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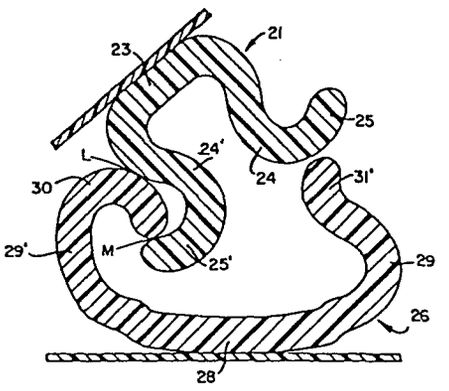
(54) Single hinge interlocking closure profile configuration.

(57) An interlocking closure fastening device comprising an omega-shaped closure element and a co-acting clamping closure element. The co-acting clamping closure element may have a profile portion comprising two generally parallel arm portions wherein one of the arm portions terminates in an inwardly curved hook portion, and the other arm portion curves slightly inward prior to terminating in an outwardly extending clamp portion; or the profile portion may comprise two outwardly curved arm portions wherein one of the arm portions terminates in an inwardly curved hook portion, and the other arm portion curves inwardly prior to terminating in a slightly outwardly curved hook portion; or the profile portion may comprise one inwardly curved arm portion terminating in an inwardly curved hook portion, and one generally straight arm portion.



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SINGLE HINGE INTERLOCKING CLOSURE PROFILE CONFIGURATION

Field of the Invention

This invention relates to an interlocking closure fastening device, and more particularly, to an interlocking closure fastening device comprising an omega-shaped closure element and a co-acting clamping closure element.

Background of the Invention

In general, closure fastening devices for use in connection with plastic bags and the like are known. Furthermore, manufacturing methods for closure fastening devices made of plastic material are generally well-known.

In operation, a closure fastening device for use in connection with a flexible container should be relatively easy to open from the outside, but relatively difficult to open from the inside. Generally, such a container can be used with its interior either under relatively high pressure or under relatively low pressure. The closure fastening device should provide a satisfactory seal for either condition.

Preferably, the closure fastening device should be suitable for economical manufacturing and

should be relatively simple in design. In addition, the design should provide for variations in order to meet different needs. For example, it may be desirable to have a closure fastening device which is relatively difficult to open both from the inside and the outside. In general, the closure fastening device, however, should always be relatively easy to close.

In addition, when the closure fastening device is employed with a container, the container may be made from a thermoplastic material and the closure device and sidewalls of the container can be made integrally by extrusion as a unitary piece or can be made as separate components which are subsequently permanently connected together.

However, the thermoplastic resin materials heretofore found practical for the extrusion of interlocking closure devices, and their attachment to films, such as in making containers, have resulted in shrinkage and distortion problems during their use at elevated temperatures. Typical resin materials employed for interlocking closure devices and container films have included polyethylene, polyvinyl chloride copolymers, and synthetic rubbers. However, none of these construction materials have sufficient thermal tolerance for many commercial uses. Further, both occlusion and deocclusion of the interlocking closure device is generally difficult for the user when the device is made from resin materials having high temperature tolerances due to their associated high flexural moduli.

Summary of the Invention

The foregoing criteria for a closure fastening device are met by one embodiment of the present invention wherein the fastening device includes a first flexible closure element having a general omega shape comprising an apex portion, and a profile portion extending from the apex portion, said apex portion being generally flat or slightly arcuate, and said profile portion comprising two inwardly curved arm portions terminating in two outwardly facing, curvilinear hook portions. The closure device includes a second flexible closure element having a generally flat or slightly arcuate apex portion, and a profile portion extending from the apex portion. The profile portion of the second closure element comprises first and second generally parallel arm portions wherein one of the arm portions terminates in an inwardly curved hook portion, and the other arm portion curves slightly inward prior to terminating in an outwardly extending clamp portion. The first flexible closure element and the second flexible closure element are adapted to disengage and engage each other by means of a torquing action so as to form a straddling type of occlusion.

In another embodiment of this invention, the fastening device includes a first flexible closure element having a general omega shape comprising an apex portion, and a profile portion extending from the apex portion, said apex portion being generally flat or slightly arcuate, and said profile portion comprising two inwardly curved arm

portions terminating in two outwardly curving hook portions. The closure device includes a second flexible closure element having a generally flat or slightly arcuate apex portion, and a profile portion extending from the apex portion. The profile portion of the second closure element comprises two outwardly curved arm portions wherein one of the arm portions terminates in an inwardly curved hook portion, and the other arm portion curves inwardly prior to terminating in a slightly outwardly curved hook portion. The first flexible closure element and the second flexible closure element are adapted to disengage and engage each other by means of a torquing action so as to form an overlapping type of occlusion.

In a further modification of the preceding embodiment, the profile portion of the second closure element comprises two outwardly curved arm portions wherein one of the arm portions terminates in an inwardly curved hook portion, and the other arm portion curves progressively inwardly as to make contact with one of the arm portions of the first closure element when the fastening device is occluded, prior to terminating in a slightly outwardly curved hook portion.

