An improved reclosable fastener profile assembly is provided, said assembly comprising a continuous supply of a first profile strip this first profile strip being substantially flat but having at least one rib that extends from the surface of first strip; and a continuous supply of a second profile strip opposite the first strip; this second strip being substantially flat but having at least two ribs that extend from the surface of this second strip. The rib of the first strip and the ribs of the second strip are adapted to sealingly engage and maintain an airtight seal when so engaged. A compression molded segment seal portion fuses the first profile strip, the second profile strip and the ribs of the first profile: strip and second strip. The compression molded segment seal includes a fused section of the first and second profile strips formed through the application of heat and pressure without further filling material or plastic. This fused section is substantially flattened to form an airtight seal of the first and second profile strips less than the combined thickness of the first and second profile strips, without distorting said ribs of said first and second profile strips outside of said fused section, thereby maintaining the airtight seal of the first and second profile strips when interlocked. The compression molded segment seal portion further has a thickness less than the combined thickness of the first profile segment and the second profile segment, so as to allow easier sealing of the ends of the fastener strips to the side walls of a reclosable bag.
Fig. 7
Provide interconnected first and second profile strips 82

Apply heat and pressure to portion of first and second profile strips 84

Advance interconnected profiles strips 86

Provide interconnected first and second profile strips

Apply heat and pressure to portion of first and second profile strips 84

Cut interconnected profile strips 88

Advance interconnected profile strips 86

Fig. 9

Fig. 10
AIRTIGHT RECLOSABLE FASTENER


BACKGROUND OF THE INVENTION

[0002] The invention relates generally to reclosable fasteners and a method of forming a reclosable fastener profile assembly which allows for fast, automated production and accurate, seal registration. In particular, the invention relates to a seal arrangement for a reclosable zipper profile strip, which is created through the application of heat and pressure to a male and female profile to form a ‘compression molded segment’ seal, and to a method of producing such a seal.

[0003] The popularity of reclosable zipper fasteners has created a demand for a large number and wide variety of reclosable bag sizes and types. It is commonly known in the art to form a reclosable bag through the addition of a zipper profile to a pair of bag walls in order to form a bag with a reclosable, airtight seal. However, improper registration may cause the seal to weaken and fail over time or become permeable to the air. In many reclosable bag applications, an airtight seal is necessary to maintain the freshness of articles placed in the bag. Further, such seals must be suitable for high-speed automated production in order to make the production of reclosable bags commercially viable.

[0004] In the case of zipper profiles, commonly known methods of construction and seal formation often cause inaccurate, commercially unacceptable seals which cannot be produced on an economically practical scale. Commonly known profile formation methods in the art require multiple sealing devices, precise machinery or extensive retrofiling to alter the size and type of reclosable fastener. Exemplary devices are shown and described in U.S. Pat. No. 5,601,368 (Bodolay); U.S. Pat. No. 3,847,711 (Howard); U.S. Pat. No. 5,461,845 (Yeager); U.S. Pat. No. 5,823,933 (Yeager); U.S. Pat. No. 4,241,865 (Ferrell); U.S. Pat. No. 4,335,817 (Bahr); U.S. Pat. No. 4,909,017 (McMahon); and U.S. Pat. No. 5,024,537 (Tilman) and, in particular, U.S. Pat. No. 6,033,113 (Anderson). As such, none of the devices referenced above satisfy the need for a multi-purpose reclosable zipper profile, which can be accurately and economically manufactured using a minimum quantity of plastic material.

[0005] Therefore, an unfulfilled need remains for a zipper profile which can be accurately manufactured at a high rate of speed and which can be adapted to a wide range of reclosable zipper bag applications.

SUMMARY OF THE INVENTION

[0006] The present invention provides a reclosable fastener profile seal and a disclosed method of forming a fastener profile assembly. In particular, the preferred embodiment of the method of forming a fastener assembly includes a first profile strip, a second profile strip and a compression molded segment seal fusing the first and second profiles together to provide a reclosable faster having fused ends which form the opening for a reclosable bag. To manufacture the assembly, the first profile strip and second profile strip are fed by at least one motorized roller from a web or roll of respective profile strips. Interlocking ribs are included on the profiles to create an airtight reclosable seal which is suitable for a wide range of applications.

[0007] The present invention provides reclosable bags with air tight fasteners. Webster’s Collegiate Dictionary, Tenth Edition, copyright 1997 by Merriam-Webster, Inc., defines “air tight” to mean “impermeable to air, or nearly so.” Under such definition for “air tight,” those of ordinary skill in the art might construe an “air tight” seal on a plastic bag to mean a seal that is actually impermeable, or only nearly impermeable to air. Persons of ordinary skill in the packaging art construe an “air tight” reclosable seal to be defined by an industry standard air leak test known as ASTM D3078-02. Under this standard, a bag is submerged in water above which a pressure is applied. Leaks in the bags seal are manifested as air bubbles. As used herein, an “air tight” seal means a seal that will prohibit the transfer or movement of air molecules at atmospheric pressure and room temperature, across or through the seal structure for a substantially long time. In other words, an airtight seal should prohibit the transfer of air molecules from the inside to the outside and vice versa. For example, an “air tight” seal should be able to keep air molecules in a bag for at least two hours after the seal’s closure and air molecules outside the bag after the seal’s closure, so long as the product contained within the bag is expected to be kept reasonably fresh.

