

March 27, 1945.

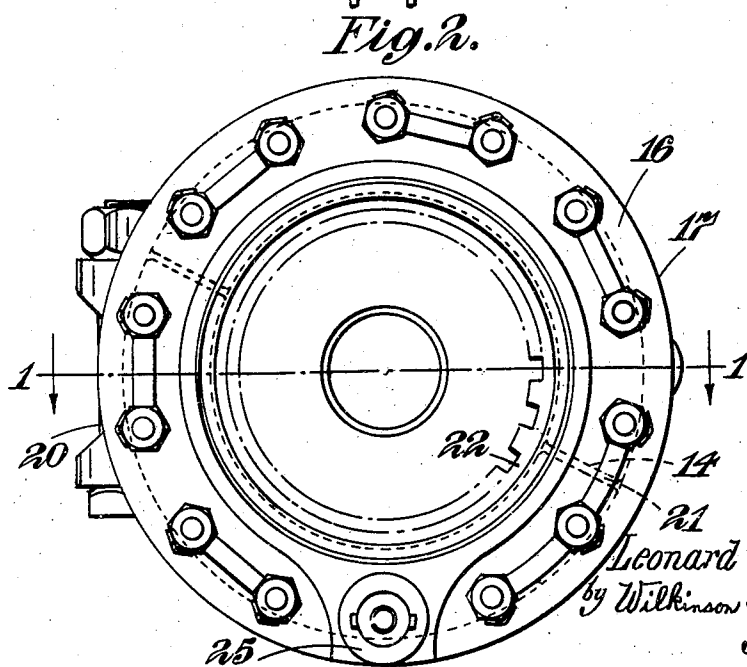
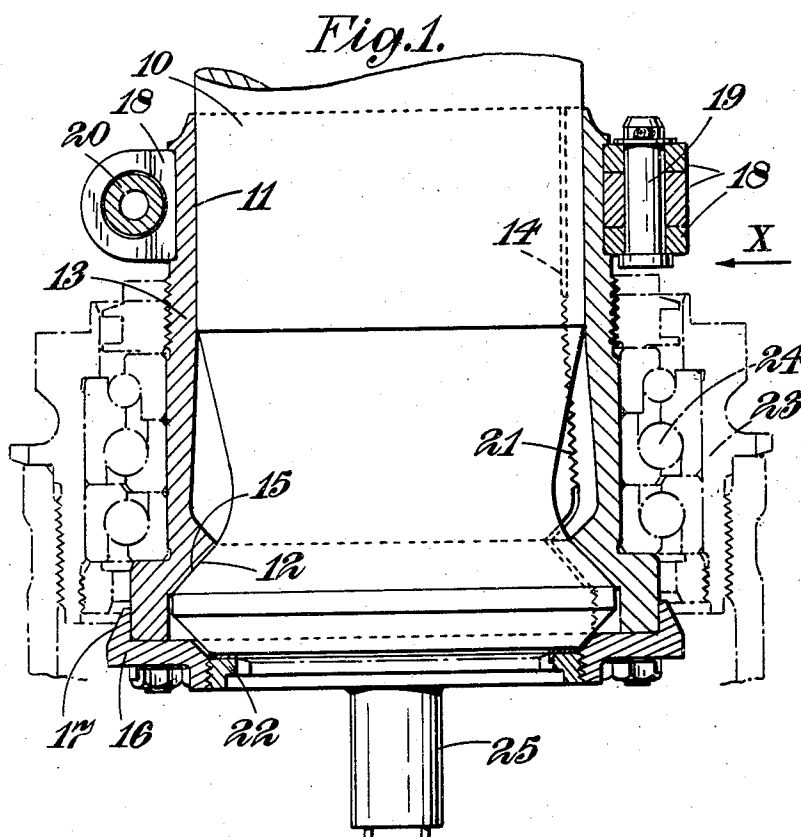
L. G. FAIRHURST