In a further embodiment of this invention, the fastening device includes a first flexible closure element having a general omega shape comprising an apex portion, and a profile portion extending from the apex portion, said apex portion being generally flat or slightly arcuate, and said profile portion comprising two inwardly curved arm

portions, an outwardly extending arm portion from each of said inwardly curved arm portions, each of said outwardly extending arm portion terminating in an outwardly curved hook portion. The closure device includes a second flexible closure element having a generally flat or slightly arcuate apex portion, and a profile portion extending from the apex portion. The profile portion of the second closure element comprises one inwardly curved arm portion terminating in an inwardly curved hook portion, and one generally straight arm portion extending from said apex portion in a generally perpendicular direction therefrom. The first flexible closure element and the second flexible closure element are adapted to disengage and engage each other by means of a torquing action so as to form a straddling type of occlusion.

Brief Description of the Drawings

Fig. 1 is a cross-sectional view of one embodiment of the closure fastening device in accordance with this invention in an occluded position;

Fig. 2 is a cross-sectional view of another embodiment of the closure fastening device in accordance with this invention in an occluded position;

Fig. 3 is another cross-sectional view of the embodiment of the closure fastening device shown in Fig. 2;

Fig. 3-A is a cross-sectional view of a closure fastening device shown in Fig. 3 to illustrate typical physical dimensions;

Fig. 4 is a cross-sectional view of the closure fastening device shown in Fig. 3 in an occluded position, in a partially deoccluded position, and in a deoccluded position;

Fig. 5 is a cross-sectional view of a preferred embodiment of the closure fastening device in accordance with this invention in a partially deoccluded position;

Fig. 6 is a cross-sectional view of another embodiment of the closure fastening device in accordance with this invention in a deoccluded position;

Fig. 7 is a cross-sectional view of the closure fastening device shown in Fig. 6 in an occluded position; and

Fig. 8 is a cross-sectional view of the closure fastening device shown in Fig. 7 in a partially deoccluded position during deocclusion.

Detailed Description of the Preferred Embodiments

The closure fastening device of the instant invention may be made from a thermoplastic material selected from the group consisting of polyolefins such as polyethylene, polypropylene, and polybutylene; polyamides such as nylon; or other thermoplastic materials, including combinations thereof. The closure fastening device is preferably made from a thermoplastic resin composition comprising polypropylene, or a mixture of polypropylene resin and ethylene-propylene-diene monomer elastomer, or a mixture of polypropylene resin and ethylene-propylene copolymer elastomer. The dimensions of the closure fastening device may

vary in accordance with intended use, and depending upon the materials used in their manufacture because of the variations in physical properties, such as flexural moduli.

The closure fastening device of this invention can be manufactured by known methods such as by extrusion, by the use of molds or other known methods of producing such devices. The closure fastening device can be manufactured as a strip for later attachment to a film or it can be manufactured integral with the film. In addition, the closure device can be manufactured with or without flanges on one or both of the closure elements, depending upon intended use or expected additional manufacturing operations.

The closure elements can be connected to a container or to a film to be formed into a container by the use of many known methods. For example, a thermoelectric device can be applied to a film opposite a closure element to cause a transfer of heat through the film to produce melting at the interface of the film and the closure element. After cooling, the interface region joins the film and the closure element.

The thermoelectric device can be heated by rotary discs, or resistance heated wires, or traveling heater bands, or the like.

The connection between the film and the closure element can also be established by the use of hot melt adhesives, or hot jets of air to the interface, or ultrasonic heating, or other known methods.

Generally, the present closure fastening device can be made from a heat sealable material and then attached to a heat sealable film so that a container can be formed economically by heat sealing surfaces to form the container.

The instant closure fastening device provides many advantages for consumers when used on containers. For instance, it is easy to close a container because the closure elements torque or twist with respect to each other from the deoccluded to the occluded position with little effort in spite of the high flexural moduli of the temperature resistant resins used. The action contrasts with prior art structures such as arrow type of closures where, in the female elements, the hooked sides have to be bent or otherwise distorted for occlusion or deocclusion. In a prior art channel closure a base portion has to be bent to accomplish occlusion or deocclusion. And still another structure made very stiff, requires longitudinal displacement to a non-hooked end before the male and female elements can be pried apart by elastic bending of portions of each element.

For a fuller understanding of the nature of the invention, reference should be had to the following detailed description, taken in conjunction with the accompanying drawings.

