Fig. 5
The present invention relates to balancing means for a propeller blade assembly and more particularly to balancing mechanism that is utilized after a blade, per se, has been initially balanced, to obtain adequate vertical and horizontal balance of the blade assembly and propeller unit.

Balancing assemblies for propeller blades are ordinarily inaccessible from the exterior of the blade by reason of their disposition within the hollow root end or shank portion thereof. This undesirable feature is particularly apparent in blade balancing assemblies which structurally embody a balancing cup assembly. Should it become necessary to rebalance blades equipped with this type of assembly in the field, it is necessary to remove the blade from its associated propeller hub, which procedure is arduous. Accordingly, one of our objects is to provide balancing means for propeller blade assemblies that are accessible from the exterior of the blade whereby removal of the blade assembly from its associated hub is not ordinarily required to rebalance the blade in the field.

The aforementioned and other objects are accomplished in the present invention by providing a plurality of arcuate channels which circumscribe the shank portion of a propeller blade and within which balancing weights may be attached. Specifically, the propeller blade, per se, is initially horizontally and vertically balanced by removing portions of the blade by a grinding operation. The blade is provided with the usual cufit ring or shoulder on the shank portion thereof, which is adapted to support accessories, such as a cufit element, a seal, and de-icing equipment, to thereby complete the blade assembly. The cufit element is retained on the propeller blade by means of a cufit retaining ring that encompasses the shank of the propeller blade and is provided with a radially inward extending shoulder that abuts the cufit ring formed on the blade shank. A plurality of arcuate channels are provided between an extension of the cufit retaining or accessory supporting ring and the blade shank within which balance weights may be disposed. In this manner, any unbalance of the blade assembly, including the accessories, may be compensated for by the attachment of weights, the number and location of which is initially determined by any well known means.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:
Fig. 1 is a fragmentary view of a propeller blade assembly embodying the invention, partially in elevation and partially in section, the section being taken along line 1—1 of Fig. 2.

Fig. 2 is a sectional view taken along line 2—2 of Fig. 1.

Fig. 3 is a fragmentary view taken in the direction of arrow 3 in Fig. 1.

Fig. 4 is a view in elevation of a propeller unit.

Fig. 5 is an enlarged fragmentary view, partly in section and partly in elevation, depicting the cufit mounting on the blade shank.

Referring more particularly to the drawings, the invention is exemplified in conjunction with a propeller blade 1 having a hollow cylindrical shank 2, which may be secured in a propeller hub in any well known manner. The blade assembly, as shown, includes the propeller blade 1 and a cufit element 3, which assembly is completely fabricated before the mass constituted by weights for horizontal and vertical balancing of the blade assembly are attached thereto. The longitudinal axis of the blade assembly is indicated by the line A—A in Fig. 1, and the hub axis of the propeller unit by B in Fig. 4. Hereinafter reference to balance of the blade assembly about its longitudinal axis will be referred to as vertical balance and balance about its hub axis as horizontal balancing.

Propeller blade 1 may be hollow construction and includes an airfoil portion 4 and the hollow shank portion 2. An annular shoulder 5 is provided on the shank portion 2, this shoulder being commonly termed a cufit ring. The cufit element 3 is provided to perfect the airfoil contour of that portion of the blade between the shank proper and the airfoil section 4.

The cufit elements 3 and propeller units may be of the type disclosed and claimed in copending application, Serial No. 276,312, filed March 13, 1952, in the name of Wallace Blanchard, Jr. The cufit elements generally comprise a member 6 of airfoil configuration which is attached to a bulkhead closing the inner edge of the member 6. The outer edge of the member 6 merges with the leading edge of the blade 1 and also merges with the thrust and camber surfaces thereof. In addition, cufitting means 28, of the type disclosed in copending application, Serial No. 276,312, filed March 13, 1952, in the name of Wallace Blanchard, Jr., are provided for drawing the leading edge of member 6 into engagement with the leading edge of the blade 1. An extension of the bulkhead 7 is attached by rivets 30, or other suitable means, to a cufit retaining ring 8. The cufit retaining ring 8 is provided on its inner periphery with a shoulder 8a which is adapted to abut the lower edge of the cufit ring 5, which is integral with the shank 2. Other accessories such as de-icing slip rings and spinner seals, not shown, may also be supported by the ring 8. The propeller units include hubs having sockets for the retention of blade assemblies and a spinner 25, as is shown in Fig. 4.

As is seen more particularly in Figs. 2 and 5, the cufit retaining ring 8 is also provided with three axially extending flanges 9, 10 and 11, which are apertured to receive bolts 12, 13 and 14. The cufit ring 8 is also provided with three openings in radial alignment with the flanges 9, 10 and 11, two of which, 15 and 16, are shown in Fig. 5. The openings are formed in the cufit retaining ring 8 to permit the insertion of T-shaped nuts 17, which threadedly engage the bolts and also abut the upper surface of the cufit retaining ring 5. In this manner, the cufit ring 8 and the cufit element 3 are retained in position upon the blade 1.

