

[54] RENECKING METHOD

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113/120 AA, 120 H, 120 S; 72/354, 370,
348, 367, 81, 82, 283

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[57]

ABSTRACT

This disclosure relates to a method of improving axial static load resistance of tubular metallic bodies, specifically can bodies, by first necking-in a normally cylindrical open end (or ends) of the metallic body to form a neck shoulder forming the transition area between the body proper and its neck, and thereafter renecking the body open end to reduce the angle of the neck shoulder to between 13°–18°. Pursuant to this method different degrees of axial load resistance improvement were obtained ranging from 25 percent to 53 percent. Preferably renecking penetration is 0.020 inch axially greater than the initial necking penetration thus achieving the advantage of increased body height after renecking approximately 0.010 inch.

13 Claims, 4 Drawing Figures

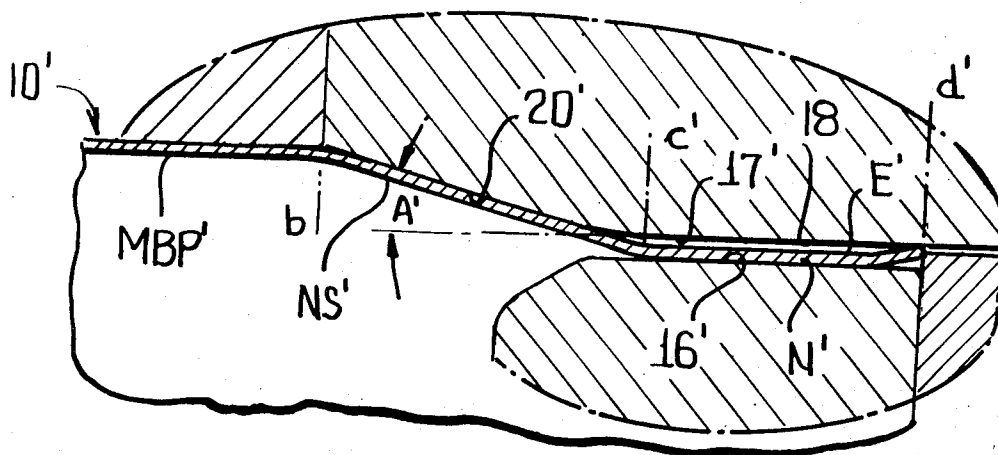


FIG. 1

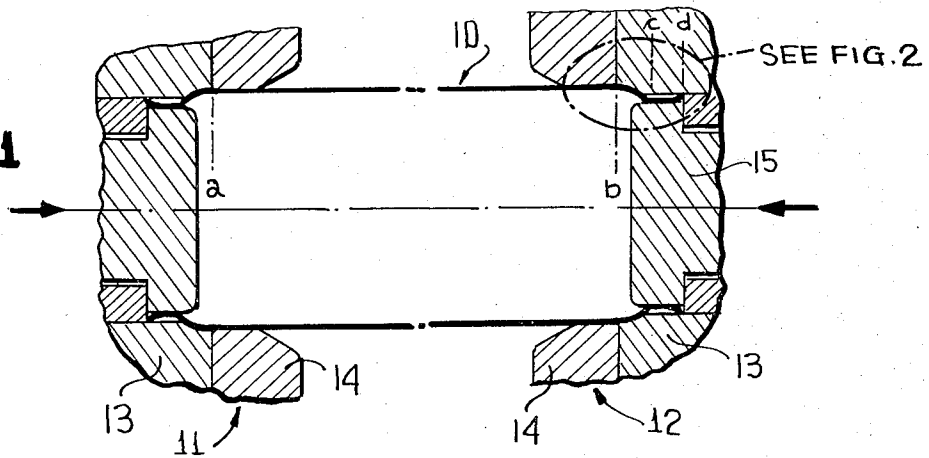


FIG. 2

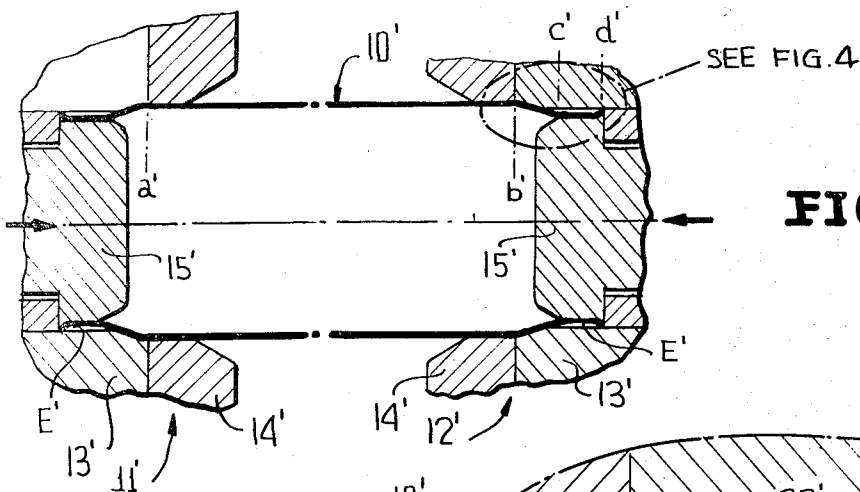
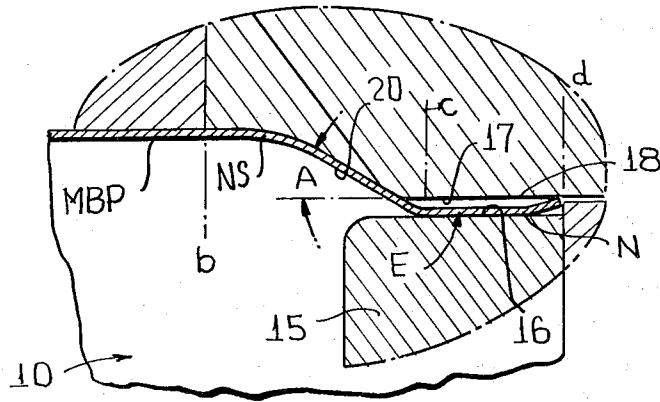
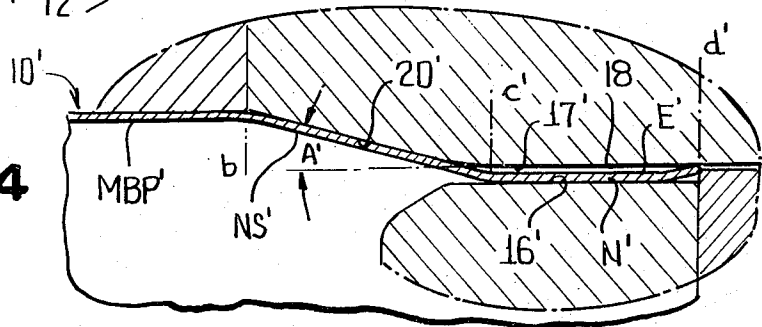


FIG. 3

FIG. 4



RENECKING METHOD

This invention relates in general to new and useful improvements in the manufacture of can bodies, and more particularly relates to a method of first necking-in an end of a can body and thereafter renecking or re-

forming, preferably by a female die having a floating punch center, so as the end of the can body is conformed for the reception of a small diameter end or cover and achieved thereby is not only a gain in axial length as compared to a necked container, but an increase in axial load strength is obtained ranging from 25 to 53 percent.

It is well known to reduce the single open end of two piece cans and both ends of three piece cans by necking-in and/or beading operations. Static and/or dynamic tools are employed and in most cases the material of the can bodies is subjected to compression during the reduction in initial diameter and circumference. Such compression causes minute wrinkles or pleats to be formed and during the forming of the usual double seam between the can body end or ends and its associated closures these small wrinkles or pleats result in the formation of cracks and subsequently leaky cans. Moreover, cans which are simply necked are not exceptionally resistive to axial loading, and until the present invention exhaustive trials achieved only a 5 percent increase in axial load although this was undesirably obtained by increased pleating in the shoulder areas of soldered, aluminum, and other type cans whereas increased wrinkling occurred in the radius notches of welded cans.

