A method of forming metal drawpieces for the manufacture of packaging, where the preforms are molded in the first phase in a metal strip and the strip is held during the molding of the preforms, and the drawpieces are punched from the strip with the preforms, which form the drawpieces. The preforms (2) molded in the first phase in a metal strip (1) have at least one surface (3) disposed in a plane (P2) substantially parallel to the plane of the sheet metal (P1), wherein the surface (3) is evenly stretched. A blank (4) which may also include a flange (i.e. a fragment of an unpressed sheet metal) is punched from such pressed preform (2) and then the drawpiece (5) is punched from which the blank (4), while the bottom (3) of the drawpiece (5) is molded from the top surface (3) of the preform (2) and the walls (8) of the drawpiece (5) are formed with oblique walls (6) of the preform (2) and a flange (7) of the blank (4).
The subject of the invention is a method of forming metal drawpieces for the manufacture of packaging, in particular aluminum cans for beverages or food.

Current trends in environmental protection inspire packaging manufacturers to develop solutions that meet customers’ expectations as well as regulatory requirements. An example can be a standard EN13428 "Packaging. Requirements specific to manufacturing and composition. - Prevention by source reduction", imposing on the manufacturers of packaging an obligation to provide a weight reduction of packaging to a minimum. The consequence of reducing the weight of the packaging is the material usage reduction, which should also lead to a reduction in manufacturing costs.

Beverage cans are mostly manufactured using drawing & ironing method (D&I). One of the presently known processes for manufacturing beverage cans is described, inter alia, in the publication of Brian T. Berge son and Maynard Reiling "Two Piece Beverage Canmaking", ISBN 0953100901 (published in UK by Sayers Publishing Group Ltd., first edition 1997). A device for forming a container with a shaped base wall and a method of forming the base wall is also known, for example, from a specification in a British Patent number GB 2316029.

The process of forming cans consists in cutting a round metal causing structural changes and its strengthening. Stretching the input material. A phenomenon of stretching the bottom can be achieved in principle by two methods, the thickness of the material. Reducing the thickness of the bottom of the can is only slightly smaller than the thickness of the peripheral surface walls. It is important that the thickness of the bottom of the can is only slightly smaller than the thickness of the material. Reducing the thickness of the bottom can be achieved in principle by two methods, by reducing the thickness of the input material or by stretching the input material. A phenomenon of stretching metal causing structural changes and its strengthening is known. As a result of the stretching operation the mechanical properties of aluminum increase.

The invention published as WO 95/05253 and PL 175587 discloses a method of reducing the instability by making a recess in the bottom of the cup, as is apparent from the drawings of the invention having a substantially flat end portion and then shaping the spherical part in the process of shaping the can body. Specifications US 5881593 and EP 1036607 B1 disclose a method for improving the transport of the cups by making a cylindrical recess in the bottom of the cup.

Specification WO 2011/049775 A1 discloses a method for reducing the thickness of the bottom of the can body while maintaining the strength requirements of packaging, keeping the initial thickness of the input material, while decreasing the diameter of a disc (blank). In the invention, the bottom of the cup is drawn into the interior of the cup using a spherical punch.

Specification WO 2011/128385 discloses a method and instrumentation for the implementation of an internal spherical recess in the bottom of the cup to reduce the thickness of the bottom of the cup in relation to the thickness of input material. Invention WO 2011/095613 discloses a method of thinning the thickness of the bottom of the can body by pulling the bottom of the cup using a spherical punch and counter-drawing and ironing the walls. The present inventors have focused mainly on the steel but they did not limit the applicability only to this material. The possibility of performing initial deformation in the sheet metal was indicated, however a method both for performing this operation as well as a method of using the discs with the indicated deformations was not disclosed. Invention WO 2013/017485 discloses several possibilities of drawing the bottom of the cup.

Specification WO 2009/097678 discloses a method of reducing the cost of returning the processing waste to the manufacturer of strip for the can bodies by making discs (blanks) for the drawpieces, preferably with pre-drawing in the form of a suitably shaped bulge in order to facilitate feeding of said discs to the cup press. According to the applicants the main objective of performing these bulges is to avoid sticking of the discs (blanks) together. Specification WO 2008/067522 discloses a method and means of production of two-piece beverage cans using the pre-cut discs (blanks), consisting in using previously cut discs instead of the strip and the disc feeder instead of roll dispenser. Discs (blanks) are supplied from the manufacturer in special sets and are placed on the feeder.

