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3,415,098
METHOD OF EXTRUDING CAPACITOR CASES
Filed March 8, 1966

Fig. 1.

Fig. 2.

Fig. 3.

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METHOD OF EXTRUDING CAPACITOR CASES

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Filed Mar. 8, 1966, Ser. No. 532,684
2 Claims. (Cl. 72—267)

ABSTRACT OF THE DISCLOSURE

A zinc alloy casing of ovate cross-section is extruded by the combined use of a heated zinc alloy blank and a punch whose flat punch face includes a pair of parallel grooves therein, parallel to the longer axis of the cross-section with one groove on each side of the center of the punch face.

This invention relates to the extrusion of zinc tubular articles, and more particularly to the extrusion of zinc tubular articles of a noncircular cross-section.

The extrusion of zinc cups or containers of circular cross-section is well known as shown in U.S. Patent No. 1,492,230, Towne. However, great difficulty has been encountered in extruding articles of an oval or elliptical cross-section because of the tendency of the article to wrinkle or split during extrusion. It is a principal object of the invention to provide a method for extruding tubular corrosion resistant zinc articles of noncircular cross-section.

A further object of the invention is to provide a method of extruding corrosion resistant zinc capacitor cases of oval or elliptical cross-section, capacitor cases of this shape having much advantage for such use.

It is further objects of the invention to provide a method of extruding corrosion resistant zinc capacitor cases of oval or elliptical cross-section, capacitor cases of this shape having much advantage for such use. In accordance with the stated objects it has been found that the splitting or wrinkling of the zinc articles extruded from a blank can be eliminated by heating the blank to a temperature below 150° C. and applying a nonuniform pressure to the blank so that the resultant flow of material is uniform.

Further objects and advantages will be apparent as the following detailed specification and from the drawings which, in conjunction with the following detailed description, constitute a complete disclosure of the invention and its preferred embodiments.

FIG. 1 is a perspective view of the capacitor case; FIG. 2 is a perspective view, partly in section, of the blank and extruding tool; and FIG. 3 is a chart showing the relationships between temperature and pressure and reject rate.

As shown in FIG. 1, this invention relates to the manufacture of a capacitor case 5 having a generally tubular shape closed at one end by an integral bottom portion 7 and provided with a flange 9 at its open other end, which flange 9 is for the purpose of mating with a cover member (not shown) to be sealed thereto. The bottom 7 and the cross-sectional shape of the case 5 are elliptical or oval with side wall portions 11 of a large, or greater, radius curve and end wall portions 13 of a small, or lesser, radius curve. The wall portions 11 and 13 respectively intersect the minor and major axes of the ellipse defining the cross-section of the case 5. Since as shown in the drawing the side wall portions 11 may, in part, be planar, the use of the term elliptical with reference to the shape of the case will be understood to a general use, as distinguished from a precise geometric use.

The case 5 is extruded from a blank 15 (FIG. 2) of a corrosion resistant zinc alloy containing small amounts of copper and titanium to improve its creep strength. Preferably, this alloy consists essentially of 0.5% copper, 0.15% Ti, and the balance zinc. The blank 15 has an area and shape substantially corresponding to the bottom 7 of the case 5 and a thickness determined by the wall thickness of the case to be formed and its height. For example, in manufacturing a case with a major axis of about 2.78" a minor axis of about 1.78" having a height of about 3.5" and a wall thickness of about .023" with a bottom thickness of about .035", a blank thickness of about .220" is required.

The extrusion of the blank 15 may be effected by a tool pair comprising a female die 17 and a male die or punch 19 as illustrated somewhat diagrammatically in FIG. 2. The die 17 has an oval or elliptical cavity 21 corresponding to the shape of the outside surface of capacitor case 5 and into which cavity the blank 15 is fed. The punch 19 closes on the blank and applies sufficient pressure thereto to cause the metal to flow along the walls of the cavity, the punch area and shape determining the amount of material permitted to flow and hence the wall thickness of the case. Since the material flow is opposite in direction to the direction of the application of pressure by the punch 19, the extrusion here referred to is more specifically identified as reverse extrusion.

While the extrusion may be theoretically effected at any temperature as illustrated by curve 23 of FIG. 3, in accordance with an important feature of the invention, the blank 15 is heated to a temperature below 150° C. and subjected to uniform pressure in the die cavity 17 so as to reduce the pressure necessary to effect material flow. However, in extruding articles of a noncircular shape, such as the capacitor case herein referred to, it has been discovered that the reject rate, that is production of defective cases, increases with increasing temperature as illustrated by curve 25. Therefore, the temperature of the blank upon placement in the die must be kept below 150° C. and preferably the blank is pre-heated to approximately 125° C.

