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(54) IMPROVEMENTS IN AND RELATING TO THE OPENING OF PACKAGING CONTAINERS

(71) We, TETRA PAK INTERNATIONAL, A.B., a Swedish corporate body of Fack S-221 01 Lund 1, Sweden, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to packaging containers formed of sheet laminate material folded about fold lines to a pre-arranged shape. The laminate may comprise a relatively rigid and unstretchable base layer, on at least one face of which—(constituting the inner face of the container) is provided a continuous, liquid-impervious, plastics coating. Such containers are often provided with a tear-line, e.g. a weakened line of spaced incisions penetrating the base layer to a substantial proportion of its thickness, but not passing through the plastics layer.

Modern liquid packages of the aforesaid type are often made from a laminate comprising a relatively stiff and unstretchable basic layer, e.g. of paper, having a homogenous plastics coating on each face. A usual method of producing containers from such a laminate is to form the material by folding and heat-sealing, in such a manner as to obtain closed containers with a continuous internal liquid-tight plastics layer. Packaging containers of the above type can be formed in a variety of shapes, e.g. of tetrahedral or parallelepipedic shape, but in all it is desirable to provide easily-breakable facilities for opening the container. Thus in the wall of the container there may be an opening sealed with a cover strip, which can be torn off to expose the said opening. Alternatively the container may be provided with a set of tear-open incisions by means of which a part of the container wall can be torn open with a view to freeing an aperture through which the contents can be removed.

The provision of tear-open cover strips operates satisfactorily, but suffer unforunately from the drawback that they are relatively costly to use in connection with disposable containers for everyday goods, such as milk, since the manufacture of such arrangements requires extra material and extra operations. The provision of a tear-line of incisions in the wall of the container suffers, however, from the drawback that the tear-open incisions which have to be disposed in the laminate material before the forming of the material into containers cannot be made too easily tearable, since the laminate material is exposed to relatively high tensile and compression stresses during the fold-forming operation liable to rupture the tear line. Thus a compromise must be reached in which the tear-line must be made in such a manner that it bears the stresses to which the material is exposed during the forming of the container, but on the other hand is not too difficult to tear when the container is opened and the contents are made accessible. This means that the tear-open incisions of known type cannot be made as easily tearable as might otherwise be desirable, and therefore they function relatively unsatisfactorily.

The object of this invention is to provide a container in which this difficulty is overcome, and with this end in view the invention consists in a packaging container formed of sheet laminate material folded to a pre-arranged shape, the sheet being provided with a weakened tear-line intersecting a fold-line, along which weakened line an aperture can be torn open in the finished container, the tear strength of said weakened line being varied along its length so that said tear strength is substantially greater at, and in the vicinity of, the point of intersection of said tear-line and said fold-line, and substantially less along other parts of the tear-line.

An embodiment of the invention will now be described by way of example with reference to the accompanying diagrammatic drawings.

Fig. 1 shows a parallelepipedic packaging container provided with a tear-open arrangement in accordance with the invention.

Fig. 2 shows the same container after it has been torn open.

Fig. 3 shows a part of a flat packaging material suitable for making packaging containers such as shown in Figs. 1 and 2; and

Fig. 4 shows a diagram which represents the connection between the tear-strength of incisions and the percentage of punched incision length for various arrays of incisions and gaps.

