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(54) **PROCESS FOR THE PRODUCTION OF CAN BODIES AND OF FILLED AND CLOSED CANS**

VERFAHREN ZUM HERSTELLEN VON DOSENKÖRPERN, UND VON GEFÜLLTEN UND
GESCHLOSSEN BEHÄLTERN VON DOSEN

PROCEDE DE PRODUCTION DE CORPS DE BOITES ET DE BOITES REMPLIES ET FERMEES

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Description

[0001] The invention relates firstly to a process for producing can bodies from substantially metal blanks, which process comprises the operation of punching discs out of sheet material and the production of can bodies by deep drawing and/or wall ironing, each can body comprising a can wall and a can base (see JP-A-07232230). In the packaging industry, blanks are generally understood to mean the preforms from which can bodies are produced by deep drawing and/or wall ironing.

[0002] Apart from the production of can bodies, the invention also relates to a process for producing filled and closed cans. Large numbers of cans of this nature are used for the packaging of drinks and foodstuffs, but also of other materials.

[0003] The basis of the following text will generally relate to the production of a beverage can, although the invention is specifically not limited thereto.

[0004] A generally customary process consists in round discs being punched out of a sheet-metal material, which discs can be used as blanks. This production of blanks may take place at the can-maker's factory, but also at the steel manufacturer's factory, in which case the manufacturer can immediately reuse the return scrap. The processing of flat blanks of this nature involves one or more deep-drawing operations, optionally followed by a so-called wall-ironing operation. During deep drawing, the wall thickness of the can formed, or the intermediate forms thereof, remains essentially unchanged. During wall ironing, however, the wall material becomes much thinner, resulting in a considerable saving of material. However, the base of the can to a large extent retains the original sheet thickness, or slightly less, if the base is subsequently also profiled.

[0005] Such profiling may, for example, consist in pressing a so-called core into the base in order to provide the base with a somewhat greater dimensional stability. Nevertheless, the base is still only slightly thinner than the original thickness of the sheet material used. Likewise, the mechanical properties of the base are substantially determined by those of the starting material.

[0006] The choice of the starting material is essentially determined by the requirements which the deep drawing and/or the wall ironing of the can wall impose on this material; consequently, it is impossible to use a more rigid and harder starting material, which could lead to a thinner base.

[0007] Therefore, the object of the invention is to provide a process in which it is nevertheless possible to save considerable amounts of material in the blank, and therefore also in the can body.

[0008] To this end, the invention consists in the process for producing can bodies as described in the preamble, in which the sheet material is biaxially stretched at the location of the centre section of the blank which is to be formed, while an area of the blank which is to

be formed, outside the centre section, is held clamped in place.

[0009] As a result of this biaxial stretching, the centre section of the blank becomes thinner but, in the process, also undergoes considerable work-hardening. That part of the blank which lies further towards the outside is not biaxially stretched, and consequently maintains the original properties of the material.

[0010] As a result of the biaxial stretching of the centre section, material is displaced outwards from the centre, with the result that some of the material which would otherwise form the can base now forms part of the can wall. Consequently, the stamped disc from which a blank is formed may be smaller, with the result that material is saved. Moreover, this makes it possible to deep draw a can from a blank by means of a single deep-drawing operation. By suitably adapting the shape of the can base, it is possible for the latter to retain the same rigidity.

[0011] The biaxial stretching of the centre sections of the blanks which are to be formed may take place before discs are stamped out of the sheet material. In that case, the sheet has to be clamped locally in place at every position from which a disc is stamped out and has to be stretched within each clamping rim. The blanks can then be stamped out of the sheet.

[0012] However, preference is given to a process in which the discs are stamped out of the sheet material prior to the biaxial stretching of the centre section of the blank. In this way, simple equipment for the biaxial stretching can be used.

[0013] Metal can bodies for beverage cans are usually produced from aluminium or steel. Although the novel process can also be applied to aluminium sheet material, it has been found that it is preferable to use the process on steel-based sheet material. This is because it has been found that in this case more substantial deformation of the base material is possible, leading to a greater saving of material.

