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Franek et al.

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[54] **MAKING CAN BODIES**

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[52] **U.S. Cl.** ..... **113/1 G,** 113/120 AA, 72/94

[51] **Int. Cl.** **B21d 19/06**

[58] **Field of Search** ..... 113/1 G, 120 H, 120 AA; 72/348, 91, 94, 107, 108, 109, 111, 105

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[57] **ABSTRACT**

A metal can body is given an end neck by a two stage process in which it is first flanged, and then has the neck formed immediately behind and merging with the flange by a spinning (rolling) process in which the flange is itself reduced in diameter.

11 Claims, 8 Drawing Figures

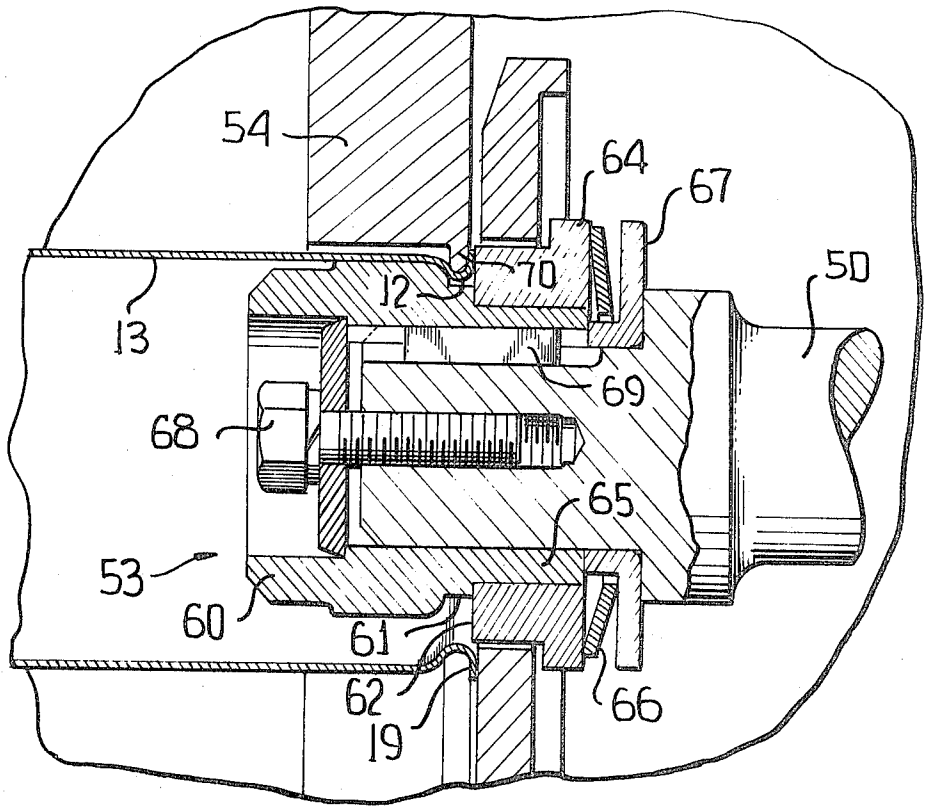


FIG. 1

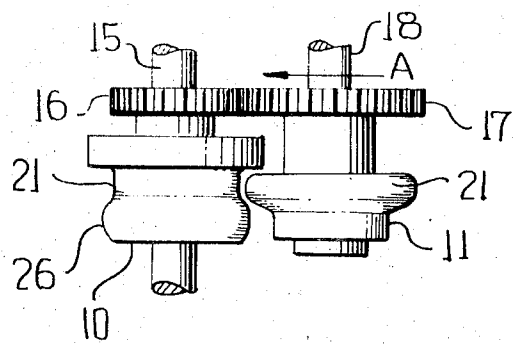


FIG. 2

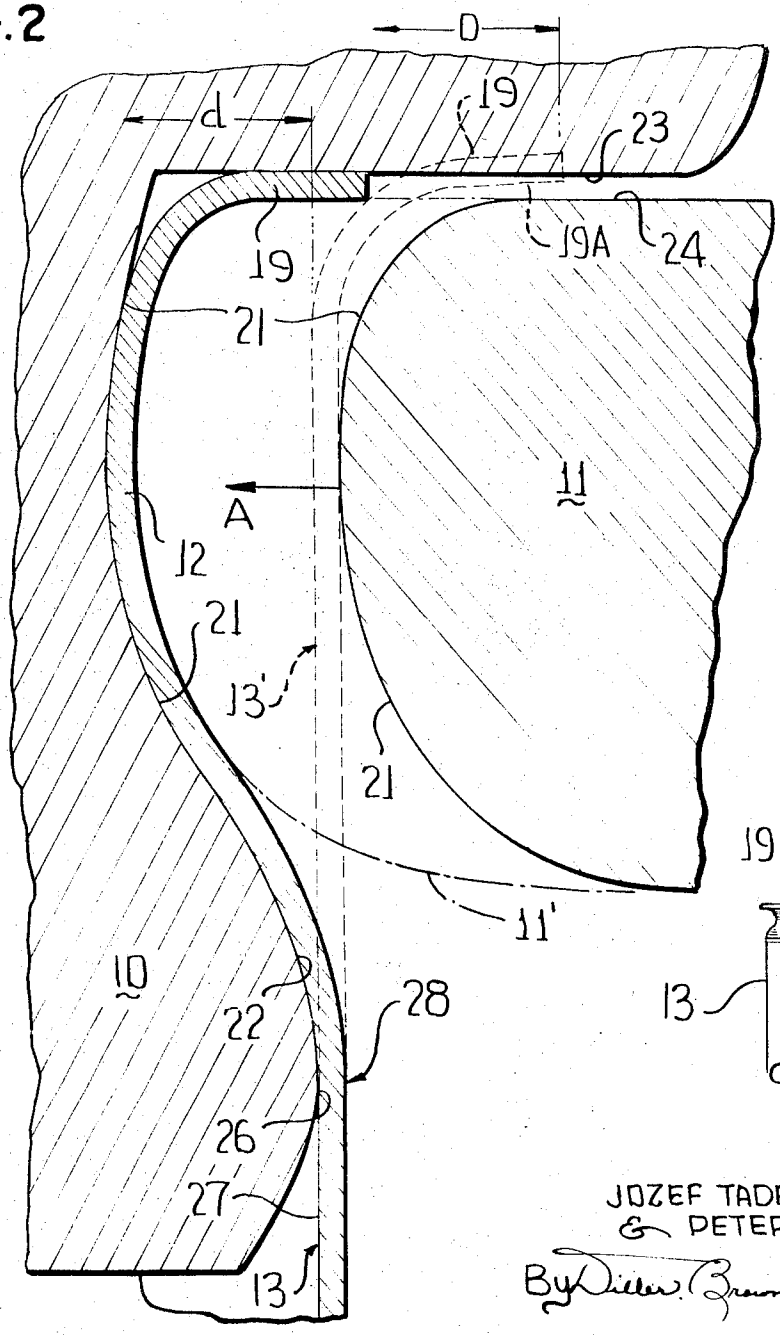
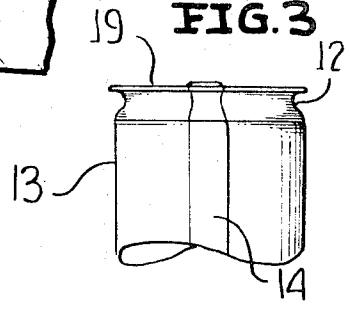


