April 4, 194[illegible]

S. WESTIN ET AL

2,345,692

ELECTRICALLY FORMING TUBES

Filed Jan. 8, 1943

FIG. 1.

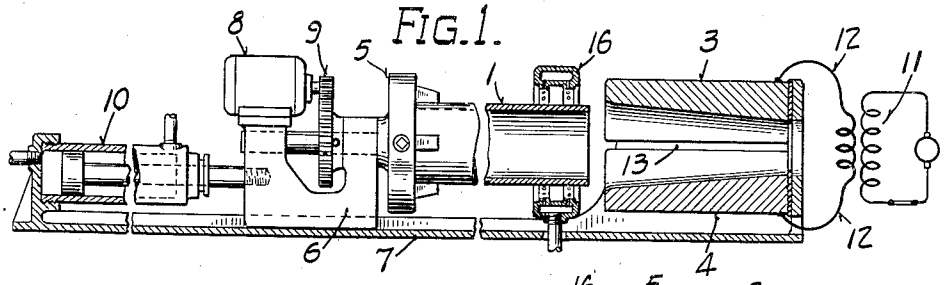


FIG. 2.

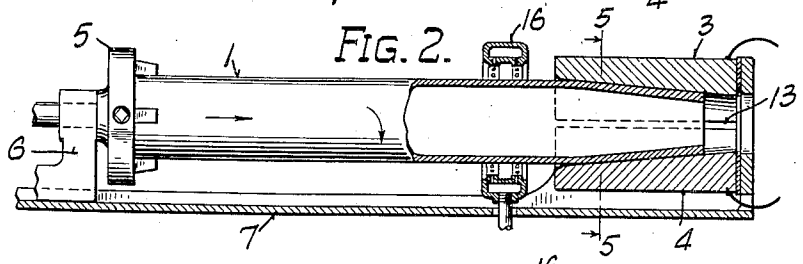


FIG. 3.

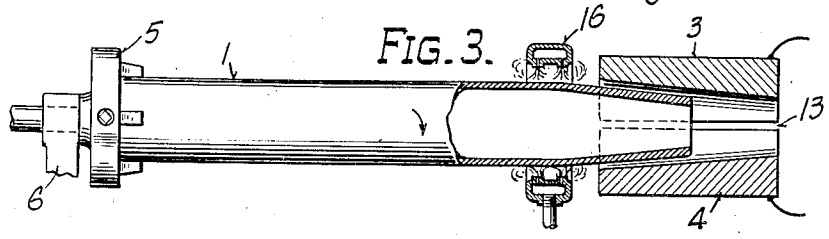


FIG. 4.

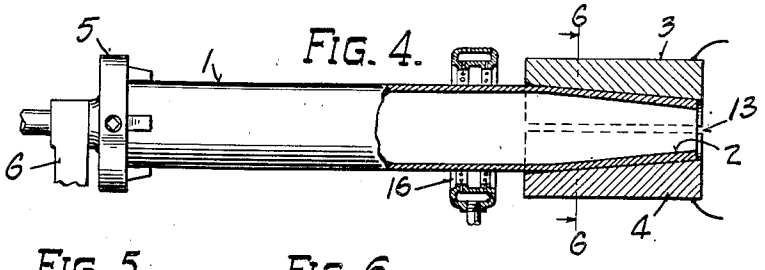


FIG. 5.

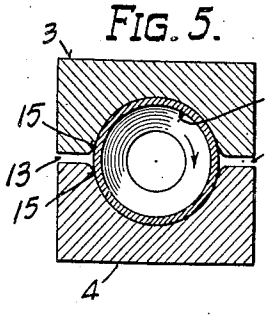


FIG. 6.

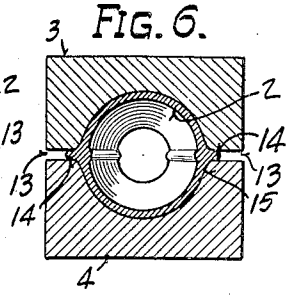
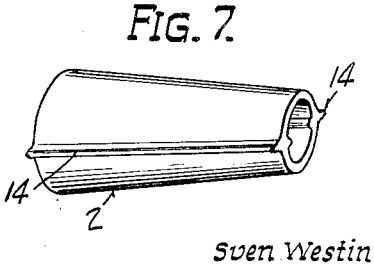


FIG. 7.



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UNITED STATES PATENT OFFICE

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ELECTRICALLY FORMING TUBES

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Application January 8, 1943, Serial No. 471,750

5 Claims. (Cl. 219—3)

This invention relates to electrically forming tubes as in the construction of tips for airplane propellers. In the manufacture of such propeller tips it is desired to provide a conical tube with a pair of opposed side ribs thereon which form the leading and trailing edges of the propeller blade when the tube is flattened.

The principal object of the invention is to provide a more efficient and less costly method of forming ribs on a tubular blank.

Another object is to prevent machining waste by extruding the ribs in an upsetting operation.

Another object is to provide for forming the ribs in the same apparatus employed for forming the blank into a conical shape.

Another object is to provide for an equalizing of the heat in the blank after forming and prior to upsetting of the ribs to obtain a more uniform extrusion.

The invention is illustrated in the accompanying drawing in which:

Figure 1 is a schematic side elevation partly in section of the apparatus for carrying out the invention;

Fig. 2 is a longitudinal section of the apparatus showing a blank partially formed;

Fig. 3 is a similar longitudinal section showing the blank partially withdrawn for temperature equalization;

Fig. 4 is a similar section showing the upsetting or extruding operation;

Fig. 5 is a transverse section taken on line 5—5 of Fig. 2;

Fig. 6 is a similar transverse section taken on line 6—6 of Fig. 4; and

Fig. 7 is a perspective view of the finished product.

