

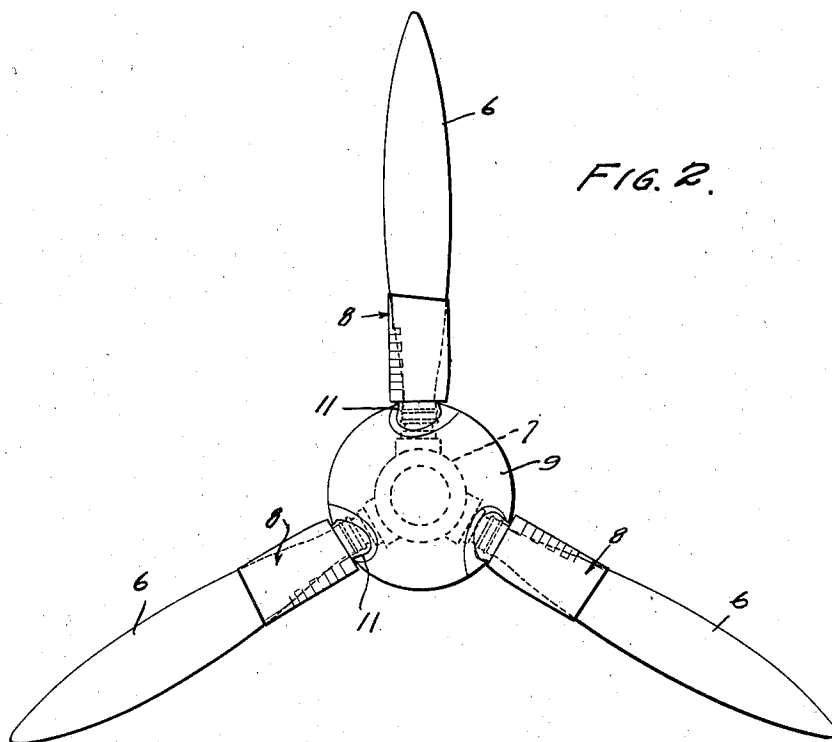
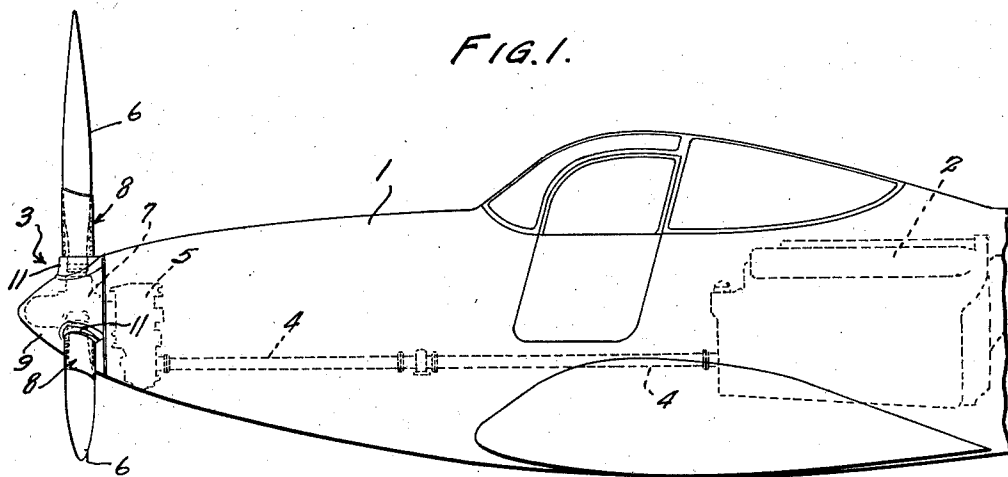
July 14, 1942.

R. J. WOODS
PROPELLER FAIRING

2,289,400

Filed March 23, 1939

5 Sheets-Sheet 1



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July 14, 1942.