Fig. 1 is a cross-sectional view of one embodiment of the closure fastening device in accordance with this invention, in an occluded position. As shown therein, a first flexible closure element 10 having a general omega shape is

connected to a flange portion 11 for use in connection to a thermoplastic film. Closure element 10 has an apex portion 12 which is typically flat or slightly arcuate, and extending from apex portion 12 is a profile portion which comprises two inwardly curved arm portions 13 and 13' which terminate in two outwardly curving hook portions 14 and 14', respectively. A second flexible closure element 15 is shown connected to a flange portion 16, and it comprises an apex portion 17 which may have a flat or slightly arcuate configuration. Extending from apex portion 17 is a profile portion comprising two generally parallel arm portions 18 and 18'. Arm portion 18' terminates in an inwardly curved hook portion 19, whereas arm portion 18 curves slightly inwardly prior to terminating in an outwardly extending clamp portion 20. As shown in Fig. 1, when the closure fastening device is in an occluded position, hook portion 14' of closure element 10 and hook portion 19 of closure element 15 are interlocked, and arm portion 18 and clamp portion 20 of closure element 15 are in locked contact with arm portion 13 of closure element 10. It can also be seen from Fig. 1 that arm portion 18' terminating in inwardly curved hook portion 19 is adapted to engage in a hinging contact with arm portion 13' terminating in outwardly curving hook portion 14', and arm portion 18 terminating in outwardly extending portion 20 is adapted to engage in a clamping contact with arm porton 13 terminating in outwardly curving hook portion 14. As can be seen from Fig. 1, closure element 10 and closure element

15 form a straddling occlusion wherein arm portion 18 and clamp portion 20 of closure element 15 are positioned between arm portions 13 and 13' of closure element 10. When the closure fastening device is connected to a plastic container, arm portion 13 and hook portion 14 are positioned closest to the mouth or outside portion of the container, and arm portion 18' is positioned closest to the interior or inside portion of the container.

Fig. 2 is a cross-sectional view of another embodiment of the closure fastening device in accordance with this invention, in an occluded position. It may be seen therefrom that the first flexible closure element 21 has a general omega shape, and that it may be connected to a flange portion 22 for connection to a thermoplastic film. Closure element 21 has an apex portion 23 which is slightly arcuate or generally flat, and extending from apex portion 23 is a profile portion which comprises two inwardly curved arm portions 24 and 24' which terminate in two outwardly curving hook portions 25 and 25', respectively. A second flexible closure element 26 is shown connected to a flange portion 27, and it comprises an apex portion 28 which has a flat or slightly arcuate configuration. Extending from apex portion 28 is a profile portion comprising two outwardly curving arm portions 29 and 29'. Arm portion 29' terminates in an inwardly curved hook portion 30, and arm portion 29 curves inwardly prior to terminating in a slightly outwardly curved hook portion 31. From Fig. 2, it may be seen that when the closure

fastening device is in an occluded position, hook portion 25' of closure element 21 and hook portion 30 of closure element 26 are interlocked, while arm portion 29 and hook portion 31 of closure element 26 are in contact with hook portion 25 of closure element 21. It can also be seen from Fig. 2 that arm portion 29' terminating in inwardly curved hook portion 30 is adapted to engage in a hinging contact with arm portion 24' terminating in outwardly curving hook portion 25', and arm portion 24 terminating in outwardly curving hook portion 25 is adapted to engage in a clamping contact with arm portion 29 terminating in outwardly curved hook portion 31. It can further be seen from Fig. 2 that closure element 21 and closure element 26 form an overlapping type of occlusion wherein hook portion 30 of closure element 26 overlaps hook portion 25' of closure element 21, and arm portion 29 and hook portion 31 of closure element 26 overlap hook portion 25 of closure element 21. When thus occluded, arm portion 29 and hook portion 31 of closure element 26, and hook portion 25 of closure element 21, together form an easily disengagable structure, while hook portion 30 of closure element 26 and hook portion 25' of closure element 21 form a hinge structure which is strongly resistant to deocclusion without considerable rotation.

Fig. 3 is a free body diagram showing a cross-sectional view of the closure fastening device shown in Fig. 2. The first flexible closure element 21 shown therein is the same as that shown in Fig. 2. However, the second flexible closure element 26

has been modified, whereby hook portion 31 may be positioned progressively laterally inward, as depicted by alternate hook portion 31' and alternate hook portion 31" shown in free body, toward arm portion 24 of closure element 21 until hook portion 31 makes contact with said arm portion 24 or is even deflected outwardly by arm portion 24. When the closure fastening device is thus constructed, the successively inward curvature of arm portion 29 and hook portion 31 to the positions shown by hook portion 31' and hook portion 31" results in gradually increasing the opening force required to separate and deocclude closure element 26 and closure element 21. It has been found that successively inwardly curving hook portion 31 to the position depicted by hook portion 31" results in increasing the external opening force required in deoccluding closure element 26 and closure element 21 from a force of about 0.5 pound to a force of about 2.0 pounds. It was also found that hook portion 31' and hook portion 31" result in increased interference between these hook portions and hook portion 25, thereby requiring bending of these parts during deocclusion of closure element 26 and closure element 21. In operation, hook portions 31, 31' and 31" act as a clamp in maintaining occlusion of the closure device. By the same token, hook portion 25' and hook portion 30 provide a hinge action during deocclusion of closure element 26 and closure element 21 whereby hook portion 25' rotates with respect to hook portion 30 as shown in Fig. 4.

