter-balancing pressure chamber in communication with the sealing chamber.

3. A centrifugal pump comprising a casing, a rotary impeller shaft having a slight axial movement, an intake chamber at the suction end of the pump, a high-pressure discharge chamber at the discharge end of the pump, a series of rotary centrifugal impellers mounted on the impeller shaft and directing the water in successive pressure stages from the intake chamber to the high-pressure discharge chamber, a balancing pressure chamber at the discharge end of the pump and in communication with the high-pressure discharge chamber, a thrust balancing disk rigidly mounted on the shaft and subject to pressure in the pressure balancing chamber, a counter-balancing pressure chamber on the opposite side of said disk from the balancing pressure chamber, the thrust balancing disk controlling communication between said two chambers, a sealing chamber surrounding the impeller shaft at the suction side of the pump and in communication with the said intake chamber, means operated by the axial movement of the impeller shaft to control the flow of water from the sealing chamber into the intake chamber, means placing the counter-balancing pressure chamber in communication with the sealing chamber, a stuffing box for the impeller shaft at the suction end thereof and communicating with the seal-

ing chamber, and a stuffing box at the discharge end of the impeller shaft and in communication with the counter-balancing pressure chamber.

4. A centrifugal pump comprising a casing, a rotary impeller shaft having a slight axial movement, an intake chamber at the suction end of the pump, a high-pressure discharge chamber at the discharge end of the pump, rotary centrifugal means mounted on the impeller shaft and directing the water from the intake chamber to the high-pressure discharge chamber, a balancing pressure chamber at the discharge end of the pump and in communication with the high-pressure discharge chamber, a thrust balancing disk rigidly mounted on the shaft and subject to pressure in the pressure balancing chamber, a counter-balancing pressure chamber on the opposite side of said disk from the balancing pressure chamber, the said disk controlling communication between said two chambers, a sealing chamber surrounding the impeller shaft at the suction side of the pump and in communication with the said intake chamber, a throttling sleeve arranged in said communication, means operated by the axial movement of the impeller shaft to control the flow of water from the sealing chamber through said throttling sleeve into the intake chamber, and means placing the counter-balancing pressure chamber in communication with the sealing chamber.

5. A centrifugal pump comprising a casing, a rotary impeller shaft having a slight axial movement, an intake chamber at the suction end of the pump, a high-pressure discharge chamber at the discharge end of the pump, rotary centrifugal means mounted on the impeller shaft and directing the water from the intake chamber to the high-pressure discharge chamber, a balancing pressure chamber at the discharge end of the pump and in communication with the high-pressure discharge chamber, a thrust balancing disk rigidly mounted on the shaft and subject to pressure in the pressure balancing chamber, a counter-balancing pressure chamber on the opposite side of said disk from the balancing pressure chamber, the said disk controlling communication between said two chambers, a sealing chamber surrounding the impeller shaft at the suction side of the pump and in communication with the said intake chamber, a throttling sleeve arranged in said communication, means operated by the axial movement of the impeller shaft to control the flow of water from the sealing chamber through said throttling sleeve into the intake chamber, an adjustable nozzle on the end of the throttling sleeve, and means placing the counter-balancing pressure chamber in communication with the sealing chamber.

6. A centrifugal pump comprising a cas-

ing, a rotary impeller shaft having a slight axial movement, an intake chamber at the suction end of the pump, a high-pressure discharge chamber at the discharge end of the pump, rotary centrifugal means mounted on the impeller shaft and directing the water from the intake chamber to the high-pressure discharge chamber, a balancing pressure chamber at the discharge end of the pump and in communication with the high-pressure discharge chamber, a thrust balancing disk rigidly mounted on the shaft and subject to pressure in the pressure balancing chamber, a counter-balancing pressure chamber on the opposite side of said disk from the balancing pressure chamber, the said disk controlling communication between said two chambers, a sealing chamber surrounding the impeller shaft at the suction side of the pump and in communication with the said intake chamber, a throttling sleeve arranged in said communication, an annular throttling shoulder carried by the impeller shaft within the throttling sleeve, an adjustable nozzle at the end of the throttling sleeve, the inner end of said nozzle co-acting with the throttling flange carried by the impeller shaft, and means placing the counter-balancing pressure chamber in communication with the sealing chamber.

7. A thrust balancing mechanism comprising a casing, a shaft therein having a slight axial movement, an intake chamber at one end of the mechanism, a high-pressure discharge chamber at the other end of the mechanism, means for forcing fluid from the intake chamber to the high-pressure discharge chamber, a balancing pressure chamber at the discharge end of the mechanism and in communication with the high-pressure discharge chamber, a thrust balancing disk rigidly mounted on the shaft and subject to the pressure in the pressure balancing chamber, a counter-balancing pressure chamber on the opposite side of said disk from the balancing pressure chamber, the thrust balancing disk controlling communication between said two chambers, a sealing chamber surrounding the shaft at the intake side of the mechanism and in communication with the intake chamber, means operated by the axial movement of the shaft to control the flow of water from the sealing chamber into the intake chamber, and means placing the counter-balancing pressure chamber in communication with the sealing chamber.