[0014] It has also been found preferable to apply the novel process to sheet material which is metallurgically coated and/or coated with a plastic. As a result, fewer subsequent operations are required on the final can body in order to fill and close the can.

[0015] The biaxial stretching of the centre section of the blank to be formed may be carried out in various ways. For example, it is conceivable to employ the generally known technique of hydroforming for this purpose, or alternatively the technique of spinning using a spinning roll. However, both methods have been found to be extremely time-consuming. Therefore, preference is given to a method according to the invention in which the biaxial stretching is carried out by pressing a punch with a convexly shaped head against the centre section of the blank which is to be formed. The shape of the convexly shaped head may be adapted to the desired distribution of the strengthening over the surface of the blank. Generally, however, the surface of this head will

be approximately in the shape of a segment of a sphere.

[0016] The biaxially stretched centre section will correspond to at least the can base which is to be formed from the blank. Making the whole of this can base thinner saves additional material. In particular, however, it is preferable for the biaxially stretched centre section also to comprise that part of the blank from which a conical transition piece from the can base to the can wall is formed. It should be noted that a conical transition piece of this nature is in very widespread use for beverage cans.

[0017] It will be clear that as the extent of stretching increases, the amount of material which can be saved rises. However, it must also be realized that in this case too there are limits imposed by the material used.

[0018] A good level of biaxial stretching for steel cans can be achieved if this biaxial stretching leads to a thickness reduction of between 20 and 30% on the average. To date, the best results have been obtained with thickness reductions which are uniformly distributed over the centre section and which constitute a reduction of between 23 and 27%.

[0019] As has already been stated, it is possible to start from sheet material which is coated. If the sheet material is steel-based, it has been found that good results are obtained if the starting material is steel sheet which is metallicity coated on two sides with one of the materials selected from the group consisting of tin and chromium-chromium oxide, and which is furthermore coated on two sides with at least one layer of plastic selected from the group consisting of PET, polypropylene and copolymers thereof.

[0020] Steel sheet which has been coated in this way is generally known per se and requires no further explanation.

[0021] Furthermore, it has proven important for the novel process for the sheet material used to have an n-value of at least 0.16. The way in which the n-value, also known as the "strain-hardening exponent", is determined is described in ASTM method E 646.

[0022] In the known process for deep-drawing and wall-ironing steel cans, it is customary, first of all, to deep draw a so-called cup from blanks, and then to subject this cup itself to a further deep-drawing operation before a wall-ironing operation is carried out. Preferably, in this case, the second deep-drawing operation and the wall-ironing operation are combined in a single operation. It has been found that when the novel process is used, after the biaxial stretching of the blank only a single deep-drawing operation, preferably in combination with the wall-ironing operation, is required. Moreover, an additional advantage of this novel process is that, surprisingly, the generally recognized problem of chime wrinkling, particularly in the conical transition zone of the base, no longer arises.

[0023] As has been noted above, one possibility consists in making the blanks separately from the work involved in forming the can bodies. However, it has been

found that it is entirely possible to carry out the biaxial stretching of punched discs to form blanks and the forming of can bodies therefrom in line in successive processing steps using separate processing machines.

[0024] The invention furthermore relates to a process for producing filled or closed cans. By starting from material which has been coated with plastic on two sides, it has proven possible not only to form can bodies from the coated blanks, but also subsequently to fill these can bodies and to seal them with a lid in a known way. This makes it possible to provide a so-called "form-fill-seam" line for beverage cans. This saves the costs of transporting empty cans.

[0025] Finally, the invention also relates to the metal can body itself, comprising a can wall and a can base. This novel can body is characterized in that the can base is made from work-hardened material with a thickness of between 2.5 and 2.75 x the wall thickness of the can wall. This thickness ratio is significantly lower than in known beverage cans, in which this ratio is generally between 2.8 and 3.2. Preference is in this case given to a thickness ratio of the base and the wall of between 2.55 and 2.66. This provides a good compromise between, on the one hand, demands which are imposed on the material and, on the other hand, the possibility of saving material.

