June 10, 1969 J. A. GEIGER 3,448,887

CONTAINER WITH EASY-OPENING DEVICE

Filed Dec. 12, 1967 Sheet 1 of 2

Fig. 1

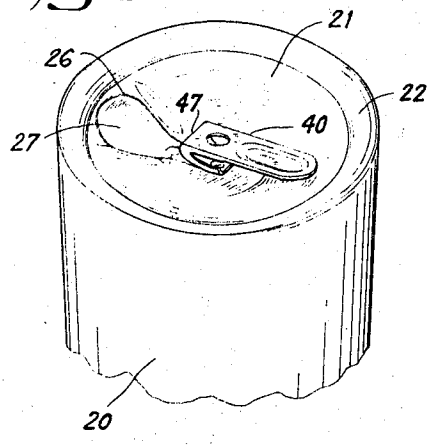


Fig. 2

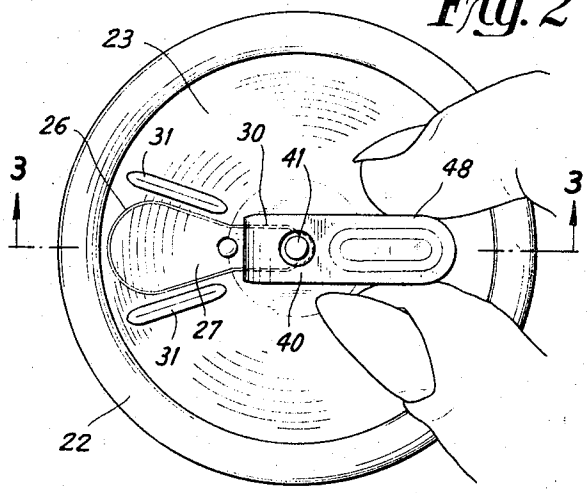


Fig. 3

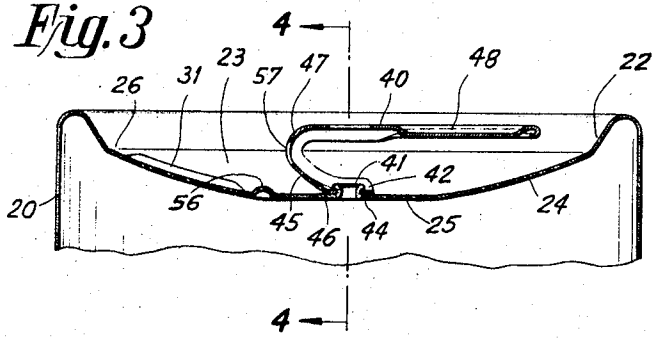


Fig. 4

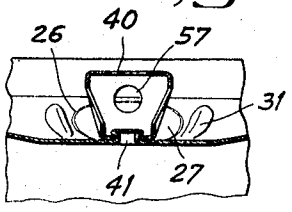


Fig. 5

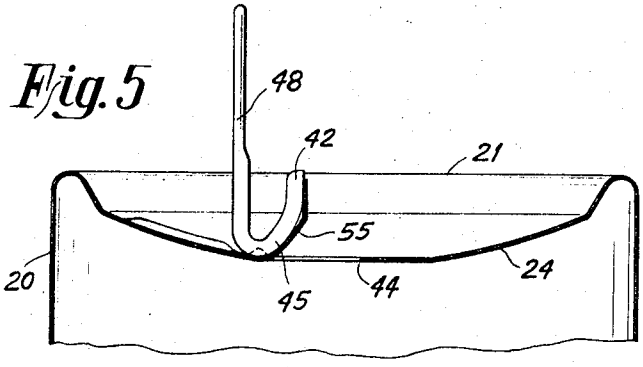


Fig. 6

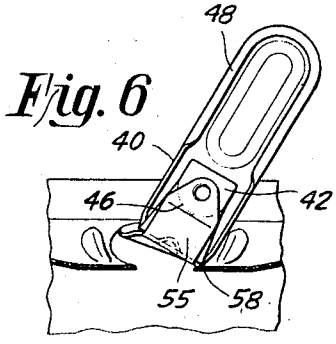
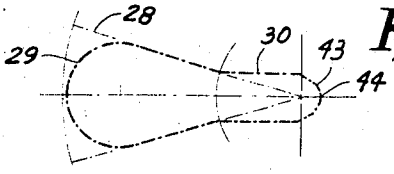


