United States Patent

Brown

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[54] **METHOD OF MAKING A RIVETED JOINTURE**

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[52] **U.S. Cl.**.....**29/509,** 29/522, 113/116 FF, 113/121 C, 220/54

[51] **Int. Cl.**.....**B21d 39/00,** B23p 11/00

[58] **Field of Search** .....29/509, 522; 220/54; 113/121 C, 116 FF

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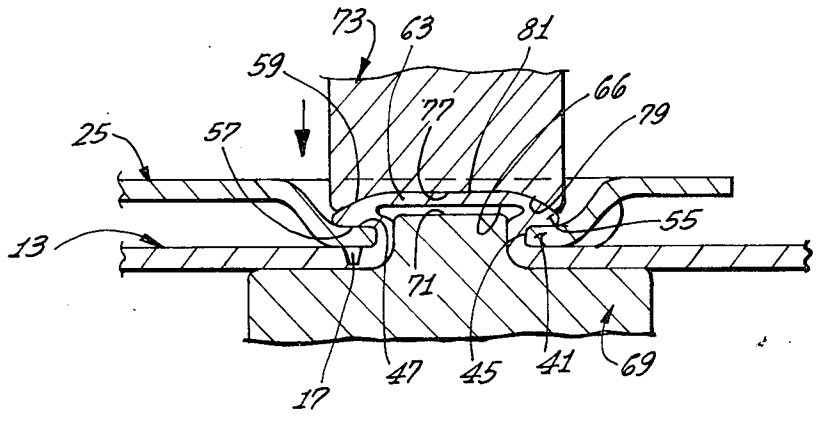
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[57] **ABSTRACT**

An easy opening container wall including a container wall of sheet material having a line of weakness therein defining a tear portion at least partially removable from the container wall. A hollow rivet is formed integrally with the sheet material of the tear portion and projects through an aperture of a tab. The hollow rivet is headed by a punch which forces the material making up the bead of the rivet tightly against the region of the tab immediately surrounding the aperture therein so that the area of engagement between the bead and the tab is generally annular and has substantial radial width.

