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(71) Applicant: **METAL BOX p.l.c., Queens House Forbury Road, Reading RG1 3JH Berkshire (GB)**

(72) Inventor: **Juty, Andrzej Jan Jozef, 36 Ivenhoe Drive, Kenton Harrow Middlesex (GB)**
Inventor: **Pavely, Andrew Philip, 14 Beech Lea, Blunsdon Wiltshire (GB)**

(74) Representative: **Wright, Peter David John et al, R.G.C. Jenkins & Co. 12-15, Fetter Lane, London EC4A 1PL (GB)**

(54) Containers for pressurised products.

(57) A method for mounting a plastics member (20), such as an easy opening device, in a metal member (10), such as a metal end for a pressurised container, comprising forming the metal member to provide an inclined margin (18) around an opening (12) in the metal member, inserting the plastics member into the opening from the exterior side of the metal member, and reforming the metal of the margin to embed the free edge (14) of the margin in, and cause the same to seal around, the plastics member, the reforming being such that after reformation the margin is inclined at a substantial angle towards the interior side of the metal member. Apparatus for performing the method is also disclosed.

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CONTAINERS FOR PRESSURISED PRODUCTS

This invention concerns containers for pressurised products. A primary application of the invention is to essentially metal cans for carbonated beverage products and having easy opening end closures for ready access to the contents by the consumer.

Most easy opening ends which are currently available employ a metal easy opening device which is integrally attached to the can end along a score line. Plastics easy opening devices have been proposed in the past and can have various advantages over their metal counterparts. However, with the plastics easy opening devices which have been proposed hitherto, it has in practice been found difficult to consistently achieve the very high degree of seal integrity that is needed for pressurised, particularly carbonated beverage, products. Accordingly, pressurised containers with plastics easy opening devices have not yet achieved commercial acceptance, although a substantial amount of research has been devoted to their development.

The present invention seeks to overcome the problems previously experienced in obtaining a satisfactory seal between a plastics member and a

metal member for a pressurised container, and seeks in particular to provide a method capable of reliably retaining and sealing a plastics easy opening device in a metal end for a carbonated beverage can.

A method in accordance with the invention for mounting a plastics member in a metal member for a pressuried container comprises: forming the metal member to provide an inclined margin around an opening in the metal member, inserting the plastics member into the opening from the exterior side of the metal member, and reforming metal of the margin to embed the free edge of the margin in, and cause the same to seal around, the plastics member, after such reformation the margin being inclined at a substantial angle towards the interior side of the metal member.

A particular advantage of an easy opening end having a plastics easy opening device mounted in a metal end by this method is that, by virtue of the substantial angle of inclination of the reformed margin, internal pressures within a can to which the end is fitted will tend to cause the margin to bite increasingly into and seal more firmly about the easy opening device, the greater the pressure the better being the seal which is formed. As a

result, the seal may be able to withstand the considerable pressures associated with carbonated beverages.

According to a preferred feature of the invention, the effect of the reformation of the metal to embed the free edge of the metal in the plastics member is augmented by reformation of the plastics member radially outwardly along the margin on the interior side of the metal member. Advantageously, the reformation of the metal is achieved indirectly during the reformation of the plastics material, by tooling which makes no direct contact with the margin; scuffing of any protective coating or lacquer on the margin is thereby avoided.

Reforming of the plastics material enables the free edge of the metal to be more deeply embedded in the plastics material than would be possible by reformation of the metal alone. In this way, the free edge of the metal can be more fully isolated from the product in a container of which the metal member forms part, and the danger of product contamination and metal corrosion is thereby minimised.

For maximum protection of the free edge of the metal from attack by the product it is further preferred to cut the free edge of the metal margin so that it is axially directed and therefore readily engageable over its whole area with the plastics material.

A further advantageous feature is the offsetting of the root of the margin from the main plane of the metal member to form an annular shoulder or elbow in the metal. The shoulder acts as a hinge about which the margin may pivot during the metal reforming operation or subsequently in use. By forming such a hinge, distortion of the metal member which might otherwise occur may be eliminated.

Another aspect of the invention concerns apparatus for carrying out the above method.

According to this aspect, apparatus for mounting a plastics member in a metal member for a pressurised container comprises first means for forming the metal member to provide an inclined margin around an opening in the metal member, second means for inserting the plastics member into the opening from the exterior side of the metal member, and third

means for reforming metal of the margin to embed the free edge of the margin in, and cause the same to seal around, the plastics member, after such reformation the margin being inclined at a substantial angle towards the interior side of the metal member.

