Dec. 13, 1966 E. C. FRAZE 3,291,336

CAN TOP

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Fig. 1

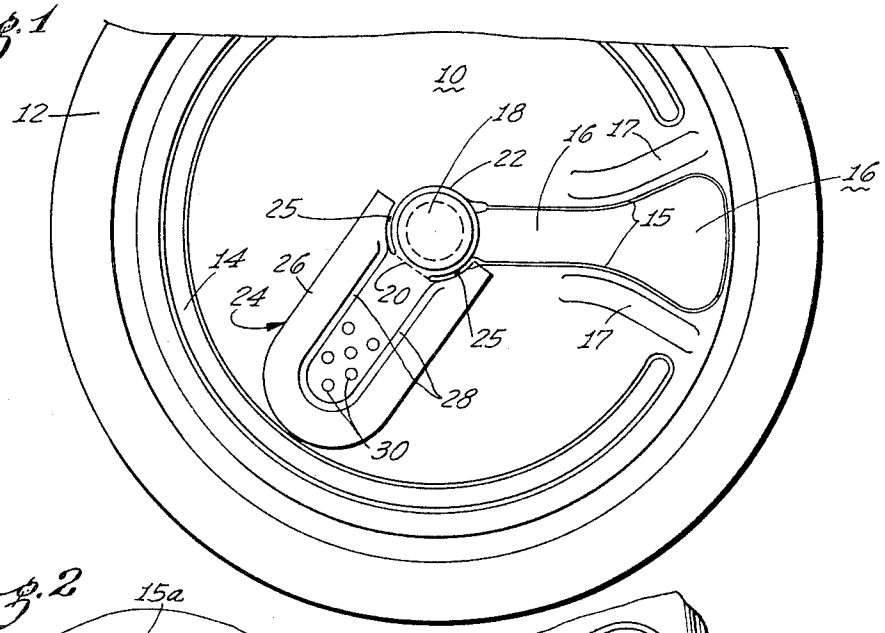


Fig. 2

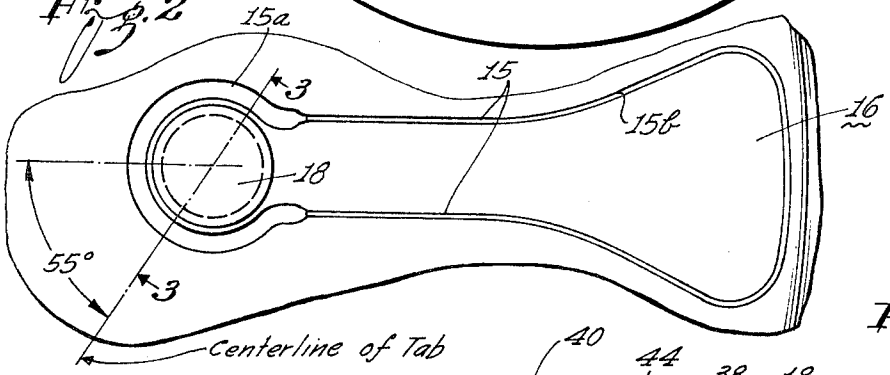


Fig. 3

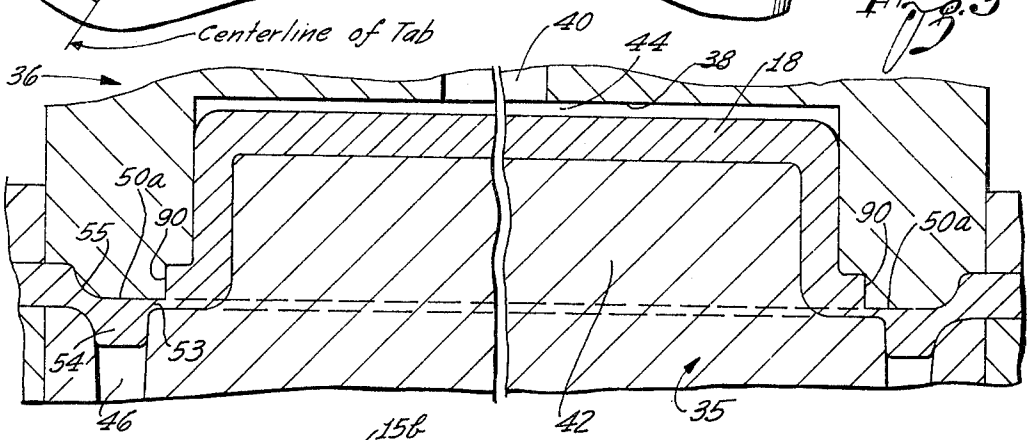
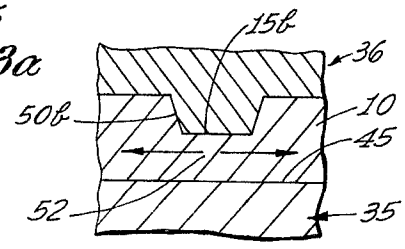


