D. D. WELLS.

PROPELLER FOR FLYING MACHINES OR MARINE VESSELS.

APPLICATION FILED AUG. 5, 1909.

997,884. Patented July 11, 1911.

2 SHEETS—SHEET 1.

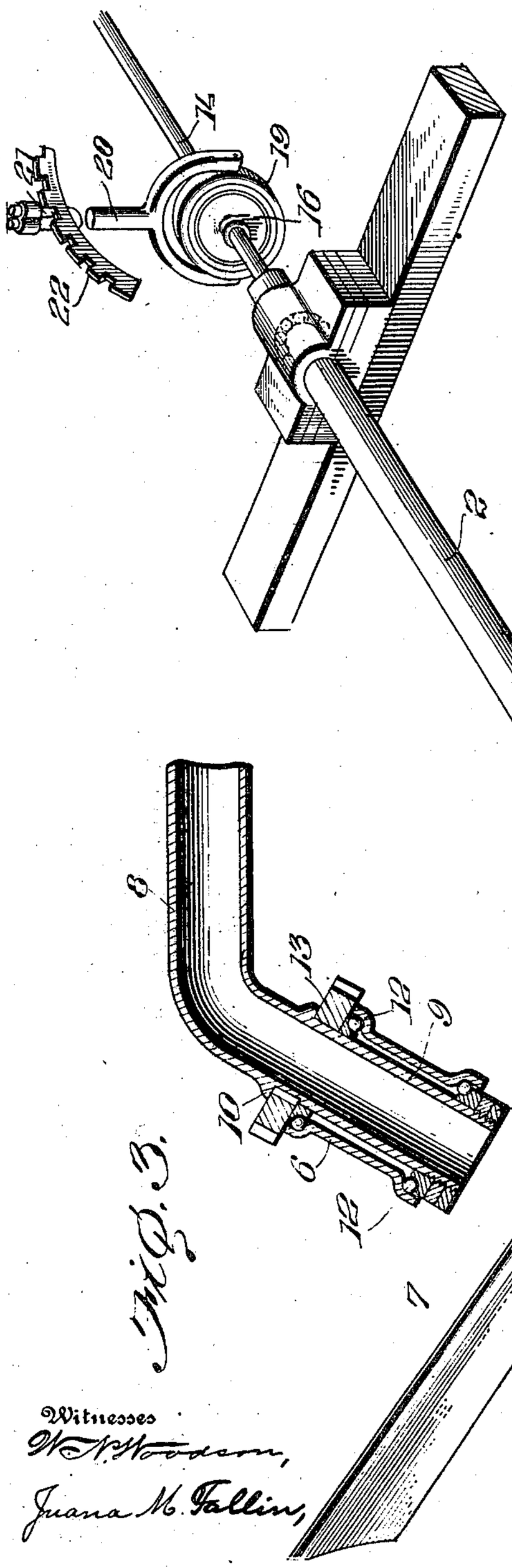

Fig. 2.

Fig. 3.

