

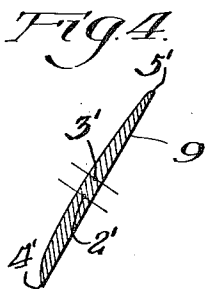
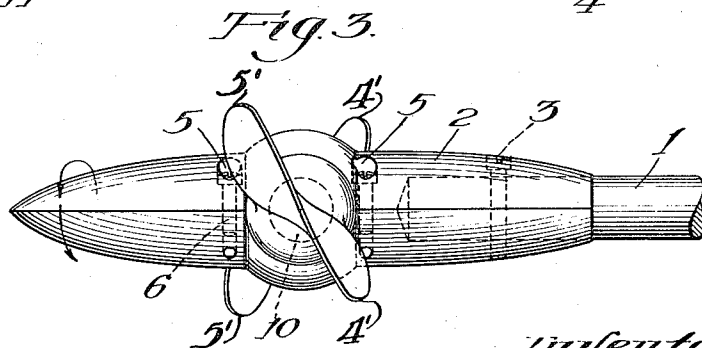
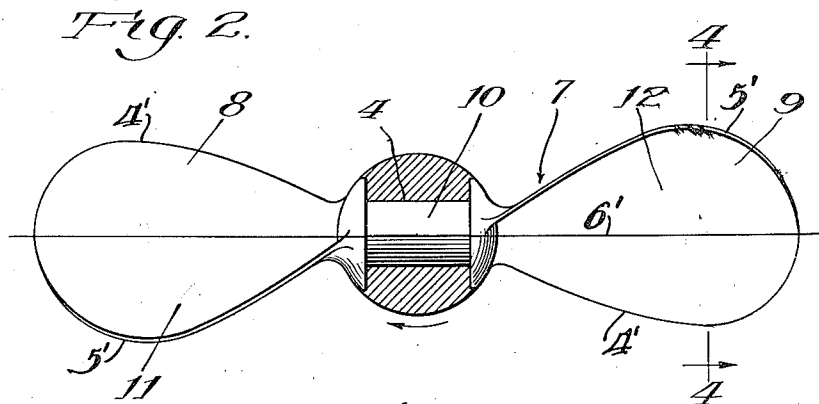
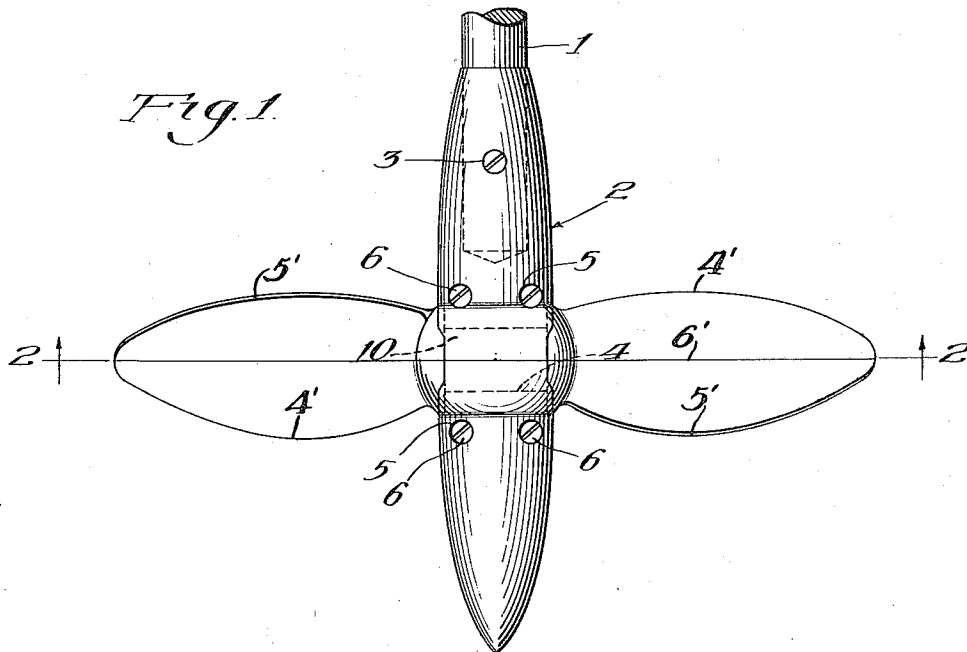
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PROPELLER

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PROPELLER

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1 Claim. (Cl. 170—162)

This invention relates to improvements in propellers, and refers specifically to a multi-blade propeller characterized in that during operation connected blades perform the same amount of work irrespective of the medium, variations in the movement of the medium or variations in density or pressure of the medium in which the blades work.