Fig. 7



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CONTAINER WITH EASY-OPENING DEVICE

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Fig. 8

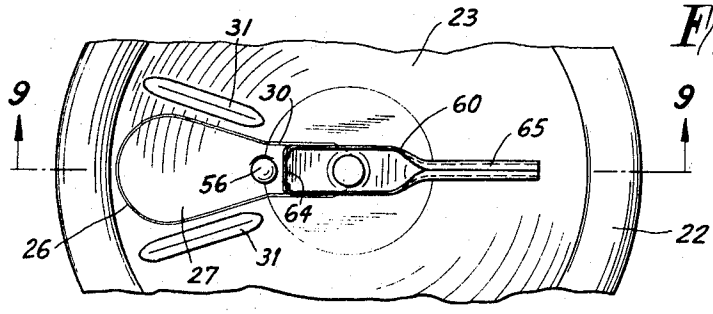


Fig. 9

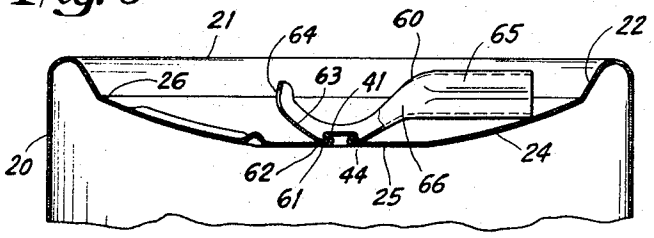


Fig. 10

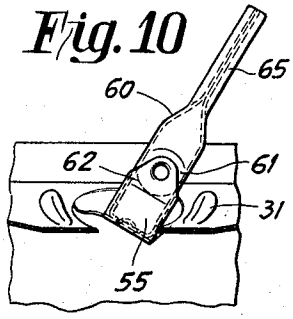


Fig. 11

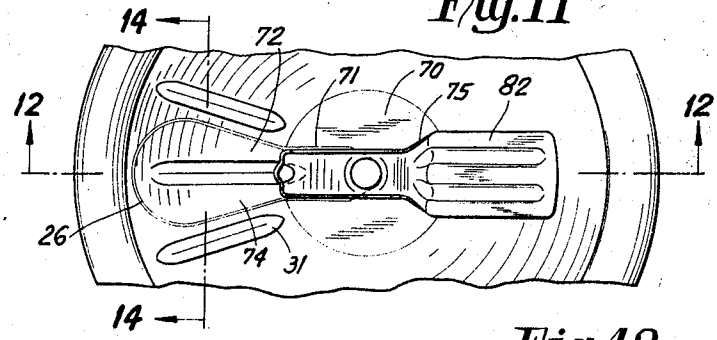


Fig. 14

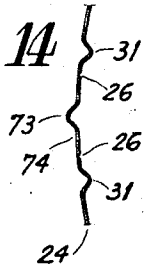


Fig. 12

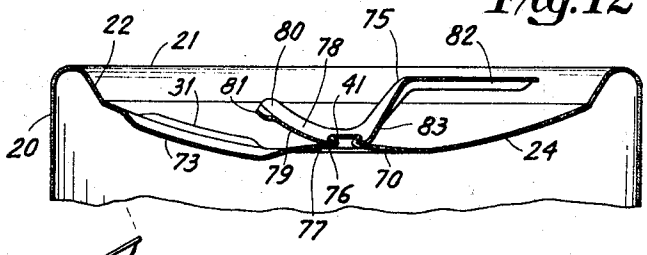
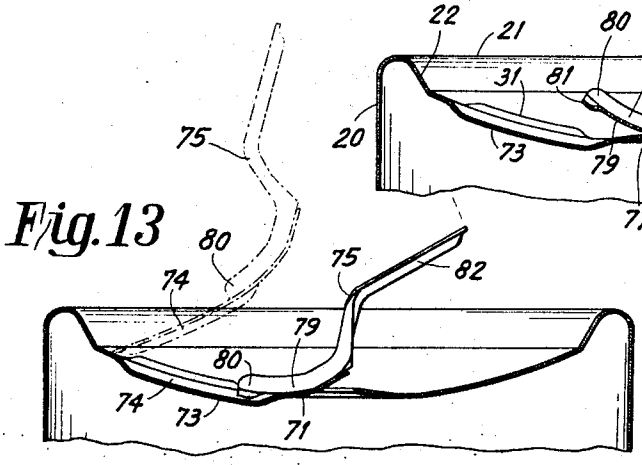