In accordance with this invention, it has been found that undesired wrinkling, pleating, cracking, etc., can be avoided with a corresponding increase (from 25 to 53 percent) in resistance to axial load by the novel method of this invention which includes providing a tubular metallic body having at least one open end, necking the body open end to form a neck shoulder forming the transition area between the body proper and its neck, and renecking the body open end to reduce the angle of the neck shoulder to between 13°-18°.

A further object of this invention is to provide a novel method of the type heretofore set forth wherein the metallic body prior to the necking operation has a predetermined axial length which is foreshortened as a result of the necking operation, and the renecking step increases the axial length of the foreshortened neck body.

Preferably in accordance with a further object of this invention the renecking or reforming spans an axial distance approximately 0.020 inch greater than the initial necking step, and preferably both necking and renecking operations are performed in female dies having floating punch centers in internal telescopic relationship to the metallic body end or ends being necked and renecked.

With the above and other objects in view that will hereinafter appear, the nature of the invention will be more clearly understood by reference to the following detailed description, the appended claimed subject matter, and the several views illustrated in the accompanying drawing:

IN THE DRAWING

FIG. 1 is a schematic sectional view of a normally right cylindrical can body, and illustrates axially oppo-

site ends being necked-in between external female dies and internal floating punch centers.

FIG. 2 is an enlarged fragmentary sectional view of the encircled portion of FIG. 1, and illustrates the formation of a neck shoulder forming the transition area between the body proper and its neck, with the initial neck shoulder angle being approximately 30°.

FIG. 3 is a view similar to FIG. 1 but illustrates the initial necked can body of FIGS. 1 and 2 being renecked or reformed, and more particularly illustrates a reduction in the neck shoulder angle.

FIG. 4 is an enlarged fragmentary sectional view of the encircled portion of FIG. 3, and more clearly illustrates the reduction in the neck shoulder angle of between 13°-18°.

Referring now to the drawing in detail, a typical can body is generally designated by the reference numeral 10, and prior to being necked-in initially as shown in FIGS. 1 and 2, the can body 10 is of a right cylindrical configuration of constant circumference and diameter from end to end. Typically the can body may initially be any one of the type described in reference to FIG. 1 of applicant's corresponding application Ser. No. 100,264 entitled Method of Forming Necked-In Can Bodies, filed Dec. 21, 1970, now U.S. Pat. No. 3,763,807, and assigned to the assignee of the present application.

Reference is now made to FIGS. 1 and 2 wherein there are illustrated a pair of opposed conventional necking dies, generally designated by the reference numerals 11, 12. Each necking die 11, 12 includes a female necking die 13, a lead in ring 14, and a "floating" punch center 15. An outer periphery 16 of the punch center 15 is spaced from a peripheral wall 17 of the die 13 and defines therewith a gap 18 which receives an associated end E of the container body 10 during a necking operation. Due to the "floating" mounting of the punch center 15 the radial distances between the surfaces 16, 17 and thus the radial width of the gap 18 may vary to accommodate tolerances between different can bodies. As an example, the diameter of the punch center which is that of the surface 16 is 2.460 inch minus 0.0002 inch whereas that of the surface 17 is 2.4832 inch plus 0.0004 inch for a can body whose diameter prior to necking-in is 2.594 inch plus 0.002 inch. Thus the gap 18 can vary between 0.0066 inch minimum and 0.0166 maximum due to the "float" of the center punch 15.