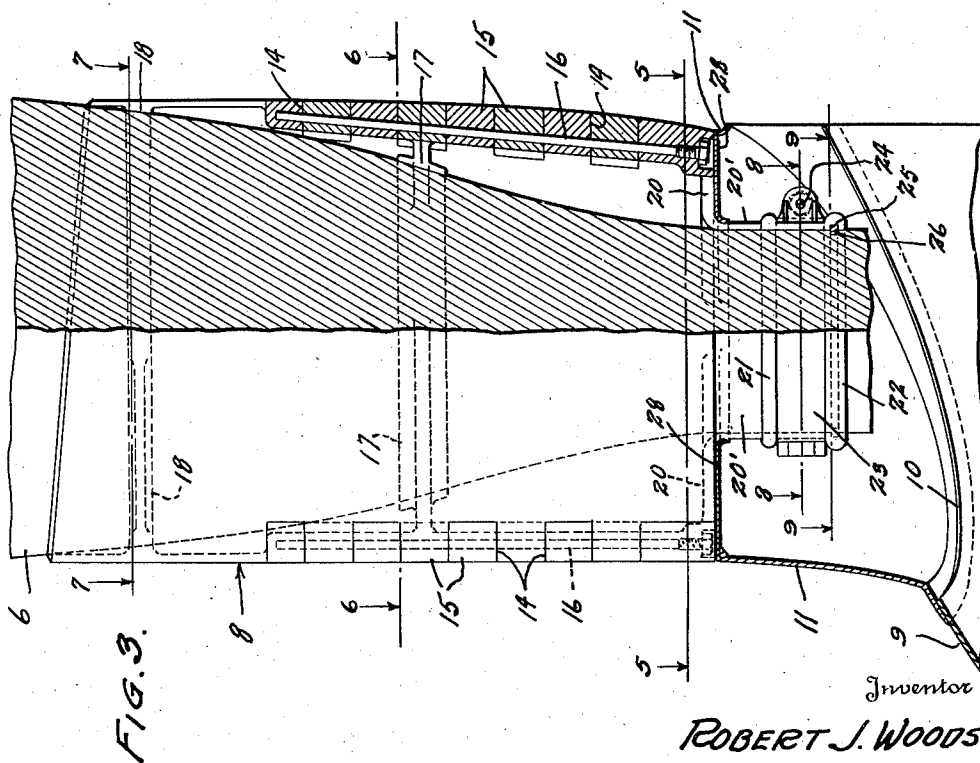
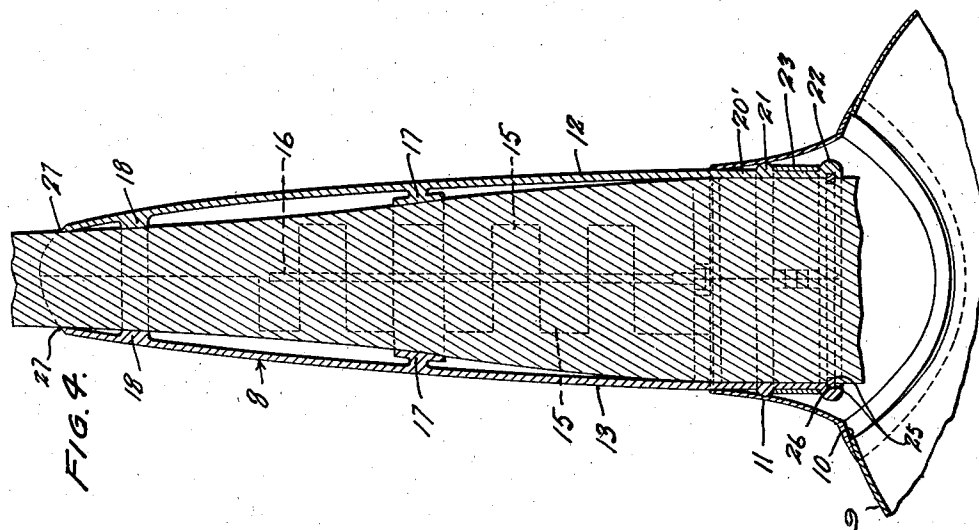
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PROPELLER FAIRING

