June 20, 1950 E. MARTIN 2,511,862

PROPELLER

Filed April 23, 1943 3 Sheets-Sheet 1

Fig. 1.

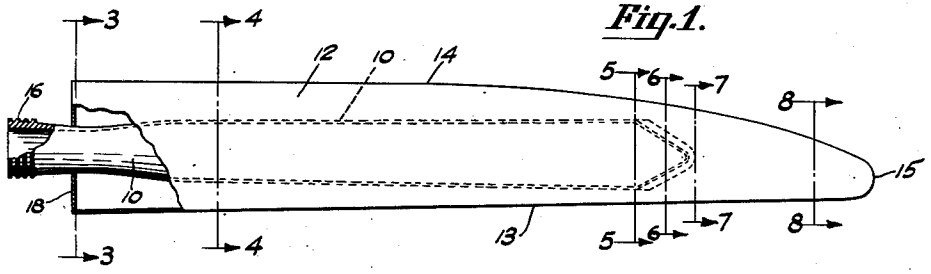


Fig. 2.

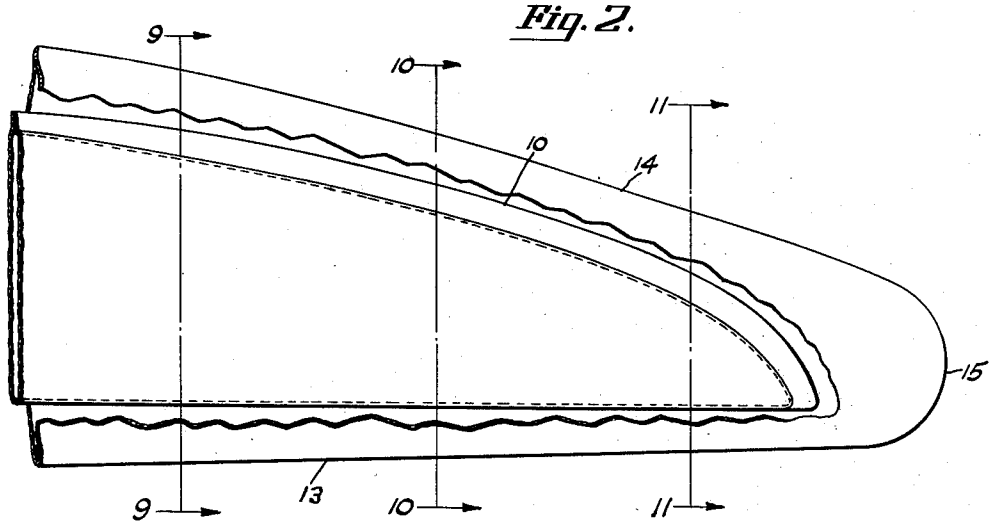


Fig. 9.

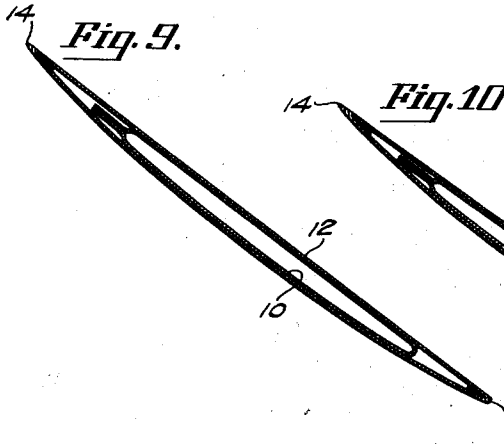


Fig. 10.

