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IMPROVED CLOSURE AND METHOD FOR  
PRODUCING THERMOPLASTIC CONTAINERS

The invention relates to a method of forming integral zipper-like fastener elements on flexible film or sheet to be made into bags or containers which are closable by such fastener elements or in which the fastener elements are formed on separate film strips which can subsequently be laminated onto a film or sheet to be made into bags or containers which are closable by such fastener elements.

A method of forming fastener elements is shown in U.S. Patent No. 4,263,079, for example, in which the fastener elements, in the shape of interengaging male and female profiles extending from a base, are extruded onto a plastic sheet or film with the male profile positioned to interengage with the female profile for closing the container opening. In such containers, however, the width of the base portions of the fastener elements over which the fingers pass while applying pressure for closing the fastener elements are so narrow that it is difficult to align the fastener elements with one another for easy interengagement of the profiles with one another upon the application of

finger pressure to the fastener elements. One way of improving the "feel" of alignment and interengagement of the profiles with one another is to provide additional stiffening ribs on opposite sides of at least one of the profiles. While the use of additional ribs on either side of a thermoplastic profile has been suggested in the past, such as in U.S. Reissue Patent No. 28,969, none of the prior art has taught how to obtain the desired spacing between the ribs and the profiles of the fastener elements so as to provide stiffened fastener elements for an improved "feel" of alignment and interengagement of the profiles to facilitate interlocking. Moreover, the prior art does not teach how to manufacture the fastener elements in a way that will assure a desired spacing between the ribs on either side of a profile. Likewise, none of the prior art has indicated that there is an advantage to be derived by providing a predetermined spacing of the ribs with respect to the profile in order to achieve such a good "feel".

The invention particularly resides in an improved integral zipper-like closure for thermoplastic containers or other film or sheet products which require a closure and comprising complementary interlocking profiles in which the profiles are readily engagable with each other in an interlocking relationship and disengagable from each other by the end user. It has previously been found desirable to include ribs on opposite sides of at least one of the profiles of the fastener elements in order to permit the user to more readily "feel" the fastener elements and to interlock the profiles with one another when running the fingers over the backs of the fastener elements to thereby

force the profiles into an interlocking relationship. In the type of closure taught in U.S. Patent No. 3,340,116, for example, it has been found desirable to include ribs on either side of one of the profiles, preferably the male profile, so that the protrusions of the female profile extend on either side of the male profile and between the male profile and the ribs. If the ribs are spaced too far from the male profile, the fingers of the user do not "feel" the ribs as part of the fastener element. If the ribs are too close to the profile, they will not provide a sufficient amount of space therebetween for interengagement of the protrusions of the female profile between the male profile and the ribs nor will the fastener elements feel much wider than they would without the ribs. Spacing of the ribs a predetermined distance on either side of a profile is thus a critical and primary feature of the present invention.

Merely cutting a die with a preselected spacing of the ribs with respect to a profile will not normally result in the same relative spacing of the ribs in the finished product because of lateral or transverse stresses in the film experienced in the extrusion process which tend to draw the ribs apart from the profile. It has been discovered that by increasing or decreasing the thickness of the base of a profile that a predetermined spacing of the ribs with respect to the profile can be obtained. Thickening the base of the profile causes the ribs to stay closer to the profile during extrusion. Thus, if it is desirable to have a closer rib spacing, the thickness of the base is increased. If it is desirable to space the ribs further apart, then the thickness of the base is

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decreased. While fastener elements comprising a profile extending from a base are known from, for example, U.S. Patent Nos. 3,198,228, 3,338,284, and 4,263,079, it has not been known heretofor that

5 varying the thickness of a profile base can affect the spacing of ribs with respect to a profile. Accordingly, by controlling the base thickness and the rib spacing in an extrusion process, an improved "feel" for "alignment" and interengagement of the  
10 profiles with one another for closing the fastener elements is obtained.