In addition, the invention from a further aspect provides a component of or for a pressurised container, which comprises a plastics member mounted within an opening in a metal member, the metal member having a margin around the opening which is inclined at a substantial angle towards the interior side of the metal member and whose free edge is embedded in, and seals around, the plastics member.

The invention is of particular benefit in, and is intended primarily for use in, the manufacture of easy opening ends for beverage containers, but may have application to the mounting of plastics members in metal members for pressurised containers generally.

The invention is described further, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic sectional view illustrating the mounting of a plastics easy opening device in an opening in a metal can end and showing tooling provided for securing the easy opening device in position;

Figure 2 is a perspective view of the easy opening device prior to being mounted in the opening in the can end but partially opened out to show internal detail;

Figure 3 is a perspective view of the can end prepared for receiving the easy opening device;

Figure 4 is a plan view of the easy opening device secured in the opening in the can end;

Figure 5 is a diagrammatic sectional view illustrating a first modification of the method and apparatus represented in Figure 1;

Figure 6 is a diagrammatic sectional view illustrating a second modification of the method and apparatus represented in Figure 1; and

Figure 7 is a diagrammatic sectional view illustrating a third modification of the method and apparatus represented in Figure 1.

Referring initially to Figure 1, there is shown a can end 10 made of aluminium of relatively light gauge (e.g. ·0115 inches thick), and having a circular opening 12 defined by a free edge 14. From Figure 1, it will be seen that a region of the can end 10 around the opening 12 has been formed to create an annular shoulder or elbow 16, which is offset from the main plane of the can end 10 towards the upper and exterior side of the can end 10, and an inclined frustoconical margin 18, which tapers downwardly (as shown) and inwardly from the annular shoulder 16 towards the lower and interior side of the can end 10, and terminates at the free edge 14.

The formation of the opening and of the inclined margin 18 is not shown or described in detail, because this may be achieved conventionally. Preferably, the margin 18 and opening 12 are produced by forming the can end 10 to create the offset shoulder 16 and also a dimple or depression in the metal can end projecting inwardly from the shoulder 16, and by thereafter severing the crown of the dimple to form the opening 12. The flank

of the dimple then provides the inclined margin 18, and moreover the free edge 14 produced by the severing action extends axially for the reason to become apparent later.

Figure 1 also shows a moulded plastics easy opening device 20having a plug portion 22. This plug portion 22 is inserted into the opening 12 from the exterior side of the can end 10 following the formation of both the opening 12 and the margin 18.

The plug portion 22 of the easy opening device 20 comprises a tubular plug body 24 having a cylindrical outer surface 9 which is dimensioned to be an interference fit in the opening 12, and a flange 26 which encircles the plug body 24 and is arranged to rest against the annular shoulder 16. A removable closure disk 28 closes the outer end of the plug body 24. For clarity, only the general outline of the plug portion 22 is shown in Fig. 1. Further detail of the plug portion is given later in the specification.

After the plug portion 22 of the easy opening device 20 has been inserted into the opening 12 in the metal can end 10, the position of these

two parts relative to one another is as shown in the left-hand side of Figure 1.

In this position of the two parts, the plug portion 22 is compressed between opposed tools, as illustrated in the right-hand side of Figure 1, with the direction of the applied pressure being at right angles to the general plane of the metal can end 10. The pressure exerted on the plug body 24 progressively reforms the plastics material of the easy opening device 20 radially outwardly along the inclined margin 18 to create a retaining bead 30 in intimate contact with the underside of the margin. In addition, the pressure transmitted to the margin though the plastics material under reformation causes a substantial and significant reformation of the margin itself, the angle of inclination of the margin (to the plane of the can end) thereby being typically reduced by an angle of 6°, from an initial angle of 30° to a final angle of 24°.

By virtue of the formation of the bead 30 and ofthe reduced angle of inclination of the margin 18, the free edge 14 of the margin is deeply embedded in the plastics material so that subsequently, in use of the end as part of a can of a carbonated beverage, the easy opening device 20 is firmly

retained in position and moreover there is substantially no danger of contact of the carbonated beverage with the free edge 14 of the margin. The can end therefore presents a high resistance to corrosion and product contamination. Additional features contributory to a permanently high enamel rating and leakage resistance for the can end are the axial orientation of the free end 14 (which ensures optimum contact of the free end with the plastics material of the plug body 24), and remanent tensile force which is created in the plug body by the resilience of the margin following the reformation of the latter. Such tensile force maintains the bead in tight sealing engagement with the interior side of the margin, assisted by the pressure of the carbonated beverage.

