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C. F. ROPER.

SPEED CONTROLLING REVERSING PROPELLER.

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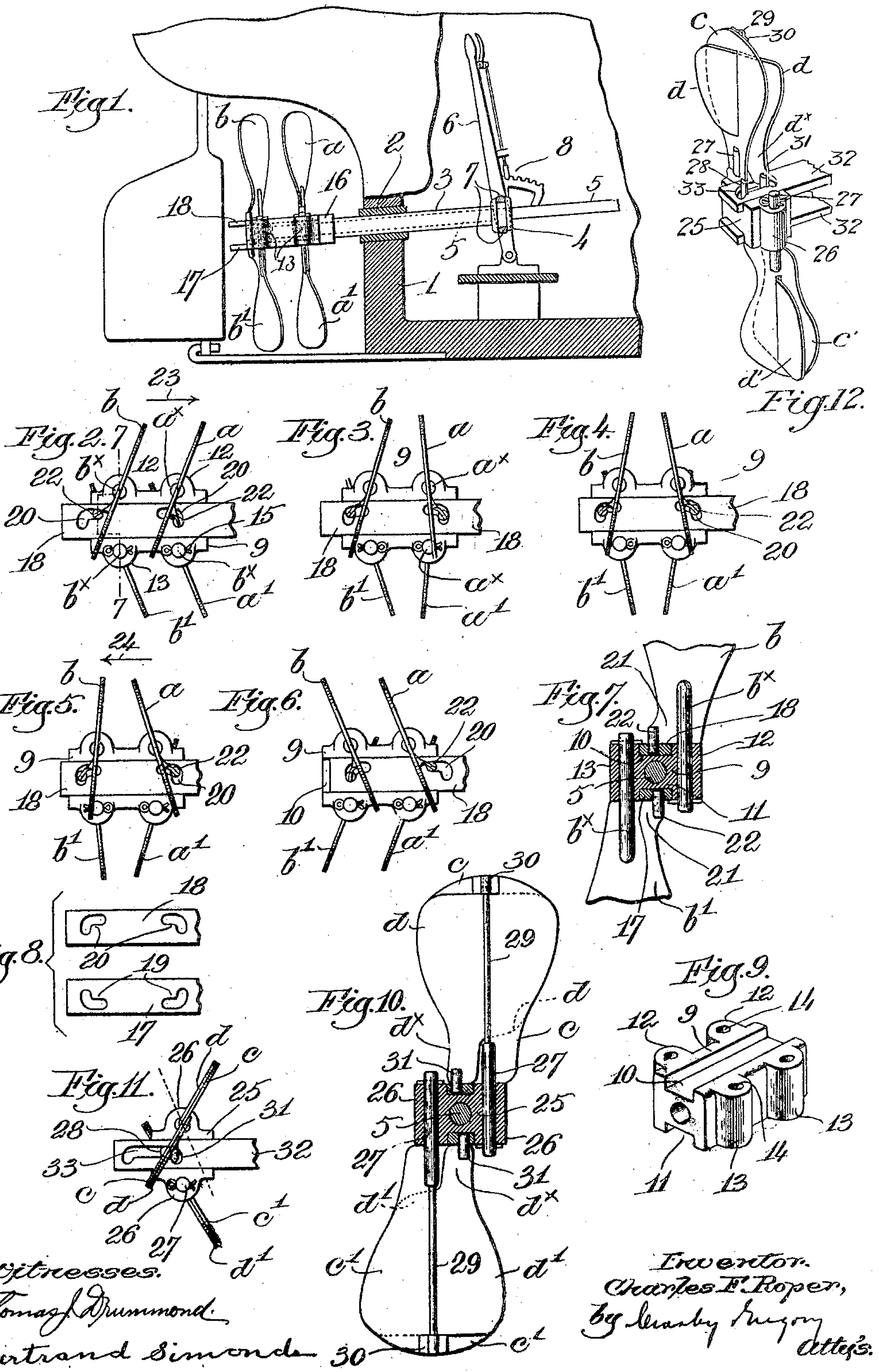

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SPEED-CONTROLLING REVERSING-PROPELLER.

