

April 29, 1924.

1,491,997

C. MESSICK

COMPENSATING PROPELLER

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Fig. 1.

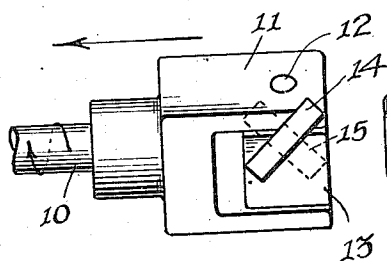


Fig. 2.

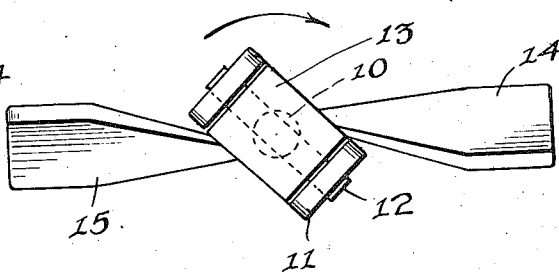


Fig. 3.

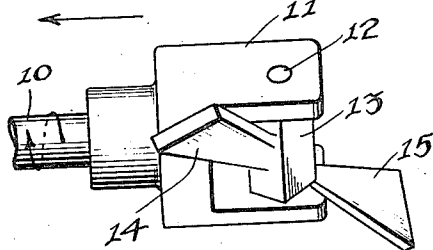
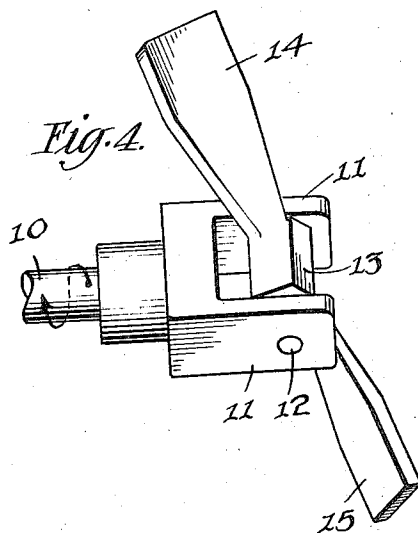


Fig. 4.



