Jan. 16, 1945. H. BADRUTT 2,367,190

AIRPLANE PROPELLERS

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Fig.2.

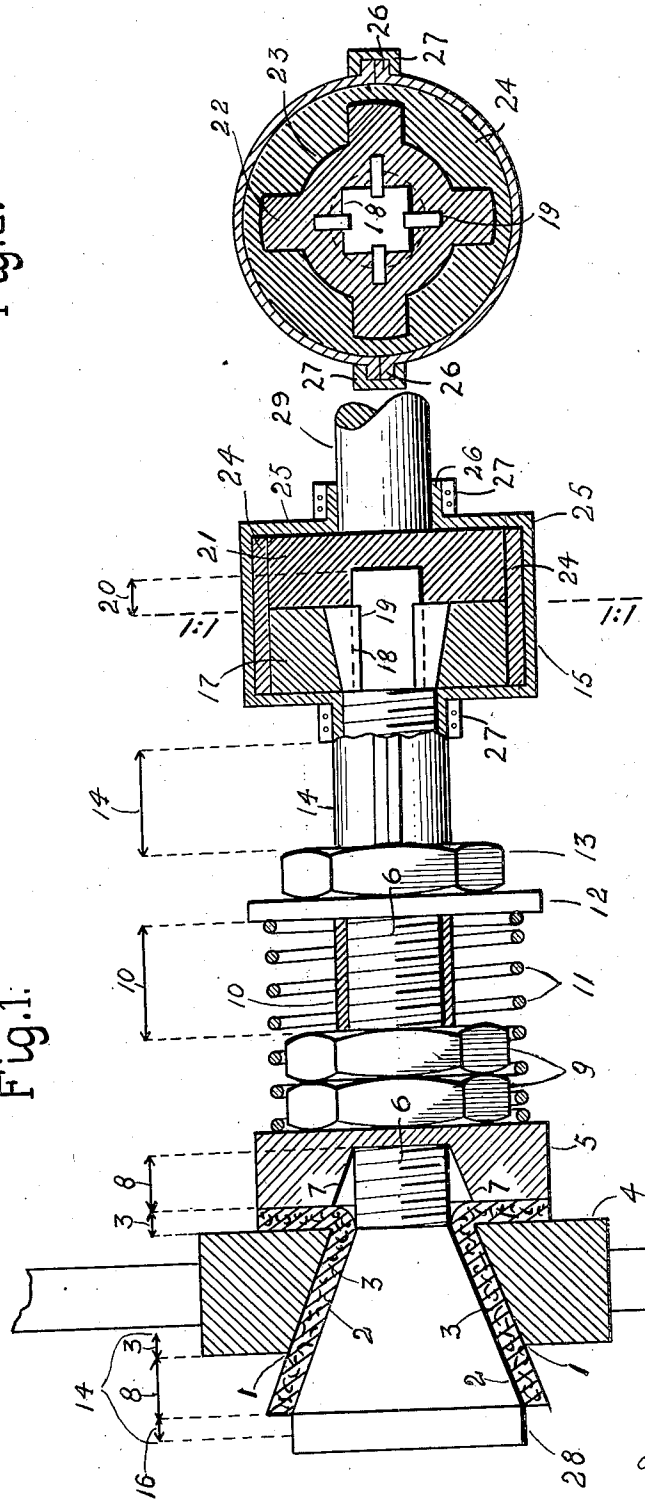


Fig.1.

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Fig. 3.

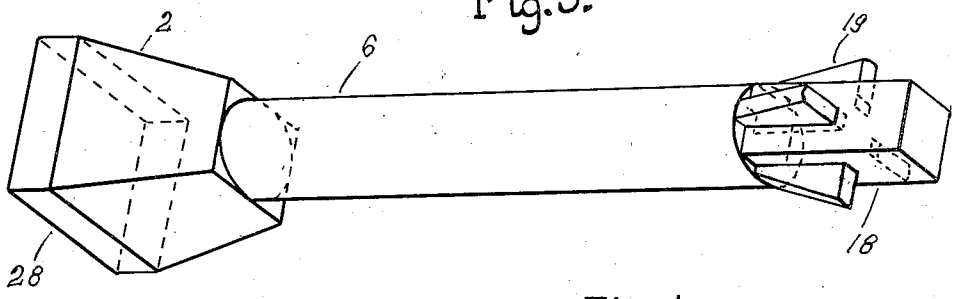


Fig. 4.

