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GB 2251197 A

(58) Field of Search
UK CL (Edition P) **B3M , B3Q**
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(54) Abstract Title
Deforming cylindrical bodies

(57) Cylindrical bodies such as aluminium cans are deformed to a predetermined configuration by means of tools acting in partnership. One tool is provideed with a relief formation and another has a resiliently deformable outer surface. The tools move about the cylindrical body 1 in partnership, one internally of the cylinder and the other externally of the cylinder such that the relief formation tool 14 presses into and deforms the cylinder material causing corresponding deformation of the resiliently deformable forming surface of the other tool 16. The technique is particilarly suited to producing threaded necks and the like for aluminium cans particularly to avoid damage to internal protective coatings applied to the can.

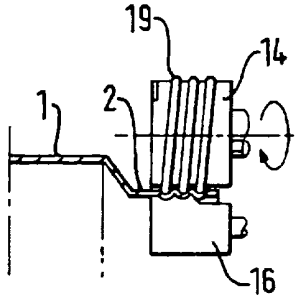

FIG. 4a

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1995

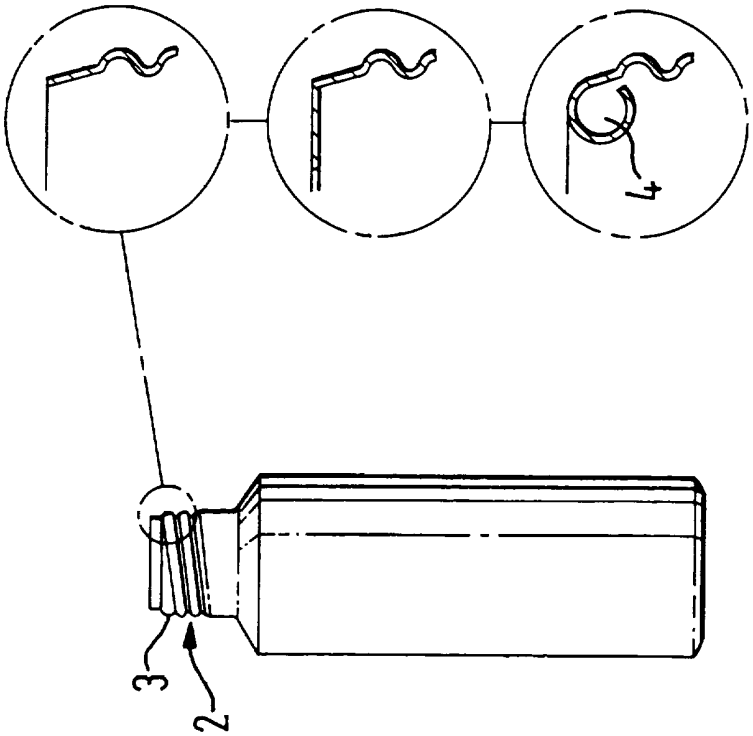

FIG.3

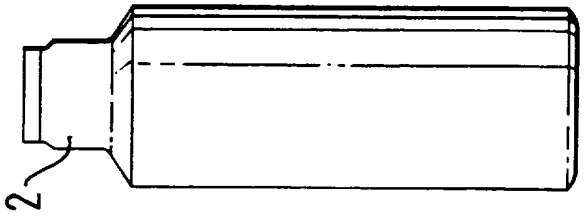

FIG.2

