

"A method of and an apparatus for rounding cans"

DESCRIPTION

The invention relates to a method of rounding cans in which a sheet bar is placed into a gap between a core and a first shaping die which comprises a first shaping chamber the internal contours of which are at least approximately complementary to the external contours of the can and extends over at least half the periphery of the can and in which by relative penetration of the core into the first shaping chamber the sheet bar is in a pre-shaping stage bent substantially to a U-shape, relative penetration of the core inserted into the first shaping chamber into a second shaping chamber of a second shaping die resulting in the two arms of the sheet bar which is bent to a U-shape being in a final shaping stage formed into a can, the edges of both shaping chambers of both shaping dies opening out into parallel end face planes of the shaping dies, the said end face planes at least approximately touching each other in the closed position of both shaping chambers.

A method of this type is known. Most round housings, cans and bearing shells are according to this principle bent from pre-stamped sheet bars but certainly, following final shaping, the result is unsatisfactory, particularly because in the region of the end face planes of the shaping dies the roundings are imperfect. Irregularities also occur at the can ends. Generally, secondary machining is necessary by calibrating the cans. With the known methods, also grinding marks on the can surfaces cannot be avoided and high-grade materials, for example comprising multiple layers, plastics coated sheet bars and the like cannot be worked by this method without surface damage.

The object of the invention is to provide a method and an apparatus for carrying it out by which sheet bars can be bent to a round shape more precisely than hitherto, this bending process

taking place in a more material-protective fashion so that even sensitive materials can be machined.

In most cases, rounding refers to the bending of rotationally symmetrical objects such as cylindrical or conical cans although it is not confined to these processes. The bending parts may also have oval, elliptical, drop-shaped or similar cross-sections.

In the case of a method according to the invention, the problem of the type mentioned at the outset is resolved in that the core penetrates the first shaping chamber more deeply than corresponds to the radius of the can so that after the pre-shaping the can axis is at a distance from the plane of the end face of the shaping die within the first shaping chamber.

A further development of the invention resides in that the core is also allowed to penetrate the second shaping chamber more deeply than corresponds to the cam radius so that after final shaping of the can, the can axis is at a distance from the end surface plane of the second shaping die within the shaping chamber.

Since the can centre of preferably both shaping dies are respectively overrun by their end planes, the can is substantially better rounded in the 90° range and in the 270° range than by the known bending methods in which the shaping dies run precisely as far as the plane of the can centre. In order to carry out this method, at least the core but preferably also the first shaping die must undergo a cross-sectional change between pre-shaping and final shaping. The apparatus according to the invention provides a solution to this problem and this will be dealt with hereinafter.

A further important development of the invention resides in the fact that between pre-shaping and final shaping there is an auxiliary shaping by which only the ends of the members of the U-shaped sheet bar are, by relative penetration of the core into the second shaping chamber, bent according to the curvature thereof without the parts of the members of the U disposed between these ends and the base of the U-shaped sheet bar blank which is curved during the preliminary shaping process being bent at the same time. In this intermediate shaping stage, therefore, the blank is converted to an extended round profile which does in particular favour precise rounding of the can ends.

Although the method according to the invention makes it possible to achieve a very precise rounding of cans, a further development of the invention lies in the fact that machining of the can takes place in two working stages, the pre-shaping, auxiliary shaping and final shaping being directed at the first working stage and in that after final shaping the can is pushed into the second working stage in which it is calibrated.

An important feature of the method according to the invention resides in that prior to commencement of the preliminary shaping, the core acquires a greater overall cross-section by axial insertion of an auxiliary core so that an overrunning of the can centre by at least one of the shaping dies becomes possible. According to the invention, this auxiliary core is then advantageously used for pushing the can, after its final shaping, into the second working stage and onto an expansion sleeve in the calibrating station.

The invention further relates to a bending apparatus for carrying out the bending process and this apparatus is characterised in that during the pre-shaping process, the core

and the first shaping chamber have a greater cross-section than during the final shaping process. This feature can be carried out by exchanging the cores. An advantageous alternative is the use of an auxiliary core which is temporarily removed for the final shaping. Preferably, this auxiliary core has its concave surface seated on the core and a convex working surface which is complementary to the inside surface of the shaping chamber. Therefore, this auxiliary core has a sickle-shaped cross-section in which the working surface and the inner surface are on circularly cylindrical planes of the same size.