Fig. 3-A is a cross-sectional view of the closure fastening device shown in Fig. 3 wherein the second flexible closure element is modified pursuant to alternate hook portion 31". The typical physical dimensions of a closure fastening device in accordance with Fig. 3-A are as follows:

1. A may be from about 0,127 cm (0.050) to about 0,254 cm (0.100 inch), preferably about 0,198 cm (0.078 inch);

2. B may be from about 0,102 cm (0.040) to about 0,203 cm (0.080 inch), preferably about 0,170 cm (0.067 inch);

3. C may be from about 0,102 cm (0.040) to about 0,203 cm (0.080 inch), preferably about 0,152 cm (0.060 inch);

4. D may be from about 0,017 cm (0.007) to about 0,030 cm (0.012 inch), preferably about 0,022 cm (0.009 inch);

5. E may be from about 0,020 cm (0.008) to about 0,038 cm (0.015 inch), preferably about 0,027 cm (0.011 inch);

6. F may be from about 0,020 cm (0.008) to about 0,038 cm (0.015 inch), preferably about 0,033 cm (0.013 inch);

7. G may be from about 0,020 cm (0.008) to about 0,038 cm (0.015 inch), preferably about 0,030 cm (0.012 inch);

8. H may be from about 0,020 cm (0.008) to about 0,038 cm (0.015 inch), preferably about 0,027 cm (0.011 inch);

9. I may be from about 0,017 cm (0.007) to about 0,030 cm (0.012 inch), preferably about 0,020 cm (0.008 inch);

10. K may be from about 0,020 cm (0.008) to about 0,038 cm (0.015 inch), preferably about 0,027 cm (0.011 inch);

11. L may be from about 0,020 cm (0.008) to about 0,038 cm (0.015 inch), preferably about 0,030 cm (0.012 inch);

12. M may be from about 0,022 cm (0.009) to about 0,050 cm (0.020 inch), preferably about 0,043 cm (0.017 inch);

13. R may be from about 0,154 cm (0.061) to about 0,330 cm (0.130 inch), preferably about 0,274 cm (0.108 inch); and

14. S may be from about 0,101 cm (0.040) to about 0,266 cm (0.105 inch), preferably about 0,198 cm (0.078 inch).

As indicated in Fig. 3-A, A represents the height dimension of the closure fastening device in an occluded position as measured from the apex portion of the first closure element to the apex portion of the second closure element.

B represents the height dimension of the second closure element as measured from the apex portion of the second closure element to the tip of the second arm portion of the second closure element.

C represents the height dimension of the first closure element as measured from the apex portion of the first closure element to the highest part of the profile portion of the first closure element.

R represents the width dimension of the second closure element as measured from the widest part of the first arm portion of the second closure element to the widest part of the second arm portion of the second closure element.

S represents the width dimension of the first closure element as measured between the tips of the outwardly facing hook portions of the first closure element.

Fig. 4 is a cross-sectional view of the closure fastening device shown in Fig. 2 in an occluded position, in a partially deoccluded position, and in a deoccluded position. It has been found that during occlusion and deocclusion of the closure fastening device of this invention, one or both of the closure elements of the fastening device

experience a gradual twisting or torquing operation spread over a significant length of the closure on either side of the point of initial force application. The spreading action of this torque reduces stress levels, thereby reducing force. During deocclusion of the fastening device, this twisting or torquing operation continues until the hook portions of the closure elements have disengaged from each other.

Fig. 4 shows in detail some of the operational steps during deocclusion of a closure fastening device as described with respect to Fig. 3 wherein the second closure element is modified pursuant to alternate hook portion 31'. More specifically, when said closure fastening device is in the occluded position, hook portion 31' of closure element 26 is in contact with arm portion 24 of closure element 21, or hook portion 25 of closure element 21 is in contact with arm portion 29 of closure element 26. Typically, for deocclusion of the closure fastening device, an external release force is exerted on hook portion 31' and arm portion 29 of closure element 26, and on hook portion 25 and arm portion 24 of closure element 21, to cause release of hook portion 31' and arm portion 29 of closure element 26, from hook portion 25 and arm portion 24 of closure element 21. The afore-mentioned parts of the fastening device are rotated over an arc of about 35° to a position generally designated as A, as shown by the arrows in Fig. 4. In order to obtain full release of the closure elements and deocclusion of the fastening

device, rotation of the closure elements is continued over an arc of between about 100° and 120° to a position generally designated as B, as shown by the arrows in Fig. 4. During the continued rotation, arm portion 24' and hook portion 25' of closure element 21, disengage from hook portion 30 of closure element 26, while rotating around hook portion 30 of closure element 26 until the parts are separated from each other.