[0026] A steel can body as described above should preferably have a can base in which the material exhibits a tensile stress, at 0.2% elongation, of $620 \pm 70 \text{ N/mm}^2$ and a hardness R 30 C of $76 \pm 3 \text{ N/mm}^2$.

[0027] The invention will now be explained in more detail with reference to a number of figures and test results.

[0028] Fig. 1 illustrates the biaxial stretching of a centre section of a disc.

[0029] Fig. 2 shows the further processing of the blank obtained in this way.

[0030] In Fig. 1, reference numeral 1 denotes a disc of steel sheet, a wide periphery of which is clamped between an upper clamping ring 2 and a lower clamping ring 3, and is held between these clamping rings 2,3. A convex punch 4 is pressed against the centre section of disc 1; the left-hand side of the figure shows the position of convex punch 4 prior to deformation of the disc 1, while the right-hand part of the figure shows its position at the end of the biaxial stretching of the disc. In this position, the centre section of the disc has bulged outwards into the shape 5. A disc diameter of 125 mm and a disc thickness of 0.22 mm are used. The starting material was tin-plated steel sheet with a yield stress of 283 N/mm², a tensile strength of 385 N/mm², an r-value of 1.21 and an n-value of 0.16. During production of the convex shape 5, the material becomes thinner and harder in the centre section of disc 1, which will ultimately form the base of the can which is to be formed.

[0031] Fig. 2 shows the blank 5, formed as shown in Figure 1, located in a following processing device. In this case, the edge of the blank 5 is located between a draw-

ing die 6 and a blank-holder ring 7 of a deep-drawing press. The left-hand half of Figure 2 shows the position of a punch 8 at the beginning of deep-drawing, while the right-hand half of the figure shows a position virtually at the end of this deep-drawing operation. Unlike in the operation shown in Figure 1, in which the edge of the disc is held in place, during the deep-drawing operation the edge is drawn out between the drawing die 6 and the blank-holder ring 7. The punch 8 shown is approximately conical in the vicinity of its end, making it possible to form the conical transition 11 to the base 10 which is customary in many beverage cans. Due to the convex shape 5 of the blank, the material now matches the shape of the punch better, thus preventing chime wrinkling.

[0032] Due to the hardened and thinner base 10, some of the material emanating from the centre section of the blank is displaced outwards and, in so doing, forms the transition zone 11 or even part of the wall of the deep-drawn cup. Consequently, it is possible to start with a disc diameter of 125 mm in order to form a beverage can with a diameter of approximately 66 mm and a height of 115 mm, which has hitherto required discs with a diameter of 130 mm. In the can formed, this leads to a material saving of approximately 8%.

[0033] Fig. 2 also shows a wall-ironing ring 9. By moving the punch 8 further, the cup formed by deep-drawing can be shaped further into a can body by wall ironing.

[0034] It should be noted that in practice a plurality of wall-ironing rings, for example 2 to 4 such rings, are generally positioned one behind the other. The positioning of these wall-ironing rings is generally known and is not shown in the figure.

Claims

1. Process for producing can bodies from metal blanks (5), which process comprises the operation of punching discs (1) out of sheet material and the production of can bodies by deep drawing and/or wall ironing, each can body comprising a can wall and a can base, **characterized in that** the sheet material is biaxially stretched at the location of the centre section of the blank which is to be formed, while an area of the blank which is to be formed, outside the centre section, is held clamped in place.
2. Process according to Claim 1, **characterized in that** the discs (1) are stamped out of the sheet material prior to the biaxial stretching of the centre section of the blank.
3. Process according to Claim 1 or 2, **characterized in that** steel-based sheet is used as the starting material.
4. Process according to Claim 1, 2 or 3, **characterized**

in that the sheet material is metallicity coated and/or coated with a plastic.