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5 Sheets-Sheet 2



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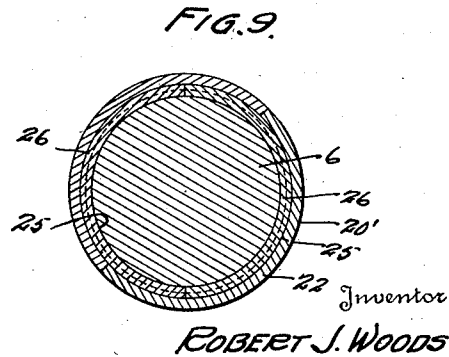
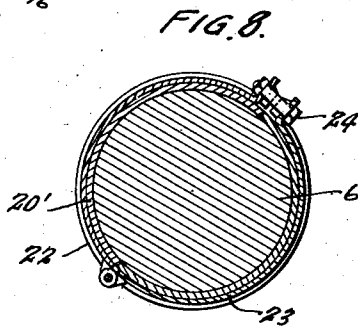
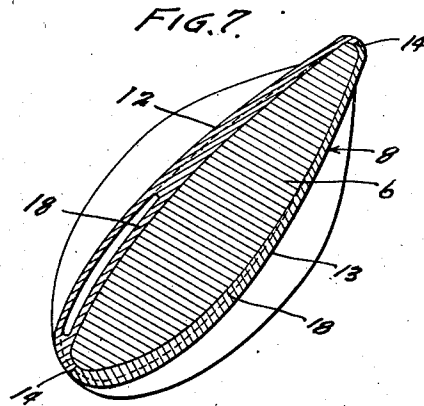
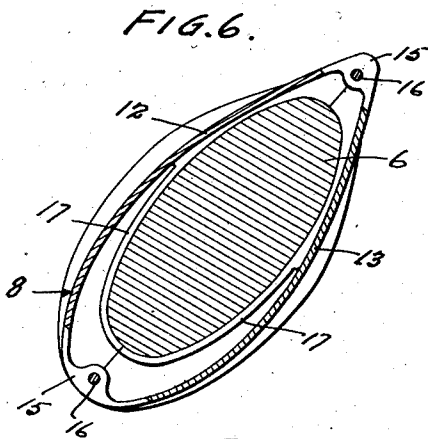
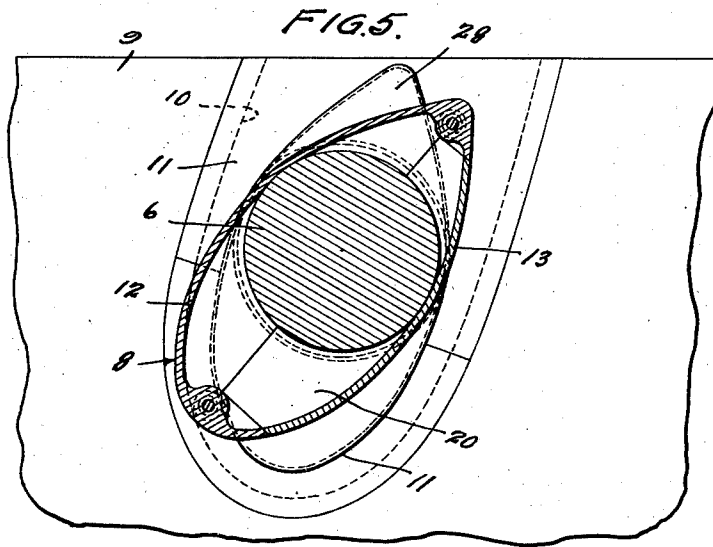
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PROPELLER FAIRING