My invention, although applicable to many types of propellers for propelling objects through a fluid medium or imparting motion or agitation to a fluid, is ideally adapted for use in conjunction with ships, and although I will describe my invention in this latter environment, I do not wish to be limited to this specific application thereof.

One of the most serious limitations to the speed and comfort of ships is the vibration caused by the propeller when the ship is driven at high speed. Such vibration, in a predetermined instance, may be lessened slightly by adding weight to the ship, but this in no wise remedies or lessens the cause of the vibration. Obviously, this solution of the problem merely dodges the issue and in practice the adding of such non-paying weight soon renders the slight benefits accruing therefrom uneconomical.

I have observed that one of the principal causes of vibration results from the dynamic unbalance of the propeller, that is, the blades of a propeller do not perform equal work. It has been found that the amount of work done by a propeller is a function of the following items:

1. The revolution per unit of time of the propeller;
2. The speed of the water impinging upon the blade;
3. The area of the blade surfaces; and
4. The pitch of the blades with respect to the driving axis.

Item No. 3 is constant and heretofore item No. 4 was often considered a constant. However, propellers have been built where item No. 4 could be varied from time to time through a manually operated screw device running through a hollow shaft to the propeller whereby the pitch of all blades could be increased or decreased at the same time. However, the pitch of the blades has heretofore been increased or decreased equally to change boat speed while maintaining propeller R. P. M. constant.

In the above list item No. 2 is a variable. One of the most important functions of this variable is recognized as the effect produced by the motion of the ship through the water. As is well

known, the propeller is mounted at the rear of the ship normally below the water line. When the hull of a ship moves through the water friction causes the water adjacent the hull surface to move forwardly at a predetermined rate. The movement of the water is a maximum adjacent the hull surface and decreases along a line normal to, and away from said surface. Further, the rate of movement of the water is also dependent upon the length of the hull with which the water has contacted, resulting in a greater velocity of water adjacent the water surface where the ship's wetted length is greatest than water close to the ship down near the keel where the ship's wetted length is least.

This fact results in a variable movement of the water at the rear of the ship, the medium in which the propeller operates, the movement of the water with respect to the propeller increasing substantially inversely as the wetted length of the ship and generally inversely as the depth. Heretofore, therefore, with items Nos. 1, 3 and 4 maintained constant, the propeller assumed a state of dynamic unbalance which, of course, resulted in vibration.

Accordingly, I have so constructed my propeller that variations in item No. 2 are compensated by corrective variations in item No. 4, that is, variations in the movement of the medium in which the propeller operates automatically causes variations in the pitch of the blades of the propeller with respect to the driving axis.

Other objects and advantages of my invention will be apparent from the accompanying drawing and following detailed description.

In the drawing, Fig. 1 is a top plan view of my propeller.

Fig. 2 is a rear elevational view of the propeller blades and a sectional view taken on line 2—2 of Fig. 1.

Fig. 3 is a side elevational view of the propeller as illustrated in Fig. 1.

Fig. 4 is a sectional view of a blade of the propeller taken on line 4—4 of Fig. 2.

Referring in detail to the drawing, 1 indicates a propeller shaft of a ship (not shown), the shaft 1 projecting from the lower rear portion thereof. A longitudinally separable collar 2 is mounted upon the end of shaft 1 and is secured rigidly therewith by means of pin or screw 3 which is countersunk below the surface of the collar. The collar 2 is of typical stream line construction so as to encounter a minimum resistance in movement through the water. For purposes of my invention the collar 2 may be mounted upon shaft

1 in any conventional manner, the showing of pin or screw 3 being merely for purposes of illustration.

Each of the separable portions of collar 2 is provided intermediate its length with a semi-cylindrical bearing surface, which when the collar is assembled, register with each other to form a bearing. The collar 2 adjacent said bearing is provided with bores 5 for the reception of screws 6 or other fastening means, said screws being countersunk similar to screw 3. By the provision of screw 3 and screws 6, the collar 2 is securely maintained in assembled relation.