It is to be understood that for the reforming operation the can end 10 and the easy opening device 20 are at ambient temperature, and the tooling employed is likewise unheated. The plastics material of the plug body 24 is therefore cold-formed to produce the bead 30. Moreover, by virtue of the substantial cold-working of the plastics material which is achieved, any "memory" of the plastics material is destroyed and there is little tendency

for subsequent plastics creep to impair the metal-to-plastics seal.

Tooling suitable for attaching the easy opening device 20 to the metal can end 10 will now be described in detail with reference to Figure 1.

Such tooling basically comprises a fixed lower tool 32, and an upper tool 34 which is mounted above the lower tool 32 and is arranged for reciprocation vertically towards and away from the lower tool 32.

The lower tool 32 is mounted on a bed plate 36 and comprises a lower block 38 which is bolted to the bed plate 36, and a cold-forming die 40 which is received in an opening in the lower block 38 and which is fixedly located thereby on the bed plate 36.

An upper block 42 is mounted on the lower block 38 by means not shown, for limited vertical movement relative to the lower block. It is biased upwardly by means of compression springs 44 to the limiting position shown at the left hand side of Fig. 1. It is formed with an opening 46 into which the cold-forming die 40 projects with clearance.

A locating spigot 48 is held captive in a cavity 50 centrally within the cold-forming die 40, and is biased upwardly by a compression spring 52 to the upper limiting position shown on the left hand side of Fig. 1; it then projects beyond the top surface of the cold-forming die 40. An annular space 54 is defined between the spigot 48 and the upper end of the cold forming die 40.

The upper tool 34 comprises a compression head 56 mounted for vertical movement towards and away from the lower tool 32 and provided in its lower surface with a recess 58. The recess is dimensioned for receiving the easy opening device 20 as is now to be described, and corresponds in plan elevation to the opening 46 in the lower tool 32.

Operation of the tooling is as follows:

The metal can end 10, already formed with the opening 12 and having the easy opening device 20 already assembled thereon as shown, is located manually or automatically by machine on the spigot 48; The spigot 48 is dimensioned to fit snugly within the plug body 24 so as thereafter to locate the parts laterally in relation to one another during the

operation which follows. The primary support for the can end 10 at this time is provided by the upper block 42 which, as shown, engages the underside of the can end at a plate area surrounding the shoulder 26.

The upper tool 34 is then progressively lowered so that the head 56 engages over the easy opening device 20 and receives it within its recess 58, making a small annular clearance around the flange 26. Outside the shoulder 26 it engages the top surface of the can end so as to pinch the end resiliently against the underlying upper block 42.

Continued downwards movement of the compression head 56 causes it to press the can end 10 and easy opening device 20 simultaneously downwardly until the lower end of the plug body 24 engages the upper surface of the cold-forming die 40, whereupon the plug portion 22 is compressed between the compression head 56 and the cold-forming die 40, and an outer peripheral portion of the plug body 24 is formed radially outwardly and upwardly as shown to create the bead 30. During this cold-forming of the plastics material, the plane area of the can end 10 surrounding the shoulder 16 is resiliently but firmly

clamped between the upper block 42 and the compression head 56 to restrain the can end against gross movement or distortion outside the shoulder 16. Within the shoulder 16, however, the margin 18 is subject to substantial compressive forces transmitted through the plastics material of the plug portion 22, and as a result itself undergoes substantial reformation as previously mentioned. No direct contact of the margin by the tools 32,34 occurs to cause possible damage to the margin, e.g. by scuffing. The reforming forces on the margin are applied indirectly through the plastics material.

The spigot 48 is depressed resiliently as the compression head 56 descends; in addition to providing lateral location for the easy opening device 20 as previously described, it also serves to prevent the plastics material from being deformed radially inwardly during the cold-forming operation and thereby encourages the outward movement of the plastics material necessary for the formation of the bead 30.

The reforming operation is complete when the upper block 42 bottoms on the lower block 38. The compression head 56 is then lifted away from the

completed can end so as to allow the upper block 42 and the spigot 48 to rise to their upward limiting positions under the action of the springs 44 and 52, the upper block acting as an ejector to release the can end from the spigot. Another can end assembly is then located on the spigot, and the operation is repeated as before.