If a closure fastening device is preferred requiring a smaller arc of rotation resulting in earlier deocclusion of the closure elements, then closure element 21 and closure element 26 may be modified as described with respect to Fig. 5. In Fig. 5 is shown the closure elements described with respect to Fig. 4 with the following modifications having been made thereto. More particularly, the inside radius of curvature of hook portion 30 is decreased. During deocclusion of the closure fastening device, after hook portion 31' and arm portion 29 of closure element 26 are released from hook portion 25 and arm portion 24 of closure element 21, continued rotation of the closure elements results in hook portion 30 of closure element 26 having a camming or leverage effect upon arm portion 24' and hook portion 25' of closure element 21 to provide release of these parts at an arc of about 75°. The contact point between hook portion 30 of closure element 26 and arm portion 24' of closure element 21 is generally designated in Fig. 5 as point L, and the contact point between hook portion 30 of closure element 26 and hook

portion 25' of closure element 21 is generally shown therein as point M. It has been found that the aforedescribed closure elements provide deocclusion of the occluded fastening device more quickly by requiring a lesser amount of rotation of the closure elements without affecting good occlusion.

It should be noted at this point that the actions discussed and illustrated for deocclusion apply in the reverse order to occlusion, which re-engages the hook elements forming the hinge structure, releases torsionally twisted elements and, by further movement, re-establishes the clamping action. This is predicated upon portions of the closure being maintained in an occluded position at the terminal ends of the closure device. Such a condition exists when a length of such a closure device is incorporated in a plastic bag having sealed side edges.

Fig. 6 is a cross-sectional view of another embodiment of the closure fastening device in accordance with this invention in a deoccluded position. As shown therein, the closure fastening device includes a first flexible closure element 40 having a general omega shape, and comprises a generally flat or slightly arcuate apex portion 41 and a profile portion extending from the apex portion. The profile portion comprises two inwardly curved arm portions 42 and 42', respectively, with arm portions 43 and 43' outwardly extending from said inwardly curved arm portions, respectively, and with said outwardly extending arm portions terminating in outwardly curving hook portions 44

and 44', respectively. The closure fastening device includes a second flexible closure element 45 having a generally flat or slightly arcuate apex portion 46 and a profile portion extending from said apex portion. The profile portion of said second closure element comprises one inwardly curved arm portion 47 terminating in an inwardly curved hook portion 48, and one generally straight arm portion 49 extending in a generally perpendicular direction from said apex portion.

Fig. 7 is a cross-sectional view of the closure fastening device described with respect to Fig. 6, but shown herein in an occluded position. It can be seen from Fig. 7 that when the instant closure fastening device is in an occluded position, arm portion 49 of closure element 45 is located between and in contact with outwardly extending arm portions 43 and 43' of closure element 40, and hook portion 44 of closure element 40 is interlocked with hook portion 48 of closure element 45. It can also be seen from Fig. 7 that arm portion 43 terminating in outwardly curving hook portion 44 is adapted to engage in a hinging contact with arm portion 47 terminating in inwardly curved hook portion 48, and arm portion 49 is adapted to engage in a clamping contact with either arm portion 43 or arm portion 43', or both arm portion 43 and arm portion 43', but in any event, with at least one of said arm portions. When this closure fastening device is employed with a container, hook portion 44' and arm portion 49 are preferably located toward the outside portion of the container, and hook portion 44 and

hook portion 48 are located toward the inside portion of the container. When thus located on a container, the closure fastening device of this invention provides a fastening device which is relatively easy to deocclude or open from the outside of the container, but which is relatively difficult to deocclude or open from the inside of the container. Accordingly, when thus employed on a container, the closure fastening device provides improved security to contents stored in said container.

Fig. 8 is a cross-sectional view of the closure fastening device shown in Fig. 7 in a partially deoccluded position such as during deocclusion of the fastening device. It may be seen from Fig. 8 that during deocclusion of closure element 45 and closure element 40, arm portions 43 and 43' of closure element 40 first separate from arm portion 49 of closure element 45. As closure element 40 and closure element 45 are further rotated with respect to each other for separation, hook portion 44 of closure element 40 will rotate around and then slip away from hook portion 48 of closure element 45, thereby resulting in their separation and in the complete deocclusion of the closure fastening device.

Some of the preferred closure fastening devices of this invention were evaluated for opening loads for comparison with several commercial plastic container products having a closure fastening device. In all the evaluations, each occluded closure fastening device was cut into a 15,24 cm (six inch)

long sample. The closure fastening device samples were tested by attaching a piece of (one inch 2,54 cm) wide scotch tape doubled over to grip the inside and/or outside flange portions of the fastening device. Each sample was tested independently as described herein. The male portion of the closure fastening device was mounted in the upper jaw, and the female portion of the closure fastening device was mounted in the lower jaw, of an Instron© tensile tester. The force required to deocclude the closure fastening device was recorded on a strip chart recorder as the maximum force registered. The average value was listed as the average of five test specimens and it was recorded as release force. The jaw separation (deocclusion) rate was (20 inches 50,8 cm) per minute and the full scale load was (20 pounds 9,07 kg). Each of 5 identical samples was reoccluded and retested for a total of 5 tests. The value reported was thus the average of 25 tests for each sample.

