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(54) **METHOD OF SHAPING AN OPEN END OF A METAL TUBULAR BODY**

VERFAHREN ZUR FORMUNG DES OFFENEN ENDES EINES ROHRFÖRMIGEN KÖRPERS
METHODE DE MISE EN FORME DE L'OUVERTURE D'UN CORPS TUBULAIRE

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(56) References cited:
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Description

[0001] The present invention relates to a method of shaping metal tubular closures or can bodies such that the open end of the tube is formed into a flared shape. In particular, but not exclusively, it relates to the shaping of a metal closure or can body in which the side wall height is greater than the diameter of the open end(s) and/or end wall.

[0002] It is known to produce metal closures or can bodies from such easily worked materials as aluminium. These are typically formed from a flat sheet of relatively thin metal which may be shaped by means of one. Or a series of, die or spin-flanging tools such that the finished product is tubular with one axial end closed integrally and with the other end open.

[0003] In the case of the closures, the finished product is then typically rolled onto a bottle neck so that threads are formed in the sides of the closure corresponding to the threads on the bottle neck.

[0004] The tubular nature of these products is such that the diameter of the end of the tube is substantially the same as the closed end.

[0005] However, it is desirable to be able to produce metal closures or can bodies which are a flared open end, so that the diameter of the open end is greater than the diameter of the closed end.

[0006] Further, typical food and drink cans are known in which a flange is formed at the axially distal open end of the can body by means of die or spin flanging tools. The flange acts as a feature for connecting the lid to the body for sealing purposes and is therefore typically oriented perpendicularly to the axial length of the can body.

[0007] A method according to the preamble of claim 1 and one prior art such as is described in PCT application WO99/32242. This can has flared end formed in a single outward necking step which may compromise a die flanging operation.

[0008] The flange is created by stretching and bending part of the can wall. However, in the case of a typical flange, the length of the portion of can wall which is formed into the flange is relatively short, being typically in the region of 2 to 3 mm. Accordingly, the amount of the wall that is stretched to increase its diameter is relatively small.

[0009] The stretching and expansion of the wall creates hoop stress in the flange, but the metal is supported by the adjacent material that is less stressed thus avoiding splitting during flanging operations.

[0010] However, it is desirable to be able to stretch and expand a greater proportion of a can body or closure sidewall to produce a flared open-end.

[0011] A prior art closure having a flared sidewall is disclosed in DE-A-28 29 755.

[0012] Due to increased hoop stress, and reduced support from less stressed material, it has hitherto been problematical to create such flared shaped metal closures or can bodies due to splitting of the material.

[0013] It is therefore desired to provide an industrial method of producing metal closures or can bodies with a flared open end such that the method is capable of producing such enclosures at a high throughput speed and with low spoilage rates due to splitting.

[0014] In one aspect, the invention provides a method of shaping an open end of a metal tubular body into a flared shape so that the diameter of the tubular body increases gradually from a point axially spaced from the mouth at the open end of the tubular body towards the said mouth itself, the method being characterised by comprising the steps of:

- a. Forming a flange with a flanging tool whereby to increase the diameter of the said mouth at the open end of the tubular body to a desired diameter; and
- b. After the flange is formed increasing tubular body in the region between the said point and the said mouth using one or more forming tools such that the diameter of the said mouth of the tubular body remains unchanged from the said desired diameter formed in step a.

[0015] An advantage of this method is that splitting of the metal is avoided by the expansion of the overall desired axial length taking place in stages. Further, by increasing the open end to the desired diameter in one step, rather than in more than one step, there is less change of work-hardening of the metal which may cause splitting.

[0016] The flare may be formed either straight or curved, which has advantages in matching the profiles of containers, in the case of closures. Further embodiments are disclosed in the dependent claims attached hereto.

[0017] Embodiments of the invention will now be described, by way of example, with reference to the following drawings in which;

Figure 1 shows different views of a typical can body before and after having a flange formed at both ends.