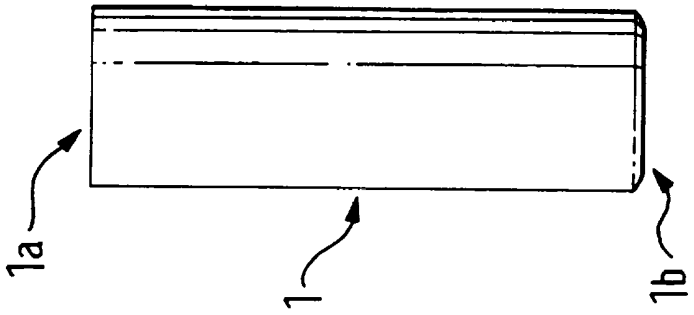

FIG.1

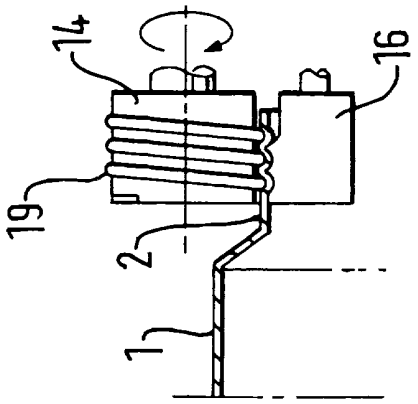

FIG. 4a

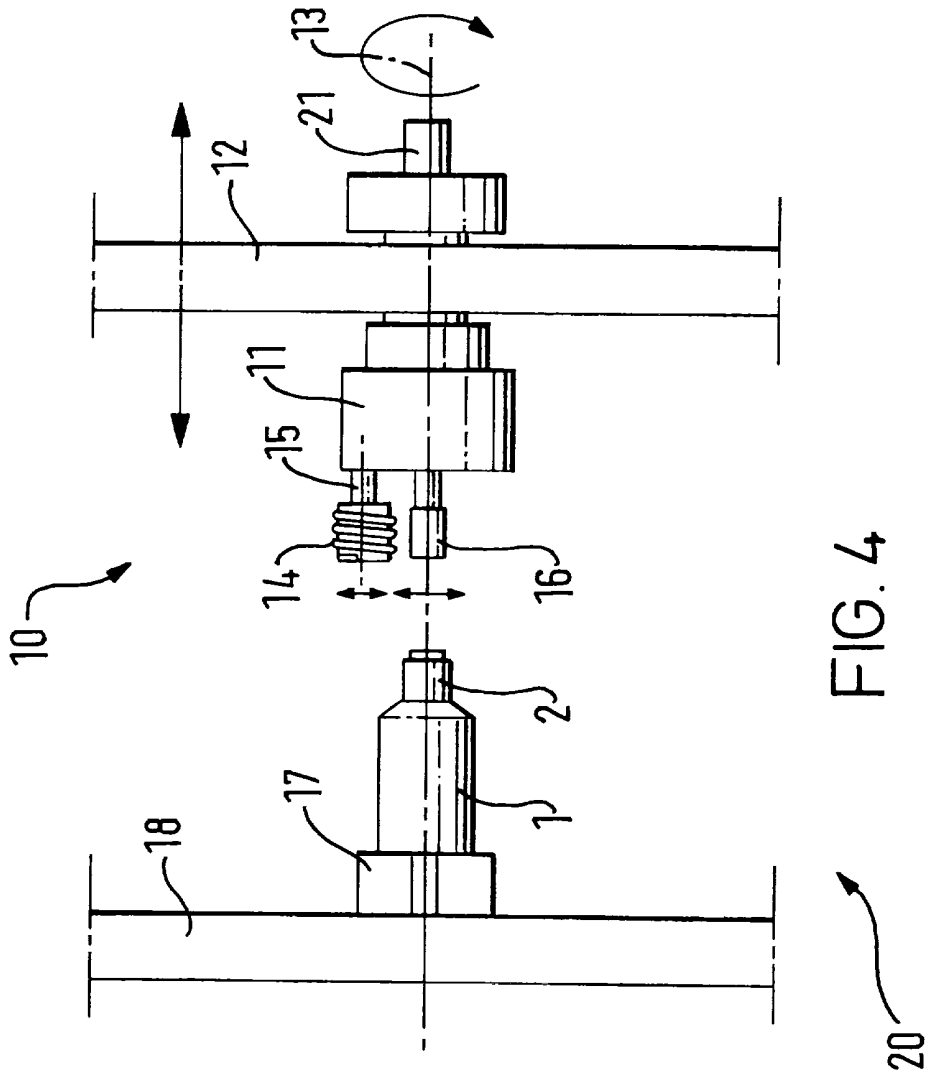

FIG. 4

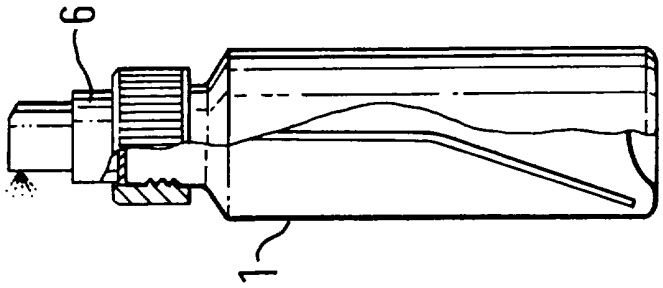

FIG.6b

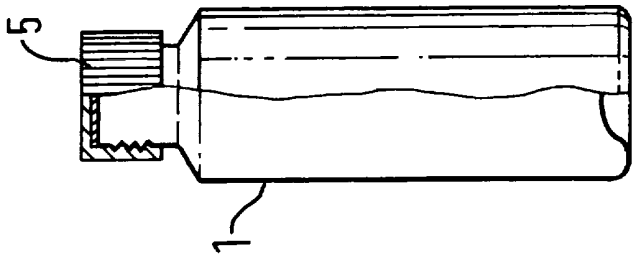

FIG.6a

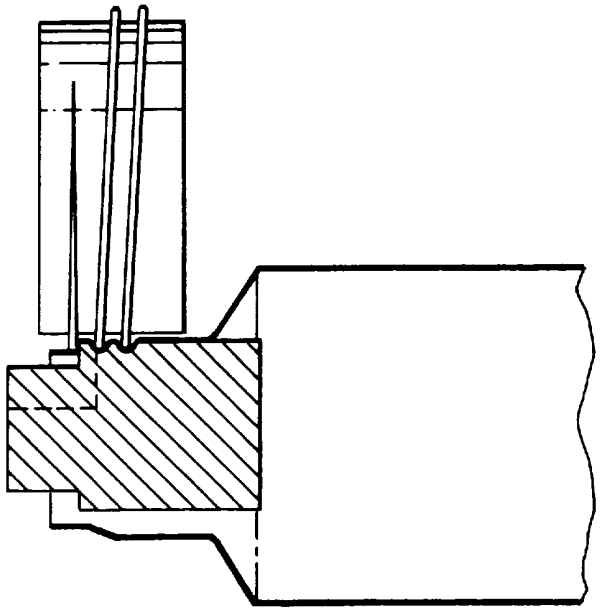

FIG.5

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Deforming Cylindrical Bodies

The present invention relates to deforming of cylindrical bodies, and in particular apparatus for deforming cylindrical bodies according to a predetermined configuration to provide a relief feature such as, for example, a screw thread.

Cylindrical bodies such as thin walled metallic containers frequently have relief formations applied. For example a screw thread may be applied to the neck of a metallic container, the screw thread being arranged to mate with a complementarily threaded fitting (such as, for example, a cap or pump dispenser fitment).

In the production of extruded cylindrical aluminium containers, which are widely used for containing beauty, haircare and bathroom products, it has become desirable to produce a screw thread on a neck portion of the container for the reasons mentioned. Typically, the container is first provided with a varnish layer on the interior surfaces thereof in order to prevent the container contents from contacting and reaction with the interior aluminium surface of the container. In such circumstances, it is important that the varnish layer is not damaged when rolling the thread on the container neck.

US-A-5293765 discloses apparatus for use in rolling a thread on a cylindrical aluminium container. The apparatus comprises an internal tool which is positioned within the neck of the container, and an external thread rolling tool positioned externally of the container neck. Both tools are provided with threadform formations, and are guided to move in partnership about the container neck to produce the thread. In order to ameliorate damage to the internal varnish layer, the tools are guided so that a slippage occurs between the can neck and the tools. It is therefore extremely important that the external and

internal tools are guided to move in a predetermined manner. It is also important that the threadforms on the internal and external tools are aligned accurately with one another before, during and after each threadforming operation.