No. 807,498. **Specification of Letters Patent.** **Patented Dec. 19, 1905.**

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To all whom it may concern:

Be it known that I, CHARLES F. ROPER, a citizen of the United States, and a resident of Hopedale, county of Worcester, State of Massachusetts, have invented an Improvement in Speed-Controlling Reversing-Propellers, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention has for its object the production of a speed-controlling reversing-propeller particularly adapted for use in connection with motors whose greatest efficiency is attained when running at a predetermined and substantially uniform speed.

It is now very common to provide small boats and launches with motors of the internal-combustion type for fishing or cruising purposes; but it is difficult to readily control the speed of the boat and its direction of movement ahead or astern. Such regulation of the boat's movement cannot be effected with such nicety as is possible with a steam-motor, for while the four-cycle gasolene-motor can be better regulated than the two-cycle type neither can be slowed down sufficiently for fishing without danger of complete stoppage at most inopportune times. Reversing-propellers have been used with gasolene-motors; but if it is attempted to attain satisfactory speed by means of such a propeller the engine is practically certain to "race," quickly taking in too much gasolene and smothering itself. Many launches have two-cycle motors with a maximum speed of seven to eight miles per hour, and they cannot be slowed down to less than four or five miles, which is much too fast for fishing, making a landing, or for cruising in unknown shoal water or among rocks.

I have devised a propeller which is inexpensive, easily controlled, and particularly adapted for use with gasolene-motors, as I can attain any speed from zero to maximum, either ahead or astern, with the engine running at normal speed and always in the same direction, the construction of the propeller being such that at all times a substantially constant resistance is maintained on the motor, the reversal in direction, as well as the speed variation, being effected wholly by the propeller itself and without the use of clutches or similar devices.

To this end the propeller comprises two sets of blades bodily rotatable with the shaft, but angularly movable thereon, means being provided to vary the relative angularity of the blades of the sets to thereby not only reverse the direction, but also to vary the propulsive effort of the blades from zero to maximum in either direction, while at all times maintaining a substantially constant resistance on the motor.

The various novel features of my invention will be fully described in the subjoined specification and particularly pointed out in the following claims.

Figure 1 is a side elevation of a propeller embodying one form of my invention shown as mounted at the stern of a boat, the motor-shaft and the manually-controlled means for regulating the speed and direction being shown. Fig. 2 is a top plan view of the propeller-blades, the blade-carrying hub, and the blade-controller, the blades being set for full speed ahead. Fig. 3 is a similar view, but showing the blades set for, say, half-speed ahead. Fig. 4 is a like view, but with the blades set in neutral position, reducing speed to zero. Fig. 5 shows the blades set for, say, half-speed astern; and Fig. 6 shows the blades set for full speed astern. Fig. 7 is an enlarged transverse sectional detail on the line 7 7, Fig. 2, looking toward the left, the blades being in elevation. Fig. 8 shows the opposite cheeks or bifurcations of the controller with the cam-slots therein to illustrate the relative arrangement of the latter. Fig. 9 is a perspective view of the blade-carrying hub. Fig. 10 is a cross-section and elevation of a modified arrangement of propeller-blades to be referred to. Fig. 11 is a smaller top plan view thereof with the blades set for full speed ahead; and Fig. 12 is an enlarged perspective view of the modified construction, showing the same more clearly, the blades being set in neutral position.

Referring to Fig. 1, the stern-post 1 of the boat is provided with a suitable bearing 2, in which is mounted a rotatable longitudinally-movable sleeve 3, having a grooved collar 4 on its inner end, the driving-shaft 5 extending through and rotating with the sleeve, it being supposed that the motor by which the shaft is driven is of the internal-combustion type referred to. A controlling-lever 6, having a yoke 7 coöperating with the collar 4 and provided with a well-known form of locking device 8, serves to effect longitudinal movement of the sleeve upon the motor-shaft in order to control the speed of the boat and also its movement ahead or astern, as will be described.

