

The term "radially depressed" herein means that pushtabs are pressed inward toward each other predominantly along a radius of the bottle finish. Radial depression is the optimum choice wherever two pushtabs must be depressed by one hand. They are usually depressed by a thumb and forefinger. Radial depression of opposing pushtabs ensures that both pushtabs have to be depressed simultaneously. Otherwise individually depressed pushtabs will return to their locking position when released.

Another construction has two 180° opposing pushtabs that are cantilevered from the sides of the pushtabs. Pushtabs rotate inward along a curved path which is approximately radial. Similar to the pushtabs cantilevered from their bottoms, pressing occurs at the center of the pushtab and the release of locking surfaces occurs at the outer end of the pushtabs.

A significant disadvantage of prior art pushtab designs is their poor leverage. That is, pressing at a point between the pushtab cantilever and the closure locking surface requires higher pushtab pressing forces than if pressing occurred outwardly of the closure locking surface. It has been found that in order to achieve child resistance, pushtabs must have either relatively short strokes and high depression forces or relatively long strokes and low depression forces. However, relatively high pushtab depression forces are also difficult for adults to manage. An adult user-friendly pushtab depression force should be less than about 2 lbs. It is therefore advantageous to provide pushtabs with longer strokes and lower forces. For a given pushtab depression force and stroke, it is also beneficial to have leverage between the pushtab force and the closure releasing force so that the closure releasing force can be high enough that the closure cannot be released by over twisting it against the locking mechanism.

It is believed that child resistance is also enhanced by making pushtabs unobvious for a child to press. Pushtabs which extend beyond the outermost surface of the closure are more obvious for a child to press than flush mounted or recessed pushtabs. Flush or recessed pushtabs guarded by a rigid surface adjacent to the edges of the pushtabs is another feature believed to enhance child resistance by minimizing inadvertent depressions.

SUMMARY OF THE INVENTION

A primary advantage of the present invention is a pushtab located outwardly from both the locking surface and the cantilever connection of the beam of which the pushtab is a part. Such location maximizes pushtab stroke and minimizes pressing force, while maintaining the pushtab flush with or recessed inside an outermost surface of the closure. Child resistance is thereby maximized while adult friendliness is also improved. Child resistance is optimized by having two pushtabs which must be depressed simultaneously.

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What is claimed is:

1. A package suitable for storing and dispensing potentially dangerous material, said package being resistant to opening by children yet readily openable by adults, said package comprising:
 - a) a bottle for containing said potentially dangerous material, said bottle having a body and a finish portion, said finish portion having a threaded outer end;
 - b) a resiliently deformable cantilevered beam connected to said finish portion between said threaded outer end of said finish portion and said body of said bottle, said cantilevered beam being positioned outward and downward from said finish portion to form an angle to said finish portion, said cantilevered beam having a length, a substantially vertical locking surface, and a pushtab spaced along said length, said angle to said finish portion being small enough that said pushtab may be depressed substantially radially toward said finish portion; and
 - c) a closure having an outermost surface, an upper inner surface, and a lower inner surface, said upper inner surface having threads for rotatably securing said closure to said threaded outer end of said finish portion, said closure also having a tooth projecting radially inward from said lower inner surface, said tooth being so shaped and positioned that it engages said locking surface of said cantilevered beam whenever there is an attempt to unscrew said closure, thereby preventing removal of said closure until said pushtab is manually depressed to disengage said tooth of said closure from said locking surface of said cantilevered beam.
2. The package of Claim 1 wherein said finish portion has two resiliently deformable cantilevered beams extending therefrom at positions 180° opposed, and said closure has two teeth projecting radially inward from said lower inner surface, said two teeth being so shaped and positioned that they will engage said locking surface of each of said two cantilevered beams.
3. The package of Claim 1 wherein said pushtab is located radially flush with said outermost surface of said closure when said locking surface of said cantilevered beam engages said tooth of said closure.
4. The package of Claim 1 wherein said pushtab is radially recessed interior to said outermost surface of said closure when said locking surface of said cantilevered beam engages said tooth of said closure.