In a first aspect, the present invention provides a method of controlling the spacing of ribs each formed  
15 adjacent a respective side of an extruded thermoplastic closure profile formed on a film or sheet stock, the profile having a base extending at least to the ribs, and the base, profile and ribs being extruded from a die and joined to form the film  
20 or sheet stock as they are being simultaneously extruded with the film or sheet stock, the extrusion process introducing lateral stresses in the film or sheet stock, the method comprising sizing the depth of the die cut-out for the base so as to obtain the  
25 desired spacing between the ribs, the spacing being such that the profile and ribs move together as a unit when the closure profile is engaged with or separated from a complementary closure profile.

30 In another aspect there is provided a closure for containers made from a thermoplastic film or sheet, the closure comprising interlocking fastener elements, at least one fastener element having a base portion and at least one rib and a profile integrally  
35 formed with the base portion, the rib being positioned adjacent the profile at a distance from

the profile sufficient for interlocking engagement of the profile, with a complementary profile on another fastener element, the base portion having a thickness greater than the thickness of the film or sheet and  
5 the ribs having a height significantly less than that of the profile element to which they are adjacent.

The present invention is further described by way of example only with reference to the accompanying  
10 drawings, in which :

Figure 1 is a perspective view of a section of a container formed from a thermoplastic sheet or film having a zipper-like closure.  
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Figure 2 is an enlarged fragmentary perspective view of a fastener element comprising a male profile and a pair of ribs in which the male profile has been forced into an interlocking relationship with a  
20 female profile upon the application of finger pressure to the fastener elements.

Figure 3 is an enlarged cross-sectional view of a closure made with widely spaced ribs.  
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Figure 3A is an enlarged cross-sectional view of a profile die for making the male fastener element extrusion illustrated in Figure 3.

30 Figure 4 is an enlarged cross-sectional view of a closure of the invention made with more closely spaced ribs compared to those shown in Figure 3.

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Figure 4A is an enlarged cross-sectional view of a profile die for making the male fastener element illustrated in Figure 4.

5 Figure 5 is an enlarged cross-sectional view of a series of male fastener elements with gradually narrower rib spacings.

Figure 6 is a graphical representation of the effect that a profile die base (Y of Figure 4A) has on actual rib spacing.

10 Integral zipper-like closures for thermoplastic sheets or films can be made by the process of U.S. Patent No. 3,340,116, or by a tubular or cast extrusion process as in U.S. Patent No. 4,263,079. In each case, the extrudate is formed with a certain amount of stress  
15 in both the longitudinal and transverse directions of the film during extrusion. It has been noted that during extrusion, the transverse stress, in particular, affects the relative spacing of the ribs with respect to each other and the profile.

20 Figure 1 more particularly illustrates a section of a container 10 having a female profile 12 engaged with a male profile 14 to form a closure for the container. Adjacent to the male profile are protuberances, ribs, or ridges 15 and 16 (more clearly  
25 shown in Figure 3) which are spaced by a distance D-1 and D-2 from the center of the profile. The distance D-3 is the combined distance of D-1 plus D-2.

Figure 3A is an enlarged view of a pattern cut in a die through which the thermoplastic material

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forming the male profile 14 and ribs 15 and 16 are extruded. The base of the male profile cut-out 14C terminates at the corners 18 and 20 of the die and these corners are common to die cut-outs 15C and 16C for forming ribs 15 and 16. Accordingly, the terminal points 18 and 20 are coplanar with the outside bottom corners 22 and 23 of the cut-outs 15C and 16C. Although the rib cut-outs 15C and 16C join the profile cut-out 14C at 18 and 20, Figure 3 clearly shows that the distances between the male profile 14 and the ribs 15, 16, i.e., distances D-1 and D-2, are substantially greater than desired. This is caused by the transverse stresses (as compared to stresses exerted in the extrusion direction) that are exerted upon the film as it is stretched and cooled immediately following extrusion. Merely cutting a die with a selected spacing of the rib cut-outs 15C, 16C with respect to the profile cut-out 14C will not result in the same spacing of the ribs with respect to the profile on the final product. When the extrudate is drawn down after it leaves the extrusion die, all cross-sectional dimensions of the extrudate tend to decrease. Furthermore, transverse stresses experienced in the extrusion process tend to pull the ribs further apart from the profile. On the other hand, whenever a thick component such as a rib is adjacent to a thin component such as the film, the thicker component will tend to become narrower and remain thick, while the thin component (i.e., the film) will tend to become wider and thinner. In spite of the complex inter-relationship, it has been discovered that by increasing the dimension Y of the profile die (Figure 4A) a thickened base portion for the profile and the ribs is provided which will resist the stretching effect produced during extrusion of the film and fastener element and thus prevent