[0008] The first and second profile strips are engaged to form a reclosable profile assembly. After the first and second profiles are interconnected, a portion of the first and second profile are sealed together. The interconnected first profile and second profiles are advanced and staggered applications of a compression molded segment seal are applied to the end portions of each profile assembly. This allows the profile assembly to be formed at a high rate with good accuracy. While being fused, the first and second profiles are cut to provide for individual reclosable fasteners.

[0009] In an alternative embodiment, the individual reclosable fastener profiles are not cut, thereby providing a continuous linear strip of fully formed reclosable bag profiles. In such an embodiment, the completed reclosable fasteners may be wound onto a roll for later separation and addition to bag walls.

[0010] It is a principal advantage of the invention to provide a reclosable fastener profile seal and method of forming a fastener profile assembly that can be produced quickly and precisely to form a zipper profile suitable for use in a wide range of reclosable bag applications.

[0011] It is another advantage of the invention to provide a reclosable profile assembly and a method of forming a reclosable fastener profile assembly, which is easily adjustable to provide a reclosable fastener profile of any commercially desirable length.

[0012] It is another advantage of the present invention to provide a reclosable profile assembly and a method of forming a reclosable fastener profile assembly, which is readily adaptable to seal and form reclosable fasteners and profiles of various sizes and styles.
It is yet another advantage of the invention to provide a reclosable profile assembly, which is suitable for attachment to a wide range of bag wall sizes and types.

Various other features and advantages of the invention are set forth in the following detailed description, drawings and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevational view of a portion of the profile assembly embodying the invention including the compression molded segment seal.

FIG. 2 is a front elevational view of a portion of the first profile and second profile prior to engagement and fusion.

FIG. 3 is a side elevational view of the first profile of FIGS. 1 and 2.

FIG. 4 is a side elevational view of the second profile of FIGS. 1 and 2.

FIG. 5 is a perspective view of the first and second profiles including the sealing apparatus that forms the compression molded segment seal and a single compression molded segment seal.

FIG. 6 is a perspective view of the first and second profiles including the compression molded segment seal formed in FIG. 5 and the formation of a second compression molded segment seal.

FIG. 7 is a front elevational view of a reclosable bag including the profile seal disclosed in FIGS. 1 through 6.

FIG. 8 is a perspective view of a reclosable bag including the profile seal disclosed in FIGS. 1 through 6.

FIG. 9 is a flowchart of the method of forming a reclosable fastener profile assembly disclosed in FIGS. 1 through 6.

FIG. 10 is a flowchart of an alternative method of forming a reclosable fastener profile assembly also disclosed in FIGS. 1 through 6.

FIG. 11 is an elevation view of the fastener strip depicted in FIG. 1;

FIG. 12 is a cross-section taken along line 3-3 of FIG. 11;

FIG. 13 is a cross-section taken along line 4-4 of FIG. 11;

FIG. 14 is a cross-section taken along line 5-5 of FIG. 11;

FIG. 15 is a perspective view of a first stage of an apparatus of the present invention;

FIG. 16 is a perspective view of a vibrator of the present invention;

FIG. 17 is an end view of the vibrator depicted in FIG. 15;

FIG. 18 is a partial cross-section of the vibrator taken along line 9-9 of FIG. 17;

FIG. 19 is an elevation of the first shape, which is produced by the first stage;

FIG. 20 is a perspective view of a second stage, a third stage, a fourth stage and a fifth stage of the apparatus depicted in FIG. 15.

While the specification and claims herein may refer to specific fastener or rib structures, it will be understood and fully appreciated that the principles of the present invention refer to closures generally and incorporate any compatible closure type or style. As such, before one embodiment of the invention is explained in detail, it is to be understood that the invention is not limited to its application to the details of the construction and the arrangements of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced or being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As seen in FIGS. 1 through 4, the reclosable profile assembly disclosed in the present embodiment includes a first profile 14, a second profile 18 and a compression molded segment seal 22. The profile assembly 10 has a length, which may be reduced or enlarged in accordance with the present application to accommodate any length required by a particular industry application.

The profile assembly 10 includes a first profile 14. The first profile 14 is a flat, thin piece of packaging material preferably manufactured from polyethylene. As most clearly depicted in FIGS. 1, 2, 3 and 4, the first profile 14 includes a first profile surface 26 including an end 28, a first rib 30, second rib 34 and third rib 38. The first rib 30, second rib 34 and third rib 38 are in a location offset from the center of the first profile 14, thereby defining a profile adherence surface 42 between ribs 30, 34, 38 and the edge 44 of the first profile strip 14. As seen in FIGS. 1 through 4, the first rib 30, second rib 34 and third rib 38 of the first profile 14 extend the entire length of the first profile surface 26.

The second profile 18 is preferably manufactured from the same material and with the same dimensions as the first profile 14. As best depicted in FIG. 2, the second profile 18 includes a second profile surface 46 including an end 48, first rib 50, second rib 54 and third rib 58. As best depicted in FIG. 4, the first rib 50, second rib 54 and third rib 58 are located along one edge 40 of the second profile 18. As seen in FIGS. 1 through 4, the first rib 50, second rib 54 and third rib 38 of the second profile 18 extend the entire length of the second profile surface 46.

