Sept. 27, 1927. 1,643,314

J. J. NOVAK

COMBINED PROPELLING AND STEERING APPARATUS

Filed Jan. 20, 1926 3 Sheets-Sheet 1

Fig. 2

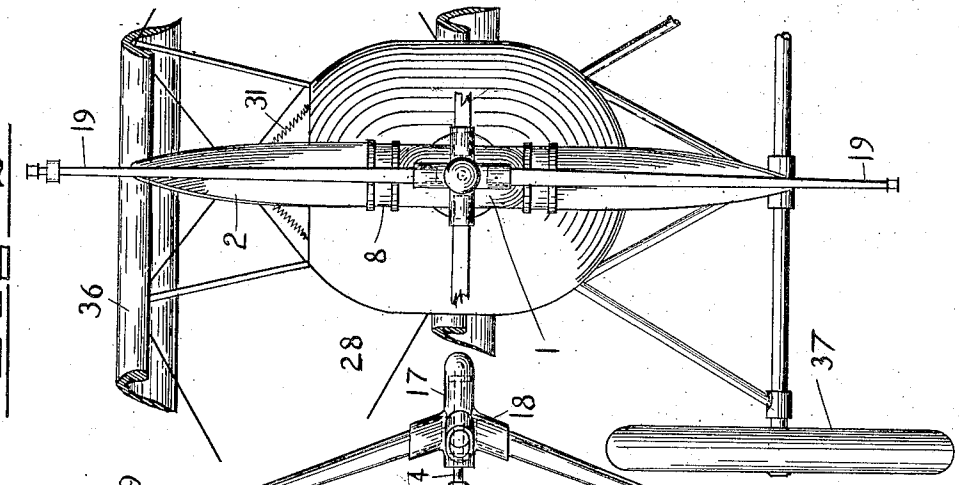
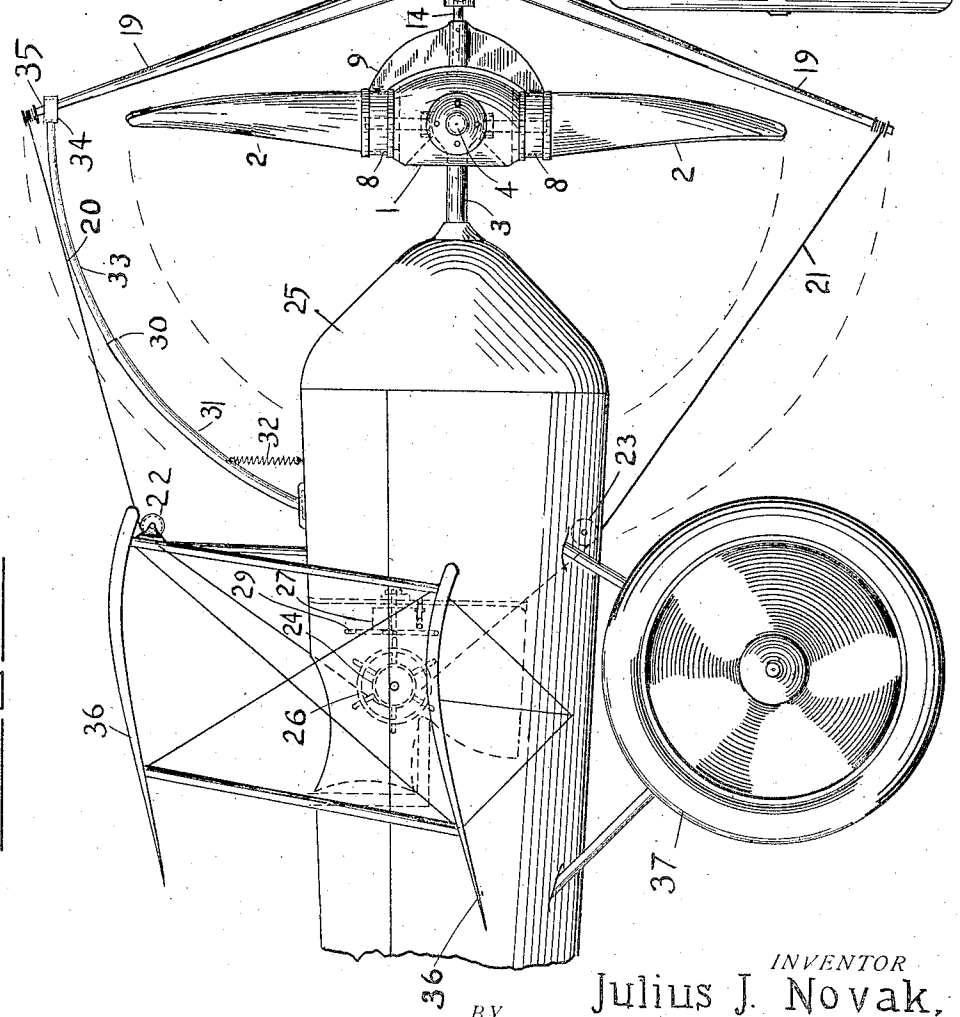