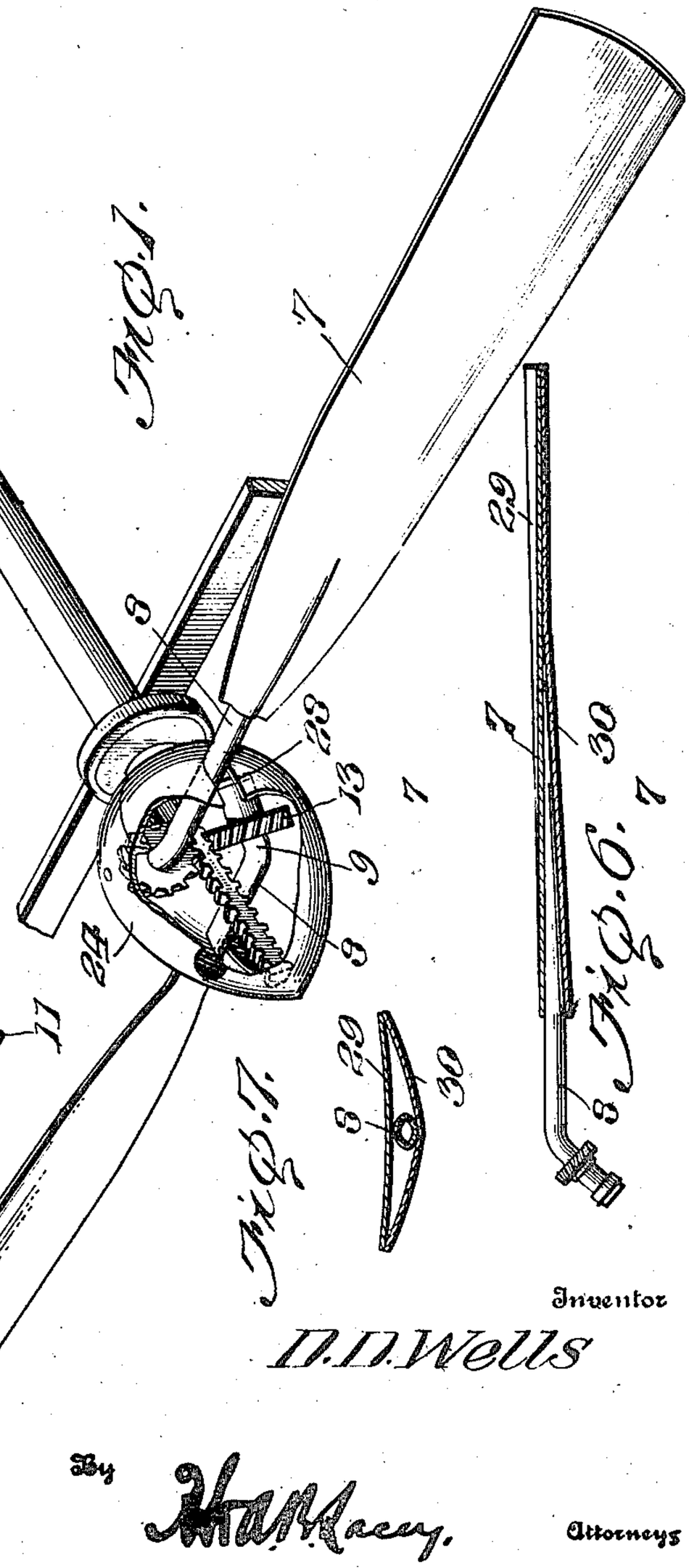

Fig. 4.

Fig. 5.

Fig. 6.

Witnesses
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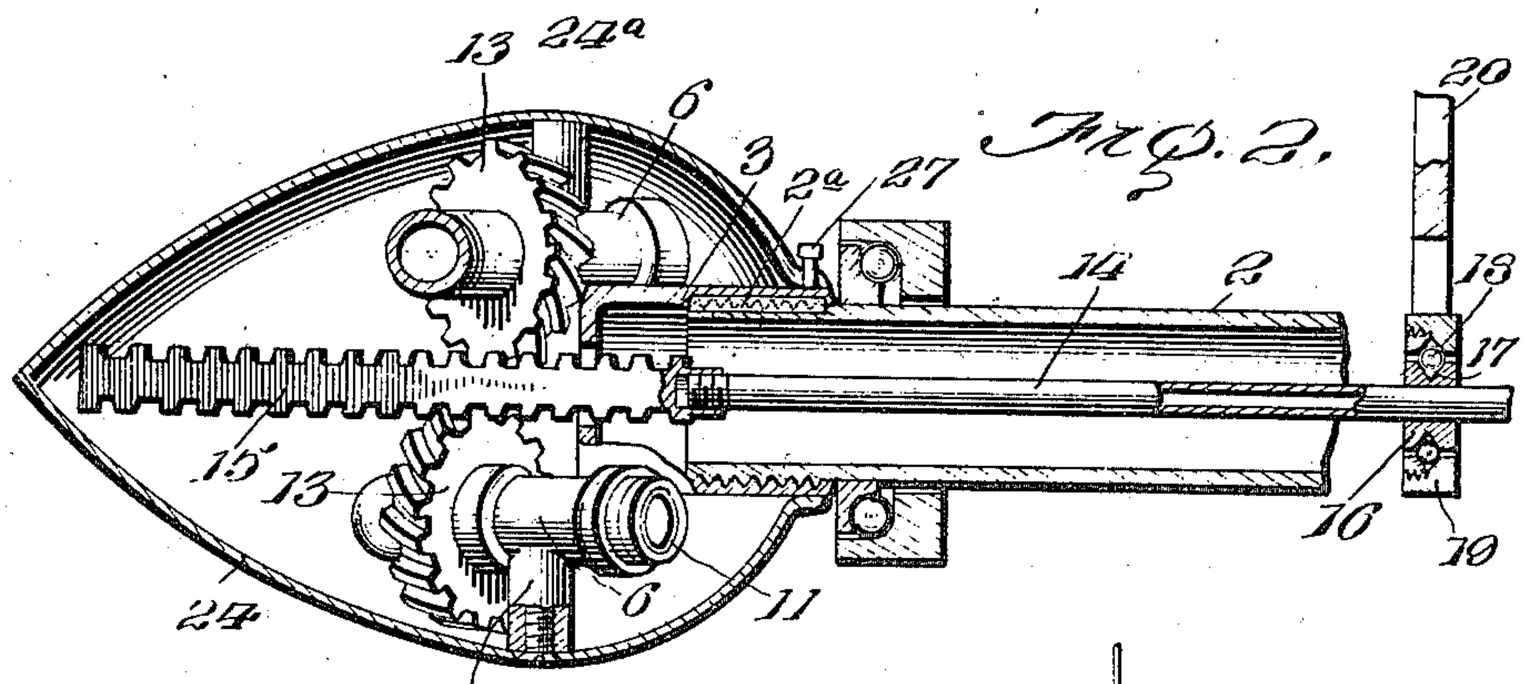