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5 Sheets-Sheet 3



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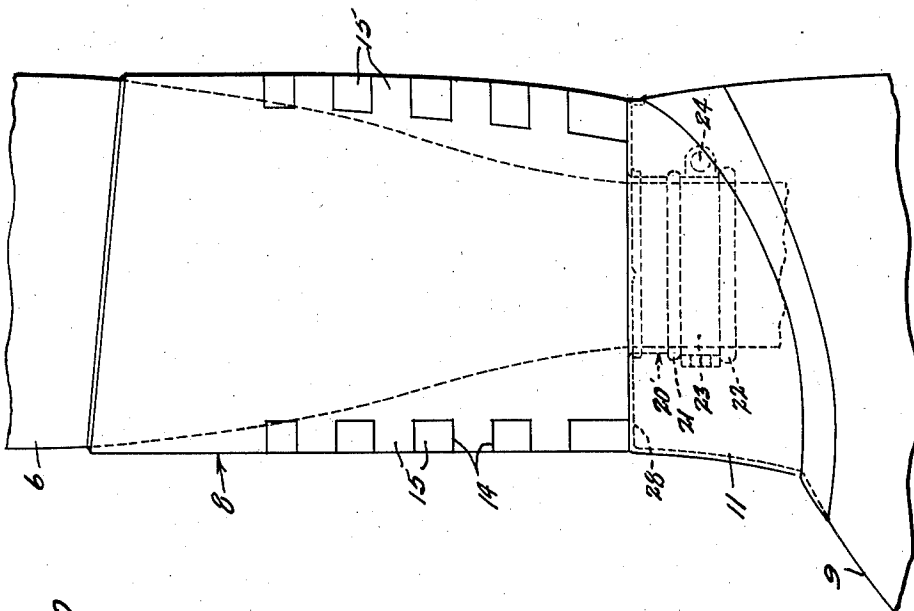
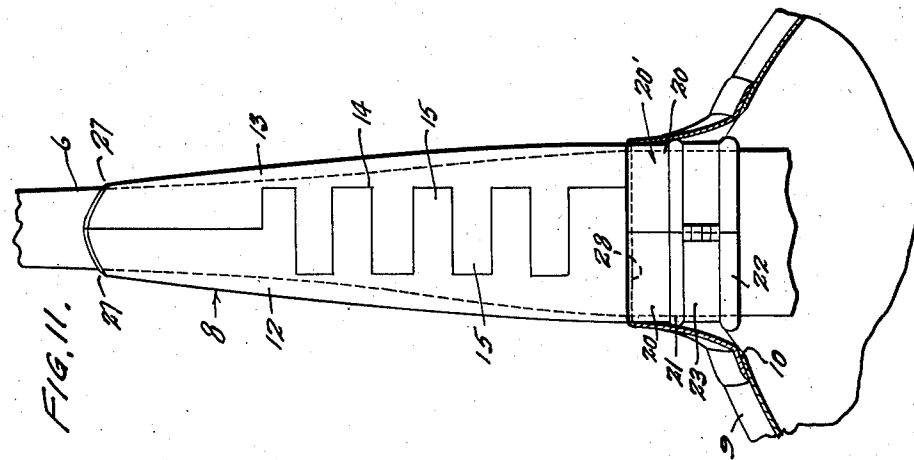
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PROPELLER FAIRING

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5 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

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PROPELLER FAIRING

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11 Claims. (Cl. 170—159)

This invention relates to a device which is designed to be attached to the shank of a propeller blade to give this portion an airfoil section, and more particularly to the combination of this device with a fairing to increase its effectiveness.

At present, propeller manufacturers are usually required to produce propellers the blades of which are airfoil sections only from a radius of approximately two and one-half feet outward. The remaining portion of the blade near its root is cylindrical in shape.

This construction is necessary for the blades of adjustable pitch propellers to give added strength, and is not objectionable where radial engines having a large frontal area are used because the presence of these areas in the slip stream destroys the effectiveness of those portions of the radii of the propeller blades which are positioned in front of the engine. However, where liquid cooled engines and in-line air cooled engines, and particularly engines which are connected to the propeller by an extension shaft, are used, thus reducing the frontal area of the fuselage, the propeller efficiency can be greatly increased by providing blades for the propeller which present an airfoil section throughout their entire length.

One of the objects of my invention is to overcome the above-mentioned disadvantages of the prior art.

Another object of my invention is to provide a device in the form of a cuff which is of airfoil section and which is adapted to be secured on the cylindrical end portion of a propeller blade.

Yet another object of my invention is to provide a cuff of the type described which is made of cast metal and is so molded that it cannot be displaced in relation to the blade by the forces created by the rapid rotation of the propeller.

Still another object of my invention is to provide a cuff of airfoil section which is composed of sheet metal and is so constructed that it cannot be displaced in relation to the blade by the forces created by the rapid rotation of the propeller.

Another object of my invention is to provide a cuff of the type described which is so constructed that when mounted on the blade of a propeller, the effective surface of the propeller will be increased without altering the blade angle.

Still another object of my invention is to provide a fairing which is mounted on the spinner of the propeller assembly and forms a streamlined surface between the said spinner and the

cuff mounted on the propeller blade shank in the manner described above.

A further object of my invention is to provide a fairing which is so constructed and positioned that it will continuously provide a streamlined surface between the spinner and a cuff mounted on the shank of the blade of an adjustable pitch propeller throughout the adjustable range of the blade.

With these and other objects in view, my invention embraces the concept of providing a device of airfoil section which is designed to be secured to the shank portion of the blades of propellers in order to increase their effectiveness. A fairing is also provided which forms an airflow surface between the spinner of the propeller assembly and the cuff to prevent turbulence in the airstream adjacent the bottom of the cuff. This fairing is so constructed that when used in combination with the cuff mounted on an adjustable pitch propeller it will present a virtually streamlined surface throughout the range of positions assumed by the adjustable propeller blade.