Each female die 13 includes a neck shoulder forming surface 20 defining an angle A of 30° plus or minus two degrees. Thus upon positioning the can body 10 in axial alignment with the punch centers 15 and the female dies 13 axial forces applied to the can ends E upon movement in the direction of the unnumbered headed arrows in FIG. 1 results in the ends E riding along the neck shoulder forming surfaces 20 and thereafter upon the surfaces 16 of the respective female dies 13, 13 and the punch centers 15, 15 whereupon the normally cylindrical can body 10 is configured in the manner best illustrated in FIGS. 1 and 2 to include, namely, a major or main body portion MBP between points a and b, a neck shoulder NS between points b and c (FIG. 2), a neck N between points c and d, and an identical neck shoulder (unnumbered) and neck (also unnumbered) to the left of point a in FIG. 1. Thus the both ends E of the container body 10 as necked-in are identical in that each end E includes neck shoulders NS forming the

transition area between the main body portion MBP and the adjacent neck N.

Upon relative retracting movement of the punch centers 15, 15 and the female dies 13, 13 in the opposite direction of the unnumbered headed arrows in FIG. 1, the now necked-in can body 10 is transferred to the apparatus of FIGS. 3 and 4 which reforms or renecks the necked-in container 10 of FIGS. 1 and 2 and has accordingly been provided with like though primed reference numerals. However, in this case the neck shoulder forming surface 20' includes an angle A' whose angle ranges between 13°-18° which in turn transforms the initial neck shoulder NS of the necked-in container 10 to a neck shoulder NS' likewise defining an angle of between 13°-18°. Within this range of renecked angles improvement has been found in resistance to axial load with the improvement over standard neck containers ranging between 25 to 53 percent.

In addition to renecking within the range (13°-18°) heretofore noted, the points c'-d' of the female renecking dies 13', 13' is actually greater by approximately 0.020 inch which in effect transforms a like axial dimension (0.02 inch) of the main body portion inboard of points a and b to a portion of the renecked neck surface NS'. That is, the ends E of the neck container 10 when renecked, as shown in FIGS. 3 and 4, penetrate past the original neck at each end of FIGS. 1 and 2 up to 0.020 inch. The advantage thereof is an increase in can body height or axial length from end to end (E'-E') which amounts to an approximate increase of 0.010 inch added to the standard necked-in can height of FIGS. 1 and 2 since material rebound or memory must be accounted for. Typically, the standard 12 ounce can body cylinder has an original axial length of 4.937 inch plus or minus 0.002 inch. Renecking in accordance with FIGS. 3 and 4 after initial necking in accordance with FIGS. 1 and 2 effects a recovery of 0.010 inch plus or minus 0.002 inch of the metal length lost in the necking operation (FIGS. 1 and 2). The final renecking axial length would then be 4.932 inch plus or minus 0.002 inch. The range here represents the original range incurred in slitting the metal sheet to blank size. The recovery of 0.010 inch axial length in the renecking operation (FIGS. 3 and 4) is an advantage since it is obviously desirable to be as close as possible to the standard height that is established for straight sided (nonnecked) 12 ounce cans as delivered to the customer.

However, the major importance of the subsequent renecking in the range of 13°-18° is the axial load improvement ranging from 25 to 53 percent.

The following table indicates the desirable effects particularly in axial loading between a welded standard necked can (30°) (Control-W), a soldered standard necked (30°) side seam can (Control-S), and three renecked welded and three renecked soldered cans. The control cans were necked but not renecked whereas each of the six sample cans were necked and renecked at respectively 18, 15, and 13°. From the table it will be noted a marked increase in resistance to axial load as, for example, the Control-W can failing at 811 pounds whereas the three sample welded cans which were both necked and renecked resisted axial loading up to 1,016 pounds, 1,148 pounds, and 1,193 pounds at the respective angles of 18, 15 and 13 during the respective renecking operations. Like resistance to axial loads is evidenced from the third vertical column which compares

the necked but nonrenecked Control-S soldered can with three other soldered cans both necked and renecked at 18°, 15° and 13°, respectively.