Inventor
C. Messick

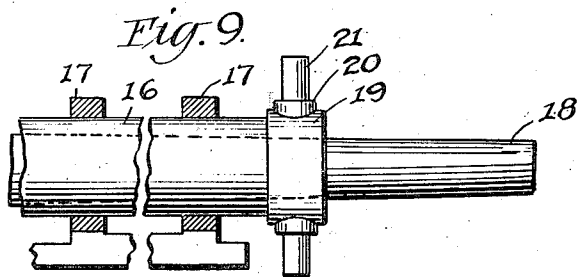
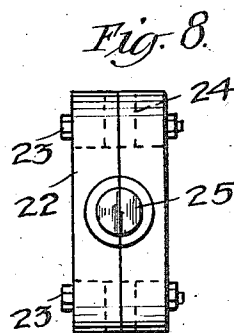
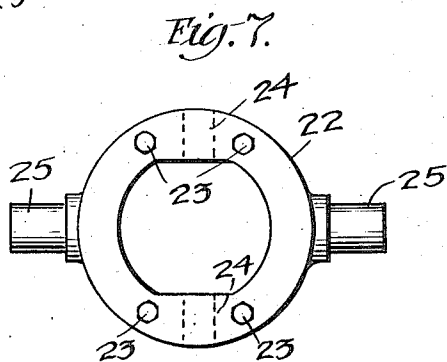
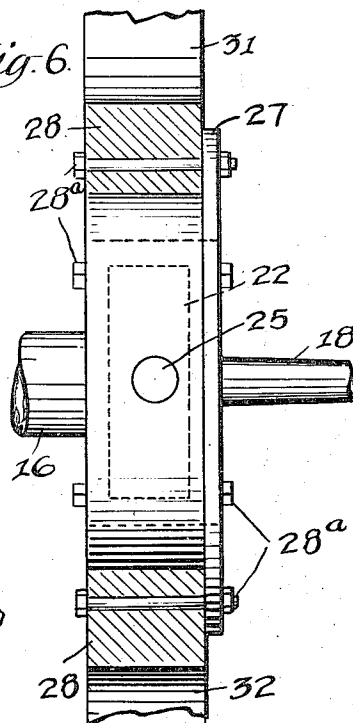
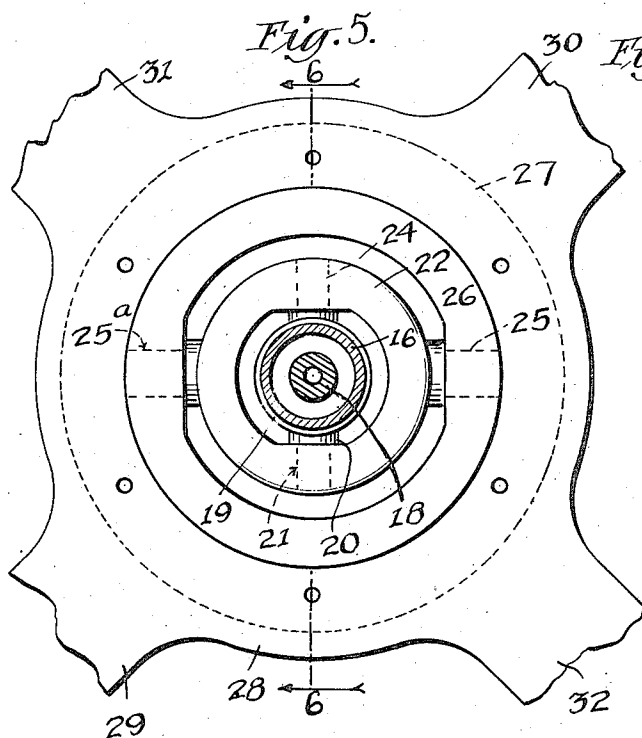
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Inventor
C. Messick

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UNITED STATES PATENT OFFICE.

CHARLES MESSICK, OF BRENTWOOD, NEW YORK.

COMPENSATING PROPELLER.

Application filed February 5, 1918, Serial No. 215,464. Renewed August 2, 1923.

To all whom it may concern:

Be it known that I, CHARLES MESSICK, a citizen of the United States, residing at Brentwood, in the county of Suffolk and State of New York, have invented an Improvement in Compensating Propellers, of which the following is a full, clear, and exact description.

By my invention I seek to accomplish a number of distinct objects, among them being the following:

I. To reduce the vibration and gyroscopic effect transmitted from a propeller to its shaft by providing an automatically compensating hub for the propeller.

II. To compensate for and thereby practically to diminish the resistance of the propeller whenever a force is applied to change the direction of its axis of rotation.

III. To compensate for and thus practically to overcome the degree of vibration ordinarily transmitted from the propeller (or propeller-like member such as a turbine) to its shaft and various other parts.

IV. To mount the propeller upon the propeller shaft by a flexible coupling so constructed and arranged that, with the propeller in action, any change in the direction of the axis of the propeller shaft will permit the axis of the propeller to lag, cause the propeller blades to act differentially upon the air and thus assist in reestablishing a coincidence of the two axes.

V. To so construct and arrange the propeller as to practically cause the propeller, during its rotation, to automatically oppose or overcome various factors otherwise tending to cause dynamic unbalance and dynamic thrust unbalance.

VI. To so construct and arrange the propeller as practically to overcome or compensate for the gyroscopic effect of the propeller, in so far as such gyroscopic effect might otherwise resist a force tending to change the direction of the axis of the propeller shaft.

VII. To give the propeller such form and arrangement as to facilitate, in a general way, a change in the direction of its axis of rotation.