By the use of my invention, a propeller of increased effectiveness is produced, when engine installation of small frontal areas are used, without reducing the strength of the propeller blades. Moreover, as mentioned previously, my invention can be used with an adjustable pitch propeller.

In the drawings:

Figure 1 is a side elevational view of the forward portion of the fuselage of an airplane showing the engine installation in dotted lines.

Figure 2 is a front view of the propeller shown in Figure 1, disclosing the device which forms one of the features of my invention mounted on each of the propeller blades.

Figure 3 is a projected plan form view partly in section disclosing the construction of one form of cuff which may be used in my invention and the fairing which forms a streamlined surface between the spinner of the propeller assembly and the cuff.

Figure 4 is a vertical, cross-sectional view of the device shown in Figure 3.

Figure 5 is a view taken along the line 5—5 of Figure 3, looking in the direction of the arrows.

Figure 6 is a view taken along line 6—6 of Figure 3, looking in the direction of the arrows.

Figure 7 is a view taken along line 7—7 of Figure 3, looking in the direction of the arrows.

Figure 8 is a view taken along line 8—8 of Figure 3, looking in the direction of the arrows.

Figure 9 is a view taken along line 9—9 of Figure 3, looking in the direction of the arrows.

Figure 10 is a view partly in elevation showing the relationship of the cuff and the fairing which is used in one form of the invention.

Figure 11 is a vertical view partly in elevation of the structure shown in Figure 10.

Figure 12 discloses a projected plan form view of a second form of cuff construction mounted on a propeller blade, the shank portion of which is indicated by dotted lines.

Figure 13 is a view taken along line 11—11 of Figure 12, looking in the direction of the arrows.

Figure 14 is a view taken along line 12—12 of Figure 12, looking in the direction of the arrows.

Figure 15 is a view taken along line 13—13 of Figure 12, looking in the direction of the arrows.

Figure 16 is a view taken along line 14—14 of Figure 12, looking in the direction of the arrows.

Figure 17 is a view taken along line 15—15 of Figure 12, looking in the direction of the arrows.

In order to illustrate my invention, I have shown in Figure 1 an airplane which comprises a fuselage 1, liquid cooled engine 2, and a propeller assembly 3. The engine 2 is connected to the propeller assembly 3 by means of a drive shaft 4 and suitable reduction gearing 5.

While for purposes of illustration I have disclosed a three bladed, adjustable pitch propeller driven by an extension shaft, it is to be understood that the invention which is to be described is suitable for use with either an adjustable or non-adjustable propeller having any desired number of blades. Moreover, it is not necessary to use a single engine or an extension shaft if the engine selected presents a relatively small frontal area or is housed within the fuselage or nacelle of the airplane.

The propeller 3 consists of three propeller blades 6 carried by a hub 7 which is mounted on a propeller shaft, one extremity of which is operatively mounted in the housing 5. The shanks of these blades are substantially cylindrical in shape to afford added strength and each blade is provided with a cuff 8 which forms one of the features of my invention.

A spinner or nose piece 9, provided with cut-away portions 10, forms an integral part of this assembly 3 and is mounted coaxially with the propeller shaft in such a manner that the cut-away portions 10 encircle the inner extremities of the blades 6.

In order to form a virtually streamlined surface between the spinner 9 and the propeller blades 6, a fairing 11 is provided. This fairing forms another feature of my invention and will be subsequently described.

In one form of my invention shown in Figures 3 through 9, the cuff 8 is made of cast metal of any suitable type, such as a magnesium-aluminum alloy, and consists of two complementary parts 12 and 13 which are adapted to embrace the propeller blades 6.

As best shown in Figure 3, a portion of two of the opposite extremities of each of the complementary parts 12 and 13 are castellated to form fringed edges in which the notches are so positioned that the complementary portions may be tightly fitted as shown at 14. The projections 15 formed by these notches are provided with aligned apertures through which a rod is inserted on each side of the cuff to securely join the complementary portions.

The complementary member 12 is also provided with a pair of integrally formed interior flanges which are spaced so as to cooperate when the cuff 8 is mounted on the propeller 6 with similarly

formed flanges on the complementary part 13 to form collar members 17 and 18. The inner surface of these collar members 17 and 18 is shaped to allow them to closely fit the contour of the portion of the propeller blade with which they are designed to come in contact. This construction prevents any possibility of angular displacement of the cuff member 8 in relation to the blade 6.