Using the above method, it has been found possible to achieve a seal which will reliably withstand pressures of 100 psi and above, and such as are met in a carbonated beverage can. The carbonating pressure acts outwardly on the easy opening end, and by lifting the device 20 tends to cause the margin 18 to pivot in the same direction about the shoulder 16 in the sense to reduce its angle of inclination to the plane of the can end. Any such movement results in a contraction of the opening 12, so bringing the free edge 14 increasing tightly into sealing engagement with the plug body 24. As a result, the metal embeds further within the plastics material and the seal is enhanced. Again, the shoulder 16 localises the movement to the margin 18.

Figures 2 to 4 show in detail the plastics easy opening device 20, the metal can end 10, and the

easy opening end produced by joining the two together using the above method.

Referring to Figure 2, the easy opening device 20 is integrally moulded from a suitable thermoplastics polymer, e.g. high density polyethylene, to include a first portion 60 and a second portion 62 together providing the plug portion 22 of Figure 1.

The first portion 60 has a body portion 64 forming the outer part of the plug body 24 and including the flange 26. Within the body portion 64 there is a central opening 66.

The second portion 62 of the easy opening device 20 is joined to the first portion 60 at an integral hinge 70 and includes a stopper portion 72 forming the inner part of the plug body 24. The stopper portion 72 includes the closure disk 28, and a tubular skirt 74 which is a push fit into the body portion 64 of the first portion 60 to close and seal the opening 66. The second portion 62 also includes a pull-ring 76 joined to the stopper portion 72 at an integral hinge 78.

The easy opening device 20 is moulded in an open state in which the stopper skirt 74 is free from the opening 66. It is prepared for attachment to the can end by folding the first and second portions 60,62 together so as to insert the stopper skirt 74 into the opening 66, and by heat sealing the portions together around the opening 66. Such heat sealing may form a continuous annular heat seal around the opening, or it may be effected at a number of spaced locations. In either case, the heat seal is rupturable to allow the device 20 to be opened for dispensing product from the can.

Turning to Figure 3, the metal can end 10 has a peripheral seaming ring 80 at which it may be double seamed to a can body. Within the seaming ring 80, the end has a generally planar closure panel 82 formed with the opening 12 and, around the opening 12, the annular shoulder 16 offset from the panel 82 and surrounding the margin 18.

After the easy opening device 20 is fitted to the metal can end 10 in the manner already described, the pull-ring 76 of the easy opening device 20 lies flat just above the panel 82 of the can end 10. It can be lifted away from the

panel 82 by the consumer, and then used to pull the stopper skirt 74 out of the opening 66. The opening 66 is then available as a dispensing orifice for the can to which the can end 10 is fitted. If desired, the skirt can be replaced in the opening as a re-closure.

In the embodiment of the invention described with reference to Figure 1, the plug body 24 is generally tubular and has a flat undersurface prior to the reforming operation. During reforming, an inner portion of the plug body 24, corresponding to the stopper skirt 74 and an inner portion of the body portion 64 (Fig. 2), remain intact, while an outer portion of the plug body 24 (corresponding to an outer portion of the body portion 64) is formed outwardly to produce the bead 30. According to the modification shown in Figure 5, the plug body 24 is rebated to leave a lower projecting portion 90 which is completely reformed in the outward direction to produce the bead 30. The bottom surface of the plug body is then substantially plane after reforming. Again, a substantial reduction in the angle of inclination of the margin, typically 6°, occurs during the formation of the bead, leaving residual tension in the plug body to help to maintain the metal-to-plastics seal.

In this example, the spigot 48 is modified to provide an upstanding boss 92 which fits snugly within the plug body 24, and a horizontal shoulder 94 which is capable of supporting the undersurface of the main part of the plug body 24 at the rebate, as shown. The bead-forming portion 90 of the plug body fits, with clearance, over the main body of the spigot 48. Otherwise, the method of securing the plastics easy opening device 20 in the metal can end 10, and the tooling employed, are as already described.

Another variation on the method and apparatus described with reference to Figure 1 is illustrated in Figure 6, wherein like parts are indicated by the same reference numerals as before.

The plastics easy opening device 20 employed in the method of Figure 6 is the same as that employed in the method of Figure 1. However, the metal can end 100 has been modified by the omission of the annular shoulder 16, although an inwardly inclined margin 18 is again provided, terminating in an axially extending free edge 14.