8. A thrust balancing mechanism comprising a casing, a shaft therein having a slight axial movement, an intake chamber at one end of the mechanism, a high-pressure chamber at the other end of the mechanism, means for forcing fluid from the intake chamber to the high-pressure discharge chamber, a balancing pressure chamber at

the discharge end of the mechanism and in communication with the high-pressure chamber, a thrust balancing disk rigidly mounted on the shaft and subject to the pressure in the pressure balancing chamber, a counter-balancing pressure chamber on the opposite side of said disk from the balancing pressure chamber, the thrust balancing disk controlling communication between said two chambers, a sealing chamber surrounding the shaft at the intake side of the mechanism and in communication with the intake chamber, means operated by the axial movement of the shaft to control the flow of water from the sealing chamber into the intake chamber, means placing the counter-balancing chamber in communication with the sealing chamber, a stuffing box surrounding the shaft at the high-pressure end of the mechanism and in communication with the counter-balancing pressure chamber, and a stuffing box surrounding the shaft at the intake end of the mechanism and in communication with the sealing chamber.

9. A thrust balancing mechanism comprising a casing, a shaft extending through said casing, an intake chamber at one end of said mechanism, a pressure discharge chamber at the other end of said mechanism, means to force fluid from the intake chamber to the discharge chamber, a balancing pressure chamber at the discharge end of said mechanism and in communication with the pressure discharge chamber, a thrust balancing means connected to and movable axially with said shaft and subject to pressure in the balancing pressure chamber, a counter-balancing pressure chamber on the opposite side of the thrust balancing means, the said thrust balancing means controlling communication between said two chambers, a sealing chamber at the intake end of the mechanism and surrounding the shaft, and means for maintaining a substantial equality of pressures in the counter-balancing pressure chamber and the sealing chamber.

10. A thrust balancing mechanism comprising a casing, a shaft therein having a slight axial movement, an intake chamber at one end of said mechanism, a pressure discharge chamber at the other end of said mechanism, means to force fluid from the intake chamber to the discharge chamber, a balancing pressure chamber at the discharge end of said mechanism and in communication with the pressure discharge chamber, a thrust balancing means connected to and movable axially with said shaft and subject to pressure in the balancing pressure chamber, a counter-balance pressure chamber on the opposite side of the thrust-balancing means, the said thrust balancing means controlling communication between said two chambers, a sealing chamber at the intake

end of the mechanism and in communication with the intake chamber, means placing the counter-balancing pressure chamber in constant communication with the sealing chamber, and means for controlling the communication between the sealing chamber and the intake chamber the said means being operated by the thrust-balancing means and in unison therewith to throttle the communication between the sealing and intake chambers when the communication between the balancing pressure and counter-balancing pressure chambers is open and open the communication between the sealing and intake chambers when the communication between the balancing pressure and counter-balancing pressure chambers is closed.

11. A thrust balancing mechanism comprising a casing, a shaft extending through said casing, an intake chamber at one end of said mechanism, a pressure discharge chamber at the other end of said mechanism, means to force fluid from the intake chamber to the discharge chamber, a balancing pressure chamber at the discharge end of said mechanism and in communication with the pressure discharge chamber, a thrust balancing means connected to and movable axially with said shaft and subject to pressure in the balancing pressure chamber, a counter-balancing pressure chamber on the opposite side of the thrust-balancing means, the said thrust balancing means controlling communication between said two chambers, a sealing chamber at the intake end of the mechanism and surrounding the shaft, means placing the counter-balancing pressure chamber in communication with the sealing chamber, and means operated by the axial movement of the shaft to control the flow of fluid from the sealing chamber into the intake chamber.

12. A thrust balancing mechanism comprising a casing, a shaft extending through said casing, an intake chamber at one end of said mechanism, a pressure discharge chamber at the other end of said mechanism, means to force fluid from the intake chamber to the discharge chamber, a balancing pressure chamber at the discharge end of said mechanism and in communication with the pressure discharge chamber, a thrust balancing means connected to and movable axially with said shaft and subject to pressure in the balancing pressure chamber, a counter-balancing pressure chamber on the opposite side of the thrust balancing means, the said thrust balancing means controlling communication between said two chambers, a sealing chamber at the intake end of the mechanism and surrounding the shaft and in communication with the intake chamber through a central annular passage extending around the shaft, and means placing the counter-balancing pressure chamber

in communication with the sealing chamber.

13. A thrust balancing mechanism comprising a casing, a shaft extending through said casing, an intake chamber at one end
5 of said mechanism, a pressure discharge chamber at the other end of said mechanism, means to force fluid from the intake chamber to the discharge chamber, a balancing pressure chamber at the discharge
10 end of said mechanism and in communication with the pressure discharge chamber, a thrust balancing means connected to and movable axially with said shaft and subject to pressure in the balancing pressure chamber,
15 a counter-balancing pressure chamber on the opposite side of the thrust balancing

means, the said thrust balancing means controlling communication between said two chambers, a sealing chamber at the intake end of the mechanism and surrounding the
20 shaft and in communication with the intake chamber through a central annular passage extending around the shaft, an annular adjustable means for varying the flow from the sealing chamber into the intake chamber,
25 and means placing the counter-balancing pressure chamber in communication with the sealing chamber.

In testimony whereof I hereunto affix my signature.

ALADAR HOLLANDER.