Heating of the blank to a temperature in excess of 150° C. generally resulted in splitting or wrinkling of the side walls 11 of the case, hence it is believed that one of the factors requiring a lower temperature is the noncircular shape. With a small radius curve defining the end walls 13 and a large radius curve defining the side walls 11 the flow of material is more restricted in the small radius curve area and the material flow takes place more rapidly in the side wall area. As the side wall forms more rapidly, differential stresses result and the material on the sides of the case separates. Another explanation for the splitting is that the zinc alloy is extremely temperature-sensitive, and becomes very weak as its temperature is elevated. Thus, if the temperature is too high, the material becomes very weak as it travels along the side of the punch and any condition creating nonuniform flow of the material, such as a misalignment of the punch with respect to the die, will cause shear stress and fracture.

To further eliminate the differential stresses, the application of nonuniform pressure to the blank is preferred. Thus, recesses or grooves 27 (FIG. 2) placed in the face of punch 19 have been found to provide uniformity of flow of material during extrusion. It will be noted that the grooves are adjacent the side walls 11 of the resultant case and extend parallel to the minor axis thereof. Thus, it is believed that greater pressure is applied to the material required to flow in the restricted flow areas of minor axis intersecting end walls 13 which results in the forming of the end walls at the same rate as the side walls.

While the effect of the recesses 27 has been explained in terms of the resultant pressures, it is thought to be possible that this method of effecting uniform flow of material in the extruding of noncircular articles might actually be occurring merely because of the differential time rates of flow or some other phenomena. Therefore, the use of the term nonuniform pressure is herein intended to include nonuniform time rates of application of a uniform pressure or other phenomena.
By way of the specific example, the process in accordance with the preferred embodiment of the invention takes place as follows. Blanks of zinc alloy are placed in a tumbling barrel along with a lubricant, such as lard, for a sufficient time to coat the blanks with the lubricant. The lubricated blanks are heated to approximately 125° C. by feeding through a suitable oven or furnace, and then fed singly into the die cavity. The punch 19 in immediately actuated to apply non-uniform pressure to the blank and effect uniform flow of the walls of the resultant case. The case is then finished on a suitable metal cutting and forming machine to trim the top edge and form the flare 9 thereon.

It will thus be seen that there is provided a new and useful process for extruding zinc articles of a noncircular cross-section and more particularly for extruding zinc capacitor cases of an elliptical or oval cross-section. While the invention has been disclosed with reference to the preferred embodiment thereof, it will be understood that the invention is not limited to the particular details shown and described but may be varied within the spirit and scope of the appended claims.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A method of manufacturing a corrosion-resistant tubular article of noncircular ovate cross-section having a major and minor axis comprising the steps of:
   (a) lubricating a zinc alloy blank;
   (b) heating said blank to a temperature of at least about 100° C. but less than about 150° C.;
   (c) extruding said blank into the shape of the article by placing said blank in a suitable die cavity and forcing a die therein having a flat punch face perpendicular to said tubular article; and
   (d) providing uniform flow of said zinc alloy into the wall of said article by channeling a proportional part of said zinc alloy in plural elongated opposite cavities in said punch face;
   (e) said cavities being parallel to the major axis of said ovate cross-section with one said cavity of each side of the center of said punch face, the said cavities being spaced within the perimeter of said punch face.

2. A method as recited in claim 1 wherein said zinc alloy consists essentially of 0.5% copper, 0.15% titanium and the balance zinc and said blank is heated to a temperature of approximately 125° C.

References Cited

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Patent No.</th>
<th>Date</th>
<th>Inventor</th>
<th>Class</th>
<th>Examiners</th>
</tr>
</thead>
<tbody>
<tr>
<td>959,900</td>
<td>10/1909</td>
<td>Frank</td>
<td>72—271</td>
<td></td>
</tr>
<tr>
<td>1,492,230</td>
<td>4/1924</td>
<td>Towne</td>
<td>72—267</td>
<td></td>
</tr>
<tr>
<td>2,080,399</td>
<td>5/1937</td>
<td>Deibel</td>
<td>72—267</td>
<td></td>
</tr>
<tr>
<td>2,533,942</td>
<td>12/1950</td>
<td>Jongedyk</td>
<td>72—267</td>
<td></td>
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</tbody>
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