Fig. 1



INVENTOR
Julius J. Novak,
BY
ATTORNEYS.

Sept. 27, 1927. 1,643,314

J. J. NOVAK

COMBINED PROPELLING AND STEERING APPARATUS

Filed Jan. 20, 1926 3 Sheets-Sheet 2

Fig 3

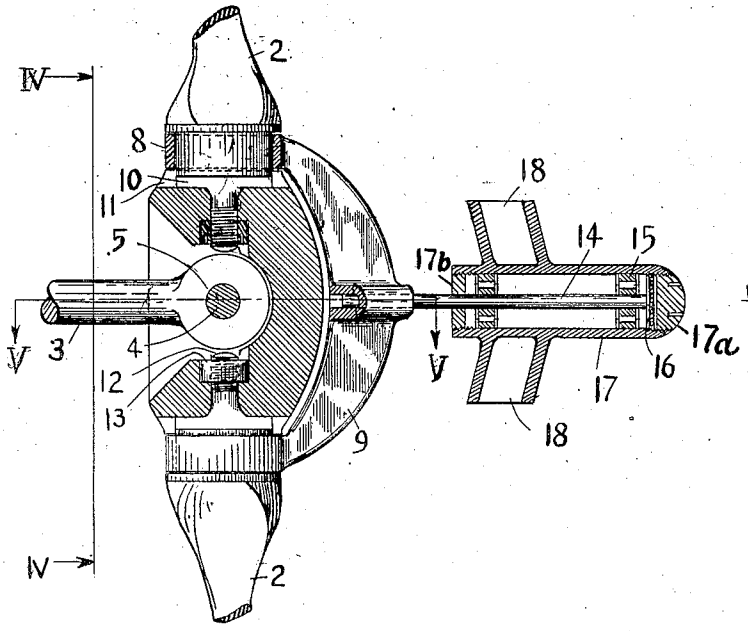


Fig 4

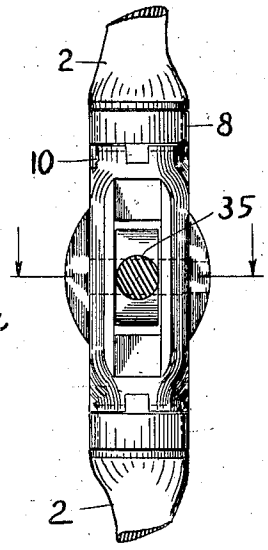
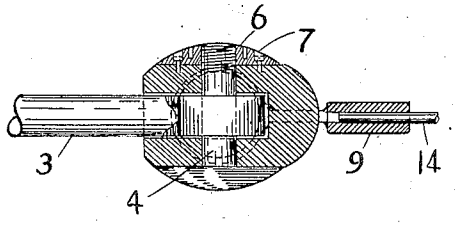


Fig 5



INVENTOR
Julius J. Novak,
BY
ATTORNEYS.

Sept. 27, 1927. 1,643,314

J. J. NOVAK

COMBINED PROPELLING AND STEERING APPARATUS

Filed Jan. 20, 1926 3 Sheets-Sheet 3

Fig. 8.

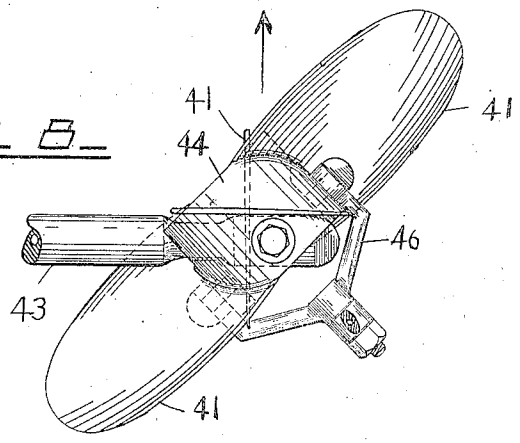


Fig. 6.