The Instron instrument was a tensile tester Model No. 1130, using a "B" load cell with a zero to (20 pound 9,07 kg) range. The Instron tester is initially calibrated in the following manner. The pen and chart recorder are turned on. The zero button is pressed and held, and the zero adjust knob is positioned for a 0.00 reading on the recorder. The zero button is then released. The range switch is then turned to the setting of 1 on its 1, 2, 5, 10, 20 scale. The coarse balance control is turned so that if the pen is all the way over to the left, it starts coming towards zero on the right. The coarse balance control is left at this position. Then the

fine balance control is turned so that the pen is at a setting of 0.00. A (20 pound) 9,07 kg weight is placed in the upper jaw of the Instron instrument and the calibration control is adjusted for a full-scale recorder reading. After removing the weight, the recorder should again read 0.00. The zero button is pressed and held, and the recorder should again read 0.00.

Sample 1 represents a closure fastening device employed with a container available from Dow Chemical Company, Midland, Michigan under the Tradename ZIPLOC® The closure fastening device is believed to have been made with low density polyethylene having a density of about 0.921 grams per cubic centimeter.

Sample 2 represents a closure fastening device employed with a container available from Dow Chemical Company, Midland, Michigan under the tradename ZIPLOC® Microfreez.

Sample 3 represents a closure fastening device produced by Union Carbide Corporation and commercially available with a container identified as SNAP LOCK®. The closure fastening device was made with low density polyethylene, that is, having a density of about 0.923 grams per cubic centimeter.

Sample 4 represents a closure fastening device prepared in accordance with this invention and as described herein with respect to Fig. 3, wherein the second flexible closure element was modified pursuant to alternate hook portion 31'.

Sample 5 represents a closure fastening device prepared in accordance with this invention

and as described herein with respect to Fig. 3, wherein the second flexible closure element was modified pursuant to alternate hook portion 31".

The closure fastening devices of sample 4 and sample 5 were made with a thermoplastic resin composition comprising about 84 percent by weight of polypropylene homopolymer, about 15 percent by weight of an ethylene-propylene-diene monomer elastomer, and about 1 percent by weight of a slip agent, all weight percentages being based on the weight of the fastening device.

Both external release forces and internal release forces were recorded. By external release forces is meant the forces required to deocclude the closure fastening device from the outside portion of a container. By internal release forces is meant the forces required to deocclude the closure fastening device from the inside portion of a container.

The test results are given below in Table 1.

TABLE 1

	Release Force (lbs)		Force Ratio
Sample	Internal	External	(Internal:External)
1	(3.8)16,9	(1.5) 6,7	2.5:1.0
2	(3.3)14,7	(1.6) 7,1	2.1:1.0
3	(4.5)20,0	(2.5)11,1	1.8:1.0
4	(10.0)44,5	(0.5) 2,2	20.0:1.0
5	(12.0)53,4	(2.0) 8,9	6.0:1.0

From the above results in Table 1, it can be seen that the closure fastening devices of this invention provide internal release resistance forces

which are between two and three times as high as those of some commercial closure fastening devices, while manipulative external deocclusion forces may be held to a minimum, thereby providing easy and gentle deocclusion of the closure fastening devices of this invention.

In addition to its use with a container, the closure fastening device can be used to electrically insulate wire leads or bind together a group of wires. The closure device can also be used as a flexible straw because a good seal at the engaged surface is possible and the compartment defined by the elements provides a passageway which does not collapse when the closure fastening device is bent.

Generally, the closure device of the invention can be manufactured in a variety of forms to suit the intended use. In addition to the embodiments shown herein the elements can be positioned on opposite sides of a film. Such an embodiment would be suited for enwrapping an object or a collection of objects such as wires. Generally, the elements on a film should be parallel to each other but this would depend on the intended use.

Although the present invention has been described and set forth in some detail, it should be further understood that the same is susceptible to changes, modifications and variations without departing from the scope and spirit of the invention as set forth in the appended claims. Such changes, modifications and variations are within the scope of this invention.

CLAIMS:

1. A closure fastening device (55) comprising a first closure element (10; 21; 40) and a second closure element (15; 26; 45); said first closure element (10; 21; 40) having a general omega shape, comprising an apex portion (12; 23; 41) and a profile portion extending from said apex portion, said profile portion comprising two inwardly curved arm portions (13, 13'; 24, 24'; 42, 42') terminating in two outwardly facing hook portions (14, 14'; 25, 25'; 43, 43'; 44, 44'); said second closure element (15; 26; 45) comprising an apex portion (17; 28; 46) and a profile portion extending from said apex portion, said profile portion comprising first (18'; 29'; 47) and second (18; 29; 49) arm portions, characterized in that said first arm portion terminates in an inwardly curved hook portion (19; 30; 48) adapted to engage in a hinging contact with one arm portion (13'; 24'; 42) of said first closure element, and that said second arm portion is adapted to engage in a clamping contact with one arm portion (13; 24; 42') of said first closure element.

2. A device in accordance with claim 1, characterized in that said arm portions (18, 18') of said second closure element (15) are generally parallel to each other.