By the term "motor-shaft" as herein used I mean either a direct continuation of the shaft of the motor or a shaft connected with and rotated by the actual shaft of the motor, the shaft 5 being supposedly driven uniformly as to direction and speed—that is, it is rotated in one direction only and at practically the same speed irrespective of the speed of the boat.

On the outer end of the shaft 5 I fixedly secure a blade-carrying hub 9, separately shown in Fig. 9, preferably an elongated casting substantially rectangular in cross-section and having longitudinal and parallel guideways or grooves 10 11 in two opposite sides. The other two sides are shown as provided with bosses 12 13, arranged in opposite pairs and apertured at 14, the apertures of the several bosses being in parallelism and in planes at right angles to and intersecting the shaft 5.

I have shown in Figs. 1 to 6 two sets of propeller-blades mounted on the hub, each set consisting of two oppositely-extended blades, the blades of one set being indicated by a a' and the blades of the other set by b b' for convenience in referring thereto.

Pintles or studs $a^{\times}$ $b^{\times}$, secured to the bases of the blades, are loosely mounted in the apertures 14 of the bosses on the hub, the arrangement being clearly shown in Fig. 7 for the pair of blades b b', the other pair being arranged in a similar manner, and any suitable device may be employed to hold the pintles in the bosses, such as cotter-pins 15, though for large blades nuts threaded onto the pintles might be employed.

From the foregoing it will be seen that the angularity of the blades may be varied, either of the two blades of a set or the blades of one set may be varied as to their angularity relatively to the blades of the other set, and the controller by which such variation in angularity is effected will now be described.

The controller proper is a casting 16, bifurcated to present two elongated parallel cheeks or extensions 17 18, which fit into and are longitudinally slidable in the hub-grooves 11 and 10, respectively. The forward end of the controller is rigidly secured to the rear end of the sleeve 3, the shaft 5 passing through an opening in the said end of the controller. I have provided the cheeks with cam-slots, and referring to Fig. 8, where the cheeks are offset in order to show the relation of the cam-slots, it will be seen that the cheek 18 has two of such slots 20 and the cheek 17 has two, as 19, but reversely arranged. Each slot has a longitudinal portion and a short transverse bend at its outer end.

Referring to Fig. 7, each blade has its base extended inward to overhang the adjacent cheek, as at 21, and such overhang is provided with a pin or lug 22, which enters the adjacent cam-slot and serves as a follower.

Referring now to Fig. 2, it will be seen that the blades a and b are in parallelism and the blades a' and b' are in parallelism, being held in such position by the coöperation of the cam-slots with the several followers 22, the controller 16 at such time being in its extreme outward or left-hand position viewing Fig. 1. The propeller-blades are now set for full speed ahead, or in the direction of arrow 23, Fig. 2, and the propeller will exercise its maximum propulsive force to send the boat ahead when the blades are revolved by shaft 5 bodily about their common axis of revolution. If it be desired to reduce the speed, the operator, by means of the lever 6 and intervening connections, moves the controller 16 forward or inward, such movement acting first to change the angularity of the blades a and a', as their followers are acted upon by the bends of their cam-slots, while the resistance on the motor is maintained by the blades b b', the angularity whereof has not yet been changed, and when the controller is positioned as in Fig. 3 the speed will be reduced to about half-speed, and the angularity of blades b b' has been slightly changed, as will be apparent by comparing Figs. 2 and 3. The blades b b', however, are still acting to drive the boat ahead; but the other set of blades a a' are effecting a slight reverse action, the resultant of the two reducing the speed, it being remembered that the shaft 5 is still rotating in the same direction and at uniform speed, but the resistance on the motor has not been varied in any substantial degree, because any decrease in resistance due to the change in angularity of the blades b b' has been made up by the increased resistance of the blades a a', the latter having passed beyond a plane at right angles to the shaft. By further movement inward of the controller the outer blades b b' are increasingly changed as to their angularity, (see Fig. 4,) and the propulsive effort of one set neutralizes the opposite propulsive effort of the other set, reducing the speed to zero, for in Fig. 4 the two sets of blades are set at equal opposite angles. A substantially constant resistance is still maintained by the blades, however, and hence the motor cannot race, the movement of the boat being stopped while the motor continues to operate. Between the maximum speed ahead, Figs. 1 and 2, and no speed, or zero, as in Fig. 4, the speed ahead can be varied as desired, as will be manifest.