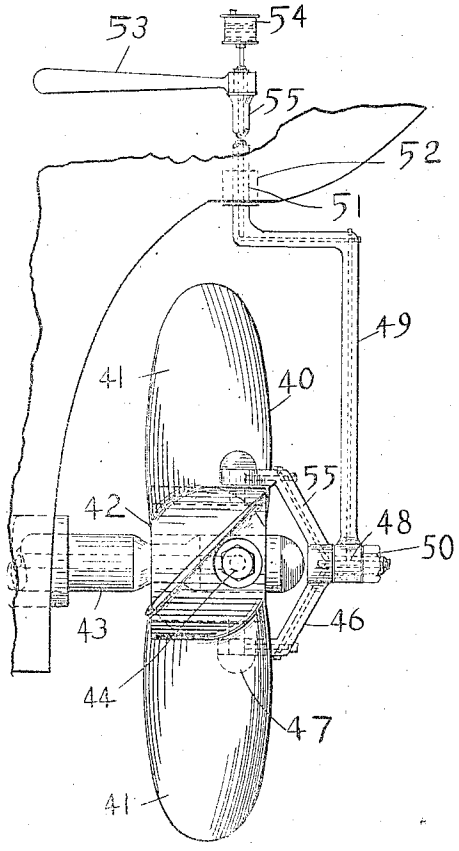
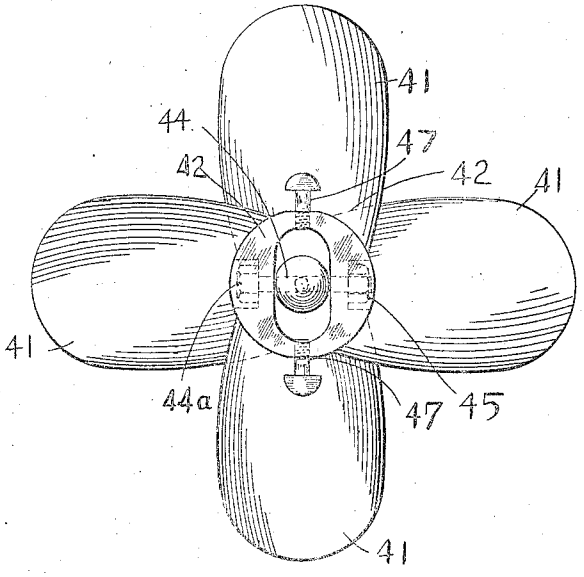


Fig. 7.



INVENTOR
Julius J. Novak,
BY
ATTORNEYS.

Patented Sept. 27, 1927. 1,643,314

UNITED STATES PATENT OFFICE.

JULIUS J. NOVAK, OF NEW YORK, N. Y., ASSIGNOR TO JOHN NOVAK, OF NEW YORK, N. Y.

COMBINED PROPELLING AND STEERING APPARATUS.

Application filed January 20, 1926. Serial No. 82,538.

This invention relates to means for steering aircraft and watercraft and more particularly to propellers adapted for varying their direction of action with respect to the craft driven thereby and to means for effecting such variations in the action of said propellers.

An important object of the invention is to provide apparatus adapted for changing in a minimum of space, the direction of movement of a craft to which such apparatus is applied.

Another important object of the invention is to provide a propeller adapted for steering a craft and efficient means for controlling the steering action of said propeller.

Other objects of the invention are to provide a novel and efficient swivelling propeller adapted for adjustment to such an extent that in a limiting position of each blade, the plane of the blade is substantially parallel to the axis of the propeller shaft; a construction comprising a pilot shaft and a universal joint connecting the pilot shaft with the propeller shaft and including the hub of the propeller; and a swivelling propeller construction comprising pivotal connections with their axes at right angles to each other and determining the plane of rotation of the propeller.