The packaging container shown in Fig. 1 is of parallelepipedic shape and consists of side walls 1, an upper end wall 2 together with a base, (not visible). The container is made in a relatively stiff form, from unstretchable but foldable strip material. A convenient way of producing such containers is to form the strip material into a tube and, by flat-pressing and transverse-sealing, to close the tube at narrow transverse zones spaced along the length of the tube. If the tube is filled, before such sealing, with the intended contents, the said contents become sealed in each container, which may then be formed into the desired parallelepipedic shape by fold-forming. As a result of said flat-pressing and transverse sealing along spaced zones of the tube, there is formed at each zone a sealing fin 3, which, during the subsequent forming process, is folded down against the top end wall 2 of the container. During the forming of the package into parallelepipedic shape, as shown, there are formed four triangular double-walled lugs 4, located at the corners of the container. Of these four corner tabs 4 two are folded in against the bottom end wall (not shown) and those at the top of the container are folded against the side walls. Of these only one lug 4 is visible in Fig. 1. This corner lug 4 is folded about the straight edge 6 of the side wall 1, by an easily-broken connection, held against the side wall 1. The fin 3 extends over both the visible lug 4, the end wall 2, and the lug, (not visible), folded against the opposite side wall. The container, shown by way of example, may furthermore be provided with crease lines 5 which extend from the ends of the edges 6 over the end wall 2 to a point of inter-section with the base line 7 of the sealing fin 3.

To facilitate the opening of the container it is provided with tear-open means consisting of a rectilinear or arc-shaped line 8 of incisions penetrating the packaging material only partly. The line, starting from a common point *a*, on the inner or under side of the lug 4 runs over symmetrical points *b*, *b*, on the free sides of the lug, and ends at a point *c* on the base line 7 inwards from the fold-line 6 of the lug 4.

The said line of incisions may be provided in the simplest manner by forming it in the packaging material, before the formation of the containers, with the line extending over the material in such a manner that the desired line 8 appears in the finished container as shown in Fig. 1. Figure 3 shows diagrammatically an area of strip packaging material with a repeated incision pattern which, in the case being described here, is of a slightly V-shaped line 8, located in such a manner on the strip material that on the forming of the container it lies round a pre-arranged area of the container.

To open the aperture 9 the lug 4 is lifted away from the side wall of the container and part of the fin 3 is raised, whereafter the tip portion of the lug 4 torn away along the lines $a\,b$, $a\,b^1$ of the under-wall of the lug, and along the lines 8, 8^1 of the outer wall, and detached from the raised part of the fin 3 (Fig. 2).

As shown in Fig. 1, the tear-line 8 has a plurality of break points *b*, *d*, b^1, d^1, at which the incisions are exposed to considerable stresses in connection with the forming of the container. It will be appreciated that leakage would arise if the incisions thus stressed were so easily torn-open as to break when exposed to such stresses.

To avoid this difficulty without at the same time making the tear-open line more difficult to tear open the incisions are provided, as shown in Fig. 3, with differentiated tear strength. The tear-open incisions shown in Fig. 3 consist of two straight lines at an angle; (but if another form is to be given to the tear-open incisions on the container, the form of the line on the packaging material may be selected so that the tear-open line of incisions in the finished container is modified, and suited to the form of the finished packaging container. As shown the tear-open incisions may form a single straight or arc-shaped line, but may alternatively form a plurality of connected straight or arc-shaped lines of incisions. In the present case the line of incisions 8 is formed and disposed in such a manner that some points, such as *b* and *d*, (which correspond to intersections of the line of incisions with fold-lines as shown in Fig. 1), are located in areas of the packaging material exposed to folding. The line 8 shown in Fig. 3 consists in a series of spaced cut-in or punched-in incisions in the strip of material, (Fig. 3). The cut-in or punched-in incisions 11 are separated one from the other by uncut gaps 12. The gaps 12 may advantageously be made of equal size along the entire line, while on the other hand the length of the incisions 13 along the sections such as *b* and *d* are made considerably shorter than the incisions 11 along the remaining sections of the tear-open line. The shorter incisions are less easy to tear open, and therefore more resistant within the sections such as *b* and *d*, while the remaining portions of the tear-open line are more easily breakable.

As in the finished container the tearing of

the line starts either at point *c* or point *a*, that is to say points where the line is more easily breakable, it is simple to initiate the tearing-open, and when this is actually started, other parts such as *b* and *d* where the line is less easily torn open offer only a smaller, and in most cases, a hardly noticeable, resistance.