Figures 2 and 4 show a sequence of cross-sectional views of a metal closure having been treated in accordance with the method described herein.

Figure 5 shows enlarged cross-sectional views superimposed on one another of the distal and of a metal closure having been treated in accordance with the method described herein.

Figure 6 shows a flanging tool which may be used in accordance with the method described herein.

Figure 7 and 8 show a sequence of forming tools which may also be used in accordance with the method described herein;

[0018] In Figure 1, a tube of metal 10 is shown in perspective on the left with substantially cylindrical side-walls. This could be a food or drink can body. The middle drawing, also in perspective, shows this can body with flanges 12 formed at both ends. The drawing on the right is an enlarged view of one of flanges 12 seen in cross-section.

[0019] It may be seen that the flange 12 is formed such that the distance of the end of the flange from the wall of the tube 'D' is substantially equal to the axial length of can wall which has been stretched. Further, this flange lies substantially perpendicular to the longitudinal axis of the can body 10.

[0020] As has been stated above, the greatest value for 'D', at which no splitting of the metal occurs, is known to be approximately 3mm with typical food or drink cans in which the call wall is comparatively thin (less than 1 mm).

[0021] Although a can body with both ends open is shown it should be understood that the can body could be formed from one sheet of metal so that the can body has an integral closed end and an open opposite end.

[0022] Figure 2 shows a cross section of a typical metal closure 20. The closure has a closed end 22 and has a milling 24 formed at one end to increase grip. The walls 26 of the closure extend axially away from the closed end 22 and terminate at a mouth 25 at an open end. In some instances part of the walls 26 of the closure 20 have already been shaped such as bulge 28.

[0023] Using a flanging tool, such as is shown in Figure 6, the mouth 25 at the open end of the closure 20 is expanded outwards so as to form flange 30. This occurs because the tool 80 is inserted inside the body of the closure 20 until the axial end of the walls 26 butt up against the curved stop 81 of the tool. Further respective movement of the tool 80 and closure 20 forces the open end of the tube outwards so that it conforms to the shape of the tool.

[0024] The next step of the method is to use a subsequent forming tool, for instance the one shown in Figure 7. This tool 90 is inserted into the closure body. However rather than the flange 30 butting up against the shaped feature 91 of the tool, the portion of the wall which is immediately adjacent but axially "behind" this flange 30, that is the portion between the mouth 25 and a point 27 spaced axially from the open end or mouth 25, is forced outwards such that the diameter of this wall is increased.

[0025] Finally, this step is repeated with another tool, such as shown in Figure 8. Again, rather than the flange 30 of the tube being affected it is the wall portion of the tube "behind" the axially furthest portion which is expended that is the portion between the open end 25 and the axially spaced point 27.

[0026] It should be understood that although only two steps have been described above following the initial flange-forming step, there could in fact be only one step, using one forming tool, or indeed more than two steps, using several differently shaped forming tools, before the

final desired profile is reached.

[0027] The progression of expansion of the diameter of the tube may best be seen in Figure 5.

[0028] This figure shows a portion of wall 26. Only one side of the cross-sectional view of the tube is shown as it is symmetrical about the longitudinal axis shown as "X". The wall thickness is exaggerated so that it is indicated by two parallel lines to improve understanding.

[0029] The original shape of the wall is straight without any curve at the right hand end as indicated by reference 45. The portion indicated 50 extending between the mouth 25 at the open end and the axially spaced point 27 shows how the mouth 25 at the open end of the tube has been expanded by the first step, as described above, such that a flange has been formed.

[0030] The portions indicated 60 and 70, also identifying the portion of the tube between the open end and the axially spaced point 27, and show how the tube has been further expanded by means of forming tools such as are shown in Figures 7 and 8. It will be observed that the diameter of the mouth 25 at the open end of the tube remains constant after the initial expansion. Rather it is the portion of the tube axially "behind" this flange up to the point 27 which is expended progressively to the final desired shaped.

