

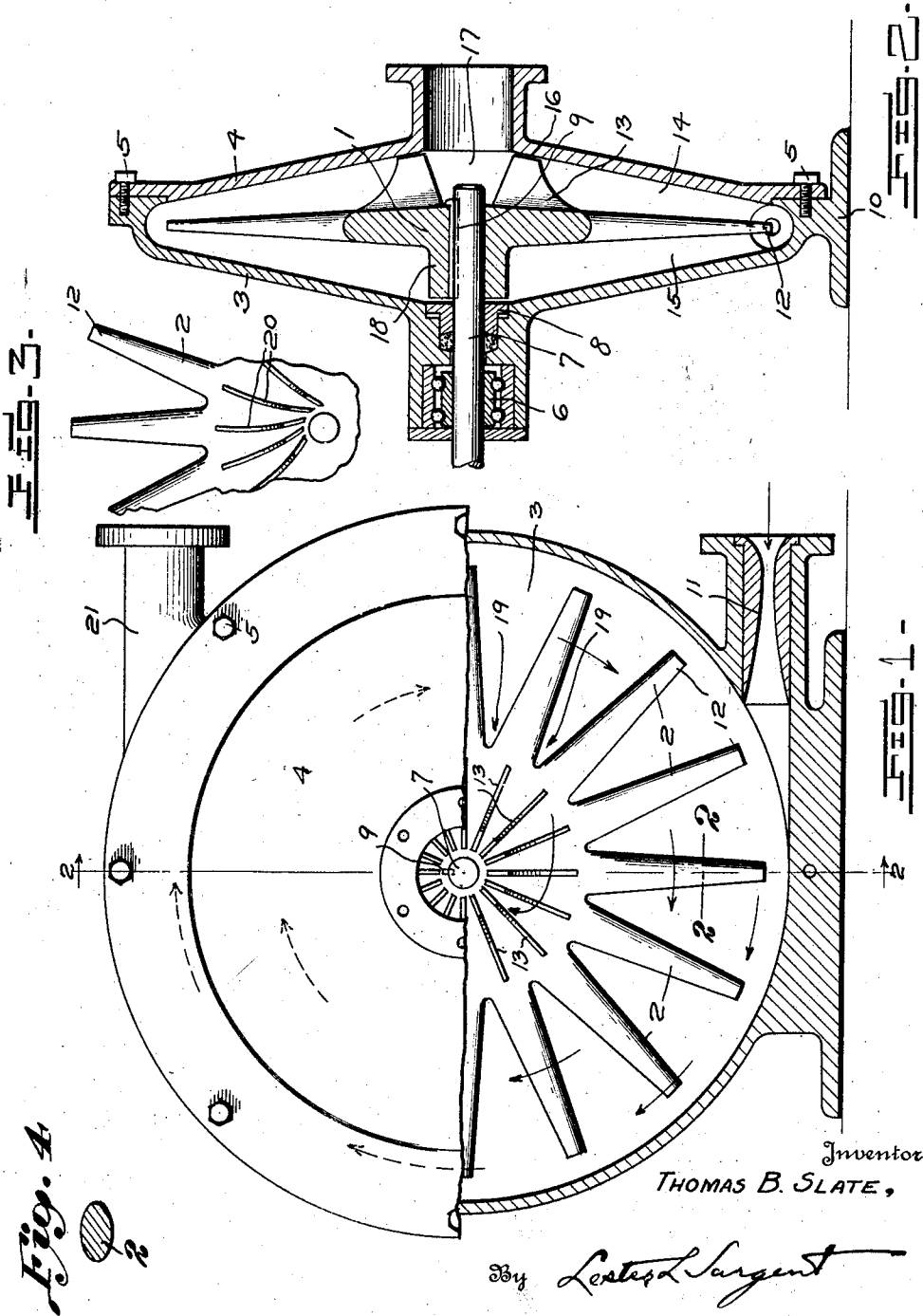
Dec. 31, 1929.

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1,741,379

STEAM TURBINE

Filed April 12, 1927



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STEAM TURBINE

Application filed April 12, 1927. Serial No. 183,090.