Apparatus constructed according to the present invention would be useful in airplanes for taxying on the ground when the usual rudder control is not fully operative; for extremely rapid maneuvers in the air; for steering in the air when usual rudder and elevator controls are not operative, as in a "stalling" condition; for increasing climb under certain conditions; and for steering if by some accident rudder or elevator controls broke in the air.

In dirigibles, such apparatus would be useful in altitude control, avoiding expenditure of lifting gas or ballast; in making a landing, and particularly in avoiding bad landings; in lessening the number of men required to handle a dirigible in landing and in getting into and out of a hangar; in rapid maneuvers in the air; and in case rudder and elevator controls were fully or partially inoperative.

These being among the objects of the present invention, the same consists of certain features of construction and combinations of parts to be hereinafter described and then claimed, with reference to the accompanying drawings illustrating desirable embodiments of the invention and in which—

Fig. 1 is a view in side elevation illustrating one embodiment of my invention as applied to an aeroplane.

Fig. 2 is a front view of the structure shown in Fig. 1.

Fig. 3 is a view in cross section through the hub of the propeller;

Fig. 4 is a view along the line IV—IV of Fig. 3, looking in the direction of the arrows;

Fig. 5 is a view in section taken along the line V—V of Fig. 3;

Fig. 6 is a view illustrating another embodiment of the invention adapted for marine use;

Fig. 7 is a rear elevation of the propeller in the position shown in Fig. 6; and

Fig. 8 is a top plan view of the marine propeller showing one of the blades in an extreme position with the plane of such blade substantially parallel to the axis of the propeller shaft.

Referring to Figs. 1, 2, 3, 4, and 5 of the drawings, a propeller hub 1 with removable blades 2 is mounted on a driving shaft 3 by means of a pivot pin 4 extending through a transverse eye 5 in the enlarged end of the driving shaft 3, the head of the pin resting against one side of the hub 1 and having threaded on its other end an arc nut 6 which is locked in position by screw 7. Adjacent their inner ends the detachable or removable blades 2 are provided with substantially cylindrical portions which extend through collars 8 of a balancing or controlling yoke 9 which is capable of relative rotary movement about the axes of said cylindrical portions and are provided at their inner ends with tongues 10 fitting snugly in grooves 11 in the hub 1 to prevent turning of the blades relative to the hub 1, and with bolt extensions 12 which pass inwardly through the wall of the hub 2 and are held against outward movement by nuts 13, which may be circular, positioned in countersinks provided for the purpose.

Fastened rigidly to the yoke 9 midway between its ends is a pilot shaft 14 which revolves freely in roller bearings 15 which together with thrust bearings 16 are assembled in a journal housing 17 which has preferably cast integrally therewith, four sockets 18 to receive radial control arms 19 of lighter material which are secured in said

sockets. Journal housing 17 is capped front and rear by plugs 17[a] and 17[b] to hold lubricating oil. Connected with the outer ends of the upper and lower vertical control arms are flexible members 20 and 21, such as cords, cables or wires, which are guided over pulleys 22 and 23 respectively and secured to a control drum 24 for winding thereon in opposite directions. Said control drum 24 is mounted in the fuselage 25 in or adjacent the cock pit and may be turned by a control wheel 26 attached thereto. Provision is also made of a drum 27 for use with cables or the like attached to the horizontal control arms 19, and of a wheel 29 attached to said drum 27.

Provision must also be made of means to prevent the control arms 19 from turning about the axis of the shaft 3. As herein disclosed, this result may be effected by means of an arcuate telescoping device 30 which extends substantially in the arc of a circle having for its center the point about which the propeller swivels. This device comprises an outer tubular portion 31 connected at one end with the fuselage and also supported against lateral movement by springs 32, and an arcuate portion 33 slidably mounted in the portion 30 and having at its outer end a ring 34 in which turns a bushing 35 secured on the upper end of the upper control arm so that its axis will pass through the point about which the propeller swivels.

It will be seen that the pivotal connection between the hub 1 and the shaft 3 and the pivotal connections of the yoke 9 with the inner ends of the propeller blades 2 provide a universal joint structure in which the two pivotal axes intersect at right angles, and the position of the pilot shaft 14 determines the plane of rotation of the blades and consequently the steering action of the propeller.