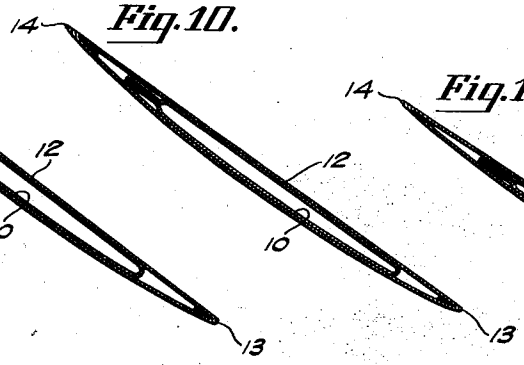
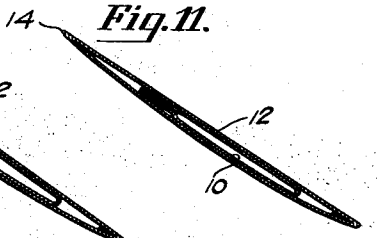


Fig. 11.



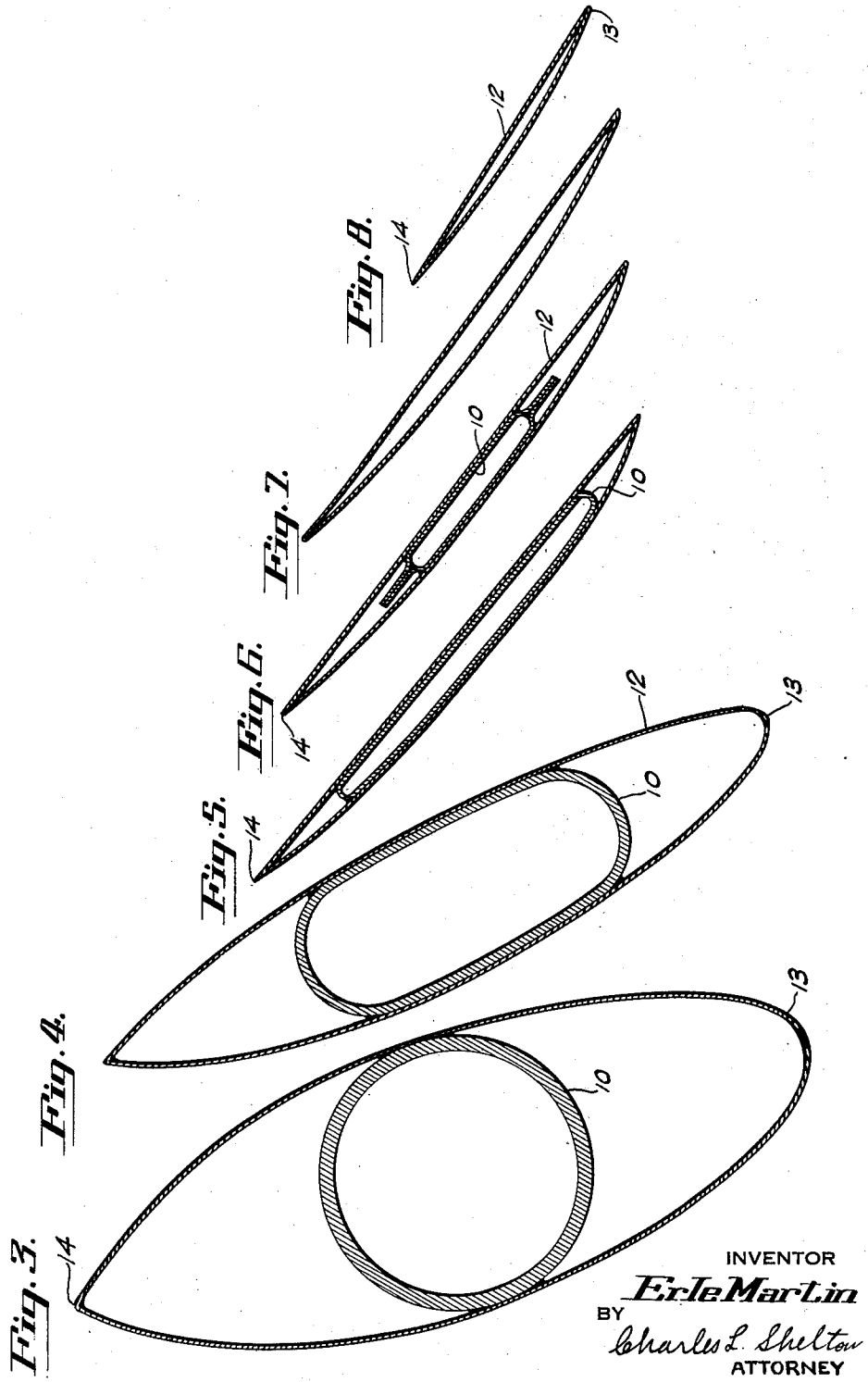
INVENTOR
Erle Martin.