The cufit retaining ring 8 is concentric with the shank 2 and between the flanges 9, 10 and 11 thereof are formed a plurality of arcuate channels 18, 19 and 20 which substantially circumscribe the shank 2. The lower surface of the shoulder 9 may be provided with a plurality of threaded openings 21, which provide means for securing balance weights within the arcuate channels 18 and 19. A balance weight 22, secured by screw devices and a lock wire, is shown in Fig. 2. However, it is to be understood that the balance weights may be secured by any suitable means other than screw devices.
and lock wires, such as by arc welding or self locking nuts.

The blade 1 is initially fabricated so as to be vertically and horizontally balanced within specific limits. Thereafter, the cuff element 3, and any other accessories are attached thereto and the blade assemblies may be anchored to a hub. The unbalance of the blade assembly or the propeller unit is then determined by any well known testing apparatus after which the location and the amount of mass to be added within the channels 18 and 19 is determined in any well known manner. Arcuate weight elements, such as the one designated by 22, are then anchored to the shoulder 8a of the cuff retaining ring 8 to compensate for any unbalance which had previously been determined.

After the blade assemblies have been installed in a propeller hub, should it become necessary to remove or add balance weights to correct for unbalance of the propeller blade assembly or propeller unit, as shown in Fig. 4, due to reworking of the blades in the field, replacement of accessories, or refinishing operations, balancing of the propeller blade assembly may ordinarily be effected without removal of the blade from its associated hub. Accordingly, the task of making minor adjustments in the blade balance is greatly simplified through utilization of the construction disclosed herein.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. Means for supporting weights for balancing a propeller blade assembly, said assembly being constituted by a blade and a cuff element, said blade having a cylindrical shank and an airfoil section, said cuff element perfecting the airfoil contour of a portion of the blade between the airfoil section and said shank, including, a member encompassing said shank and being attached thereto, means interconnecting said member and said cuff element for restraining said cuff against axial movement relative to said blade, said member having an axial extension concentric with and radially spaced from said shank to form a plurality of arcuate channels therebetween adapted to receive the balancing weights, and means for anchoring the weights within said channels.

2. Means for supporting weights for balancing a propeller blade assembly, said assembly being constituted by a blade and a cuff element, said blade having shank and airfoil sections with an annular shoulder circumscripting the shank section, said cuff element having a cylindrical extension encompassing a portion of said shank section, including, a cuff retaining ring encompassing said shank section and having an internal annular shoulder, means adapted to maintain the shoulder of said shank section and the shoulder of said cuff retaining ring in engagement so as to attach said cuff retaining ring to said shank section, means interconnecting said cuff retaining ring and said cylindrical cuff extension, said cuff retaining ring having portions concentric with and radially spaced from said shank section to form a plurality of arcuate channels therebetween adapted to receive the balancing weights, and means for anchoring said weights within said arcuate channels.

3. Means for supporting weights for balancing a propeller blade assembly, said weights being accessible exteriorly of the blade assembly, said blade assembly including a blade having shank and airfoil sections and a cuff element for perfecting the airfoil contour of a portion of said blade between said airfoil section and said shank section, including, a member encompassing said shank section and removably attached thereto, and means interconnecting said member and said cuff element for preventing movement of said cuff element relative to said blade, said member having an axially extending portion concentric with and radially spaced from said shank section to form a channel therebetween adapted to receive the balancing weights.

4. Means for supporting weights for balancing a propeller blade assembly, said assembly including a blade having shank and airfoil sections, and a cuff element for perfecting a portion of the airfoil contour of said blade, said blade including a cuff ring integral with said shank section, including, a cuff retaining ring having an internal annular shoulder, means interconnecting said cuff retaining ring and said integral cuff ring of said shank section, means interconnecting said cuff retaining ring and said cuff element, said cuff retaining ring having a portion concentric with and radially spaced from said shank section to form a channel adapted to receive the balancing weights, and means for anchoring said weights within said channel.

5. Means for supporting weights for balancing a propeller blade assembly, said assembly including a propeller blade having an airfoil section and a cylindrical shank, said shank having an integral shoulder thereon, including, an accessory supporting ring having an internal shoulder, means maintaining contiguous surfaces of said accessory ring shoulder and said shank shoulder in engagement, said accessory ring having a portion concentric with and radially spaced from said shank section to form a channel adapted to receive the balancing weights, and means for anchoring said weights within said channel whereby the balance of said assembly may be altered from the exterior thereof.

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