Viewing Fig. 4, it will be seen that the followers of the blades a and b are similarly positioned in their cam-slots and locked therein, and in like manner the blades a' and b' are held by their slots. If now an additional movement ahead be given the controller 16 from the position shown in Fig. 4 to that shown in Fig. 5, both sets of blades will be changed, but differentially, the blades *a a'* being set at nearly full-speed-astern position, while the blades *b b'* are set for a reduced propulsive effort ahead, and the resultant will be about half-speed astern, (see arrow 24, Fig. 5,) but the resistance on the motor has not been substantially changed. Completing the inward movement of the controller now brings the adjacent blades of the sets into parallelism again, but in reversed position relative to shaft 5, as in Fig. 6, and the propeller is set for full speed astern, the blades *a a'* coming into position first and maintaining the resistance while the blades *b b'* are being changed.

From the foregoing description it will be seen that the controller serves to not only reverse the blades to thereby change the direction of the propulsive effort of the blades, but that it also changes the angularity of the blades of a set relatively to each other and the angularity of the blades of one set relatively to the blades of the other set to thereby vary the propulsive effort from zero to maximum, or vice versa, either ahead or astern, the relative angularity being changed by a differential movement, so that the resistance on the motor remains substantially constant. This is all accomplished without any alteration in the operation of the motor, so that the boat is under perfect control both as to its speed and direction of movement.

I have shown a modification of the arrangement of blades and controller in Figs. 10, 11, and 12, the blade-carrying hub 25 being similar to the one described, but having only one pair of opposite bosses, as 26, apertured to receive the pintles 27 of the two blades *c c'*, these blades being of usual shape. Said blades have cam-followers on their bases, the follower 28 of blade *c* being shown in Figs. 11 and 12, and each of the blades is slitted along its median line to permit the passage through it of the body of a somewhat smaller blade, the smaller blades being shown at *d d'*. Said blades are secured to rods 29, rotatably mounted at their inner ends in the pintles 27 and at their outer ends in bearings 30 on the blades *c c'* near their extremities. The base of each of the smaller blades *d d'* has an overhanging extension $d^{\times}$ (see Figs. 10 and 12) eccentric to the pivot-rod 29, each extension having a follower-lug, as 31. The controller 32 is bifurcated, as before described, to slide in the opposite grooves of the hub 25; but each cheek of the controller has a single cam-slot, as 33, the cam-slots being reversed, as before, and comparing Figs. 8 and 11 and 12 it will be seen that the slot 33 is substantially the joinder of the two separated cam-slots 20. The follower 28 of blade *c* and follower 31 of blade *d* coöperate with one cam-slot 33 and the followers of blades *c'* and *d'* coöperate with the opposite slot. When the controller is positioned as in Fig. 11, the adjacent blades of the two pairs are folded together and set for full speed ahead; but a gradual movement of the controller to the right, Fig. 11, will open out the blades till *d* and *d'* occupy the dotted-line position, Fig. 11, and as shown in Fig. 12, when the speed is reduced to zero. At such time the follower 28 will be in one end of the straight portion of a slot 33 and its fellow follower 31 in the opposite end, as shown in Fig. 12. Now by continuing the movement of the controller the blades *c* and *c'* will be swung around until they are again against blades *d d'*, but all four blades will be set for full speed astern. In the modification the differential movement in changing the relative angularity of the two sets of blades provides for maintaining the resistance on the motor substantially constant, as before described.

My invention is not restricted to the precise construction herein shown and described nor to the particular details of arrangement, as various changes may be made therein by those skilled in the art without departing from the spirit and scope of my invention.