As seen in FIG. 1, the completed profile assembly 10 also includes a compression molded segment seal 22 portion. “Compression molding” is well known. In general, compression molding entails placing a predetermined amount of material between mold halves. The mold halves are closed, causing the enclosed material to become heated, and in turn, causing it to liquefy, filling voids in the molds. Various embellishments to compression molding have been disclosed in various patents. For example, U.S. Pat. No. 4,309,379, which issued Jan. 5, 1982, discloses a "Method
and Apparatus for Runnerless Injection-Compression Molding Thermosetting Materials.” In this patent, a thermosetting molding material is heated and passed through a heated nozzle into a heated manifold. The heated material is passed from the manifold into a heated mold. The mold is closed to press and cure the material enclosed within it. The cured, finished article is removed from the mold and the process repeated.

In the preferred embodiment of the present invention, the “mold” is a die and anvil. Heat and pressure applied to the seal material causes the seal material to liquefy. When it liquefies, it flows into voids between the two film layers. The sealed areas are gradually cooled, causing the material in the mold to cool and solidify, taking the shape of the mold. In a preferred embodiment of the invention, the cooling time in the mold is increased and the amount of heat is reduced in order to cure the finished product more slowly. In so doing, the segment seal 22 retains its cross section better than it would if the mold were opened quickly or at a relatively higher temperature, and gaps between the film layers which would otherwise allow the passage of air across the seal, are eliminated.

The compression molded segment seal 22 of FIG. 1 comprises the profile adherence surface 42 of the first profile surface 26 fused to the portion of the second profile surface 46, which engages the profile adherence surface 42 and a portion of the first 30, second 34 and third 38 ribs of the first profile surface 14 and the corresponding engaged portion of the first 50, second 54 and third ribs 58 of the second profile surface 46. In the embodiment depicted, the compression molded segment seal 22 portion has a thickness less than the combined thickness of the individual first profile 14 and second profile 18.

The formation of the profile assembly 10 and compression molded segment seal 22, as depicted in FIGS. 5 and 6, is accomplished by providing a continuous supply of an interconnected first profile 14 and second profile 18 where the ribs 30, 34, 38 of the first profile 14 are engaged with the ribs 50, 54, 58 of the second profile 18.

As seen in FIG. 5, the engaged first profile 14 and second profile 18 are fed or otherwise positioned in proximity to the compression molded segment sealer 62. The compression molded segment sealer 62 provides reduced heat and increased pressure to the profile assembly to form the compression molded segment seal 22. In a preferred embodiment of the invention, multiple compression molded segment sealers 62 may be utilized in order to reduce the amount of heat and/or pressure applied at each segment sealer 62. This method is disclosed in U.S. Pat. No. 7,041,249, parent of the present application. As a result, the compression molded segment seals 22 and 24 are formed without distorting the faster profiles 14 and 18. Thus, an airtight seal between the faster profiles can be maintained without leakage.

As seen in FIG. 6, the engaged first profile 14 and second profile 18 are repositioned 82 with the first compression molded segment seal 22 advanced 82 past compression molded segment sealer 62. The second compression molded segment seal 24 is formed, defining the second compression molded segment seal 24 of the completed profile assembly 70 and the first seal 22 of a second incomplete profile assembly 78. While the second compression molded segment seal 24 is being formed, the first profile 14 and second profile 18 are simultaneously cut 60 by the compression molded segment sealer 62 to define the completed profile assembly 70 and form a portion of the first compression molded segment seal 22 for a second incomplete profile 78. The area between the first compression molded segment seal 22 and second compression molded segment seal 24 defines the opening 80 of the reclosable bag profile 70 (as seen in FIG. 8). The second incomplete profile 78 depicted in FIG. 4 is advanced 82 and the process (as depicted in FIGS. 9 and 10) is repeated to form an additional completed profile assembly 70 (as shown in FIGS. 7 and 8).

As seen in FIGS. 7 and 8, a reclosable storage bag 84 is created by fusing or otherwise affixing a completed profile assembly 70 to a first bag wall 72 and second bag wall 74. The completed reclosable storage bag 84 includes a first bag wall 72, a second bag wall 74 and the reclosable fastener profile assembly 70 depicted in FIG. 6. As depicted in FIGS. 8, the reclosable fastener profile and first 72 and second bag walls 74 combine to define a storage bag 84 with a reclosable opening 80.

FIGS. 9 and 10 represent graphically the method of forming a faster profile assembly 70 disclosed herein. As seen in FIG. 9, the following steps are performed in sequence: first 82, an interconnected profile strip 10 is provided; second 84, heat and pressure is applied by the compression molded segment sealer 62 to the interconnected profile strip 10 to form a compression molded segment seal 22; and third 86, the profile strip 10 is advanced 82. The second 84 and third 86 steps are then repeated to form additional completed profile assemblies 70.

Alternatively, as seen in FIG. 10, the steps 82, 84, 88 depicted in FIG. 9 are duplicated, however, a cutting step 88 is added after the interconnected first 14 and second 18 profiles are fused 22 during the second step 84. The cutting step 88 cuts 60 the compression molded segment seal 22, thereby defining a second compression molded segment seal 24. The second step 82, cutting step 88 and third step 86 are then repeated sequentially to form additional individual profile assemblies 70.