8 Claims, 6 Drawing Figures



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SHEET 1 OF 2

Fig. 1

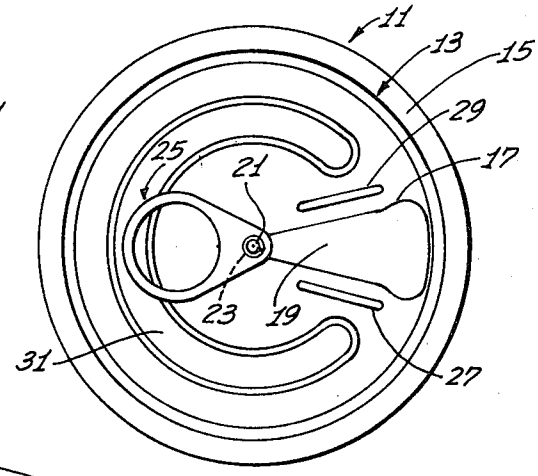


Fig. 2

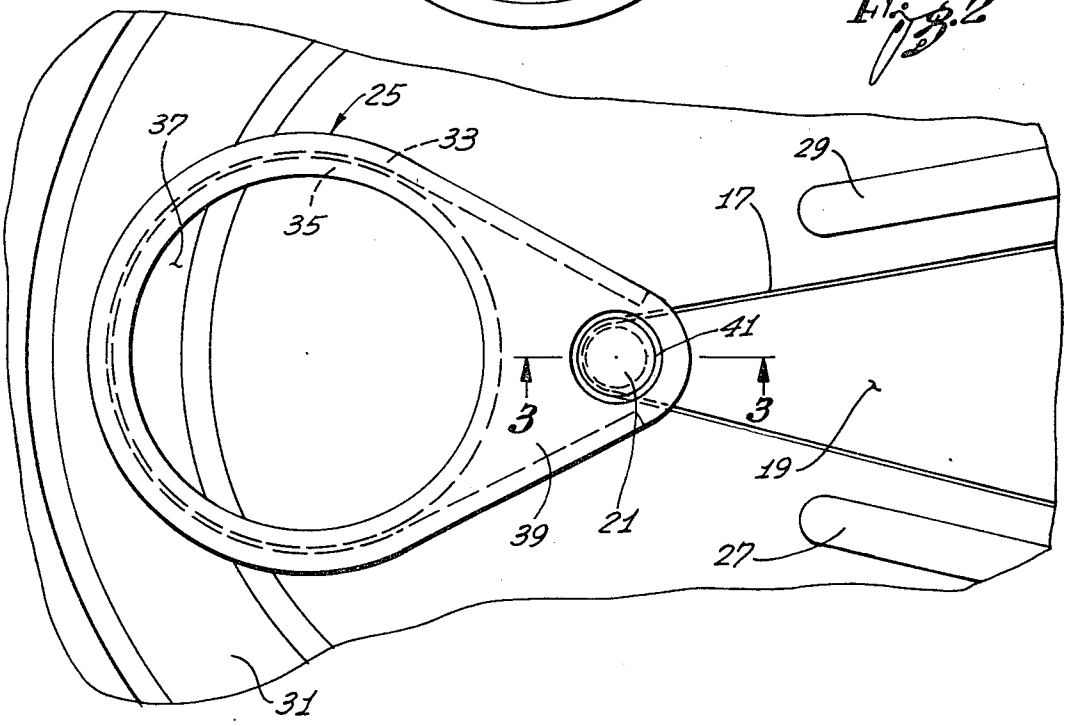
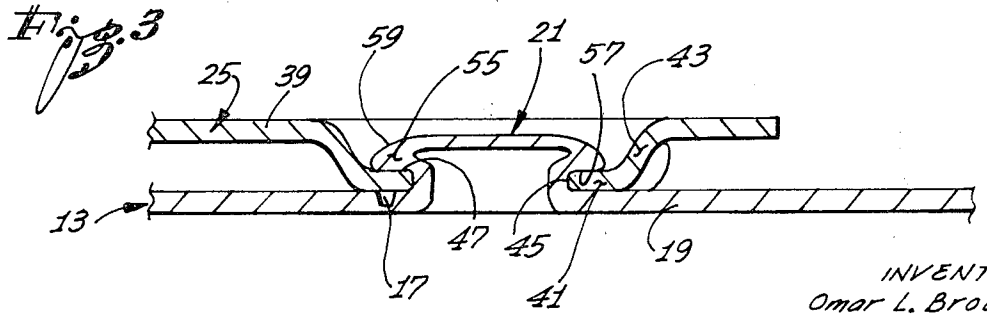