Fig. 3a



INVENTOR:
Ermal C. Fraze

By Smyth, Roston & Pavitt
Attorneys

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Fig. 4

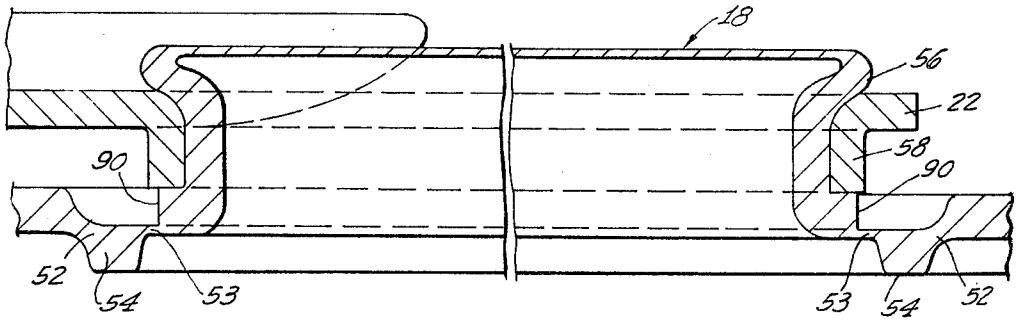


Fig. 5

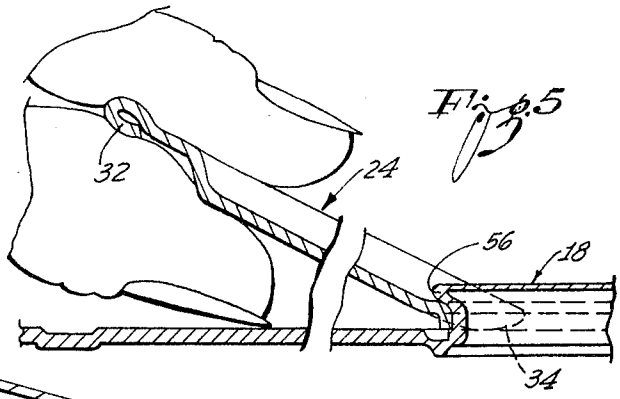


Fig. 6

INVENTOR
Ermal C. Fraze

By Smyth, Roston & Pavitt

Attorneys

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Fig. 7

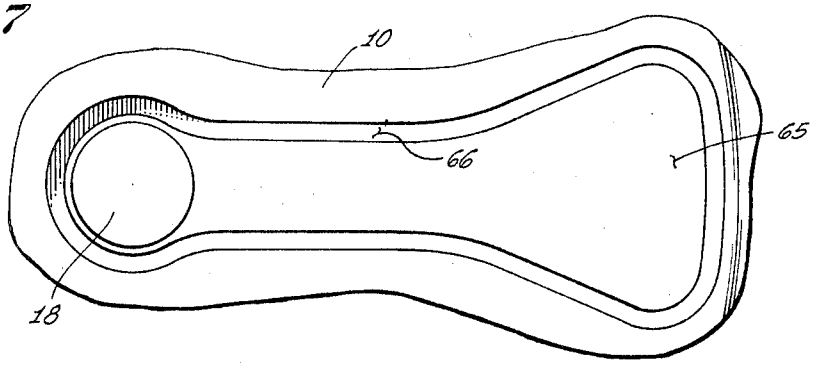


Fig. 8

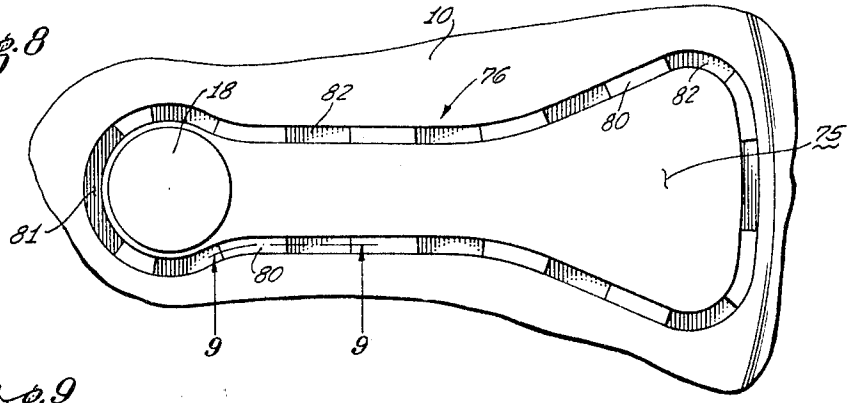
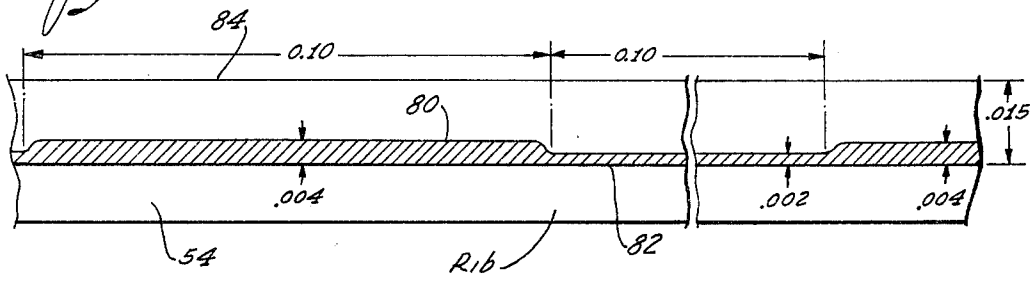


Fig. 9



INVENTOR:
Ermal C. Fraze

By Smyth, Roston & Pavitt

Attorneys

United States Patent Office

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CAN TOP

Ermal C. Fraze, 355 W. Stroop Road, Dayton, Ohio

Filed Jan. 22, 1965, Ser. No. 427,424
10 Claims. (Cl. 220—54)

This invention relates to a container of the type that has a wall of sheet material scored to form a tear strip, a suitable tab being attached to the tear strip to serve as a handle for manual severance of the tear strip. The invention is directed to the problem of scoring the sheet material deeply enough to make it relatively easy to remove the tear strip and, more specifically, the invention is directed to the problem of achieving such deep scoring in a single scoring operation.

Metals used for the tops of easy opening cans, such as cans for beer, carbonated soft drinks, juices, soups, etc., are made of various metals including aluminum alloy and tin-coated steel and vary in thickness usually within the range of .008" to .015". For really easy severance of a tear strip it is necessary to score most metals deeply enough to leave an exceedingly thin residual web of metal along the score line. It has been found, however, that reducing the thickness of sheet metal to leave a residual which is easily torn results more often than not in cracking of the metal along the score line.

Careful study of the cause of the cracking reveals that two different effects of the scoring operation are involved. One effect is the work-hardening of the metal that forms the thin residual web. In itself, the work-hardening is desirable because, on the one hand, it increases tensile strength of the residual web of metal, and, on the other hand, it gives the residual web a desirable degree of brittleness which facilitates severance of the tear strip.

The second effect of the scoring operation is transverse tensioning of the residual web by the advancing scoring die. The transverse tensioning of the residual web is caused by flow displacement of the metal in opposite directions and the usual tapered configuration of the scoring element increases the transverse tensioning by a wedging action. If the penetration of the sheet material by the scoring die is less than 50% of the initial thickness of the sheet material, as is the case in conventional scoring, the residual web is relatively thick and the tensioning of the residual web by the advancing scoring die is moderate and well within the elastic limits of the residual web. If the penetration by a conventional scoring die substantially exceeds 60% of the initial thickness of the sheet metal, however, the transverse tensioning of the residual web by the scoring die increases rapidly and at the same time the residual web becomes progressively thinner with progressively reduced ability to withstand the steeply rising tension. Consequently, the web is soon subjected to transverse tension of a magnitude beyond its breaking point.