As before, the easy opening device 20 is inserted into the opening 12 in the can end 100 from

the exterior side of the can end. The assembly of device 20 and can end 100 is then subjected to an operation in which the easy opening device 20 is pressed downwardly whilst a clinching die engaging the underside of the margin 18 reforms the metal of the margin upwardly to clinch the margin 18 onto, and cause it to bite into, the plug body 24. In contrast with the embodiments previously described, substantially no reforming of the plastics material takes place during this operation.

As before, the free edge 14 of the margin 18 becomes firmly embedded within the plastics material to create a secure hermetic seal between the plastics and metal members. At the end of the clinching operation, the margin 18 remains inwardly inclined at a substantial angle, so that again the plastics-to-metal seal is enhanced by the carbonation pressure.

The tooling shown in Figure 6 comprises a fixed lower tool 132, and an upper tool 34 corresponding to the upper tool 34 of Figure 1. The lower tool 132 is similar to the lower tool 32 of Figure 1 except that the cold-forming die 40 and spigot 48 are replaced by a single clinching

die 140. As shown, the clinching die 140 has a cylindrical upper portion 142 surrounding a recess 144 which is closely dimensioned for receiving the plug body 24. The upper surface 146 of the cylindrical upper portion 142 is arranged to engage the margin 18 for clinching the margin onto the plug body 24.

A further variation is illustrated in Figure 7, and again like parts are indicated by the same reference numerals.

In this case, the metal can end 200 is initially formed with an inwardly offset annular shoulder 216 and an outwardly directed inclined margin 218 as shown in the left-hand side of Figure 7. The plastics easy opening device 220 is provided with a downwardly sloping shoulder 222 between its plug body 24 and flange 26.

The plug body 24 is initially inserted into the opening 12 from the exterior side of the can end 200, and the easy opening device 220 and the can end 200 are then compressed between opposed tools, as illustrated in the right-hand side of Figure 7, to progressively reform the metal

of the margin 218 downwardly towards and through the horizontal until the margin 218 is inclined at a substantial angle towards the interior side of the metal can end 200. Substantially no forming of the plastics material takes place during this operation. In the course of the operation the opening 12 is closed down onto the plug body 24 so that, as with the embodiment of Fig. 6, the metal of the margin 218 bites into and becomes firmly embedded in the plastics material of the plug body to provide a hermetic seal between the plastics and metal members.

In order to enable the reformed margin to be engaged into the plug body 24 at the desired substantial angle without substantial interference with the plug body as it is being reformed, only a part of the margin is reformed beyond the horizontal to the required angle. This part, which is indicated in the right hand part of Fig. 7 by the reference numeral 300, carries the free edge 14 and occupies approximately one half of the radial width of the margin.

The tooling shown in Figure 7 comprises a vertically reciprocable upper tool 34 as before, and

a lower tool 232 in the form of a single fixed block 238 bolted to the bed plate 36. The block 238 has an opening 240 sized to freely receive the plug body 24, and a contoured upper surface 242 shaped to fit closely about the annular shoulder 216 of the metal can end 200 and to provide an annular limiting surface 244 for limiting the downwards formation of the metal margin 218. The annular limiting surface 244 has a horizontal radially outer portion 244A and a downwardly inclined radially inner portion 244B, the outer portion 244A of which forms the horizontal outer part of the reformed margin. The inner portion 244B forms the inner part 300 of the margin, and is inclined appropriately.

The method and apparatus described with reference to Figure 7 again provide an easy opening end wherein the metal margin 218 engages the easy opening device at a substantial angle and therefore again provides a sealing performance which is enhanced with increasing internal pressure of a can carrying the can end.

As previously mentioned, in the embodiment of Fig. 1 the margin 18 has an initial inclination of 30° and a final inclination of 24° to the plane of the

can end. However, other values would be possible and it is believed that the initial inclination should lie within the range 25° to 45°, the final inclination lying within the range 10° to 30°, and the reduction in the angle of inclination caused by the reformation process being within the range 5° to 20°.

The preferred initial and final values of the angles of inclination of the metal margin for the Figure 5 embodiment are the same as those for the embodiment of Figure 1; For the Figure 6 embodiment they are 30° and 20° respectively.

For the embodiment of Figure 7 preferred values of the initial and final angles of inclination are 45° above the plane of the can end and 15° below the plane of the can end.

CLAIMS:

1. A method for mounting a plastics member (20) in a metal member (10) for a pressurised container comprising forming the metal member to provide an inclined margin (18) around an opening (12) in the metal member, and inserting the plastics member into the opening from the exterior side of the metal member, characterised in that the metal of the margin is reformed to embed the free edge (14) of the margin in, and cause the same to seal around, the plastics member, the reforming being such that after reformation the margin is inclined at a substantial angle towards the interior side of the metal member.