Fig. 13



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3,448,887

CONTAINER WITH EASY-OPENING DEVICE

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Int. Cl. B65d 17/20
U.S. Cl. 220—54 19 Claims

ABSTRACT OF THE DISCLOSURE

A tear tab and a radial tear strip in the concave integral end panel of an aluminum beverage container, with the tear strip starting portion contained in a small, tension-stressed center panel and the tear strip main portion in the compression-stressed concave main panel. The tear tab has an elevated handle and, when pivoted upward, rolls up the starting portion over a cam and then locks together with the main portion which can be twisted out, or which snaps out under leverage, when provided with a stiffening profile.

The present invention relates in general to the construction of metal containers, and more particularly to convenience containers of the so-called easy-opening type.

This invention particularly relates to a pressure-resistant easy-opening container of the kind used for carbonated beverages and the like. In most cases such containers includes a score line, or weakening line, defining a removable tear section in an end closure. Frequently also, there is a simple flat tear tab permanently attached to one end of the tear section to facilitate the initial rupture and complete removal of the tear section.

One of the disadvantages of presently used easy-opening constructions is the hazard connected with the blowing off of tear sections. When carbonated contents are subjected to shock shortly before opening, internal pressure may cause the entire tear section to break away and be ejected in a highly undesirable manner, particularly when the tear tab is not firmly held at this moment. Another disadvantage is the difficulty of initial rupture of the tear section which is in part due to the requirement of nestability of unsealed container ends, which calls for a snugly fitting tear tab. To initiate the opening procedure, this tab must therefore be lifted with the finger nail against the high resistance offered by the unruptured tear section. The usefulness of the improvements disclosed and claimed hereinafter resides in the elimination of the above disadvantages, in the provision of other new and advantageous operation features, and in economic attractiveness of the improved manufacture.

A first object of this invention is to provide a pressure-resistant container with a concave end panel in one end section which is primarily subjected to compression stress, instead of the tension stress occurring in flat or convex end sections, so that the tear section is laterally compressed and restrained as long as it is subjected to internal gas pressure.

A complementary object of this invention is to provide the above-mentioned pressure-resistant container with a central, non-concave portion in the otherwise concave end panel and to locate the starting portion of the tear section within this area, so as to have the starting portion subjected primarily to tension stress when internal pressure is generated in the container.

Another object of this invention is to provide a container having in one end panel a tear section with a permanently attached tear tab which is arranged at a distance from the end panel, so that it can be seized positively and firmly between two fingers even before the initial rupture is effected.

Still another object of this invention is to provide a tear-open structure which includes as a part of the tear tab a cam which controls the bending of the tear section during at least part of the opening procedure, and which includes means to guide the upward-pivoting motion of the tear tab.

A further object of this invention is to provide a tear-open structure with a tear tab having a cam which, after the tab has been pivoted upwardly, tearing out a portion of the tear section and bending it around the cam, cooperates with the tear section in such a way as to allow an effortless twisting out of the remaining tear section.

A still further object of this invention is to provide a tear-open structure with a tear tab having a cam, and with a tear section having a retalively flexible first portion and a relatively stiff second portion, so that the first portion of the tear section is torn out while bending around a portion of the tab cam, and that the second portion of the tear section cooperates with another portion of the tab cam to form a relatively inflexible connection which transmits increased leverage to this second portion of the tear section to facilitate its quick removal.

A last object—and by no means the least important—is to provide a container presenting a smooth and clean exterior aspect without any hard-to-clean recesses and corners, and one which is more acceptable to persons who would like to drink directly from the container.

The above and other features of this invention, including various novel details of construction, will now be more explicitly described with reference to the accompanying drawings, and pointed out in the claims. It will be understood that the particular easy-opennig devices embodying this invention are shown by way of illustraiton only, and not as a limitation of the invention. The principles and features of this invention may be employed in varied and numerous embodiments without departing from the scope of the invention.

In the drawings, in which like reference numbers indicate like parts throughout the several views:

FIGURE 1 is a fragmentary perspective view of a beverage container and it shows the invention embodied in an integral end section of the container.