VIII. To give the propeller such form and arrangement that when used upon an aeroplane, any bodily turning movement of the aeroplane will cause the propeller blades to act differentially upon the adjacent air in

such manner as to facilitate said turning movement.

My invention may assume different forms and may be used in connection with propellers and turbines employed in different media and also in connection with various revoluble members. To avoid prolixity, however, I will show my invention as applied to a two-blade tractor propeller and also as applied to a four-blade propeller, used upon aircraft.

For the purposes here contemplated, the two propellers shown are each assumed to be in static balance.

In this connection it may be noted that if a power-driven aeroplane, with a propeller mounted rigidly upon the propeller shaft, be turned in its flight, the rotation of the propeller causes each blade thereof to develop dynamic unbalance twice during each rotation of the propeller upon its axis. This dynamic unbalance, together with dynamic unbalance arising from other causes, which is rendered manifest in the form of undesirable vibrations, is compensated for by my device.

It may be further noted that where a propeller is mounted rigidly upon the propeller shaft of an aeroplane, as heretofore used, another undesirable condition arises. That is to say, the aeroplane has wings extending horizontally and it has been found that as each propeller blade passes one of these wings there is a distinct vibration. This is apparently due to the fact that each propeller blade, while in action, carries a little volume of compressed air upon its rearward face, and a partial vacuum close to its forward face; and as a consequence of this difference in the density of air close to the blade, each passage of the blade into and out of proximity to any wing or other object sets up the vibration just mentioned. My invention tends to reduce this fault.

An aeroplane when in other than straight flight is deflected from normal response to the controls by gyroscopic precession of the rotating parts, particularly by the rotating mass of the propeller and my invention tends to permit normal response to the controls by preventing the gyroscopic precession of the propeller being transmitted to the shaft and through it to the aeroplane.

Reference is made to the accompanying drawings forming a part of this specifica-

tion, and in which like letters indicate like parts throughout the several views.

Figure 1 is a fragmentary side elevation of a two-blade propeller made in accordance with my invention, and shows the various parts in normal position as they appear with the machine moving to the right according to this figure; the curved arrow indicating the direction of rotation of the propeller shaft, and the straight arrow showing the direction of the air stream relative to the propeller.

Figure 2 is an end elevation of the propeller shown in Figure 1, the various parts having the same respective positions as in said last mentioned figure.

Figure 3 is a side elevation of the same propeller and differs from Figure 1 in that it shows the propeller blades as rocked from normal position, as hereinafter more completely described.

Figure 4 is an inverted plan, or bottom view, of the propeller shown in Figure 3.

Figure 5 is a fragmentary front elevation, showing a four-blade propeller equipped with my invention.

Figure 6 is a section on the line 6-6 of Figure 5, looking in the direction indicated by the arrows.

Figure 7 is a side elevation of one of the gimbals of Figures 5 and 6.

Figure 8 is an end elevation of the gimbal shown in Figure 7.

Figure 9 is a fragmentary side elevation of the propeller shaft of Figures 5 and 6.

Referring to Figures 1 to 4, inclusive, a propeller shaft 10 carries a hub 11, secured rigidly upon it and having in this instance the form of a fork.

Located within this fork and journaled relatively thereto by a pin 12 is a rocking hub 13, carrying a pair of propeller blades 14, 15, each extending in a general direction oblique to the length of the pin 12, as shown in Figure 2.

The direction of rotation of the propeller and its shaft is indicated by curved arrows, the air stream being indicated in Figures 1 and 3 by straight arrows.

This is a tractor propeller—that is, one which pulls rather than pushes—and the direction of travel of the aeroplane is to the right according to Figures 1, 3 and 4.