When the pilot desires to turn the aeroplane upwardly, he turns the control wheel 26 so as to wind the cable 20 on the drum 24 and at the same time to unwind the same length of the cable 21. This causes the upper arm 19 to be moved toward the fuselage and the lower arm to be moved away therefrom, thus shifting the housing 17 to swing the pilot shaft 14 through the required vertical angle and thereby determine the direction of action of the propeller. The control for horizontal change of direction of the aeroplane is obtained in the same way by the control wheel 29.

The foregoing description applies to an embodiment of the invention as applied to a single-propeller aeroplane having wings 36 and landing gear 37. It should be understood, however, that the invention may equally well be applied to an aeroplane having a plurality of propellers.

An embodiment of the invention as applied to marine propulsion is illustrated in Figs. 6, 7, and 8. In this form the propeller 40 comprises four blades 41 secured to a hub 42 which is pivotally secured to a propeller shaft 43 by means of a bolt 44 having its head 44[a] positioned in a countersink in one side of the hub, and held in position by a nut 45 located in a countersink on the opposite side of the hub. It will be seen that the inner part of the hub 42 is cut away to permit the hub to swing about the axis of the bolt 44.

To control the direction of action of the propeller 40, provision is made of a yoke 46 pivotally secured to the hub 42 by suitable means, such as screws 47 and having a rearward extension 48 journalled in a steering member 49 and secured thereto by means including a nut 50. The steering member 49 has a journal portion 51 mounted in a bearing 52 in the rearward overhang of the stern of the vessel and in such a position that the axis of the journal portion 51 when extended passes through the swivelling point of the propeller. As herein disclosed the steering member 49 may be turned by an operating member or handle 53 fixed thereto. To permit lubrication of the connections, provision is made of an oil cup 54 connected by oil ducts 55, with the extension 48 of the yoke 46 and with the pivot screws 47. Such oil ducts may also be provided to lubricate the bearing portions of the bolt 44.

As shown in Fig. 8, the blades of the propeller are arranged at angles of 45° with the plane of rotation of the propeller 40 and when the propeller is swung about a vertical axis through an angle of 45°, the blades will, during the rotation of the propeller assume limiting positions in which they act in a plane perpendicular to the axis of the propeller and in opposite positions which they exert no side thrust on the propeller shaft. It will be evident that by shifting the plane of rotation of the propeller a strong steering action is obtained and that such steering apparatus will also be effective when the inclination of the blades differs from the 45° angle of the illustrative form and where the plane of rotation of the propeller is shifted through a different angle.

The foregoing detailed description has been given for clearness of understanding, and no undue limitation should be deduced therefrom, but the appended claims should be construed as broadly as possible, in view of the prior art.

Having thus described my invention, I claim:

1. In combined propelling and steering apparatus, the combination of a propeller shaft, a propeller hub pivoted directly thereto on an axis perpendicular to that of the shaft, two diametrically opposed propeller blades secured to said hub, and a steering

member pivotally connected with said hub to swing about an axis substantially perpendicular to but in the same plane as the axis of the pivotal connection between the hub and the propeller shaft.

2. In combined propelling and steering apparatus, a propeller shaft, a propeller hub pivotally connected directly with said propeller shaft, a steering yoke having two collars positioned on opposite sides of said hub, and propeller blades secured to said hub and having base portions fitting said collars with provision for relative rotation.

3. In combined propelling and steering apparatus, a propeller shaft, a propeller pivotally connected directly with said shaft, two propeller blades secured to said hub on opposite sides thereof, and having base portions, and a steering member fitting over the hub and having openings in which said base portions of the blades have a relative rotary fit to provide a pivotal connection between the hub and the steering member.

4. In combined propelling and steering apparatus, in combination, a propeller shaft, a pilot shaft, a universal joint between said shafts, said universal joint including a propeller hub as one of its elements, and means for shifting the pilot shaft in a plurality of different planes and thereby shifting the plane of rotation of the propeller accordingly.

5. In combined propelling and steering apparatus for air and water craft, in combination, a propeller shaft, a pilot shaft, a universal joint between said shafts, said universal joint including a propeller hub as one of its elements, and means for shifting the pilot shaft to change the direction of action of the propeller, comprising a bearing in which said pilot shaft turns and radial control arms projecting from the pilot shaft bearing.