Fig. 2.

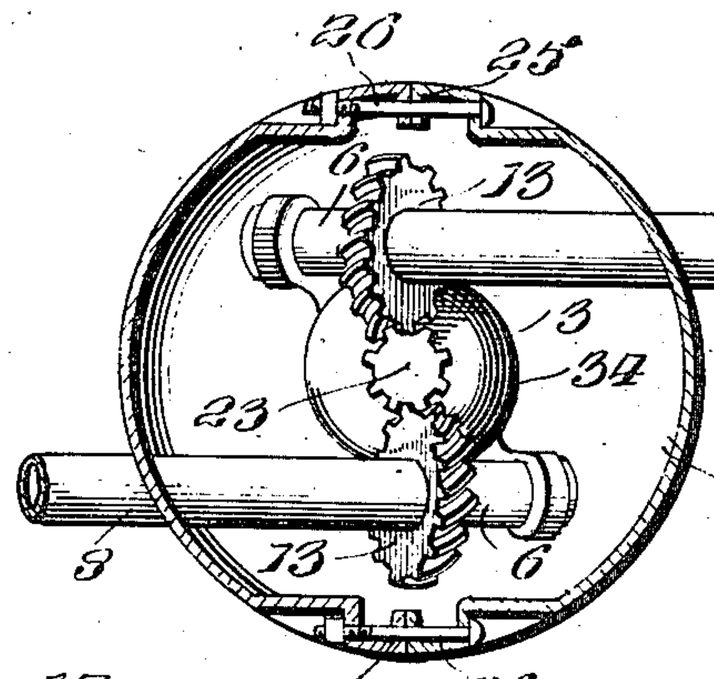

Fig. 5.

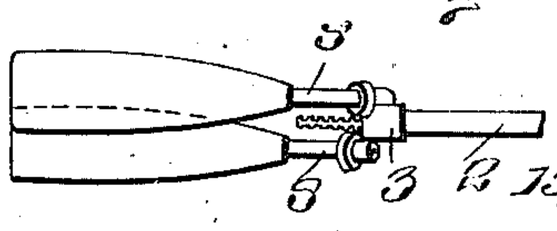

Fig. 11.

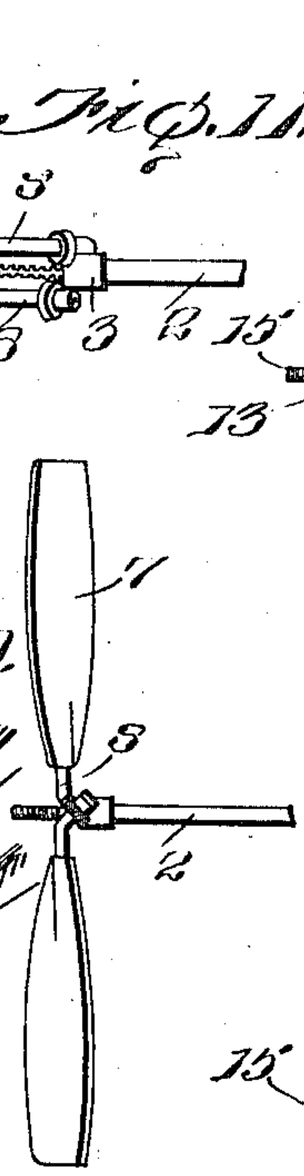

Fig. 6.