Improved apparatus has now been devised.

According to a first aspect, the invention provides apparatus for deforming cylindrical bodies according to a predetermined configuration, the apparatus comprising:

a) a first tool provided with a relief formation for deforming the material of the cylindrical body;

b) a second tool having a resiliently deformable forming surface;

c) co-ordinating means for coordinating the movement of the first and second tools to move about the cylindrical body in partnership, one internally of the cylinder and the other externally of the cylinder such that the first tool presses into and deforms the cylinder material causing corresponding deformation of the resiliently deformable forming surface of the second tool.

As the tools move about the cylindrical body in partnership, they are clamped in register with the external and internal surfaces of the cylinder. The apparatus therefore preferably comprises clamping means which may comprise the co-ordinating means.

The co-ordinating means preferably comprises an arrangement for driving the tools concurrently to follow a circular path.

According to a second aspect, the invention provides a method for deforming cylindrical bodies according to a predetermined configuration, the method comprising:

clamping a wall portion of the cylindrical body between first tool provided with a relief formation for deforming the material of the cylindrical body and a second tool having a resiliently deformable forming surface; and

driving the first and second tools to move about the cylindrical body in partnership, one internally of the cylinder and the other externally of the cylinder such that the first tool presses into and deforms the cylinder material causing corresponding deformation of the resiliently deformable forming surface of the second tool.

Desirably, the first tool comprises the external tool, the second tool comprising the internal tool.

Advantageously, the external tool comprises a rotatable element (preferably a roller) arranged to rotate about an axis. The relief formation is preferably provided on the circumferential surface of the rotatable element. In one embodiment the external tool is arranged to be substantially freely rotatable about its rotational axis such that the tool is substantially free rolling as the co-ordinating means drives the tools about the cylinder.

In an alternative embodiment, the external tool is arranged to be driven rotate about its rotational axis such that the tool is forcibly rolled as the co-ordinating means drives the tools about the cylinder.

In a preferred embodiment the coordinating means comprises a carrier arranged to carry the external and internal tools, the carrier being rotatable about an axis of rotation thereby to drive the outer tool and inner tool concurrently to follow a circular path. In this embodiment the outer tool is preferably rotatably carried on a spindle spaced from the inner tool, clamping means being provided to adjust the separation of the outer and inner tools to clamp the cylindrical body therebetween. The inner tool is preferably mounted relative to the carrier so as not to be rotatable relative thereto.

It is preferred that the first tool comprises metal typically steel, most preferably tool steel. Desirably the relief formation stands proud of the remainder of the forming surface of the first tool. The relief formation is preferably threadform arranged to deform the cylinder material to produce a screw thread when the apparatus is operated.

The resiliently deformable forming surface of the second tool is preferably arranged to be resiliently deformed from an undeformed, normal state in response to the action of the first tool. The resiliently deformable forming surface of the second tool is arranged to resiliently revert to its undeformed, normal condition when the compressive influence of the first tool is relaxed.

Advantageously, in the undeformed condition, the resiliently deformable forming surface of the second tool is generally circular in outer surface profile, preferably being substantially cylindrical, or more preferably slightly frustoconical.

The resiliently deformable forming surface of the second tool preferably comprises a resilient material, preferably an elastomer material, polyurethane rubber or the like having good hardness, wear and resilience characteristics particularly under compression. A particularly suitable material for use has been found to be a polyurethane rubber commercially available under the trade name ADIPRENE; this has been found to have an advantageously rapid response time for the deformed forming surface returning to the undeformed condition, which is required for the short duration of the operation cycle between successive forming operations. In a preferred embodiment the second tool preferably comprises a body of such resiliently deformable material.

The apparatus preferably comprises a forming station of a multi-station forming apparatus in which other stations are arranged to perform different forming operations on the cylinder. Other forming stations are advantageously arranged to perform one or more functions such as necking or cutting to length.

It is preferred that the apparatus is operable to impart a thread onto the cylinder which thread is preferably arranged to mate with a complementarily threaded cap closure or other fitting encompassing the threaded portion of the cylinder.