Fig. 3



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Fig. 4 Prior Art

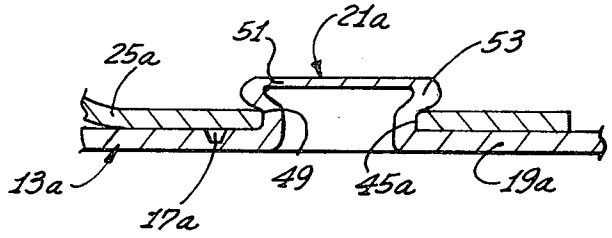


Fig. 5

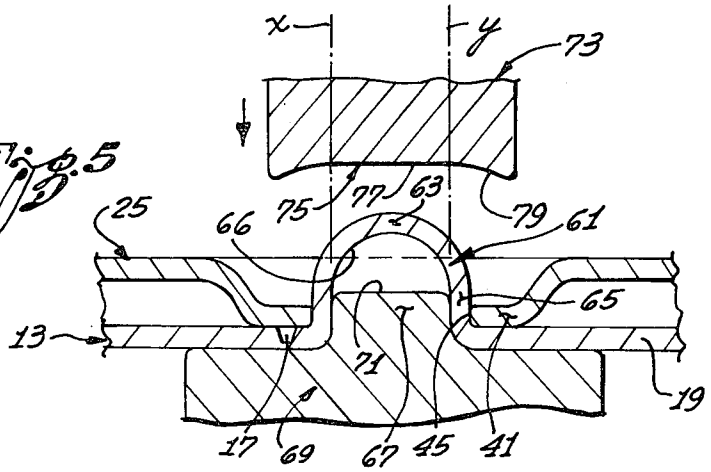
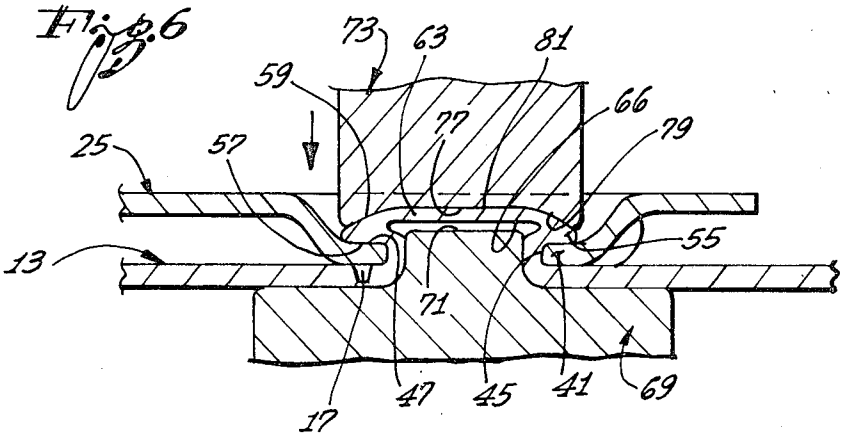


Fig. 6



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METHOD OF MAKING A RIVETED JOINTURE

BACKGROUND OF THE INVENTION

The invention relates to a joint between first and second members of sheet material positioned face to face wherein a portion of the first member is formed into a hollow rivet that extends through an aperture in the second member. This type of joint is commonly used in an easy opening container wall wherein the hollow rivet is formed in a tear portion and extends through an aperture in a tab that serves as manual means for severing the tear portion. A joint of this general type is disclosed, for example, in Fraze, U.S. Pat. No. 3,191,564.

In order to form a rivet bead of requisite strength, it is necessary to extrude material of the transverse end wall of the rivet between cooperating die surfaces during the rivet heading operation. This assists the radial outward flow of metal to form a bead of substantial strength. Recently rivets of this type have been made in smaller diameters to facilitate opening of the container. In addition the aluminum alloys from which the container wall is constructed have become harder. These factors combine to make the need for extrusion even more important in making a strong joint.

One problem with extrusion of the transverse end wall is that the sealant coating applied to the interior surface of the container wall is fractured or destroyed during the extruding operation. The sealant coating is applied to the inner surfaces of metal containers to keep the product from making contact with the bare metal. Such a sealant coating is not only tenaciously adherent to the metal but is also sufficiently ductile to survive the usual punch press operations that are required to form a can top and to join the can top to the can body. The sealant coating will also survive the rivet forming operations as where the rivet is formed in a coining operation.

The sealant coating will not, however, survive the subsequent operation of heading of the hollow rivet by squeezing the transverse end wall of the rivet between cooperating die members to extrude the metal radially outwardly. One reason for the sealant coating rupturing inside the hollow rivet in the course of the heading operation is the high unit stress involved in drastically squeezing the sheet metal. Another reason for failure of the sealant coating is that the prior rivet forming operations weaken the sealant coating. In any event, it has been discovered that the sealant coating inside of the hollow rivet is usually ruptured to expose bare metal to the acid action of a carbonated beverage within the container with consequent deterioration of the beverage. Accordingly, the rivet heading operation which produces the strongest rivet ruptures the sealant coating and without the extrusion of the transverse end wall the riveted jointure is not sufficiently strong.