My invention relates to an improved type of steam turbine designed especially for the purpose of eliminating rotor resistance and complicated rotor construction. It is designed especially to eliminate the wearing edges of blades where the high speed steam comes in direct contact with blade surfaces. It is also my purpose to provide a turbine adapted to use high pressure super-heated steam at extremely high velocities in a single stage pressure drop of the nozzle; to provide a rotor adapted to utilize the velocity of the steam as long as it retains any velocity at all and to bring its velocity down to the velocity of the rotor without reversing the direction of the steam, thereby eliminating much mechanism required in turbines heretofore devised. It is also an object of my invention to provide a rotor of novel construction without blades and having resistance bars or spokes tapering toward their outer ends, and to arrange such bars in spaced relation to the housing. It is an especial object of my invention to provide a steam turbine which is not only exceptionally efficient but which also can be built at a comparatively low cost and which is so constructed that it can be readily taken apart when required. It is also an object of my invention to provide a novel process of operating a turbine of this novel type.

I attain these and other objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a side elevation of my invention, partly in section and with a portion of the housing broken away to show the shape of the rotor bars;

Fig. 2 is a transverse section through the rotor on line 2—2 of Fig. 1;

Fig. 3 is a side elevational view of a modification of my invention in which the blades 20 are curved; and

Fig. 4 is a section on line 2—2 of Fig. 1, showing a cross sectional view of one of the spokes.

Like numerals designate like parts in each of the several views.

Referring to the accompanying drawings I provide a housing 3 mounted on the base 10. I also provide a housing member 4 detach-

ably secured to housing member 3 by screws or bolts 5. Mounted in the main housing 3 is a suitable ball bearing 6 and gland 8 in which is mounted a shaft 7 on which shaft is keyed, as at 9, rotor 1 which rotor is provided with bars or spokes tapering towards their outer ends and spaced from the housing members 3 and 4 as shown in Fig. 2. The bars or spokes 2 are approximately elliptical or rectangular in cross section. The rotor 1 may be provided with an extension hub 18 and also has outwardly extending blades 13 extending nearly to the housing 4 adjacent the steam discharge passage 17 but leaving a small clearance space 16 between the outer edges of the blades and the inner surface of the housing 4. I provide an inner nozzle 11 which is of relatively small diameter as compared with the diameter of the discharge passage 17. The inlet passage 11 is disposed tangentially to the periphery of the interior of the housing while the discharge passage 17 is disposed in proximity to the hub of the rotor and concentric therewith. I may provide a second inlet nozzle 21 preferably parallel with the nozzle 11 as shown in Fig. 1 and available for use when it is desired to drive the turbine in a reverse direction.

Referring to Fig. 3, for rotors which are to be driven almost entirely in one direction only I may provide the blades 20 of the slightly curved shape illustrated in the drawings in lieu of the straight blades 13 as shown in Figs. 1 and 2, the blades otherwise being similar in construction and position to the blades shown in Figs. 1 and 2.

The steam on entering the housing through nozzle 11 makes an impact against the outer ends of the spokes or bars 2 and gradually moves centripetally as the velocity of the steam is reduced or used up. The spokes or resistance bars of the rotor do not fill the housing and therefore the steam is at liberty to pass around the bars creating positive pressure on the rear side of the bars and suction on the forward side of the bars. The resistance of the bars retards the velocity of the steam a certain amount for each bar that it passes in its centripetal movement within the housing, and making one complete round

the steam has lost sufficient velocity so that the centrifugal force of its own weight is not equal to the high speed steam entering from the nozzle. Therefore it pulls on top or
 5 toward the center of rotation each time it goes around. It may make a number of rounds before reaching the center of the rotor and may continue to pass the rotor spokes in the direction of rotation until it reaches a
 10 point very near the center of rotation at which point the bar of the blade widens out rapidly to a point where it with the blades 13 practically fill the width of the housing to require the velocity of the steam to finally
 15 lower to the speed of the rotor at the hub where the rotation speed is comparatively low. After passing this point the steam is free to flow out through the exhaust passage 17 at the center of rotation.