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pulling of the ribs away from the profile. By controlling the distance Y a common thickened base portion is provided for the ribs and profile cut-outs 24C, 26C and 14C, respectively, which thickened base portion  
5 effectively controls the spacing of the ribs with respect to the profile in the extrudate.

Figure 4 illustrates a closure made in accordance with the invention in which the distances between the male profile 14 and the ribs 24, 26 are  
10 substantially less than those shown in the fastener element illustrated in Figure 3. Specifically, by controlling the distance Y in the die cut-out illustrated in Figure 4A and thus the thickness of a base portion for the profile and ribs, the spacing of the  
15 ribs 24 and 26 with respect to the profile can be controlled so that the ribs may be much closer to one another and to the profile 14 as illustrated by the distances D-1' and D-2' which are substantially less than the distances of D-1 and D-2 of Figure 3. By  
20 varying the distance Y (Figure 4A) where the die cut-outs 24C and 26C meet the profile cut-out 14C, (at points 28 and 30), the thickness of the base portion for the profile and ribs can be varied, and thereby also the spacing of the ribs with respect to the profile in the extrudate  
25 can be varied. It will be understood that the die cut-out 14C is the extrusion slot through which the male profile 14 is extruded and cut-outs 24C and 26C are the extrusion slots through which the ribs 24 and 26 are extruded. The cut-out 24C meets cut-out 14C at  
30 point 28C which is spaced a distance Y above the elevation of corner 22. The same spacing Y occurs between point 30C and corner 23 where cut-out 26C meets cut-out 14C.

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The distance Y between the points 28C and 30C and the corners 22 and 23, respectively, provides a base portion in the die which results in the thickened base portion represented by the distance X of the fastener element shown in Figure 4. It will be noted that the thickness of the base portion represented by X is substantially greater than the normal thickness Z of the film forming the wall of the container, as seen in Figure 4. By increasing the thickness X, the profile 14 and ribs 24 and 26 are provided with a thickened base portion, and it has been found that the distance between peaks  $P_1$  and  $P_2$ , distance D-3' between the ribs 24 and 26, respectively, is reduced in the extrudate. The distances D-1' and D-2' are still large enough, however, to permit the protrusions or legs 32 and 34 of the female profile 36 to fit readily around the upper extremity 38 of the male profile 14 and yet are small enough to provide "stiffening" for the fastener element so that when a user positions the profiles 14 and 36 in an interlocking closing position, the base portion and ribs 24 and 26 provide the fastener element with a feeling of substantial width and stiffness. The effect therefore is in the formation of an improved closure where the thumb or finger can readily feel the width of the base portion of the male profile 14 and the ribs 24 and 26 upon the application of pressure to the fastener elements. The wider base portion of the closure permits the application of less pressure by the user's fingertips when forcing the profiles into an interlocking relationship, and thereby creates an improved "feel". The stiffening effect provided by the thicker base portion X and the ribs provides greater stability to the male profile for alignment of the profiles with each other and effectively prevents tipping of the male profile or



bending of the male profile during closing of the fastener elements.

