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(54) **A method of producing metal cans and metal cans produced thereby**

Verfahren zum Herstellen von Metalldosen und damit hergestellte Metalldosen

Méthode de fabrication des boîtes en métal et les boîtes en métal fabriquées suivant cette méthode

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(73) Proprietors:
- **Corus UK Limited**
  London W1V 2BS (GB)
- **Redicon Corporation**
  Canton, Ohio 44708-1467 (US)

(72) Inventors:
- **Williams, John Selwyn**
  Swansea SA4 4GE (GB)
- **Bastable, Brian John**
  Swansea SA3 3JR (GB)
- **Bulso, Joseph**
  Canton, Ohio 44708-1467 (US)

(74) Representative: **Fry, Alan Valentine et al**
Fry Heath & Spence LLP,
The Gables,
Massetts Road
Horley, Surrey RH6 7DQ (GB)

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Description

[0001] This invention relates to a method of producing metal cans and to metal cans produced by this method.

[0002] Metal cans such as beverage cans are conventionally produced from two pieces by a process in which the base and wall of the can is formed from a single blank of starting material. One such process is known as the drawn and wall ironed (DWI) process. In this process the starting material is tinplate or aluminium and the blank is cut and drawn into a cup which is then formed into a can shell by precise thinning of the wall. This thinning is accomplished by forcing the cup through a series of annular rings using a punch, the gap between each ring and the punch gradually decreasing thereby "ironing" the metal. The can is then cleaned and coated internally and externally with organic lacquers to provide protection against corrosion and decoration to the external can surfaces. The DWI process suffers from two major drawbacks. Firstly, the required equipment is expensive and is normally only justified when large numbers of cans are to be produced. Secondly, the process is environmentally unfriendly because large volumes of water are used to cool and clean the can and solvents and other organics are emitted during the lacquer coating process. WO-A-8302577 discloses a typical DWI process.

[0003] An alternative process is one known as the draw-redraw (DRD) process. In this process the original cup is redrawn in sequential stages to produce a can of the correct diameter and height. The starting material is conventionally electro-chromium coated steel (ECCS) pre-coated with a lacquer. This DRD process has advantages in terms of simplicity, environmental friendliness and lower capital outlay. However, more metal is used for each can produced and the pre-coated lacquer cannot be relied upon to offer sufficient corrosion protection once the can has been formed.

[0004] The present invention sets out to alleviate many of the problems associated with conventional can production processes, some of these being discussed above. In particular, the invention addresses the difficulties associated with can shaping, especially can doming. The dome of a can has to withstand high internal pressures to meet industrial standards at steels of low thickness (typically 0.15-0.16mm). Conventionally, DWI cans are internally coated with a spray coat of 'lacquer' which must cover all the exposed metal. This is difficult to achieve on surfaces close to the vertical and on sharp radii. A DWI can dome may be 'reformed' after spraying to alter geometry. Therefore, it is an object of the present invention to achieve the desired geometries without the need for reforming.

[0005] This object can be achieved by a process according to claim 1 and a metal can according to claim 10.

[0006] According to the present invention in one aspect, there is provided a process for producing metal cans from a feedstock comprising a low carbon steel strip or sheet coated on each of its surfaces with a coherent laminated coating of a thermoplastic polymer material, the process including one or more redrawing stages in which the side walls are reduced in thickness by a stretching operation, and forming in the can base an inwardly projecting dome bordered by upstanding walls which subtend an angle of between 0 and 5° to the vertical.

[0007] The feedstock preferably comprises a low carbon steel strip or sheet of less than 0.25mm thickness and coated on each of its surfaces with coherent laminated films of a thermoplastic polymer, the laminate coating having sufficient formability to withstand without loss of integrity reductions in thickness of up to 40%.

[0008] The polymer laminates may comprise films of polyethylene terephthalate and polypropylene. Other film materials may however be used. The films may be bonded to the surfaces of the feedstock using heat and pressure. The films may be coextruded whereby a bonding film of approximately 2μm first makes contact with the feedstock followed by a polymer film coating which, after coating, is heated and cooled to produce an amorphous structure in the polyethylene terephthalate and a minimal crystalline structure in the polypropylene.

[0009] Preferably, the process comprises an initial cupping operation followed by first and second stretch redraw operations. Additional redraw stages may be introduced. The base of the can may be shaped to include an inwardly projecting dome during or immediately following the second stretch (or final) redraw operation. Stretching is preferably achieved by restricting - but not preventing - movement of the cupped feedstock between opposed faces of a pressure sleeve and die. One surface of the die on which the cupped feedstock seats may be recessed and a curved annular projection may extend inwardly from an upper face of the die to define a stretch point for the cupped feedstock.

[0010] Preferably, the process provides a metal can whose wall thickness is of the order of 5 to 40% less than the thickness of its base.

[0011] In a further aspect, the invention provides a process for producing a metal can from a feedstock comprising a low carbon steel strip or sheet coated on each of its surfaces with a coherent laminated coating of a thermoplastic polymer material, the process including one or more redrawing stages in which the side walls are reduced in thickness by a stretching operation.

[0012] In a preferred embodiment, the feedstock for cans to be produced in accordance with this invention is double reduced high-strength high ductility low carbon steel having a proof strength in the range 480 to 690 N/mm^2. The maximum carbon level for the steel is typically 0.05% by weight. A typical specification for this steel is by weight %, C 0.01 - 0.04; S 0.02 max; P 0.015 max; Mn 0.15-0.30; Ni 0.04 max; Cu 0.06 max; Sn 0.02 max; As 0.01 max; Mo 0.01 max; Cr 0.06 max; Al 0.02-0.09 and N_2 0.003 max. The steel is reduced by hot or cold rolling to a gauge typically of between 0.12mm and

0.25mm and is processed by known appropriate heating cycles and continuous annealing. The steel has a minimum earing quality and a strength typically in the range 500 to 600N/mm^2.

[0013] Typically, the steel is a high strength ductile steel known as TENFORM DR (RTM).