20 By this process the entire rotor is in an atmosphere that is turning in the direction of the rotor at greater speed than the rotor itself. Therefore no part of the rotor offers resistance to forward motion. The fan or
 25 blower effect of blades used in the ordinary steam turbine in those types that use only a portion of the blade area in contact with the nozzles is eliminated. My invention eliminates the surface resistance of the enormous
 30 blade area of stationary blades.

The rotor can be made of light material such as aluminum or aluminum alloys as there are no delicate surfaces or edges on the rotor. The resistance bars proper are rounded on
 35 their edges to allow all the steam to pass the bars without any of it having its direction reversed.

The nozzle and housing are so arranged that the width of the housing is the same as
 40 the width of the nozzle at the point of the nozzle discharging into the housing. The housing gradually widens from that point toward the center of the housing allowing a gradual expansion of the steam as it travels
 45 toward the point of discharge and as its velocity decreases.

The operation of the turbine in detail is as follows. Steam at high pressure which is taken in through nozzle 11 discharges at maximum velocity at the inner or large end of the
 50 nozzle opening inside the housing of the turbine in the direction indicated by the arrows on Fig. 1. The steam follows a centripetal course around the turbine housing as indicated by the arrows on Fig. 1, until it reaches the discharge opening 17 at the center of the housing. The velocity of rotation of the steam around the housing is interrupted by the arms or spokes of the turbine rotor at intervals indicated by the number of its
 60 spokes. The steam is merely interrupted by each spoke of the rotor but not brought to a stop in its direction of rotation. The spokes do not fill the width of the interior of the
 65 housing there being spaces 14 and 15 on oppo-

site sides of the spokes sufficient for the steam to pass the spokes and continue its course around the housing. The resistance of the spokes, however, is sufficient to bring the
 70 steam down to a velocity slightly greater than that of the spokes by the time the steam reaches the inner depth of the space between the spokes indicated by the numeral 19 in Fig. 1, and at that point all the steam flowing up
 75 in the space 15 has to pass through between the spokes on its way to the exhaust passage 17 and thus finally come to the velocity of the hub of the turbine, because the only opening to the exhaust is between the blades 13 from the space 14 to exhaust 17.

This turbine is reversible by switching the steam from nozzle 11 to nozzle 21 as indicated in Fig. 2, thus causing the steam to flow in the opposite direction as concerns the rotor. These blades or spoke have preferably rounded edges and are of general elliptical shape in cross section and as the edges
 85 of the spokes are rounded no portion of the steam passing the spokes will have its direction reversed on coming in contact with them
 90 but will merely create a positive pressure on the rear side of the spokes and a negative pressure on the front side. It will be noted that no part of the rotor has anything to cause a resistance to its direction of rotation
 95 and that the steam cannot gain the exhaust passage 17 without coming to the speed of the rotation of the blades 13 arranged on the hub of the rotor. It will also be noted that there is nothing but the rotor offering resistance to bring the steam to the speed of the rotor except skin resistance or surface
 100 resistance of the inner surface of the housing, which is to be machined and polished to a very smooth surface. To reverse the direction of the turbine itself it is only necessary to change the flow of steam from one nozzle to the other as the exhaust will be the same from either direction, except where the modified blade 13 as shown in Fig. 3 is used. The
 105 object of this modified construction having curved blades is to deliver the steam to the exhaust in a direction opposite the direction of rotation of the rotor 1. Except where the turbine is to be used principally for driving in one direction only the straight blades as shown in Figs. 1 and 2 are my preferred construction.

What I claim is—

1. In a steam turbine, the combination of
 120 a rotor having spokes radiating from a hub, each spoke being of substantially elliptical shape in cross section to cause a resistance or positive pressure on their rear edges as regards their direction of travel, the displacement of steam caused by this resistance causing a reaction or negative pressure on the forward portion of the spokes without
 125 changing the direction of travel of the steam, means for rotatably mounting the rotor, a

housing inclosing the rotor but spaced from it to provide a continuous chamber on either side and around the rotor spokes, an inlet nozzle opening into the rotor housing in a plane tangential to the periphery of said housing, the housing having an exhaust passage positioned in approximately the same place as the hub of the rotor, said exhaust passage being of greater cross sectional area than the inlet nozzle.

