Dec. 11, 1928. 1,694,481

L. F. MOODY

PROPELLER TYPE TURBINE OR PUMP

Filed July 12, 1926 2 Sheets-Sheet 1

Fig. 1.

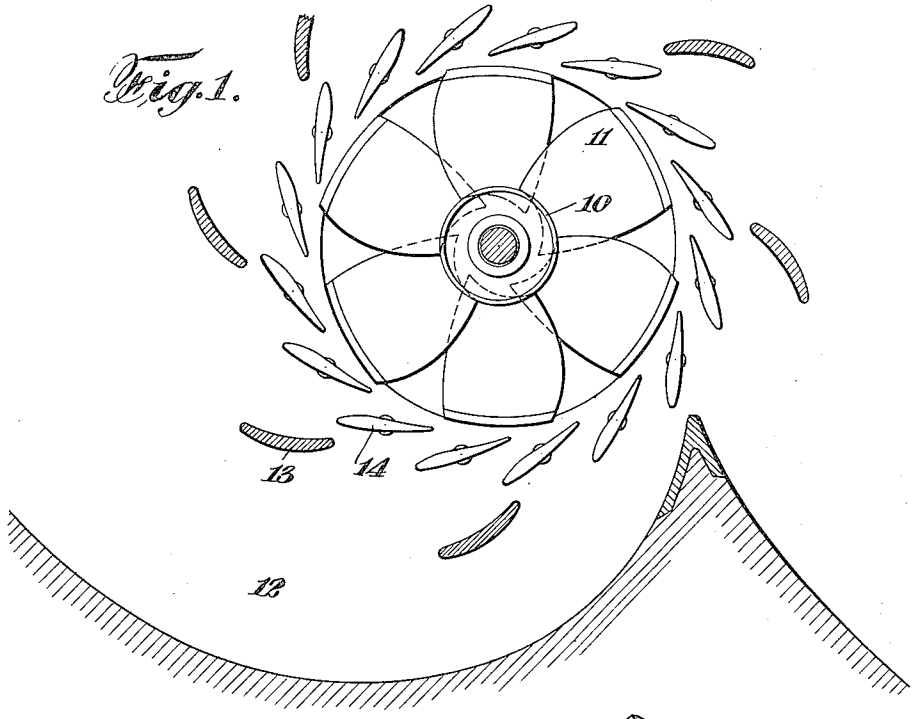
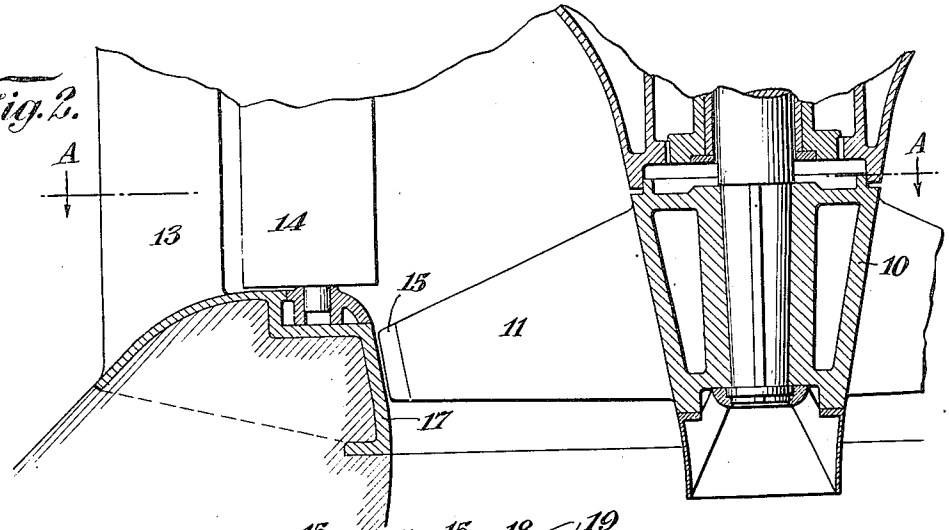


Fig. 2.



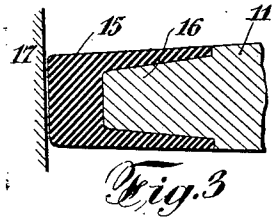


Fig. 3

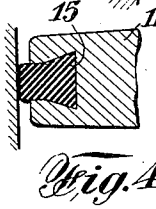


Fig. 4.

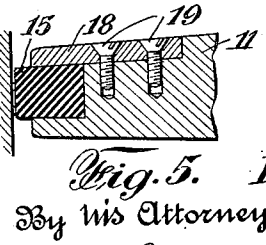


Fig. 5.

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Fig. 6.