The results of Table I were accumulated by laboratory testing which simulated the type of axial failure that occurred when standard necked soldered and/or welded cans failed in transit during route truck delivery of filled goods. In the test a 560 gram weight was dropped from a height of 10 inches (0.254 millimeters) onto the double seam of a filled can. The can is first placed in a test fixture so that the weight contacts the double seam on one side only. Repeated drops are made until metal failure in the neck shoulder area occurs and leakage of the product is evident. The values listed under the drop test in Table I signify the number of drops required to cause this type of failure. At the present, neither the drop test nor the axial load test values have been correlated with actual failures in the field, and thus until such correlation is obtained, both tests are run using a standard neck container (30°) as a control. However, from Table I it is readily apparent that all the renecked containers tested clearly outperform the controls (standard 30° necked and unnecked containers) to a substantial degree.

TABLE I

EFFECT OF RENECK ANGLE ON AXIAL LOAD AND DROP TEST RESISTANCE FOR 55 lb DR-8 WELDED AND SOLDERED 12 oz (355 cc) BEVERAGE CANS

Test Variable	Reneck Angle (degrees)	Axial Load (Av. lbs.)	Drop Test (Av. no. of drops)	Tensile Yield (psi ×10 ³)
Welded — w				
Control*	—	811	13	77.0
8w	18	1016	15	77.5
9w	15	1148	20	76.5
10w	13	1193	21	76.5
Soldered — s				
Control*	—	933	13	84.0
8s	18	1115	16	82.0
9s	15	1257	21	86.5
10s	13	1229	23	86.0

*Standard 30° neck angle

Note: lb/BB (Base Box) to g/sq meter=lb/BB×0.0224

lb to kg=lb×0.453

psi to kg/sq cm=psi×0.07

While preferred forms and arrangements of parts have been shown in illustrating the invention, it is to be clearly understood that various changes in details and arrangement of parts may be made without departing from the spirit and scope of this disclosure.

I claim:

1. A method of improving axial load resistance of tubular metallic bodies comprising the steps of providing a tubular metallic body having at least one open end, necking the body open end to form a neck shoulder forming the transition area between the body proper and its neck, and renecking the body open end to reduce the angle of the neck shoulder to between 13°-18°.

2. The method as defined in claim 1 wherein the initial neck shoulder angle is approximately 30°.

3. The method as defined in claim 1 wherein said metallic body prior to said necking operation has a predetermined axial length which is foreshortened as a result

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of said necking operation, and said renecking step increases the axial length of the foreshortened necked body.

4. The method as defined in claim 1 wherein said metallic body prior to said necking operation has a predetermined axial length which is foreshortened as a result of said necking operation, said renecking step increases the axial length of the foreshortened necked body, and said renecked body after the renecking step is approximately 0.010 inch greater in axial length than the foreshortened and necked body.

5. The method as defined in claim 1 wherein said necking and renecking operations are performed with a floating punch center in internal telescopic relationship to said one open end.

6. A method of improving axial load resistance of tubular metallic bodies comprising the steps of providing a tubular metallic body having at least one open end, necking the body open end to form a neck shoulder forming the transition area between the body proper and its neck, renecking the body open end axially a distance beyond the neck shoulder whereby a portion of the body proper after renecking becomes a portion of the renecked shoulder, and the renecking step reduces the angle of the neck shoulder to between 13°-18°.

7. The method as defined in claim 6 wherein said axial distance is approximately 0.020 inch.

8. A method of improving axial load resistance of tubular metallic bodies comprising the steps of providing

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a tubular metallic body having at least one open end, necking the body open end to form a neck shoulder forming the transition area between the body proper and its neck, renecking the body open end axially a distance beyond the neck shoulder whereby a portion of the body proper after renecking becomes a portion of the renecked shoulder, said metallic body prior to said necking operation has a predetermined axial length which is foreshortened as a result of said necking operation, and said renecking step increases the axial length of the foreshortened necked body.

9. The method as defined in claim 6 wherein said metallic body prior to said necking operation has a predetermined axial length which is foreshortened as a result of said necking operation, and said renecking step increases the axial length of the foreshortened necked body.

10. An article constructed in accordance with the method of claim 1.

11. An article constructed in accordance with the method of claim 6.

12. An article constructed in accordance with the method of claim 8.

13. The method as defined in claim 8 wherein said axial distance is approximately 0.020 inch.

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