[0031] By this progression of shaping of the can body, the flange 30, which is initially distinct from the rest of the tubular sidewalls (Figure 2), and become less distinct and in fact may become indistinguishable from the overall flare (Figure 4). In other words, the flange 30 may merge and become one with the expanded wall portion 70, such that the diameter of the tube increases gradually from a point 27 spaced from the end of the tube towards the mouth 25 at the open end of the tube.

[0032] The resultant flare shape of the closure or can body would typically be formed with the open end lying at an angle which is less than 45 degrees from the longitudinal axis.

[0033] Although in theory, a tube with any wall thickness could be shaped by this method, is advantageously possible to shape tubes with walls of thickness less than 1 mm. This is due to careful design of the flanging and forming tools, the pressure of contact between the tube and the tools, and the sequence of tool shapes utilised. Accordingly, typically relatively thin walled metal tubes, such as found in metal closures or food or drink can bodies, may indeed be shaped this way.

[0034] Further, although tubular walls of less than 1 mm thickness has been quoted, it has been found that the method will also perform well with walls with thickness of less than 0.50mm, and even less than 0.25mm.

[0035] By this method, the diameter of the tube, measured at the distal end, may be increase in a range from 1 to 20% of the original diameter, with the diameter of the portion of the tube immediately behind this distal end also being increased such that the overall diameter of the tube increases gradually from a point axially before the distal end of the tube to a point located at the distal

end of the tube.

[0036] This gradual increase in diameter may be formed over an axial length, measured back from the open end, which is greater than the increase in diameter of the tube. Indeed, the increase in diameter could be achieved over an axial length which is almost equal to the entire length of the tube.

[0037] In another embodiment, a tube could be shaped such that a series of flared profiles are formed axially along the length of the tube. Each profile could have a progressively smaller diameter than the preceding profile so that a set of tubes shaped in this way would be nestable.

[0038] Although the above mentioned method has been described in relation to can bodies or metal closures made from a single flat sheet of metal which has been formed into a tubular shape with an integral closed end, the method could also be applied to tubular bodies in which the sidewall is formed from a single sheet which has been rolled into a tubular shape and then welded along the longitudinal axis.

Claims

1. A method of shaping on open end of a metal tubular body into a flared shape so that the diameter of the tubular body increases gradually from a point axially spaced from the mouth at the open end of the tubular body towards the said mouth itself, the method being **characterised by** comprising the steps of:
 - a. Forming a flange (12; 30; 60) with a flanging tool (80) whereby to increase the diameter of the said mouth at the open end of the tubular body (10; 20; 26) to a desired diameter, and
 - b. After the flange (12; 30; 60) is formed increasing tubular body in the region (50; 60; 70) between the said point and the said mouth using one or more forming tools (90) such that the diameter of the said mouth of the tubular body (10; 20; 26) remains unchanged from the said desired diameter formed in step a.
2. A method according to Claim 1, **characterised in that** wherein one axial end of the tubular body is closed and the other end is open.
3. A method according to Claim 1 or Claim 2, wherein the said flared shape is curved.
4. A method according to Claim 1 or Claim 2, **characterised in that** the said flared shape is straight.
5. A method according to any preceding claim, **characterised in that** wherein the diameter of the tubular body (10; 20; 26) is increased in a range from 1 to 20% of the original diameter.

6. A method according to any preceding claim, **characterised in that** the diameter of the tubular body (10; 20; 26) is increased over an axial length (50; 60; 70) which is greater than the increase in diameter of the tubular body (10; 20; 26) between the said point and the said mouth at the open end of the said tubular body (10; 20; 26).
7. A method according to any preceding claim, **characterised in that** the flared shape of the metal tubular body (10; 20; 26) lies at an angle which is less than 45 degrees from the longitudinal axis thereof.