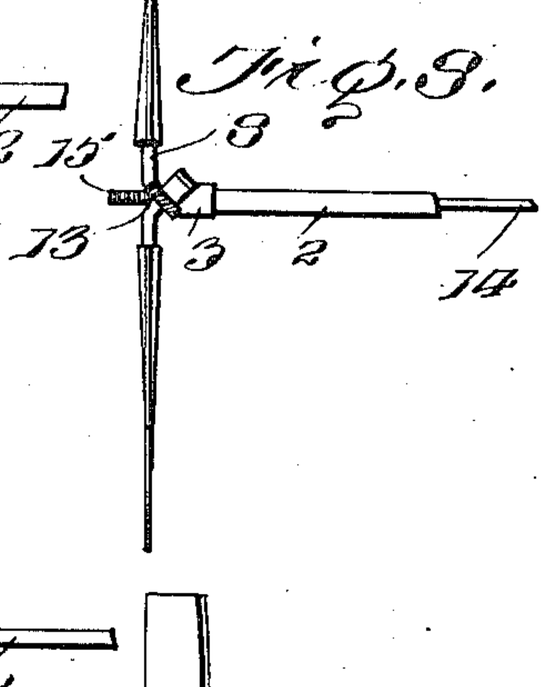

Fig. 8.

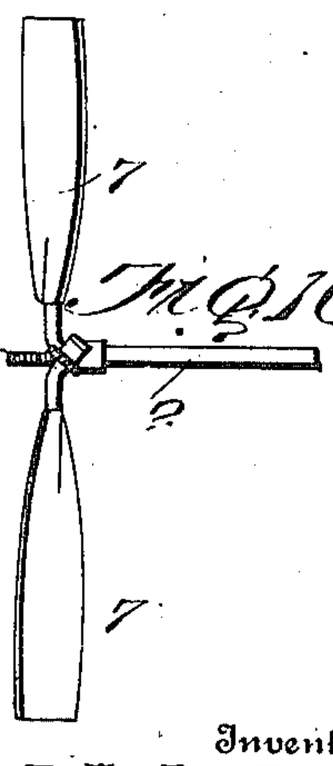

Fig. 10.