FIGURE 2 is a plan view of the container of FIG. 1 and it shows the tear open structure in more detail and suggests a preferred way of initiating the opening procedure.

FIGURE 3 is an enlarged cross-sectional view taken through the container center along the line **3—3** of FIG. 2, and it shows the tear-open structure before opening.

FIGURE 4 is a cross-sectional view taken through the container center along the line **4—4** of FIG. 3, and it shows further details of the tear-open structure.

FIGURE 5 is a cross-sectional view similar to FIG. 3 and shows the tear-open structure after a first step in the opening procedure.

FIGURE 6 is a cross-sectional view similar to FIG. 4 and shows the tear-open structure during the final portion of the opening procedure.

FIGURE 7 is a schematic geometric layout of the preferred outline of the removable tear section.

FIGURE 8 is an enlarged plan-view of a container and shows a second embodiment of the invention in a container with an integral end section.

FIGURE 9 is a cross-sectional view taken through the container center along the line **9—9** of FIG. 8, and it shows the tear-open structure before opening.

FIGURE 10 is a cross-sectional view taken through the container center, and it shows the tear-open structure during the final portion of the opening procedure.

FIGURE 11 is an enlarged plan-view of a container and shows a third embodiment of the invention in a container with an integral end section.

FIGURE 12 is a cross-sectional view taken through the container center along the line **12—12** of FIG. 11, and it shows the tear-open structure before opening.

FIGURE 13 is a cross-sectional view similar to FIG. 12 and shows the tear-open structure during the opening procedure.

FIGURE 14 is a cross-section taken along the line **14—14** of FIG. 11, and it shows details of the wall profile of the container end panel.

The three different embodiments illustrated show a container with an integral end section of the kind fabricated of aluminum by either the impact-extrusion method or the deep-drawing method. This kind of container is presently also being used for the packaging of carbonated beverages, including beer. It is to be understood, however, that the principles of this invention may be readily applied to other kinds of containers, or incorporated in separate end closures which are later hermetically sealed to suitable container bodies. For descriptive purposes only, the invention will be specifically described with respect to a beverage container, such as a beer can, for example.

Referring now specifically to the drawings, reference is first made to the embodiment illustrated in FIGURES 1–7. The container shown has a cylindrical body **20** and an integral end section **21**, consisting of an end bead **22** and a concave end panel **23** supported and restrained by the end bead **22**. During the filling operation, and until the other end of the container is sealed tight, this end section **21** serves as the bottom of the container. The end bead **22** then supports the container and protects the end panel **23** with the tear-open structure.

The major part of the end section **21** is taken up by the concave end panel **23** which in turn consists of a calotte-shaped main panel **24**, and a much smaller flat center panel **25**. The end panel **23** includes in its wall a score line, or weakening line **26** which defines a removable tear section **27**, as illustrated in FIGS. 2 and 7. The tear section **27** has its outline derived from a slender geometric sector **28** taken from the end panel **23**, as is schematically illustrated in FIG. 7. It includes a large terminal radius **29** near the periphery of the end panel **23** and a narrow tongue-shaped starting portion **30** in the place of the tip of the sector **28**, which is also the center of end panel **23**. The rupture of the tear section **27** along the weakening line **26** creates a combined dispensing and air-admitting spout, facilitating a liquid flow of comparatively low turbulence.

A pair of ribs **31** flanking the tear section **27** on the radial portions of its outline provides a protective profile against accidental contact between the raw edge of the opening and the upper lip of a person who is drinking directly from the container.

A tear tab **40** is shown attached to the tear section **27** by means of an integral blister rivet **41**, which firmly secures the tab base **42** to the starting portion **30** in the center of the end panel **23**. The rivet **41** is surrounded by the starting portion **30**, and the weakening line **26** has in this area an arc portion **43**, as shown in FIG. 7, which includes a point of initial rupture **44** which is located adjacent to the rivet **41** in order to produce the greatest possible leverage for initial rupturing at this point. The tab base **42** which overlies the inner part of the starting portion **30** continues in a tab cam **45** which is oriented away from the tab base **42**, opposite the point of initial rupture **44**. At the junction with the tab base **42** the tab cam **45** forms a sharp upward bend, or kink **46**, which is also located very closely to the blister rivet **41** in order to enhance the concentration of bending forces during initial rupture.