Referring more particularly to Figure 2, it will be noted that the pivot pin 12 extends through the hub of the propeller at an angle of approximately 45 degrees relatively to the length of the propeller blades, and that the propeller blades, though rigid relatively to the hub and each other, are as a unit free to rock on the swivel pin. It will also be noted that when the blades thus rock, the pitch of the rearward blade increases as that of the forward blade decreases. This causes the blades to act dif-

ferentially upon the air and tend to re-establish the blades 14 and 15 in perpendicular relation to shaft 10. When the propeller rotates 180 degrees blade 15 assumes the indicated position of blade 14 and blade 14 that of blade 15. At some intermediate point both blades become momentarily perpendicular to shaft 10, thus each blade thrusts the air with more than its normal pitch during half a complete revolution and less than normal pitch during the other half revolution, so that the unbalanced air thrust between the blades tends twice in each revolution to re-establish them in perpendicular relation to shaft 10.

In some cases, where this variable pitch is found undesirable, the angle of the pivot pin with relation to the length of the blades may be made 90 degrees or more to meet such requirements as develop with the progress of the art.

In Figures 3 and 4, the propeller is shown in a slightly different position with relation to the axis of the shaft, indicating the change of pitch in the blades (14 and 15) with relation to the shaft which has automatically occurred as a result of the rocking of the propeller on the swivel pin (12). This increase in pitch of blade 14 causes an increased air thrust to be delivered by it and the pitch and air thrust of blade 15 are decreased, which tends to return the propeller to the normal plane perpendicular to the shaft 10, as indicated in Figures 1 and 2.

The movement of the blades from the position indicated in Figures 1 and 2 to the position indicated in Figures 3 and 4 may be caused by inequality of air thrust on the blades, gyroscopic effect of the propeller tending to resist the turning of the aeroplane, or by other factors of dynamic unbalance, which may arise in operation; but the tendency is always for automatic compensation to be provided by the device, so that the axis of the propeller and the axis of the shaft are caused to coincide upon the cessation of the force tending to cause dynamic unbalance. Because of the compensation provided by this device, the net effect of dynamic unbalance in the propeller is cushioned and not impressed upon the shaft. The air thrust of the two blades collectively is approximately constant and operates perpendicular to the length of the blades and, as their position with relation to the shaft is only momentarily distorted from the perpendicular, the air thrust is communicated to the shaft constantly and but little vibration due to dynamic unbalance is imposed upon it.

In the form of my device shown in Figures 5 to 9 inclusive the propeller shaft appears at 16, and has a tubular form. It

is mounted in bearings 17, encloses the barrel of a gun 18, and the axis of the gun coinciding with the axis of the shaft in the usual manner.

5 Secured rigidly upon the tubular shaft 16 is a collar 19, carrying a pair of trunnions 21, each trunnion having a shoulder 20. The tubular shaft 16 extends through a gimbal ring 22, the trunnions 21 extending through bearings 24. The gimbal ring 22 is made in halves as indicated in Figure 8, and is provided with a pair of trunnions 25, which are journaled in bearings 25^a in a gimbal ring 26. This gimbal ring carries an annular supporting member 27, which supports a propeller hub 28. The propeller hub carries a number of propeller blades 29, 30, 31, 32. These blades are arranged in pairs, the blades of each pair being balanced relatively to each other.

In this four-bladed type of the device, when the axes of the propeller and the propeller shaft are forced out of coincidence by movements of the aeroplane or air, they are restored to coincidence by the well-known laws governing the movements of a fly-wheel driven by shaft. The pitch of the blades is constant in the four bladed type.

When the propeller is in action, any general turning movement of the aeroplane during its manoeuvres tends to cause the propeller to lag behind, as it were, but owing to the flexible coupling and the centrifugal force and the reaction of the air upon the propeller, it is gradually shifted around until it becomes normal to the axis of the propeller shaft. In other words the lagging of the propeller is only momentary, and the propeller quickly turns bodily around and faces the new direction in which the aeroplane is then traveling. The momentary lag, however, avoids the necessity for a positively-driven turn of the propeller corresponding to the turning movement of the aeroplane, and this momentary lag affords relief to the propeller shaft and its supports.