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VARIABLE-PITCH AIRSCREW

Filed Feb. 11, 1942

2 Sheets-Sheet 1



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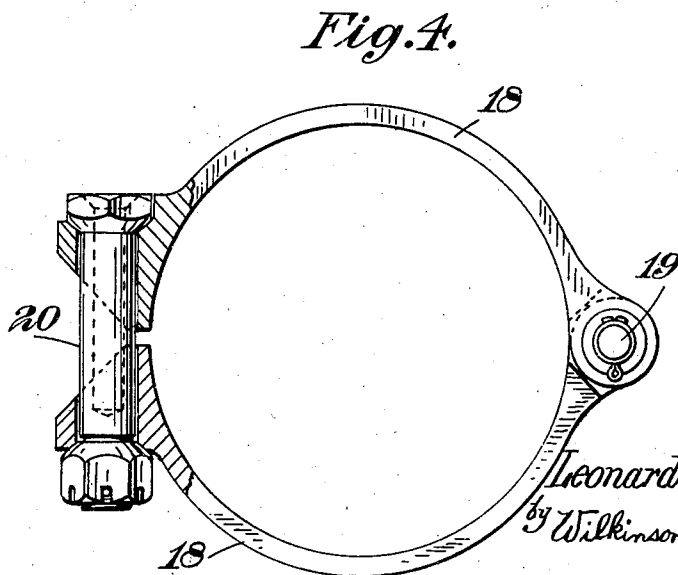
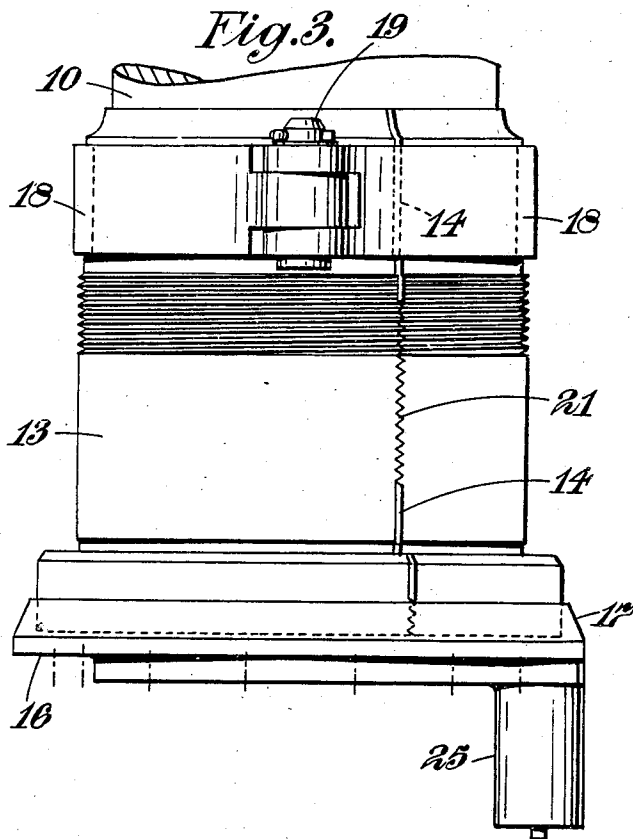
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UNITED STATES PATENT OFFICE

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VARIABLE-PITCH AIRSCREW

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Application February 11, 1942, Serial No. 430,459
 In Great Britain December 19, 1940

2 Claims. (Cl. 170-162)

This invention relates to variable-pitch airscrews of the type in which each blade is mounted, usually by an adaptor surrounding the blade-root, to rotate in bearings in the hub. The blade-root is subjected to high centrifugal loads in the direction of its length and also to bending loads due to aero-dynamic forces, and it has hitherto been customary to form the blade-root with a radial flange and a cylindrical portion to carry these two loads respectively. The use of a flange has, however, two disadvantages in that its provision usually means that the stress-concentration at the root of the blade will be fairly high so that the root-diameter will be greater than would otherwise be necessary, and that the formation of the flange also involves the interruption of the grain flow in the material of the blade and a consequential weakness near the flange where the stress-concentration is greatest. These disadvantages are particularly serious when the airscrew blades are made of a light alloy, such as an alloy of magnesium, which is particularly sensitive to the notch effect on their strength.

According to the present invention a blade for a variable-pitch airscrew has its root formed with a conical surface to engage a bearing, directly or indirectly, substantially normally to the direction of the resultant loading on the surface. This loading is due partly to centrifugal force acting along the axis of the blade and partly to the bending load acting normally of said axis so that the resultant load acts in a direction inclined to the axis of the blade.

The root of the blade is, preferably, formed to provide the conical surface by an upsetting or equivalent operation so that the grain flow of the material is not unduly disturbed and weakness due to the interruption of the grain flow is avoided. The use of a conical surface eliminates sharp angle so that high stress-concentration is avoided in this portion of the blade.

It is a feature of this invention to form the root of the blade with a cylindrical surface spaced away from the conical surface to carry, or assist in carrying, the bending load on the blade.

The present invention also includes the combination with a blade arranged as set out above of an adaptor comprising a longitudinally-divided two-part sleeve arranged to fit the cylindrical surface of the blade and formed with a conical surface to engage the conical surface on the blade, and means for securing the two parts of the blade together. The securing means may comprise an integral ring secured to the end of

the sleeve nearest the base of the blade and means at the other end of the sleeve for clamping its two parts together, preferably against the cylindrical portion of the blade.