The tab cam **45** extends upward and outward from the kink **46** and over the tear section **27**, thereby forming a C-shaped knee **47** which in turn continues in a rigid

flat tab handle **48** extending horizontally above, and a distance beyond, the tab base **42**. Thus, the tab handle **48** is positioned at a distance above the end panel **23**, facilitating greatly the initial application of finger force to the tear tab **40**. But, being located within the depression formed by the concave end panel **23** and the projecting end bead **22**, the tear tab **40** is protected against accidental application of opening forces during handling and shipping operations.

The particular configuration of the calotte-shaped main panel **24** and the flat center panel **25**, in conjunction with the disclosed contour of the weakening line **26**, have the advantage of simplifying the design of the scoring tools. More importantly, however, this configuration produces a novel stress pattern in the end panel **23** and along the contour of the weakening line **26**.

Normally, any flat or convex container panel is subjected to tension stress when the container is under internal gas pressure. Similarly, any concave panel is subjected to compression stress under internal gas pressure. The actual amount of stress depends on, besides the existing pressure, the wall thickness of the panel, the curvature of the panel, and finally the kind of peripheral restraint provided. From the configuration illustrated in the drawings, in FIG. 3, for example, it follows that the entire area of the main panel **24**, including the portion of the weakening line **26** located within it, is subjected primarily to compression stress. Along the weakening line **26** itself the compression stress is supplemented by shear stress. The center panel **25**, on the other hand, is subjected primarily to tension stress, except for a peripheral margin where the compression stress from the main panel **24** is transmitted radially to the center panel **25**.

The blister rivet **41** is drawn from the wall material of the center panel **25** in accordance with well-known methods. Other attachment means could be utilized in its place, although the rivet illustrated is the preferred kind. In addition, the method of forming the blister rivet **41** results in a reduced wall thickness of the center panel **25** in the vicinity of the starting portion **30**, thereby eliminating any possible radial compression stress which might otherwise be transmitted to this area from the main panel **24**.

The novel stress pattern described in the foregoing results in an important advantage, in that the initiation of rupture is located in a panel area subject to tension stress, while the main body of the tear section **27** is located in a panel area subject to compression stress. Therefore, when the tear-open procedure is initiated while high gas pressure exists inside of the container, initial rupture is not inhibited, but rather facilitated, while the hazardous uncontrolled blow-off of the entire tear section is prevented because of the compression effect present along the weakening line surrounding the main portion of the tear section **27**. This restraining effect under internal gas pressure represents an important safety feature. However, as soon as the excess gas has escaped through the initial small opening in the center panel **25**, the compression stress disappears from the main panel and further rupturing along the weakening line for complete removal of the tear section **27** is no longer restrained.

The operation of the easy-opening device of FIGURES 1–7 is preferably started by firmly seizing the tab handle **48** between the thumb and the index. There is no longer any need for the use of a finger nail in order to apply initial lifting force to the tab. When the tear tab **40** is pivoted upwardly it acts in the manner of a second-class lever, using the kink **46** as a fulcrum, thereby creating a first break at the point of initial rupture **44**. As the tear tab **40** is pivoted further, moving toward the position shown in FIG. 5, it rolls up the remainder of the starting portion **30** by bending the torn portion **55** around the tab cam **45**. Instead of the pivoting motion with the rolling effect, it would of course also be possible to apply a straight pull force to the tear tab **40**, and the tear

section 27 would rupture in much the same way as in known easy-opening structures. However, the rolling operation requires only a fraction of that force, due to its leverage effect.

The tear section 27 is also provided with a round protrusion 56 on its upper surface, and which cooperations with a hole 57 in the tab cam 45 as the tab handle 48 approaches an upright orientation. The protrusion 56 and the hole 57 have the effect of locking the tab cam 45 to the torn portion 55, so that a sideways pivoting motion of the tear tab 40, such as is illustrated in FIG. 6, causes the remainder of the tear section 27 to be twisted out of the end panel 23 with a minimum of effort. The edge 58 of the tab cam 45 thereby serves as a fulcrum point against the end panel 23.

It will be observed that during the entire opening procedure, i.e. during the upward pivoting as a first step, and during the sideways pivoting as a second step, the tear tab 40 works in the way of a true lever and not as a pull tab. In addition to the benefit of reduced effort, this has the further advantage of eliminating the final jerk frequently encountered at the end of the usual pull tab operation.