As indicated in the first full paragraph on page 6 of the Ser. No. 09/415,696 application as filed, parent of the present application, the compression molded segment seal 22 of FIG. 1 comprises the profile adherence surface 42 of the first profile surface 26 fused to the portion of the second profile surface 46, which engages the profile adherence surface 42 and a portion of the first 30, second 34 and third 38 ribs of the first profile surface 14 and the corresponding engaged portion of the first 50, second 54 and third ribs 58 of the second profile surface 46. In the embodiment depicted, the compression molded segment seal 22 portion has a thickness less than the combined thickness of the individual first profile 14 and second profile 18.

The formation of the profile assembly 10 and compression molded segment seal 22, as depicted in FIGS. 5 and 6, is accomplished by providing a continuous supply of an interconnected first profile 14 and second profile 18 where the ribs 30, 34, 38 of the first profile 14 are engaged with the ribs 50, 54, 58 of the second profile 18.

As seen in FIG. 5, the engaged first profile 14 and second profile 18 are fed or otherwise positioned in prox-
imity to the compression molded segment sealer 62. The compression molded segment sealer 62 provides heat and pressure to the profile assembly to form the compression molded segment seal 22. In one embodiment of the invention, multiple compression molded segment sealers 62 may be utilized in order to reduce the amount of heat and/or pressure applied at each segment sealer 62.

[0051] As noted in U.S. Pat. No. 7,041,249, which is one of the parents of the present application, in regard to avoiding distortion, Col. 8, lines 37-51

[0052] “A portion of fastener strip 100 is vibrated between a vibrator and an anvil at a first stage. The vibrating is effective to increase the malleability of the portion, as compared to the malleability of fastener strip 100 before vibrating. A first matrix is pressed against the malleable portion to produce a first shape. The pressing may be carried out simultaneously with the vibrating. Second matrix 260, third 280 and fourth 300 matrices are subsequently pressed against the malleable portion to produce a second shape, a third shape, and a fourth shape, respectively. Each pressing is accomplished in a separate stage at a different location. The fastener strip may be heated before or during the stages. The finished fastener strip is cooled to room temperature and may then be wound on a spindle or roll for later use by the bag converter, again at a precise tension to avoid distortion.

[0053] Thus avoiding distortion of the fastener profiles during manufacture is one of the principal objectives and advantages of the present invention.

[0054] FIGS. 9 and 10 represent graphically the method of forming a fastener profile assembly 70 disclosed herein. As seen in FIG. 9, the following steps are performed in sequence: first 82, an interconnected profile strip 10 is provided; second 84, heat and pressure is applied by the compression molded segment sealer 62 to the interconnected profile strip 10 to form a compression molded segment seal 22; and third 86, the profile strip 10 is advanced 82. The second 84 and third 86 steps are then repeated to form additional completed profile assemblies 70.

[0055] As seen in FIG. 11, in a preferred embodiment, the invention includes a fastener strip such as fastener strip 100 depicted in FIG. 1. Fastener strip 100 includes at least one reclosable portion 120 and at least one permanently sealed, generally planar portion 140. Although the perspective view shown in FIG. 1 is necessarily truncated, due to space limitations, it is contemplated that fastener strip 100 may be wound on a reel or accordion-folded in a box for convenient shipping and storage and include hundreds or even thousands of reclosable portions 120 and generally planar portions 140.

[0056] Reclosable portion 120 includes first backing 122 and troughs 124, which typically extends lengthwise along fastener strip 100. Reclosable portion 120 also includes second backing 126 and ridges 128 for mating with troughs 124 in an airtight, reclosable seal that essentially prevents air flow from one side of the seal to the other. Flap or flange 127 conveniently extends from second back 122 to an exterior side of fastener 100 in order to protect trough 124 and ridge 128 from damage and to facilitate a user’s grip for opening fastener strip 100.

[0057] The relative positions of troughs 124 and ridges 128 are depicted in FIG. 1 are arbitrary and need not be as shown for the invention to succeed. Also, either first backing 122 or second backing 126 may be positioned on the exterior side of fastener strip 100 and either of the backings 122, 124 may extend in the form of a flange, such as flange 127. The thicknesses of backings 122, 124 are often in the range of about 10 to 20 thousandths of an inch and the heights of trough 124 and ridge 128 are often in the range of about 50 to 100 thousandths of an inch. The invention however is not limited to these ranges.

[0058] Commonly, the thickness of planar portion 140 is about the thickness of one of the backings 122, 124 to about the combined thickness of both of the backings. Planar portion 140 is essentially free of mating ridges and troughs, such as trough 124 and ridge 128, and includes essentially no void spaces.

[0059] Plug 160 joins troughs 124 and ridges 128 in an airtight seal at adjacent end 130 of reclosable portion 120. Troughs 124 and ridges 128 define longitudinal interstitial voids (best seen in FIG. 3) that communicate hydraulically lengthwise along reclosable portion 120. Even if troughs 124 and ridges 128 mate effectively so as to prevent air flow between them from one side of fastener 100 to the other (for example, from the interior side of fastener strip 100 to the exterior of fastener strip 100), the ends of trough 124 and ridge 128 must be sealed to prevent air from flowing longitudinally through these voids and passing through end 130. Plug 160 provides this seal.

[0060] Dam 180 joins plug 160 to first backing 122 and to second backing 126 as depicted in FIG. 11. Dam 180 is essentially impervious to air flow and forms airtight seals where it meets plug 160, first backing 122 and second backing 126, respectively. A primary purpose of dam 160 is to prevent air one side of fastener strip 100 from leaking around plug 160 to the other side of fastener 100.