5       The ribs 24 and 26 are positioned close enough to the male profile so that the ribs and the male profile must move together as a unit. The generally triangular shape of the ribs permits ready positioning and interlocking engagement of the female profile with the male profile and also provides additional structural strength. The integral base  
10   portion, ribs, and male profile collectively exhibit a higher moment of inertia compared to a male profile by itself. It will be obvious to persons skilled in the art that the ribs can be formed such that they have various cross-sectional shapes which can be generated  
15   by merely changing the shape of the cut-outs in a die. The construction of the fastener elements in accordance with the invention results in an improved resistance of the fastener element to bending. The degree of stiffening and resistance to bending can, therefore, be  
20   controlled by controlling the thickness of the base portion X and thereby the rib spacing. This is advantageous when closing the bag as it reduces lateral movement of the male profile relative to the female profile and therefore aids in maintaining alignment of  
25   the male and female profiles.

      The distance W between the juncture 28 of the profile 14 and rib 24 and the bottom 40 of upper extremity 38 represents the height of the stem 42 of male profile 14. As the distance X (representing  
30   the thickness of the base portion for the profile 14 and ribs 24 and 26) increases, it is important that the length W of the stem 42 be kept sufficiently long so



that the legs 32 and 34 of the female profile 36 can be easily positioned to engage over and lock with the extremity 38. A lengthening of the male profile stem can be achieved by simply lengthening the die cut-out 42C or by shortening the distance Y. Shortening distance Y would also affect rib spacing.

Figure 5 illustrates a series of fastener element samples I through V. Sample I is similar to the fastener element of Figure 3 in that the thickness X-I minus the film thickness Z is in effect about zero. The die cut-out through which the profile and ribs is extruded is like that of Figure 3A where the distance Y is zero (indicated to the right of Sample I). Sample II is an embodiment of the invention where the distance Y is about 0.127 mm (0.005 inches) and provides for a slightly thickened base portion; Sample III is one where the distance Y is increased to about 0.254 mm (0.010 inches); Sample IV is one where the distance Y is further increased to about 0.381 mm (0.015 inches); and Sample V is one where the distance Y is about 0.508 mm (0.020 inches). In each case, it will be noted that the spacing of the ribs (spacings D-3I through D-3V, respectively) with respect to each other and the male profile becomes progressively smaller. Accordingly, as the distance Y in Figure 4A increases even further, the progression will continue until the rib spacing D-3 becomes too close for the closure to be operable.

The actual rib spacing for Samples I to V of Figure 5 were plotted graphically as illustrated in Figure 6. In forming the Samples, the blow-up ratio was kept substantially constant, the temperature of the

melt was kept within 2°C; the temperature of the cooling air was held within 2°C, and the air pressure and position of the air cooling means all remained about the same as did the line speed. The actual film thickness was about 0.0467 mm (1.84 mils). It is believed that the distance D-3 should preferably be 3.3 to 5.8 mm (0.13 to 0.23 inches) but that the distance could range from 1.78 to 7.6 mm (0.07 to 0.30 inches) or perhaps even a greater range depending on closure sizes and materials.

Accordingly, while it is apparent that variations within the scope of this invention may be obtained by the use of differently shaped profiles or different resin materials and differing operating conditions, the principles of this invention would be applicable to any variation and combination not herein disclosed in detail but falling within the scope of the appended claims. For example, whether one extrudes the fastener elements from the resin supply for the film or instead extrudes the fastener elements from a different resin supply the principles of this invention would still be applicable. Similarly, there may be other ways in which to thicken or thin the base of a profile than that specifically illustrated herein. Likewise, extruding the materials in a cast system as contrasted to a tubular system would generate different levels of transverse stresses and effect actual rib spacing to a degree, yet the process would still benefit from employing the method of the present invention. Further, if the dimension Y were something less than zero, rib spacing could still be affected, but then one must look at other possible associated problems, such as excessive thinning, to determine the practicality of such structures.



- Additionally, protuberances might be placed adjacent to the female profile instead of the male profile or adjacent to both profiles, or the interengaging profiles might take different configurations or be formed of
- 5 different materials than those used in said film or sheet stock and still present embodiments within the scope of this invention.