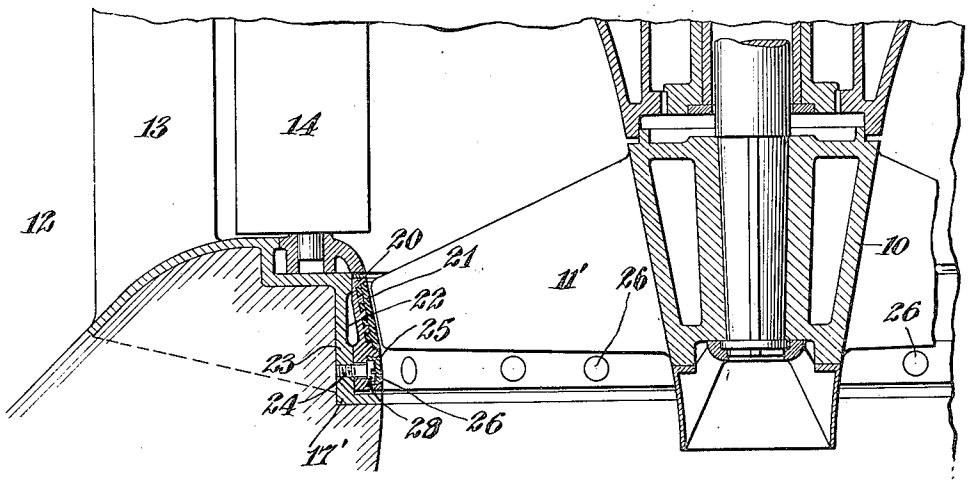
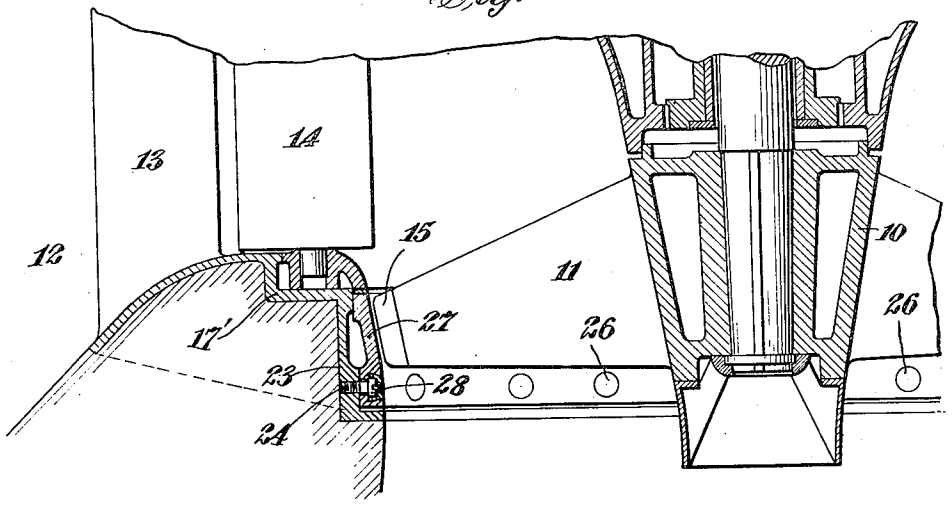


Fig. 7.



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Patented Dec. 11, 1928. 1,694,481

UNITED STATES PATENT OFFICE.

LEWIS FERRY MOODY, OF PHILADELPHIA, PENNSYLVANIA.

PROPELLER-TYPE TURBINE OR PUMP.

Application filed July 12, 1926. Serial No. 121,787.

This invention relates to hydraulic turbines and pumps and more particularly to such machines having a revolving element or runner of the unshrouded type.

In turbine installations the blades of the propeller type runner are spaced from the surrounding wall to allow clearance between the periphery of the runner and the wall. This clearance which in some installations, usually of the larger propeller type runners, is considerable, causes loss of efficiency. The clearance must be sufficient to prevent the runner blades touching the surrounding wall in case there is any vibration, in perfect alignment or irregularity of construction, or in case the thrust bearing should allow the runner to drop a small distance or in case a rubber or wood lined bearing is used which may permit lateral displacement of the runner. The object of this invention is to provide means for reducing the clearance between the periphery of the runner and the outer wall so as to increase the efficiency and to improve the operation of the turbine.

A further object of the invention is to provide means for preventing breakage of the runner blades when any foreign material or obstruction passes within the clearance between the runner and the outer wall, or if the blades should touch the wall.

