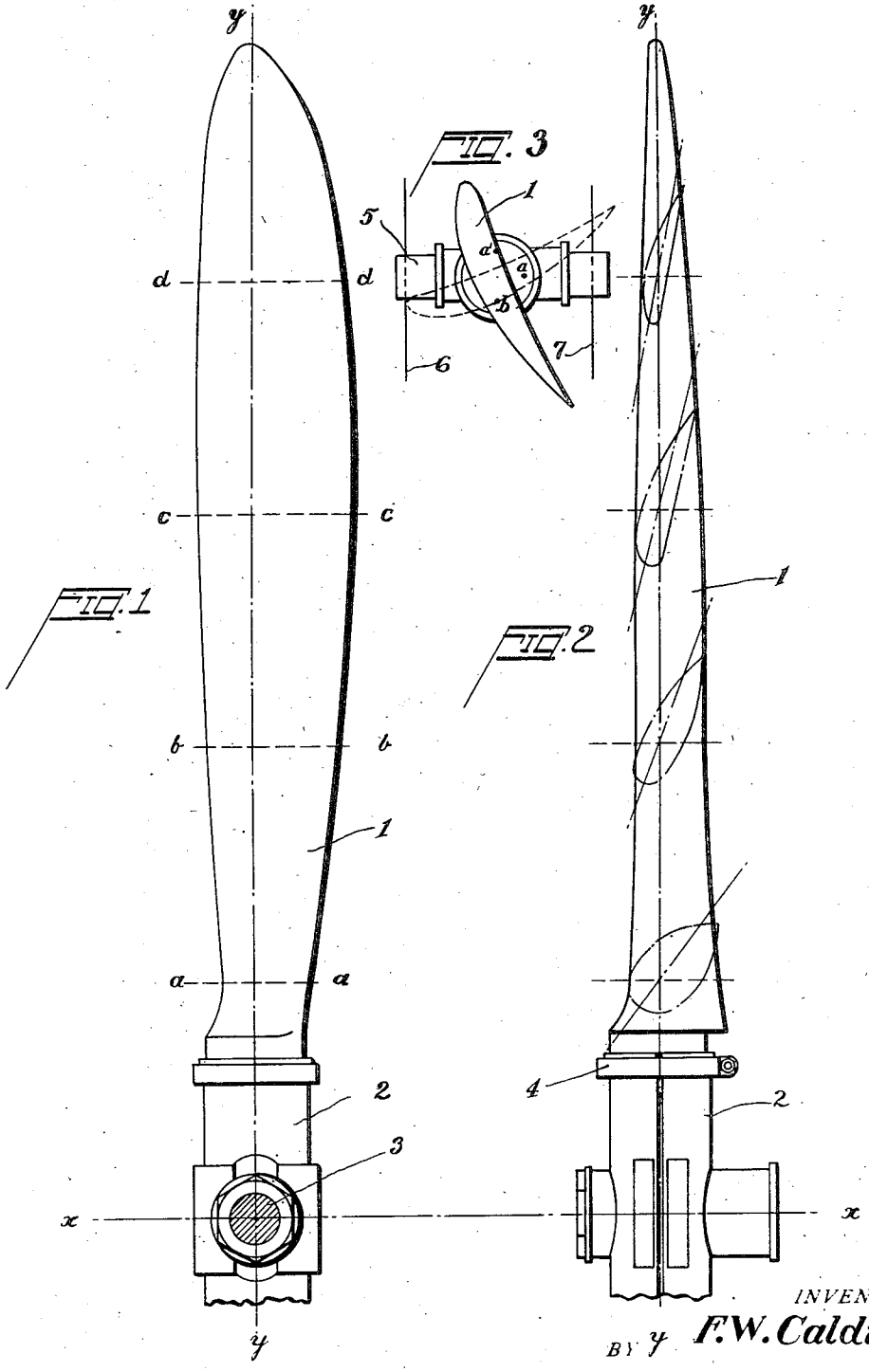
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PROPELLER

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PROPELLER

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This invention relates to improvements in aeronautical propellers.

The principal object of the invention consists in the provision of a propeller in which the center of gravity of all of the transverse sections of the blade are located on a straight line at right angles to the axis of revolution of the blade and passing through that axis.

While the invention is of advantage generally as applied to propeller blades of various types, it is designed particularly for detachable, reversible, and adjustable pitch aeronautical propellers, in which connection the invention has particular utility in securing a greater uniformity in blades, and lessening the work necessary in the standardizing and balancing operations performed in the production of propeller blades. At the same time blades constructed in accordance with this invention, whether of wood, composition, or metal, are found to operate with less vibration and give more continued satisfactory service, primarily because they are inherently dynamically balanced when they are in static balance by reason of the manner in which the center of gravity of any section always balances the center of gravity of the corresponding section of an opposite blade, regardless of the pitch of the blades, since these centers are all on the same straight line through the axis of revolution.