A propeller 7 is adapted to be carried by collar 2 and comprises appropriately pitched helicoidal blades 8 and 9 formed integral with or rigidly connected by shaft 10. Shaft 10 is adapted to be journaled in the bearing provided in collar 2 and is rotatable therein. The axis of rotation of shaft 10 will, for convenience, be hereinafter designated the compensating axis to distinguish from the axis about which shaft 1 turns which will be hereinafter termed the driving axis. It can readily be seen that the blades being rigidly connected to each other by shaft 10, maintain a fixed pitch relationship to each other irrespective of rotation of propeller 7 about the driving axis or the compensating axis, but the angular relationship of the surfaces of blades 8 and 9, that is, the pitch of said individual blades change with respect to the driving axis when shaft 10 rotates.

The surfaces of blades 8 and 9 are not symmetrical about the compensating axis, that is, the area of blade 8 upon one side of the axis is greater than the area of the blade 8 upon the opposite side of said axis, and the area of blade 9 on one side of its axis is greater than the area of blade 9 on the opposite side of said axis. Referring to Figs. 2 and 3, it will be seen that the area of the blade 8 above the compensating axis is less than the area of said blade below said axis and with respect to blade 9 the opposite is true. Referring to the direction of rotation of the propeller 7, as indicated by the arrow, the area of each of the blades on the leading side of the compensating axis is less than the area on the trailing side thereof.

Similar to the concept of the center of gravity of a body, that is, the weight of a body may be considered as being concentrated at its center of gravity with respect to forces acting on said body, the force exerted by a propeller may be considered as originating at what may be termed the centers of effort of the blades. The center of effort of a blade is primarily determined by its effective working area and in my construction, the blades being of helicoidal surface, the center of effort falls on the trailing side of the compensating axis, that is, the side of greater area. For purposes of illustration, I have designated said points as 11 and 12 on blades 8 and 9 respectively.

Assuming propeller 7 as rotating about its driving axis in still water, the force of reaction of the water in the case of both blades will act on a moment arm equal to the distance of each center of effort 11 and 12 from the compensating axis. These moment arms are equal, by construction of the propeller, and inasmuch as still

water is considered, the forces acting will be substantially equal. Therefore, no rotation of shaft 10 about the compensating axis will take place. This condition, of course, is ideal, and in the case of ships, is never met with in practice.

Practically, as has been hereinbefore described, the movement of the medium changes the force of the water reacting at the centers of effort and one moment of force of one blade will temporarily overbalance the moment of force of the other blade. The propeller will then rotate about its compensating axis, thereby changing the pitch of the blades with respect to the driving axis. An equilibrium, of course, will soon be established when the moments of said forces will equalize each other. This, therefore, results in an arrangement wherein the moments of the reacting forces are equalized by a change of pitch of the blades with respect to the driving axis, and hence each blade performs equal work irrespective of the motional or other physical variations of the medium in which the blades act.

Of course, since the propeller 7 rotates about the driving axis, it is statically balanced with respect to such axis. However, the propeller also rotates about the compensating axis and therefore I also statically balance said propeller about this axis. By referring to Fig. 4, a cross sectional view of one of the blades shows that the center of inertia 2' does not coincide with the center of width 3' of the blade but due to increased thickness on the side of the leading edge 4' of the blade, the center of inertia falls closer to the leading edge than the trailing edge 5'. In other words, the locus 6' of the centers of inertia of all of the sectional increments coincides with the compensating axis.

I claim as my invention:

A marine propeller device of the class described which comprises a two-part collar mounted upon a rotating drive shaft, the said collar being split in a plane through the axis of said shaft and being formed intermediate its length with coacting semi-cylindrical portions radially extending blades carried by said collar, said blades having helicoidal surfaces, means integral with said blades comprising a central cylindrical element rigidly connecting said blades together to maintain the pitch of said blades constant with respect to each other and to maintain the compensating axis of the blades at right angles to the axis of the drive shaft, said means being journaled in said coacting semi-cylindrical portions and freely rotatable to change the pitch of said blades with respect to the axis of the drive shaft, the face of each blade on one side of the projected axis of said compensating axis being greater in area than the area of the face of said blade on the opposite side of said projected axis, the center of effort of each blade being on opposite sides of said projected axis, the thickness of each blade on opposite sides of said projected axis bearing an inverse ratio to the area of said blades to substantially statically balance said blade about the projected axis.

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