Having fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A shaft adapted to be rotated in one direction at a substantially uniform speed, a propeller mounted thereon, comprising two sets of angularly-movable blades, and means to vary the angularity of the blades of the sets and to vary the relative angularity of the blades of the two sets by a differential movement of such blades, the change in the angularity of the blades effecting a variation in the force of propulsion, and also serving to reverse the direction thereof, while the differential movement causes the blades to maintain a substantially constant resistance on the motor.

2. A rotatable shaft, two sets of propeller-blades mounted thereon, each set consisting of two blades oppositely extended and pivotally connected with the shaft in a plane at right angles thereto, and a controlling instrumentality to effect equal and opposite angular movement of the blades of a set in unison, and also to cause a differential movement of the blades of one set relatively to the blades of the other set to vary their relative angularity, said controlling instrumentality including means to hold the blades of one set from angular movement while the blades of the other set approach and pass beyond their pivotal plane.

3. A propeller having a plurality of sets of blades, two oppositely-extended blades in each set, and means to vary the relative angularity of the blades of the several sets while maintaining a substantially constant resistance on the motor, such variation in angularity effecting a change in propulsive effort from zero to the maximum either ahead or astern.

4. A shaft adapted to be rotated uniformly

in direction and speed, two sets of propeller-blades mounted thereon and angularly movable with relation thereto and to each other, and a controller movable longitudinally of the shaft and operatively connected with the several blades, to vary the angularity of the blades and to vary the relative angularity of the two sets of blades by a differential movement, to thereby maintain a substantially constant resistance on the motor.

5. A rotatable shaft, two sets of propeller-blades mounted thereon, each set consisting of two blades oppositely extended and pivotally connected with the shaft in a plane at right angles thereto, and controlling means to effect equal and opposite angular movement of the blades of a set and also to vary the angularity of the blades of one set relatively to those of the other set.

6. A rotatable shaft, a blade-carrying hub fixed thereon and having parallel bosses thereon at opposite sides of the shaft, a pair of propeller-blades oppositely extended and pivotally mounted in the bosses, a controller longitudinally movable on the hub and operatively connected with the said blades eccentric to their pivots, to swing them oppositely thereon, a second pair of oppositely-extended blades, and connections between them and the controller, to oppositely swing said blades and also to vary the angularity of the same relatively to the first-named pair.

7. A shaft adapted to be rotated uniformly as to direction and speed, a speed-controlling and reversing propeller mounted thereon comprising two pairs of oppositely-extended blades, and a pivot connection between each blade and the shaft, whereby the blades are angularly movable with relation thereto, combined with a controller operatively and individually connected with the several blades, to effect simultaneous opposite angular movement of the blades of a pair and to also vary the angularity of the blades of one pair relatively to the blades of the other pair.

8. A rotatable shaft, a blade-carrying hub fast thereon and longitudinally grooved on opposite sides, two pairs of propeller-blades pivotally mounted on the hub, a blade of each pair extending in the same direction from the shaft, a bifurcated controller slidably mounted in the grooves of the hub and having cam-slots in its bifurcation, and a follower on the base of each blade eccentric to its pivot and coöperating with a cam-slot, longitudinal movement of the controller varying the angularity of the blades of one pair with relation to the blades of the other pair and swinging oppositely the blades of a pair, whereby the propulsive effort of the blades can be varied from zero to the maximum and its direction reversed.

9. A shaft adapted to be rotated uniformly as to speed and direction, two pairs of oppositely-extended propeller-blades, each having a pivot, bearings for said pivots rigidly connected with the shaft, the several pivots being in parallelism in planes intersecting the shaft, and means to vary the relative angularity of the blades of the two pairs, to thereby change the direction and vary the propulsive effort of the blades from zero to the maximum ahead or astern.

10. A propeller comprising a hub, two sets of blades arranged in oppositely-extended pairs and pivotally connected with the hub, and means to effect differential angular movement of the blades of one set relatively to the blades of the other set, whereby the adjacent blades of said sets can be set in parallelism for movement ahead or astern, and at an angle to each other, to vary the speed.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CHARLES F. ROPER.

Witnesses:
JOSEPH W. FULTON,
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