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CLAIMS

1. A method of controlling the spacing of ribs  
5 each formed adjacent a respective side of an extruded  
thermoplastic closure profile formed on a film or  
sheet stock, the profile having a base extending at  
least to the ribs, and the base, profile and ribs  
being extruded from a die and joined to form the film  
10 or sheet stock as they are being simultaneously  
extruded with the film or sheet stock, the extrusion  
process introducing lateral stresses in the film or  
sheet stock, the method comprising sizing the depth  
of the die cut-out for the base so as to obtain the  
15 desired spacing between the ribs, the spacing being  
such that the profile and ribs move together as a  
unit when the closure profile is engaged with or  
separated from a complementary closure profile.

20 2. A method as claimed in Claim 1 wherein the  
rib spacing is decreased by increasing the thickness  
of the base portion.

25 3. A method as claimed in Claim 1 wherein the  
rib spacing is increased by decreasing the thickness  
of the base portion.

30 4. A closure for containers made from a  
thermoplastic film or sheet, the closure comprising  
interlocking fastener elements, at least one fastener  
element having a base portion and at least one rib  
and a profile integrally formed with the base  
portion, the rib being positioned adjacent the  
profile at a distance from the profile sufficient for  
35 interlocking engagement of the profile, with a  
complementary profile on another fastener element,



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the base portion having a thickness greater than the thickness of the film or sheet and the ribs having a height significantly less than that of the profile element to which they are adjacent.

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5. A closure as claimed in Claim 4 wherein the fastener element has a rib formed on each side of the profile.

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6. A closure as claimed in Claim 5 wherein the distance between the crests of the ribs is from 1.78 to 7.6mm (0.07 to 0.30 inch).

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7. A closure as claimed in Claim 6 wherein the distance between the crests of the ribs is from 3.3 to 5.1mm (0.13 to 0.20 inches).

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8. A closure as claimed in Claim 4 comprising a pair of fastener elements having complementary interlocking male and female profiles, and a thickened base portion with a pair of ribs formed on each side of one of the profiles.

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9. A closure as claimed in Claim 8 wherein the ribs are extruded on either side of the male profile and the space between the ribs and the male profile is sufficient to permit the female profile to engage the male profile between the ribs and the male profile.

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10. A closure as claimed in Claim 9 wherein the male profile is extruded with a stem of a length sufficient to permit ready interlocking engagement between the male and female profiles.

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11. A closure as claimed in Claim 4



substantially as hereinbefore described with reference to and as illustrated in any one of Figures 1 to 3, or Figure 4 of the accompanying drawings.

5           12. A process comprising a method as claimed in Claim 1 and substantially as hereinbefore described with reference to the accompanying drawings.

10           13. A fastener element whenever made by a process comprising method as claimed in any one of the Claims 1 to 3 or 12.

15           14. A container comprising two flexible sidewalls and an interlockable closure device formed of resilient plastic material and including interlocking fastener elements, the fastener elements respectively comprising male and female closure profiles operable for being interlocked continuously over a predetermined length and connected to the  
20   side-walls, external flanges formed on the upper exposed edges of the walls and extending outwardly of the profiles and adapted to be gripped and drawn apart to separate the profiles with the container being opened by drawing the profiles apart and being  
25   closed by pressing the profiles together and a structure with an inclined generally planar surface adjacent at least one side of and along the length of a selected one of the closure profiles, one of the fastener elements being as defined in any one of  
30   Claims 4 to 11 or 13.

          15. A container as claimed in Claim 14 wherein the inclined generally planar surface is on both sides of the structure.

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          16. A container as claimed in Claim 15 wherein



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5 a similar structure to the first-mentioned structure is located along the length of the selected one of the closure profiles adjacent the side thereof opposite from where the first-mentioned structure is located.

10 17. A container as claimed in Claim 16 wherein the closure profiles and structures are formed of the same plastic material as that of which the sidewalls are formed.

15 18. A container as claimed in any one of the Claims 14 to 17 wherein the selected profile is the male profile.

19. A thermoplastic sheet or film having a closure as claimed in any one of Claims 4 to 11 or a fastener element as claimed in Claim 13.

20 20. A contained as claimed in Claim 14 substantially as hereinbefore described.

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