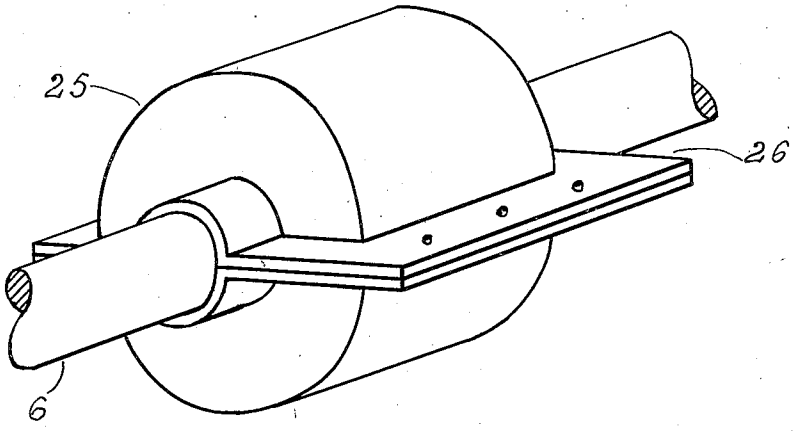
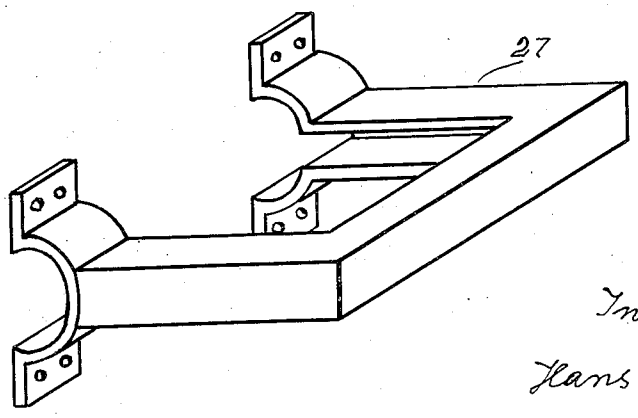


Fig. 5.



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Patented Jan. 16, 1945 2,367,190

UNITED STATES PATENT OFFICE

2,367,190

AIRPLANE PROPELLER

Hans Badrutt, Detroit, Mich.

Application May 2, 1942, Serial No. 441,493

3 Claims. (Cl. 170—173)

The invention relates to improvements of airplane propellers which reduce or abolish the roar of a rotating propeller.

The improvements are based upon the assumption that the roar of the propeller is intensified by the structure of the airplane upon the principle of resonance, the airplane being the resonator and that a vibration absorbing packing placed between the propeller and the airplane will stop the resonance and reduce or stop the noise of the rotating propeller.

Also it is contended that this same improvement when applied to a ship propeller will reduce the distance the propeller vibrations can be detected in the water. Further it is claimed that the elimination of resonance in a propeller will increase the speed of the propelled ship in air or water by virtue of the assumption that the vibrations of resonance are transmitted in sufficient strength to the surrounding medium to set up eddy currents impeding its progress and that the blow of the resonating propeller can be compared to a blow given with a trembling fist.

In consequence thereof the rest of my invention centers solely in practicable and safe means to install such a packing and those means in turn converge upon a solution to counteract a shrinking and deteriorating packing. To obtain the objectives I contrived to give the opening of the propeller hub a pyramidal shape of an order which is called in geometry of solids a frustum of a regular right quadrangular pyramid the hereinafter referred to hubfrustum, its main characteristic being its bottom base constituting the front of the propeller hub and provide the outer end of the propeller shaft with a frusto pyramidal enlargement, the so-called "shaft frustum" which lateral sides are parallel to the lateral sides of the hubfrustum. Both frustums are called the propeller frustums. Their lateral sides do not touch but hold between them the packing, their top bases are aligned, their bottom bases are congruent, consequently the shaft frustum extends to the front over the hubfrustum. The packing covers the shaft frustum fully and is folded over the rear side of the propeller hub head. The lateral sides of the propeller frustums are smooth to permit sliding of the hubfrustum over a deteriorating packing and to form a perfect union of the propeller frustums upon full packing deterioration. The propeller is secured against forward movements by the inclined sides of the propeller frustums and upon full packing deterioration by the congruency of their bottom bases, and against backwards movements before packing deterioration sets in by a continuous line of rigid parts plus a heavy compressed coil spring assembled concentrically on the propeller shaft beginning in consecutive order with a so-called "hubwasher," two hubwasher nuts threaded on the propeller shaft, a tubular so-called "spring spacer" the aforesaid compressed spring concentric to and bearing upon the hubwasher nuts and extending exactly and concentrically over the length of the spring spacer and acting simultaneously with the front hubwasher nut upon the hubwasher, a so-called "spring washer" securing the rear end of that spring by means of the springwasher nut, threaded on the propeller shaft, a so called "auxiliary spacer" consisting of two flanged and bolted together semicylindrical casings and ending up with a coupling uniting the propeller shaft with the engine shaft.