[0061] The relationship of plug 160 to dam 180 is best seen in FIG. 12. FIG. 12 shows how plug 160 seals end 130 of reclosable portion 120 to prevent longitudinal interstitial voids from passing through end 130. Dam 180 joins and seals the backings 122, 126 with plug 160 and planar portion 140. Lines 3-3, 4-4 and 5-5 correspond to cross-sections depicted in FIGS. 13-15.

[0062] Inspection of FIGS. 13-15 indicate that line 3-3 of FIG. 12 is at or near end 130. As can be seen in FIG. 13, trough 124 and ridge 128 define interstitial voids that are sealed by plug 160. The view in FIG. 13 looks away from planar portion 140 and toward reclosable portion 120. Longitudinal interstitial voids can be seen in cross-section, with plug 160 filling the voids. Significantly, FIG. 13 shows that trough 124 and ridge 128 are not significantly deformed at line 3-3 and, therefore, are capable of creating an airtight, reclosable seal across fastener strip 100. FIG. 3 is representative of reclosable portion 120, except that plug 160 covers over and/or infiltrates the interstitial voids.

[0063] The view in FIG. 14 is in the same direction as that of FIG. 3, but from a position closer to planar portion 140. Only vestiges of trough 124 and ridge 128 are apparent, and these are essentially filled by plug 160. FIG. 14 is representative of plug 160, except that the vestiges are present.

[0064] FIG. 14 shows a relatively flattened and homogenous cross-section, as compared to FIGS. 13 and 14. No
vestiges of trough 124 and ridge 128 are visible. FIG. 5 represents the juncture of dam 180 with planar portion 140.

[0065] Turning now to FIGS. 12-14, prior art fastener strip 101 includes first backing 122, having a plurality of longitudinal troughs 124 thereon, and second backing 126, which has a plurality of longitudinal ridges 128 and flap or flange 127. At least one of the troughs 124 reclosably mates with one of the ridges 128 to produce an essentially airtight seal that prevents air leakage between interior and the exterior sides of fastener strip 10.

[0066] Longitudinal interstitial voids commonly exist between trough 124 and ridge 128. While the voids do not necessarily interfere with the airtight seal between the sides of fastener strip 100, the voids permit air flow longitudinally along trough 124 and ridge 128. Fastener strip 10 is composed of a material that becomes progressively more fluid with increasing temperature, hereinafter referred to as a “thermoplastic” material.

[0067] FIG. 15 depicts first stage 256 of apparatus 200 of the present invention for sealing portions of a prior art fastener strip, such as thermoplastic fastener strip 10 shown in FIGS. 17-19. First stage 256 of apparatus 200 includes vibrator 220 for vibrating a portion of fastener strip 10 to produce a relatively more malleable portion 212, best seen in FIG. 9. FIG. 15 also shows anvil 230, which supports fastener strip 10 from below during the vibrating, and four pneumatic piston and cylinder assemblies 202. The use of four pneumatic pistons 202 assures that the anvil 230 is properly aligned and level, and also helps direct more of the energy from vibrator 220 to the fastener strip, rather than causing the anvil 230 to vibrate. First stage 256 is positioned at location 258, which is a short distance away from stages 276, 296, 316 and 320 (best seen FIG. 20) of apparatus 200.

[0068] Vibrator 220, illustrated in FIG. 16, includes pneumatic actuator 231, ultrasonic horn or resonator 233 and first matrix 240. Actuator 231 receives compressed air and provides energy to vibrator 220 in the form of mechanical vibrations in the range of about 10,000 to about 100,000 cycles per second, more preferably at least about 20,000 cycles per second. Horn or resonator 233 focuses and intensifies the vibrations at first matrix 240, which is a single, integral unit with horn 233.

[0069] Horn 233 is also known as a solid resonator, a concentrator, or a mechanical amplifier. Horn 233 is dimensioned to be resonant at a predetermined frequency of vibration. When horn 233 is energized at its proximal input surface by an actuator 231, it provides ultrasonic energy (vibrations) at its opposite distal end to a workpiece that is in forced contact with the distal end.

[0070] As depicted in FIG. 16, first matrix 240 is the distal end of horn 233. Alternatively, first matrix 240 can be constructed as a separate die and securely mounted on the distal end of horn 233. It is believed that fashioning first matrix 240 integrally with horn 233, rather than as a separate die mounted on horn 233, tends to promote efficient and reproducible transmission of the vibrations. In either case, first matrix 240 is located at the distal end of horn 233 and can be utilized to press and mold a thermoplastic substrate, such as fastener strip 100, while vibrator 220 is vibrating.

[0071] Details of first matrix 240 are presented in FIG. 17. First matrix 240 includes a planar face 246 having cutouts 248, 250. Groove 252 of approximately semicircular cross-section extends across face 246 from cutout 248 to cutout 250. FIG. 17 illustrates that groove 252 is generally linear along the longitudinal axis of fastener strip 10 and that cutouts 248, 250 are each generally symmetrical and aligned along a shared axis of symmetry. The groove axis and the cutout axis are offset and generally parallel to each other. During use, the groove axis is aligned with and positioned directly over trough 24 and ridge 28.

[0072] FIG. 18 is a partial cross-sectional view taken along the groove axis of FIG. 17. It is evident from FIG. 18 that horn 233 is unitary with matrix 240. Cutouts 248 and 250 each include a transition volume 251, 253 having a depth that increases as distance from groove 252 increases. Each cutout 248, 250 has an arcuate cross-section, with the arcs positioned convexly to each other.