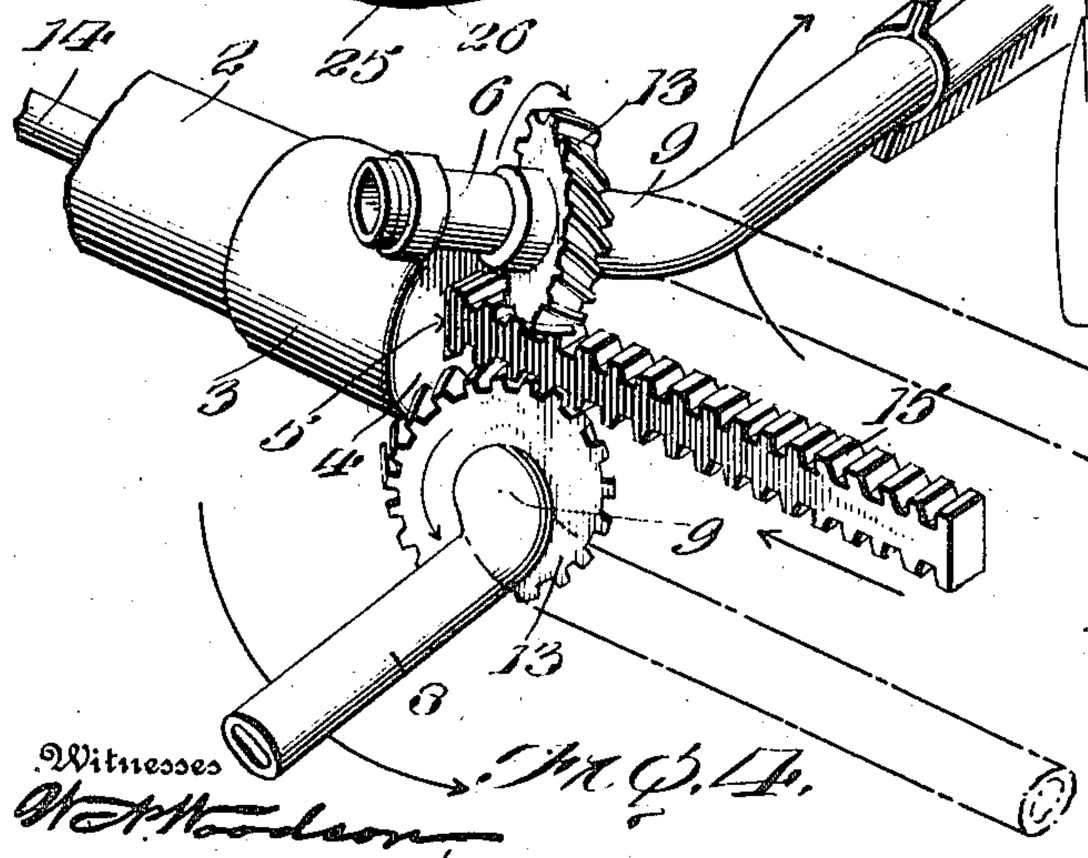

Fig. 4.

Witnesses

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UNITED STATES PATENT OFFICE.

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PROPELLER FOR FLYING-MACHINES OR MARINE VESSELS.

997,884. Specification of Letters Patent. Patented July 11, 1911.

Application filed August 5, 1909. Serial No. 511,338.

To all whom it may concern:

Be it known that I, DANIEL D. WELLS, citizen of the United States, residing at Jacksonville, in the county of Duval and State of Florida, have invented certain new and useful Improvements in Propellers for Flying-Machines or Marine Vessels, of which the following is a specification.

My invention relates to propellers and particularly to bladed propellers for use in either marine or aerial navigation, and the objects of the invention are: first; to provide a propeller in which the pitch of the blades may be readily changed while in operation and without stopping the propeller; second; through this ability to change the pitch of the blades, to readily shift the propeller from a go-ahead position to a reversed position, and from either of these positions to a neutral position wherein the blades shall have no effect; third; to provide a propeller wherein the blades may be shifted into a position wherein they shall lie parallel with each other and extended in the direction of the axis of the propeller shaft, such position being one wherein the least impediment is presented to the onward passage of the craft to which the propeller is applied.

The advantages secured by my invention are reversibility of the blades, whereby the reverse movement of the propelled craft can be secured without reversing the engines; variable blade pitch; and ability to fold the blades when desired, as when, in aerial navigation, the propelled craft is soaring, or alighting, or as in marine navigation when the craft is under the impulsion of sails or other power and it is desired to place the propeller blades in a position where they shall offer the least possible impediment to the passage of a vessel.

The mechanism for accomplishing these ends includes broadly a propeller shaft having mounted on the extremity thereof a plurality of opposed blades, each blade being rotatable upon its own axis in an opposite direction to the opposed blade, the inner ends or supporting shafts of the blades being angled and the angular ends being provided with gears meshing with an actuating rod carried within the hollow propeller shaft.

For a full understanding of the invention and the merits thereof and also to acquire a knowledge of the details of construction, reference is to be had to the following description and accompanying drawings, in which:

Figure 1 is a perspective view of my propeller; Fig. 2 is a longitudinal section of the rear end of the propeller shaft, the gears being shown in elevation; Fig. 3 is a longitudinal section enlarged of one of the bearing sleeves and the inner end of a blade shaft; Fig. 4 is a fragmentary perspective view of the rear end of the propeller shaft showing the gears; Fig. 5 is a transverse section through the outer casing showing a modified form of gear for driving the blades; Fig. 6 is a longitudinal section through one of the blades; Fig. 7 is a transverse section thereof on the line 7—7 of Fig. 6; Fig. 8 is a view showing the neutral position of the blades; Fig. 9 is an elevation showing the forward driving position of the blades; Fig. 10 is a like view of Fig. 9 but showing the reversed position of the blades; and, Fig. 11 is a like view of Fig. 9 but showing the folded position of the blades.

Corresponding and like parts are referred to in the following description and indicated in all the views of the drawings by the same reference characters.

Referring to these figures, 2 designates a tubular propeller shaft supported in any desired manner, preferably in ball bearings. The extremity of the shaft is preferably thickened and exteriorly screw threaded. A hub 3 interiorly screw threaded at one end engages with the end of the propeller shaft. The outer surface of the extremity of the shaft 2 and the inner face of the inner end of the hub 3 are both grooved for the reception of a key 2^a, whereby the hub and shaft are held in rigid engagement with each other, so that the hub is prevented from turning upon the shaft unless the key is withdrawn, when, of course, the hub may be unscrewed. This hub has a rounded end 4 formed with an opening 5 through its end in line with the axis of the shaft 2. This opening is preferably rectangular in the construction shown in these figures. The hub 3 has projecting from it on opposite sides, oppositely inclined sleeves 6 that are designed to support and afford bearings for

