March 29, 1949. E. R. KOPPEL 2,465,884

METHOD OF FORMING PROPELLER TIP SECTIONS

Filed Jan. 22, 1944

FIG. 1.

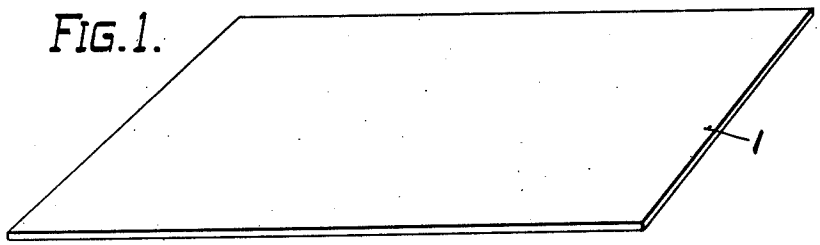


FIG. 2.

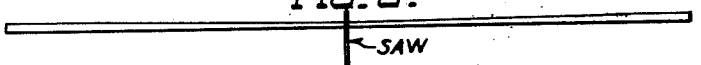


FIG. 3.

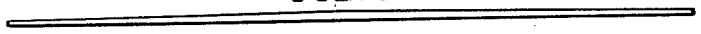


FIG. 4.

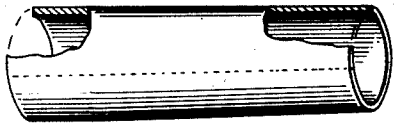


FIG. 5.

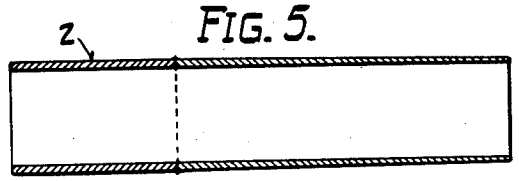


FIG. 6.

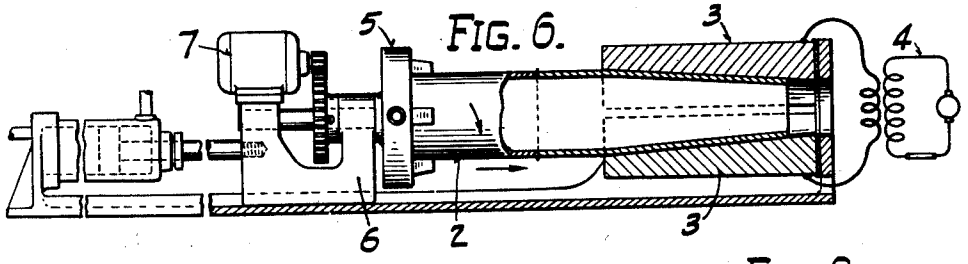


FIG. 7.

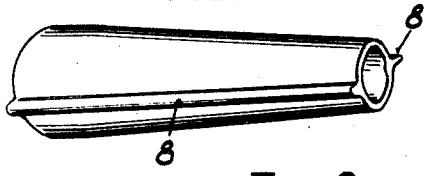


FIG. 8.

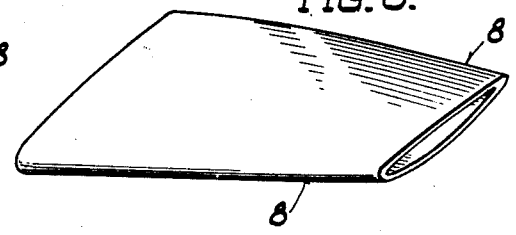


FIG. 9.

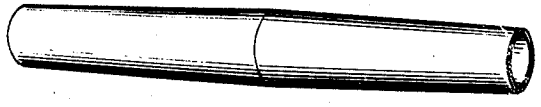
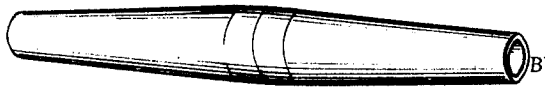


FIG. 10.



Ernst R. Koppel
INVENTOR.

BY Elvin C. Andrus
ATTORNEY.

Patented Mar. 29, 1949 2,465,884

UNITED STATES PATENT OFFICE

2,465,884

METHOD OF FORMING PROPELLER TIP SECTIONS

Ernst R. Koppel, Milwaukee, Wis., assignor to A. O. Smith Corporation, Milwaukee, Wis., a corporation of New York

Application January 22, 1944, Serial No. 519,365

1 Claim. (Cl. 29—156.8)

1

This invention relates to a method of forming propeller tip sections.

Heretofore it has been the practice to employ expensive alloy seamless cylindrical blanks and to taper machine the same on the inside to provide a progressive varying in wall thickness from end to end, followed by an electroforming operation which provides a conical blank of substantially uniform wall thickness from which the tip is made. Considerable metal had to be machined away, and in making a complete and finished tip section for a propeller it was ordinarily necessary to start with a blank weighing about six times the weight of the finished section. The difference in weight was scrap.

The object of the present invention is to reduce the scrap involved in making such a tip and to reduce the labor and machining operations so that a less costly tip section can be fabricated.

In carrying out the invention a taper rolled plate varying in thickness from end to end is formed into tubular shape and its longitudinal side edges welded together to provide the blank which is then conically shaped and subsequently flattened into the tip section.