Patentansprüche

1. Verfahren zum Formen eines offenen Endes eines rohrförmigen Metallkörpers in eine aufgeweitete Form, sodass sich der Durchmesser des rohrförmigen Körpers allmählich von einem Punkt aus vergrößert, der sich axial von der Mündung am offenen Ende des rohrförmigen Körpers in Richtung der besagten Mündung selbst befindet, **dadurch gekennzeichnet, dass** das Verfahren aus folgenden Verfahrensschritten besteht:
 - (a) aus dem Formen eines Flansches (12; 30; 60) mit einem Flanschwerkzeug (80), wodurch der Durchmesser der besagten Mündung am offenen Ende des rohrförmigen Körpers (10; 20; 26) auf einen gewünschten Durchmesser vergrößert wird; und
 - (b) nach dem Formen des Flansches (12; 30; 60) aus der Vergrößerung des rohrförmigen Körpers im Bereich (50; 60; 70) zwischen dem besagten Punkt und der besagten Mündung mit einem oder mehreren Flanschwerkzeugen (90), sodass der Durchmesser der besagten Mündung des rohrförmigen Körpers (10; 20; 26) von dem in Schritt (a) des Verfahrens geformten Durchmessers unverändert bleibt.
2. Verfahren gemäß Anspruch 1, **dadurch gekennzeichnet, dass** ein axiales Ende des rohrförmigen Körpers geschlossen und das andere Ende offen ist.
3. Verfahren gemäß Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die besagte aufgeweitete Form gebogen ist.
4. Verfahren gemäß Anspruch 1, **dadurch gekennzeichnet, dass** die besagte aufgeweitete Form gerade ist.
5. Verfahren gemäß einem der vorhergehenden Ansprüche,

dadurch gekennzeichnet,

dass der Durchmesser des rohrförmigen Körpers (10; 20; 26) um einen Bereich von 1 bis 20 % des ursprünglichen Durchmessers erweitert wird.

6. Verfahren gemäß einem der vorhergehenden Ansprüche,

dadurch gekennzeichnet,

dass der Durchmesser des rohrförmigen Körpers (10; 20; 26) um eine axiale Länge (50; 60; 70) vergrößert wird, was größer ist als die Vergrößerung des Durchmessers des rohrförmigen Körpers (10, 20, 26) zwischen dem besagten Punkt und der Mündung am offenen Ende des besagten rohrförmigen Körpers (10, 20, 26).

7. Verfahren gemäß einem der vorhergehenden Ansprüche,

dadurch gekennzeichnet,

dass die aufgeweitete Form des rohrförmigen Körpers einen Winkel darstellt, der um weniger als 45 Grad von seiner Längsachse abweicht.

5. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le diamètre du corps tubulaire (10 ; 20 ; 26) est augmenté dans une plage de 1 à 20% du diamètre d'origine.

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6. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le diamètre du corps tubulaire (10 ; 20 ; 26) est augmenté sur une longueur axiale (50 ; 60 ; 70) qui est supérieure à l'augmentation de diamètre du corps tubulaire (10 ; 20 ; 26) entre ledit point et ladite embouchure à l'extrémité ouverte dudit corps tubulaire (10 ; 20 ; 26).

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7. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la forme évasée du corps tubulaire métallique (10 ; 20 ; 26) se situe à un angle qui est inférieur à 45 degrés par rapport à l'axe longitudinal dudit corps.