the angular ends of the propeller blades 7. These blades which are formed, as hereinafter described in detail, are each provided with a central supporting rod or shaft 8 which has its end 9 bent at an angle of about forty-five degrees. The angularly bent end of the tubular shaft 8 is provided with a shoulder 10 above the bend in the shaft and at its extremity is exteriorly screw threaded for engagement with locking nuts 11. The bent end of the shaft is adapted to be inserted through the sleeve 6 and to turn within said sleeve, the sleeve 6 being formed with opposed cups 12 at each end, designed to contain anti-friction balls, whereby the blade shaft will have an anti-frictional bearing within the sleeve 6. Fast on the angular section 9 of the shaft is the toothed gear 13 having inclined teeth. The anti-friction balls 12 fit between the cups and the gear wheel 13 at one end, and at the other the anti-friction balls bear against the nuts 11. By screwing down upon the nuts 11, one of which is a lock nut, it will be seen that the shaft 8 will be held within its bearings in the sleeve 6. It will also be obvious that the shaft and blade may be rotated within the sleeve 6.

Mounted within the tubular drive shaft 2 is an actuating rod 14 which is preferably tubular and carries at its end the rack 15 having oppositely toothed faces. The rack is rectangular in section and passes through the rectangular opening 5, thus the rack will turn with the shaft 2, but is shiftable longitudinally through the shaft. The teeth on the rack 15 engage with the inclined teeth on the gear wheels 13. It will be seen that as the gear wheels are inclined at an angle to the axis of the shaft 2, that the teeth on both gear wheels will extend transversely of the shaft 2, and that the teeth on the rack 15 also extend transversely of the shaft, and that thus the rack will mesh with both of the gear wheels at the same time, and that a movement of the rack in one direction will operate to rotate the gears 13 in opposite directions. This rotation of the gears 13 in opposite directions, of course, rotates the blades 7 in opposite directions on their axes. This rotation not only causes the blades to rotate around the axes of the blade shafts 8, but also causes the blades to describe a circular movement around the axes of the bearing sleeves 6. This circular movement will bring the blades either into a parallel relation to each other, as in Fig. 11, or into alinement with each other, when they extend transversely of the axis of the shaft 2. This transverse position at various angles to the shaft 2, is the actuating position of the blades, except at one portion of the movement when the blades are so turned that their surfaces lie in precisely the same plane, when, of course, the blades are incapable of moving the vessel to which they are attached in either direction.

As a means of shifting the actuating rod 14, I have shown a collar 16 fast on the rod, this collar having a circumferential V-shaped groove 17 which forms a race-way and carries a series of anti-friction balls 18. Surrounding the collar 16 and the balls carried therein, is a shipping ring 19 formed in two opposed sections, one of said sections being screw threaded into the other, the two sections being so formed on their inner faces as to provide a V-shaped groove carrying the balls 18. This ring is provided with the usual pins engaging with the bifurcated end of any suitable shifting lever 20. I have shown the extremity of this lever as provided with a detent 21 engaging with an arcuate rack bar 22, whereby the lever may be held in any adjusted position. It is to be understood however that I do not wish to limit myself to this means of shifting the actuating rod 14, and have merely shown it as illustrative of the manner in which the said rod may be shifted.

While I preferably use an actuating rod 14 which is formed with opposite rack teeth, I wish it understood that I may use for the purpose of actuating the blades a rod having an ordinary pinion 23 thereon engaging with the opposed gear wheels 13, as shown in Fig. 4. It will be seen that for this purpose the gears are simply reversed to the position shown in Fig. 2.

Attached to the exterior of the hub 3 by screws or other suitable means, is an inclosing casing 24. This casing is preferably made in two approximately semi-ovoid or semi-conical opposed sections, each section having inwardly turned flanges 25, whereby the sections may be attached to each other. Screws 26 or other suitable fastening devices pass through countersunk openings in the face of the casing 24 and through the two inwardly turned flanges 25, thus holding the casing securely together. Screws 27 also pass through the rear portions of the casing sections and extend into the hub 3 at the rear end thereof. Studs 24ª project from the sleeves supporting the casing, countersunk screws holding the casing in place. The openings for these screws are likewise countersunk, so that there shall be no projections upon the exterior face of the casing. It is for this reason that I form the casing of an ovoid shape, as this form will give the least resistance to passage through air or other fluid. The casing is, of course, slotted, as at 28, for the passage of the blade shafts 8.