5. The package of Claim 1 further comprising:

5 d) a guard ring supported from said finish portion of said bottle and located below said outermost surface of said closure when said closure is installed, said guard ring having an outermost surface, said outermost surface having a recess therein, said recess providing clearance for said pushtab such that said pushtab may be depressed by an adult's finger or thumb, said guard ring also having a bottom edge, which together with said outermost surface of said guard ring protects said pushtab from being inadvertently depressed by a child.

6. The package of Claim 5 wherein said pushtab is located radially flush with said outermost surface of said guard ring when said locking surface of said cantilevered beam engages said tooth of said closure.

7. The package of Claim 5 wherein said pushtab is radially recessed interior to said outermost surface of said guard ring when said locking surface of said cantilevered beam engages said tooth of said closure.

8. The package of Claim 5 wherein said guard ring has a stop surface internal to said outermost surface behind said pushtab so that said pushtab may be pressed against said stop surface in order to avoid overstroking said pushtab.

9. A package suitable for storing and dispensing potentially dangerous material, said package being resistant to opening by children yet readily openable by adults, said package comprising:

5 a) a bottle for containing said potentially dangerous material, said bottle having a body and a finish portion, said finish portion having a threaded outer end;
 b) a resiliently deformable cantilevered beam connected to said finish portion between said threaded outer end of said finish portion and said body of said bottle, said cantilevered beam being positioned outward and downward from said finish portion to form an angle to said finish portion, said cantilevered beam
 10 having a length, a substantially vertical locking surface, and a pushtab spaced along said length, said angle to said finish portion being small enough that said pushtab may be depressed substantially radially against said finish portion, said locking surface being located between said finish and said pushtab so that depression of said pushtab results in a greater beam deflection and lower deflection force at said
 15 pushtab than at said locking surface; and

c) a closure having an outermost surface, an upper inner surface, and a lower inner surface, said upper inner surface having threads for rotatably securing said closure to said threaded outer end of said finish portion, said closure also having a tooth projecting radially inward from said lower inner surface, said tooth being so shaped and positioned that it engages said locking surface of said cantilevered beam whenever there is an attempt to unscrew said closure, thereby preventing removal of said closure until said pushtab is manually depressed to disengage said tooth of said closure from said locking surface of said cantilevered beam.

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10. The package of Claim 9 wherein said finish portion has two resiliently deformable cantilevered beams extending therefrom at positions 180° opposed, and said closure has two teeth projecting radially inward from said lower inner surface, said two teeth being so shaped and positioned that they will engage said locking surface of each of said two cantilevered beams.

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11. The package of Claim 9 wherein said pushtab is located radially flush with said outermost surface of said closure when said locking surface of said cantilevered beam engages said tooth of said closure.

12. The package of Claim 9 wherein said pushtab is radially recessed interior to said outermost surface of said closure when said locking surface of said cantilevered beam engages said tooth of said closure.

13. The package of Claim 9 further comprising:

d) a guard ring supported from said finish portion of said bottle and located below said outermost surface of said closure when said closure is installed, said guard ring having an outermost surface, said outermost surface having a recess therein, said recess providing clearance for said pushtab such that said pushtab may be depressed by an adult's finger or thumb, said guard ring also having a bottom edge, which together with said outermost surface of said guard ring protects said pushtab from being inadvertently depressed by a child.

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14. The package of Claim 13 wherein said pushtab is located radially flush with said outermost surface of said guard ring when said locking surface of said cantilevered beam engages said tooth of said closure.

-- 15. The package of Claim 13 wherein said pushtab is radially recessed interior to said outermost surface of said guard ring when said locking surface of said cantilevered beam engages said tooth of said closure.

16. The package of Claim 13 wherein said guard ring has a stop surface internal to said outermost surface behind said pushtab so that said pushtab may be pressed against said stop surface in order to avoid overstroking said pushtab.

by a child feeling around the closure while trying to figure out how to open it.

An adult may easily remove closure 12. The adult is instructed by label directions to press pushtab(s) 34 and twist closure 12 simultaneously, and the forces are low compared to most other child resistant closures. Therefore, even older adults with arthritis find the package of the present invention user-friendly.

FIGS. 3 and 4 are cross-section views which show more clearly how the child resistant closure mechanism functions. FIG. 3 shows the condition of two pushtabs 34, two locking surfaces 36 and two closure teeth 22 when the package is fully closed and locked. FIG. 4 shows the condition after the pushtabs 34 have been depressed to release the teeth 22 from locking surfaces 36, but prior to twisting the closure 12 to unscrew it.