[0014] Strip produced from the feedstock may then be subjected to an electrolytic coating process. In this process, the steel strip is cleaned and pickled before being passed through a plating bath in which it is coated with a thin layer of chromium metal (typically of 0.01μm thickness) followed by a thin layer of chromium oxide (again typically of 0.01μm thickness). Alternatively, tinplate, blackplate or other suitable substrate could be employed.

[0015] The strip is then laminated with a polymer material, typically that known under the name "Ferrolite" (RTM). In this laminating process a film of PET (polyethylene terephthalate) and/or PP (polypropylene) and/or nylon either separately or simultaneously is bonded to the surface of the metallic coated steel strip or sheet using heat and pressure. The films are co-extruded so that a bonding layer of ~ 2μm first makes contact with the steel and forms a strong bond. After the bond is formed with the substrate the polymer films are melted and held above the recrystallisation temperatures for a few seconds before being rapidly quenched to below their softening temperatures. This produces an amorphous structure in the PET and a minimal crystalline structure in the PP.

[0016] No solvent emissions result from this laminating process.

[0017] Typically the thickness of the external polymer coating is of the order of 25μm thickness and the internal thickness is between 15 and 30μm.

[0018] Laminating processes and polymer films of a different structure and composition other than those discussed may be employed.

[0019] The strip, either in sheet or coil form, is fed to a cupper either in a pre waxed condition or is passed through a waxer on entry to the cupping system. The wax may be edible and petroleum based with film weights in the range of 5-20 mg/ft^2. At this stage the laminate may be heated in the range 70°-120°C. Alternatively the heating process may be carried out after the cupping or first redrawing stage. Pre-heating relieves stresses and ageing effects in the laminate so that subsequent forming is carried out more easily. Discs are stamped from the strip or sheet. The cup is stretch drawn in one operation using a disc with a diameter typically in the range 150mm to 200mm. This diameter is dependent (with gauge) upon the required can size and type of application. The draw ratio (i.e. ratio of the diameter of the disc to that of the cup) is typically in the range 1.0-2.0:1. The geometry of the tooling is designed in combination with the correct blank holding load to give a reduction in wall thickness at the cupping stage of up to 10%. This is accomplished with a die radius range typically between 0.5mm and 1.5mm and a parallel land length of up to 5mm. The blank holding load is achieved by use of a boosted air pressure of up to 200 psi fed into a series (typically three) of internal multiplying pistons. The punch/die gap is important and is controlled by the feedstock gauge and coating and gaps of 1.20 - 1.50 times the starting total laminate thickness are typically used. The punch nose radius is carefully controlled to achieve the required stretch whilst minimising subsequent can wall marking which could lead to laminate rupture. Punch nose radii in the range 2.5mm to 7mm are generally required.

[0020] The cupper cup is passed into the stretch redraw press which contains tooling for both first and second redraw operations. The diameter of the cup is reduced in the first redraw operation with a draw ratio in the range 1.0-1.7:1, and with a wall thickness reduction of up to 25% of the ingoing cup wall thickness. The wall thickness reduction is achieved by a stretching technique. The wall thickness reduction is balanced with the draw ratio and is achieved by use of pressure sleeve and die geometries in combination with controlled blank holding loads. The tooling geometries typically fall in the following ranges:

- pressure sleeve diameter up to 0.66mm smaller than the cupper cup ID;
- pressure sleeve radius up to 2.0mm;
- die radius up to 2mm with a parallel land length up to 5mm.

[0021] The blankholding load is achieved by use of air pressure of up to 100 psi fed into a stack of two or more internal multiplying pistons.

[0022] Location of the cup on the die is effected by means of a nest recess with a diameter matched to the cupper cup, allowing for the thickness of the actual laminate in use. The radius of the nest diameter with the die at the base of the nest is in the range 0.10 - 2.00mm.

[0023] The punch has a taper which is typically between 40mm and 60mm from the punch nose with an increase in punch diameter of 0.25mm to 0.50mm to aid stripping. The gap between the largest punch diameter and die (per side) is generally controlled to between 1.20 and 1.50 times the starting laminate thickness. The punch radius is important to achieve the required stretch whilst minimising subsequent can wall marking which could lead to laminate rupture. Punch nose radii in the range 1mm to 3mm are typically used.

[0024] Gap control or arrested draw is employed at the first redraw stage to

[0025] eliminate cup high spot clip offs or the generation of laminate "Whiskers". When gap control is used, gaps of 0.10 to 0.15mm between the pressure sleeve and die face are generally used depending upon the laminate feedstock used.

[0026] A small reverse draw in the cup base may also be used in this operation depending upon the dome re-

quired in the final can. Domes for carbonated beverages may be 206 (2 6/16 inches), 204 or 202 diameter. The purpose of the reverse draw is to eliminate the tendency to form chime wrinkles in the finished can and to make the cup base more rigid and thus keep the can circular and eliminate the tendency for oval cans.

[0027] The first redraw cup is passed back into the stretch redraw press in a station containing the second redraw tooling. The cup diameter is reduced in this operation to the final can diameter. This may be 211 for normal beverage cans or 209 for shaped beverage cans. The draw ratio used is generally in the range 1.0-1.7:1 with a wall thickness reduction of up to 25% of the ingoing cup wall thickness. The wall thickness reduction is again achieved by a stretching technique using a combination of pressure sleeve and die geometries with controlled blankholding loads. The correct choice of diameter reduction ratio to achieve the finished can is also important in enabling the stretching process to be successful. The tooling geometries used are typically in the following ranges:

- pressure sleeve diameter up to 0.30mm smaller than the first redraw cup internal diameter;
- pressure sleeve radius up to 2.0mm;
- die radius up to 2mm with a parallel land length up to 5mm.

[0028] The blankholding load is achieved by use of air pressure up to 100 psi fed into a stack of two or more internal multiplying pistons.

[0029] Location of the cup on the die is by means of a nest recess with a diameter matched to the first redraw cup, allowing for the thickness of the actual laminate in use. The radius of the nest diameter with the die at the base of the nest is typically in the range 0.10 - 2.0mm.

