July 30, 1968 D. T. VAN ALLMAN 3,394,572

METHOD AND APPARATUS FOR FORMING A CURLED EDGE ON A TUBULAR ARTICLE

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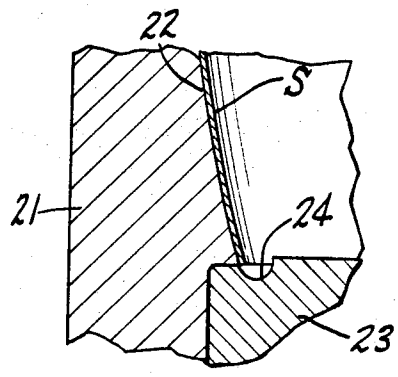


FIG-3

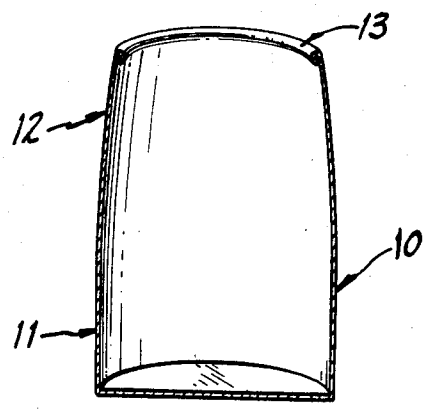


FIG-1

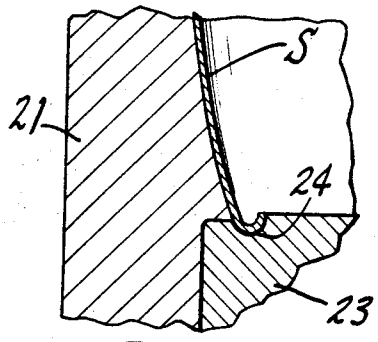


FIG-4

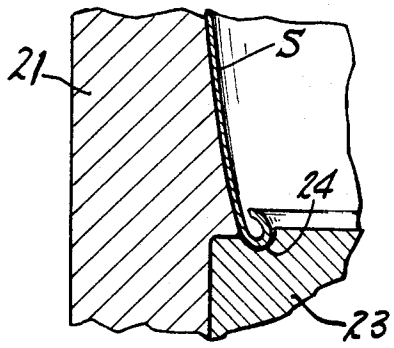


FIG-5

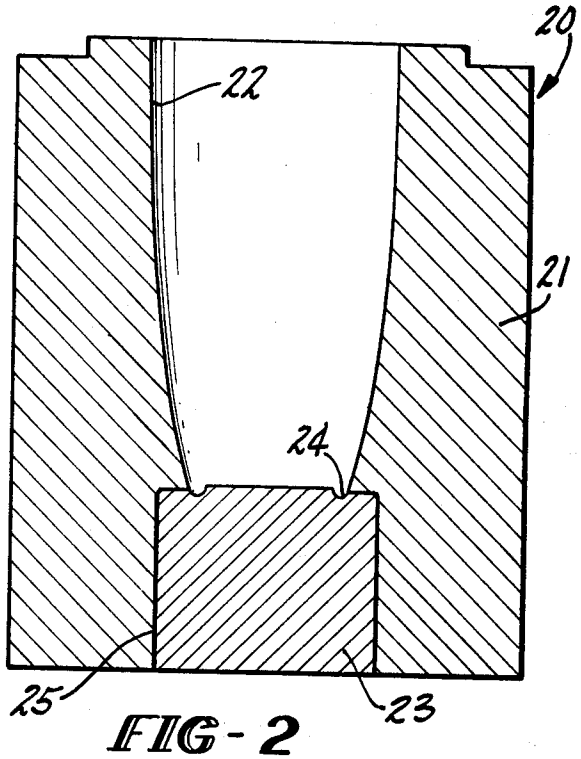


FIG-2

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METHOD AND APPARATUS FOR FORMING A CURLED EDGE ON A TUBULAR ARTICLE

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ABSTRACT OF THE DISCLOSURE

The production of a cylindrical article having a neck portion of reduced diameter terminating in a curled end portion, the method comprising the steps of providing a shell of uniform diameter, reducing successive portions of said shell, and concurrently with said reducing step, curling the periphery of said shell at one end thereof.

This invention relates in general to the manufacture of cylindrical articles and more particularly to a method of, and apparatus for, producing a cylindrical article having a neck portion of substantially reduced diameter terminating in a curled end portion.

In a great number of applications, such as a container for solids or liquids, it is advantageous to provide a cylindrical article tapering in diameter toward one end and terminating in an end portion which is of a curled configuration. Conventional production of such an article includes the separate steps of forming a cylinder of uniform diameter, reducing the diameter of the cylinder as required, and thereafter forming the end portion of the cylinder into the desired curled configuration.

According to the instant invention, a method and apparatus are provided for performing substantially concurrently the steps reducing the cylinder diameter and curling the end portion thereof. The resultant cost savings in time, labor, and tools will be readily evident to those skilled in the art.

In brief, the method of the instant invention comprises providing a cylindrical shell of substantially uniform diameter, reducing successive portions of the cylindrical shell to provide a shell tapering in diameter toward one end, and substantially concurrently with the reducing step, curling the periphery of said shell at one end thereof. The method is most advantageously performed employing a die structure comprising a first die portion having a cylindrical recess tapering in diameter toward one end of the recess and adapted to reduce selected portions of the shell to provide a shell tapering in diameter toward one end, and a second die portion contiguous with such end of the recess and comprising an annular groove adapted to receive and curl the terminal end of the shell upon full insertion of the shell into the die structure. Preferably, the curling operation is performed to curl the end of the shell inwardly, to provide articles where such a relationship is required.