2. In a steam turbine, the combination of a rotor having spokes radiating from a hub, said spokes gradually tapering from the portion adjacent the hub to the outer end, each spoke being of substantially elliptical shape in cross section whereby to cause a resistance or positive pressure on their rear edges as regards their direction of travel, the displacement of steam caused by this resistance causing a reaction or negative pressure on the forward portion of the spokes, means for rotatably mounting the rotor, a housing inclosing the rotor but spaced from it to provide a continuous chamber on either side and around the rotor spokes, an inlet nozzle opening into the rotor housing in a plane tangential to the periphery of said housing, the housing having an exhaust passage positioned in approximately the same plane as the hub of the rotor, said exhaust passage being of greater cross sectional area than the inlet nozzle.

3. In a steam turbine, the combination of a rotor having spokes radiating from a hub, said spokes gradually tapering from the portion adjacent the hub to the outer end, each spoke being of substantially elliptical shape in cross section whereby to cause a resistance or positive pressure on their rear edges as regards their direction of travel, the displacement of steam caused by this resistance causing a reaction or negative pressure on the forward portion of the spokes, means for rotatably mounting the rotor, a housing inclosing the rotor but spaced from it to provide a continuous chamber on either side and around the rotor spokes, a plurality of inlet nozzles opening into the rotor housing in planes tangential to the periphery of said housing to permit of driving the rotor in reverse directions, the housing having an exhaust passage positioned in approximately the same plane as the hub of the rotor, said exhaust passage being of greater cross sectional area than the inlet nozzle.

4. In a steam turbine, the combination of a rotor comprising a hub having rounded spokes radiating therefrom and having outstanding blades on the hub of the rotor in proximity to the exhaust passage from the housing, a housing inclosing said rotor and spaced from it to provide a continuous chamber around the rotor spokes, one or more inlet nozzles opening into the rotor housing in a plane tangential to the periphery of the

interior of the rotor housing, the housing having a single exhaust passage positioned in approximately the same plane as the hub of the rotor and through which the steam must pass to escape from the rotor thereby inducing a centripetal movement of the steam through the turbine.

5. In a steam turbine, the combination of a rotor having tapering spokes radiating from a hub, a shaft on which the rotor is keyed, a housing inclosing the rotor and spaced from it to provide a continuous chamber encircling the rotor spokes, an inlet nozzle opening into the rotor housing in a plane tangential to the periphery of the interior of the rotor housing, the housing having an exhaust passage positioned in approximately the same plane as the hub of the rotor and extension blades on the hub of the rotor the aforesaid extension blades being slightly curved.

6. In a steam turbine, the combination of a rotor having spokes radiating from a hub, said spokes being elliptical in cross section and tapering towards their ends, a shaft on which the rotor is keyed, a housing inclosing the rotor and spaced from it to provide a continuous chamber around the rotor spokes, an inlet nozzle opening into the rotor housing in a plane tangential to the periphery of the interior of the rotor housing, and the housing having an exhaust passage positioned in approximately the same plane as the hub of the rotor.

7. In a steam turbine, the combination of a rotor having spokes radiating from a hub, said spokes being elliptical in cross section and tapering toward their ends, a shaft on which the rotor is keyed, a housing encircling the rotor and spaced from it to provide a continuous chamber around the rotor spokes, inlet nozzles opening into the rotor housing in planes tangential to the periphery of the interior of the rotor housing, the housing having an exhaust passage positioned in approximately the same plane as the hub of the rotor, it being required that the steam move continuously in a centripetal direction toward the hub of the rotor and discharge through the aforesaid exhaust passage.

8. In combination with the mechanism set forth in claim 7, extension blades on the hub of the rotor, the aforesaid extension blades preferably being slightly curved.

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