The present invention also comprises an adaptor for the blade of a variable-pitch airscrew, comprising a longitudinally divided two-part sleeve whereof the abutting edges are serrated transversely of their length to interlock and prevent relative longitudinal movement of the two parts.

A blade and an adaptor for a variable-pitch airscrew will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a section through the blade and adaptor in the plane containing the axis of the blade and the axis of the airscrew of which the blade forms part; this figure is a section on the line 1-1 of Figure 2;

Figure 2 is an under plan of the blade and adaptor;

Figure 3 is an elevation of the blade and adaptor as seen when looking in the direction of the arrow X in Figure 1, and

Figure 4 is a plan of a clamping ring employed.

The root 10 of the blade is formed with a cylindrical surface 11 and with a conical surface 12 which is formed by an upsetting or equivalent operation. The surface 12 is substantially normal to the direction of the resultant load on this surface due to centrifugal and bending loads. The root 10 is supported in the adaptor which comprises a two-part sleeve 13 divided longitudinally at 14 (see Figure 3). The sleeve 13 fits the cylindrical surface 11 of the blade root and is formed with a conical surface 15 to engage the conical surface 12 on the blade root. A ring 16 is bolted to the lower end of the sleeve 13, after the two parts have been placed around the blade-root, and has a lip 17 which fits over the outer surface of the sleeve and holds the two parts of the sleeve together at this end. A clamping ring 18 (see Figure 4) is formed in two parts articulated together at 19 and tightened round the upper end of the sleeve 13 by means of a nut and bolt 20. This clamping ring holds the upper ends of the two parts of the sleeve together and also clamps them against the cylindrical surface 11 of the blade-root. The abutting edges of the two parts of the sleeve 13 are serrated at 21 (see Figure 3) and the serrations interlock to prevent relative longitudinal movement of the two parts. The serrations terminate short of the top of the sleeve in order to leave

gaps between the two parts of the sleeve which enables the two parts to be clamped against the blade-root. The conical surfaces 12 and 15 are held in engagement with one another by a ring 22 which is screwed into the ring 16 and into engagement with the base of the blade-root so as to hold the surfaces 12 and 15 in engagement. This ring should, of course, be tightened up before the clamping ring 18 is tightened up.

The adaptor is mounted in a socket 23, provided in the airscrew hub, by means of ball bearings 24 so that the adaptor, and the blade, can be rotated in the socket to vary the pitch of the blade. The pitch-variation is effected by a pitch-varying motor which may be an electric motor arranged to rotate the blade through bevel gearing including a bevel-wheel secured to the root of the blade, or which may be an hydraulic motor connected by a link to a pin on the blade. The present blade is arranged for pitch-variation by an hydraulic motor having a movable cylinder which is connected to a pin 25 on the base of the blade. It will be observed that this pin is integral with the ring 16 which is secured to the adaptor 13 so that the pitch-varying motor is operatively connected to the adaptor and rotates the adaptor which, in turn, rotates the blade-root to which it is clamped. This has the advantage that the pitch of the blade can be adjusted by slackening the clamping ring 18, which is readily accessible, and turning the blade in the adaptor to the required pitch-setting, it being unnecessary to disturb the connection to the pitch-varying motor.

I claim:

1. For a variable-pitch airscrew, the combina-

tion with a blade whereof the root is formed with a cylindrical portion and a conical surface facing towards the tip of the blade, of a longitudinally-divided two-part sleeve fitting the cylindrical portion of the blade-root and formed with a conical surface to engage the conical surface on the blade, means for clamping the two parts of the sleeve together at its end remote from the root end of the blade, a ring secured to the other end of the sleeve to hold its two parts together and a member screwed into the ring to engage the root-end of the blade and force the conical surfaces on the blade and the sleeve into contact.

2. For a variable-pitch airscrew, the combination with a blade whereof the root is formed with a cylindrical surface and a conical surface facing towards the tip of the blade and located between the cylindrical surface and the root end of the blade, of a sleeve longitudinally divided into two parts of which the abutting edges are serrated transversely of their length to interlock, fitting around the cylindrical portion of the blade-root and formed with a conical surface engaged with that on the blade-root, a clamping ring tightened around the sleeve to clamp its two parts together against the cylindrical portion of the blade-root, an integral ring secured to the end of the sleeve nearest the root end of the blade and formed with a lip snugly surrounding the sleeve to hold its parts together, a member screwed into the integral ring to engage the end of the blade-root and force the said conical surfaces together and a pin projecting from the integral ring.

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