FIG. 3 shows small angle 38, described hereinbefore. Pushtabs 34 move through a portion of angle 38 when they are depressed. Because angle 38 is small, pushtabs 34 move predominantly in a radial direction. Radial motion of pushtabs 34 enables either pushtab to be depressed without causing rotation of the closure. Therefore, if one pushtab is pressed but not the other, the depressed pushtab will spring back to its outermost locking position when it has been released. Without radial pushtab motion, some rotation of the closure is typical. Then one pushtab may become stuck in a depressed condition before the other pushtab has been pressed. This condition enables sequential pressing of the pushtabs, which is less child-resistant than simultaneous pressing.

FIG. 3 also shows a closure-to-finish seal 50, which is an element commonly known in the art for packages where an air-tight seal is desired. Other means for closing bottle finish 24 are also applicable to this package. In FIG. 3 it can also be seen that support ring 30 for cantilevered beams 32 extends almost to lower inner surface 19 of closure 12. Support ring 30 acts as a centering device for the installation of closure 12 to prevent cross-threading.

FIG. 4 includes all the elements of FIG. 3, but in addition has pressing forces 52 shown at pushtabs 34. Cantilevered beams 32 are shown bent under the load of forces 52. Under about a 2 pound load pushtabs 34 are pressed against stop surfaces 44 of recesses 42 in guard ring 40. In this condition, teeth 22 of closure 12 are clear of locking surfaces 36 on cantilevered beams 32, so that closure 12 is free to be unscrewed.

FIG. 4 also shows outermost surface 46 of guard ring 40 flush with the largest part of outermost surface 16 of closure 12. Closure 12 clears guard ring 40 by only a small gap when it is fully installed. Guard ring 40 has recesses 42 for pushtabs 34. Guard ring 40 is not necessarily continuous. It can be molded as part of the bottle or be a separate piece, depending on its shape.

FIG. 5 discloses an alternative embodiment 60 of the present invention. Embodiment 60 has a bottle 64 with two pushtabs 66 cantilevered from bottle 64 which are initially radially recessed interior to the outermost surfaces of closure 12 and guard ring 40 when locking surface 36 of cantilevered beam 32 engages tooth 22 of closure 12.

In one preferred embodiment of the present invention, closure 12 is a 35 mm standard thread cap which is made of polypropylene in either a homo or co-polymer form. The material preferably has a modulus of elasticity of 200,000 psi or higher so that the teeth 22 are not easily distorted and prematurely released by a child

attempting to remove the closure without pressing the pushtabs. Closure rigidity is therefore important. Closure 12 is made by a commonly known injection molding process, wherein the mold has an unscrewing core for forming female threads on the inside of the closure. The closure is preferably tapered from an outer diameter of about 1.56 inches at the top to about 2 inches at the bottom in order to provide space for support ring 30 and the downward extending cantilevered beams 32. Closure height is about 1.93 inches. The closure preferably has an internal skirt to fit the threads of the straight bottle finish. The double skirt design allows for a greater overall closure taper than might otherwise be permitted.

Bottle 14 has a standard 35 mm male threaded finish portion which is approximately 2.75 inches tall from bottom of pushtabs 34 to its open top end. The width of cantilevered beam 32 is approximately 0.31 inches. The overall length of the beam is about 1.1 inches. The length from support ring 30 to the center of locking surface 36 is about 0.65 inches, and the distance from support ring 30 to the center of pushtab 34 is about 0.9 inches. On average the beam is about 0.09 inches thick. Leverage provided by having the pushtab located outward from the locking surface is about 1.38:1. Therefore, a 2.75 pound force at the locking surface to clear the 0.06 tooth engagement requires only a 2 pound pressing force at the pushtab. Angle 38 is approximately 10°. For this geometry, the preferred material of construction for bottle 14 is a thermoplastic polyester (PET) having a modulus of elasticity of about 375,000 psi. The preferred method of manufacture is to injection mold the finish down through the guard ring along with a cylindrical preform therebelow. The preform is then transferred to a blow mold and blown outward to the shape of an external bottle mold. This process is commonly known as "injection blow molding". The injection molded portion is preferably made in a split cavity mold. However, the guard ring configuration shown may require a solid body, split thread cavity mold arrangement.