After packing deterioration sets in the propeller is held in place only by the above mentioned compressed spring until a landing of the airplane has been made, the front hubwasher nut tightened up and the ensuing slack between the two nuts filled out by two piece riveted together metal gaskets which periphery extends sufficiently at their junctions over the periphery of the hubwasher nuts to permit riveting.

The conspicuous result of such a propeller mounting is that the propeller cannot fly off the shaft in spite of complete packing deterioration as the congruency of the bottom bases of the propeller frustums prevents it and conversely the propeller and accessories can not be inserted at the front of the shaft but at the rear end. This has forced me to cut the propeller shaft in two and unite it with the aforesaid coupling which has to answer the just mentioned exigencies.

The hubwasher forms with the propeller frustums the nucleus of my invention. Its construction is precisely correlated with the latter as follows: Its front core facing the propeller is recessed into the so called "hubwasher frustum" which lateral sides are aligned and parallel to the corresponding sides of the hub frustum and which top base is congruent to the top base of the shaft frustum and which height is the difference of the heights of the propeller frustums making thereby its bottom base congruent to the top base of the hub frustum. The hubwasher lies slidably upon the propeller shaft which is threaded all the way through up to its frustum.

When packing deterioration sets in the powerful compressed spring pushes that hubwasher forward until by full packing deterioration the following alignments take place: the bottom bases

of the propeller frustums with each other, the bottom base of the hubwasher frustum with the top base of the hub frustum and the top base of the hubwasher frustum with the top base of the shaft frustum.

Pertinent features of the other parts are:

1. The length of the spring spacer which is exactly the length of the spring under greatest compression (that is before packing deterioration sets in) minus the width of the two hubwasher nuts. The compression of the spring is analyzed in the detailed description and graphically illustrated in Fig. 1.

2. The function and length of the auxiliary spacer 14. Its primary function is to lock the spring washer nut doing away with the shaft weakening effect of a cotter pin, secondly it is an auxiliary to an expedient of assembly by taking up that extra length of the shaft which is reserved to permit the decompressing and compressing of the spring without removing the coupling and putting the shaft in a vise on the ground, necessarily then the minimum length of that extra shaft length must be equal the distance the spring is compressed or made shorter before packing deterioration sets in assuming that by the time the spring is decompressed the springwasher nut abuts the coupling and it must consist of two pieces because it is the last part to be assembled and the first part to be dissembled and it is flanged to permit bolting together.

3. My coupling which outstanding features are that no torsional and tensile strains are carried by bolts. The four bolts necessary and applied next to the shaft are subjected only to the centrifugal strain of the housings. The coupling is an improved flange coupling, its flanges are cut into sprockets, the one of the propeller shaft is keyed to the latter while the companion flange is rigidly attached to the engine shaft, both flanges are united by a heavy one piece collar with reciprocating sprockets, the collar is covered by two semicylindrical flanged housings, the latter's flanges are held together by two semicircular housings jointed at the shafts.

The mechanism of my invention is illustrated in the accompanying drawings of which

Fig. 1 is a longitudinal section of the propeller shaft, plus parts embodying my whole invention,

Fig. 2 is a transversial section on the line 1—1 of the shaft coupling facing the propeller,

Fig. 3 is a perspective view of the propeller shaft minus parts but with the coupling keys,

Figs. 4 and 5 are perspective views of the first and second coupling housings, respectively.