The complementary part 12 is also provided with a base 20 having a downwardly extending semi-cylindrical portion which coacts with the downwardly projecting semi-cylindrical portion of the similarly formed base 20 of the complementary part 13 to form a collar 20'. This collar 20' is of a proper diameter to fit closely the shank portion of the propeller 6 near its root, as shown in Figures 8 and 9. The collar 20' is provided with a pair of annular beads 21 and 22 which are spaced apart to form an annular groove in which is positioned a hinged clamp ring 23, the free extremities of which are drawn together by the bolt assembly 24.

The bead 22 and the adjacent portion of the blade 6 are grooved to provide keyways 25 in which is positioned a key 26. This construction together with the clamping ring 23 prevents the cuff 8 from being moved in relation to the blade 6 by the centrifugal forces created by the rotation of the propeller 3.

The cuff 8 is of airfoil section and its jointed edges extend radially outwardly in parallel lines which are substantially perpendicular to the base 20. Therefore, when mounted on the blade 6, the leading and trailing edges of the cuff are in spaced relation to the leading and trailing edges of the blades where it tapers toward the root. The inner surface of the collar 20', however, is in continuous contact with the adjacent surface of the blade 6 as shown in Figures 8 and 9, and this snug contact also exists between the collars 17 and 18 and adjacent portions of the blade 6 as shown in Figures 6 and 7. The front and rear surfaces of the cuff 8 converge to fair into the propeller blade 6 as indicated at 27. These surfaces also twist to conform to the change in the blade angle to present the most effective angle of attack of the cuff to its relative wind.

Each of the fairings 11 consists of an airfoil sectioned collar which is mounted on the spinner 9 in such a manner as to cover the aperture 10. This collar is positioned at such an angle and so shaped as to closely approximate the shape of the base 20 of the cuff to form an air-flow surface between the surface of the spinner 9 and the surface of the cuff 8. In order to form a smooth working fit between the cuff and the fairing, the outer edge of the fairing 11 is provided with a closure 28 apertured to surround the collar 20'.

By preparing a fairing of this construction, turbulence in the stream of air flowing across the spinner 9 is reduced, thereby increasing the effectiveness of the propeller 3. Moreover, as shown in Figure 5, by providing the closure portion 28, the blade 6 may be adjusted to any pitch angle without disturbing the continuity of surface between the fairing 11 and the cuff 8.

In the second form of my invention which is shown in Figures 12 through 17, the upper portion 30 of the cuff 8' is composed of a ductile sheet metal of any suitable type, such as a magnesium-aluminum alloy. This upper portion 30 is mounted on a cast metal base 31 to which it is secured in any suitable manner such as by se-

curing it in position by means of spaced screw assemblies 32 and 33, as shown in Figure 16.

In mounting, the upper portion 30 is shaped into the form of a cuff having leading and trailing edges which are substantially perpendicular to the base 31. The trailing edge is provided with longitudinally extending straps 34 which are provided with interlocking knuckles 35 joined by a pin 36. In order to secure the cuff 8' in fixed relation to the blade 6, the front and rear edges of the upper portion 30 are tapered to virtually conform with the surface of the blade 6 as shown in Figure 13. The leading and trailing edges of the cuff form straight lines which are substantially perpendicular to the base 31 and extend outwardly to a juncture with the leading and trailing edges of the blade.

As best shown in Figure 17, the base 31 is formed of two complementary portions 37 and 38 which are joined by countersunk screw bolts 39. These complementary portions 37 and 38 are provided with downwardly extending semi-cylindrical portions which are complementary and combine to form the collar 40. This collar encircles the blade 6 and is in continuous contact with the surface of the blade adjacent its root.

As similarly shown in Figure 3, the collar 40 is provided with an annular groove which coacts with an annular groove in the propeller shank to form a key seat in which is positioned a key 41. A hinged collar 42 surrounds the collar 40 and is adapted to be drawn tight by a bolt 43 passing through corresponding ears formed on the free ends of the hinged collar 42. Suitable beading 44 is provided on the collar to prevent longitudinal displacement of the collar 42. By tightening the collar 42, the collar 40 is forced into snug relationship with the shank of the blade 6, thereby preventing relative movement of the blade of the cuff 8' in relation to the blade 6.