The first shaping die preferably mounts a slider displaceable in the actual direction of the can and which forms a part of the first shaping chamber and constructed on this slider is the end face of the shaping chamber which defines the plane of division of the shaping dies during pre-shaping and intermediate or auxiliary shaping. Then, this plane of division is at a distance from the can centre on the side of the first shaping die. In a very advantageous manner, the auxiliary core can be connected to the slider to form one common displaceable component unit so that after withdrawal of this component unit from the first working stage the core and the first shaping chamber can acquire new cross-sectional shapes for final shaping of the can so that the unchanged second shaping die is able to overrun the can centre for final shaping of the can.

Whereas, according to the state of the art, relatively small sheet bars can hang centrally over a web on a carrier strip, the method according to the invention allows the sheet bars to be attached to the carrier strip by two webs associated with the end portions of the sheet bar. Therefore, the sheet bar can be more accurately positioned in the bending apparatus. Since, after separation from the carrier strip, these webs leave shearing marks on the ends of the can, the cans produced

according to the invention differ from the state of the art in that these shearing marks are to be found in the quarter-peripheries adjacent the can gap.

The three-stage bending method involving changing the core and shaping chamber cross-sections leads in the final analysis to a protective and very accurate rounding of sheet bars so that the method according to the invention is also suitable for highly-sensitive laminated sheet bar materials.

The two shaping dies of the apparatus according to the invention have a width which is at least equal to twice the width of the can to be bent and have axially in addition to their shaping chambers a calibrating chamber, both calibrating chambers being identical in mirrored-opposite fashion while coinciding in their curvature with that of the associated shaping chambers but respectively extending over just a peripheral angle of 180° . The two calibrating chambers form a closed-periphery calibrating cavity corresponding to the outer surface of the can. Disposed in this calibrating cavity is an expanding device which preferably consists of an expanding sleeve which can be widened or narrowed by an interior cone by axial displacement of an actuating rod.

With this further development, in addition to the advantage of can-bending in one and the same tool, a calibration is achieved in a second working stage of this tool so that multiple removal and insertion of sheet bars and the resulting inaccuracies are unnecessary.

The invention is described in greater detail hereinafter with reference to an example of embodiment shown in the accompanying drawings in which:

Fig. 1 - Fig. 6 show the bending apparatus with the sheet bar to be bent, in successive working cycles and

Fig. 7 - Fig. 12 show cross-sections through the bending apparatus in the working cycles associated with the respective views.

The drawings illustrate diagrammatically parts of a bending apparatus 10 which comprises a first shaping die 12, a second shaping die 14, a circularly cylindrical hollow core 16, an auxiliary core 18 and a slider 20 mounted for displacement on the first shaping die 12 in the axial direction of the core 16. The auxiliary core 18 and the slider 20 form one structural unit which is reciprocated in the direction of the arrow A (Fig. 10) by an actuating tool, not shown. The first shaping die 12 comprises a shaping chamber 22 with a partially cylindrical bottom in the form of a portion of a cylinder. In the area of the slider 20, the partially cylindrical inner surface of the shaping chamber 22 merges steadily into a semi-cylindrical surface and has parallel portions of the inner surface which emerge at the end plane 23 of the first shaping die 12.

The second shaping die 14 consists of two die halves 14a and 14b which together form a shaping chamber 24. This is of approximately mirrored-opposite construction to the shaping chamber 22 and, apart from a step between the two die parts 14a and 14b, it has a semi-cylindrical contour adjacent to which there are the downwardly directed parallel portions of the inner surface. The guide part 14b is mounted for displacement at right-angles on the die part 14a and is, by means of a spring 15 which is only shown here diagrammatically, so pre-tensioned against an abutment on the die part 14a that a step 17 is created in the central plane of the shaping chamber 24.

In Fig. 1, the two shaping dies 12, 14 are moved away from each other. The core 16 is stationary. Pushed into the gap between the core and the end face of the first shaping die 12 is a sheet bar 26. The shaping die 12 then travels upwards in the direction of the arrow shown in Fig. 1 and bends the sheet bar 26 into a U-shape as is shown in Fig. 2. The core centre which corresponds to the can centre, lies under the end face 23 of the first shaping die 12. Consequently, the core 16 has penetrated more deeply into the shaping chamber 22 than corresponds to the can radius. The 90° and 270° positions of the can to be formed are therefore situated in the shaping chamber 22 so that the U-shaped arms formed from the sheet bar 26 no longer spring outwards but bear closely against the auxiliary core 18. The process of pre-shaping the sheet bar 26 is therefore completed.