A second, closely related, embodiment is illustrated in FIGURES 8–10. The differences between the first-disclosed structure and the present one are to be found primarily in the arrangement of elements of construction. The basic functions and the operational features are unchanged and will therefore not be repeated.

The container body 20 and the entire end section 21, including the weakening line 26, and the blister rivet 41, are unchanged. A modified tear tab 60 includes a basically unchanged tab base 61, a kink 62, and a tab cam 63 with a similar curvature. The previous hole 57 is replaced by an open slot 64. A narrow but thick handle 65 is rigidly connected to the tab base 61 by a knee 66 which has the appearance of a stretched S-shape, and which overlies the point of initial rupture 44.

This structure has all the advantages of the first embodiment, and it offers in addition an improved grip profile at the tab handle 65. It further offers manufacturing and assembly advantages. This embodiment does not include a fulcrum point comparable to the edge 58 of FIG. 6, but this does not materially impair the effectiveness of the sideways pivoting in the second step of the opening procedure, as illustrated in FIG. 10.

A third, related, embodiment is illustrated in FIGURES 11–14. Again, the container body 20, the end section 21, including the weakening line 26, and the blister rivet 41, are basically unchanged. Only the previously flat center panel 25 of the concave end panel 23 is replaced by a convex center panel 70. The effect of this convexity is similar to that of thinning of the center panel; to eliminate any possible radial compression which might otherwise be transmitted to the starting portion 71 of the weakening line 26.

A modified tear section, 72, in outline similar to the one previously disclosed, includes a groove profile 73 which renders the tear section main portion 74 relatively stiff and resistant against rolling up, while the tongue-shaped starting portion 71 of tear section 72 is similar to the previously described starting portion 30 and therefore relatively flexible. A modified tear tab 75 includes a basically unchanged tab base 76, a kink 77, and a tab cam 78. The new tab cam 78 has a first portion 79 which cooperates with the relatively flexible starting portion 71 in essentially the same way as previously described. A second cam portion 80 cooperates with the relatively stiff main portion 74 of the tear section 72 to form a relatively inflexible connection between the tear tab 75 and the tear section 72, so as to permit the application of a leverage-augmented lifting force directly to the remaining main portion 74.

A protrusion 81 at the end of the tab cam 78 cooperates with the groove profile 73 to offer lateral guidance for the tear tab 75 during part of the upward-pivoting motion. A flat tab handle 82 is rigidly connected to the tab base 76 by an S-shaped knee 83, in a manner comparable to the second embodiment disclosed herein.

The opening procedure of this third embodiment is initially identical with the one suggested for the two preceding versions. The second step, however, represents a simplification, inasmuch as it asks only for continuation of the pivoting motion in the same direction. This step is illustrated in FIGURE 14. By yielding only to a limited extent, the relatively stiff main portion 74 avoids the characteristic upward-folding of presently used tear strip and pull tab combinations. These combinations, by allowing sharp upward bending of the tear strip near the point of rupture, lose the leverage which could be obtained from the upward pull.

While three preferred embodiments of the invention have been specifically illustrated and described in the foregoing, it should be understood that certain variations and modifications, as well as the substitution of equivalent elements for those shown for illustration, may be made without departing from the scope and spirit of the invention as defined in the appended claims. The foregoing specification and drawings are accordingly to be regarded in an illustrative rather than in a restrictive sense.

I claim:

1. A pressure-resistant container comprising, in an end section, a recessed end panel of generally concave configuration having a weakening line defining the outline of a removable panel portion of tear section, said end panel including a substantially calotte-shaped main panel and a much smaller non-concave center panel, so that internal pressure causes primarily compression stress in said main panel and primarily tension stress in at least the inner portion of said center panel, said weakening line including a starting portion with a point of initial rupture which is located in the panel area subject to tension stress, and another portion located within the panel area subject to compression stress.

2. A container as set forth in claim 1, wherein said weakening line has its general outline derived from a slender sector of said end panel, including a terminal radius near the periphery of said sector and a tongue-shaped portion in the place of the tip of said sector, the earlier-mentioned starting portion and point of initial rupture being a part of said tongue-shaped portion.

3. A container as set forth in claim 1, wherein said center panel has a reduced wall thickness in at least the inner portion of its area, to permit easier flexing of said center panel.

