

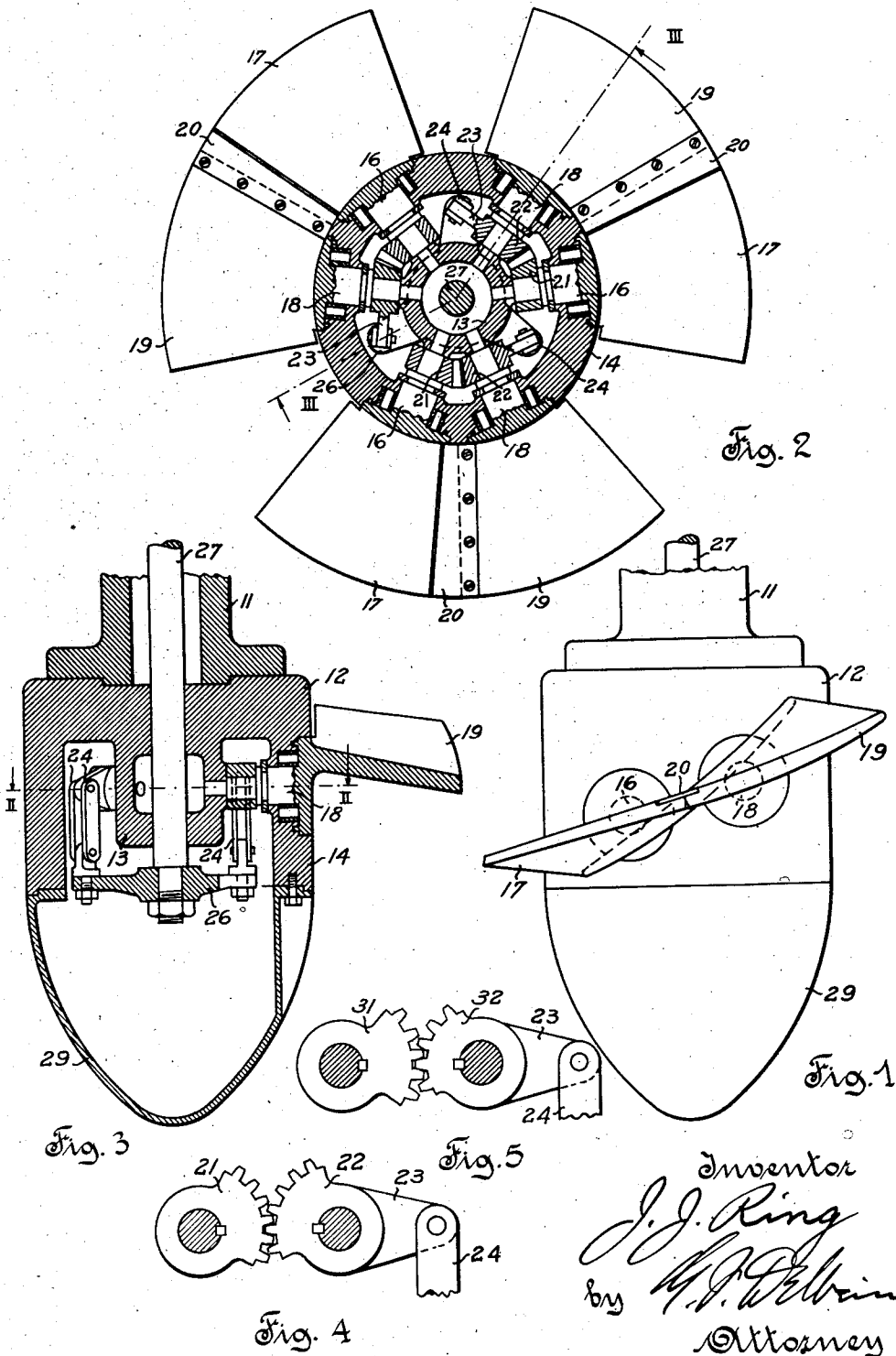
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PROPELLER TYPE HYDRAULIC MACHINE

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PROPELLER TYPE HYDRAULIC MACHINE

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This invention relates to improvements in the structure of hydraulic machines of the propeller type and particularly in the construction of and means for varying the position of the blades of such propeller.

In hydraulic machines of the propeller type, whether used as turbines to deliver power or as pumps requiring the delivery thereto of power, the hydraulic head acting on the turbines may vary or the quantity of power available to drive the pumps may vary. Both turbines and pumps should however operate at a constant predetermined speed to avoid complication of the control system for such machines. Efficient operation of such propeller type machine can only be obtained if the entering angle and the discharge angle of the propeller blades are both kept as close as possible to the theoretically most effective value which maintains the water passages through the runner at the most effective area and at the best angular relation with respect to other portions of such water flow passages. It is however impossible to maintain the maximum efficiency of operation at constant speed but under variable heads or at variable power with the known type of unitary blade propeller runner for the reason that the angle of the entering edge of the blade relative to the horizontal and the angle of the discharge edge of the blade relative to the horizontal are variable only in the same sense and to the same degree. Increase of the angles increases the quantity of water discharged from each blade but decreases the speed, the opposite effect occurring when the angles are decreased.