BY Charles L. Shelton
ATTORNEY.

June 20, 1950 E. MARTIN 2,511,862

PROPELLER

Filed April 23, 1943 3 Sheets-Sheet 2



INVENTOR
Erle Martin
BY
Charles L. Shelton
ATTORNEY

June 20, 1950 E. MARTIN 2,511,862

PROPELLER

Filed April 23, 1943 3 Sheets-Sheet 3

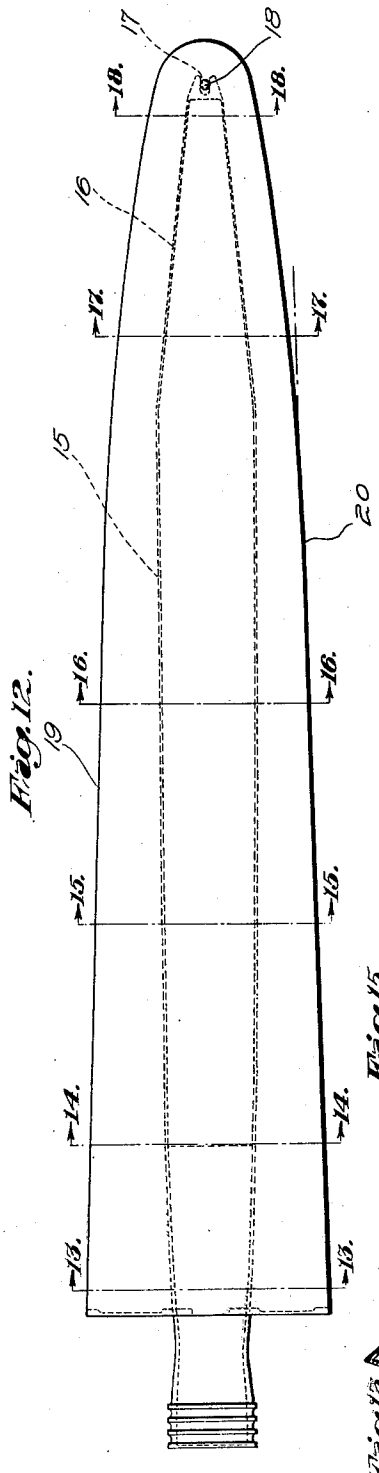


Fig. 12.

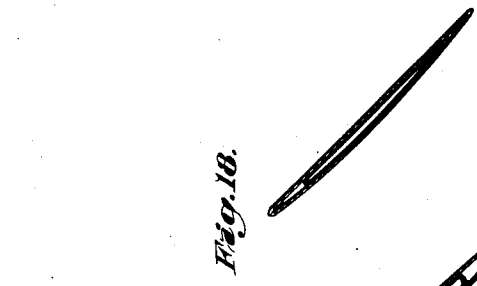


Fig. 18.

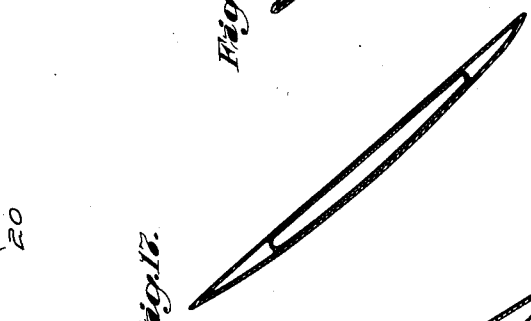


Fig. 17.

