

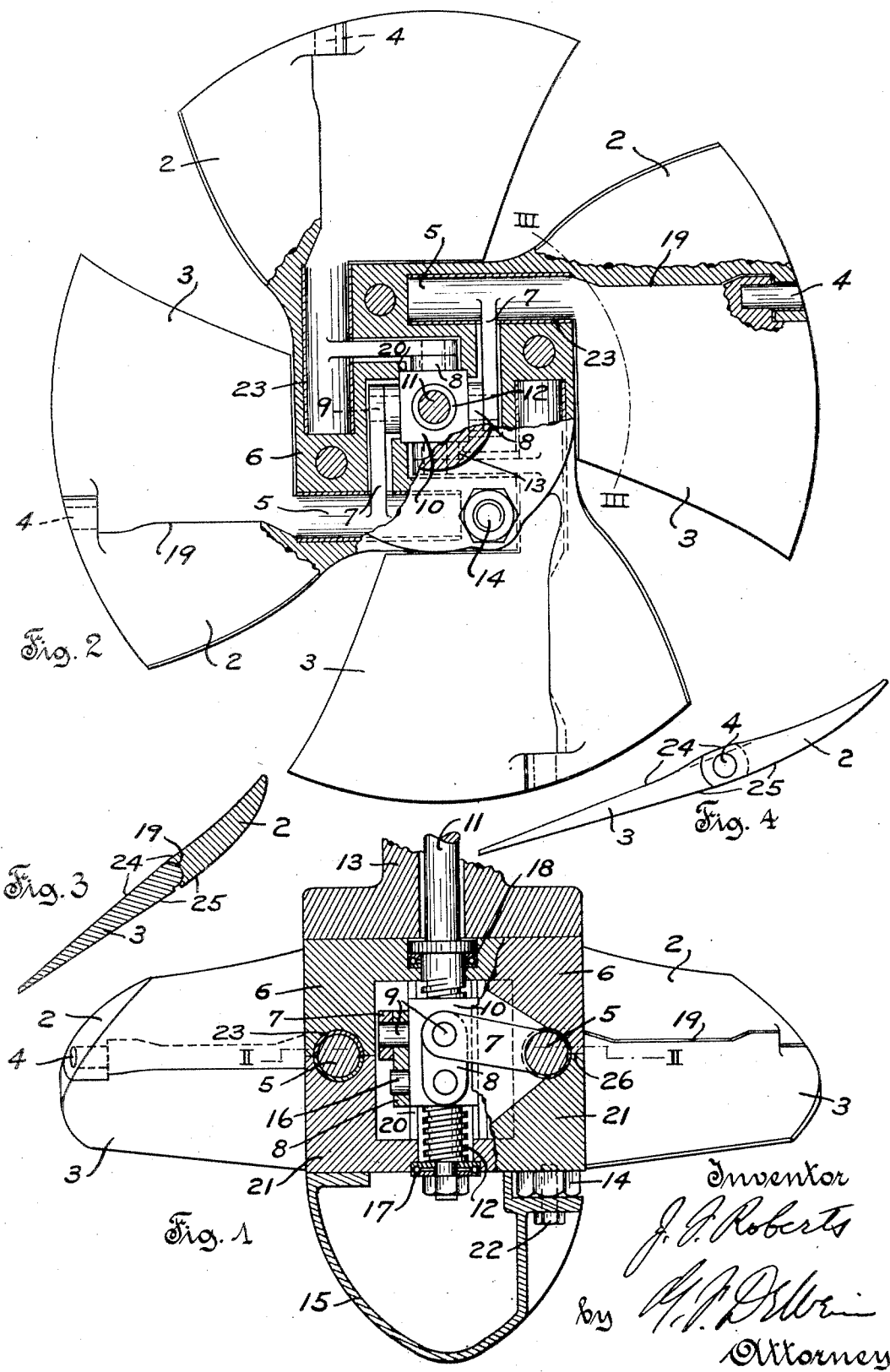
Jan. 10, 1928.

1,656,019

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ROTOR

Filed May 21, 1926



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ROTOR.

Application filed May 21, 1926. Serial No. 110,601.

This invention relates in general to improvements in the construction of rotors, and relates more specifically to improvements in adjustable vane rotors for fluid pressure operated turbines, fluid pumps, conveyance propellers, or the like.

An object of the invention is to provide a new and useful rotor which is simple in construction and efficient in operation. Another object of the invention is to provide improved means for effecting adjustment of the vane surfaces of a rotor. A further object of the invention is to provide an adjustable vane rotor especially adapted to withstand operation at relatively high speed. Still another object of the invention is to provide a relatively durable and extremely compact rotor structure comprising adjustable vane surfaces. Another object of the invention is to provide rotor vane adjusting mechanism which is readily manipulable and whereby the movable vane elements are positively locked in adjusted position. These and other objects and advantages will appear in the course of the accompanying description.