If means are provided by which the angles of the entering and the discharge edges of the propeller blade may be varied in opposite sense but either by the same amount or a different amount relative to each other, the speed of the machine may be kept constant and its efficiency may be maintained at a maximum even when the available head is varying or when the power delivered from or supplied to the machine is varied. To obtain such constant speed operation under varying heads, it is accordingly necessary that it be possible to increase the entrance angle which tends to decrease the speed of the machine and to decrease the discharge angle which tends to decrease the quantity of water discharged through the machine and hence to decrease the power delivered by or required by the machine. When constant speed operation at variable power is desired, the entrance angle is decreased and the discharge angle is increased or vice versa which tends to increase the speed and to increase the

power respectively or to decrease the speed and to increase the power respectively.

It is, therefore, one of the objects of the present invention to provide a blade construction for hydraulic machines of the propeller type in which the power delivered to the machine or required for the operation of the machine may be varied without varying the speed of the machine.

Another object of the invention is to provide blades and operating means therefor for hydraulic machines of the propeller type in which the angle of the entrance edge and the angle of the discharge edge of the several blades are simultaneously changed in opposite sense.

Another object of the invention is to provide blades and operating means therefor for hydraulic machines of the propeller type in which the entrance and discharge angles of the blade are changed in degree relative to each other.

Another object of the invention is to provide a blade construction and the operating means for such blade for hydraulic machines of the propeller type in which the entrance and discharge angles of such blade are simultaneously changed by different amounts and in opposite sense relative to each other.

Objects and advantages other than those above set forth, will be apparent from the following description when read in connection with the accompanying drawing in which:

Fig. 1 is an elevation of the blade and the mounting therefor of a hydraulic machine of the propeller type and illustrates the divided construction of such blades;

Fig. 2 is a horizontal sectional view taken on the plane of II—II of Fig. 3 to illustrate the divided construction of the propeller blades and the manner of operating the several blade portions;

Fig. 3 is a vertical sectional view taken on the plane of the line III—III of Fig. 2 to aid in illustrating the mechanism for operating the several blade portions;

Fig. 4 illustrates the use of gear segments of equal diameters to secure equal operation in opposite directions of the two portions of each blade; and

Fig. 5 illustrates the use of gear segments of unequal diameter to secure movement of the two blade portions relative to each other.

Referring more particularly to the drawing by characters of reference, the reference numeral 11 designates a hollow shaft to which is attached a hub member 12 which is also hollow and is provided with a central boss 13 defining an annular space when considered together with the outer

5 wall 14 of the hub. The hub wall 14 is formed with a plurality of apertures therethrough, the apertures being arranged in pairs to receive the separate pivots 16 and 18 of the several portions 17 and 19 cooperating to form one of several similar propeller blades, all of which are similarly mounted in the hub.

10 In the position of the blade portions 17 and 19 as shown in Figs. 1 and 2, it will be seen that the adjacent edges of such portions are closely in contact. However as the blade portions are tilted to different angles, a crevice is left in the pressure surface of each of the blades or the surface over which the water flows and which 15 crevices, if left uncovered, would disturb the stream flow lines. To minimize such disturbance, a strip 20 of flexible material such as rubber is attached to the entering portion 19 of the several blades by suitable means such as the rivets shown and is allowed to extend over a portion of the discharge portion 17 of the blade.

20 The blade pivots 16, 18 are keyed to or have otherwise mounted thereon, in the annular space between the hub wall 14 and the hub central boss 13, gear segments 21 and 22 respectively which are formed to mesh with each other and which are shown in Fig. 4 as being of the same size and hence as capable of rotating the several blade portions 17 and 19 by equal amounts. Segments 22 are provided with arms 23 to which are pivotally attached links 24 which are in turn pivotally connected with a spider 26 which interconnects the operating links 24 and arms 23 of the several pairs of vane portions forming each 35 of the blades 17, 19. The spider 26 is connected with a rod 28 extending through the central boss 13 of the hub and through the hollow shaft 11 to either manually or automatically operable means which are suitable for operating such rod, such means being well known and therefore not 40 illustrated. The open end of the hub 12 is enclosed by a suitable substantially conical cover 29. The pivots 16 and 18 extend through the outer wall 14 of the hub 12 and into the central boss 13 of the hub to secure adequate bearings on each side of the annular space within the hub and within which space the gear segments are mounted on the pivot.