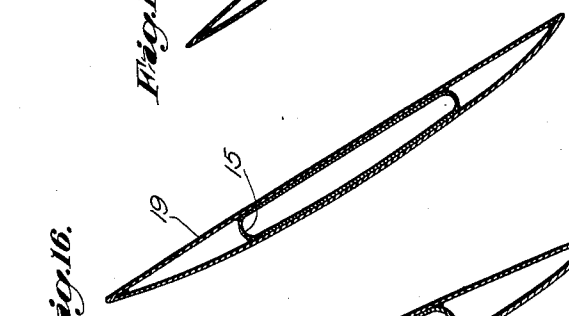


Fig. 16.

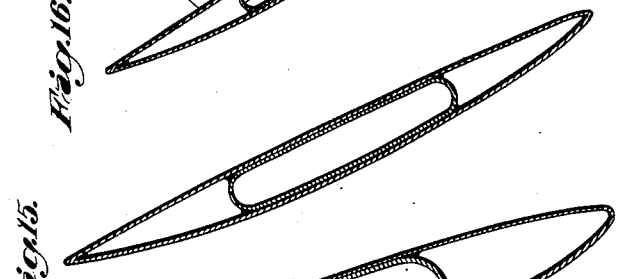


Fig. 15.

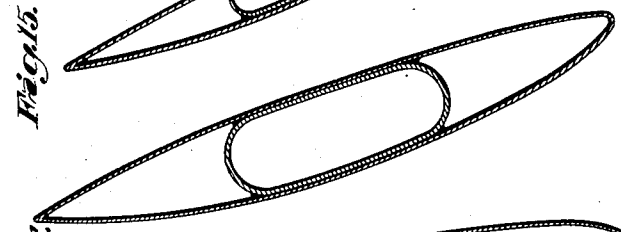


Fig. 14.

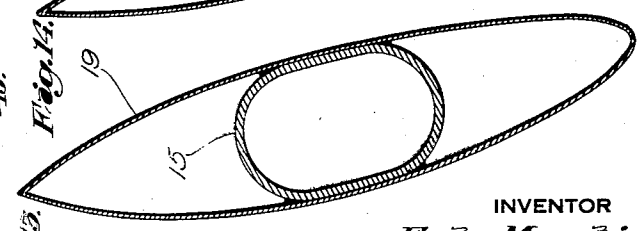


Fig. 13.

INVENTOR
Erle Martin
BY Charles L. Shelton
Attorney

Patented June 20, 1950 2,511,862

UNITED STATES PATENT OFFICE

2,511,862

PROPELLER

Erle Martin, West Hartford, Conn., assignor to United Aircraft Corporation, East Hartford, Conn., a corporation of Delaware

Application April 23, 1943, Serial No. 484,229

8 Claims. (Cl. 170—159)

1

This invention relates to aeronautical propellers and particularly to a hollow all metal propeller blade having a central tubular supporting member extending longitudinally therein to which is permanently attached a covering member of sheet material conformed to airfoil shape and extending substantially throughout the entire active length of the blade.

A primary object of the invention is to provide a hollow all metal propeller of approved airfoil form, the outer surface of which is of stressed skin type formed from a thin sheet of metal doubled longitudinally upon itself to form along its fold a major portion of the leading edge of the blade and having its opposite longitudinal edges brought together and welded to form the trailing edge of the blade, there being an inner tubular member welded or brazed to the outer member longitudinally along contacting portions of adjacent side surfaces, the inner tubular member before assembling being elongated and flattened progressively toward the tip portion, and preferably also having its wall thickness reduced gradually and uniformly from the shank to the tip portion of the blade.

Another important object of the invention is to provide a blade comprising an inner tubular member enclosed within an outer airfoil member or "cuff," the tubular member forming the principal structural or stress sustaining member and being the sole connection between the airfoil member and the propeller hub; the outer member being secured to the tubular member as by brazing, soldering or otherwise along their adjacent surfaces throughout their length and at widely spaced portions laterally of the blade, thereby adding stiffness to the blade; both longitudinally and transversely and the outer member being conformed to an aerodynamically efficient shape throughout its length preferably after assembling.