In this form of my invention the fairing 11 is similar in construction to that previously described and cooperates with the surface of the cuff 8' in a similar manner. Moreover, the fairing 11 will function in this manner if the cuff 8' is used on the blade of an adjustable pitch propeller.

By the use of cuffs of airfoil section on the blades of propellers, the blade is given an airfoil section of correct pitch, and angular twist throughout its entire effective span is provided. The efficiency of the propeller is substantially increased without reducing the strength of the propeller blades. If a fairing is used in combination with the cuff, this efficiency is further increased. For instance, tests of standard propellers to which my fairing was attached have shown that the propeller efficiency was increased approximately eight percent.

While for purposes of illustration I have shown two forms of cuff construction which may be used and one form of fairing construction, it is obvious to one skilled in the art that various changes can be made in the construction of both of these members and changes can be made in their relation to one another without departing from the spirit of this invention.

It is therefore understood that I desire this invention only to be limited by the prior art and the scope of the appended claims.

I claim:

1. An aircraft propeller construction comprising a spinner, a propeller blade extending radially from the spinner, a cuff mounted on said propeller blade, and a fairing, said fairing being

mounted on the spinner and extending to a point contiguous with the said cuff.

2. An aircraft propeller construction comprising a spinner, a propeller blade extending radially from the spinner, a cuff mounted on said propeller blade, and a fairing mounted on the spinner, said fairing encircling the root portion of the said propeller blade and extending to a point contiguous with the said cuff.

3. An aircraft propeller construction comprising a spinner, a propeller blade extending radially from the spinner, a cuff mounted on the root portion of the said propeller blade, and a fairing mounted on the spinner and extending to a point contiguous with the said cuff.

4. An aircraft propeller construction comprising a spinner, a propeller blade extending radially from the spinner, a cuff mounted on the root portion of the said propeller blade, and a fairing mounted on the spinner, said fairing encircling a portion of the root of the said propeller blade and extending to a point contiguous with the said cuff.

5. An aircraft propeller construction comprising a spinner, a propeller blade extending radially from the spinner, a cuff of airfoil section mounted on a portion of the root of the said propeller blade, and a fairing of airfoil section mounted on the spinner, said fairing extending to a point contiguous with the said cuff and terminating in an airfoil section corresponding to the airfoil section of the cuff when the propeller blade is in high speed position.

6. An aircraft propeller construction comprising a spinner, a propeller blade extending radially from the spinner, a cuff mounted on said propeller blade, and a fairing provided with a flanged extremity mounted on said spinner, the flanged portion of said fairing encircling the root portion of the propeller blade and abutting the inner extremity of the said cuff.

7. An aircraft propeller construction comprising a spinner, a propeller blade extending radially from the spinner, a cuff of airfoil section mounted on the root portion of the said propeller blade, the chord of said cuff throughout its length being substantially the same length as the maximum chord of the propeller blade section, and a fairing mounted on the spinner, said fairing extending to a point contiguous with the said cuff.

8. An aircraft propeller construction comprising a spinner, a propeller blade extending radially from the spinner, a cuff of airfoil section mounted on the root portion of the said propeller blade, the chord of said cuff throughout its length being substantially the same length as the maximum chord of the propeller blade section, and a fairing of airfoil section mounted on the spinner, said fairing extending to a point contiguous with the said cuff and terminating in an airfoil section corresponding to the airfoil section of the cuff when the propeller blade is in high speed position.

9. An aircraft propeller construction comprising a spinner, a propeller blade extending radially from the spinner, a cuff mounted on the root portion of the said propeller blade and extending to a point on the propeller blade having approximately the maximum chord, and a fairing mounted on the spinner and extending to a point contiguous with the inner extremity of the said cuff.

10. An aircraft propeller construction comprising a spinner, a propeller blade extending radially from the spinner, a collar mounted on the

root portion of the propeller blade, a cuff mounted on the collar and encircling the blade, and a fairing provided with a flanged extremity mounted on said spinner, the flanged portion of said fairing encircling the root portion of the propeller blade and enclosing the collar and abutting the inner extremity of the said cuff.

11. An aircraft propeller construction comprising a spinner, a propeller blade extending radially from the spinner, a collar mounted on 10

the root portion of the propeller blade, a cuff of airfoil section mounted on the collar and encircling the blade, and a fairing of airfoil section provided with a flanged extremity mounted on said spinner, the flanged portion of said fairing encircling the root portion of the propeller blade and enclosing the collar and abutting the inner extremity of the said cuff.

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