SUMMARY OF THE INVENTION

The present invention teaches that one reason that prior art riveted jointures do not possess maximum strength is that the tab and the bead of the rivet are in substantially line contact. Specifically, the underside of the bead is generally frustoconical and the aperture through the tab is generally cylindrical. Accordingly, the conical bead surface engages the circular rim or corner of the aperture along a circular line which surrounds the rivet. The line contact between the tab and the rivet results in high stresses acting on the rivet and on the region of the tab immediately surrounding the aperture therein. Furthermore, the relatively sharp rim of the aperture may have a cutting effect on the rivet.

According to the present invention, the bearing area between the rivet and the tab is materially increased as a result of the forcing of the metal of the bead downwardly against the region of the tab immediately surrounding the aperture. Thus, with the present invention, the bead engages the tab in an annular region having substantial radial width. This results in reduced stress on the bead of the rivet and on the region of the tab immediately surrounding the aperture and reduces the tendency of the rim of the aperture to cut the bead during manipulation of the tab.

Because of the increased strength of the joint as a result of the large bearing area between the bead and the tab, it is no longer necessary to extrude the material of the transverse end wall of the rivet during the rivet heading operation. Thus, the sealant coacting on the inner surface of the transverse end wall is maintained intact throughout the riveting operation.

In practicing the method of this invention, the transverse end wall of the rivet is struck to axially collapse the rivet to cause radial outward movement of the material of the rivet to form a bead or larger dimensions in plan than the aperture through the tab. The material making up the bead is forced further toward the tab than the transverse end wall to thereby cause the bead to tightly engage the tab along an annular region which has substantial radial width.

The rivet heading operation can be advantageously carried out with a punch having a working surface with a bead forming region of the working surface surrounding and projecting axially of a first region of the working surface. Preferably, the bead forming surface slopes toward the tab as it extends radially outwardly. Accordingly, the first region of the punch engages the transverse end wall of the rivet to cause the axial collapse thereof. The bead forming region, being advanced axially of the first region, engages the material making up the bead and forces the latter tightly against the tab. Because the bead forming region is advanced axially of the first region, the bead is forced closer to the tab than is the transverse end wall with the result that the underside of the bead is forced flat against the tab.

The invention, together with further features and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying illustrative drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view of an easy opening container constructed in accordance with the teachings of this invention.

FIG. 2 is an enlarged fragmentary plan view of a portion of the easy opening container wall.

FIG. 3 is an enlarged fragmentary sectional view taken along line 3—3 of FIG. 2.

FIG. 4 is a sectional view similar to FIG. 3 showing a prior art riveted joint construction.

FIG. 5 is an enlarged sectional view of a portion of the container wall and of the hollow rivet with the hollow rivet projecting through an aperture of the tab

prior to the rivet heading operation. The tooling for use in the rivet heading operation is also illustrated in section.

FIG. 6 is a sectional view similar to FIG. 5 with the rivet heading tooling having been advanced to form a bead on the rivet.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings and in particular to FIG. 1 thereof, reference numeral 11 designates an easy opening container wall constructed in accordance with the teachings of this invention. The easy opening container wall 11 includes a container wall 13 constructed of aluminum or aluminum alloy and having a peripheral attaching flange 15 for attaching the easy opening container wall 11 to a can body (not shown).

The container wall 13 has a line of weakness in the form of a scoreline 17 therein which defines a tear portion 19 which is removable from the container wall 13 to form a pouring opening. A hollow rivet 21 is formed integrally with the sheet material of the tear portion 19 adjacent a leading end 23 of the scoreline 17. The hollow rivet 21 anchors a tab 25 to the leading end of the tear portion 19. The container wall 13 may be formed with ribs 27 and 29 along opposite edges of the scoreline 19 and a large rib 31 may also be formed in the container wall.