FIG. 3



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FIG.4

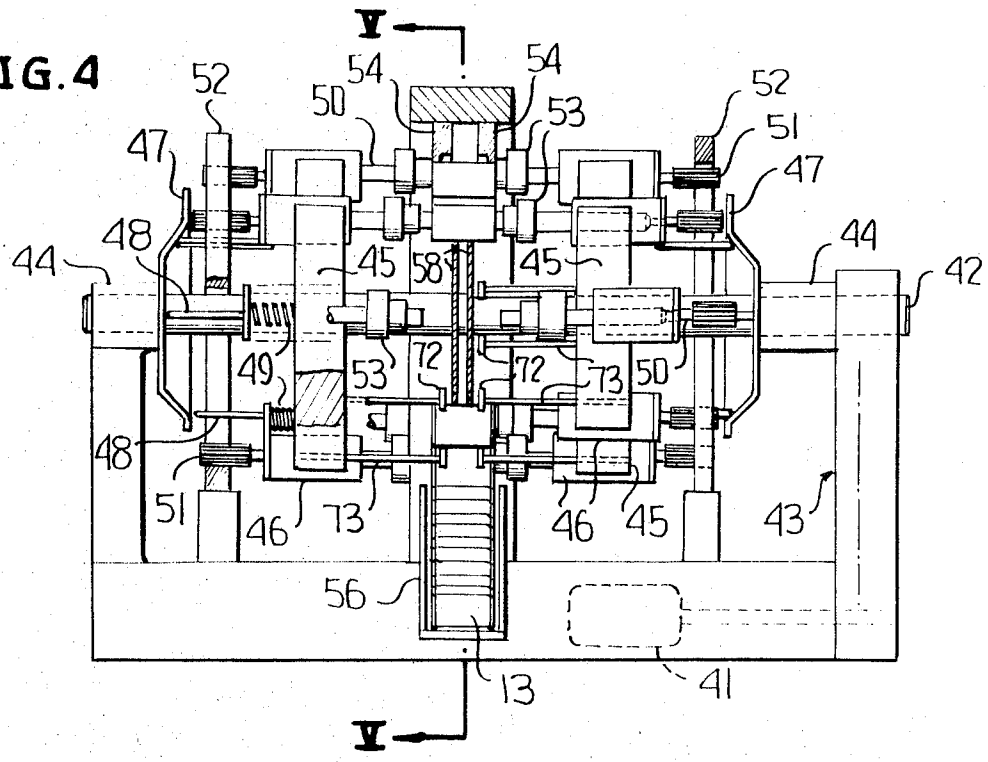
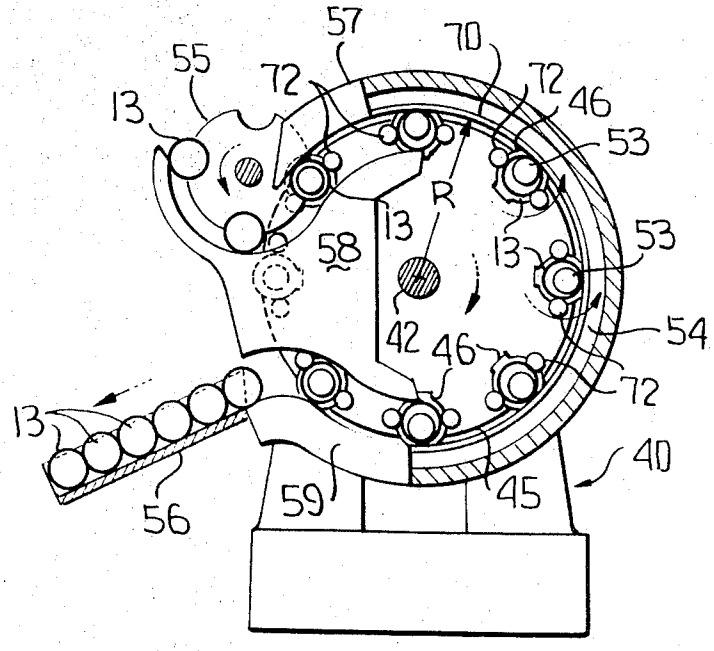