The cylinder is preferably a can or other container, advantageously formed to have a neck portion provided with the deformation of predetermined configuration (for example the thread). The cylinder, can or other container is preferably thin walled and advantageously of metallic construction.

The invention is particularly suited to the production of thin walled aluminium cans having a screw threaded neck portion now becoming more prevalent for connection to screw threaded pump dispensers for dispensing hair care, body and beauty products. Such cans are typically provided with an internal protective coating (such as a lacquer or the like) to prevent the can contents from contacting (and possibly corroding) the can wall. In forming the thread or other deformation configuration, it is important to avoid damaging the internal protective coating. Because the internal tool can be made of relatively soft, non-abrasive deformable material damage is ameliorated.

A further significant advantage over known apparatus is that minimal coordination between the tools is needed for them to act in partnership.

The invention will now be further described in a specific embodiment by way of example only and with reference to the accompanying drawings, in which:

Figures 1 to 3 show successive stages in production of a threaded container;

Figure 4 is a schematic view of apparatus according to the invention;

Figure 4a is a schematic view of the apparatus of Figure 4 in use in rolling a thread on a cylindrical body;

Figure 5 is a view similar to Figure 4a; and

Figures 6a and 6b are side views of cylindrical containers provided with threaded necks mating with alternative complementarily threaded fitments.

Referring to the drawings and as shown in Figures 1 to 3, a thin walled aluminium container 1 is formed, on a production line, from a circular disc-like blank (not shown) which is stamped using known technology to form an elongate thin walled container 1 which is open at one end 1a and closed at its other end 1b. The internal surface of container 1a is sprayed with a protective varnish/lacquer coating which is cured and the exterior surface of the container is typically painted with indicia identifying the ultimate contents of the container. The container is then in the condition shown in Figure 1.

The container 1 is next passed to a multi-station forming machine 20 in which the closed base 1b of the container is clamped in a clamping station 17. The multi-station forming machine 20 typically comprises a vertically orientated carousel 18 having a number of clamping stations 17 arranged peripherally thereabouts, each clamping station 17 being arranged to clamp a respective container 1. The rotatable carousel 18 is incrementally rotated about its horizontal axis such that clamped containers 1 are indexed between a number of forming stations; a first series of forming stations is arranged to incrementally deform the open end 1a of container 1 to form a neck portion 2. Following this the containers are indexed to a threadforming station 10 in which the screw thread 3 is rolled on the container neck 2 (Figure 3). Finally, the container is indexed to a station where the waste material at end 1a is paired off and/or a lip 4 is formed.

As shown in Figure 6, the purpose of rolling a thread on the neck portion 2 of container 1 is such that a closure cap 5 or pump dispenser fitment 6 can be fitted to the container.

As shown in Figures 4, 4a and 5 the thread rolling apparatus generally designated 10 comprises a carrier 11 mounted to a support plate 12 so as to be rotatable on a shaft 21 about an axis 13. Driving means (not shown) is provided for rotatably driving shaft 21 such that carrier 11 is driven to rotate about axis 13.

Carrier 11 carries an outer thread roll tool 14 mounted to be rotatable on a drive spindle 15, and an internal tool 16 arranged to be advanced into the interior of the neck 2 of container 1 which is clamped within clamping station 17 of the rotatable carousel 18. The external thread rolling tool 14 comprises a roller provided with a raised threadform profile 19, formed of tool steel. The internal tool 16 is not rotatable relative to carrier 11 and comprises a substantially cylindrical block having a slight frustoconical surface taper, the block 16 being formed of a wear resistant, resilient elastomer polyurethane rubber commercially available under the trade designation ADIPRENE.

