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The present invention relates to a method and apparatus for forming a base on a tubular container.

Numerous such methods are known. For example, it is known in the manufacture of aluminium and tin cans to form the base onto the tubular container by rolling adjacent edge flanges into interlocking engagement. In plastic tubes and containers, it is known to mould the base from a similar material, and then to glue the base onto the tube. It is also known to glue plastic bases onto laminated cardboard tubes, and the like.

In all such prior art methods, however, a number of discrete process steps are required first to form the base itself, and then to secure the base to the tube. As is well known by those skilled in the art, excessive process steps of this nature substantially increase the costs of production and capital equipment, and lead to reduced reliability and increased maintenance of equipment and process lines. This is particularly undesirable in high rate production applications.

It is therefore an object of the present invention to provide an improved method and/or apparatus which overcomes or substantially ameliorates at least some of the shortcomings of these prior art.

Accordingly, in a first aspect, the invention provides an apparatus for forming a base on a tubular container, said apparatus comprising a die, a punch plate having an aperture defining an open end of said die, a punch co-operable with said punch plate and said die,



transport means to feed a strip of thermoplastic material between said punch and said punch plate, heating means to heat the thermoplastic material, and locating means to locate the container such that one end extends marginally into said die, the punch being selectively operable in a single stroke to shear off a slug of said material by forcing said strip against said plate and to punch the slug through the aperture into forming engagement with the die such that a peripheral edge of the slug is thermoplastically bonded to the exposed end of the container within the die to form said base.

Preferably, the transport means is disposed to feed the strip of hot thermoplastic material directly from an extrusion die to minimise the extent of intermediate cooling and thereby obviate the need for a separate heating step. In one embodiment, the extrusion die itself constitutes the transport means.

Preferably, the apparatus includes a vent to direct air from the die cavity during the punching cycle.

Preferably also, the apparatus further includes ejection means disposed to direct pressurised gas between the base and the die upon withdrawal of the punch to eject the container.

The punch and die are preferably liquid cooled to minimise cycle time.

In the preferred embodiment, the locating means comprises an inner shell and a complementary outer shell disposed respectively to provide inwardly and outwardly



directed radial support for the side walls of the container during the forming process. One of the shells preferably incorporates abutment means to locate the remote end of the tube and thereby determine the extent to which the exposed end extends into the die. The abutment means is preferably adjustable to accommodate tubular containers of different length. In the preferred embodiment, the abutment means comprises an annular shoulder formed on the inner shell.

10 According to a second aspect, the invention provides a method of forming a base on a tubular container, said method comprising the steps of locating the container such that one end extends marginally into a die, heating a strip of thermoplastic material, feeding
15 the strip of thermoplastic material between a punch and a punch plate having an aperture defining an open end of said die, shearing off a slug of said material by forcing said strip against said plate, and punching said slug through said aperture into forming engagement with said
20 die such that a peripheral edge of the slug is thermoplastically bonded to the exposed end of the container within the die to form said base.

A preferred embodiment of the invention will now be described, by way of example only, with reference to the
25 accompanying drawings in which:-

Figure 1 is a cross sectional side elevation showing an apparatus according to the invention; and

Figure 2 is a cross sectional view similar to



Figure 1 incorporating a pair of die assemblies disposed to shuttle beneath the punch.

Figure 3 is a cross sectional view showing a tubular container incorporating a base formed in accordance with the method and apparatus of the invention.

Referring firstly to Figure 1, the invention provides an apparatus 1 for forming a base 2 on a tubular container 3 as shown in Figure 3. The apparatus comprises a die 5 partially defined by a die face 6, and a fixed punch plate 7 having an aperture 8 defining an open end of the die. A punch 10 is selectively operable by means of a conventional hydraulic, pneumatic or mechanical actuator (not shown) to co-operate with the punch plate and the die.

The apparatus further includes locating means 12 in the form of respective inner and outer shells 14 and 15. The shells together define an intermediate radial clearance space adapted nestingly to accommodate the tubular container 3 and thereby provide radial support during the base forming process. The terminal end of the inner shell 14 opposite the punch forms the die face 6. The remote end of the inner shell incorporates abutment means in the form of an annular shoulder 20 to locate the remote end of the tube. The inner and outer shells and associated shoulder 20 are disposed to locate the tubular container such that an exposed end 21 extends marginally into the die cavity by several millimeters.

The apparatus further includes an extrusion die





(not shown) located above the punch 10 to feed a strip or ribbon 22 of hot thermoplastic material downwardly between the punch plate 7 and the punch 10.

Turning now to describe briefly the operation of the apparatus, a tubular body or container 3 is first loaded between the inner and outer supporting shells such that the exposed marginal end 21 extends into the die cavity. A ribbon 22 of hot thermoplastic material is then extruded and progressively fed downwardly between the punch 10 and the punch plate 7. The strip 22 is fed directly from the extrusion die through the forming apparatus so that the thermoplastic material disposed adjacent the die is at an appropriate temperature for the subsequent forming operations, without the need for a separate heating step.

At the desired time, the punch is moved through the punch plate to shear off a slug of the hot material. Further movement of the punch forces the slug through the aperture 8 and into forming engagement with the lower die face 6, at which stage the punch face effectively closes the die. Whilst the slug is being driven into the die, the die cavity is vented through passages 25 in the punch 10 to prevent unintentional distortion of the hot plastic during the forming process. Application of further forming pressure by the punch causes the peripheral edge of the slug to be thermoplastically bonded to the exposed end 21 of the container within the die, in order to form the base 2. As best seen in Figure 3, the die cavity is



configured such that the exposed end of the can is sandwiched between respective inner and outer lips 32 and 33 of plastic material to ensure maximum mechanical and thermoplastic bonding and an air-tight seal.