2. A method as claimed in claim 1, characterised in that, to augment the effect of the reformation of the metal in embedding the free edge (14) of the metal in the plastics member (20), the plastics member is reformed radially outwardly along the margin on the interior side of the metal member.

3. A method as claimed in claim 2, characterised in that the reformation of the metal is achieved

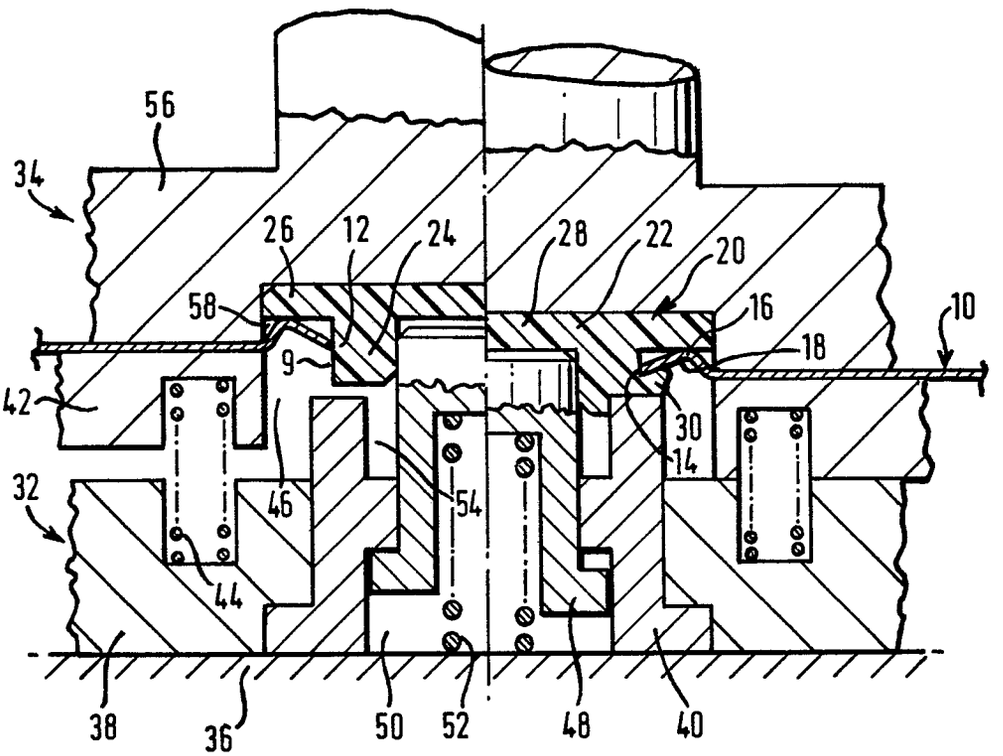
indirectly during the reformation of the plastics material, by tooling which makes no direct contact with the margin (18).

4. A method as claimed in any one of claims 1 to 3 characterised in that the free edge (14) of the metal margin (18) is directed axially.

5. A method as claimed in any one of claims 1 to 4, characterised in that the root of the margin (18) is offset from the main plane of the metal member (10) to form an annular shoulder or elbow (16) in the metal.

6. Apparatus for mounting a plastics member (20) in a metal member (10) for a pressurised container, characterised by first means for forming the metal member to provide an inclined margin (18) around an opening (12) in the metal member, second means for inserting the plastics member into the opening from the exterior side of the metal member, and third means for reforming metal of the margin to embed the free edge (14) of the margin in, and cause the same to seal around, the plastics member, after such reformation the margin being inclined at a substantial angle towards the interior side of the metal member.

FIG. 1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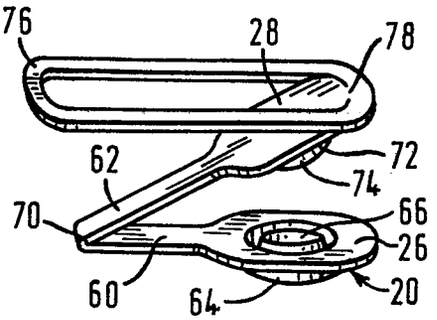