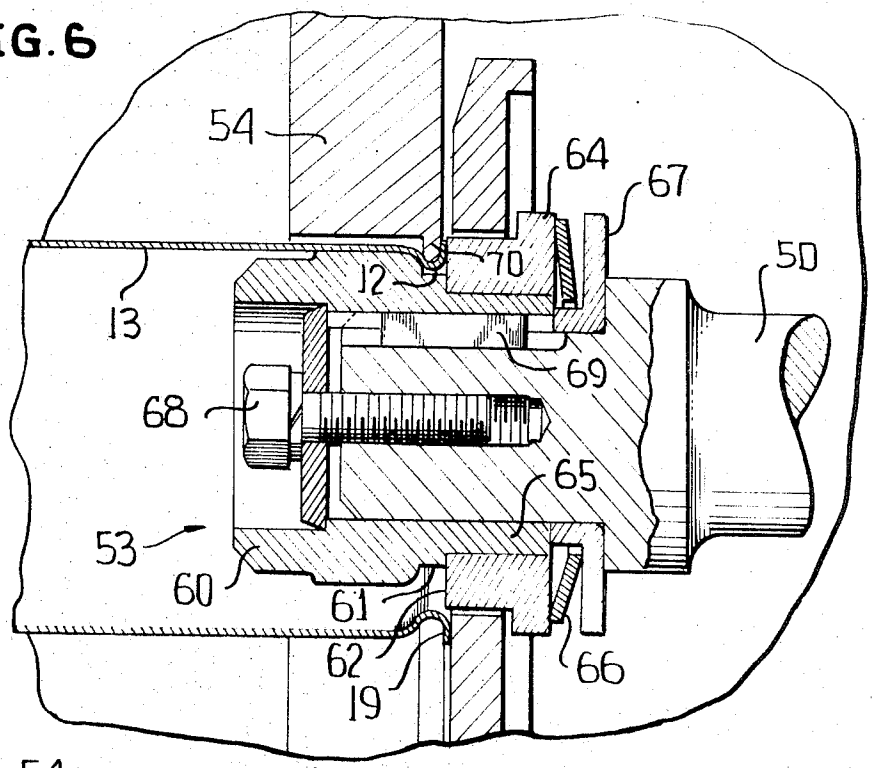
FIG.5



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FIG.6



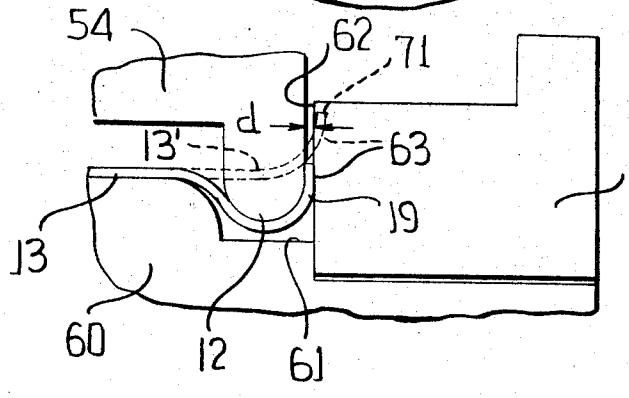


FIG.7

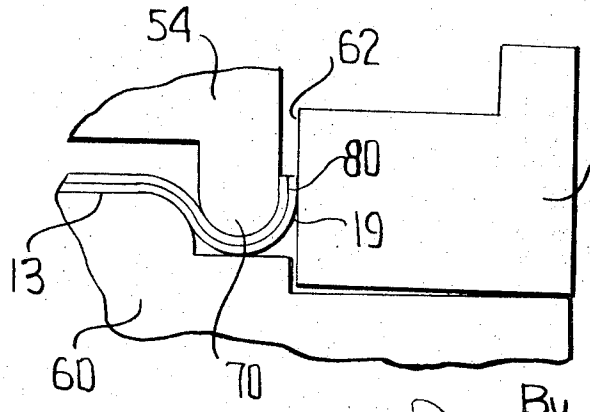


FIG.8

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MAKING CAN BODIES

This invention relates to the necking of metal can bodies, that is to say the formation of a neck in the can body adjacent an open end of the body, such that a can end of smaller diameter than would be required if the neck were absent may be applied to the end of the can body.

Can ends are normally applied by seaming them on to an outwardly-directed flange around the open end of the can body, and it is known to form the flange on the end of a neck or inwardly-directed circumferential bead, so that the flange defines the axially outermost side of the bead, by forming the neck and then the flange in two stages, using for each stage a die held in a press. This process has been found quite satisfactory for use with can bodies having no longitudinal side seams, or with a welded longitudinal side seam. We have not found it satisfactory where the can body has a soldered or cemented side seam, because it is not possible to control the thickness of the lap seam within acceptable limits.

One object of the present invention is therefore to provide a method of necking a metal can body having a soldered or cemented side seam.

A further object of the present invention is accordingly to provide a method of necking a metal can body at high speed.

Another object is to provide a method of necking which is applicable to can bodies with side seams secured by welding or by methods other than welding, as well as those having no side seam.

It is well known to form an inwardly-directed circumferential bead around a metal can body by a rolling or spinning process where the bead is not at an end of the can, i.e. where there is a cylindrical portion of the can on each side of the bead, these cylindrical portions being of equal diameters. In this method of beading, the stresses induced by the rolling process mainly consist of tangential compression stresses and axial beading stresses and give rise to plastic deformation of the metal which, because of the symmetrical support given by the cylindrical portions above-mentioned, which absorb the said stresses and prevent buckling, can result in a smooth satisfactory bead.

In the formation of a neck or inwardly-directed circumferential bead at one end of the can body, however, the bead is only flanked on one side by a cylindrical portion of the body, the other side being unsupported. A rolling process on the end of a cylindrical can body thus sets up an asymmetrical strain pattern which has been found to cause a secondary effect, namely failure due to buckling, especially at the lap seam and along the edge of the cylinder which eventually forms the body end flange.

It is therefore another object of the present invention to overcome this problem and provide a method of forming a neck or inwardly-directed circumferential bead around an open end of a metal can body by rolling without the abovementioned secondary effect.