In the accompanying drawing illustrating the invention,

Fig. 1 is a front view of a propeller blade of the detachable, pitch-adjustable type constructed in accordance with the invention.

Fig. 2 is a side view of Fig. 1 illustrating the positionment of the transverse sections with their centers of gravity in line passing through the propeller axis and at right angles thereto.

Fig. 3 is a diagrammatic view looking down on a propeller blade mounted on knife edges for balancing and standardizing.

The propeller blade is shown mounted in a hub 2 and secured on a shaft 3, constituting the usual extension of the engine crankshaft. The hub 2 may be of any suitable or preferred form, providing for adjustment of the blade to vary the pitch. The clamping means 4 illustrated serves to secure the blade in its adjusted position. The blade 1 has its shank suitably held in the hub 2 and is laid out on a longitudinal axis y—y at right angles to the axis x—x of the shaft 3, corresponding to the axis of revolution of the propeller. The axis y—y passes through the axis x—x as shown in Fig. 1 and is at right angles thereto, as shown in Fig. 2. The center of gravity of each of the transverse sections of the blade lies on the line of the axis y—y. Sections a—a, b—b, c—c, and d—d are shown in Fig. 2 so located with reference to the axis y—y.

The advantage derived in this design, aside from the fact that the likelihood of vibration due to slight irregularities and uncompensated moments in the blade is minimized, resides in the fact that large quantities of blades of the detachable type may be produced of so uniform a character as to be readily interchangeable and replaceable. This is due to the fact that in the balancing and standardizing of a blade, the described location of the center of gravity of all of the sections renders it easy to locate and properly compensate for any parts out of balance. Thus, as shown in Fig. 3, a particle represented by the dot a represents a part out of balance. When the blade is tested for horizontal and vertical balance, this particular part, if compensated for in the horizontal balance, would nevertheless throw the blade out of balance when the blade is rotated, say for example, to the dotted line position which is approximately 90° from the full line position. In this position the particle now represented by the dot a' is off the axis of the shaft 3, which is free to roll on the knife edges represented at 6 and 7. A balancing particle b is therefore necessary on the opposite side of the axis. By displacing the blade 90° from the first position of balance, a very sensitive balance of all unbalanced particles is secured, since the unbalanced particles are thereby given a maximum moment arm. If a blade constructed in accordance with my invention is in perfect balance statically, it will then be also in perfect dynamic balance as a result inherent in the construction; since

all of the centers of gravity of all the sections of the blade will all be on the same straight line through the axis of rotation at 90 degrees to that axis. This will be true regardless of the angle to which the blade is adjusted. The blade will therefore operate without appreciable vibration within the range of its adjustments in use. As it is almost impossible to dynamically balance the propellers heretofore made, due to the fact that they are operable at extremely high speeds and always under load of the air pressure, it will be obvious that my invention renders such an attempt unnecessary, since the dynamic balance will be assured.

I claim:

1. An aeronautical propeller comprising a blade-clamping hub, and a plurality of similar detachable blades adapted to be rotatably mounted with respect to the hub to permit pitch-adjustment, each blade having its mass so distributed throughout that its axis of rotation with respect to the hub passes through the centers of mass of all transverse sections of the blade.

2. An aeronautical propeller comprising a blade-clamping hub, and a plurality of detachable pitch-adjustable blades radially disposed relative to the propeller axis, each blade having its mass so distributed throughout that the centers of mass of all cross sections lie in a line which passes through the propeller axis, whereby to maintain the dynamic balance of the blades in operation regardless of pitch-adjustment thereof.

3. An aeronautical propeller comprising a blade-clamping hub and separate removable pitch-adjustable blades constructed and mounted with equal and similar sections at equal distances respectively from the axis of revolution of the blades, each blade having the centers of mass of all of its cross sections lying on a line that passes through the propeller axis.

4. An aeronautical propeller comprising a blade-clamping hub and separate removable pitch-adjustable blades constructed and mounted with equal and similar sections at equal distances respectively from the axis of revolution of the blades, each blade having the centers of mass of all of its cross sections lying on a line that passes through the propeller axis at right angles thereto.

5. An aeronautical propeller comprising a blade-clamping hub and two diametrically oppositely positioned symmetrical pitch-adjustable blades carried by said hub, said blades being constructed with equal and similar sections at equal distances from the propeller axis, respectively, and so proportioned and positioned that a straight line passes through the centers of mass of all cross sections of the two blades and through the propeller axis.

6. An aeronautical propeller comprising a blade-clamping hub and two diametrically oppositely positioned symmetrical pitch-adjustable blades carried by said hub, said blades being constructed with equal and similar sections at equal distances from the propeller axis, respectively, and so proportioned and positioned that the axis of rotation for pitch-adjustment comprises the centers of mass of all cross-sections of the blade.

7. In aeronautical propellers, a separate blade having a shank adapted to be rotatively engaged by a hub member, said blade having the center of mass of all of its cross sections lying in the axis of its rotation with respect to the hub.

In testimony whereof I affix my signature.

FRANK W. CALDWELL.