FIG.2

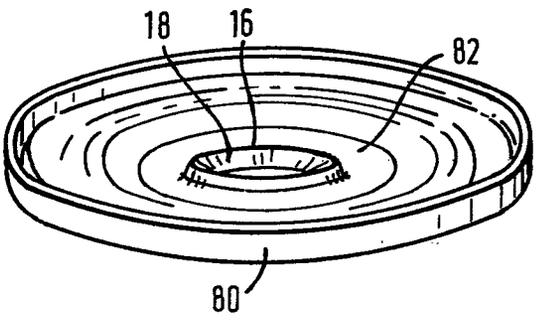

FIG.3

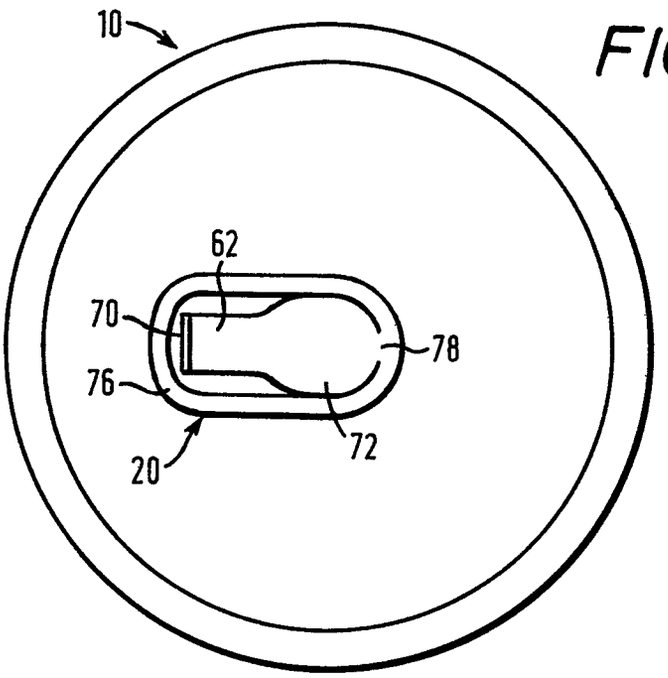

FIG.4

FIG.5

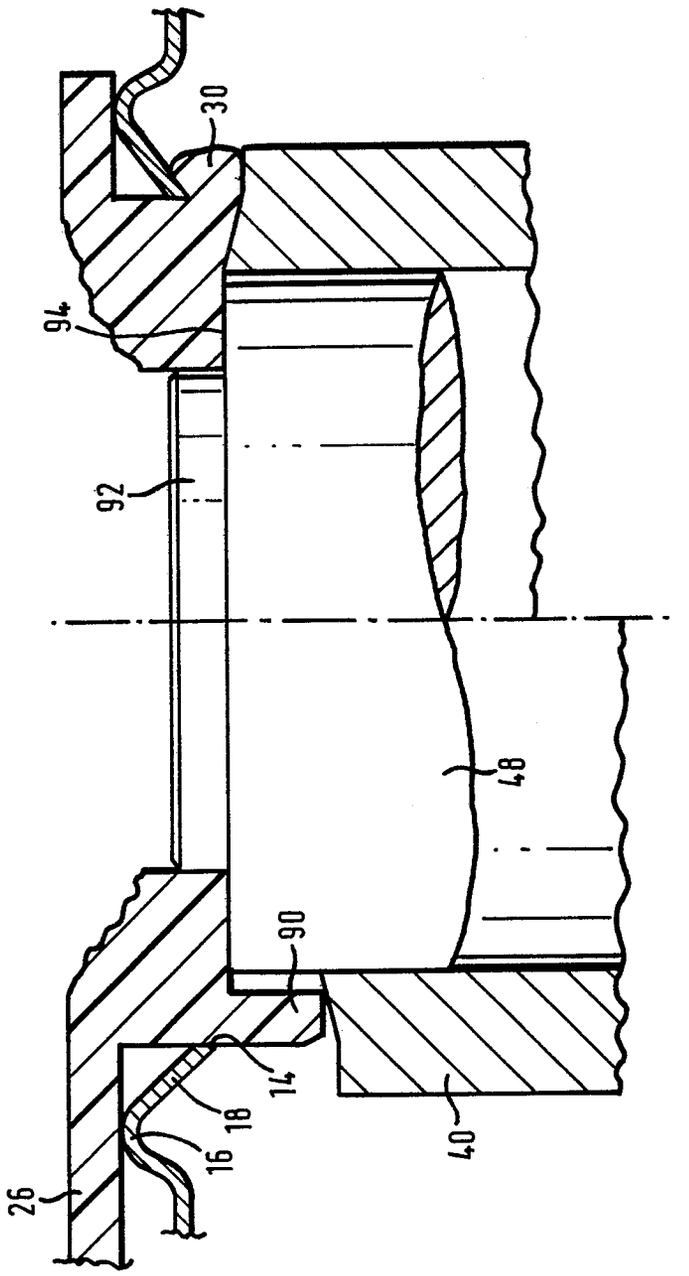

FIG.6