The method employed to form the cylindrical blank 1 into the tapered tube 2 is similar to that set forth and claimed in the application of the present inventors, Serial No. 376,669, filed January 30, 1941, and entitled Method of treating metallic bodies, now Patent No. 2,309,561, dated January 26, 1943. In this method the cylindrical blank 1 is rotated and fed longitudinally into a conical die cavity between a pair of spaced electrode dies 3 and 4. As the end of the rotating blank contacts with the tapered surface of the dies, electric resistance heating current is passed through a circumferential portion of the blank between the dies, and as the blank softens by heat, it yields inwardly and progresses into the die cavity until the required length of cone is formed.

The apparatus employed to move the blank comprises a chuck 5 mounted on an upright member 6 which in turn is slidable along a base 7. A motor 8 and gears 9 are carried by member 6 for rotating the chuck 5. A hydraulic cylinder 10 moves the member 6 on base 7 to feed the blank into the die cavity.

The electrode dies 3 and 4 are connected to a transformer 11 by leads 12 for supplying current to the blank. The spacing of the electrodes serves to provide the required flow of current through the blank.

The spacing of the electrode dies 3 and 4 has the additional purpose, in carrying out the present invention, of providing slots 13 into which the metal of the blank is extruded to form the ribs 14 previously referred to. For this purpose, the slots 13 are shaped to provide ribs of the desired thickness and width and having a curvature at the base of the rib merging into the side wall of the blank. The inner conical die surface is cut away adjacent the slots for a substantial distance to provide an area 15 of lack of support of the blank and thereby encourage the outward upsetting of the blank wall.

In carrying out the invention, immediately following completion of forming of the conical blank 2, the latter is withdrawn from the dies for a sufficient distance to allow additional heating of the blank at its large end. This heating is accomplished by a ring of heating torches 16 disposed to impinge a heating flame on the conical section of the blank. Rotating of the blank during this heating process effects more uniform heating and prevents undue sagging of the blank. This heating may be applied in the position of the large end while the tube is being fed forward in the first electric heating and forming operation.

The objective of heating the large end of the blank in this manner is to equalize the temperature of the blank by compensating for the inequalities resulting from the fact that in the first forming operation the small end of the blank is heated to a higher temperature by reason of the greater length of time it contacts the electrode dies.

When all portions of the blank are at a substantially uniform temperature, the hydraulic cylinder 10 is operated to force the conical blank 2 endwise into the die cavity, without rotation. The conical blank 2 is caused to contract further, and in doing so the walls of the blank upset and extrude ribs 14 into the slots 13. This upsetting is facilitated by continuing to supply resistance heating current to the blank through the dies. Since the blank is not rotated

at this stage of the process, the metal lying between the two electrodes becomes heated rapidly so that it readily flows into slots 13 as the blank yields inwardly in its longitudinal movement into the die cavity. Upon completion of fins 14 the blank is withdrawn from the dies and allowed to cool.

The slots 13 may lie at an angle to a plane containing the axis of the die cavity so as to simulate a slight spiral curvature for ribs 14. This reduces the required twisting of the blank after formation of the ribs. However, a sizing operation should be applied to the finished blank in a press which more accurately locates the ribs.

The blank 1 may be of multiple lengths so that several conical blanks 2 are successively formed and cut off from it. In this way there is less waste from the part that is gripped by the chuck.

Various embodiments of the invention may be employed within the scope of the accompanying claims.

We claim:

1. In the manufacture of a tapered tubular member with external longitudinal ribs thereon, heating a tapered blank, and axially forcing the same into a tapered die cavity having longitudinal slots therein for receiving the upset walls of the blank to form the ribs while passing heating current through the member between separate sections of the die.

2. In the manufacture of a tapered tubular member with external longitudinally extending ribs thereon, rotating and feeding a tubular blank into a tapered die cavity provided by a plurality of circumferentially spaced electrode dies to heat and form the tapered tubular member, and thereafter axially forcing said member into said die cavity without rotation to upset the walls of said member and extrude the metal thereof into the spaces between the dies.

3. In the manufacture of a tapered tubular member with external longitudinally extending ribs thereon, rotating and feeding a tubular blank into a tapered die cavity provided by a plurality of circumferentially spaced electrode dies to heat and form the tapered tubular member, and thereafter axially forcing said member into said die cavity without rotation while supplying heating current to the member in the regions bridging the gaps between the electrodes to upset the walls of said member and extrude the metal thereof into the spaces between the dies.

4. In the manufacture of a tapered tubular member with external longitudinally extending ribs thereon, rotating and feeding a tubular blank into a tapered die cavity provided by a plurality of circumferentially spaced electrode dies to heat and form the tapered tubular member, withdrawing the member from the dies and equalizing the temperature of the member, and subsequently axially forcing said member into said die cavity without rotation to upset the walls of said member and extrude the metal thereof into the spaces between the dies.

5. In the electrical forming of projections on the surface of a tubular member, the steps of confining the member in a tapered die cavity having recesses disposed between separate electrode dies, passing heating current through the walls of the member across said recesses between said electrodes, and simultaneously applying axial pressure to the member to force the same into said tapered die cavity and flow the electrically heated metal of the member into said recesses.

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