The tab 25 is preferably constructed of sheet material such as an aluminum alloy and may take the form shown in FIG. 2. In the embodiment illustrated, the tab 25 has an outer reinforcing bead 33 which substantially circumscribes the tab 25 except for an end portion of the tab adjacent the rivet 21. The tab also has a generally circular inner reinforcing bead 35 which defines a generally circular finger receiving opening 37.

As shown in FIG. 3, the tab 25 has an elevated region 39 and a bottom wall or depressed region 41 with a sloping connecting wall 43 integrally joining the wall 41 to the elevated region 39. The elevated region 39 and the connecting wall 43 completely surround the bottom wall 41. An aperture 45 of circular configuration in plan is formed in the bottom wall 41. A planar, annular, flat surface or seat 47 on the bottom wall 41 surrounds the aperture 45.

The rivet 21 anchors the tab 25 to the leading end of the tear portion 19. By lifting the ring portion of the tab 25, a rupturing force is transmitted through the rivet 21 to the leading end 23 of the scoreline 17 to rupture the latter. By exerting an outward pulling force on the tab 25 the tear portion 19 can be completely removed from the container wall 13.

Before considering the characteristics and features of the rivet 21 and a preferred manner of making same, consideration should be given to a typical prior art rivet configuration shown in FIG. 4. In FIG. 4, where corresponding reference character followed by the letter a are used to designate corresponding parts, a rivet 21*a* is formed integrally with a container wall 13*a* and projects through an aperture 45*a* of a tab 25*a* to mount the tab on the container wall. The container wall 13*a* may be identical to the container wall 13 and have a scoreline 17*a* therein defining a tear portion 19*a* in which the rivet 21*a* is formed. The tab 25*a* has sharp rim or corner 49.

The rivet 21*a* has a transverse end wall 51, some of the material of which has been extruded radially outwardly during the rivet heading operation to form a bead 53 which extends all around the rivet 21*a*. As shown in FIG. 4, the sharp corner 49 engages the frustoconical underside of the bead 53 to define the sole region of engagement between the upper face of the tab 25*a* and the rivet 21*a*. That is, the bead 53 engages the corner 49 and then projects upwardly away from the tab 25*a* so that the region of engagement between the upper face of the tab 25*a* and the rivet 21*a* is in the form of a circular line. Accordingly, when the tab 25*a* is raised to sever the leading end of the tear portion 19*a*, the stress on the corner 49 and the portion of the bead 53 engaging the corner 49 is very high. This makes it necessary to utilize a bead having substantial dimensions and substantial strength in order to withstand the high stress. In addition, there is a danger of failure of the tab due to distortion of the sheet metal of the tab surrounding the aperture 45*a*.

The present invention solves the problems inherent in the construction shown in FIG. 4 by providing a bead 55 (FIG. 3) which is clamped tightly against the seat 47 over a relatively large area. Specifically, the bead 55 circumscribes the aperture 45, and the area of engagement between the bead and the seat 47 is annular and has a substantial radial dimension. The bead 55 has a flat, annular, inner surface 57 which firmly engages the seat 47. The large area of engagement between the surfaces 47 and 57 reduces the stress on the bead 55 and on the bottom wall 41 so that the joint will withstand a relatively high force applied to the tab 25 during manipulation thereof to remove the tear portion 19. By comparing FIGS. 3 and 4, it can be seen that the entire bead 55 has been displaced downwardly from the position which the bead 53 occupies. The bead 55 has an upper or outer surface 59 which is generally annular in plan and which curves toward the bottom wall 41 as it extends radially outwardly.

FIGS. 5 and 6 illustrate a preferred manner of making the rivet 21. In FIG. 5, a hollow rivet 61 which has been formed integrally with the leading end of the tear portion 19 projects through the aperture 45 of the tab 25. The hollow rivet 61 may be formed according to known processes and includes a dome-shaped transverse end wall 63 and a cylindrical peripheral wall 65 integral with the end wall 63. The peripheral wall 65 fits within the aperture 45 with a minimum amount of clearance. The inner surface of the container wall 13 has a sealant coating 66 adhered thereto.