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Revendications

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1. Procédé de mise en forme d'une extrémité ouverte d'un corps tubulaire métallique en une forme évasée, de telle sorte que le diamètre du corps tubulaire augmente graduellement depuis un point axialement distant de l'embouchure à l'extrémité ouverte du corps tubulaire en direction de ladite embouchure elle-même, le procédé étant **caractérisé en ce qu'il** comprend les étapes consistant à :

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a. former une collerette (12 ; 30 ; 60) avec un outil à border (80), afin d'augmenter le diamètre de ladite embouchure à l'extrémité ouverte du corps tubulaire (10 ; 20; 26) à un diamètre souhaité; et

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b. une fois la collerette (12 ; 30 ; 60) formée, agrandir le corps tubulaire dans la région (50 ; 60 ; 70) entre ledit point et ladite embouchure en utilisant un ou plusieurs outils de formage (90), de telle sorte que le diamètre de ladite embouchure du corps tubulaire (10 ; 20 ; 26) reste inchangé par rapport audit diamètre souhaité formé à l'étape a.

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2. Procédé selon la revendication 1, **caractérisé en ce qu'une** extrémité axiale du corps tubulaire est fermée et l'autre extrémité est ouverte.

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3. Procédé selon la revendication 1 ou 2, **caractérisé en ce que** ladite forme évasée est incurvée.

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4. Procédé selon la revendication 1 ou 2, **caractérisé en ce que** ladite forme évasée est rectiligne.