It has been found heretofore that the destructive tensioning of the thin web of residual metal by the advancing scoring die may be avoided by taking a preliminary step of reducing the thickness of the metal drastically by what may be termed a coining operation. Thereafter, the thinned metal may be scored to produce an exceedingly thin residual web without cracking because the lesser depth of penetration in proportion to the thickness of the coined metal has only a moderate tensioning effect on the residual web. Unfortunately, however, scoring the metal of a can top in two steps by two successive operations is objectionable in the mass production of easy-opening cans by automatic machinery. The purpose of the present invention, therefore, is to achieve the same result by a single scoring operation that may be economically incorporated in a mass production fabrication procedure.

This purpose is achieved by a concept of a new method of scoring which is based on the above discovery of the reasons for the cracking of the metal in a deep scoring operation. In a conventional scoring operation one face of the sheet metal is supported by a planar surface of one die while a second scoring die penetrates the other face of the sheet metal. In the new scoring method, the surface of the supporting die is formed with an elongated recess that conforms to the pattern of the penetrating edge of the scoring die and which provides a space into which the metal may be extruded in the course of the scoring operation. Thus, in a conventional scoring operation the paths of flow of the metal displaced by the advancing scoring die are restricted to two opposite directions perpendicular to the direction of advance of the scoring tool, whereas, in the improved method, the displaced metal is offered a third direction of flow into the cavity of the supporting die with the consequence that a relatively large proportion of the displaced metal is extruded into the cavity to form a solid metal rib along the line of scoring.

It is the restriction of the metal to the two opposite directions of lateral flow in the path of the advancing scoring die that creates the destructive lateral tensioning of the progressively thinning web of metal. Affording the displaced metal the third direction of escape in the same general direction of the advance of the scoring die reduces the lateral stressing of the metal to a magnitude that is well under the tensile strength of the progressively thinning web. For this reason, aluminum alloy sheet metal of an initial thickness of .015" may be reduced abruptly in a single operation by the new method to a residual thickness of only .003" and a sheet of an initial thickness of .008" may be scored to a residual thickness of .0025".

It is apparent that the solid rib may be extruded to lie on either side of the score line, i.e., on either side of the thin residual web of metal. A feature of the preferred practice of the invention, however, is that the location of the extruded rib is outside of the area of the tear strip, i.e., on the side of the scored line that is opposite from the side adjacent the tear strip. Bearing in mind that the basic purpose of the invention is to minimize resistance to severance of the tear strip, this feature may be appreciated when it is considered that severance of the sheet metal is accomplished by lifting the tear strip away from the can top to stress the thin web of metal in shear across the score line. If the adjacent sheet metal of the can top bulges outward to follow the lifting of the tear strip, the desired shearing stress is correspondingly reduced. Consequently, the presence of the extruded rib to reinforce the adjacent metal of the can top against bulging action results in an abrupt rise in the shear force to facilitate severance of the tear strip.

When an easy-opening can constructed in accordance with the invention confines a fluid under exceptionally high pressure, for example, a highly carbonated beverage, it may be desirable to provide greater strength across the score line without correspondingly increasing the resistance to severance of the tear strip. The invention teaches that for this purpose spaced shallow transverse ribs of the metal may be formed across the thin residual web integrally therewith by the scoring operation. The transverse shallow ribs locally thicken the residual web to provide the desired increase in tensile strength across the score line but the residual web is of the usual minimum thickness in the spaces between the shallow transverse ribs and these spaces afford minimum resistance to initiation of the tearing of the metal. Once the tearing action is initiated, it progresses easily across the spaced shallow ribs in its path.

An unexpected advantage of the new method of scoring relates to the undesirable tendency of a can end to bulge outwardly and especially when the can confines a fluid under pressure, such as a carbonated beverage. It is well known that scoring a can end in a conventional manner spreads the metal laterally in both directions along the score line and thus expands the can end to cause bulging or "oil canning." It is for this reason that can ends are commonly embossed to form ribs or depressions to take up metal and thus compensate at least in part for the expansion by scoring.

It has been found that the new method of scoring reduces bulging of the can end in two ways. In the first place, the new scoring technique does not spread or expand the can end. In the second place, the new method of scoring forms an extruded rib along the score line which stiffens the can end for better resistance to the internal fluid pressure.

The features and advantages of the invention may be understood from the following detailed description and the accompanying drawings.