[0030] The punch has a taper located between 15mm and 30mm from the top of the second redraw cup in the range 0.10mm - 0.25mm increase in diameter to aid stripping of the can from the punch. The gap between the punch and the die (per side) at the widest point is controlled to between 1.0 and 1.20 times the starting laminate thickness.

[0031] Gap control or arrested draw is employed again as the second redraw stage to eliminate cup high spot clip offs or the generation of laminate "whiskers". When gap control is used, gaps of 0.10mm to 0.15mm are used between the pressure sleeve and die face dependent upon the laminate feedstock used. The overall can wall thinning employed is 5 - 40% dependent upon the end use of the can.

[0032] A dome is formed in the can at this stage by use of a doming station with a forming ring acting as a blank holder. The blankholding load on the form ring is achieved by use of a boosted air pressure up to 500 psi fed into a series (typically three) of internal stacked pistons. The positions of the forming ring relative to the dome die is important in that the ring must clamp the laminate to the dome chime of the punch before the dome die starts to draw the dome. For carbonated beverage cans, domes of 202, 204 and 206 are used.

[0033] The dome profile must be capable of withstanding a dome reversal pressure of 90 - 100 psi depending upon can contents (pasteurised or non pasteurised). The dome, the can walls and neck must be capable of withstanding an axial load of 1.0KN. This is achieved by the combination of the high strength formable DR steel and the geometry of the design. It is also facilitated by the polymer laminate coatings which can withstand the forming operations and still offer protection at sharp radii and angles. Normally DWI cans are internally coated with a spray coat of 'lacquer' which must cover all exposed metal, but this is difficult to achieve on surfaces close to the vertical and on sharp radii. A DWI can dome may be 'reformed' after spraying to alter geometry but in this can the geometry described below is achieved without reforming.

[0034] The necessary features are the depth of the dome, which is preferably > 11 mm, the spherical radius of the dome, which preferably lies between 48 and 54mm, the radius at the the point where the inner upstanding wall meets the spherical dome is preferably less than 0.6mm and most importantly, the angle made between the upstanding walls (which border the inwardly projecting dome) should lie between 0 and 5° to the vertical.

[0035] After the final redraw the can is trimmed and passed through an oven. This oven is typically held at 200-230°C and the pass time is typically between 1 and 3 minutes. This facilitates the removal of petroleum wax lubricant to such a level so that it does not interfere with the laydown of printing inks used to decorate the can. It also raises the surface energy of the PET coating to at least 38 dynes/cm which increases the wettability of the PET surface to printing inks. The temperature cycle in the oven is chosen to minimise recrystallisation of the PET by rapid temperature rise and cooling times.

[0036] Printing is currently carried out using conventional machinery which applies thermally curing inks onto the external surface of the can. Again, recrystallisation of the PET is minimised as above. Alternatively a shrink-wrap sleeve may be applied at lower temperatures.

[0037] Can fillers are continually seeking methods of product differentiation in various forms. To date, this has mainly been achieved by the use of various decorations and decorating techniques. Another method of product differentiation being sought is by the use of shaped cans. The shaping of three-piece cans, particularly in the speciality packaging market, has been used for many years but the shaping of two-piece cans has hitherto been unknown. The key to the solution of can shaping is the formability inherent in the can wall presented to the shaping machine. There are various methods of achieving the desired shape, but all rely on a measure of formability, given by a combination of can wall thick-

ness and ductility. Three-piece cans have can walls with mechanical properties and thickness essentially the same as the ingoing plate. Two-piece cans have walls that are thinner than the starting material and hence due to strain hardening effects, stronger and less ductile than the starting material.

[0038] Different methods of can shaping require differing levels of formability and hence the level of formability left in a can wall will dictate the method of shaping that is likely to prove successful.

[0039] For 211 diameter beverage cans, the maximum outside can diameter at any point on the can after shaping should remain at 211 but for some applications increased diameter would be suitable. The reason for this is that this will minimise any disruption to existing filling lines, since, with any can making development, cost is by far the biggest driver. The trend, therefore, has been to manufacture cans with a smaller diameter, typically 209 and expand to 211 in various ways. This implies a diametrical expansion requirement of ~ 5.0%. The diametrical expansion possible by simple stretch forming alone on steel DWI cans varying from lightweight through to heavyweight cans has been measured at 0.7% - 1.2%. That for cans in accordance with this invention is 1.6% and that for aluminium DWI cans is 3.6%. These results indicate that if the can is to be shaped to current expected levels, then the deformation for all cans cannot be by stretch alone. However, these results indicate varying levels of formability and whereas the aluminium DWI cans claims of successful shaping have been made, increases of up to 30% of wall thickness are needed to achieve this. After shaping, the can still has to comply with the mechanical properties required of the can, particularly axial crush levels. Since aluminium cans do not exhibit strain hardening properties then the axial crush strength of a shaped aluminium can is very low.

[0040] Whilst steel DW1 cans have been successfully shaped, the process route involves intermediate treatment and/or advanced forming techniques which add significantly to be manufacturing cost.

[0041] Cans in accordance with the invention however, have been shaped successfully and with diametrical expansions recorded of 10% with much higher levels expected. This is possible with the increased formability of the can wall resulting from the special steel and production route used which is designed to increase ductility with little reduction in strength. This property, coupled with the strain hardening property of the steel also results in the formation of a shaped can with relatively high axial crush strength. Shaping is typically achieved using expandable mandrels which locate within the can interior, but other methods (such as hydro-forming) are possible.

[0042] A further advantage of the present invention is that if either an aluminium or steel DWI can is shaped, coating is particularly difficult with the problems of internal lacquer damage and the difficulty of internally spraying a shaped can. Cans in accordance with the invention are particularly suited since the coating is abrasion resistance and withstands current shaping operations, whilst maintaining good corrosion protection.

[0043] Also, no internal lacquers or external base coats are required.