45 As shown in Fig. 5 the gear segments 31 and 32 which are comparable to the gear segments 21 and 22, are formed with different diameters to secure a different degree of rotation of the blade portions 17 and 19 upon movement of the rod 28. Although the gear portion 31 which is attached to the entrance plate portion 19, has been shown as being the larger of the two gears and therefore as rotating to a lesser degree than the discharge blade portion 17 to which the gear 32 is attached, it will be understood that either of 50 the gears may be made the smaller as may be required by the operating condition which it is desired to attain.

55 It will be apparent that the gear sections may be made so that any desired ratio may be obtained between such segments. Due to the use of the intermeshing gear segments, the two blade portions are rotatable in opposite directions about their pivots to vary the angle of the entering edge of the portion 19 of the blade to decrease or increase the speed of rotation of the machine dependent on whether the angle is increased or decreased and the angle of the discharge edge of the blade portion 17 may be decreased or increased to give a decreased or increased discharge. Thus when the head of water 60 65 70 75

decreases, the quantity of water passing through the machine may be increased by increasing the entrance angle and the speed may be kept constant or even increased by decreasing the discharge angle. The machine is thus kept in operation at high efficiency even at the lower head. If the quantity of water delivered by or supplied to the machine is to be varied as by reduction of such power, the entrance angle would be decreased and the discharge angle would be increased to obtain constant speed operation of the machine.

15 Although but one embodiment of the present invention has been illustrated and described, it will be apparent to those skilled in the art that various modifications and changes may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

20 It is claimed and desired to secure by Letters Patent:

1. A hydraulic machine rotor of the propeller type comprising a shaft, a hub mounted on said shaft, a blade divided into a plurality of separate portions individually and movably mounted in said hub on separate axles intermediate the edges of said blade portions, gears severally mounted on each of said blade portions and arranged wholly within said hub, and means for actuating said gears to change entrance and discharge angles of said blade portions.

2. A hydraulic machine rotor of the propeller type comprising a shaft, a hub mounted on said shaft, a blade divided into a plurality of separate portions individually and movably mounted in said hub, intermeshing gear segments severally mounted on each of said blade portions wholly within said hub for rotating said blade portions in opposite directions to change both the entrance and discharge angles of each of said blades in opposite sense, and means for actuating all of said gear segments.

3. A hydraulic machine rotor of the propeller type comprising a shaft, a hub mounted on said shaft, a blade divided into a plurality of separate portions individually and movably mounted in said hub, intermeshing gear segments of unequal diameters severally mounted on each of said blade portions and arranged wholly within said hub for rotating the portions of each said single blade in opposite direction to change the entrance and discharge angles of each of said blade portions in opposite sense and by different amounts, and means extending into said hub and interconnecting said gear segments therein for rotating said blade portions for actuating all of said gear segments.

4. A hydraulic machine rotor of the propeller type comprising a hollow shaft, a hollow hub mounted on said shaft, a plurality of blades each divided into a plurality of separate portions individually and movably mounted in said hub and cooperating to act as a single blade, gear segments severally mounted on the blade portions within said hub, said gear segments being intermeshed and mounted on the blade portions for rotating the blade portions in opposite directions upon movement thereof, means wholly within said hub for interconnecting all of said gear segments, and a rod extending through said shaft and into said hub for actuating said means.

5. In a hydraulic turbine of the propeller type, a hollow shaft, a hollow hub mounted on said shaft, a plurality of vanes mounted in and extending from said hub, each of said vanes being 75

divided into a pair of portions movable in closely adjacent relation to act as a single vane, an operating rod extending through said shaft and into said hub for actuating said vanes, gear segments of unequal diameter mounted on each pair of the portions of said vanes within said hub, and a crosshead connecting one of said segments directly and the other of said segments indirectly with said operating rod for simultaneously varying the positions of said pairs of vane portions in opposite sense relative to each other and by different amounts upon movement of said rod.

6. In a hydraulic turbine of the propeller type, a shaft, a hub mounted on said shaft, a plurality of vanes mounted in and extending from said hub, each of said vanes being divided into a plurality of portions individually mounted on separate axles and movable in closely adjacent relation, a strip of flexible material mounted on the pressure surface of said vanes and extending from one of the vane portions partially over the

other of the vane portion to cover the space therebetween.

7. In a hydraulic turbine of the propeller type, a hollow shaft, a hollow hub mounted on said shaft, a plurality of vanes pivotally mounted in and extending from said hub, each of said vanes being divided into a plurality of portions individually mounted on separate axles and movable in closely adjacent relation, intermeshing gear segments mounted on each of the portions of said vanes within said hub, an operating rod extending through said shaft into said hub and connected with and actuating said gear segments to move said vane portions in opposite directions, and a strip of flexible material mounted on the pressure surface of said vanes and extending from one of said vane portions partially over the other of said vane portions to cover the space therebetween.

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