In the drawings, which are to be regarded as merely illustrative:

FIG. 1 is a plan view of a can top incorporating one embodiment of the invention in which extrusion scoring is employed only around the leading end of the tear strip, the remainder of the tear strip being defined by conventional scoring;

FIG. 2 is an enlarged fragmentary plan view of the tear strip of FIG. 1 with the tab removed to expose the scoring around the leading end of the tear strip;

FIG. 3 is a greatly enlarged sectional view showing the construction of dies to produce the new extrusion scoring, the section being taken along the region of the line 3—3 of FIG. 2;

FIG. 3*a* is a fragmentary section showing how conventional scoring dies are used to produce the conventional portion of the score line that defines the tear strip;

FIG. 4 is a section in the same region as FIG. 3 taken after the tab has been attached to the tear strip;

FIG. 5 is a fragmentary sectional view through the tab and the leading end of the tear strip showing how the tab is lifted for the purpose of initiating severance of the leading end of the tear strip;

FIG. 6 is a fragmentary sectional view similar to FIG. 5 on a larger scale showing how the tab serves as a second class lever for lifting the leading end of the tear strip to initiate the severance of the tear strip;

FIG. 7 is an enlarged fragmentary plan view similar to FIG. 2 showing how extrusion scoring may be employed for the entire line of scoring that defines the tear strip;

FIG. 8 is a view similar to FIG. 7 showing how shallow transverse ribs may be formed across the score line for added strength along the score line; and

FIG. 9 is a greatly enlarged fragmentary sectional view taken along the line 9—9 of FIG. 8.

FIG. 1 shows a can top, generally designated **10**, which may, for example, be made of aluminum alloy of a thickness of approximately .015" and which is formed in the usual manner with a rim flange **12** for joining the can top to a cylindrical can body in a well known manner. The can top **10** is formed with a C-shaped recess **14** that extends around the major portion of its circumference to minimize bulging of the sheet metal and the can top is formed with a line of grooved scoring, generally designated **15**, to define a tear strip that may be manually removed to form a corresponding opening in the can top through which the can may be emptied. The tear strip is generally designated **16**. Suitable short ribs **17** may be embossed in the can top on opposite sides of the tear strip **16** to reduce the tendency of the metal to bulge and to serve to a desirable degree as guard means for contact with the user's lips in the event that the user elects to drink the liquid directly out of the can.

The grooved scoring that defines the tear strip **16** is in accord with the teaching of the invention to minimize resistance to severance of the tear strip and a tab of any suitable construction and configuration may be attached in any suitable manner to the leading end of the tear strip to serve as a handle for manual severance of the tear strip. In this particular embodiment of the invention the tab is attached to the tear strip **16** by means of a hollow rivet **18** that is formed in the metal of the tear strip and extends through a corresponding aperture in the tab in positive overlapping engagement with the rim of the aperture.

In this particular practice of the invention, the tab is divided along a transverse fold line **20** into a minor end portion **22** that is attached to the tear strip **16** by means of the hollow rivet **18** and a major longitudinal handle portion in the form of a second class lever, generally designated **24**. The lever **24** is, in effect, hingedly connected to the hollow rivet **18** along the transverse fold line **20** and the metal of the tab is formed with two arcuate slots **25** that extend from the fold line to the inner end or fulcrum end of the lever. The two slots **25** free the fulcrum end of the lever for movement relative to the hollow rivet and at the same time give the fulcrum end of the lever a forked configuration whereby two fulcrum ends straddle the hollow rivet outside of the area of the tear strip **16**.

The lever **24** must be relatively rigid to accomplish its purpose. In this instance, the tab is made of sheet metal and the lever is stiffened by an embossed marginal rib **26** that extends around two sides and one end of the lever, the marginal rib forming a sloping shoulder **28** that is U-shaped in plan as shown in FIG. 1. In addition, the central area of the lever **24** may be embossed to provide small bosses **30** that serve as "hob nails" to facilitate frictional gripping of the lever. As indicated in FIG. 5 the metal around the periphery of the lever may be folded to form a strengthening bead **32** and to avoid exposure of a sharp metal edge. Preferably the two fulcrum ends of the lever that are provided by the forked configuration are formed with rounded noses **34** as shown in FIGS. 5 and 6.

As shown in FIG. 2, the line of grooved scoring **15** in this first embodiment of the invention is divided into two portions, namely a portion **15***a* which extends around the leading end of the tear strip, i.e. around three sides of the hollow rivet **18**, and a portion **15***b* of major length which extends around the rest of the tear strip. The portion **15***b* of the line of grooved scoring is conventional scoring which is produced in the manner shown in FIG. 3*a* and the portion **15***a* of the line of grooved scoring, which may aptly be termed extrusion scoring, is produced by the new method illustrated by FIG. 3.