A head portion 67 of a tool or support member 69 is inserted into the hollow rivet 61 to prevent radial inward collapse of the peripheral wall 65 during the rivet heading operation. The head portion 67 has an end face 71 which is spaced from the transverse end wall 63.

A punch 73 having a working face 75 is suitably mounted above the rivet 61. The working surface 75 has a central region 77 positioned above the transverse end wall 63 and a peripheral bead forming region 79 which surrounds the central region 77. The bead forming region 79 slopes toward the container wall 13 as it extends radially outwardly. Thus, the region 79 is advanced axially of the region 77 in that it lies closer to the tab 25 and the container wall 13 than the central re-

gion 77. Although the contour of the working surface 75 may be varied, preferably, the bead forming region 79 is arcuate in cross section and blends smoothly with the central region 77 which may be substantially planar. Viewed differently, the working surface 75 is concave with the concavity opening toward the rivet 61.

Although the portion of the working surface 75 which is formed by the planar central region 77 can be varied, in the embodiment illustrated the diameter of the central region 77 is preferably equal to the internal diameter of the peripheral wall 65. Furthermore, the central region 77 is preferably co-axial with the rivet 61 so that the central region 77 terminates at lines *x* and *y* (FIG. 5) which lines extend axially of the rivet 61 and lie along the inner surface of the peripheral wall 65. The bead forming region 79 begins at the central region 77 and projects radially outwardly therefrom to substantially the periphery of the punch 73.

By relatively advancing the punch 73 and the tool 69, the central region 77 will contact the transverse end wall 63 and begin to axially collapse the rivet 61. The axial collapse of the rivet 61 is accompanied by an outward movement of the metal of the rivet to begin formation of the bead 55. Ultimately, the bead will be contacted by the bead forming region 79 and displaced downwardly thereby from the position which it would normally occupy toward the bottom wall 41. The displacement of the bead 55 causes the surface 57 to engage the seat 47 along an area which circumscribes the aperture 45 and which has substantial width as described hereinabove with reference to FIG. 3.

The outer surface 59 is forced axially downwardly and shaped by the region 79. As shown in FIG. 6 the surface 59 lies axially inwardly of the outer surface 81 of the transverse end wall 63.

The entire rivet heading operation is carried out with little or no extrusion of the transverse wall of the rivet. As shown in FIG. 6, the end face 71 of the tool 69 is spaced from the transverse end wall 63 of the rivet and also spaced from the sealant coating 66. Accordingly, the sealant coating 66 remains intact throughout the entire rivet heading operation. As shown in FIG. 3, the head portion 67 of the tool 69 is withdrawn from the rivet subsequent to completion of the work operation shown in FIG. 6. By comparing FIGS. 5 and 6 it is readily apparent that the rivet heading operation does not deform the head portion 67.

Although an exemplary embodiment of the invention has been shown and described, many changes, modifications, and substitutions may be made by one having ordinary skill in the art without necessarily departing from the spirit and scope of this invention.

I claim:

1. A method of joining an apertured tab of sheet material to a container wall wherein the container wall has a line of weakness forming a tear portion and a hollow rivet with a peripheral wall and a transverse end wall is attached to the container wall and projects through the aperture of the tab, said method comprising:

providing a punch having a working surface with the working surface having a first region and a bead forming region with the bead forming region at least substantially circumscribing the first region and tapering axially of the first region toward the container wall as it extends radially outwardly;

supporting the rivet against inward collapse by inserting a support member into the hollow rivet with the support member being spaced from the transverse end wall;

relatively advancing said punch and the rivet toward each other to impact the first region of the working surface against the transverse end wall to axially collapse said hollow rivet with consequent radial outward flow of material to form a bead integrally joining the peripheral wall and the transverse end wall with the relative advance of the punch and rivet causing said bead forming region to force the bead against the region of the tab immediately surrounding the aperture;

said step of relatively advancing being carried out without substantially deforming said support member;

relatively moving the support member and the rivet to withdraw the support member from the rivet without destroying the rivet, the withdrawal of the support member occurring after the formation of the bead.