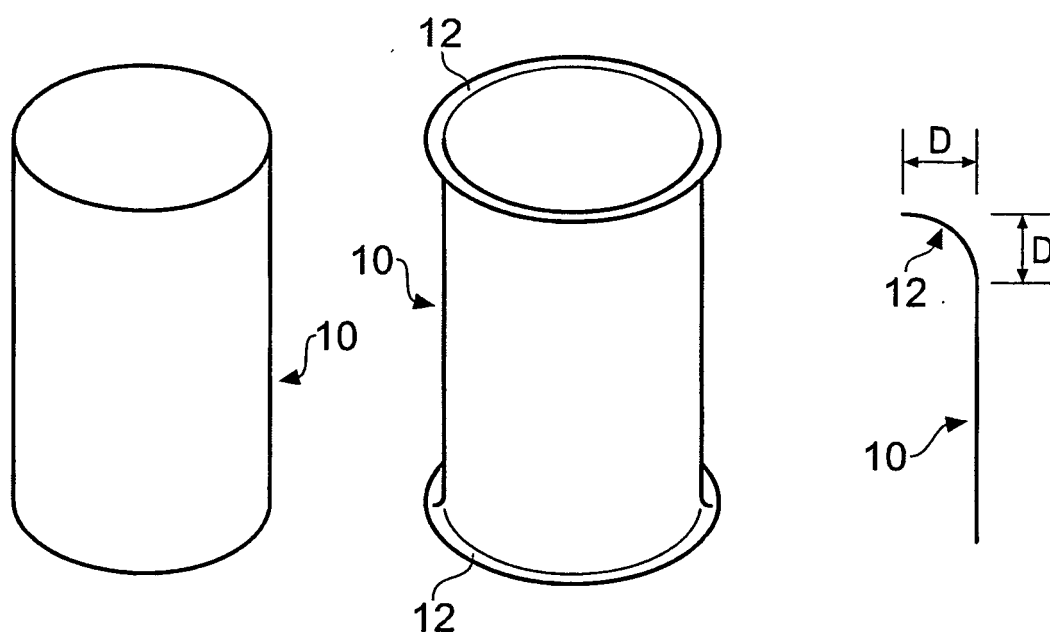


Fig. 1

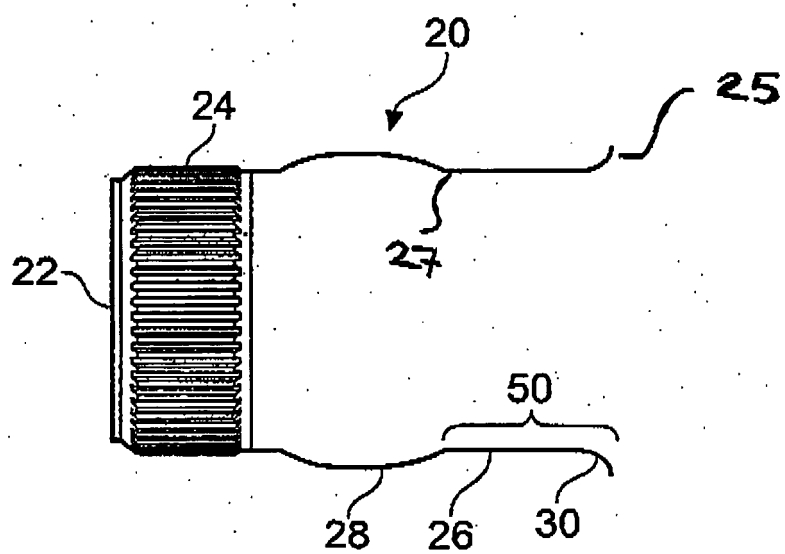


Fig. 2

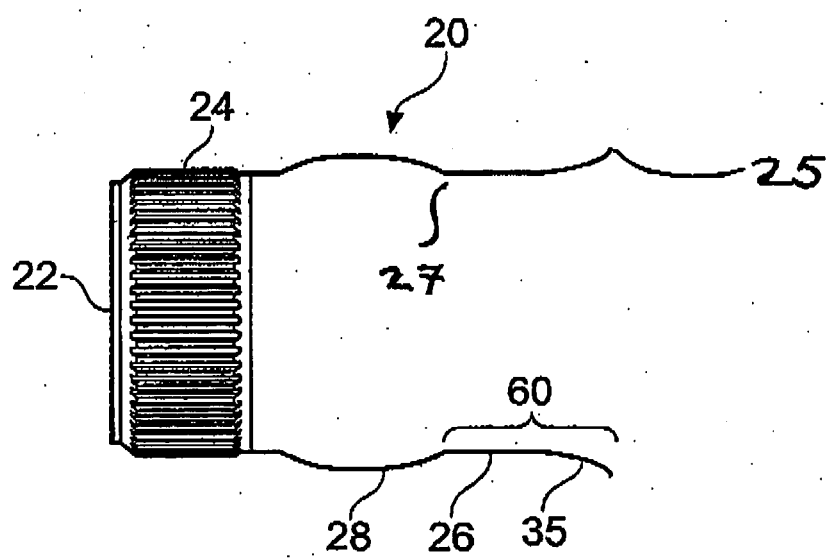


Fig. 3

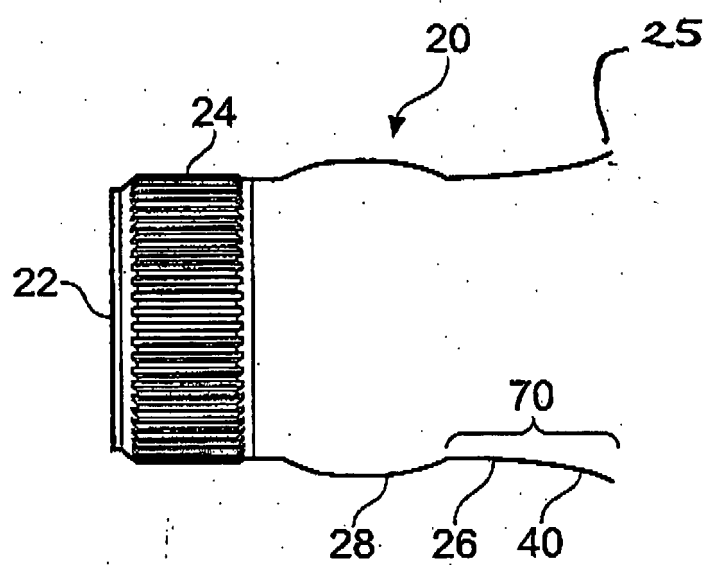


Fig. 4

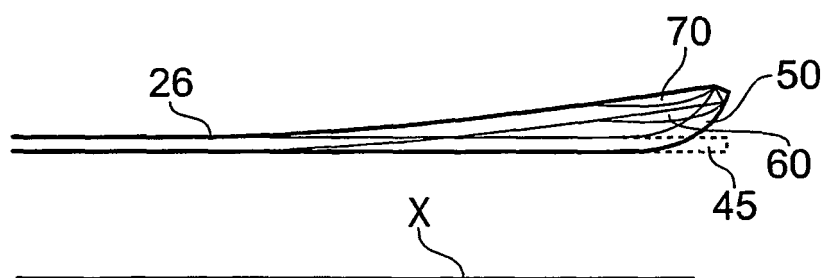