5. Process according to one of Claims 1-4, **characterized in that** the biaxial stretching is carried out by pressing a punch (4) with a convexly shaped head against the centre section of the blank which is to be formed.
6. Process according to one of Claims 1-5, **characterized in that** the biaxially stretched centre section corresponds to at least the can base which is to be formed from the blank.
7. Process according to Claim 6, **characterized in that** the biaxially stretched centre section comprises also that part of the blank from which a conical transition part from the can base to the can wall is formed.
8. Process according to Claim 3 or one of Claims 4-7 in combination with Claim 3, **characterized in that** biaxial stretching is carried out to an extent which results in a thickness reduction of between 20 and 30% on the average.
9. Process according to Claim 8, **characterized in that** the thickness reduction is uniformly distributed within a range from 23 to 27%.
10. Process according to one of Claims 5 to 9, **characterized in that** the starting material is steel sheet which is metallicity coated on two sides with one of the materials selected from the group comprising tin and chromium-chromium oxide, and which is furthermore coated on two sides with at least one layer of plastic selected from the group comprising PET, polypropylene and copolymers thereof.
11. Process according to one of Claim 1 to 10, **characterized in that** the sheet material used has an n-value of at least 0.16.
12. Process according to one of the preceding Claims, **characterized in that** the can body is produced from the biaxially stretched blank using a single deep-drawing step, followed by at least one wall-ironing operation.
13. Process according to one of the preceding Claims, **characterized in that** the biaxial stretching of sheet material, and the forming of can bodies therefrom, are carried out in line in successive processing steps.
14. Process for producing filled and closed cans, **characterized in that** can bodies are formed using the process of Claim 10, in combination with Claim 12

or 13, after which the can are filled and are sealed in a known way using a lid.

Patentansprüche

1. Verfahren zum Herstellen von Dosenkörpern aus Metallrohlings (5), welches den Arbeitsgang des Ausstanzens von Scheiben (1) aus Blechmaterial und der Herstellung von Dosenkörpern durch Tiefziehen und/oder Abstreck- oder Gleitziehen der Wandungen umfasst, wobei jeder Dosenkörper eine Dosenzarge und einen Dosenboden aufweist, **dadurch gekennzeichnet, dass** das Blechmaterial entlang zweier Achsen an der Stelle gereckt wird, an der sich der Mittelabschnitt des zu formenden Metallrohrlings befindet, wohingegen ein Bereich des zu formenden Rohrlings, der außerhalb des Mittelabschnitts liegt, in seiner Position festgeklemmt gehalten wird. 5
2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** die Scheiben (1) vor dem biaxialen Recken des Mittelabschnitts des Rohrlings aus dem Blechmaterial ausgestanzt werden. 10
3. Verfahren nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** als Ausgangsmaterial ein Blech auf Stahlbasis verwendet wird. 15
4. Verfahren nach Anspruch 1, 2 oder 3, **dadurch gekennzeichnet, dass** das Blechmaterial mit einer metallischen Beschichtung versehen und/oder mit einer Kunststoffschicht überzogen wird. 20
5. Verfahren nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** der Vorgang des biaxialen Reckens durch Aufpressen eines Stanzteils (4) mit konvex geformtem Kopf gegen den Mittelabschnitt des zu formenden Rohrlings ausgeführt wird. 25
6. Verfahren nach einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass** der biaxial gereckte Mittelabschnitt zumindest dem Boden der Dose entspricht, der aus dem Rohling geformt werden soll. 30
7. Verfahren nach Anspruch 6, **dadurch gekennzeichnet, dass** der biaxial gereckte Mittelabschnitt auch den Teil des Rohrlings umfasst, aus dem ein konisch zulaufendes Übergangsteil vom Deckel der Dose bis zur Dosenzarge geformt wird. 35
8. Verfahren nach Anspruch 3 oder einem der Ansprüche 4 bis 7 in Kombination mit Anspruch 3, **dadurch gekennzeichnet, dass** der Arbeitsgang des biaxialen Reckens in einem Ausmaß ausgeführt wird, das zur Verringerung der Dicke um 20 bis 30 % im Mittel führt. 40