It is a relatively straightforward matter to adapt a conventional can body beading machine to operate according to the invention, and this is a further advantage of the invention.

According to the invention in one aspect, a method of making a end-necked metal can body includes the steps of forming a thin tubular metal body with an outwardly-curved end flange around an open end thereof, and subsequently forming, by rolling, a neck immediately behind the flange so that the flange merges directly with the neck.

We have found that by this method it is possible to form at high speed a satisfactory end-necked can body, even with a soldered or cemented side seam, without buckling or wrinkling of the metal.

During the rolling of the end neck, the diameter of the flange decreases but its width remains substantially constant. The outwardly-curved shape of the flange enables a smaller can end to be applied than would be the case without necking

According to a preferred feature of the invention, the flange is formed, before the rolling step, so that the whole flange is directed away from the body axis and longitudinally away from the remainder of the body, the rolling step including deformation of the radially outermost portion of the flange so that said portion extends radially.

Preferably, the rolling step comprises

a. mounting the body on a mandrel having a neck bounded at one end by an annular surface abutting the outer end face of the body flange;

b. bringing into external contact with the body, immediately behind said flange, beading means including a body-engaging portion having a profile substantially corresponding to the required external cross-section of the neck on the can body; and

c. causing relative rotation and relative approaching movement in a generally radial direction between the body and the beading means, whereby to form the neck on the can body.

The mandrel is preferably rotated so as to rotate the can body carried thereby with respect to the beading means.

An end-necked can body, made by a method according to the invention, is included within the scope of the invention.

According to the invention in another aspect, apparatus for making an end-necked can body by a method according to the invention includes

a. a mandrel for carrying a thin tubular metal can body and having a neck bounded at one end by an annular surface for abutting the outer end face of a flange formed around an open end of the can body;

b. beading means including a body-engaging portion having a profile substantially corresponding to the required external cross-section of a neck on the can body; and

c. means for causing relative rotation between the beading means and the mandrel:

the beading means being adapted to cause relative approaching movement in a generally radial direction between the beading means and the mandrel, so that when a said can body is mounted on the mandrel a neck can be rolled, between the beading means and the mandrel, on the body immediately behind the said flange and merging therewith.

Due to "spring-back" after the neck has been formed, the final diameter of the neck may be greater than its diameter after it is formed but before the beading means is withdrawn. The dimensions of the said profile of the beading means are determined accordingly. Preferably, the said profile is a continuous curve.

According to another preferred feature of the invention, the apparatus includes resilient means biasing at least the part of the mandrel including said annular surface axially towards the neck of the mandrel. This arrangement provides an axial force to prevent wrinkling of the outer edge portion of the can body flange as the latter is reduced in diameter. It also allows the annular surface of the mandrel to move so as to compensate for the increased thickness of the flange where it is intersected by the lap seam.

Where both ends of the can body are provided with a neck or inwardly-directed circumferential bead according to the invention, the two necks or beads may be of equal radial depth, this depth being preferably such that the outside diameter of each end seam will be substantially the same as the outside diameter of the can body. Alternatively, however, one end may be necked by a greater amount than the other, the difference preferably being such that the finished closed cans will be stackable.

Two embodiments of the invention will now be described by way of example and with reference to the accompanying drawings, of which:

FIG. 1 is an elevation of a support chuck or mandrel and a beading roll in one apparatus for making an end-necked can body;

FIG. 2 is a scrap section, on a much larger scale, showing the operation of the same mandrel and beading roll;

FIG. 3 is a small-scale elevation of part of the end-necked can body;

FIG. 4 is a diagrammatic and much simplified part-sectional elevation showing parts of a machine constituting another apparatus for making an end-necked can body;

FIG. 5 is a transverse section, similarly diagrammatic and simplified, taken on the line V—V in FIG. 4;

FIG. 6 is a section on a much larger scale, showing a mandrel and beading rail of the machine of FIGS. 4 and 5, with a can body in position thereon;

FIG. 7 is a scrap section taken from FIG. 6 but on a still larger scale; and

FIG. 8 is a view corresponding to FIG. 7 but including a can body having a longitudinal side seam.