In order that a removed closure may be reinstalled without having to manually depress both pushtabs, the most preferred embodiment of the present invention includes ramped surfaces on both teeth 22 of closure 12. While such ramps are not shown in FIG. 1, they comprise a gradual blending of lower inner surface 19 with the tips of teeth 22 from the sides opposite teeth 22 which engage locking surfaces 36. Therefore, when closure 12 is threaded clockwise onto bottle 14, the ramps act to cam the cantilevered beams 32 inward while the teeth rotationally pass the locking surfaces. Once the teeth have passed the locking surfaces, the cantilevered beams snap back to their pre-deflected positions, thereby locking the closure in place.

While particular embodiments of the present invention have been illustrated and described, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from the spirit and scope of the invention, and it is intended to cover in the appended claims all such modifications that are within the scope of the invention.

What is claimed is:

1. A package suitable for storing and dispensing potentially dangerous material, said package being resistant to opening by children yet readily openable by adults, said package comprising:

- a) a bottle for containing said potentially dangerous material, said bottle having a body and a finish portion, said finish portion having a threaded outer end and a support ring located between said threaded outer end and said body of said bottle;
 - b) a resiliently deformable cantilevered beam connected to said support ring, said cantilevered beam being positioned outward and downward from said support ring to form an angle to said finish portion, said cantilevered beam having a length, a substantially vertical locking surface, and a pushtab spaced along said length, said angle to said finish portion being small enough that said pushtab may be depressed substantially radially toward said finish portion; and
 - c) a closure having an outermost surface, an upper inner surface, and a lower inner surface, said upper inner surface having threads for rotatably securing said closure to said threaded outer end of said finish portion, said closure also having a tooth projecting radially inward from said lower inner surface, said tooth being so shaped and positioned that it engages said locking surface of said cantilevered beam whenever there is an attempt to unscrew said closure, thereby preventing removal of said closure until said pushtab is manually depressed to disengage said tooth of said closure from said locking surface of said cantilevered beam.
2. The package of claim 1 wherein said finish portion has two resiliently deformable cantilevered beams extending therefrom at positions 180° opposed, and said closure has two teeth projecting radially inward from said lower inner surface, said two teeth being so shaped and positioned that they will engage said locking surface of each of said two cantilevered beams.
3. The package of claim 1 wherein said pushtab is located radially flush with said outermost surface of said closure when said locking surface of said cantilevered beam engages said tooth of said closure.
4. The package of claim 1 wherein said pushtab is radially recessed interior to said outermost surface of said closure when said locking surface of said cantilevered beam engages said tooth of said closure.
5. The package of claim 1 further comprising:
- d) a guard ring supported from said finish portion of said bottle and located below said outermost surface of said closure when said closure is installed, said guard ring having an outermost surface, said outermost surface having a recess therein, said recess providing clearance for said pushtab such that said pushtab may be depressed by an adult's finger or thumb, said guard ring also having a bottom edge, which together with said outermost surface of said guard ring protects said pushtab from being inadvertently depressed by a child.
6. The package of claim 5 wherein said pushtab is located radially flush with said outermost surface of said guard ring when said locking surface of said cantilevered beam engages said tooth of said closure.
7. The package of claim 5 wherein said pushtab is radially recessed interior to said outermost surface of said guard ring when said locking surface of said cantilevered beam engages said tooth of said closure.
8. The package of claim 5 wherein said guard ring has a stop surface internal to said outermost surface behind said pushtab so that said pushtab may be pressed against said stop surface in order to avoid overstroking said pushtab.