3. A device in accordance with claim 1, characterized in that said second arm portion (18) of said second closure element (15) terminates in an outwardly extending portion (20).

4. A device in accordance with claim 1, characterized in that said arm portions (29, 29') of said second closure element (26) are outwardly curved.

5. A device in accordance with claim 1 or claim 4, characterized in that said second closure element (29) terminates in an outwardly curved and outwardly extending portion (31).

6. A device in accordance with claim 1, characterized in that said first arm portion (47) of said second closure element (45) is inwardly curved before terminating in said inwardly curved hook portion (48).

7. A device in accordance with claim 1 or claim 6, characterized in that said second arm portion (49) of said second closure element (45) is generally straight and extends generally perpendicular from said apex portion (46) of said second closure element.

8. A device in accordance with claim 3 or claim 5, characterized in that said second arm portion (18, 29) of said second closure element (15; 26) curves inwardly before terminating in said outwardly extending portion (20; 31).

9. A device in accordance with anyone of claims 3, 5 and 7, characterized in that said first closure element and said second closure element are adapted to engage and disengage each other by means of a torquing action so as to form a straddling occlusion.

10. A device in accordance with any of the previous claims 1 through 9, characterized in that said first closure element and said second closure element are adapted to engage and disengage each other by means of a torquing action so as to form an overlapping occlusion.

11. A device in accordance with any of the previous claims 1 through 10, characterized in that said apex portion of said first closure element is arcuate.

12. A device in accordance with anyone of claims 1 through 10, characterized in that said apex portion of said first closure element is generally flat.

13. A device in accordance with any of the previous claims, characterized in that said outwardly facing hook portions of said first closure element are curvilinear.

14. A device in accordance with any of the previous claims, characterized in that said apex portion of said second closure element is arcuate.

15. A device in accordance with anyone of claims 1 through 13, characterized in that said apex portion of said second closure element is generally flat.

16. A device in accordance with any of the previous claims, characterized in that said first closure element and said second closure element are made from thermoplast amterials.

17. A device in accordance with claim 16, characterized in that said thermoplastic materials are selected from the group consisting of polyolefins and polyamides.

18. A device in accordance with claim 17, characterized in that said polyolefins include polyethylene, polypropylene, and polybutene.

19. A device in accordance with anyone of claims 1 through 15, characterized in that said first closure element and said second closure element are made from a mixture of polypropylene and ethylene-propylene-diene monomer elastomer, or a mixture of polypropylene and ethylene-propylene copolymer elastomer.

20. A device in accordance with any of the previous claims, characterized in that said closure fastening device in an occluded position has a height of between about 1,27 mm to about 2,54 mm as measured from the apex portion of said first closure element to the apex portion of said second closure element.

21. A device in accordance with any of the previous claims, characterized in that said second closure element has a height of between about 1,02 mm to about 2,03 mm as measured from the apex portion of said second closure element to the tip of said second arm portion of said second closure element.

22. A device in accordance with any of the previous claims, characterized in that said first closure element has a height of between about 1,02 mm to about 2,03 mm as measured from the apex portion of said first closure element to the highest part of the profile portion of said first closure element.

23. A device in accordance with any of the previous claims, characterized in that said second closure element has a width of between about 1,55 mm to about 3,3 mm as measured from the widest part of said first arm portion of said second closure element to the widest part of said second arm portion of said second closure element.

24. A device in accordance with any of the previous claims, characterized in that said first closure element has a width of between about 1,02 mm to about 2,67 mm as measured between the tips of said outwardly facing hook portions of said first closure element.