Similar numbers refer to similar parts throughout the several views of which a detailed description is the following:

The propeller with the hubfrustum 1, its bottom base constituting the front, rests slidably upon the vibration absorbing packing 3, the latter being folded over the hubhead 4 and having a thickness 31. The packing 3 covers fully the lateral sides of the shaft frustum 2. The top bases of the propeller frustums 1 and 2 are aligned. The difference of the height of those frustums is designated with the numeral 8. Abutting the rear side of the folded over packing 3 is the hubwasher 5 with its frontal core recessed into the hubwasher frustum 7, its height being the difference 8 of the hights of the propeller frustums 1 and 2. Hubwasher 5 is pressed against the packing 3 by two hubwasher nuts 9 threaded on the propeller shaft 6. Abutting the rear of the nuts 9 is the tubular shaft spring spacer 10, its length being previously defined and is referred to by the numeral 32. Abutting the rear of the hubwasher 5 and resting partially upon the nuts 9 is the coil spring 11, its rear end being held in a state of compression by means of the spring washer 12 and spring washer nut 13, threaded on the shaft 6, which in turn is rigidly locked by the auxiliary spacer 14, having a length 33 and is set between nut 13 and coupling 14. Its minimum length is as previously stated the distance the spring 11 is compressed or made shorter upon assembly.

The compression of the spring 11 is calculated for a full packing deterioration, the ensuing alignments having been discussed previously, the distances the spring 11 has to push hubwasher 5 forward are the following: first, the thickness 31 of the folded over packing 3, second, the difference of the heights of the propeller frustums 1 and 2 or the height 8 of the hubwasher frustum 7, at this position the spring has to be given an extra compression 16 to press the hubwasher 5 with great force against the propeller to keep the latter from wobbling.

The compressions of the spring are summarized as follows: (see Fig. 1, the aforementioned dimension numerals indicating the different compressions, 34 being substituted for the thickness of one hubwasher nut). The compression c_{32} equals the compressions $c_{31}+c_{8}+c_{16}$, reducing the spring to the length $2\times d_{34}+d_{32}$, while its full length is $2\times d_{34}+d_{32}+d_{33}$.

The coupling 15 joins the propeller shaft 6 with the engine shaft 29 of the engine 30 and is constructed as follows: A flange 17 is keyed on the quadrangular rear end 18 of the propeller shaft 6, the tapered keys 19 are set flush with the faces of that flange and are set back of the shaft end the length 20 which is inserted into the companion flange 21. These two coupling flanges are cut into sprockets 22. Into the recesses between those sprockets is pushed in longitudinally the reciprocating sprockets 23 of the metal collar 24 which length is equal to the thickness of the two coupling flanges. Collar and flanges are covered and held together by the flanged housings 25 which join in an axial plane of the shafts. Their flanges 26 are bolted or covered by two flanged housings 27 which meet around the periphery of the two shaft ends where its flanges are bolted together.

In order that the propeller with the packing be slipped on quicker on the shaft it is suggested that the diameter of the top base of the shaft frustum be made bigger than the diameter of the shaft in which case the hubwasher bore is set in to make the top base of the hubwasher frustum congruent to the top base of the shaft frustum.

In behalf of the armoring of the propeller shaft, the shaft frustum is provided with a quadrangular head 28 upon which the nose armor is secured.

I claim:

1. In a propeller mounting, a propeller shaft, an enlargement on the outer end of the shaft, said enlargement having the shape of a frustrum of a regular right quadrangular pyramid, a propeller hub, a correspondingly shaped bore in the hub to receive the enlargement, the bottom base of said pyramidal enlargement and the outer end of the hub bore being congruent, the top base of said pyramidal enlargement and the inner end of the hub bore being radially aligned and spaced apart, a vibration absorbing packing positioned

in the space between said enlargement and the hub bore, said packing extending over the inner face of the hub, a washer slidably mounted on the shaft to secure the hub, the core of said washer being recessed at the outer end into a bore aligned and corresponding to said hub bore and a lock nut threaded on said shaft to secure said washer.

2. A propeller mounting as described in claim 1, having automatic means to take up the gap caused by the partial and complete deterioration of said packing.

3. A propeller mounting as described in claim 1 with automatic means to take up the gap caused by the partial and complete deterioration of said packing wherein those means consist of a compressed heavy coil spring mounted concentrically on the propeller shaft and said lock nut, the outer end of said spring abutting said hub securing washer and the inner end a washer mounted on the shaft and secured by a nut threaded on said shaft.

HANS BADRUTT.