While I may form the blades in any desired manner, preferably I make the shafts 8 tubular and extend these shafts forward about two-thirds the length of the blade 7. Each blade 7 is preferably made of metal

and preferably consists of a flat blade-like plate 29 and a laterally curved plate 30, these two plates being brazed or otherwise connected to each other along their edges. Both plates are, of course, conformed at their inner ends to the tubular shaft 8 and are brazed or otherwise attached thereto, along the whole length of the inclosed tube so as to be rigid therewith. It will be seen that these blade constructions make the blades extremely light and yet particularly rigid with very little danger of the blades breaking or otherwise becoming damaged.

The operation of my device is as follows: The shaft 2 is, of course, to be driven by any suitable motor (not shown), while the blade actuating rod is to be moved to its various positions and held adjusted in them, by any suitable mechanism, such as the shipper lever shown. By moving the actuating rod the blade gears are rotated, thus rotating the angled blade shafts and bringing the blades to their several positions. This rotative movement of the blade shafts not only rotates the blades on their axes, thus changing the inclination or pitch of the blades, but also changes the angle of the blades to the driving shaft, and thus rotates them around the axial center of the blade shaft bearings. In Fig. 8, the blades are shown in their neutral position, that is the blades extend at right angles to the shaft 2 and the faces of the blades are both in the same plane, which is at right angles to the shaft. Upon an inward movement of the actuating rod the blades are rotated in opposite directions, so that the plane of each blade is inclined to the axis of the driving shaft, the opposed blades, however, being inclined in opposite directions as in all screw propellers. Upon an outward movement of the actuating rod from its neutral position, the blades will be turned upon their axes to an inclination the reverse of that just before described, so that being driven the blades will reverse the movement of the vessel, without the necessity of reversely driving the driving shaft, as shown in Fig. 10. When it is desired to fold the blades the actuating rod is moved to swing the blades through a one-quarter circle until they occupy the position shown in Fig. 10, the blades having at the same time so rotated on their axes, that when they become parallel to each other the faces of the blades will lie in the same plane. In this position they offer the least possible impediment to the movement of the vessel or flying machine. While the blades are capable of adjustment to these different full positions, it will be obvious that they may be rotated on their axes to various inclinations between a full driving inclination, or pitch and their neutral position, thus quickly changing the pitch of the blades to any degree required. This ability to change the blade pitch is of great importance and especially when the mechanism is to be applied to propelling a flying machine.

While it is for flying machines that this propeller has been especially designed, yet I do not wish to limit myself to this use, as it is obvious that it can be applied to any other form of vessel for the propulsion thereof or may be used in any other circumstances where a bladed fan or propeller wheel is applicable.

Having thus described the invention what is claimed as new is:

1. In a propelling mechanism, a driving shaft and propeller blades rotatable with the driving shaft, said blades being rotatable individually around their major axes to vary their pitch, said blades being also foldable into and out of positions of more or less parallelism with the driving shaft, and common means operatively engaging with all of the blades simultaneously for positively rotating the blades around their major axes and moving said blades into or out of their folded positions.

2. In a propelling mechanism, a driving shaft and a bladed propeller, each blade being individually rotatable around its major axis to vary the pitch thereof, and common positively acting means for simultaneously rotating all of said blades around their major axes and folding the blades into and out of positions of more or less parallelism with the axis of the driving shaft.

3. In a propelling mechanism, a driving shaft and a bladed propeller rotatable with the driving shaft, the blades of the propeller being each rotatably adjusted around its major axis to vary the pitch of the blade, said blades being simultaneously movable from positions at right angles to the driving shaft to positions of parallelism with the driving shaft, and common, positively acting mechanism operatively engaging with the blades for simultaneously rotating the same upon their axes for folding or unfolding the blades.

4. In propelling mechanism, a driving shaft, opposed blades carried by said shaft and rotatable therewith, said blades being each rotatable in opposite directions around the longer axes of the blades to change the pitch thereof, and mechanism engaging with the inner ends of the blades for positively rotating them around their major axes and for simultaneously swinging the blades bodily into various angular relations to the axis of the driving shaft.

5. In propelling mechanism, a driving shaft, opposed blades mounted thereon and rotatable therewith, said blades each having an axial shaft having an angularly bent end rotatably mounted upon the driving shaft, and means engaging with the angularly bent ends of the blade shafts for rotating said

shafts and blades, thereby causing the blades to rotate about their major axes and simultaneously folding the blades into various angular relations to the axis of the driving shaft.