I do not limit myself to the precise construction shown, the scope of my invention being commensurate with my claims.

I claim:—

1. The combination of a propeller shaft, a propeller balanced thereon and driven thereby, and a flexible coupling to transmit torque and thrust only between the shaft and the propeller.

2. The combination of a propeller shaft, a propeller balanced thereon and driven thereby, and a coupling for the shaft and the propeller designed to transmit torque and thrust only whereby dynamic vibrations arising in the propeller may be insulated from the shaft.

3. In a device of the character described, the combination of a propeller shaft, a pro-

PELLER provided with blades and mechanism connecting said propeller and shaft for compensating dynamic unbalance between the blades.

4. In a device of the character described, the combination of a propeller shaft, a propeller provided with blades and mechanism connecting said propeller and shaft for compensating dynamic thrust unbalance between the blades.

5. A device of the character described comprising a propeller shaft, a propeller, and mechanism so connecting said propeller shaft and said propeller as to balance the thrust of the propeller against the gyroscopic effect thereof whenever the axis of the propeller shaft is changed in direction.

6. A device of the character described, comprising a propeller shaft, a propeller, and mechanism so connecting the propeller shaft and the propeller as to compensate for gyroscopic retardation of said propeller by fluid thrust when the axis of rotation of said shaft is changed in direction.

7. A device of the character described, comprising a revoluble propeller shaft and a propeller provided with blades carried thereby, said propeller being free to rock on an axis crossing the axis of the propeller shaft, and so arranged that the pitch of each blade is changed by the rocking of said propeller.

8. A device of the character described, comprising a revoluble propeller shaft, a propeller provided with blades carried thereby and a flexible connection to enable said propeller to rock on an axis crossing the axis of the shaft to cushion vibration and balance gyroscopic effect against fluid thrust when the direction of the axis of the shaft is changed.

9. A device of the character described, comprising a propeller shaft and a pair of propeller blades carried thereby, said blades being free to rock lengthwise of the shaft and having variable pitch controllable by this rocking movement of said blades, said propeller blades being so connected that an increase in the pitch of one blade is accompanied by a diminution in the pitch of the other blade.

10. A revoluble shaft and a propeller mounted thereon and provided with a hub and with blades carried by said hub and extending therefrom in order to balance each other, said blades being revoluble with the shaft and journaled to rock upon an axis crossing the general direction in which the blades extend.

11. A revoluble shaft and a propeller mounted thereon and provided with a pair of blades balancing each other and extending in opposite directions, the blades as a unit being rigid relatively to each other and revoluble with the shaft, and journaled to

rock upon an axis crossing the general direction of the length of the blades.

12. The combination of a revoluble shaft and a pair of propeller blades carried thereby and extending therefrom in opposite directions, said blades being rigid relatively to each other and as a unit journaled to rock upon an axis extending oblique to the length of the blades.

13. The combination of a revoluble shaft and a propeller carried by said shaft and extending radially therefrom, said propeller being journaled to rock upon an axis oblique to the length of the propeller and crossing the general axis of the revoluble shaft.

14. The combination of a revoluble shaft and a propeller carried by said shaft and extending radially therefrom, said propeller being journaled to rock upon an axis crossing at right angles the general axis of the

revoluble shaft but inclined obliquely to the length of the propeller.

15. The combination of a revoluble shaft carrying a pair of propeller blades extending radially therefrom in opposite directions in order to balance each other, said blades being revoluble bodily with said shaft and journaled to rock upon a single axis crossing at right angles the general axis of the revoluble shaft and at all times inclined relatively to the common length of the blades.

16. A revoluble shaft, a member designed for high peripheral speeds, whereby gyro-scope effects of great magnitude may be developed and a flexible coupling at the center of the member and at the shaft, whereby the axes of the shaft and member may be more easily moved out of coincidence at high speeds than if rigidly coupled together.

CHARLES MESSICK.