A clear conception of an embodiment of the invention and of the mode of adjusting the vane surfaces of rotors constructed in accordance therewith, may be had by referring to the drawing accompanying and forming a part of this specification in which like reference characters designate the same or similar parts in the several views.

Fig. 1 is a sectional view taken through the hub of an improved hydraulic turbine rotor embodying the invention.

Fig. 2 is a part sectional top view of the improved hydraulic turbine rotor.

Fig. 3 is a section taken through one of the rotor vanes adjacent to the rotor hub, the section being taken on the line III—III of Fig. 2.

Fig. 4 is an end view of one of the rotor vanes.

The hydraulic turbine rotor to which the invention is herein specifically applied, comprises in general a central hub formed of upper and lower detachable portions 6, 21 respectively, cooperating to form a central chamber; and four dove-tail shaped vanes radiating from the rotor hub and each comprising a fixed inlet section 2 and an adjustable discharge section 3 cooperating

with an adjacent inlet section 2. All of the inlet sections 2 of the several vanes are formed integral with the upper hub section 6, and each of the adjustable discharge vane sections 3 is pivotally associated at its outer end with an adjacent fixed vane section 2, and at its inner end with a wearing bushing 23 clamped between the hub sections 6, 21. The outer pivots 4 of the adjustable vane sections 3 may be rigidly attached to the outer ends of the fixed vane sections 2, and coact with openings in the ends of the adjacent adjustable vane sections 3. The inner ends of the vane sections 3 are provided with integral inner pivots 5 which coact with the wearing bushings 23 and have laterally projecting adjusting arms 7 formed integral therewith and extending into the hub chamber. The portion of each adjustable vane section 3, between the pivots 4, 5, is provided with a semi-cylindrical bearing 19 providing a half bearing upon the adjacent fixed vane section 2 as clearly shown in Fig. 3, and the pivots 4, 5 and the bearing 19 of each vane have concentric bearing surfaces.

The swinging extremities of the arms 7 are pivotally connected by means of pins 9 to the upper ends of adjusting links 8, the lower ends of the links 8 being pivotally connected to a central adjusting block 10 by means of pivot pins 16. The adjusting block 10 is slidable along guideways 20 formed upon the hub sections 6, 21 adjacent to the inner chamber of the hub, and has internal screw threads formed for coaction with the external screw threads 12 of an adjusting shaft 11. The adjusting shaft 11 is provided with upper and lower thrust bearings 18, 17 respectively which prevent longitudinal displacement of the shaft 11, and extends away from the rotor hub and through a central bore of the hollow main shaft 13.

The hub sections 6, 21 are clamped together along a plane surface of coaction 26 by means of a series of clamping bolts 14 these clamping bolts being positioned as indicated in Fig. 2. The clamping bolts 14 besides clamping the hub sections together may serve to connect the rotor hub to the lower flange of the hollow main shaft 13 thereby permitting complete dismantling of the rotor by removal of the bolts. The lower portion of the rotor hub is provided

with a removable cap 15 which may be secured to the rotor hub by means of cap screws 22 coacting with threaded openings in the lower ends of the bolts 14.

5 When used in a hydraulic turbine of the type having high specific speed, the rotor vanes oppositely disposed pressure surfaces 24 and suction surfaces 25 as shown in Figs. 3 and 4. With the arrangement disclosed, 10 the angularity of the pressure and suction surface of the fixed or inlet vane sections 2 are not adjustable, but the adjoining pressure and suction surfaces of the movable vane or discharge sections 3 are adjustable 15 about the axes of the pivots 4, 5 and relatively to the corresponding surfaces of the fixed vane sections 2. While the turbine is operating normally, the water is being delivered against the pressure surfaces 24 in 20 a well known manner, and the suction surfaces 25 are exposed to an under pressure or suction created by the water flowing through the draft tube.

If it is desired to vary the discharge angle of the rotor, the shaft 11 may be rotated 25 relatively to the shaft 13, either while the turbine is in operation or while it is at rest in any desirable manner. Rotation of the shaft 11 causes the block 10 to move longitudinally of the adjusting shaft by virtue 30 of the screw threads 12, thereby and causes all of the movable vane sections 3 to simultaneously swing about the axes of the pivots 4, 5 in an obvious manner. During such adjustment of the vane sections 3, the thrust 35 bearings 17, 18 positively prevent longitudinal displacement of the shaft 11 while permitting free rotation thereof. After adjustment has been effected, the screw threads 40 12 positively lock the movable vane sections 3 in adjusted position. The chamber within the rotor hub may be filled with grease or other lubricant thereby assuring abundant lubrication of the bearing surfaces. The entire rotor may be quickly dismantled by removal of the clamping bolts 14 and the outer 45 pivots 4 insure maximum rigidity of the structure. These outer pivots 4 furthermore permit reduction of the diameter of the inner pivots 5 and of the hub, to a minimum, 50 thereby providing a relatively compact rotor structure.