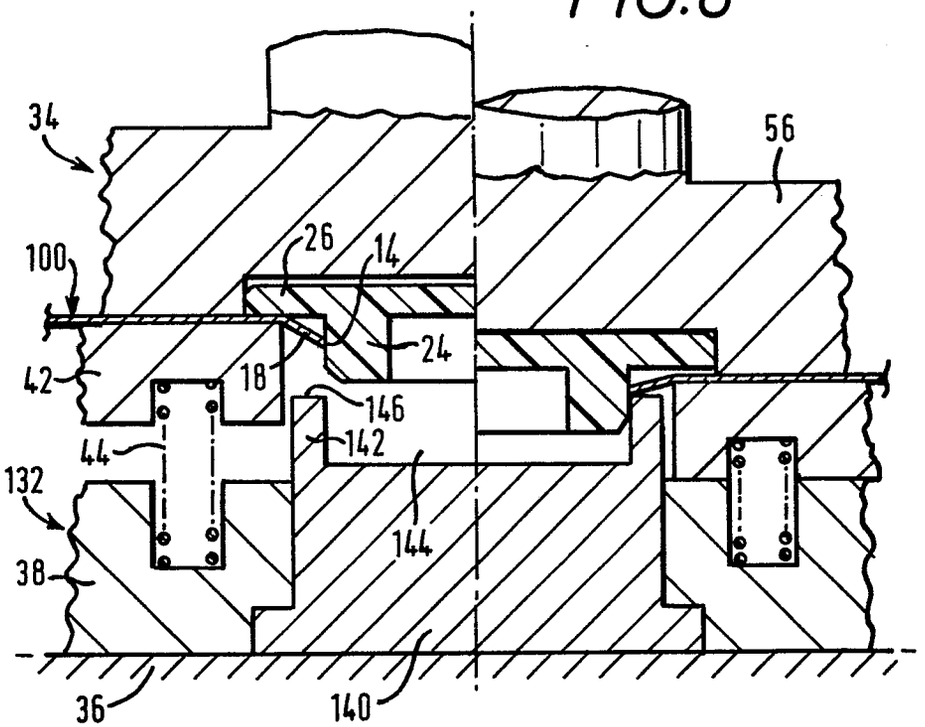
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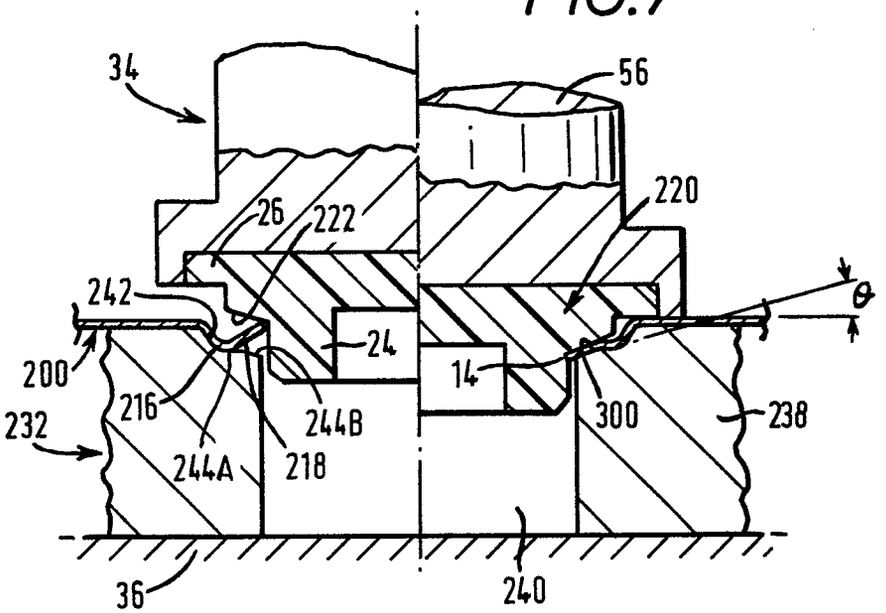
FIG.7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