[0073] During use, first matrix 240 is placed over fastener strip 10, with groove axis 252, trough 24 and ridge 28 generally aligned. Moveable anvil 230 includes a generally planar face 23 that supports fastener strip 10 from below. Alternatively, fastener strip 10 may be placed between two vibrators 220 (not shown) for vibrating and pressing between two first matrices 240 (not shown).

[0074] Vibrator 220 vibrates a portion of fastener strip 10 so as to generate internal friction within fastener strip 10, causing a portion 212 of fastener strip to become relatively more malleable. The temperature of the vibrated portion often increases during the vibrating. The pressure exerted by first matrix 240 tends to displace some of the malleable portion in predictable directions. For example, the depth of transition volumes 251, 253 and the depth of groove 252 are calculated to displace a certain amount of the malleable portion along groove 252, and displace a certain amount of the malleable portion to or from the transition volumes 251, 253. Malleable material is also displaced transversely from the groove axis as first matrix 240 flattens the region between cutouts 248, 250.

[0075] First matrix 240 is properly shaped to press and extrude the displaced material in desired directions and, also, to mold and retain the displaced material at desired destinations. Preferably, the material displaced by first matrix 240 forms plug 160 or dam 180 of fastener strip 100 of the present invention; most preferably plug 160. The result is a product having first shape 242, depicted in FIG. 10, which significantly differs from the shape of fastener strip 10.

[0076] Turning now to FIG. 19, first shape 242 includes flattened portion 142, elongated hump 144 and a curved portion abutting end 130 of reclosable portion 120. Hump 144 corresponds to the shape of groove 252. The curved portion corresponds to the shape of transition volumes 251, 253. First shape 242 facilitates sealing, and is sufficiently similar to the shape of fastener strip 10 so as to be reproducibly molded by vibrating and pressing in a single stage, as described above.

[0077] FIG. 20 is a perspective view of second stage 276, third stage 296, fourth stage 316 and fifth stage 320 of apparatus 200. Each of these stages is located a short distance from each other at locations 278, 298, 318 and 320, respectively. Each of these stages respectively has a dedicated pneumatic piston and cylinder assembly 261, 281,
that forces an anvil down upon the fastener strip. Second stage 276, third stage 296, and fourth stage 316 are pressing stages that utilize dies 266, 286, 306 to support the fastener strip from beneath.

[0078] As with first stage 256, the temperature, pressure, time and distance between die faces 266, 286, 306 and respectively associated anvils are carefully controlled. The optimum combination of these factors depends on the precise nature of the fastener strip and the specifications of the finished seal portion. However, die temperatures of about 350 to about 400 degrees F. and pressures of about 60 to about 80 pounds per square inch have been employed successfully in pressing stages 276, 296, 316 with a pressing time of about half a second. Fifth stage 320 cools the finished product, which is fastener strip 100. Also shown in FIG. 20 is conveyor belt 321 which intermittently advances fastener strip 100. Conveyor belt 321 is preferably constructed of a silicone blend to resist heat, but also has a surface 322 which sticks to or retains fastener strip 100 when it is heated sufficiently to be tacky. The fastener strip when it is heated in malleable-like taffy, but the tension on conveyor belt 321 and thereof fastener strip 100 is carefully controlled preferably by a servo motor. As a result, the fastener strip 100 remains in its original size and configuration, except where it is shaped by die faces 266, 286 and 306.

[0079] FIG. 20 shows die 264, which is typically utilized at second stage 276. Die 264 includes generally planar face 266 and a pair of oppositely located arcuate cutouts 268, 270, which are positioned with their convex sides facing each other. As compared to cutouts 248, 250 of first stage 256, cutouts 268, 270 are positioned closer together and have greater radii. As seen in FIG. 11, silicone coated stripper plate 264A is positioned between face 266 and fastener strip 100, to facilitate separation of face 266 from fastener strip 100 after compression. Consequently, only stripper plate 266 of die 260 touches first shape 242. Pressing die 264 against first shape 242 causes flattened portion 142 and hump 144 to become further flattened. Additionally, die 264a displaces material toward adjacent end 130, which ultimately forms dam 180. Preferably, plug 160 is not significantly affected by die 264.

[0080] Overall flatness of the finished fastener strip, such as fastener strip 100, is an important requirement for many fastening applications. Third stage 296 works with die 284 to generally flatten buckings 122, 126 of fastener strip 100 and ensure that relosable portion 120 and planar portion 140 are coplanar. Face 286 defines longitudinal channel 284, which is significantly deeper and wider than groove 252. Accordingly, die 284a has relatively little effect on plug 160 or dam 180. Third stage 296 produces third shape 282, which is similar to the shape of fastening strip 100. Again, a stripper plate 284A is utilized to facilitate separation after compression.

[0081] Die 304a has a generally planar face 306 with cutouts 308, 310 and is similar to die 262, except that cutouts 308, 310 are positioned closer together and have greater radii than cutouts 268, 270. When pressed against third shape 282 under proper conditions of pressure, temperature and spacing, die 304a completes planar portion 140 and produces fourth shape 302, which is the shape of fastener strip 100. Fifth stage 316 cools fastener strip 100 so that it may be more conveniently transported and packaged. Again, a stripper plate 304A is utilized to facilitate separation. After the shaping of fastener strip 100 is completed, conveyor belt 321 advances the fastener strip to a second conveyor 101. As it cools, fastener strip 100 no longer adheres to belt 100, so it can be removed without stretching or distortion. The lack of tension on fastener strip 100 is crucial to maintaining the dimensions and configuration of the fastener strip 100. Fastener strip 100 is then advanced by second conveyor 101 to a take up reel 103, again maintaining minimum tension and compression of the fastener strip 100.

