July 27, 1943. S. WESTIN 2,325,564

ELECTRIC FORMING OF METALLIC STRUCTURES

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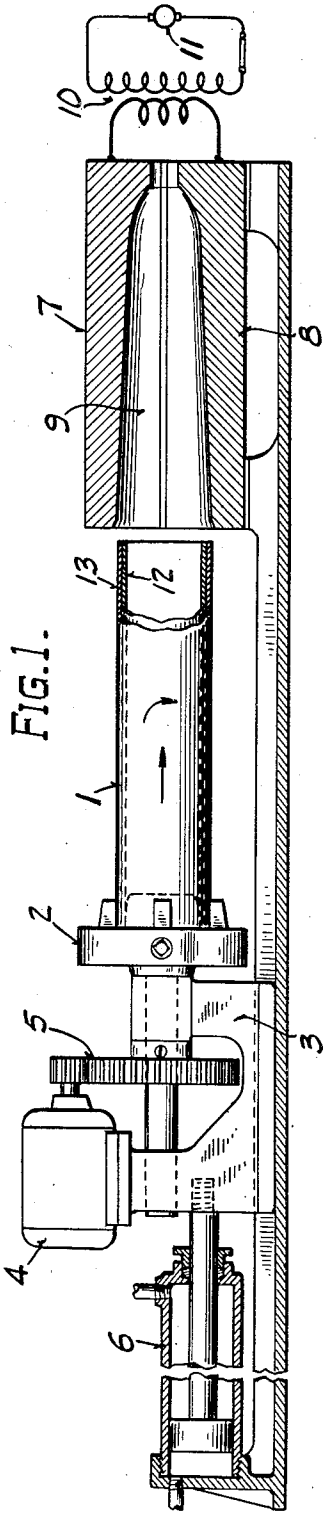


FIG. 1.

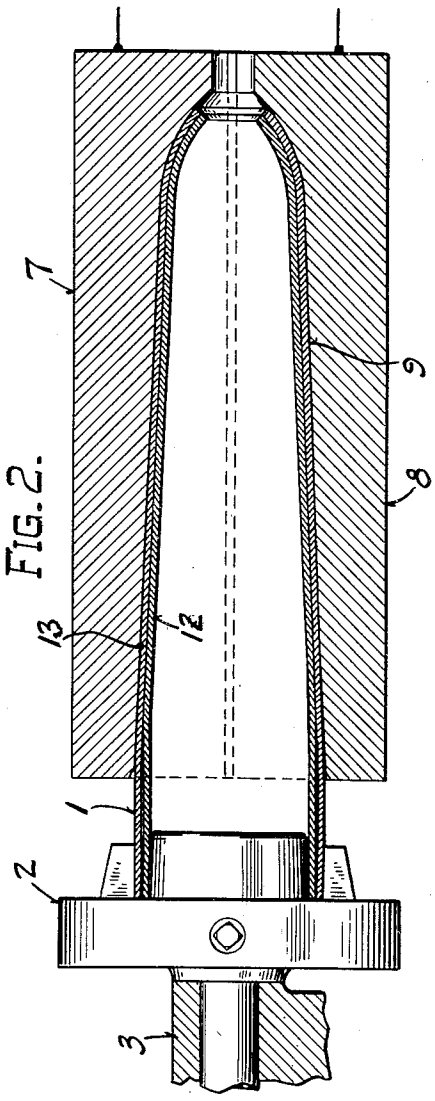


FIG. 2.

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ELECTRIC FORMING OF METALLIC STRUCTURES

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Application December 3, 1942, Serial No. 467,711

5 Claims. (Cl. 219—3)

This invention relates to electric forming of metallic structures as in the forming of tubular structures of various shapes.

The invention has been applied in the forming of a long conical member from a cylindrical blank and wherein the size and shape of the member resulted in a tendency of the walls to wrinkle and collapse in the forming operation. In this phase of the invention the latter constitues a substantial improvement in the practice of the invention set forth and claimed in the copending application for Letters Patent, Serial No. 376,669, filed January 30, 1941, jointly by the present inventor and Axel Westin.

The invention also has other applications, as in the forming of various shapes of multi-ply structures.

One of the principal objects of the invention is to provide a method of electrically forming multi-ply structures.

Another object is to prevent the formation of wrinkles in the blank during practice of the process set forth in the above-specified application.