9. Verfahren nach Anspruch 8, **dadurch gekennzeichnet, dass** die Verringerung der Dicke innerhalb eines Bereichs von 23 bis 27 % gleichmäßig verteilt ist. 45

10. Verfahren nach einem der Ansprüche 5 bis 9, **dadurch gekennzeichnet, dass** das Ausgangsmaterial ein Stahlblech ist, welches auf zwei Seiten mit einer metallischen Beschichtung aus einer der Substanzen versehen ist, die aus der Gruppe gewählt sind, welche Zinn und Chrom-Chromoxid umfasst, und welches außerdem auf zwei Seiten mit mindestens einer Kunststoffschicht versehen ist, die aus der Gruppe gewählt ist, welche PET, Polypropylen und deren Kopolymere umfasst. 50

11. Verfahren nach einem der Ansprüche 1 bis 10, **dadurch gekennzeichnet, dass** das verwendete Blechmaterial einen n-Wert von mindestens 0,16 aufweist. 55

12. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der Dosenkorpus aus dem biaxial gereckten Rohling unter Einsatz eines Arbeitsschritts mit Tiefziehen mit mindestens einem anschließenden Arbeitsgang zum Abstreckziehen hergestellt wird. 60

13. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der Arbeitsgang des biaxialen Reckens des Blechmaterials und der Arbeitsgang der Formung von Dosenkörpern aus diesem Blech in aufeinander folgenden Bearbeitungsgängen auf einer Produktionsstraße stattfinden. 65

14. Verfahren zur Herstellung befüllter und verschlossener Dosen, **dadurch gekennzeichnet, dass** unter Anwendung des Verfahrens nach Anspruch 10 in Verbindung mit Anspruch 12 oder 13 Dosenkörper gebildet werden, und dass anschließend die Dosen in an sich bekannter Weise befüllt und unter Verwendung eines Deckels dicht verschlossen werden. 70

Revendications

1. Procédé pour fabriquer des corps de boîtes à partir d'ébauches métalliques (5), ce procédé comprenant l'opération consistant à découper des disques (1) à l'emporte-pièce dans de la tôle métallique et à fabriquer des corps de boîtes par emboutissage profond et/ou étirage de paroi, chaque corps de boîte comportant une paroi et une base de boîte, **caractérisé en ce que** la tôle est soumise à un étirage bi-axial au niveau de la partie centrale de l'ébauche à mettre en forme, tandis qu'une zone de l'ébauche 75

- à mettre en forme en dehors de la partie centrale, est maintenue en place par serrage.
2. Procédé selon la revendication 1, **caractérisé en ce que** les disques (1) sont formés par estampage de la tôle métallique avant l'étirage bi-axial de la partie centrale de l'ébauche. 5
 3. Procédé selon la revendication 1 ou 2, **caractérisé en ce que** la tôle à base d'acier est utilisée comme matière initiale. 10
 4. Procédé selon la revendication 1, 2 ou 3, **caractérisé en ce que** la tôle est revêtue de métal et/ou est revêtue de matière plastique. 15
 5. Procédé selon l'une quelconque des revendications 1 à 4, **caractérisé en ce que** l'étirage bi-axial est effectué en poussant un poinçon (4) à tête de forme convexe contre la partie centrale de l'ébauche à mettre en forme. 20
 6. Procédé selon l'une quelconque des revendications 1 à 5, **caractérisé en ce que** la partie centrale soumise à un étirage bi-axial correspond au moins à la base de boîte à mettre en forme à partir de l'ébauche. 25
 7. Procédé selon la revendication 6, **caractérisé en ce que** la partie centrale soumise à un étirage bi-axial comporte également la partie de l'ébauche à partir de laquelle est formée une partie de transition conique depuis la base de la boîte vers la paroi de la boîte. 30
 8. Procédé selon la revendication 3 ou selon l'une quelconque des revendications 4 à 7 en combinaison avec la revendication 3, **caractérisé en ce que** l'étirage bi-axial est effectué dans une mesure qui aboutit à une réduction d'épaisseur comprise en moyenne entre 20 et 30%. 35
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 9. Procédé selon la revendication 8, **caractérisé en ce que** la réduction d'épaisseur est uniformément répartie entre 23 et 27%. 45
 10. Procédé selon l'une quelconque des revendications 5 à 9, **caractérisé en ce que** la matière initiale est de la tôle d'acier pourvue d'un revêtement métallique sur ses deux faces, l'une des matières étant choisie dans le groupe comprenant l'étain et le chrome-oxyde de chrome, et en outre revêtue sur ses deux faces d'au moins une couche de matière plastique choisie dans le groupe comprenant le PET, le polypropylène et des copolymères de ceux-ci. 50
55
 11. Procédé selon l'une quelconque des revendications 1 à 10, **caractérisé en ce que** la tôle utilisée a une valeur n d'au moins 0,16.
 12. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le corps de boîte est réalisé à partir de l'ébauche soumis à un étirage bi-axial en utilisant une seule étape d'emboutissage profond suivie par au moins une opération d'étirage de paroi.
 13. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** l'étirage bi-axial de la tôle et la mise en forme de corps de boîte à partir de celle-ci sont effectués sur une chaîne lors d'étapes de traitement successives.
 14. Procédé pour réaliser des boîtes remplies et fermées, **caractérisé en ce que** des corps de boîtes sont formés à l'aide du procédé selon la revendication 10, en combinaison avec la revendication 12 ou 13, après quoi les boîtes sont remplies et sont fermées hermétiquement d'une manière connue, à l'aide d'un couvercle.