Further objects and advantages of the invention will be apparent by reference to the following specification and accompanying drawings, in which

Fig. 1 is a plan view on section A—A of the turbine shown in Fig. 2 embodying the invention;

Fig. 2 is an enlarged sectional elevation through a hydraulic turbine showing the runner and the surrounding parts;

Fig. 3 is an enlarged sectional view of an edge or tip of a runner blade;

Figs. 4 and 5 show other arrangements for fastening the material to the runner tips;

Fig. 6 is an enlarged sectional elevation through a hydraulic turbine showing the runner and the surrounding parts with an adjustable rubber lined ring in the stationary wall;

Fig. 7 is an enlarged sectional elevation showing an adjustable metal ring in the stationary wall and runner blades tipped with yieldable material.

In the embodiment of the invention shown, a runner of the propeller type is provided having hub 10 and blades 11. The flow is directed to the runner from the volute casing 12 through the stay vanes 13 and guide vanes 14. The tip of the blades are provided with a strip of rubber or other material of a relatively soft or yielding nature 15 which is cemented, molded, vulcanized or mechanically fastened to the metal. In Fig. 3 the metal tip of the blade 11 is provided with a flange 16, around which the rubber is secured so as to provide the blade with a continuous smooth surface, the rubber being ground to merge with the metal surface.

After the rubber strip is secured to the tip of the blade by cementing, molding or vulcanizing, the rubber is further ground down to fit the clearance space, substantially eliminating the clearance between the runner and the outer casting 17. The grinding is accomplished with the ordinary portable grinder, the runner mounted for rotation on a boring mill or rotating table. The blades are ground to fit the required shape of the outer casting, which is usually conical or cylindrical or formed with a circular arc in meridian section.

The rubber tip of the blades closely spaced from the casting 17 will yield if for any reason foreign material, obstructions or trash enters the turbine casing. The obstruction if small enough to enter the clearance space will pass through to the draft tube without causing breakage of the runner blade. The use of rubber tipped runner blades increases the efficiency because it makes possible the provision of very small clearance between the runner blades and the surrounding wall, and therefore permits little leakage of water to pass between the runner and the stationary wall. The leakage which occurs when there is considerable clearance is objectionable not only on account of the direct loss of useful flow, but also from the disturbance which it causes in the adjacent flow near the blade tips.

Fig. 4 shows another modification of the invention in which the yielding material 15 is dovetailed into the tip of the runner blade and projects beyond the metal portion of the blade to form a close seal between the surrounding wall and the blade.

Fig. 5 shows a further modification in which the strip of yielding material 15 is held mechanically in place in the tips of the runner blades. This strip may be made of rubber or material of like nature or might be made of wood or of soft metal, such as lead or babbitt. The metal should be soft enough

that it would wear down if the runner touched the surrounding wall without scoring or injuring the latter in any way.

The blades 11 are provided with removable plates 18 which are held in place by means of screws 19 tapped into the blades.

In Fig. 6 a modification of the invention is shown wherein an adjustable ring 20 having a rubber lining 21 is set into a circular opening 22 in the casting 17'. The ring 20 is held in position by screws or bolts 28 tapped into the casting 17' at 24. These bolts are in recesses 25 filled with type metal finished flush with the wall surface. If the ring 20 or the blade tips become worn or if the ring needs adjustment to decrease the clearance between the wall and the runner blades 11', the type metal 26 can be melted out of the recesses, the screws or bolts 28 loosened to permit the ring 20 to be raised a small amount, and the bolts 28 again made tight and the recesses 25 refilled with type metal. The slightly tapering or conical outer surface of ring 20 will thus be moved toward the runner blades to decrease the clearance. By these means the clearance between the casing and runner is made adjustable.

Fig. 7 shows a modification wherein the blade tips are provided with rubber and the casting 17' is provided with an adjustable clearance ring 27.

While the invention is illustrated and described more particularly with reference to propeller type turbines, the invention is not confined thereto, but is applicable to pumps having unshrouded impellers or any other uses or modifications within the scope of the appended claims.

I claim:

1. In a runner for a turbine or pump the combination with a central hub portion, of a circumferential series of unshrouded blades thereon normally having a fixed relation thereto, each blade being provided with yielding means at its tip for reducing clearance and increasing the efficiency of the runner.

2. In a runner for a turbine or pump the combination with a central hub portion, of a circumferential series of unshrouded blades thereon, normally having a fixed relation thereto, each blade being provided with a rubber tip for reducing clearance and increasing the efficiency of the runner.

3. In a runner for a turbine or pump the combination with a central hub portion, of a plurality of blades thereon, each blade being flanged at its tip, and a rubber strip secured to said flange for reducing clearance and increasing the efficiency of the runner.

4. In a hydraulic turbine the combination with an outer stationary wall, of a runner surrounded by said wall having a central hub portion and a plurality of unshrouded blades thereon having normally an immovable relation thereto, each blade being provided with a yielding means at its tip for reducing clearance between the runner and the wall.