In operation, with tools 14 and 16 relatively spaced apart, support plate 12 carrying thread forming station 10 is advanced toward carousel 18 such that tool 16 is introduced into the interior of neck 2 of container 1. Tools 14 and 16 are then brought together to clamp neck 2 therebetween. In bringing together tools 14 and 16 to clamp neck 2, the threadform relief 19 of external thread roll tool 14 presses into and deforms the relevant portion of the neck 2 causing corresponding deformation of the outer resilient surface of the tool 16 (this is best shown in Figures 4a and 5). With tools 16 and 14 in the clamped position, carrier 11 is rotated about axis 13, with container 1 being held in a fixed position. In so doing external thread rolling tool 14 is co-ordinated to roll on the exterior of neck 2 about substantially the entire circumferential surface thereof, simultaneously block 16 is tracked correspondingly about the internal circumferential surface of neck 2. The resilient block comprising internal tool 16 effectively acts as a support for neck 2 as the threadform formations 19 are impressed upon the neck by external thread roll tool 14 as carrier 11 is rotated about axis 13. The polyurethane rubber block comprising tool 16 has a substantially cylindrical outer surface which is deformed to conform to the configuration produced by the external thread rolling tool 14 on can neck 2. Tools 14 and 16 move about the periphery of neck 2 in partnership such that where the threadform profile engages the outer surface of neck 2, the inner tool 16 supports the corresponding inner surface portion of the neck.

Following rolling of the thread, the tools 14,16 are separated from their clamping position, and the outer surface profile of tool 16 returns to its normal, undeformed condition. The tools 14,16 are then retracted away from the open end of neck 2 which is now provided with the required threadform. The diameter of internal tool 16 is less than the internal diameter of the neck 2 (both before and after thread rolling) permitting insertion and retraction of tool 16 into, and out of, neck 2.

Because the internal tool 14 is of resilient, low abrasion material, damage to the varnish coating on the interior 1 of the container is minimised. Furthermore, because no lubrication is needed for the internal tool, no subsequent degreasing of the interior of the container in the region of the thread 3 is necessary. When the tools 14,16 are moved away from the clamping position, the outer surface of tool 16 reverts resiliently to its normal condition at a rapid rate permitting retraction of the tool 16 from the neck 2, and subsequently re-entry into the undeformed neck of the next container to be indexed to the threadforming station 10. The use of a "shape memory" elastomer having good hardness and rapid resilience properties is important because typically, in the region of 150 containers per minute will be passing through threadforming station 10.

A further important advantage of utilising an internal tool 16 having a resilient forming surface is that minimal co-ordination is required between the external tool and the internal tool 16. This is because internal tool 16 does not have a permanent rigid threadform formation defined on its working surface which needs to be accurately co-ordinated with the threadform relief 19 of the external tool 14. The arrangement shown for example in US-A-529365 requires a relatively complex gearing and drive arrangement to ensure accurate co-ordination of tools such that the threadform relief on the external and internal tools are aligned before, during and after the thread rolling operation.

The invention is particularly suited to the production of thin walled threaded aluminium containers, because the material of the container is relatively easily deformed and the resilient internal tool is of sufficient hardness to support the neck during the thread rolling operation.

Claims:

1. Apparatus for deforming cylindrical bodies according to a predetermined configuration, the apparatus comprising:
   a) a first tool provided with a relief formation for deforming the material of the cylindrical body;
   b) a second tool having a resiliently deformable forming surface;
   c) co-ordinating means for coordinating the movement of the first and second tools to move about the cylindrical body in partnership, one internally of the cylinder and the other externally of the cylinder such that the first tool presses into and deforms the cylinder material causing corresponding deformation of the resiliently deformable forming surface of the second tool.

2. Apparatus according to claim 1, comprising clamping means arranged to clamp the tools in register with respective external and internal surfaces of the cylinder as the tools move about the cylindrical body in partnership.

3. Apparatus according to claim 1 or claim 2, wherein the co-ordinating means comprises an arrangement for driving the tools concurrently to follow an arcuate path.

4. Apparatus according to any preceding claim, wherein the first and second tools are drivable to move about the cylindrical body in partnership, one internally of the cylinder and the other externally of the cylinder such that the first tool presses into and deforms the cylinder material causing corresponding deformation of the resiliently deformable forming surface of the second tool.