[0044] The invention will now be further described by way of example only with reference to the accompanying diagrammatic drawings, in which:-

Figure 1 illustrates five stages of a cupping operation of the method of the present invention;

Figure 2 illustrates five stages of a first stretch redraw operation of the method of the present invention;

Figure 3 illustrates six stages of a second stretch redraw operation of the method of the present invention;

Figure 4 is a detail to an enlarged scale of a stretch redraw operation in accordance with the invention; and

Figure 5 is a half-section taken through a can produced in accordance with the invention.

[0045] Figure 1 shows five stages of a cupping operation of the method of the present invention. The five stages are labelled A to E. Stage 1 A shows a feedstock strip 1 of laminated steel strip held between a draw pad 2 and a blank and draw die 3. A disc 4 of the required diameter is cut from the strip, by downward movement of a cutter 5 (see Figure 1B). A punch 6 (Figures 1 C and 1 D) is then moved downwardly with the disc edges trapped between the opposed surfaces of the draw pad 2 and draw die 3. A cup 7 is thereby formed which is removed from the die by air pressure (see Figure 1E).

[0046] Typically, the feedstock strip is of the order of 0.16mm gauge. This compares with a gauge of around 0.28mm for conventional aluminium feedstock.

[0047] As will be seen from Figure 2, the cup 7 is then placed on a die 8 for first redraw purposes. This stage is illustrated in Figure 2A. The die is formed with a shaped lip 9 and has a curved annular projection 10 protruding inwardly from its upper surface. The lip 9 and projection 10 can be seen more clearly from Figure 4. As seen in Figure 2B, a pressure sleeve 11 and punch 12 move downwardly and within the side wall of the cup 7. The outer rim of the cup base seats between the opposed surfaces of the pressure sleeve 11 and the die 8. The gap between these members is sufficient only to restrict movement of the cup 7, not to impose a force sufficient to deform or iron the cup. As the punch is moved downwardly, so the cup wall is stretched to increase cup height. This stretching process can be seen more clearly from Figure 4. It will be seen that the cup

wall between the projection 10 and the punch lower face is not in contact with either the die 8 or the side wall of the punch 12. Movement of the cup between the pressure sleeve 11 and the die 8 and over the curvilinear projection 10 is restricted to cause stretching of the cup wall.

[0048] After stretching, the cup is ejected by air pressure (see Figure 2E).

[0049] Turning now to Figure 3, the second redraw operation uses the same or very similar pressure sleeve and die as those used in the first redraw operation. These have accordingly been given the same reference numerals.

[0050] In Figure 3, the cup 7 is again shown positioned on the die 8. See Figure 3A. The pressure sleeve 11 is moved downwardly as shown in Figure 3B to position the sleeve within the cup 7. Again, the spacing between the sleeve 11 and the die 8 is to restrict movement of the cup, not to preclude such movement.

[0051] A punch 14 including a recessed base 15 is moved downwardly into engagement with the cup base to once again stretch the cup side wall and effect elongation thereof. The stretching operation being as described above in relation to Figure 2. This stretching operation is shown in Figures 3C and 3D. After the cup leaves the die 8 continual downward movement of the punch 14 places the cup base into engagement with a dome die 16 and a forming ring 17 which operate to produce in the cup base a required dome which imparts strength to the finished article.

[0052] The fully stretched and formed cup is the ejected using air pressure as shown in Figure 3F.

[0053] Typically, the fully stretched and formed cup has a midwall thickness of around 0.12mm and a top wall thickness of around 0.15mm. These dimensions compare with 0.104mm and 0.165mm respectively for conventional aluminium cans.

[0054] The shape imposed in the can base by the forming ring and dome die is shown in Figure 5. This dome has to withstand internal pressures of at least 95 psi to meet current industrial standards at steel thicknesses below 0.20mm (typically 0.15/0.16mm). This is achieved by the combination of the high strength formable DR steel and the geometry of the design. It is also facilitated by the polymer laminate coatings which can withstand the forming operations and still offer protection at sharp radii and angles. Normally DWI cans are internally coated with a spray coat of 'lacquer' which must cover all exposed metal, but this is difficult to achieve on surfaces close to the vertical and on sharp radii. A DWI can dome may be 'reformed' after spraying to alter geometry but in this can the geometry described below is achieved without reforming. With reference to Figure 5, the important features are the depth of the dome, DD, which should be > 11 mm, the spherical radius of the dome, SR, which should lie between 48 and 54mm, the radius at position 20 which should be less than 0.6mm and the angle θ which should lie between 0 and 5°.

[0055] If the can is to be shaped, this can be achieved by insertion of an expandable mandrel which, one expanded, imposes any required shape to the can. This is possible only because of the particular pre-coated laminated strip feedstock employed which has sufficient inherent formability to withstand the stretching and forming operation discussed without any loss of coating integrity. Other can shaping processes including hydroforming can be employed.

[0056] It will be apparent from the foregoing that the invention provides can shaping by mechanical expansion (typically up to 10%) with no intermediate treatment, upgauging or lacquer repair system required. Thus, the expansion potential for lightweight cans is maximised and the higher strength and work hardening achieved results in improved axial crush performance. Also, solvent emissions are virtually eliminated and all coatings are PVC free. Waste products from the can making process are also significantly reduced.

[0057] It will be appreciated that the foregoing is merely exemplary of methods and apparatus in accordance with this invention and that modifications can readily be made thereto without departing from the scope of the invention, which is defined by the appended claims.

Claims

1. A process for producing metal cans from a feedstock comprising a low carbon steel strip (1) or sheet coated on each of its surfaces with a coherent laminated coating of a thermoplastic polymer material, the process including one or more redrawing stages in which the side walls are reduced in thickness by a stretching operation, and forming in the can base an inwardly projecting dome (10) bordered by upstanding walls which subtend an angle of between 0 and 5° to the vertical.

2. A process as claimed in claim 1 wherein the low carbon steel strip (1) is a double reduced high-strength high ductility low carbon steel having a proof strength in the range 480 to 690 N/mm^2.