Fig. 5

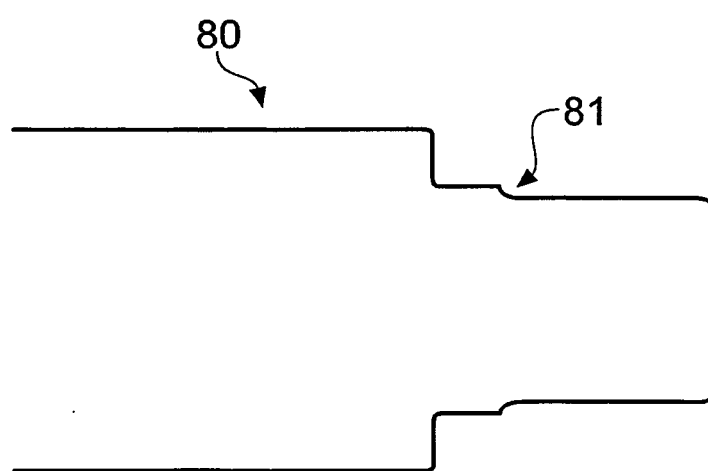


Fig. 6

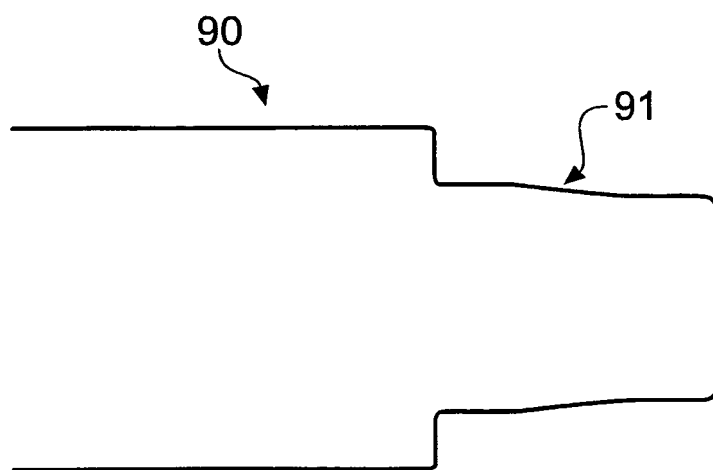


Fig. 7

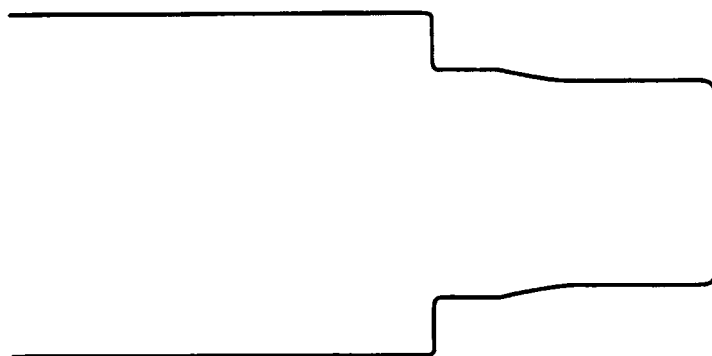


Fig. 8

REFERENCES CITED IN THE DESCRIPTION

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