A still further object of importance is that a practical and efficient light weight all metal hollow blade may be produced having its leading edge extending in a straight line in space for the greater portion of its length; and finally a feature of importance accomplished by the present construction is that the blade is stiffened both longitudinally and laterally by the brazing, soldering or uniting of the tubular member to the outer or shell member substantially throughout their length and along widely spaced transverse portions of the blade.

Other objects and advantages will be apparent from the specification and claims, and from the

2

drawings which illustrate what are now considered to be preferred embodiments of the invention.

Fig. 1 is a longitudinal view in plan-form of a propeller blade made in accordance with the present invention, a portion being broken away to more clearly show its construction.

Fig. 2 is a fragmentary view of a slightly modified form of the blade showing the tip portion thereof in plan-form upon an enlarged scale compared to Fig. 1.

Figs. 3, 4, 5, 6, 7 and 8 are cross sectional views taken on the planes of lines 3—3, 4—4, 5—5, 6—6, 7—7, and 8—8 of Fig. 1.

Figs. 9, 10, and 11 are cross sectional views taken on the planes of lines 9—9, 10—10, and 11—11 of Fig. 2.

Fig. 12 is a longitudinal plan form view similar to Fig. 1 and showing a further modified form of the invention, and

Figs. 13, 14, 15, 16, 17 and 18 are cross sectional views taken on the planes of lines 13—13, 14—14, 15—15, 16—16, 17—17 and 18—18 of Fig. 12.

In its preferred forms, the invention may include the following parts: First, a central supporting tubular member having before being flattened a bore of gradually reduced diameter toward its tip and having its outer diameter and its wall thickness gradually decreased progressively from shank to tip, there being at the shank end of the tubular member means for attaching the blade to a hub; second, an airfoil shaped outer member 12 made from a metal sheet bent centrally and longitudinally upon itself and having its opposite longitudinal edges brought together and welded or brazed from end to end; and third, seams formed by brazing, welding or soldering together the airfoil member and the tubular member along their adjacent surfaces on opposite sides of the blade substantially throughout their length.

Referring more in detail to the embodiment of the invention shown in the drawings, and first to the embodiment shown in Fig. 1, tubular member 10 has a shank which is provided with grooves 11 for connection to a propeller hub. In the finished blade, member 10 is gradually elongated and flattened toward the tip, and has its wall thickness progressively decreased toward the tip, the successive forms of this member at different distances from the shank being indicated by Figs. 3 to 6 inclusive in transverse sections. To limit the transverse dimensions of the tubular member due to this member being flattened, the member is materially elongated

throughout its length prior to the flattening operation.

The outer member 12 is formed from a sheet of material of uniform thickness such as steel folded or bent, as shown more clearly in Fig. 3, substantially longitudinally and centrally to form a large portion of the leading edge 13 of the blade. The opposite longitudinal edges are trimmed substantially as indicated in Figs. 1 and 2 and are welded, brazed or otherwise permanently secured together along their entire length to form the trailing edge 14 of the blade. The leading edge 13 due to the sheet being folded or bent will be straight in space substantially throughout its length and preferably is disposed parallel to the axis of the inner or tubular member 10. At the tip the outer member 12 is rounded to any desired extent and the seam joining the edges of the sheet along the trailing edge 14 of the blade is carried around the tip and extends for a short distance toward the shank along the leading edge 13.

The outer member 12 is conformed to its final airfoil shape by any preferred shaping operations so that member 12 forms an elongated airfoil cuff for the blade extending from the shank to the tip and at the tip completely encloses the outer end of member 10. These two members 10 and 12 are soldered, brazed or otherwise united permanently to each other from the shank to the tip along their adjacent or contacting surfaces. The method of manufacture of the two principal blade members and the method employed for their assembly is covered in a separate application Serial No. 484,254, filed April 23, 1943 by Glen T. Lampton.