3. A process as claimed in claim 2 wherein the maximum carbon level for the steel is 0.05% by weight.

4. A process as claimed in any one of claims 1 to 3 wherein the low carbon steel strip includes by weight %, C 0.01- 0.04; S 0.02 max; P 0.015 max; Mn 0.15-0.30; Ni 0.04 max; Cu 0.06 max; Sn 0.02 max; As 0.01 max; Mo 0.01 max; Cr 0.06 max; Al 0.02-0.09 and N_2 0.003 max.

5. A process as claimed in any one of the preceding claims wherein the steel is reduced by hot or cold rolling to a gauge of between 0.12mm and 0.25mm.

6. A process as claimed in any one of the preceding claims wherein the feedstock comprises a low carbon steel strip (1) or sheet of less than 0.25mm thickness and coated on each of its surfaces with coherent laminated films of a thermoplastic polymer, the laminate coating having sufficient formability to withstand without loss of integrity reductions in thickness of up to 40%.

7. A process as claimed in claim 6 wherein the polymer laminates comprise films of polyethylene terephthalate and polypropylene.

8. A process as claimed in claim 6 or claim 7 wherein the films are bonded to the surfaces of the feedstock using heat and pressure.

9. A process as claimed in any one of claims 6 to 8 wherein the films are coextruded whereby a bonding film of approximately 2µm first makes contact with the feedstock followed by a polymer film coating which, after coating, is heated and cooled to produce an amorphous structure in the polyethylene terephthalate and a minimal crystalline structure in the polypropylene.

10. A metal can of low carbon steel coated on its internal and external surfaces with a laminated coating of thermoplastic polymer having good formability, the base of the can being formed with a dome shaped projection (10) whose inner wall subjects an angle no greater than 5° to the vertical.

11. A metal can as claimed in claim 10 wherein side walls of the can are reduced in thickness by a stretching operation.

12. A metal can as claimed in claim 10 or claim 11 of double reduced high-strength high ductility low carbon steel having a proof strength in the range 480 to 690/mm^2.

13. A metal can as claimed in claim 12 wherein the maximum carbon level for the steel is 0.05% by weight.

14. A metal can as claimed in claim 13 including by weight %, C 0.01-0.04; S 0.02 max; P 0.015 max; Mn 0.15-0.30; Ni 0.04 max; Cu 0.06 max; Sn 0.02 max; As 0.01 max; Mo 0.01 max; Cr 0.06 max; Al 0.02-0.09 and N_2 0.003 max.

15. A metal can as claimed in any one of claims 10 to 14 wherein the steel is reduced by hot or cold rolling to a gauge of between 0.12mm and 0.25mm.

Patentansprüche

1. Verfahren zum Herstellen von Metalldosen aus einem Ausgangsmaterial, bestehend aus einem kohlenstoffarmen Stahlband (1) oder einem kohlenstoffarmen Stahlblech, die auf beiden Seiten mit einem kohärenten laminierten Überzug aus einem thermoplastischen Polymermaterial überzogen sind, wobei das Verfahren eine oder mehrere Nachziehstufen aufweist, in denen die Seitenwände in ihrer Dicke durch Strecken verringert werden und in der Dosenbasis eine nach innen vorstehende Kuppel (10) erzeugt wird, die durch aufrecht stehende Wände begrenzt ist, die einen Winkel zwischen 0° und 5° gegenüber der Vertikalen einschließen.

2. Verfahren nach Anspruch 1, bei welchem das kohlenstoffarme Stahlband (1) aus einem doppelt reduzierten, hochfesten, kohlenstoffarmen Stahl mit hoher Duktilität besteht, der eine Streckgrenze im Bereich zwischen 480 bis 690 N/mm^2 aufweist.

3. Verfahren nach Anspruch 2, bei welchem der maximale Kohlenstoffgehalt des Stahls 0,05 Gew. % beträgt.

4. Verfahren nach einem der Ansprüche 1 bis 3, bei welchem das kohlenstoffarme Stahlband die folgenden Bestandteile in Gewichtsprozenten enthält: C 0,01-0,04; S 0,02 maximal; P 0,015 maximal; Mn 0,15-0,30; Ni 0,04 maximal; Cu 0,06 maximal; Sn 0,02 maximal; As 0,01 maximal; Mo 0,01 maximal; Cr 0,06 maximal; Al 0,02-0,09 und N_2 0,003 maximal.

5. Verfahren nach einem der vorhergehenden Ansprüche, bei welchem der Stahl durch Warmwalzen oder Kaltwalzen auf eine Stärke zwischen 0,12 mm und 0,25 mm reduziert wird.

6. Verfahren nach einem der vorhergehenden Ansprüche, bei welchem das Ausgangsmaterial aus einem kohlenstoffarmen Stahlband (1) oder kohlenstoffarmen Stahlblech mit einer Dicke von weniger als 0,25 mm besteht, überzogen auf beiden Oberflächen mit kohärenten, beschichteten Filmen aus einem thermoplastischen Polymer, wobei der Laminatüberzug eine ausreichende Formbarkeit besitzt, um ohne Integrationsverlust Dickenverminderungen bis zu 40 % widerstehen zu können.

7. Verfahren nach Anspruch 6, bei welchem die Polymerlaminate aus Filmen von Polyehtylenterephthalat und Polypropylen bestehen.

8. Verfahren nach den Ansprüchen 6 oder 7, bei welchem die Filme auf den Oberflächen des Ausgangs-

materials unter Benutzung von Wärme und Druck festgelegt werden.

9. Verfahren nach einem der Ansprüche 6 bis 8, bei welchem die Filme gemeinsam stranggepresst sind, wodurch ein Verbindungsfilm von etwa 2µm zunächst mit dem Ausgangsmaterial in Berührung gelangt, gefolgt von einem Polymerfilmüberzug, der nach dem Überzugsvorgang erhitzt und abgekühlt wird, um eine amorphe Struktur in dem Polyehtylenterephthalat und eine minimale kristalline Struktur in dem Polypropylen zu erzeugen.