[0082] The invention also provides a method for sealing portions of a thermoplastic fastener strip, which process will now be described. The invention is not limited to the described process, starting materials, equipment or products.

[0083] A fastener strip, such as fastener strip 10 is the starting material. A tensioning assembly, such as a dancer roller assembly, is suitable for tensioning fastener strip 10. Dancer roller assembly 216 applies a precise tension to fastener strip 100, as will be appreciated and understood by practitioners. Fastener 100 is preheated by preheaters to a temperature warmer than room temperature and cooler the melting point or index of the thermoplastic material that composes fastener strip 100. For example, a temperature in the range of about 120° to about 130 degrees F. is often useful. Control of temperature and tension prevents distortion of the fastener strip 100. Fastener strip 100 is then advanced by conveyor belt 321.

[0084] A portion of fastener strip 100 is vibrated between a vibrator and an anvil at a first stage 200. The vibrating is effective to increase the malleability of the portion, as compared to the malleability of fastener strip 100 before vibrating. A first matrix 240 is pressed against the malleable portion to produce a first shape. The pressing may be carried out simultaneously with the vibrating. Second matrix 260, third and fourth matrices 280 and 300 are subsequently pressed against the malleable portion to produce a second shape, a third shape and a fourth shape, respectively. Each pressing is accomplished in a separate stage at a different location. The fastener strip may be heated before or during the stages. The finished fastener strip is cooled to room temperature and may then be wound on a spindle or roll for later use by the bag converter, again at a precise tension to avoid distortion.

[0085] The vibrator oscillates in contact with the fastener strip at a frequency of about 10,000 to about 100,000 cycles per second, preferably at about 20,000 cycles per second. As described above, the vibrator includes an actuator, a resonator or horn, and a first matrix, which is unitary with the horn. The vibrator is positioned over the fastener strip and an anvil is positioned under and in contact with the fastener strip. Preferably, the vibrator does not touch the anvil. Alternatively, two or more vibrators may be brought in to contact with the fastener strip with the fastener strip positioned between the vibrators.

[0086] FIG. 20 is a perspective view of second stage 276, third stage 296, fourth stage 316, and fifth stage 320 of apparatus 200. Each of these stages is located a short distance from each other at locations 278, 298, 318 and 320, respectively. Each of these stages respectively has a dedicated pneumatic piston and cylinder assembly 261, 281, 301, 321 that forces an anvil down upon the fastener strip.
Second stage 276, third stage 296, and fourth stage 316 are pressing stages that utilize matrices 260, 280 and 306. Alternatively, each matrix 260, 280 and 306 can be constructed as a separate die 260, 280 and 306.

[0087] Applicant respectfully submits that one of ordinary skill in the art at the time of the invention would know precisely what the term “compression molding” means, and the appropriate parameters for compression molding. In Modern Plastics Encyclopedia dated October, 1991, on page 271-272, is a complete description of compression molding.

[0088] In the preferred embodiment of the present invention, the “mold” is a die and anvil. Heat and pressure applied to the seal material causes the seal material to liquefy. When it liquefies, it flows into voids between the two film layers. The sealed areas are gradually cooled, causing the material in the mold to cool and solidify, taking the shape of the mold. In a preferred embodiment of the invention, the pressure is increased, the cooling time in the mold is increased and the amount of heat is reduced in order to cure the finished product more slowly. In so doing, the segment seal 22 retains its cross section better than it would if the mold were opened quickly or at a relatively higher temperature and gaps between the film layers which would otherwise allow the passage of air across the seal, are eliminated. The aforesaid process is referred to herein as compression molding.

[0089] As seen in Modern Plastics Encyclopedia, 1991, pages 609-618, compression molding machines were widely known as early as 1991. The pressures of 1,000-2,000 psi and 300-400° are described in the Modern Plastics Encyclopedia, page 272. In the present case, in order to avoid deformation of the fastener profiles, as claimed, temperature was reduced and pressure was greater than in comparison with conventional heat sealing methods for sealing fastener profiles such as Anderson U.S. Pat. No. 6,033,113.

[0090] In regard to the patent of Anderson ‘113, the claims include the limitations that the first and second profile strips are substantially flat but have, in the case of the first profile strip, at least one rib extending therefrom without further filling material or plastic and similarly in the case of the second profile strip. The compression molded segment seal portion is formed by fusing the first profile strip and the second profile strip and the ribs of the first and second profile strips through the application of heat and pressure without further filling material or plastic, unlike Anderson. The fused section is substantially flattened to form an air-tight seal of first and second profile strips, less than the combined thickness of the first and second profile strip, as disclosed in the original application. The claims of the present invention are limited to “without further filling material or plastic.” The patent of Anderson requires use of a fillet, either formed integrally of the fastener strip, or provided as additional material in order to seal the ends of the fastener strips together. Thus, unlike Anderson, the ends of the first and second profile strips are sealed to each other to form an airtight seal “without further filling material or plastic.” The advantages in terms of reduction of plastic usage, easier sealing of the ends of the fastener strips without bumps or bulges of additional plastic, and a simpler profile strip to initially manufacture are obvious.