Once the base has been formed, the punch is retracted and the shell assembly 14 and 15 moved from beneath the punch. The container incorporating the freshly moulded base is then ejected from the supporting shells by compressed air injected between the die face and the base through passage 25. The cycle is then repeated.

During the forming cycles, coolant is directed through the punch through cooling passages 30. This prevents overheating of the punch head, minimises cycle time, and permits increased control over the temperature of the thermoplastic material during the forming process. Similarly, coolant may be directed through the inner and/or outer supporting shells 14 and 15 through appropriate cooling passages if required.

In the embodiment of Figure 2, a pair of die and shell assemblies are disposed to shuttle beneath the punch. This arrangement permits the tube to be loaded from a magazine into the free die, whilst the punch forms the base in the operative die. The positions are then alternated permitting the tube incorporating the newly formed base to be ejected whilst a base is simultaneously formed on the tube in the other die. In other embodiments, a rotary barrel supporting an array of die



stations may be provided.

It will be appreciated that in accordance with the present method, the base is punched, transported into the die cavity, and formed onto the container in a single punch stroke. This minimises heat loss, reduces the force required to forge the hot slug, minimises the chance of flash within the die, obviates the need for intermediate heating steps, and substantially simplifies the forming procedure. Thus, the invention represents a commercially significant improvement over the prior art.

Although the invention has been described with reference to a specific example, it will be appreciated that the invention may be embodied in many other forms.



Claims: -

1. Apparatus for forming a base (2) on a tubular container (3), the apparatus comprising a die (5), a punch plate (7) having an aperture (8) defining an open end of the die (5), a punch (10) co-operable with the punch plate (7) and the die (5), transport means for feeding a strip (22) of thermoplastic material between the punch (10) and the punch plate (7), heating means for heating the thermoplastic material, and locating means (12) for locating the container (3) such that one end extends marginally into the die (5), the punch (10) being operable in a single stroke to shear off a slug of the material by forcing the strip (22) against the punch plate (7) and to punch the slug through the aperture (8) into forming engagement with the die (5) such that a peripheral edge of the slug is thermoplastically bonded to the exposed end of the container (3) within the die (5) to form the base (2).

2. Apparatus according to claim 1, wherein the transport means is disposed to feed the strip (22) of thermoplastic material directly from an extrusion die.

3. Apparatus according to claim 2, wherein the extrusion die feeds the thermoplastic material directly between the punch (10) and the punch plate (7) and thereby constitutes the said transport means.

4. Apparatus according to any preceding claim, further including a vent (25) to direct air from the die





cavity during the punch stroke.

5. Apparatus according to any preceding claim, further including ejection means disposed to direct pressurised gas between the base and the die upon withdrawal of the punch to eject the container.

6. Apparatus according to any preceding claim, wherein the locating means (12) comprises an inner shell (14) and a complementary outer shell (15) disposed respectively to provide inner and outer support for the side walls of the tubular container (3) during the forming process.

7. Apparatus according to claim 6, further including abutment means (20) for locating the remote end of the tubular container (2) and thereby determine the extent to which the exposed end extends into the die (5).

8. Apparatus according to claim 7, wherein the abutment means (20) is adjustable to permit selective variation of the extent to which the exposed end extends into the die (5) and to accommodate tubular containers (3) of different lengths.

9. Apparatus according to claim 7 or 8, wherein the abutment means comprises a shoulder (20) formed on the inner shell (14).

10. Apparatus according to any of claims 6 to 9, wherein the proximal end of the inner shell (14) opposite the punch (10) defines one face (6) of the die





(5), and the punch (10) defines a corresponding opposite face of the die (5).

11. Apparatus according to any preceding claim, wherein the die (5) is configured such that the exposed end of the container (3) within the die (5) is sandwiched between respective inner and outer lips (32, 33) of thermoplastic material associated with the base (2) to enhance mechanical engagement and thermoplastic bonding between the container (3) and the base (2).

12. Apparatus according to any preceding claim, further including cooling means to direct coolant through the punch (10) or the die (5).

13. Apparatus according to claim 12 when dependent on claim 6, wherein the cooling means is further adapted to direct coolant through at least one of the inner and outer supporting shells (14, 15).

14. Apparatus according to any preceding claim, including a pair of the said dies (5) disposed to shuttle beneath a single punch (10), thereby permitting one container (3) to be loaded into a first one of the dies (5), whilst the punch (10) forms a base (2) on the container (3) in a second one of the dies (5), whereby alternation of positions permits the container (3) incorporating the newly formed base (2) to be ejected from the second die (5) whilst a base (2) is simultaneously formed on the container (3) in the first





die (5).

15. Apparatus according to any preceding claims, further including a rotary barrel supporting an array of the said dies (5) operable sequentially with one or more punches (10).

16. A method of forming a base (2) on a tubular container (3), the method comprising the steps of locating the container such that one end extends marginally into a die (5), heating a strip (22) of thermoplastic material, feeding the strip (22) of thermoplastic material between a punch (10) and a punch plate (7) having an aperture (8) defining an open end of the die (5), shearing off a slug of the said material by forcing the strip (22) against the plate (7), and punching the slug through the aperture (8) into forming engagement with the die (5) such that a peripheral edge of the slug is thermoplastically bonded to the exposed end of the container (3) within the die (5) to form the base (2).

17. A method according to claim 16, including the further steps of loading a tubular container (3) from a magazine into a first die (5), whilst simultaneously forming a base (2) on another tubular container (3) in a second die (5), alternating the positions of the first and second dies (5), and ejecting the other container (3) incorporating the newly formed base (2) whilst simultaneously forming a base (2) on the container (3) in the first die (5) by means of the same punch (10).