10. Metalldose aus einem kohlenstoffarmen Stahl, der an seiner inneren und äußeren Oberfläche mit einem Laminatüberzug aus einem thermoplastischen Polymer überzogen ist, welches eine gute Formbarkeit aufweist, wobei die Basis der Dose mit einem kuppelartigen Vorsprung (10) versehen ist, dessen innere Wände einen Winkel von nicht mehr als 5° gegenüber der Vertikalen einschließen.

11. Metalldose nach Anspruch 10, bei welcher die Wände der Dose in ihrer Dicke durch einen Streckvorgang vermindert sind.

12. Metalldose nach den Ansprüchen 10 oder 11, bestehend aus einem doppelt reduzierten, hochfesten, kohlenstoffarmen Stahl hoher Streckbarkeit und einer Streckgrenze im Bereich zwischen 480 bis 690 N/mm^2.

13. Metalldose nach Anspruch 12, bei welcher der maximale Kohlenstoffgehalt des Stahls 0,05 Gew. % beträgt.

14. Metalldose nach Anspruch 13, welche die folgenden Bestandteile in Gewichtsprozenten aufweist: C 0,01-0,04; S 0,02 maximal; P 0,015 maximal; Mn 0,15-0,30; Ni 0,04 maximal; Cu 0,06 maximal; Sn 0,02 maximal; AS 0,01 maximal; Mo 0,01 maximal; Cr 0,06 maximal; Al 0,02-0,09 und N_2 0,003 maximal.

15. Metalldose nach einem der Ansprüche 10 bis 14, bei welcher der Stahl durch Warmwalzen oder Kaltwalzen auf eine Stärke zwischen 0,12 mm und 0,25 mm verringert ist.

Revendications

1. Processus de production de canettes métalliques à partir d'un produit de départ comprenant une tôle ou un feuillard en acier doux (1) appliqué sur chacune de ses surfaces avec un revêtement laminé cohérent d'un matériau polymère thermoplastique, le processus comprenant une ou plusieurs étapes d'emboutissage au cours desquelles l'épaisseur des parois latérales est réduite par une opération d'étirage, et un formage dans le fond de la canette d'un dôme de projection dirigé vers l'intérieur (10) bordé de parois élevées formant un angle compris entre 0 et 5 ° à la verticale.

2. Processus selon la revendication 1, dans lequel le feuillard en acier doux (1) est un acier doux à ductilité élevée hautement résistant à double réduction ayant une limite conventionnelle d'élasticité comprise entre 480 et 690 N/mm^2.

3. Processus selon la revendication 2, dans lequel la teneur maximale en carbone pour l'acier est de 0,05 % en poids.

4. Processus selon l'une quelconque des revendications 1 à 3, dans lequel le feuillard en acier doux comprend, en % en poids, C 0,01 à 0,04 ; S 0,02 maximum ; P 0,015 maximum ; Mn 0,15 à 0,30 maximum ; Ni 0,04 maximum ; Cu 0,06 maximum ; Sn 0,02 maximum ; As 0,01 maximum ; Mo 0,01 maximum ; Cr 0,06 maximum ; Al 0,02 à 0,09 et N_2 0,003 maximum.

5. Processus selon l'une quelconque des revendications précédentes, dans lequel l'acier est réduit par laminage à chaud ou à froid à une épaisseur comprise entre 0,12 mm et 0,25 mm.

6. Processus selon l'une quelconque des revendications précédentes, dans lequel le produit de départ comprend une tôle ou un feuillard en acier doux (1) d'une épaisseur inférieure à 0,25 mm et appliqué sur chacune de ses surfaces avec des films laminés cohérents d'un polymère thermoplastique, le revêtement laminé ayant une aptitude au formage suffisante pour supporter, sans perte d'intégrité, des réductions d'épaisseur pouvant aller jusqu'à 40 %.

7. Processus selon la revendication 6, dans lequel les laminés en polymère comprennent des films de polyétylène téréphtalate et de polypropylène.

8. Processus selon la revendication 6 ou la revendication 7, dans lequel les films sont collés aux surfaces du produit de départ en utilisant chaleur et pression.

9. Processus selon l'une quelconque des revendications 6 à 8, dans lequel les films sont coextrudés moyennant quoi un film collant d'environ 2 µm prend d'abord contact avec le produit de départ puis est revêtu d'un film de polymère qui, après revêtement, est chauffé et refroidi pour produire une structure amorphe dans le polyéthylène téréphtalate et une structure cristalline minimale dans le polypropylè-

ne.

10. Canette métallique en acier doux dont les surfaces internes et externes sont revêtues d'un revêtement laminé de polymère thermoplastique ayant une aptitude au formage satisfaisante, le fond de la canette étant formé d'une projection en forme de dôme (10) dont la paroi interne forme un angle inférieur à 5 °C à la verticale.

11. Canette métallique selon la revendication 10, dans laquelle l'épaisseur des parois latérales de la canette est réduite par une opération d'étirage.

12. Canette métallique selon la revendication 10 ou la revendication 11 en acier doux à ductilité élevée hautement résistant à double réduction ayant une limite conventionnelle d'élasticité comprise entre 480 et 690 N/mm^2.

13. Canette métallique selon la revendication 12, dans laquelle la teneur maximale en carbone pour l'acier est de 0,05 % en poids.

14. Canette métallique selon la revendication 13 comprenant, en % en poids, C 0,01 à 0,04 ; S 0,02 maximum ; P 0,015 maximum ; Mn 0,15 à 0,30 maximum ; Ni 0,04 maximum ; Cu 0,06 maximum ; Sn 0,02 maximum ; As 0,01 maximum ; Mo 0,01 maximum ; Cr 0,06 maximum ; Al 0,02 à 0,09 et N_2 0,003 maximum.

15. Canette métallique selon l'une quelconque des revendications 10 à 14, dans laquelle l'acier est réduit par laminage à chaud ou à froid à une épaisseur comprise entre 0,12 mm et 0,25 mm.