[0091] Various features and advantages of the invention are set forth in the following claims.

1. A reclosable fastener profile assembly, said assembly comprising:
   a continuous supply of a first profile strip said first profile strip being substantially flat but having at least one rib that extends from the surface of said first strip; and
   a continuous supply of a second profile strip opposite said first strip; said second strip being substantially flat but having at least two ribs that extend from the surface of said second strip; said rib of said first strip and said ribs of said second strip adapted to sealingly engage and maintain an airtight seal when so engaged;
   a compression molded segment seal portion fusing said first profile strip, said second profile strip and said ribs of said first profile strip; "said second strip; said compression molded segment assembly including a fused section of said first and second profile strips formed through the application of heat and pressure without further filling material or plastic; said fused section substantially flattened to form an airtight seal of said first and second profile strips in said first and second profile strips less than the combined thickness of said first and second profile strips, without distorting said ribs of said first and second profile strips outside said fused section, thereby maintaining said airtight seal of said first and second profile strips when interlocked; and
   said compression molded segment seal portion having a thickness less than the combined thickness of said first profile segment and said second profile segment.

2. The reclosable fastener profile assembly of claim 1, wherein said compression molded segment seal includes a severing portion of said first profile strip and said second profile strip for cutting said fastener profile and creating an individual profile fastener assembly.

3. The reclosable fastener profile assembly of claim 1, wherein said continuous supply of first profile strips, said continuous supply of second profile strips and a plurality of said compression molded segment seal create a continuous linear supply of profile fastener assemblies.

4. The reclosable fastener profile assembly of claim 1, wherein said first profile strip and said second profile strip are configured to fitingly engage together such that said first profile strip is flush with said second profile strip when said first profile strip and said second profile strip are engaged.

5. The reclosable fastener profile assembly of claim 1, wherein said ribs of first and second strips have respective head portions and neck portions, wherein said head portions are arcuate in profile.

6. The reclosable fastener profile assembly of claim 1, wherein said first strip includes a first end and a second end, said second strip further including a first end and second end, wherein respective first ends and respective second ends of said first and second strips are created through application of said compression molded segment seal.

7. The reclosable fastener profile assembly of claim 1, wherein said ribs of said first and second strips have respective head portions and neck portions, wherein said head portions are wider than said neck portions.

8. The reclosable fastener profile assembly of Claim 1, wherein said second strip includes one more rib than said first strip,
9. A reclosable storage bag comprising:
   a first bag wall;
   a second bag wall;
   a reclosable fastener profile assembly, said assembly comprising:
   a first profile strip said first profile strip being substantially flat but having at least one rib that extends from the surface of said first strip; and
   a second profile strip opposite said first strip said second profile strip being substantially flat but having at least two ribs that extend from the surface of said second strip; said rib of said first strip and said ribs of said second strip adapted to sealingly engage and maintain an airtight seal when so engaged;
   a compression molded segment seal portion fusing said first profile strip, said second profile strip and said ribs of said first profile strip and said second profile strip; said compression molded segment seal including a fused section of said first and second profile strips formed through the application of heat and pressure without further filling material or plastic; said fused section substantially flattened to form an airtight seal of said first and second profile strips, less than the combined thickness of said first and second profile strips without distorting said ribs of said first and second profile strips outside of said fused section, thereby maintaining said airtight seal of said first and second profile strips when interlocked; wherein said first profile strip and said second profile strip are heat sealed to said first bag wall and said second bag wall, respectively; and
   said compression molded segment seal portion having a thickness less than the combined thickness of said first profile segment and said second profile segment.

10. The reclosable fastener profile assembly of claim 9, wherein said profile assembly further includes:
   a first bag wall;
   a second bag wall where edges of said first and second bag walls are sealed together thereby defining an inner bag; and
   said compression molded segment seal portion having a thickness less than the combined thickness of said first profile segment and said second profile segment.

11. The reclosable fastener assembly of claim 1 and further comprising:
   A pair of flanges extending laterally from said first profile strip and said second profile strip used to form said compression molded segment seal, said flanges being substantially flat without fillets or bulges extending therefrom.

12. The reclosable storage bag of claim 9 and further comprising:
   A pair of flanges extending laterally from said first profile strip and said second profile strip used to form said compression molded segment seal, said flanges being substantially flat without fillets or bulges extending therefrom.

13. A reclosable storage bag comprising:
   a first bag wall;
   a second bag wall;
   a reclosable fastener profile assembly, said assembly comprising:
   a first profile strip said first profile strip being substantially flat but having at least one rib that extends from the surface of said first strip; and
   a second profile strip opposite said first strip said second profile strip being substantially flat but having at least two ribs that extend from the surface of said second strip; said rib of said first strip and said ribs of said second strip adapted to sealingly engage and maintain an airtight seal when so engaged;
   a compression molded segment seal portion fusing said first profile strip, said second profile strip and said ribs of said first profile strip and said second profile strip; said compression molded segment seal including a fused section of said first and second profile strips formed through the application of heat and pressure without further filling material or plastic; said fused section substantially flattened to form an airtight seal of said first and second profile strips, without distorting said ribs of said first and second profile strips outside of said fused section, thereby maintaining said airtight seal of said first and second profile strips when interlocked.