In the preferred practice of the invention it is contemplated that in accord with a well known procedure a relatively large dimple (not shown) will be formed in the can top in the region of the desired location of the hollow rivet **18** and then the dimple will be formed into the hollow rivet and in the same forming operation the metal will be scored to produce the entire line of grooved scoring **15**. The construction of a suitable die means to carry out the dual operation of initially forming the rivet and of simultaneously scoring the sheet metal may be understood by referring to FIGS. 3 and 3*a* which are two different fragmentary sections of the same die means.

The die means shown in FIGS. 3 and 3*a* comprises a lower die, generally designated **35**, and a cooperating upper die, generally designated **36**. As shown in FIG. 3, the upper die **36** has a downwardly facing forming cavity **38** with a vent **40** to avoid trapping air and the lower die **35** is formed with a boss **42** that conforms in shape to the inside configuration of the desired hollow rivet. When the lower boss **42** enters the cavity **38** it converts the previously mentioned dimple into the desired rivet configuration, the preformed dimple providing ample metal to

prevent undue thinning of the wall of the rivet. As indicated in FIG. 3, there is ample clearance 44 in the cavity 38 to permit thickening of the metal that forms the transverse end wall of the hollow rivet.

The lower die 35 that is formed with the boss 42 has a flat or planar support surface throughout the region of the intended location of the conventional portion 15*b* of the line of grooved scoring 15, this flat support surface being designated 45 in FIG. 3*a*. In the region of the desired location of the extrusion scoring 15*a*, however, the lower die 35 is formed with an elongated recess that conforms to the pattern of the desired extrusion scoring 15*a*, this recess being designated 46 in FIG. 3.

The upper die 36 has a downwardly protruding continuous scoring element, a longitudinal portion of which, designated 50*a* in FIG. 3, corresponds to the portion 15*a* of the line of grooved scoring 15. The remainder of the scoring element which is designated 50*b* in FIG. 3*a* corresponds to the portion 15*b* of the line of grooved scoring in FIG. 2.

In FIG. 3*a* the metal of the can top 10 rests on the planar working surface 45 of the lower die 35 and the portion 50*b* of the scoring element of the upper die cooperates with the lower die to form the portion 15*b* of the line of grooved scoring 15 and to reduce the thickness of the sheet metal to a residual web 52. As heretofore stated, the initial thickness of this particular aluminum alloy sheet material 10 is approximately .015". In this instance the effective depth of the portion 50*b* of the scoring element is .009". Thus, the penetration of the sheet metal by the portion 50*b* of the scoring element is approximately 60% of the initial thickness of the sheet metal, leaving the residual web 52 with a thickness dimension of approximately .006". If the thickness of the sheet metal is reduced by more than 60%, the residual web is susceptible to cracking.

An inspection of FIG. 3*a* makes clear the two effects of the scoring operation that have been heretofore discussed. Thus, it is apparent in FIG. 3*a* that the metal of the residual web 52 is work-hardened to an appreciable degree and it is also apparent that the metal displaced by the penetration of the portion 50*b* of the scoring element is restricted to flow in two opposite directions as indicated by the two opposite arrows. It may be readily appreciated that if the scoring element continued to advance to penetrate the sheet metal by substantially more than 60%, the work hardening and the consequent embrittlement of the web 52 would increase and at the same time the lateral tensioning of the residual web 52 by the advancing scoring element would rise abruptly to a destructive magnitude.

The line of extrusion scoring 15*a* in FIG. 2 is accomplished by the die means in the manner illustrated in FIG. 3. As may be seen in FIG. 3, the configuration of the portion 50*a* of the protruding scoring element of the upper die and the configuration of the corresponding recess 46 in the lower die 35 are such as to cooperate to produce a line of grooved scoring which in cross section consists of a residual web of metal 53 of minimum thickness, a solid extruded rib 54 to one side of the residual web and a thicker web 55 which connects the rib directly to the can top outside of the area of the tear strip. It is to be noted in FIG. 3 that the recess 46 that forms the extruded rib 54 is narrower than the portion 50*a* of the scoring element of the upper die and it is to be further noted that the edge of the recess that is adjacent the tear strip is offset from the corresponding edge of the scoring element 50*a* towards the opposite edge of the scoring element, this offset relationship accounting for the formation of the thin residual web 53.