It should be understood that it is not desired to limit the invention to the exact details of construction and operation herein 55 shown and described, for various modifications within the scope of the claims may occur to persons skilled in the art.

It is claimed and desired to secure by Letters Patent:

1. In a rotor, a hub, a vane section rigidly associated with said hub, and another vane section movably supported directly by both said rigid vane section and said hub. 65

2. In a rotor, a hub, a vane section rigidly

associated with said hub, and another vane section movably supported at its outer end by said rigid vane section and at its inner end by said hub.

3. In a rotor, a hub, and a plurality of 70 vanes associated with said hub, each of said vanes comprising a section formed integral with said hub, and another section pivotally supported by said hub and by said first mentioned vane section. 75

4. In a rotor, a hub comprising detachable portions, a vane section rigidly associated with one of said hub portions, and another vane section pivotally supported by said fixed vane section and by all of said hub 80 portions.

5. In a rotor, a hub comprising detachable portions, and a plurality of vanes associated with said hub, each of said vanes comprising a fixed section formed integral with one 85 of said hub portions, and a movable section pivotally supported at its outer end by an adjacent fixed vane section and at its inner end by all of said hub portions.

6. In a rotor, a hub comprising detachable 90 portions forming a chamber, a vane section rigidly associated with one of said hub portions, a movable vane section pivotally supported by said fixed vane section and by said hub portions, and means within said chamber for adjusting said movable vane section 95 about its pivotal axis.

7. In a rotor, a hub comprising detachable portions coacting at a plane surface, a vane section rigidly associated with one of said 100 hub portions, and a movable vane section pivotally supported between said hub portions and in the plane of said surface.

8. In a rotor, a hub comprising detachable portions coacting along a plane surface, a 105 vane section formed integral with one of said hub portions, and a movable vane section pivotally supported by said fixed vane section and by said hub, the pivotal axis of said movable vane section lying in the plane 110 of said surface.

9. In a rotor, a hub having a chamber therein, a plurality of guideways formed within said hub adjacent to said chamber, a movable vane section supported by said 115 hub, a block movable along said guideways, means connecting said block and said movable vane section, and means for moving said block along said guideways to vary the position of said vane section. 120

10. In a rotor, a hub comprising detachable portions forming a chamber, each of said portions having guideways thereon adjacent to said chamber, a block coacting 125 with said guideways, a vane section rigidly associated with said hub, a movable vane section adjustably supported by said rigid vane section and by said hub, means connecting said block and said movable vane section, and means for moving said block 130

along said guideways to adjust said movable vane section relatively to said rigid vane section.

11. In a rotor, a hub comprising detach-
5 able portions forming a chamber, a vane section formed integral with one of said hub portions, a movable vane section pivotally supported by said fixed vane section and by said hub portions, an adjusting shaft rotat-
10 able within said chamber but fixed against longitudinal displacement, a block movable along said shaft by the rotation thereof, and means for transmitting adjusting motion from said block to said movable vane sec-
15 tion.

12. In a rotor, a hub having a chamber therein, a vane section formed integral with said hub, a movable vane section pivotally supported by said integral vane section and
20 by said hub, a rotary adjusting shaft having a threaded portion within said chamber, a threaded block movable along said shaft by the rotation thereof, and a link pivotally associated with said block and with said
25 movable vane section.

13. In a rotor, a hub having a chamber therein, an inlet vane section rigidly asso- ciated with said hub, a discharge vane sec- tion pivotally associated with said rigid

vane section and with said hub, said vane 30 sections having cooperating pressure and suction faces, and means within said cham- ber for moving said pivoted vane section relatively to said rigid vane section to vary the discharge angle of said rotor while 35 maintaining a fixed inlet angle therefor.

14. In a rotor, a hub, an inlet vane sec- tion formed integral with said hub, a dis- charge vane section pivotally associated with said hub, said sections forming a dove- 40 tail shaped vane radiating from said hub, and means within said hub for relatively adjusting said sections.

15. In a rotor, a hub, a plurality of non- overlapping vanes radiating from said hub, 45 each of said vanes comprising relatively fixed and movable sections, and means with- in said hub for relatively adjusting said sections.

16. In a rotor, a hub, and a plurality of 50 non-overlapping vanes radiating from said hub, each of said vanes comprising a section formed integral with said hub, and a mov- able section pivotally supported by said
55 hub.

In testimony whereof, the signature of the inventor is affixed hereto.

JAMES F. ROBERTS.