Fig. 1 shows the tip end of the tubular member 10 cut to form a central extended point flattened as indicated in the sectional views by bringing opposite surfaces into contact. The opposite flattened surfaces of the tubular member are welded, brazed or otherwise secured along their entire active length to the internal surfaces of airfoil member 12. Member 10, however, as shown more clearly in Fig. 2, may be extended directly to the tip so that the tip portion would consist of four sheets of material—i. e. the camber face of the sheet 12, the flattened walls of the tubular member or core 10, and the face side of the sheet 12. Also as shown in Fig. 2, the tip of the tubular member 10 along its leading edge, may be substantially straight directly up to the tip of the outer member 12 and have its trailing edge 14 trimmed as shown and welded or brazed together by any suitable means.

In the embodiment shown in Fig. 12, et seq., the inner or tubular member 15 is generally similar to those shown in Figs. 1 and 2 at its shank and intermediate portions but at its tip is different in that this end is symmetrical relative to the longitudinal axis of the blade and has a long tapered tip end portion 16 notched centrally as shown at 17. By means of this notch 17, the tip of the tubular member 15 may be centered longitudinally of the blade by a small rivet 18 extending through opposite walls of the outer members 19. The trailing edge of the airfoil member 19 may have the opposite edges of the sheet from which it is formed brought together and brazed, preferably by a copper brazing operation. In this form of the invention the members 15 and 19 are united preferably by soldering, the solder employed being employed at a lower temperature than the copper used in brazing the trailing edge of the member 19 so that this edge will not be affected. The width of the flattened tubular member 15 is such that the soldered joints along contacting surfaces of the tubular member 15 and airfoil member 19 are disposed a material distance apart laterally of the transverse dimension of the central longitudinal portion of the blade and serves to materially increase the stiffness of the blade transversely and longitudinally.

The lateral edges of the contacting surfaces of the tubular and cover members on opposite sides of the blade are disposed a material distance apart, and a substantial distance on either side of the axis of the blade. The soldering or brazing material along these edges forms fillets as indicated in Figs. 13 to 18 and thus forms an extremely strong seam. These seams are laterally spaced apart transversely of the blade and thus greatly increase the longitudinal and transverse stiffness of the blade. Also, the overhanging lateral portions of the airfoil member 19 beyond the limits of the flattened tubular member are relatively short and in the active portions of the blade do not exceed one-third of the total width of the blade. The outer or airfoil member 19 in the embodiment shown in Figs. 12 et seq., may be similar to those shown in the preceding figures. As indicated, the sheet from which this member is made is folded longitudinally upon itself and forms a straight leading edge for a substantial portion of its length. The trailing edge is formed by a welded or brazed seam which is extended around the tip end to the point indicated at 20.

In all the embodiments of the invention, the tubular members 10 and 15 may be axially elongated throughout their length and have their wall thickness reduced toward the tip prior to their flattening operation. In this way the transverse dimensions of the tubular member are materially reduced at the various progressively flattened sections of this member.

In operation, member 10 in all embodiments of the invention transmits all forces between the hub and airfoil member with the airfoil or outer member, due to its being united to the tubular member as described above, adding longitudinal and lateral stiffness to the blade. The airfoil member extends substantially the entire active length of the blade, and at its hub end may preferably be closed by plate 18 closely fitting about the tubular member 10.

It is to be understood that the invention is not limited to the specific embodiment herein illustrated and described, but may be used in other ways without departure from its spirit as defined by the following claims.

I claim:

1. A propeller blade comprising in combination, a sheet-metal, airfoil-forming elongated tubular shell closed at one end and open at the other, a supporting metal tubular core extending lengthwise within said tubular shell and projecting from the open end of said tubular shell, said tubular core having a wall thickness greater than the thickness of said sheet metal and having its major transverse dimensions substantially parallel to, but substantially smaller than, the chord of said tubular shell but otherwise conformed to the chordwise shape of, and snugly fitting, over a substantial chordwise extent, the interior surface of said tubular shell, a hub connection on the projecting end of said core, said tubular shell being held on and connected to said tubular core substantially solely by a fused metal joint of a metal different from that of the shell or core and con-

necting substantially the entire snugly fitting surfaces.