5. Apparatus according to claim 4, wherein the external tool comprises a rotatable element arranged to rotate about an axis.

6. Apparatus according to any preceding claim, wherein the relief formation is provided on the circumferential surface of the rotatable element.

7. Apparatus according to any of claims 4 to 6, wherein the external tool is substantially freely rotatable about its rotational axis such that the tool is substantially free rolling as the co-ordinating means drives the tools about the cylinder.

8. Apparatus according to any of claims 4 to 6, wherein the external tool is arranged to be driven rotate about its rotational axis such that the tool is forcibly rolled as the co-ordinating means drives the tools about the cylinder.

9. Apparatus according to any of claims 4 to 8, wherein the coordinating means comprises a carrier arranged to carry the external and internal tools.

10. Apparatus according to claim 9, wherein the carrier is rotatable about an axis of rotation thereby to drive the outer tool and inner tool concurrently to follow a circular path.

11. Apparatus according to any of claims 4 to 10, wherein the the outer tool is rotatably carried on a spindle spaced from the inner tool, clamping means being provided to adjust the separation of the outer and inner tools to clamp the cylindrical body therebetween.

12. Apparatus according to any of claims 9 to 11, wherein the inner tool is mounted relative to the carrier so as not to be rotatable relative thereto.

13. Apparatus according to any preceding claim, wherein the first tool comprises a metallic material.

14. Apparatus according to any preceding claim, wherein the relief formation stands proud of the remainder of the forming surface of the first tool.

15. Apparatus according to any preceding claim, wherein the relief formation is threadform, arranged to deform the cylinder material to produce a screw thread when the apparatus is operated.

16. Apparatus according to any preceding claim, wherein the resiliently deformable forming surface of the second tool is arranged to be resiliently deformed from an undeformed, normal state in response to the action of the first tool.

17. Apparatus according to any preceding claim, wherein the resiliently deformable forming surface of the second tool is arranged to resiliently revert to its undeformed, normal condition when the compressive influence of the first tool is relaxed.

18. Apparatus according to any preceding claim, wherein in the undeformed condition, the resiliently deformable forming surface of the second tool is generally circular in outer surface profile.

19. Apparatus according to any preceding claim, wherein in the undeformed condition, the resiliently deformable forming surface of the second tool is generally frustoconical in outer surface profile.

20. Apparatus according to any preceding claim, wherein the resiliently deformable forming surface of the second tool comprises a resilient material (such as an elastomer material, polyurethane rubber or the like) having good hardness, wear and resilience characteristics.

21. Apparatus according to claim 21, wherein the second tool preferably comprises a body of resiliently deformable material.

22. multi-station forming apparatus comprising a station including apparatus according to any preceding claim, and one or more additional forming stations arranged to perform one or more different forming operations on the cylinder.

23. Apparatus according to claim 22, wherein the one or more additional forming stations is/are arranged to perform one or more functions such as necking or cutting to length of the cylinder.

24. A method for deforming cylindrical bodies according to a predetermined configuration, the method comprising:

a) clamping a wall portion of the cylindrical body between first tool provided with a relief formation for deforming the material of the cylindrical body and a second tool having a resiliently deformable forming surface; and

b) driving the first and second tools to move about the cylindrical body in partnership, one internally of the cylinder and the other externally of the cylinder such that the first tool presses into and deforms the cylinder material causing corresponding deformation of the resiliently deformable forming surface of the second tool.

25. A method for imparting a screw thread to an open end of a cylindrical aluminium container comprising the method of claim 24, wherein the relief formation of the first tool comprises a screw thread imparting relief formation.

26. Apparatus substantially as herein described with reference to the accompanying drawings.

27. A method substantially as herein described with reference to the accompanying drawings.

The Patent Office

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Application No: GB 9722176.6
Claims searched: All claims

Examiner: A.R.Martin
Date of search: 22 July 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): B3M,B3Q

Int Cl (Ed.6): B21H 3/00

Other: On line databases WPI,EDOC,JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB2251197 A CMB Foodcan see page 16 paragraph 2	Claims 1 and 22 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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