6. In propelling mechanism, a driving shaft, opposed blades mounted thereon and rotatable therewith, said blades each having an axial shaft having an angularly bent section rotatably mounted upon the driving shaft, toothed gears fast on the angularly bent sections of the shafts, and mechanism carried by the driving shaft and meshing with the said gears for rotating the shafts.

7. In propelling mechanism, a driving shaft, opposed propeller blades carried by said shaft, each blade supported on an axial shaft formed with an angularly bent section, said angularly bent section being rotatably mounted on the driving shaft, gears fast on the angularly bent sections of the shafts to rotate the same, said gears being oppositely inclined to each other, and an actuating rod extending through the driving shaft and engaging with said teeth to rotate the gears and blade shafts.

8. In propelling mechanism, a driving shaft, opposed propeller blades rotatable with said shaft, each of said blades having an axial shaft formed with an angularly bent portion, bearings for the angularly bent ends of the blade shafts, gears carried on said angularly bent portions and formed with inclined teeth, one of said gears being inclined in an opposite direction to the opposed gear, and an actuating rod passed longitudinally through the driving shaft and having opposed rack teeth meshing with said gears.

9. In propelling mechanism, a driving shaft, opposed propelling blades rotatable with said shaft, each of said blades having an axial shaft formed with an angularly bent portion, opposed bearings for the angular portions of the blade shafts carried by the driving shaft, a gear wheel on the angular end of each blade shaft, said gear wheels being inclined in opposite directions to each other, teeth on the gear wheels inclined to the axis of the bent end of the blade shafts, and an actuating rod extending longitudinally through the driving shaft and intermeshing with said gears to rotate the same.

10. In propelling mechanism, a tubular driving shaft, a hub carried upon the extremity of the driving shaft and formed with a rectangular opening through the end thereof, opposed bearing sleeves carried at regular opposite points on the hub and rotatable with the hub and the driving shaft, propeller blades having axial shafts formed with angularly bent ends rotatably mounted within said sleeves, gear wheels fast on the bent ends of the blade shafts and having inclined teeth, one of said gear wheels being inclined oppositely to the opposed gear wheel, an actuating rod rectangular in section extending through the driving shaft and through the rectangular opening therein, said actuating rod being provided with opposed rack teeth engaging with said gears, and means for reciprocating said rod to rotate the gears and propeller blades.

11. In propelling mechanism, a driving shaft, opposed blades carried by said shaft and rotatable therewith, each of said blades having an axial blade shaft formed with an angularly bent end rotatably mounted on the end of the driving shaft, mechanism carried within the driving shaft for rotating said blade shafts independently of the rotation of the driving shaft, and a casing attached to and carried by the driving shaft extending around the extremity of the driving shaft, gears, and the inner extremities of the blade shafts and inclosing the gears, said casing being formed in detachable sections.

12. In a propelling mechanism, a driving shaft and propeller blades rotatable with the driving shaft, said blades also being rotatable individually around their major axes to vary their pitch, said blades being also foldable into or out of position of more or less parallelism with the driving shaft, and means operatively engaging with all of the blades simultaneously for positively rotating the blades around their major axes and moving said blades out of or into their folded position, said means axially rotating the blades into a like plane when the blades are at right angles to the propeller shaft and acting to incline the plane of the blades relatively to each other when the blades are turned into a position to more or less than a right angle to the shaft.

13. In a propelling mechanism, a driving shaft and propeller blades rotatable with the driving shaft, each of said blades having an axial shaft, said blades being rotatable individually around their major axes to vary their pitch and being also foldable into or out of position of more or less parallelism with the driving shaft, a mechanism contained within the driving shaft and engaging said blade shafts for positively rotating said blade shafts around their longitudinal axes and simultaneously swinging the blades bodily into and out of positions of more or less parallelism with the axis of the driving shaft.

14. In a propelling mechanism, a driving shaft and a bladed propeller, each blade having an axial shaft and each blade and blade shaft being individually rotatable around the major axis of the blade shaft to vary the pitch of the blade, a gear wheel

on each blade shaft, a mechanism operatively engaged with all of the gear wheels for simultaneously rotating all of said blades around their major axes and folding the blades into or out of positions of more or less parallelism with the axis of the driving shaft.

In testimony whereof I affix my signature in presence of two witnesses.

DANIEL D. WELLS. [L. S.]

Witnesses:
FREDERIC B. WRIGHT,
W. N. WOODSON.