The differential tear strength along the tear-line 8 is also illustrated in Fig. 1, where the line along sections such as *b* and *d* shows cut-in or punched-in incisions 13 of considerably smaller length than the cut-in or punched-in incisions 13 along other sections of the line.

The container 1 provided with tear-open incisions, shown in Fig. 1, has, as stated earlier, double-walled triangular lugs 4, the line of incisions extending to one of the said lugs 4. The line 8 is in reality in Fig. 1 hidden to a considerable extent, as the line of incisions, after it has passed the side of the triangular lug 4 at *b*, extend along the underside of the lug 4 to the point *a* and continues across the lug to b^1, where the perforations 8^1 again become visible along the upper surface of the lug 4, where it is not covered by the folded-down sealing fin 3. However much of the line 8, along the upper face of the lug 4 of the container 1, and over the upper end 2 of the container is covered by the folded-down fin 3. To show that certain sections of the line of incisions are hidden by the material above them or by the overlying sealing fin 3, the hidden portions of the line have been marked in the figure with an apostrophe i.e. 8^1, b^1, d^1, while the said hidden sections of the line have been marked with thinner lines as compared with the visible sections.

As already stated, it has been found advantageous to retain gap 12 of uniform length between the cut-in or punched-in incisions 11 or 13 respectively, as there is thus obtained the most even tear resistance when the container is to be opened, while simultaneously a considerable strengthening of the line can be achieved by making the cut-in or punched-in incisions considerably shorter (13). It is, however, possible, instead of varying the lengths of the cut-in or punched-in incisions 11 and 13, to vary the gap between them, or to vary both the length of the incisions 11 and 13, and the gaps 12. As indicated earlier, it is also possible to bring about the differential tear strength by varying the depth of penetration of incisions into the base layer of the packaging material, but such a tear-line has shown itself to be more difficult to carry into effect with sufficient accuracy to attain the intended aim; and moreover it has been found that no particular improvement of the tear-open action is achieved.

Experiments in tearing of packaging material consisting in a base layer of paper with thin surface coatings of polythene, where the incisions pass completely through the base layer, have shown surprisingly a tendency that the tear resistance of the line of incisions is greater at the small gaps between incisions than at the rather larger gaps, provided that the ratio between the incision length, and the length of the gaps is the same. This rule applies, perhaps not generally, but to the diagram in Fig. 4 which shows diagrammatically the ratio between the tear strength and the percentage of incision per unit length of tear-line, which shows that the rule is valid for gap lengths of about 0·5 to 1 mm. The diagram in Fig. 4 does not show the tear strength in absolute terms, as this is relatively uninteresting in this connection, and, e.g. varies according to paper quality, paper thickness, quality of plastics coating etc., but the diagram shows the mutual relationship between tear strength of different incisions, i.e. incisions made with cutting blades that have "teeth" of different widths. In Fig. 4 a section is shown, also diagrammatically, of an incision blade with each knife blade width A and a gap B between the blades. As mentioned earlier, the horizontal axis of the diagram is graduated in percentages and illustrates how great as a percentage of the distance between the corresponding tips of adjacent blades is the length of an incision, i.e. the graduation corresponds to an expression $\frac{100A}{A+B}$, hereinafter referred to as a break-through ratio. The vertical axis in the diagram, for the reasons given earlier, is not graduated, but is intended only to illustrate the tear strength, with increasing tear strength directed upwards and the tear strength 0 at the origin. The diagram contains a shaded area which illustrates the easily-torn area within which the unstressed sections of the tear-line can be allocated, while on the other hand the sections of the tear-line that are deformed by folding do not have to lie within this area of the diagram as they break there spontaneously during deformation. The diagram of Fig. 4 shows three curves which represent B = 0·5 mm, B = 0·7 mm and B = 1·0 mm, wherein B is the space between adjacent knife sections. For a break-through ratio of 50% (i.e. A = B) it will be seen that the tear strength is to some extent higher for a perforation of B = 0·5 mm than for perforations with B = 0·7 mm and B = 1·0 mm. The curves for the various values of B tend, however, to converge as the break-through ratio increases, and therefore it does not seem that the magnitude of the factor B has any greater influence when the break-through ratio reaches 70 to 75%.