The above solutions can be difficult to achieve or economically unjustified in the case of modernization of devices - especially over long distances between the shaped elements on the input strip. Performing the execution of the stretching of the bottom of the cup requires either an additional station, or a total redesign of the cup press to e.g. to allow discharge of the cups made. On the other hand, pre-cutting of the discs requires additional equipment both on the side of the strip manufacturer, as well as a manufacturer of cans and transport service providers. Under certain conditions, better results can be achieved by transporting the strip, which is highly compressed, than discs with necessary distances between the individual pieces. No known manner and method allows the use of metal discs pre-strengthened and thinned in such a way as to avoid a dangerous phenomenon of sticking of the discs together and the costly and complicated tooling changes. Moreover, in the solutions of the prior art, production of preforms and drawpieces for the manufacture of metal cans, pre-molding is performed by pressing the domes with a spherical or close to a spherical shape or directly on the drawpiece (cup). In the case of molding of the domes with a shape similar to a segment of a sphere, plastic deformation of the sheet is non-uniform, whereby the surface of the part of drawpiece located in the area of molding of the bottom of the cup during a can production does not have uniform strength properties. This is a disadvantage, as this part of the drawpiece forms a can bottom, being the component ensuring
its strength and stability. Consequently, the sheet from which the bottom of the drawpiece is pressed, must be of a suitably selected thickness so as to ensure the required strength of the can bottom.

[0009] The following is a method of forming metal drawpieces for the manufacture of packaging, allowing to obtain a drawpiece made with less material, while improving the mechanical properties needed to ensure the stability of the cans made of the drawpiece.

[0010] The method of forming metal drawpieces for the manufacture of cans according to the invention consists in a pre-molding of the preforms from a metal strip, punching the blanks and shaping the drawpieces. The method is characterized in that in the first phase preforms having one surface located substantially parallel to the plane of the sheet metal are molded. Molding takes place in the process of pressing on the mechanical or hydraulic press, and the strip is held during the molding. The preforms pressed from a metal strip obtain the shape similar to a truncated cone without base lying in a plane sheet, wherein the top surface is substantially parallel to the said plane. The generatrix of the cone is substantially straight. Then the blanks are punched from the so-molded preform, preferably of circular shape or contour on the basis of the wheel, wherein the blank comprises at least that part of the sheet metal, on which a preform has previously been molded. Subsequently, from so obtained blanks the drawpieces for the production of cans are formed, having a shape of a cylindrical cup, wherein the molding of the drawpieces takes place in such a way that the top surface of the preform similar to a truncated cone substantially in its entirety molds the bottom of the drawpiece, and the side surface of the drawpiece is molded from material from the side surface of the preform in a shape similar to a truncated cone and additionally from a flange material constituting a portion of a punched sheet metal from outside the base of the truncated cone.

[0011] The disclosed method of the invention allows the use of thinner sheet metal while maintaining the strength parameters of the bottom of the drawpiece, which is then formed into a can bottom. This is a benefit of the solution of the invention because it allows the use of a thinner sheet metal in the can manufacturing process, and thus material savings. A method according to the invention uses well-known phenomenon whereby mechanical properties, generally referred to as strengthening, are also changed to a certain degree as a plastic deformation progresses. Tensile strength, yield strength and hardnes generally increased in the stretched sheet metal, while reducing the plastic deformation capacity and the toughness. This is due to the phenomenon of arrangement in order of the planes and crystallographic directions of the structure of the metal subjected to cold stretching. In the solutions known, wherein the preforms are formed as domes or other type of irregular bulges, the following adverse effects on the homogeneity of the crystal structure of this plane occur, which then molds the can bottom. The present invention avoids this negative phenomenon. Using a truncated conical shape provides a substantially homogeneous and uniform stretching of the top surface of the preform. This results in the desired effect of the uniform hardening of the material over the entire flat surface of the stretched material. For example, material saving proven in the course of the research tests carried out for the aluminum beverage cans with a capacity of 0.5 liters and a diameter of approx. 66mm was (2 - 8%).

[0012] In the described embodiment, preparation of the drawpieces for molding the can bodies is done in two operating cycles of the press with the movement of the strip in between cycles where the first press cycle molds a number of preforms from a metal strip. Then, in the second press cycle punching of blanks and preforms as well as the pressing of cylindrical drawpieces therefrom is carried out. A variation of this embodiment of the invention is a variant in which the cutting of the blanks and pressing the drawpieces takes place in the movement of the press with a direction according to the direction of the movement of the press punch in the first cycle. In this embodiment, the top surface of the preform is pressed inwardly to form an inner side of the bottom of the finished drawpiece, eliminating the process of preform scrolling.

[0013] In a preferred embodiment of the invention, the strip is held during the molding of the preforms with draw thresholds, which reduces the clamping force and ensures uniform stretching in the region of the top plane of the preform.