4. A container as set forth in claim 1, wherein said tear section includes a tear tab to facilitate the rupturing and tearing out of said tear section and attachment means securing said tear tab to said tear section adjacent to said point of initial rupture.

5. A container comprising, in an end section, an end panel having a weakening line defining the outline of a removable panel portion or tear section, a rigid tear tab facilitating the rupturing and tearing out of said tear section, said tear tab including a tab base, attachment means permanently securing said tab base to said tear section adjacent to a point of initial rupture on the weakening line, an elongated tab handle arranged above said tab base and in a spaced relationship to said end panel, so that it can conveniently be seized on its sides between the thumb and forefinger, and a tab knee rigidly connecting said tab handle to said tab base.

6. A container as set forth in claim 5, wherein said tab knee has a generally C-shaped profile, said tab base extending from the lower leg of the C, and said tab handle extending from the upper leg of the C, in substantially the same direction as, and considerably beyond, said tab base.

7. A container as set forth in claim 5, wherein said tab knee has a generally S-shaped profile, said tab base extending from the lower leg of the S, and said tab handle ex-

tending from the upper leg of the S, in substantially the opposite direction.

8. A container as set forth in claim **5**, wherein said end panel is recessed with respect to the periphery of said container end section, so as to form a depression containing within its space all parts of said tear tab.

9. A container as set forth in claim **5**, wherein said end panel is of generally concave configuration and wherein said tab base and attachment means are located in the general area of the center of said depression.

10. A tear-open structure for containers comprising a panel and a weakening line in said panel defining a removable panel portion or tear section, a rigid tear tab facilitating the rupturing and tearing out of said tear section, said tear tab including a tab base, attachment means rigidly securing said tab base to said tear section adjacent to a point of initial rupture on the weakening line, a tab handle extending away from said tab base, and a tab cam, said tab cam forming an extension of said tab base in a direction upward and outward over said tear section and away from said point of initial rupture, and said tab cam being also adapted to control the bending of said tear section during at least part of the tear-open procedure, as an upwardly pivoting motion of said tear tab causes said tear section to be progressively bent around said tab cam, thereby severing said tear section from said panel along said weakening line.

11. A tear-open structure as set forth in claim **10**, wherein said tab cam has a generally C-shaped curvature and also serves as a connecting knee between said tab base and said tab handle, said tab handle extending from the upper end of the C in substantially the same direction as, and considerably beyond, said tab base.

12. A tear-open structure as set forth in claim **10**, wherein said tab handle is rigidly connected to said tab base on the side facing away from said tab cam.

13. A tear-open structure as set forth in claim **10**, wherein said tear section and said tab cam have their corresponding faces provided with guide means adapted to laterally guide the upward-pivoting motion of said tab, as said tear section is bent around said tab cam.

14. A tear-open structure as set forth in claim **13**, wherein said guide means are provided in the form of a recess in one of the two faces and a matching tapered protrusion in the other.

15. A tear-open structure as set forth in claim **10**, wherein the curvature of said tab cam includes a cam portion whose tangent plane is substantially at right angles to the general axis of said tab handle, and wherein the said cam portion and a corresponding portion of said tear section have their faces provided with guide means adapted to restrict any relative motion between said tab cam and said tear section, as said tab is pivoted upward around said tab cam to a position where said cam portion is contiguous with said tear section.

16. A tear-open structure as set forth in claim **10**, wherein the transition between said tab base and said tab cam includes a kink or sharp upward bend which is adapted to serve as a fulcrum point during the initial part of the opening procedure.

17. A tear-open structure as set forth in claim **10**, wherein said tear section includes a first relatively flexible tear section portion and a second relatively stiff tear section portion, said flexible tear section portion being adapted to be bent around a first portion of said tab cam as said tab is being pivoted upwardly, said stiff tear section portion being adapted to cooperate with a second portion of said tab cam, so as to form a relatively inflexible connection between said partially torn tear section and said tab, as said tab is moved further in an upward-pivoting direction, thereby tearing said relatively stiff tear section portion from said end panel.

18. A tear-open structure as set forth in claim **17**, wherein said first relatively flexible tear section portion has a wall of reduced wall thickness to facilitate its bending around said tab cam.

19. A tear-open structure as set forth in claim **17**, wherein said second relatively stiff tear section portion has a stiffening profile impressed in its wall which is adapted to restrict its bending during the tear-open procedure.

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GEORGE T. HALL, *Primary Examiner.*