2. A method as defined in claim 1 wherein said step of relatively advancing is carried out to cause the area of engagement between the bead and said region of the tab to be generally annular and to have substantial radial width.

3. A method as defined in claim 1 wherein said bead forming region tapers smoothly toward the container wall as it extends radially outwardly and correspondingly shapes the surface of the bead which it engages.

4. A method as defined in claim 1 wherein the container wall has a sealant coating on the inner surface thereof and said step of relatively advancing is carried out without squeezing of the material of the transverse end wall of the rivet between the support member and the punch to thereby avoid extrusion of the material of the transverse end wall to thereby maintain the sealant coating intact during the rivet heading operation.

5. A method as defined in claim 1 wherein the inner periphery of the bead forming region is generally aligned with the inner surface of the peripheral wall prior to the axial collapse of the rivet.

6. A method as defined in claim 1 wherein said first region is generally flat and blends smoothly with said second region, said working surface defining a cavity opening toward the rivet.

7. A method of joining an apertured tab of sheet material to a container wall wherein the container wall has a line of weakness forming a tear portion and a hollow rivet with a peripheral wall and a transverse end wall is attached to the container wall and projects through the aperture of the tab, said method comprising:

providing a punch having a working surface defining a cavity having an inner end and sloping sides which slope radially outwardly as they extend away from the inner end, said working surface having a first region defining at least a portion of the inner end of the cavity and a bead forming region defining at least a portion of the sides of said cavity, said bead forming region at least substantially circumscribing the first region;

relatively positioning the punch and the container wall so that the cavity opens toward the transverse end wall;

supporting the rivet against radial inward collapse by inserting a support member into the hollow rivet with the support member being spaced from the transverse end wall;

relatively advancing said punch and the rivet toward each other to impact the first region of the working surface against the transverse end wall to initiate axial collapse of said hollow rivet with consequent radial outward movement of material to at least initiate formation of a bead with the relative advance of the punch and rivet causing said bead forming region to engage some of the material of the bead and shaping the surface of the material so engaged so that said surface tapers axially away from the first region as it extends radially outwardly whereby said surface has a configuration which mates with the sides of said cavity; and

relatively moving the support member and the rivet to withdraw the support member from the rivet without destroying the rivet, the withdrawal of the support member occurring after the formation of the bead.

8. A method of joining an apertured tab of sheet material to a container wall wherein the container wall has a sealant coating on the inner surface thereof and a line of weakness forming a tear portion and wherein a hollow rivet with a peripheral wall and a transverse end wall is attached to the container wall and projects through the aperture of the tab, said method comprising:

providing a punch having a working surface with the working surface having a first region and a bead forming region with the bead forming region at least substantially circumscribing the first region and tapering radially outwardly whereby said regions define a cavity which opens toward the rivet;

supporting the container wall;

supporting the rivet against radial inward collapse by inserting a support member into the hollow rivet with the support member being spaced from the transverse end wall;

relatively advancing said punch and the rivet to impact the first region of the working surface against the transverse end wall to initiate axial collapse of said hollow rivet with consequent radial outward flow of material to initiate formation of a bead with the relative advance of the punch and rivet causing said bead forming region to engage the bead and force the portion so engaged axially of the outer surface of the transverse end wall whereby the bead is forced against the region of the tab immediately surrounding the aperture;

said step of relatively advancing being carried out without extruding the material of the transverse end wall; and

relatively moving the support member and the rivet to withdraw the support member from the rivet without destroying the rivet, the withdrawal of the support member occurring after the formation of the bead.

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