In this particular example to illustrate the invention in which the sheet material is an aluminum alloy and in which the initial thickness of the can top is on the order of .015", the residual web 53 may be on the order of .002"–.003", and the thickness of the thicker web 55 on the other side of the extruded rib 54 may be on the order of .004". Thus the line of least resistance for severing the tear strip is along the residual web 53 and the extruded rib 54 lies outside of the area of the tear strip. Since the extrusion of the rib 54 into the die recess 46 tends to cause the can top to adhere to the lower die 35, suitable ejector means (not shown) may be incorporated in the construction of the lower die to operate in the recess.

After the hollow rivet 18 is formed to the initial configuration shown in FIG. 3 and the complete grooved score line 15 comprising portions 15*a* and 15*b* has been formed in the same operation, the tab 24 is placed in the position shown in FIG. 1 with the hollow rivet 18 extending through the aperture in the minor end portion 22 of the tab. The hollow rivet is then headed into permanent engagement with the tab by suitable die means (not shown) which squeeze the transverse end wall of the hollow rivet across its thickness and thereby extrude the metal of the end wall radially to form a circumferential bead 56 around the hollow rivet as best shown in FIG. 6, the bead overhanging the rim of the aperture of the tab in permanent engagement therewith. Preferably the aperture of the tab is flanged as shown in FIG. 6 to form an integral hub 58 that snugly embraces and reinforces the hollow rivet.

FIG. 5 shows how the lever 24 may be initially swung upward from its normal position to bring the rounded noses 34 of the two fulcrum ends of the lever into contact with the can top outside of the area of the tear strip on opposite sides of the hollow rivet 18. FIG. 6 shows how continued swinging movement of the lever 24 tilts the hollow rivet 18 by lever action to initiate the tearing of the metal at the leading end of the tear strip. It is apparent that the extremely thin residual web of metal 53 along the portion 15*a* of the grooved score line 15 greatly reduces the resistance to the severance of the metal at the leading end of the tear strip. It is also apparent that the severance of the leading end is caused by stressing the metal of the residual web 52 in shear degree and that the stressing of the metal in shear is improved by the stiffening effect of the adjacent extruded rib 54.

The side wall 90 (FIGS. 3 and 4) of the groove or recess formed in the sheet metal by the portion 50*a* of the scoring die is perpendicular to the plane of the can top to form an abrupt shoulder that concentrates the shear stress at the bottom of the abrupt shoulder for further promoting initial severance of the tear strip. It is further to be noted that the rib 54 is narrower than the groove in the outer surface of the sheet material and that the side of the rib that corresponds to the abrupt side wall 90 of the groove is offset from the side wall 90 towards the other side of the groove thereby leaving the thin residual web 53.

An unexpected advantage resides in the above stated fact that the shear stress is concentrated along the side of the residual web 53 at the base of the abrupt shoulder 90 when the tear strip is progressively severed. Accordingly, the line of severance is constant at one edge of the residual web. Consequently, removal of the tear strip leaves an opening with a relatively smooth edge. In contrast, when a conventionally scored tear strip is removed from a can end, the line of severance tends to switch back and forth across the width of the residual web to leave an opening having a jagged edge.

In the second embodiment of the invention, which is illustrated by FIG. 7, the tear strip 65 is formed by a continuous line of grooved scoring 66 which throughout its length is of the same structure as the previously discussed extrusion scoring 15*a* of the first embodiment of the invention.

In the third embodiment of the invention, illustrated by FIG. 8, the tear strip 75 is defined by a line of scoring, generally designated 76, the entire line of grooved scoring being of the same character as the extrusion scoring 15*a* in FIG. 2 and the extrusion scoring 66 in FIG. 7 ex-

cept for the fact that in FIG. 8 the residual web of metal is reinforced by spaced shallow transverse ribs **80**. The residual web and the transverse ribs **80** may be of various dimensions in thickness in various practices of the invention and the shallow lateral ribs may be at any desired spacing. It has been found to be desirable, however, to provide a relatively wide gap between the transverse ribs at the leading end of the tear strip, such a gap being shown at **81** in FIG. 8.

By way of example, FIG. 9 shows the portions **82** of the residual web between the transverse ribs as being of a thickness of .002", the transverse ribs **80** increasing the thickness to .004", and FIG. 9 further shows the ribs as being of a width on the order of 0.10" with the ribs spaced apart by the same dimension except at the leading end of the tear strip. FIG. 9 shows how the metal of the can top extends to its original thickness at the line **84** above the residual web **82** and also shows how the extruded rib **54** on the outer edge of the residual web protrudes substantially below the residual web and below the plane of the can top.