Another object is to provide a support for the blank during electrical forming operations.

The invention is illustrated in the accompanying drawing in which:

Figure 1 is a side elevation partly in section showing an apparatus for carrying out the invention; and

Fig. 2 is a longitudinal section showing the forming operation in the making of a long conical member with a partially closed nose.

The apparatus illustrated is generally similar to that employed in carrying out the method described in the copending application hereinabove referred to.

In this apparatus, the cylindrical blank 1 is gripped at one end by the rotary chuck 2 which is mounted on a sliding support 3 to feed the blank longitudinally and rotate the same during forming. The chuck 2 is rotated by the motor 4 and reduction gearing 5 carried by the support 3. The support 3 is moved longitudinally by the hydraulic cylinder 6.

The forming apparatus comprises a plurality of forming dies 7 and 8 having their adjacent faces shaped to provide a conical or tapered die cavity 9 of the size and contour of the finished article to be formed. During forming the axis of blank 1 and the axis of die cavity 9 coincide.

The dies 7 and 8 are spaced apart and electrically insulated from one another. Electric resistance heating current is passed through the portion of the blank between die contacting areas to heat the blank during forming. For this purpose the dies constitute electrode terminals connected to the secondary of a power transformer 10 which in turn is supplied with current from a suitable source of power 11.

In practicing the process the blank 1 is rotated and fed endwise into the die cavity 9, and as the end of the blank contacts with the tapered surface of the dies, it receives the heating current therefrom and softens, enabling the blank to recede inwardly under the pressure of the die surfaces as the blank progressively moves forward in the dies. The pressure and heating occurs in recurrent cycles in successive adjacent circumferential regions as the blank is rotated in the dies.

Early attempts to form a product of the shape indicated having a long tapered surface resulted in prolonged heating and a tendency for the wall of the blank to collapse or wrinkle in certain longitudinal stages of the forming.

In carrying out the present invention the wall of the blank 1 is formed of two or more layers or superimposed tubular members 12 and 13 and both members are subjected to the heating and forming operations simultaneously. It was found that the inner member 12 did not overheat or collapse, and that since it tended to remain colder than the outer member 13, it supported the latter against wrinkling. The partial closure of the nose of the blank at the end was readily formed without wrinkling under the forming pressures required.

Where a smooth internal surface of the blank has to be maintained, the invention has been found to be particularly advantageous.

The invention may be applied in the construction of multi-ply and alloy lined tubular structures wherein a tight fit is desired between the members. The outer member 13 being heated more than member 12 will contract more upon cooling and insure a tight fit between the members.

The invention has various applications within the scope of the following claims.

I claim:

1. The method of electric forming a metallic structure in which a tubular blank of single plate wall thickness would have a tendency to wrinkle under the progressive heating and forming operation, comprising constructing the wall of the blank from two or more layers constituting superimposed tubular members, and simultaneously

electric resistance heating and forming the members together.

2. The method of electric forming a metallic structure in which the tubular blank has a tendency to wrinkle under the progressive heating and forming operation, comprising inserting a tubular member in the blank to support the same against wrinkling, and simultaneously electric resistance heating and forming the blank and member together.

3. The process of fabricating multi-ply tubular structures by electric forming, comprising disposing a plurality of cylindrical layers one within another, applying radial pressure in recurrent cycles to successive adjacent circumferential portions of the structure to reduce the same in diameter, progressively extending said pressure application longitudinally of the blank, and simultaneously applying an electric resistance heating current to the outer layer in the region of pressure application to soften the same, said resistance heating current passing through said outer layer and into and through the inner layer in regions of contact of the layers under forming pressure.

4. The process of fabricating multi-ply tubular structures by electric forming, comprising disposing a plurality of tubular layers one within another, applying radial pressure in recurrent cycles to successive adjacent circumferential portions of the structure to reduce each layer into tight contact with the next succeeding layer, progressively extending said pressure application longitudinally of the blank, and simultaneously heating the blank in the region of pressure application by the passing of electric current therethrough.

5. The method of tightening one layer upon another in a multi-ply tubular structure, comprising simultaneously electric resistance heating and forming each layer into tight contact with the next succeeding inner layer in recurrent cycles of operation circumferentially of the structure, and progressively extending longitudinally of the same.

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