2. A propeller blade comprising in combination a sheet metal airfoil-forming elongated tubular shell closed at one end and open at the other and having a lift-producing airfoil shape at the open end, a supporting metal tubular core extending lengthwise within said tubular shell and projecting from the open end of said tubular shell, said tubular core having a wall thickness greater than the thickness of said sheet metal and having its major transverse dimensions substantially parallel to but substantially smaller, thoughout the length of said core, than the interior chord of said shell but otherwise conformed to the chordwise shape of and snugly fitting, over a substantial chordwise extent, the interior surface of said shell, a hub connection on the projecting end of said core, said tubular shell being held on and connected to said tubular core substantially entirely by a fused metal joint of a metal different from that of the shell or core and connecting substantially the entire snugly fitting surfaces.

3. A propeller blade having an airfoil portion including a camber side and a face side and comprising in combination, a central tubular member having opposite sides corresponding to said blade sides progressively flattened toward the tip end of the blade and having hub connecting means at its shank end, said opposite sides conforming to the chordwise shape of, but separated a smaller distance than, the sides of said blade and having a chordwise dimension substantially smaller than said blade, and a covering member of sheet material doubled longitudinally upon itself and forming the leading edge of the blade at its fold and conformed to an airfoil shape comprising substantially the entire airfoil portion of said blade, said covering member having its longitudinal edges juxtaposed and secured together to form the trailing edge of said blade, said tubular member and covering member being telescopically arranged so that their corresponding sides provide chordwise extending adjacent surfaces said corresponding sides being soldered together substantially throughout said adjacent surfaces on opposite sides of said blade.

4. A propeller blade comprising in combination, a sheet metal airfoil-forming elongated tubular shell closed at one end and open at the other, a supporting metal core extending lengthwise within said tubular shell and projecting from the open end of said tubular shell, said core having its major transverse dimensions substantially parallel to, but substantially smaller than, the chord of said tubular shell but otherwise conformed to the chordwise shape of, and snugly fitting, over a substantial chordwise extent, the interior surface of said tubular shell, a hub connection on the projecting end of said core, said tubular shell

being held on and connected to said core substantially solely by a fused metal joint of a metal different from that of the shell or core and connecting substantially the entire snugly fitting surfaces.

5. A propeller blade comprising in combination, a sheet metal airfoil-forming elongated tubular shell closed at one end and open at the other, a supporting metal tubular core extending lengthwise within said tubular shell and projecting from the open end of said tubular shell, said tubular core having its major transverse dimensions substantially parallel to, but substantially smaller than, the chord of said tubular shell but otherwise conformed to the chordwise shape of, and snugly fitting, over a substantial chordwise extent, the interior surface of said tubular shell, a hub connection on the projecting end of said core, said tubular shell being held on and connected to said tubular core substantially solely by a fused metal joint of a metal different from that of the shell or core and connecting substantially the entire snugly fitting surfaces.

6. A propeller blade as described in 3 in which the central tubular member has a wall thickness at the shank end of the blade greater than the thickness of said sheet material.

7. A propeller blade as defined in 6 in which the central tubular member and the covering member are both steel members.

8. A propeller blade as claimed in 3 in which the central tubular member and covering member are both metal members.

ERLE MARTIN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,454,977	Middleton	May 15, 1923
1,789,240	Leitner et al.	Jan. 13, 1931
1,817,556	Hamilton	Aug. 4, 1931
2,081,645	Squires	May 25, 1937
2,231,888	Couch	Feb. 18, 1941
2,262,163	Brauchler	Nov. 11, 1941
2,272,439	Stanley	Feb. 10, 1942
2,276,262	Caldwell et al.	Mar. 10, 1942
2,280,337	McKee	Apr. 21, 1942

FOREIGN PATENTS

Number	Country	Date
221,906	Great Britain	Sept. 25, 1924
226,301	Great Britain	Dec. 24, 1924
231,919	Great Britain	Apr. 7, 1925
433,122	Germany	Aug. 23, 1906
546,176	Great Britain	July 1, 1942
560,706	France	July 17, 1923
700,360	Germany	Dec. 18, 1940