It is therefore an object of this invention to provide a method of, and apparatus for, producing a cylindrical article having a neck portion of substantially reduced diameter terminating in a curled end portion.

It is a further object of this invention to provide a method of, and apparatus for, producing such an article at a minimum cost and in a minimum number of separate operations.

It is a still further object of this invention to provide a method of, and apparatus for, producing such an article including substantially concurrently performing a reducing step and a curling step.

Other objects and advantages will become apparent to those skilled in the art as a detailed description of a

particular embodiment proceeds with reference to the drawings which form a part hereof, and in which:

FIGURE 1 is a cross-sectional view of a cylindrical article produced according to the instant invention;

FIGURE 2 is a cross-sectional view of an appropriate die structure according to the instant invention; and,

FIGURES 3–5 are fragmentary cross-sectional views illustrating three steps during the production of the article of FIGURE 1.

Referring now to FIGURE 1 of the drawings, there is illustrated an exemplary metallic article **10** which may be produced according to the instant invention. The article **10**, which may serve for example as a liquid heater when provided with the appropriate electrical mechanisms, is cylindrical in configuration and may be of uniform diameter along a portion of its length, such as illustrated at **11**. Another portion of the article **10**, such as that shown at **12**, is desirably of a reduced diameter tapering toward the upper end thereof. The end portion of the article **10** is of a curled configuration as shown at **13**, the curled configuration being advantageous for mating with an appropriate cover member.

Considering now the manner in which the article **10** may be produced, those skilled in the art will appreciate that apparatus is presently available for (A) forming a cylindrical shell of substantially uniform diameter, (B) reducing, or choking, one end of the shell, and (C) thereafter curling an end portion of the shell. Instead of performing these steps separately, a die structure such as that illustrated at **20** in FIGURE 2 may be employed to perform these last two steps substantially concurrently. A portion **21** of the die structure **20** is similar to a conventional choking die and includes a recess **22** tapering in diameter toward one end thereof. A cylindrical shell of substantially uniform diameter and produced in any desired manner may be appropriately treated and forced into the recess **22** of die structure **20** by any conventional means, such as a press having a ram adapted to engage one end of the shell. Of course, desired lubricants may be employed as desired, and it is preferable that the ram have no portions within the shell which would impede the choking operation. Contiguous with the lower end of recess **22** is a second die portion **23** having an annular groove **24**, the outer edge of the groove **24** being coincident with the lower end of recess **22**. The die portion **23** is appropriately secured within a matching recess **25** of the die portion **21**, and may be removably secured so that the die portions **21** and **23** are separable. In this fashion, the die portion **21** may be used for a choking operation where no curling operation is desired.

The manner in which the die structure **20** functions to form the article illustrated at **10** in FIGURE 1 will be evident from a consideration of FIGURES 3–5. In these fragmentary views, a portion of die structure **20** immediately adjacent the groove **24** is illustrated. Considering first FIGURE 3, it will be evident that as a cylindrical shell S is forced into the recess **22**, the diameter thereof is reduced to match that of the recess **22**. As the edge of the shell S approaches the bottom of recess **22** it enters the groove **24** of die portion **23**, and being inwardly unrestrained, is forced to bend into the configuration of the groove **24**. Further motion of the shell S downwardly causes curling of successive portions of the shell S as they enter the groove **24**. The curled portion of shell S illustrated in FIGURE 4, upon leaving the recess **24**, continues in an arc around to a position closely adjacent an inner surface of the shell S, as is illustrated in FIGURE 5.

It will be appreciated that the amount of curl provided in the finished article is determined by the degree to which the shell S is forced into the die structure **20**. In an application such as the exemplary liquid heater noted above, it

is desirable that the curled edge be such that no liquid is trapped therein, and accordingly the degree to which the shell S is forced into the die structure may be appropriately adjusted. It will be further appreciated that while the curling of the edge is transpiring, portions of the shell S are being reduced in diameter, and it is in this sense that the expression "substantially concurrently" is employed.

It is to be understood that the invention is not limited to the illustrations described and shown herein which are deemed to be merely illustrative of the best modes of carrying out the invention, and which are susceptible of modifications of form, size, arrangement of parts and detail of operation, but rather is intended to encompass all such modifications which are within the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

1. A method of producing a cylindrical article having a neck portion of substantially reduced diameter terminating in a curled end portion, the method comprising the steps of:

(A) providing a cylindrical shell of substantially uniform diameter;

(B) reducing successive portions of said cylindrical shell to provide a shell tapering in diameter toward one end; and

(C) substantially concurrently with said reducing step, curling the periphery of said shell at said one end in a smooth curve to a position closely adjacent an inner surface of said shell.

2. A die structure for producing a cylindrical article having a neck portion of substantially reduced diameter terminating in a curled end portion, the die structure comprising:

(A) a first die portion having a cylindrical recess tapering in diameter toward one end of said recess, said recess adapted to reduce selected portions of a shell of substantially uniform diameter to provide a shell tapering in diameter toward one end; and

(B) a second die portion contiguous with said one end of said recess and comprising an annular groove arcuate in cross section, the outer edge of said groove being coincident with said one end of said recess, and adapted to receive and curl the terminal end of said shell upon full insertion of said shell into said die structure.

3. A die structure according to claim 2 wherein said first and second die portions are separable.

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