6. In combined propelling and steering apparatus for air and water craft, in combination, a propeller shaft, a pilot shaft, a universal joint connecting said shafts, said joint having intersecting perpendicular pivotal axes and including as one of its elements a propeller hub for carrying the blades of the propeller, and means for shifting the pilot shaft to change the direction of action of the propeller, comprising a bearing in which said pilot shaft turns, radial control arms extending from said bearing to the plane of rotation of the propeller, operating means connected with said radial arms at points substantially in said plane of rotation and means for preventing rotation of said bearing from which said arms project.

7. In combined propelling and steering apparatus for air and water craft, in combination, a propeller shaft, a pilot shaft, a universal joint connecting said shafts, said joint having intersecting perpendicular pivotal axes and including as one of its elements a propeller hub for carrying the blades of the propeller, means for shifting the pilot shaft to change the direction of action of the propeller and comprising a bearing in which said pilot shaft turns, radial control arms, and means, including a telescopic device connected with the body of the craft, for preventing turning of the radial arms around the axis of the propeller shaft.

8. In combined propelling and steering apparatus, the combination with a propeller shaft, of a propeller comprising a hub directly pivoted to said shaft to swing about a pivotal axis perpendicular to the axis of the propeller shaft, a pilot shaft pivotally attached to said hub to swing about a pivotal axis perpendicular to both the first mentioned pivotal axis and the axis of propeller shaft at their point of intersection, and means to swing the pilot shaft in different directions to steer horizontally and vertically.

9. In a combined propelling and steering apparatus, the combination with a driving shaft, of a propeller having a hub directly pivoted to said driving shaft along an axis passing through the axis of the driving shaft and a pair of opposed propeller blades arranged on a line perpendicular to the axis of the hub pivot at its intersection with the driving shaft axis, a yoke, the ends of which rotatably embrace base portions of said blades to form a pivotal connection with the hub and complete a universal joint connection, and means for shifting said yoke in different directions to vary the plane of rotation of the propeller blades with reference to the driving shaft.

10. In combined propelling and steering apparatus for air and water craft, in combination, a proller shaft, a pilot shaft, a universal joint between said shafts and including as one of its elements a propeller hub for carrying the blades of the propeller and within which hub the two pivotal axes intersect, and means for shifting the pilot shaft vertically and horizontally and thereby shifting the plane of rotation of the propeller and guiding the craft vertically and horizontally.

11. In combined propelling and steering apparatus for air and water craft, in combination, a propeller shaft, a pilot shaft, a universal joint between said shafts and including as one of its elements a propeller hub for carrying the blades of the propeller, and means for shifting the pilot shaft to change the direction of action of the propeller, comprising a bearing in which said pilot shaft turns, pairs of opposite radial control arms projecting from the pilot shaft bearing, two flexible control elements connected respec-

tively with the arms of one of said pairs, and a control drum for winding up either one of said flexible elements and at the same time unrolling the other.

12. In combined propelling and steering apparatus for air and water craft, in combination, a propeller shaft, a pilot shaft, a universal joint having intersectiong pivotal axes and including as one of its elements a propeller hub for carrying the blades of the propeller, and means for shifting the pilot shaft to change the direction of action of the propeller, comprising a bearing in which said pilot shaft turns, horizontal and vertical radial control arms extending to the plane of rotation of the propeller, independent operating means connected with said horizontal and vertical radial arms, and means for preventing rotation of said bearing from which said arms project.

13. In combined propelling and steering apparatus for air and water craft, in combination, a propeller shaft, a pilot shaft, a universal joint having inter_ecting pivotal axes and including as one of its elements a propeller hub for carrying the blades of the propeller, means for shifting the pilot shaft vertically and horizontally to change the direction of action of the propeller and comprising a bearing in which said pilot shaft turns, horizontal and vertical radial control arms, and means, including a telescopic device connecting the upper vertical control arm with the body of the craft for preventing turning of the radial arms around the axis of the propeller shaft.

14. In combined propelling and steering apparatus for air or water craft a propeller comprising blades and a hub therefor; a driving shaft; a swivelling support for said propeller comprising a pivotal connection between the hub and the driving shaft along an axis substantially in the plane of rotation of said propeller blades, a pilot shaft, and a pivotal connection between said pilot shaft and said hub along an axis lying substantially in the plane of rotation of said blades; and means for varying the axial relationship between said pilot shaft and driving shaft for steering vertically or horizontally.

JULIUS J. NOVAK.