5. In a hydraulic turbine, the combination with an outer stationary wall, of a runner having a central hub portion and a plurality of blades, and means for adjusting the clearance between said outer wall and the runner blades.

6. In a hydraulic turbine the combination with an outer stationary wall, of a runner surrounded by said wall having a central hub portion and a plurality of blades all disposed substantially in a plane normal to the runner axis, said blades having normally an immovable relation to said hub and yielding material for the clearance between said outer wall and the runner blades.

7. In a rotary hydraulic machine the combination with an outer stationary wall, of a runner having a central hub portion and a plurality of blades all disposed substantially in a plane normal to the runner axis, said blades having normally an immovable relation to said hub, the clearance space between said wall and said runner blades being provided on one side with a rigid material and on the opposite side with a yieldable material.

8. In a rotary hydraulic machine the combination with an outer stationary wall, of a runner having a central hub portion and a plurality of blades, the clearance space between said wall and said runner blades being provided on one side with a rigid material and on the opposite side with a yieldable material, and means for adjusting the clearance between said wall and said blades.

9. In a rotary hydraulic machine a runner having a plurality of unshrouded blades and a circular and concentric stationary surrounding wall, said blades at their tips being closely disposed to said wall with small running clearance therebetween and each blade being provided with yieldable means at its tip to permit the provision of said small clearance.

10. In a rotary hydraulic machine the combination of a runner having a plurality of unshrouded blades and a stationary surrounding wall, said blades at their tips being closely disposed to said wall with small running clearance therebetween, said wall having a generally conical shape smaller at one end than the other, and means for effecting relative axial adjustment between said runner and the portion of said wall adjacent the runner to provide adjustment of the clearance between said wall and runner.

11. In a rotary hydraulic machine, the combination of a runner having a plurality of unshrouded blades and a circular and concentric stationary surrounding wall, said blades at their tips being closely disposed to said wall with small running clearance therebe-

tween, the clearance space between the blade tips and stationary wall having yieldable material on one side thereof and rigid material on the other side.

12. In a rotary hydraulic machine a runner having a plurality of unshrouded blades having during normal operation a fixed relation to the runner hub and an outer stationary wall extending in an axial direction and coaxial with said runner, said blades at their tips being disposed closely to said wall with small running clearance therebetween, and each blade being provided with yieldable means at its tip to permit the provision of said small clearance.

13. In a rotary hydraulic machine the combination with a runner of generally axial flow type having unshrouded blades having during normal operation a fixed relation to the runner hub and a continuous outer circular wall surrounding said runner and slightly spaced therefrom to provide a small running clearance therebetween, said blades at their tips engaging said wall with small running clearance, said blades being provided with yieldable material at the tips to permit the provision of said small clearance.

14. In a hydraulic turbine or pump the combination with a central hub portion of a circular series of unshrouded blades thereon of relatively unyielding material, said blades having a radially fixed position with respect to said hub during normal operation of the runner and each blade being provided with a different material at its tip for reducing clearance and increasing the efficiency of the runner.

15. In a hydraulic turbine or pump the combination with a central hub portion of a circular series of unshrouded blades thereon of relatively unyielding material, said blades having a radially fixed position with respect to said hub during normal operation of the runner and each blade being provided with a yielding material at its tip for reducing clearance and increasing the efficiency of the runner.

16. In a hydraulic turbine or pump the combination with a central hub portion of a circular series of unshrouded blades thereon of relatively unyielding material, said blades having a radially fixed position with respect to said hub during normal operation of the runner and each blade being provided with a relatively soft material at its tip for reducing clearance and increasing the efficiency of the runner.

17. The combination in a hydraulic turbine or pump comprising a runner having a hub and a plurality of unshrouded blades all lying substantially in a plane normal to the runner axis and having during normal operation a radially fixed position with respect to said hub, a stationary wall surrounding said blades which at their tips are closely disposed to said wall to form a small running clearance therebetween, and adjustable means adapted to vary said clearance.

18. The combination in a hydraulic turbine or pump having a runner provided with a plurality of radially fixed blades all lying substantially in a plane normal to the runner axis and stationary wall surrounding said runner, said blades at their tips being closely disposed to said wall to provide small running clearance therebetween, and means including an inclined surface adapted to adjust said clearance.

LEWIS FERRY MOODY.

CERTIFICATE OF CORRECTION.

Patent No. 1,694,481. Granted December 11, 1928, to

LEWIS FERRY MOODY.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, line 14, for the words "in perfect" read "imperfect"; and that the said Letters Patents should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 12th day of March, A. D. 1929.

M. J. Moore,
Acting Commissioner of Patents.

(Seal)