Now the second shaping die 14 according to Fig. 3 moves downwards. The ends 26' of the arms of the U-shaped blank are bent inwardly upon contact with the wall 24 of the shaping chamber and, when the shaping die 14 is placed on the auxiliary die 18, they bear on this latter. In the region of the parallel portions of the chamber surface of the two shaping dies 12, 14, the rectilinearity of the arms of the U-shaped blank 26 is retained. By reason of the step 17 in the shaping chamber 24, bending of the two ends 26' takes place at a short offset in the timing. The bending of the two ends 26' between the second shaping die 14 and the auxiliary core 18 constitutes an interposed auxiliary shaping stage after which these ends 26' of the arms are precisely bent to a circularly cylindrical shape and therefore they already have what is their final form.

Now, the auxiliary core 18 together with the slider 20 is drawn away in the direction of the arrow A (Fig. 10) axially between the shaping dies 12, 14 for which purpose the second shaping die 14 is possibly lifted somewhat. Now the second shaping die 14

again moves downwards in order to bring about the final shaping of the can 27. After the slider 20 has been withdrawn from the first shaping die 12, the shaping die 14 is able to move over the end face 23 of the first shaping die 12 and more deeply until it reaches the bottom surface 28 of the shaping die 12, whereby the end face 19 of the second shaping die 14 overruns the core centre downwards until the inside surface of the shaping chamber 24 likewise shapes the can blank at its straight portions of the arms of the U-shape into a circularly cylindrical form which means that the final shaping of the can 27 is completed.

Usually the can ends are fitted together in serrated fashion. For this purpose, the can ends have projections and recesses which engage one another alternately. Since the die half 14b first presses one can edge against the core 16, a form-locking closure of the can 27 is able to take place during the final phase of the downwards movement of the die part 14a. Both dies 12 and 14 then move apart (Fig. 5) so that the completed can 27 can be taken off the core 16.

Figs. 7 to 12 illustrate an additional calibration process conducted on the can 27 which takes place in the same apparatus 10, in a second working stage. For this purpose, tool parts 30, 32 are mounted on the right-hand side of both shaping dies 12, 14 and comprise calibrating chambers 34, 36 which have the same curvatures as the shaping chambers 22, 24 but extend over just one peripheral angle of 180° . In the closed condition of the dies 12, 14, therefore, the plane of division of the calibrating chambers 34, 36 are at the core centre. The hollow core 16 is traversed by an actuating rod 38 which carries in the second working stage a cone 40 which is surrounded by an expansion sleeve 42.

ON a basis of Figs. 5 and 11, then, following final shaping of the can 27, the component unit consisting of auxiliary core 18 and slider 20 is again pushed into the first working stage so that the auxiliary core 18 pushes the can 27 on the core 16 into the second working stage over the expansion sleeve 42. The can 27 which is calibrated there in the previous working cycle is simultaneously ejected from the apparatus 10 (Fig. 12). The apparatus 10 is then, in the first working stage, prepared to receive a new sheet bar 26. The working cycles of the pre-shaping, intermediate shaping and final shaping of the can 27 are repeated and in the position according to Figs. 4 and 10, the two tools 30, 32 are closed and form a cylindrical calibrating cavity which encloses the can 27. In this position, the actuating rod 38 is drawn in the direction of the arrow A (Fig. 10), so that the expansion sleeve 42 is widened by the action of the cone 40 and calibrates the can 27.

In the illustrated apparatus 10, therefore, a sheet bar 26 can, without any handling equipment, be rounded to a high degree of precision in a first working stage and then closed and then calibrated in the second working stage.