[0014] A method of forming the drawpieces for the manufacture of the can bodies was demonstrated in the embodiment of fig. 1, which shows a cross-section of the metal strip (1) with visualized preforms (2) in a shape similar to a trapezium with essentially straight arms (6), a blank (4) with a flute portion (7) and the drawpiece (5) with a flat bottom (3) and side walls (8).

[0015] Referenced numerals used in the drawings indicate the following elements subject to the molding: 1 - metal strip; 2 - preform; 3 - top surface of the preform and drawpiece bottom; 4 - blank; 5 - drawpiece; 6 - inclined wall of the preform; 7 - blank flange; 8 - drawpiece wall, P1 - the plane in which the metal strip is located; P2 - the plane of the top surface of the preform substantially parallel to the plane P1.

[0016] In an embodiment of the invention the process is conducted using a double-action press; a toolkit mounted on the worktable, into which the strip alloy based on aluminum with a width of approx. 1700mm and a thickness of .250mm is introduced. The strip is located in plane P1. A first operating cycle of the press in a metal strip (1) molds the preforms (2) with a truncated conical shape and an open base, where the top surface (3) of the preform (2) located in plane P2 is parallel to plane P1. The top surface (3) of the preform (2) has the shape of a circle with a diameter of approx. 110mm while the open base of the cone is a circle with a diameter of approx. 120mm. The distance between points on the axis.
of symmetry of the preforms intersecting the planes P1 and P2 (height of the cone) is approx. 8mm, while in the cross-section inclination angle of the inclined walls (6) of the preform (2) with respect to plane P1 on the outside of the trapezium is approx. 140°. After extrusion of the preform the thickness of the sheet metal forming the top surface (3) is approx. .240mm while the thickness of the sheet metal forming an oblique wall (6) of the preform (2) is approx. .246mm. In the second operating cycle of the press in a counter-punch movement relative to the movement of the punch in the first operating cycle of the press a contour-shaped blank (4) similar to the circle is cut and a diameter of approx. 160mm wherein the thickness of the preform flange (7) is approx. .250mm, and further movement of the punch pressing the drawpiece (5) of a cylindrical shape having a bottom in the shape of a circle with a diameter of approx. 95mm and a thickness of approx. .240mm. So formed drawpiece (5) has a bottom made entirely of thinned and strengthened material of a strip (1) which, after the first press operating cycle was the top surface (3) of the preform (2). A drawpiece (5) may be subjected to further metal forming in a variety of processes molding an aluminum beverage can, and in each case retaining sufficient strength of the bottom even though it is made of aluminum alloy of decreased volume than in prior art processes.

Claims

1. A method of forming metal drawpieces for the manufacture of packaging, where the preforms are molded in the first phase in a metal strip and the strip is held during the molding of the preforms, and the drawpieces are punched from the strip with the preforms, which form the drawpieces, characterized in that the preforms (2) molded in the first phase in a metal strip (1) have at least one surface (3) disposed in a plane (P2) substantially parallel to the plane of the sheet metal (P1), wherein the surface (3) is evenly stretched, and then the blank (4) is punched, from which the drawpiece (5) is pressed, while the bottom (3) of the drawpiece (5) is molded from the top surface (3) of the preform (2) and the walls (8) of the drawpiece (5) are formed with oblique walls (6) of the preform (2) and a flange (7) of the blank (4).

2. A method of forming metal drawpieces according to claim 1 characterized in that the strip (1) is held during the molding of the preforms (2) with draw thresholds

3. A method of forming metal drawpieces according to claim 1 or 2 characterized in that molding numerous forms (2) in a metal strip (1), punching the blanks (4) and molding the drawpieces (5) takes place in the on press operating cycle.

4. A method of forming metal drawpieces according to claim 1 or 2 characterized in that molding numerous forms (2) in a metal strip (1), punching the blanks (4) and molding the drawpieces (5) takes place in the on press operating cycle.

5. A method of forming metal drawpieces according to any one of the preceding claims, characterized in that the molded preforms (2) in a metal strip (1) have a shape similar to a trapezium open at its base in a plane P1;

6. A method of forming metal drawpieces according to any one of the preceding claims, characterized in that the ratio of the thickness of the sheet metal forming the top surface (3) of the preform (2) to the distance of said top surface (3) of the sheet metal plane (P1) is at least 1:0.05 (100:5).
### DOCUMENTS CONSIDERED TO BE RELEVANT

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The present search report has been drawn up for all claims.
This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on 30-08-2016.

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For more details about this annex: see Official Journal of the European Patent Office, No. 12/82.
REFERENCES CITED IN THE DESCRIPTION

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