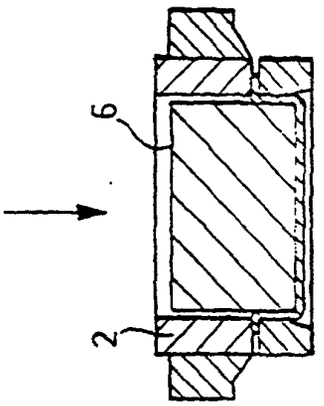


Fig.1C

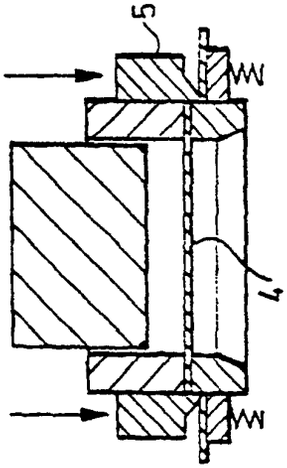


Fig.1B.

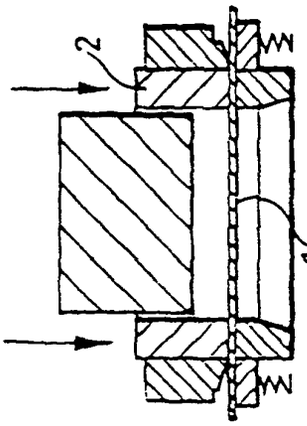


Fig.1A.

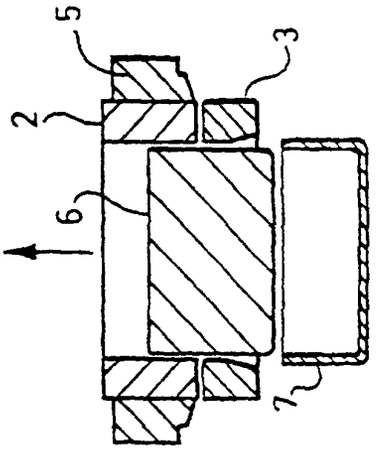


Fig.1E.

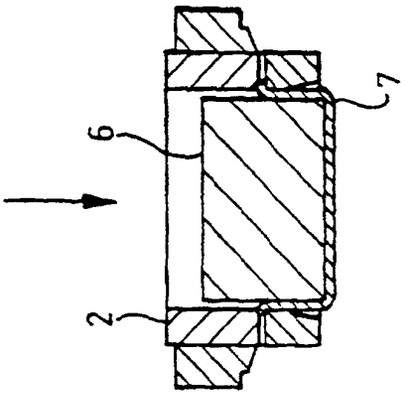


Fig.1D.

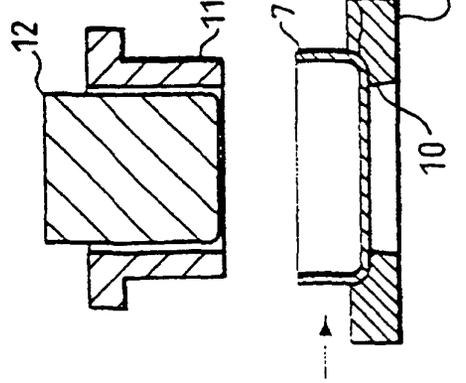


Fig.2A.

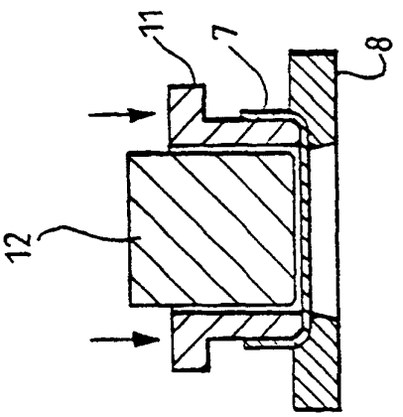


Fig.2B.

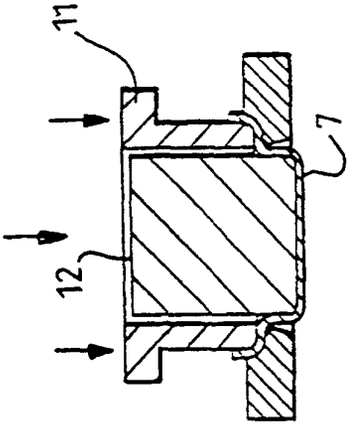


Fig.2C.

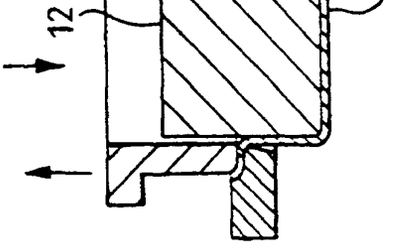


Fig.2D.

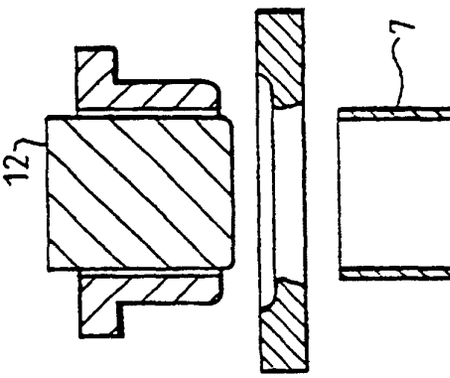


Fig.2E.

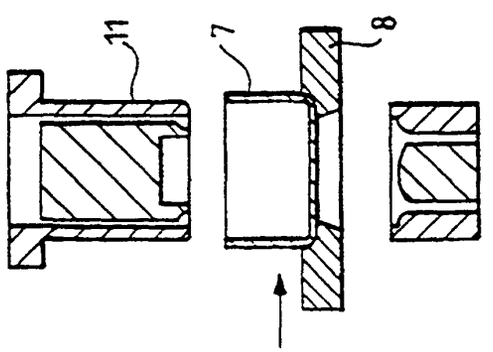


Fig.3A.