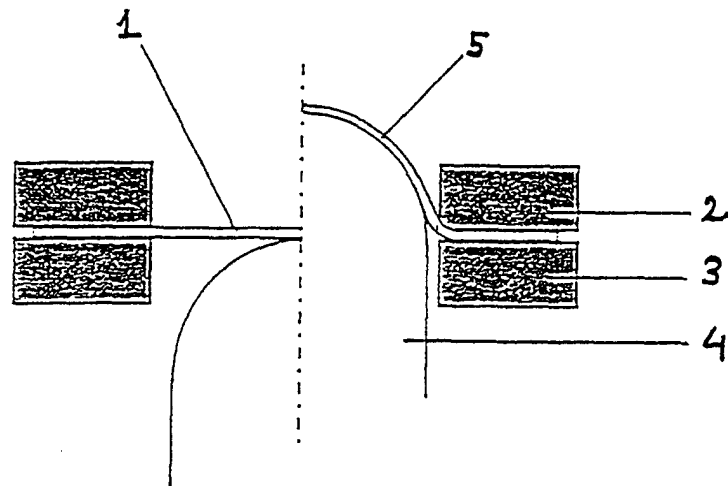


Fig. 1

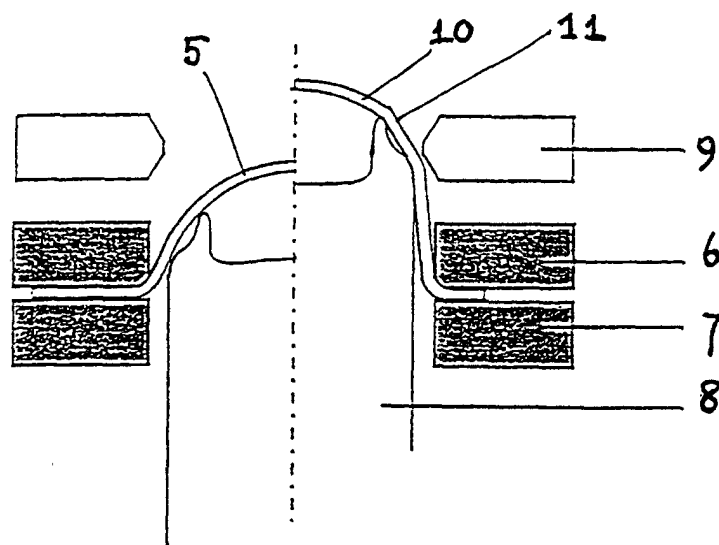


Fig. 2