Dec. 4, 1962 S. WESTIN ETAL 3,067,321

APPARATUS FOR ELECTRICALLY HEATING AND FORMING CYLINDRICAL MEMBERS

Filed April 11, 1961

Fig. 1.

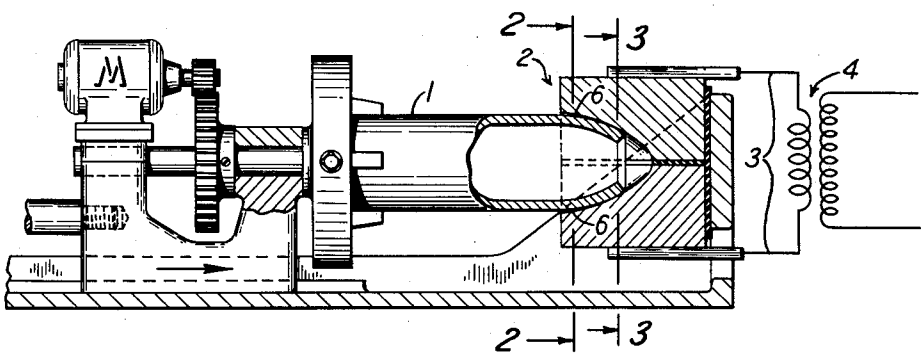


Fig. 2.

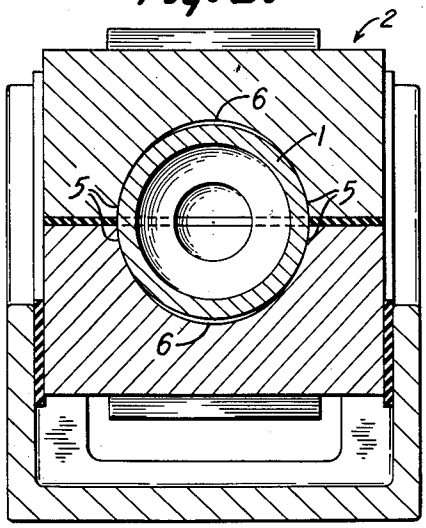
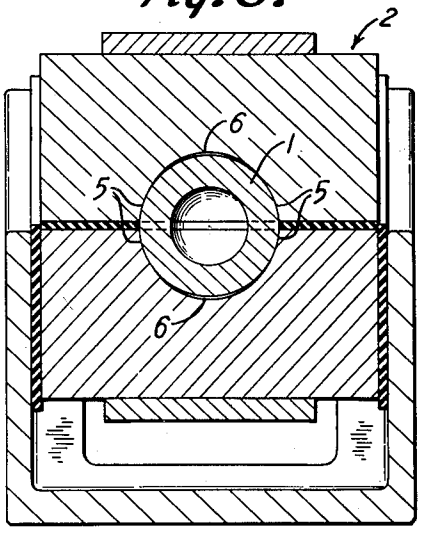


Fig. 3.



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APPARATUS FOR ELECTRICALLY HEATING AND FORMING CYLINDRICAL MEMBERS

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Filed Apr. 11, 1961, Ser. No. 102,288
3 Claims. (Cl. 219—152)

This invention relates to electrode dies employed in the hot forming of cylindrical ends of tubes as in the process set forth in United States Letters Patent No. 2,309,561 granted to the present inventors.

The process of the foregoing patent generally involves the axial movement of a rotating cylindrical blank into a die comprising a plurality of electrode segments arranged in circumferentially spaced relation to provide a substantially circular die cavity of gradually reducing diameter from the front to the rear of the die, whereby the blank is progressively heated by current flow therethrough and formed simultaneously with the electrode dies.

One of the major problems encountered in the process lies in pitting of the dies at the region of initial forming of the workpiece. It has been suggested heretofore that the die should provide a cavity that is not exactly circular, but one in which the concavity of each die segment is initially of greater radius so that the die segment is in pressure contact with the work in a region somewhat away from the edge portions of the segment. In other words the edges of each segment are gradually relieved to avoid pressure contact with the workpiece, it being the thought that a longer path of heating current through the workpiece between two adjacent electrode die segments will provide a greater heating effect for a given current value. Another suggestion has been to relieve only the leading edge of each die segment to avoid pressure contact with the work as it moves toward the segment. Neither of these suggestions have proven entirely satisfactory although each has been employed with some degree of success.

The present invention is based upon the discovery that less pitting is obtained if a substantial pressure contact is maintained between the die segments and the workpiece at both edges of each segment where the heating current tends to concentrate in its flow from one segment to another through the workpiece. It is desirable in order to obtain adequate pressure contact in this region, for the central portion of the die contact surface of each segment to be relieved from contact with the workpiece. No arcing will occur at or adjacent this relieved portion of the die segment since the heating current will not tend to flow in this region.

The invention may be better understood by reference to the accompanying drawing which illustrates the best mode presently contemplated by the inventors for carrying out the invention.