PATENT CLAIMS

1. A method of rounding cans, in which a sheet bar (26) is placed into a gap between a first shaping die (12) and a core (16) matching the internal contours of the can (27), shaping die (12) comprising a first multi-part shaping chamber (22) of which one part has an interior contour which matches the external contours of the can (27) and of which the other part increases the height of the shaping chamber so that it extends over more than half the can periphery and so that by relative insertion of the core (26) into the first shaping chamber (22), the sheet bar (26) is bent into a substantially U-shaped blank and in that by relative insertion of the core (16) which is inserted into the first shaping chamber (22) into a second shaping chamber (24) which is complementary to the can contours and which is part of a second shaping die (14), the two members of the U-shaped blank are in a final shaping stage shaped into a can (27), the core (16, 18) being more deeply introduced into the first shaping chamber (22) than corresponds to the radius of the can and after pre-shaping and preceding final shaping it undergoes an auxiliary shaping during which the gap between the members of the U-shaped blank is reduced, **characterised in that** during the auxiliary shaping, the core (16, 18) has a greater cross-section than during the final shaping and is extended in the direction of the members of the U-shaped blank and in that by a relative introduction of these members of the blank together with the enlarged core (16, 18) into the second shaped chamber (24), the ends (26') of the members are, corresponding to the contours of the shaping chamber, respectively bent inwardly towards the enlarged core (16, 18) without jointly bending the parts of the members which are adjacent the ends (26').



2. A method according to Claim 1, **characterised in that** during final shaping of the can (26), the core (16, 18) is more deeply inserted into the second shaping chamber (24) than corresponds to the radius of the can so that after final shaping of the can (27), the can axis is at a distance from the plane (19) of the end surface of the second shaping die (14) within its shaping chamber (24).
3. A method according to Claim 1 or 2, **characterised in that** the enlargement of the core (16) which matches the can takes place by axial insertion of an auxiliary core (18).
4. A method according to Claim 3, **characterised in that** commencement of bending of the two ends (26') of the blank takes place after a slight delay.
5. A method according to one of Claims 1 to 4, **characterised in that** the machining of the can (26) takes place in two parallel working planes and in that in the first working plane at least the pre-shaping and final shaping of the can (27) takes place, the can then being pushed axially into the second working plane where it is calibrated.
6. A method according to Claims 3 to 5, **characterised in that** after its final shaping the can (27) is pushed by the auxiliary core (18) into the second working plane and onto an expanding sleeve (42) of the calibrating station.
7. A method according to one of Claims 1 to 6, **characterised in that** during the pre-shaping in the closed position of both shaping chambers (22, 24) its peripheral contours - apart from the wall thickness of the can (27) - is complementary



to the outer contours of the core (16, 18) which is of enlarged cross-section.

8. A bending apparatus for producing cans (27) with a bottom shaping die (12) and an upper shaping die (14) for carrying out the method according to one or more of Claims 1 to 7, **characterised in that** the core (16, 18) and the first shaping chamber (22), during the pre-shaping process, each have a greater cross-section than during the final shaping process.
9. An apparatus according to Claim 8, **characterised in that** the first shaping die (12) mounts a slider (20) displaceable in the actual direction of the can and which forms a part of the first shaping chamber (22) and in that the plane of separation of the first shaping die (12) which comprises the slider (20) is at a distance from the can centre on the same side as the second shaping die.
10. An apparatus according to Claim 8 or 9, **characterised in that** during preliminary shaping the core (16) is supplemented by an auxiliary core (18) having a concave surface seated on the core (16) and comprises a convex working surface which complements the interior surface of the shaping chamber of the second shaping die (14).
11. An apparatus according to Claims 9 and 10, **characterised in that** the auxiliary core (18) forms a displaceable unit together with the slider (20).
12. An apparatus according to one of Claims 8 to 11, **characterised in that** the second shaping die (14) consists of two halves (14a, 14b) of which one (14b) is guided for



movement on the driven half (14a) with its shaping chamber half and in the direction of the die movement and is pre-tensioned by spring force into a starting position which is offset in relation to the other die half (14a) so that the shaping chamber (24) forms a step (17) at the position of the can rims in relation to their serrations.

13. An apparatus according to one of Claims 8 to 12, **characterised in that** the two shaping dies (12, 14) have a width which is at least equal to twice the width of the cans (27) and have axially alongside their shaping chambers (22, 24) in each case a calibrating chamber (34, 36) and in that both calibrating chambers (34, 36) have the same curvatures as their respectively associated shaping chambers (22, 24) but extend in each case over just a peripheral angle of 180° and in the final shaping process form a peripherally closed calibrating cavity corresponding to the outer surfaces of the can (27) and in that an expanding means (40, 42) is disposed in this calibrating cavity.
14. An apparatus according to Claim 13, **characterised in that** the core (16) is of hollow construction and is traversed by an axially moved actuating rod (38) which has in the region of the calibrating cavity a cone (40) which cooperates with an internal cone of an expanding sleeve (42).

Two sheets of drawings