9. A package suitable for storing and dispensing potentially dangerous material, said package being resistant to opening by children yet readily openable by adults, said package comprising:
- a) a bottle for containing said potentially dangerous material, said bottle having a body and a finish portion, said finish portion having a threaded outer end and a support ring located between said threaded outer end and said body of said bottle;
 - b) a resiliently deformable cantilevered beam connected to said support ring, said cantilevered beam being positioned outward and downward from said support ring to form an angle to said finish portion, said cantilevered beam having a length, a substantially vertical locking surface, and a pushtab spaced along said length, said angle to said finish portion being small enough that said pushtab may be depressed substantially radially against said finish portion, said locking surface being located between said support ring and said pushtab so that depression of said pushtab results in a greater beam deflection and lower deflection force at said pushtab than at said locking surface; and
 - c) a closure having an outermost surface, an upper inner surface, and a lower inner surface, said upper inner surface having threads for rotatably securing said closure to said threaded outer end of said finish portion, said closure also having a tooth projecting radially inward from said lower inner surface, said tooth being so shaped and positioned that it engages said locking surface of said cantilevered beam whenever there is an attempt to unscrew said closure, thereby preventing removal of said closure until said pushtab is manually depressed to disengage said tooth of said closure from said locking surface of said cantilevered beam.
10. The package of claim 9 wherein said finish portion has two resiliently deformable cantilevered beams extending therefrom at positions 180° opposed, and said closure has two teeth projecting radially inward from said lower inner surface, said two teeth being so shaped and positioned that they will engage said locking surface of each of said two cantilevered beams.
11. The package of claim 9 wherein said pushtab is located radially flush with said outermost surface of said closure when said locking surface of said cantilevered beam engages said tooth of said closure.
12. The package of claim 9 wherein said pushtab is radially recessed interior to said outermost surface of said closure when said locking surface of said cantilevered beam engages said tooth of said closure.
13. The package of claim 9 further comprising:
- d) a guard ring supported from said finish portion of said bottle and located below said outermost surface of said closure when said closure is installed, said guard ring having an outermost surface, said outermost surface having a recess therein, said recess providing clearance for said pushtab such that said pushtab may be depressed by an adult's finger or thumb, said guard ring also having a bottom edge, which together with said outermost surface of said guard ring protects said pushtab from being inadvertently depressed by a child.
14. The package of claim 13 wherein said pushtab is located radially flush with said outermost surface of said guard ring when said locking surface of said cantilevered beam engages said tooth of said closure.

15. The package of claim 13 wherein said pushtab is radially recessed interior to said outermost surface of said guard ring when said locking surface of said cantilevered beam engages said tooth of said closure.

16. The package of claim 13 wherein said guard ring has a stop surface internal to said outermost surface behind said pushtab so that said pushtab may be pressed against said stop surface in order to avoid overstroking said pushtab.

17. A package suitable for storing and dispensing potentially dangerous material, said package being resistant to opening by children yet readily openable by adults, said package comprising:

- a) a bottle for containing said potentially dangerous material, said bottle having a body and a finish portion, said finish portion having a threaded outer end and a support ring located between said threaded outer end and said body of said bottle;
- b) a resiliently deformable cantilevered beam connected to said support ring, said cantilevered beam being positioned outward and downward from said support ring to form an angle to said finish portion, said cantilevered beam having a length, a substantially vertical locking surface, and a pushtab spaced along said length, said angle to said finish portion being small enough that said pushtab may be depressed substantially radially against said finish portion, said locking surface being located between said support ring and said pushtab so that depression of said pushtab results in a leverage of about 1.38 to 1, said leverage providing greater beam

deflection and lower deflection force at said pushtab than at said locking surface;

- c) a closure having an outermost surface, an upper inner surface, and a lower inner surface, said upper inner surface having threads for rotatably securing said closure to said threaded outer end of said finish portion, said closure also having a tooth projecting radially inward from said lower inner surface, said tooth being so shaped and positioned that it engages said locking surface of said cantilevered beam whenever there is an attempt to unscrew said closure, thereby preventing removal of said closure until said pushtab is manually depressed by a force of about 2 pounds to disengage said tooth of said closure from said locking surface of said cantilevered beam; and

- d) a guard ring supported from said finish portion of said bottle and located below said outermost surface of said closure when said closure is installed, said guard ring having an outermost surface, said outermost surface having a recess therein, said recess providing clearance for said pushtab such that said pushtab may be depressed into said recess, said recess having a substantially vertical edge at each side of said pushtab to help prevent inadvertent depression of said pushtab.

18. The package of claim 17 wherein said cantilevered beam is about 1.1 inches long and said angle is approximately 10°.

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