With reference to FIGS. 1 to 3, an end-necked can body (FIG.3) is made by a method according to the invention in rolling apparatus including a support chuck or mandrel **10** and a beading roll **11** (FIG. 1), both of which are adapted to form an end neck or inwardly-directed circumferential bead **12** on a cylindrical metal can body **13** (FIGS. 2 and 3), which may have a longitudinal soldered, cemented or welded side seam **14.** The mandrel **10** is mounted on a rotatable drive shaft **15,** and carries a gear wheel **16** which engages a second gear wheel **17** carried by the beading roll **11.** The beading roll **11** is freely rotatable about a fixed spindle **18,** the axis of which is parallel to the axis of the mandrel **10.** The spindle **18** is mounted on means (not shown) for moving it, and therefore also the beading roll **11,** progressively radially towards the mandrel **10** as the mandrel and the roll **11** are rotated, as indicated by the arrows A in FIGS. 1 and 2. The gear wheels **16, 17** are arranged in known manner such that this movement can take place without interference with their action.

The method includes the steps of (a) forming an end flange **19,** which is curved outwardly as shown in broken lines at **20** in FIG. **2,** on an end of a cylindrical can body **13,** the side seam **14** (if provided) being formed before the flange **19** is formed; and (b) subsequently rolling the inwardly-directed bead or neck **12** around the end of the body **13** immediately behind the flange **19,** as seen in FIG. **2,** so that the flange **19** merges with, i.e. defines the outer axial limit of, the neck **12.** In other words the neck **12** terminates in the flange **19.** The neck **12** is formed by a rolling process, by means of the relative rotation and radial movement (as described above) between the beading roll **11** outside the body **13** and the co-operating mandrel **10** inside the body.

The initial position of the roll **11** relative to the mandrel **10** is shown in full lines in FIG. **2,** and its final position (when the neck **12** is fully formed) is indicated by the chain-dotted line **11'**. The broken lines **13'** indicate the initial form of the flanged body **13,** and the fully formed neck **12** is shown by full hatched lines.

The profiles of the co-operating body-engaging portions **21, 22** of the beading roll **11** and mandrel **10** are each formed as a continuous curve, and are such that during rolling the flange **19** is reduced in both its outside diameter D and its inside diameter *d*. It will be noted from FIG. **2** that the peripheral portion **19A** of the flange **19** is forced downwards into a radially-directed configuration by its initial engagement with the annular surface **23** of the mandrel **10.** During the rolling process there is an axial thrust between the surface **23** and the corresponding upper annular surface **24** of the roll **11** through the flange **19.**

The mandrel **10** is resiliently biased, for example by spring means not shown, against the can body **13** and towards the beading roll **11.**

After the roll **11** has fully formed the neck **12** to the condition shown in FIG. **2,** it is released radially away from the can body **13** so that the can body can be released axially from the mandrel **10.** On release of the roll **11,** some spring-back will occur, that is to say the material of the neck **12** and flange **19** will spring radially outwards very slightly. The mandrel **10** has a transition radius **22** between the end body-engaging surface **21** of the mandrel and the surface **26** which engages the cylindrical inside surface **27** on the can body. The radius **22** is so determined that this spring-back will not cause bulging of the can body material at the lower region **28** of the neck **12** when the roll **11** is removed.

The diameter of the surface **26** is smaller than the inside diameter of the neck **12,** so that the body **13** may be easily removed axially from the mandrel **10.**

After or simultaneously with the process described, a similar end neck **12** may be formed by the same method on the other end of the can body.

Eventually a can end (not shown) is seamed onto the flange **19** in known manner.

We have found that the directions of rotation of the mandrel and beading roll should preferably be such that the side seam, where provided, is "trailing", that is to say the beading roll passes over the lap (the overlapping portion of the can wall) before it passes over the exposed edge of the seam.

With reference now to FIGS. **4** and **5,** the machine shown therein is basically a conventional can beading machine designed for conventionally forming inwardly-directed beads at points along the can body such that each bead is flanked on both sides by equal-diameter cylindrical portions of the can body. As shown, however, it is adapted for necking can bodies according to the present invention.

The various parts of the machine are shown in FIGS. 4 and 5 generally diagrammatically. Parts not considered necessary to an understanding of how the invention may be performed are omitted for clarity.

The machine as shown comprises a main frame 40 in which is mounted an electric motor 41 arranged to drive a horizontal main shaft 42 through a suitable transmission unit 43 giving a speed reduction. The shaft 42 rotates in main bearings 44 on the frame 40. Fixed on the shaft 42 are two turrets 45, spaced apart axially and each carrying a number of mandrel shaft housings 46 spaced apart equidistantly around the circumference of the turret 45. Each housing 46 lies on the same axis as a corresponding housing 46 on the opposite turret, and each housing 46 is movable axially on its turret by means of a fixed cam 47 engaging a cam follower 48 on the housing, the cam follower being maintained in engagement with the cam by suitable means such as a spring 49. Each housing 46 is flanked by a pair of stabilizing rolls 72 each mounted on the turret 45 by a shaft 73 freely rotatable in the turret. Some of the rolls 72 are omitted from FIG. 4, for clarity.