As a consequence of the tests that have been made an attempt was made to optimise the

line of tear-open incisions, an the results of this operation are that:—

(a) for the easily torn-open area of the tear-open incisions, i.e. the area where these are not deformed by folding, the following must apply:—

B = 0·5 to 1·0 mm and A = 1·0—3·0 mm;

(b) for the area within which the tear-open incisions will be deformed by folding there must apply:—

B = 0·3—0·7 mm and A = 0·3—1·0 mm.

As mentioned above, the incisions should be dimensioned taking the nature and the quality of the base layer into consideration, also the strength of the external plastics layer or layers, but the above-indicated values should be representative and indicative for optimising the pattern of tear-line incisions.

By providing tear-open lines in packaging material and containers in accordance with the invention, it is possible in simple manner to produce functionally adequate and easily-openable lines without risk of a spontaneous breaking of the tear-open lines, and the leakage consequent thereon, when the material is folded into containers. The above-described method is intended only to exemplify the invention, and as stated earlier, it is possible to adapt the invention to different containers where the tear-open line on the forming of the container extends over a corner or another fold and may thus be exposed to increased stresses. The applicability of the invention is thus not restricted to the design of container or to the form shown herein, but may be generally adapted to all forms of containers where the technical problem first defined above arises.

WHAT WE CLAIM IS:—

1. A packaging container formed of sheet laminate material folded to a pre-arranged shape, the sheet being provided with a weakened tear-line intersecting a fold-line, along which weakened line an aperture can be torn open in the finished container, the tear strength of said weakened line being varied along its length so that said tear strength is substantially greater at, and in the vicinity of, the point of intersection of said tear-line and said fold-line, and substantially less along other parts of the tear-line.

2. A container as claimed in Claim 1 wherein the laminate comprises a base layer, and on at least one face thereof, constituting the inner face of the container, a coating of plastics material wherein the weakened tear-line is formed of spaced incisions in said base layer which do not penetrate said plastics coating.

3. A container as claimed in Claim 2 wherein said differential tear-strength is provided by variation of characteristics of the incisions and/or their spacing along the length of said tear-line.

4. A container as claimed in Claim 3 wherein the tear-line comprises incisions of different depth and/or lengths in different sections thereof.

5. A container as claimed in Claim 3 or 4 wherein the gaps between adjacent incisions are of uniform size along the length of the tear-line.

6. A container as claimed in any preceding claim wherein said tear-line forms a substantially complete loop in the container.

7. A container as claimed in any preceding claim wherein said tear-line intersects a plurality of folds of the container material and is of greater tear strength at a plurality of said intersections than at other points along its length.

8. A container as claimed in any preceding claim formed with a double-walled, substantially triangular lug portion, wherein said tear-line is so disposed that it facilitates the tearing away of a tip portion of said lug, and an adjoining area of the container wall to allow to the access container contents.

9. Strip packaging material for forming a container as claimed in any preceding claim comprising a base layer with a plastics coating and a line of incisions partially or wholly penetrating said base layer, but not said plastics coating, the incisions being of different frangibility to afford different tear strengths of different sections of the tear-line, the sections of greater tear-strength being located at points of the tear-line which will intersect folds of the material when formed into a container.

10. Strip material as claimed in Claim 9 comprising a straight line, or a line of V-shape or arc-shape, of incisions of different tear-strength at different points along its length.

11. Strip material as claimed in Claim 9 or 10 wherein a section of the tear-line of greater tear-strength comprises incisions of length within the range of 0·3 to 1 mm, separated by gaps within the range 0·3 to 0·7 mm. in length.