The invention enables the employment of a blank weighing less than three times the weight of the finished tip section, and thereby reduces the amount of scrap metal by about two-thirds.

The accompanying drawing illustrates the practice of the invention, and the views therein are as follows:

Figure 1 is a perspective view of the flat blank from which two tips are made;

Fig. 2 is an edge elevation of the blank after taper rolling and showing severing of the same into two halves with each half tapering in thickness from end to end and having one end thicker than the other;

Fig. 3 is a view similar to Fig. 2 showing a modified type of taper rolling;

Fig. 4 is a perspective view of a single tip section blank after forming to tubular shape and welding along a longitudinal seam, with parts broken away and sectioned;

Fig. 5 is a longitudinal axial section through the tubular blank after a plain carbon steel shank has been welded thereto; which in this embodiment is utilized for chucking purposes;

Fig. 6 is a schematic showing of the electroforming operation in which the blank is formed to a substantially conical shape;

Fig. 7 is a perspective view of the blank after extrusion of the side fins thereon and removal of the shank;

2

Fig. 8 is a perspective view of the blank after flattening to blade shape;

Fig. 9 is a view similar to Fig. 4 showing a double blank, made from a flat blank as shown in Fig. 3; and

Fig. 10 is a similar view of the blank after electroforming thereof.

An ordinary sheet metal blank of rectangular or square shape and of high strength low alloy steel is first taper rolled longitudinally to vary the thickness thereof.

The sheet 1 is preferably of a length suitable for the making of two tips, and the taper rolling may produce a sheet that is thinnest in the middle and of gradually increasing thickness toward the end edges, as shown in Fig. 2, or it may produce a blank that is thickest in the middle and of gradually decreasing thickness toward the ends, as shown in Fig. 3.

After taper rolling as shown in either Fig. 2 or Fig. 3, the sheet is trimmed and then severed transversely in the middle to produce two blade blanks. These are then formed into tubular shape with their longitudinal meeting edges electrically flash welded together as illustrated in Fig. 4. If desired, two such rolled sheets of less width may be formed into complementary semi-tubular sections and their corresponding meeting edges welded together to provide the tubular blank. It is also possible to form the blanks of Figs. 2 and 3 into tubular shape and weld the same, as shown in Fig. 9, and to thereafter sever the same into individual blade blanks as shown in Fig. 4.

A tubular shank 2 of ordinary steel is then electrically flash welded to the thicker end of the blank to enable chucking for electroforming.

In electroforming the thinner end of the blank is forced into a conical die cavity formed between two or more spaced die electrodes 3 which supply heating current to the blank from a source 4 of electricity. The blank is mounted in a chuck 5 on a slide 6, and the chuck and blank are rotated by a suitable motor 7 on the slide, as the slide advances toward the die.

After the blank is conically formed, it is upset, preferably in the same dies, to extrude a pair of side fins 8 on opposite sides of the blank as shown in Fig. 7. The fins 8 constitute the leading and trailing edges of the tip section. The blank is subjected to suitable machining and coining operations, the shank 2 removed and then the blank is flattened to blade shape with the pitch twist therein as shown in Fig. 8.

The rolled sheet of either Fig. 2 or Fig. 3 may be formed and welded into a tube as illustrated

in Fig. 9, providing two blade blanks which may be thereafter severed to provide two blanks such as the blank of Fig. 4.

If desired the use of a shank may be eliminated by conically forming the two blade blanks prior to severing. Instead of employing a shank, one end serves for chucking while the other is being electroformed. Then the formed end serves for chucking while the first is being formed, producing a blank that is conically reduced at both ends, as shown in Fig. 10. The fins are extruded and the blank is severed transversely in the middle to produce two tip section blanks which are then trimmed, machined and flattened as described previously.

The invention in this latter phase saves the labor and material involved in the applying and removal of the shank 2.

The invention may have various embodiments within the scope of the accompanying claim.

I claim:

In the manufacture of propeller tip sections, the steps of taper rolling a flat sheet metal blank of double the length required for one section to provide a sheet which is thickest in the middle and which tapers to a thinner thickness at the opposite ends to embody two blade blanks, forming the sheet into a tube and welding the longitudinal edges thereof, forming one end of the tube in a machine to a conical shape with the end

contracted in diameter, then similarly forming the other end, subsequently severing the blank transversely in the middle to provide two tip section blanks of varying thickness throughout, and forming the same into propeller tip sections of varying thickness and dimensions from end to end.

ERNST R. KOPPEL.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
371,312	Gracey	Oct. 11, 1887
1,339,970	Murray	May 11, 1920
1,574,563	Duff	Feb. 23, 1926
1,577,996	Wishon	Mar. 23, 1926
1,854,550	Jamison	Apr. 19, 1932
1,942,222	Squires	Jan. 2, 1934
1,980,834	Squires	Nov. 13, 1934
1,982,874	Jamison	Dec. 4, 1934
2,138,127	Squires	Nov. 29, 1938
2,151,568	Sinclair	Mar. 21, 1939

FOREIGN PATENTS

Number	Country	Date
207,949	Great Britain	June 12, 1923
554,449	Great Britain	July 5, 1943