Mounted axially in each housing 46 is a mandrel shaft 50 having at its outer end a pinion 51 which engages a fixed gear ring 52. The inner end of each shaft 50 carries a mandrel 53 for carrying one end of a thin tubular metal can body 13, the other end of which is supported on the similar mandrel on the mandrel shaft 50 on the same axis on the other turret 45.

Extending around the mandrels are a pair of fixed beading rails 54 mounted on the frame 40, to cooperate with the mandrels 53 for necking the ends of the can bodies 13 as will be described more fully hereinafter.

The machine also includes a conventional turret-type feed device 55 (not shown in FIG. 4) for feeding the can bodies onto the mandrels 53 from a hopper (not shown) via a conventional feedscrew device (not shown) of the kind which is common in canmaking machinery and which need not be described here.

A chute 56 is provided for removal of the finished can bodies from the machine.

Various fixed guide plates 57, 58, 59 guide the can bodies on entry to the machine and exit therefrom.

In operation, the motor 41 rotates the turrets 45 as shown by the arrow in FIG. 5, by means of the transmission 43 and main shaft 42, so that the mandrels 53 are rotated about their own axes, as shown by arrows in FIG. 5, by means of the pinions 51 and fixed gear rings 52, which thus constitute a means for causing relative rotation between the beading rails 54 and the mandrels 53.

The feed turret 55 is rotated at the same time, placing one can body 13 at a time (FIG. 5) between a pair of empty mandrels 53 which have been drawn apart by operation of the cams 47, the can body being guided by the stabilizing rools 72. On further rotation of the turrets 45, the cams 47 cause the mandrels to come together inside the can body so as to support it. The can bodies are then carried along the beading rails 54, which form the end necks on the can bodies as the latter are rotated by the mandrels 53 between the corresponding stabilizing rolls 72, which locate the can bodies on the mandrels. The bodies are finally ejected down the chute 56 after the mandrels 53 of each opposed pair have been drawn apart by operation of the cams 47.

Each can body, before being fed to the machine, is generally as shown at 13' in FIG. 2 and FIG. 7. Thus the method of making the end-necked metal can body includes the steps of forming a thin tubular metal body 13 with an outwardly-curved end flange 19 around an open end thereof, and subsequently forming, by rolling in the machine by means of the co-operating beading rails 54 and mandrels 53, a neck 12, immediately behind the flange 19 so that each flange 19 merges directly with the adjacent neck 12, the resulting end-necked can body being the same as that produced by the method and apparatus of FIGS. 1 and 2.

If the can body has a longitudinal side seam, it is preferably introduced into the machine so that the side seam is trailing as explained hereinbefore. With reference to FIG. 5, this means that the lap contacts the beading rail 54 before the exposed edge of the seam does.

The flange 19 is formed so that the whole flange is directed away from the body axis and longitudinally away from the remainder of the body, as shown in dotted lines in FIG. 2 and FIG. 7.

The step of forming the necks on these can bodies in the machine shown in FIGS. 4 and 5 will now be explained more fully with reference to FIGS. 6, 7 and 8.

FIG. 6 shows one of the mandrels 53, which includes a body portion 60 having a neck 61 bounded at one end by an annular surface 62 for abutting the outer end face 63 (FIG. 7) of the flange 19 already formed on the can body. The annular surface 62 is formed on a ring 64 which encircles a cylindrical extension 65 of the mandrel body 60 and which is a loose fit thereon so that it can rock slightly as shown in FIG. 8. The ring 64 can also move axially on the extension 65, but is biased axially towards the neck 61 by a resilient means which in this case consists of a conical plate spring 66, bearing on a thrust ring 67 which is fixed on the mandrel shaft 50 behind the mandrel body 60. The mandrel body itself is attached to the shaft 50 by a stud 68 and secured against rotation relative to the shaft by a key 69.

Each beading rail 54 includes a body-engaging portion 70 having a continuously-curved profile substantially corresponding to the required external cross-section of the neck 12 to be formed on the can body. Each beading rail is adapted to cause relative approaching movement in a generally radial direction between the beading rail and the mandrel, by virtue of the fact that the tip radius of the portion 70 (R, FIG. 5) decreases from a value such that at the top end of the rail 54 the portion 70 contacts the outside of the can body immediately behind the flange, to a value at the bottom end of the rail corresponding to the fully necked condition of the can body shown in FIG. 7.