12. Strip material as claimed in Claim 9, 10 or 11 wherein a section of the tear-line of smaller tear-strength comprises incisions of length within the range 1·0 to 3·0 mm. separated by gaps within the range 0·5 to 1·0 mm. in length.

13. A packaging container provided with a tear-line of differential tear-strength along its length substantially as described herein

with reference to the accompanying drawings.

14. Strip material for forming containers, the material being provided with an incised tear-line of differential tear-strength along its length, substantially as described herein with reference to the accompanying drawings.

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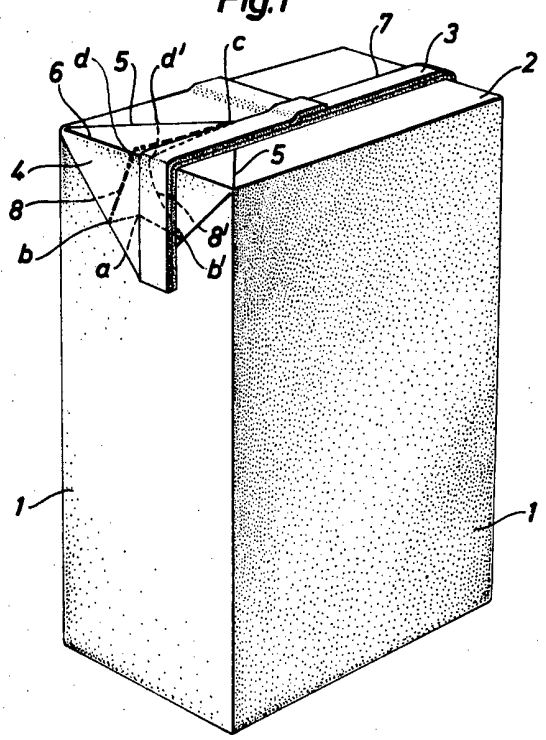
1589127 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

Fig.1



1589127 COMPLETE SPECIFICATION
3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

Fig.2

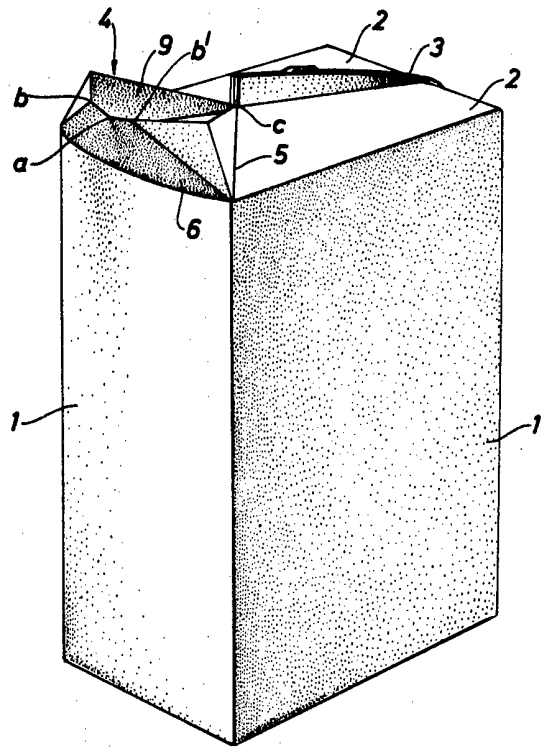


Fig. 3

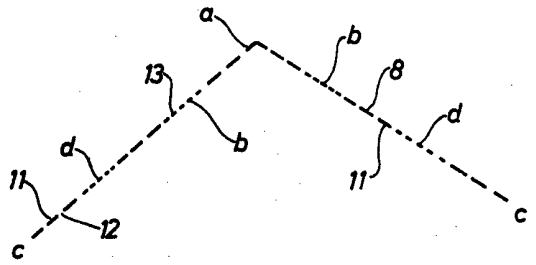


Fig. 4