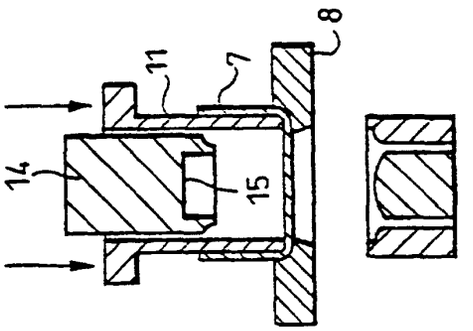


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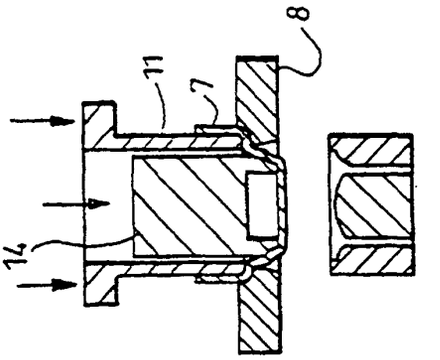


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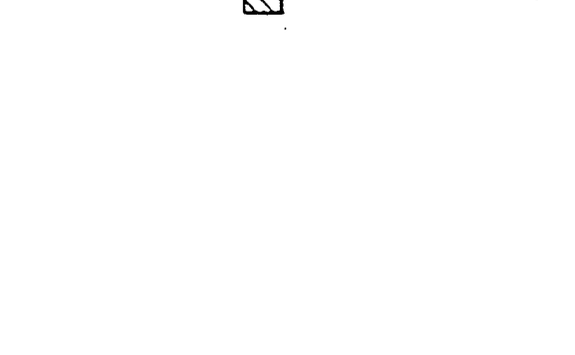


Fig.3D.

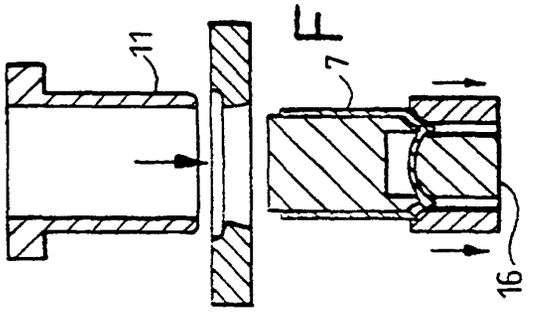


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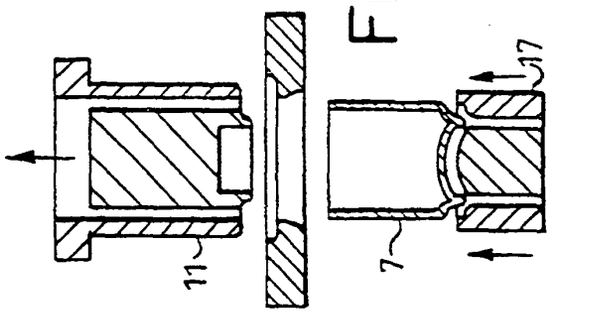


Fig.3F.

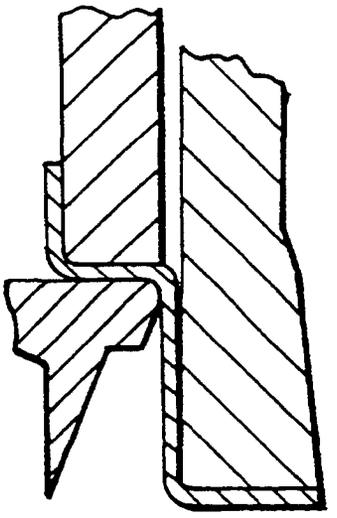


Fig.4.

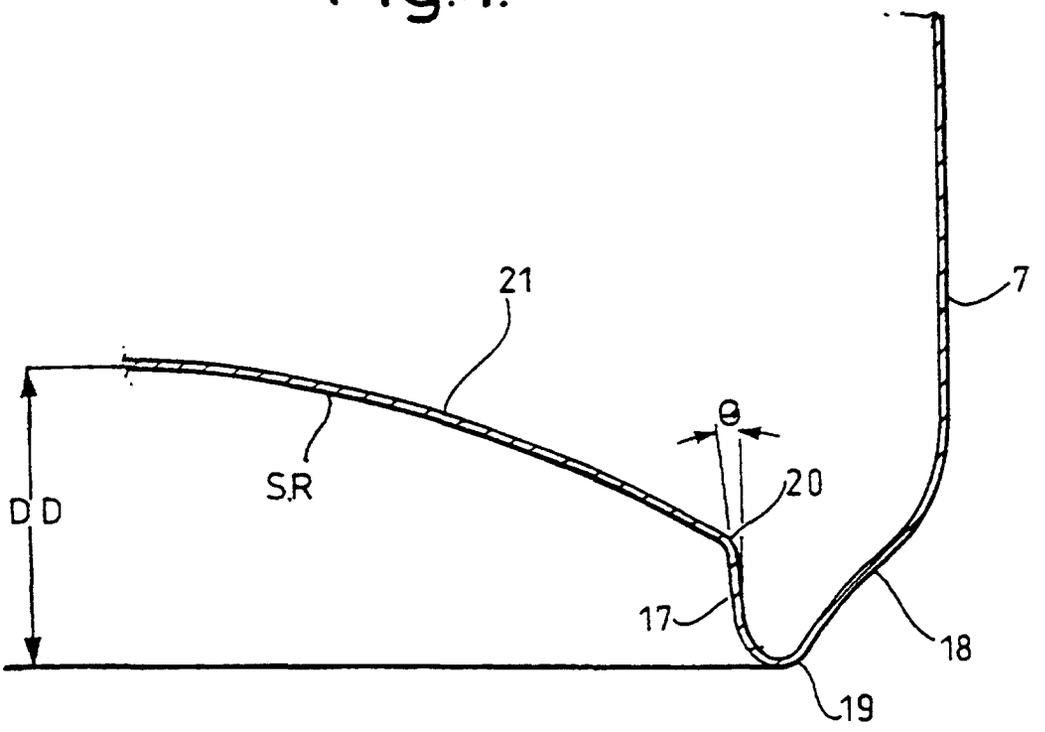


Fig.5.