It is apparent that the spaced regions in which the residual web is of the minimum thickness of .002"–.003" are regions of minimum strength along the grooved score line, in which regions it is relatively easy to initiate the severance of the tear strip. As heretofore stated, once severance is initiated, the severance continues freely across the successive transverse ribs.

My description in specific detail of the preferred practices of the invention will suggest various changes, substitutions and other departures from my disclosure within the spirit and scope of the appended claims. Obviously, the invention is applicable to sheet stock of various materials and of various initial thicknesses wherever scoring is desirable to a depth that would be destructive if carried out by a conventional scoring method in a single operation.

I claim:

1. In an easy opening container having a wall made of sheet material, wherein the wall is weakened by a groove, the bottom wall of which forms a thin residual web of material defining a tear strip that may be manually lifted from the plane of the wall for severance of the tear strip by stressing the residual web in shear, the improvement comprising:

a solid extruded rib formed integrally in the sheet material along the residual web on the longitudinal side of the residual web away from the tear strip to stiffen the sheet material adjacent the residual web against flexure in response to lifting of the tear strip thereby to cause the shearing stress across the residual web to rise abruptly when the tear strip is lifted.

2. An improvement as set forth in claim **1** in which the residual web is adjacent to side wall of the groove that is adjacent to tear strip and the side wall forms an abrupt shoulder for concentration of the shear stress at the base of the side wall, which concentration of shear stress causes the line of progressive severance of the tear strip to follow one side of the residual web instead of switching back and forth across the width of the residual web.

3. An improvement as set forth in claim **1** which further comprises spaced shallow transverse ribs across the residual web integral therewith to strengthen the web, the gaps between the ribs serving to facilitate initiation of severance of the tear strip.

4. In an easy opening container having a wall of sheet material of a given initial thickness, means forming a tear strip, comprising:

a line of scoring in the sheet material defining the tear strip, along which line the sheet material is reduced in thickness to a minimum web of thickness substantially less than 50% of the initial thickness;

an extruded rib integral with the sheet material of the wall outside of the area of the tear strip, said rib following the pattern of the line of scoring with one side of the rib immediately adjacent the minimum web; and

an integral second web of the sheet material of substantially less thickness than said initial thickness but thicker than the minimum web, the second web extending along the other side of the rib and connecting the web to the adjacent sheet material.

5. A combination as set forth in claim **4** in which the minimum web is increased in thickness at points spaced along the length of the line of scoring.

6. A combination as set forth in claim **4** in which the minimum web is strengthened by transverse ribs integral therewith and spaced longitudinally of the web, the transverse ribs being wider than the width dimension of the minimum web with the space between the successive transverse ribs approximately equal to the width of the transverse ribs.

7. In an easy opening container having a wall of sheet material of a given initial thickness, means forming a tear strip, comprising:

a groove in one face of the sheet material defining the tear strip;

a solid rib integral with the bottom wall of the groove and protruding from the other face of the sheet material, the rib conforming in plan with the pattern of the groove and being offset relative to the groove away from the tear strip and thus leaving a longitudinal portion of the bottom wall of the groove relatively thin adjacent the tear strip to provide a line of least resistance to severance of the tear strip with the rib reinforcing the sheet material on the side of the line of least resistance away from the tear strip.

8. A combination as set forth in claim **7** in which the sheet material is strengthened across said line of least resistance by spaced shallow transverse ribs integral with the sheet material.

9. In an easy opening container of sheet material having scoring defining a tear strip with a tab connected to the leading end of the tear strip, the improvement comprising:

the scoring around the leading end of the tear strip being in the form of a groove in the outer face of the sheet material leaving a thin residual web of the sheet material at the bottom of the groove connecting the tear strip with the rest of the sheet material; and

a rib integral with the sheet material and following the groove around the leading end of the tear strip, the rib lying immediately adjacent the residual web outside the area of the residual web and outside the area of the tear strip.

10. In an easy opening can having an end wall of sheet material grooved on at least one of its two faces to form a continuous score line defining a tear strip with the metal reduced in thickness to a relatively thin web along the score line, the improvement comprising an extruded rib integral with the sheet material immediately adjacent the thin web and surrounding the reduced web to stiffen the sheet material around the tear strip to facilitate manual severance of the tear strip.

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THERON E. CONDON, *Primary Examiner.*

G. T. HALL, *Assistant Examiner.*