In the drawing:

FIGURE 1 is an axial section showing a forming operation in dies constructed in accordance with the invention;

FIG. 2 is a transverse section taken on line 2—2 of FIG. 1; and

FIG. 3 is a similar section taken on line 3—3 of FIG. 1.

Referring to the drawing the tubular cylindrical blank 1 is shown as having its end reduced and necked as in the forming of various metal gas bottles and the like.

For this purpose the rotating blank 1 is moved axially as indicated by the arrow in FIG. 1 progressively into a die 2 which is formed of a plurality of circumferentially spaced separate electrode die segments.

The die 2 shown, has two such segments for connection

by suitable leads 3 and transformer 4 to a power line from a suitable source of electricity.

The die cavity into which the blank 1 gradually moves and by which it is formed, is provided by complementary similar inner surfaces of the die segments and preferably has a mouth sufficiently large to receive the initial blank end, with the cavity gradually reducing in size from the mouth to the rear neck forming portion of substantially less diameter.

In the region of slope of the die where the forming is greatest the pressure contact between the blank and the die segments is greatest and the heat input is preferably high. In the region just ahead of that, where the blank is softening, the slope of the die is preferably less and is generally just sufficient to maintain the desired pressure contact between the die electrodes and the blank to effect a proper conduction of heating current to the blank.

In carrying out the present invention the die surface of each segment in the regions referred to is transversely curved on radii somewhat less than the general radius for the die cavity at each corresponding axial location. This is best illustrated in FIGS. 2 and 3 where the edge portions 5 of each segment are shown in pressure contact with the workpiece 1, and the intermediate portion 6 of each segment is shown relieved and actually spaced radially outward from the workpiece.

In FIGS. 2 and 3 the blank 1 is illustrated as circular, although in an actual forming operation the blank may be somewhat deformed and will tend to flow into the reliefs provided centrally of each die segment and also between adjacent die segments.

Where the die 2 is composed of only two complementary electrode die segments the die cavity will have an oval or oblong section in the regions referred to, with the major axis of the cavity normal to the axial plane separating the segments.

In all embodiments of the invention there is a concentrated heating current flow through the progressively changing portions of the blank 1 that are disposed between two adjacent die segments and immediately in contact therewith. There is substantially little heating current flow through the progressively changing portions of the blank within each segment and between the opposite edge portions thereof.

The longitudinal extent of the relief 6 may vary, but should be throughout the major region susceptible to pitting. In some instances the relief 6 may extend for the full length of the corresponding die segment.

The invention greatly extends the life of a die. Redressing of the die faces may retain the corresponding reliefs 6. In some instances redressing may be accomplished on a circular basis which tends to remove the reliefs 6, and if desired the shape after several redressings of the die face may ultimately be that referred to as prior practice. In such instance the die life is enhanced insofar as the present invention is employed for any period of use.

The invention substantially eliminates danger of formation of high spots in the region of forming contact between the die and the workpiece, and results in a substantially longer die life.

Various modes of carrying out the invenion are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

We claim:

1. In apparatus for electrically heating and forming an end of a cylindrical tubular metal blank, a die comprising a plurality of circumferentially spaced electrode die segments cooperating to provide a die cavity of progressively reduced section from the mouth of the cavity and

arranged to receive a rotating blank in pressure contact to supply heating current to recurrent contacting portions of the blank to resistance heat the same by flow of current through the blank between the electrode die segments, each said die segment having a substantial relief in the die surface thereof intermediate the longitudinal edge portions thereof to effect more uniform and concentrated pressure contact between the said edge portions and the blank in regions of substantial forming of the blank.

2. In apparatus for electrically heating and forming an end of a cylindrical tubular metal blank, a die comprising a plurality of circumferentially spaced electrode die segments cooperating to provide a die cavity progressively reduced section from the mouth of the cavity and arranged to receive a rotating blank in pressure contact to supply heating current recurrent contacting portions of the blank to resistance heat the same by flow of current through the blanks between the electrode die segments, each said die segment having a concave die face curved transversely and presenting a crescent relief relative to the circular section of the die cavity.

3. In an apparatus for electrically heating and forming an end of a cylindrical tubular metal blank, a die comprising a plurality of circumferentially spaced electrode die segments cooperating to provide a die cavity of progressively reduced section from the mouth of the cavity and arranged to receive a rotating blank in pressure contact to supply heating current to recurrent contacting portions of the blank to resistance heat the same by flow of current through the blank between the electrode die segments, each said die segment having a substantial relief in the die surface thereof intermediate the longitudinal edge portions thereof to effect more uniform and concentrated pressure contact between the said edge portions and the blank in regions of substantial forming of the blank, said relief extending longitudinally of each segment in the region of major forming of the blank.

References Cited in the file of this patent

UNITED STATES PATENTS

2,335,165 Westin et al. ---------- Nov. 23, 1943

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,067,321 December 4, 1962

Sven Westin et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 13, after "cavity" insert -- of --; line 16, after "current" insert -- to --; line 18, for "blanks" read -- blank --.

Signed and sealed this 7th day of May 1963.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents

UNITED STATES PATENT OFFICE

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