The rolling step thus comprises

a. mounting the can body 13 on a pair of the mandrels 53 by the action of the feed turret 55 and cams 47;

b. bringing the beading rails 54 into external contact with the body 13 by rotation of the turrets 45; and

c. by rotation of the turrets 45 and because of the decreasing radius R, causing relative approaching movement in a generally radial direction between the can body 13 and the beading rails 54; and by rotation of the mandrels 53, causing relative rotation between the can body 13 and beading rails 54: whereby to form the necks 12 on the can body.

As can be seen from FIGS. 6 and 7, as the two mandrels come together inside the can body initially, each annular surface 62, under influence of the spring 66, deforms the radially outer-most portion 71 of the flange at each end of the can body so that the portion then extends radially. The axial distance *d* (FIG. 7) between the annular surface 62 when the spring 66 is fully extended (i.e. when the ring 64 is as near to the mandrel neck 61 as it will go), and the can body-engaging portion 70 of the beading rail 54, is preferably slightly less than the thickness of the flange 19. In this way the flange is clamped between the ring 64 and the rail 54. As the turrets 45 rotate, the beading rail 54 in effect moves radially inwards, dragging the flange inwards with it.

Where the can body has a side seam (shown in section in FIG. 8), the increased thickness of the lap seam area 80 of the flange 19 is accommodated by the slight rocking of the ring 64 on the mandrel extension 65. This rocking effect is shown in FIG. 8 exaggerated for clarity.

It will be understood that where it is only required to form an end neck at one end of the can body, the second turret 45 may be omitted, each can body being supported by a single mandrel only. Alternatively the can body may be supported by two mandrels as described, but with one of the beading rails 54 omitted.

We claim:

1. A method of forming an end-necked can body comprising the steps of providing a thin tubular can body having an outwardly curved end flange around an open end thereof, mounting the can body on a mandrel having a neck aligned with the can body immediately adjacent the flange thereof, resiliently axially engaging the can body flange and urging the flange towards a plane disposed normal to the axis of the can body, bringing into contact with the can body immediately behind the flange thereof beading means including a body-engaging portion having a profile substantially corresponding to the desired external cross section of the neck on the can body, and causing relative rotation and relative approaching movement in a generally radial direction between the body and the beading means whereby to form the neck on the can body with the axially urged flange being shaped against the beading means to a substantially planar state merging directly with the neck.

2. The method of claim 1 wherein the extent of said resilient axial urging of the flange is limited to stop short of clamping the flange flat against the beading means.

3. The method of claim 2 wherein the resilient axial urging of the flange is effected by means carried by the mandrel and axial movement thereof is limited by the mandrel.

4. The method of claim 3 wherein the resilient axial urging of the flange is effected by means carried by the mandrel.

5. The method of claim 4 wherein the resilient axial urging of the flange is effected by means carried by the mandrel and axial movement thereof is limited by the mandrel.

6. Apparatus for making an end-necked can body, including

a mandrel for carrying a thin tubular metal can body having a previously formed flange, said mandrel having a neck founded at one end by an annular surface for abutting the outer end face of a flange previously formed around an open end of a can body, said annular surface being formed separate and apart from said neck and being axially movable relative thereto, and resilient means for axially urging said surface against a flange;

b. beading means axially aligned with said neck and including a body-engaging portion having a profile generally complementary to said mandrel neck substantially corresponding to the required external cross-section of a neck on a can body; and

c. means for causing relative rotation between the beading means and the mandrel:

the beading means being adapted to cause relative approaching movement in a generally radial direction between the beading means and the mandrel, so that when a said can body is mounted on the mandrel a neck can be rolled, between the beading means and the mandrel, on the body immediately behind the said flange and merging therewith.

7. Apparatus according to claim 6 wherein the profile of the body-engaging portion of the beading means is a continuous curve.

8. The apparatus of claim 6 wherein there are stop means for limiting movement of said annular surface axially towards said beading means to a distance slightly greater than the thickness of the flange.

9. The apparatus of claim 8 wherein there is a carrier for said annular surface, and said stop means abutting portions of said carrier and said mandrel.

10. Apparatus according to claim 6 wherein said beading means are in the form of a fixed cam-like member.

11. The method of claim 1 wherein said can body has a lapped seam with a circumferentially facing exposed edge, and wherein said neck forming is in the direction wherein the exposed edge trails.

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