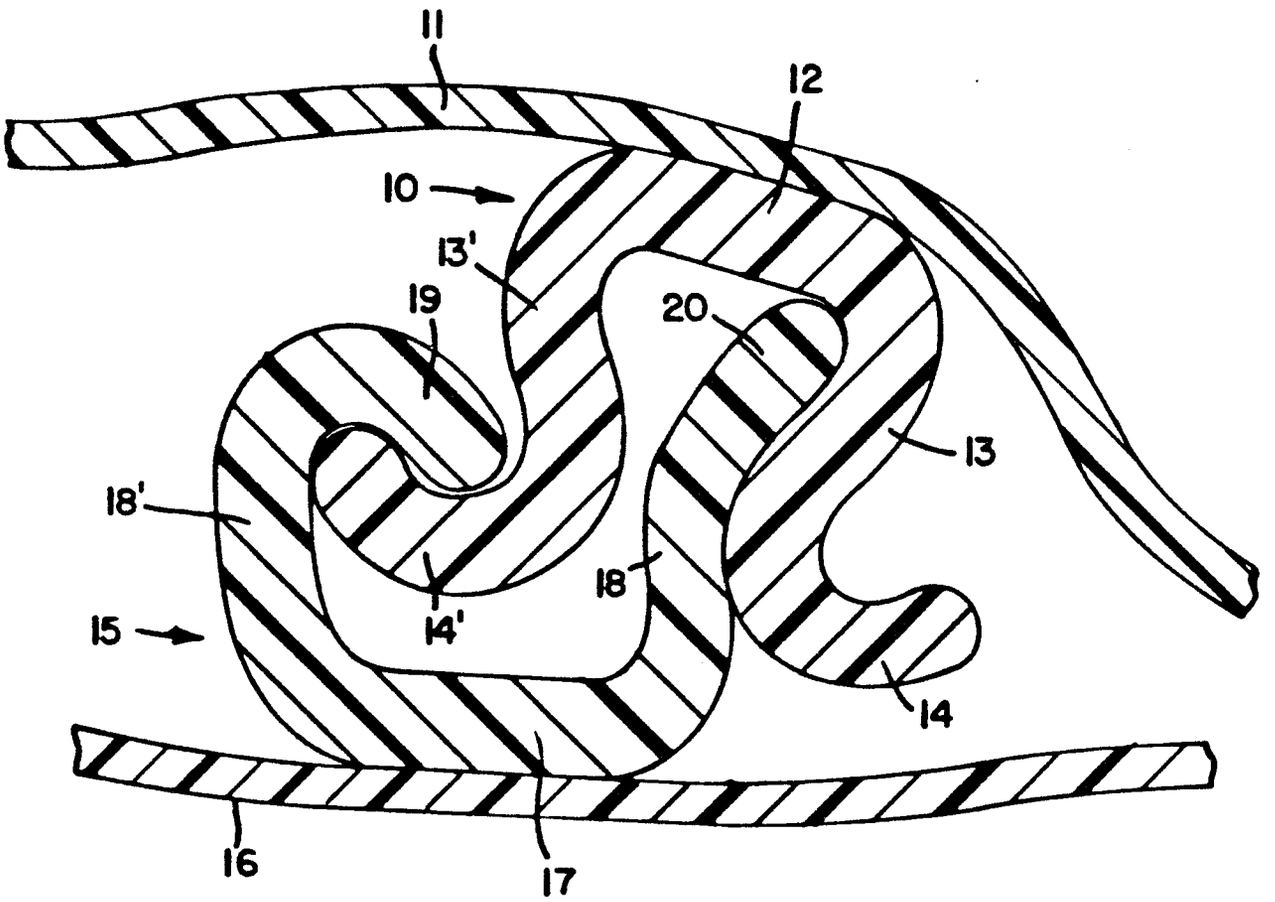


FIG. 1

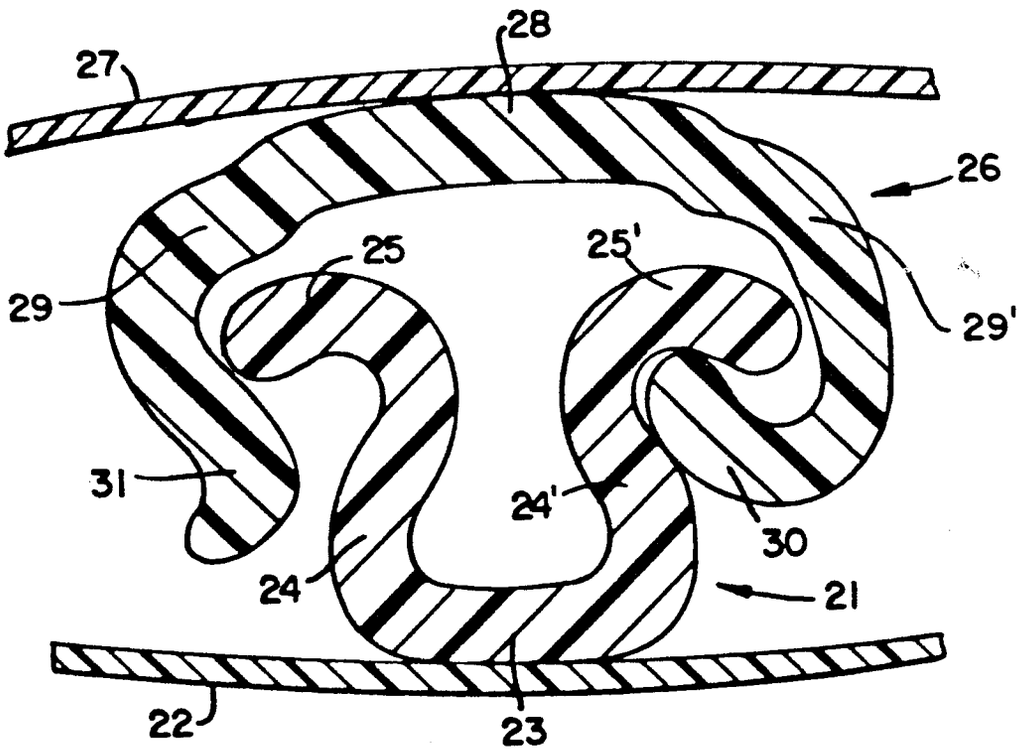


FIG. 2

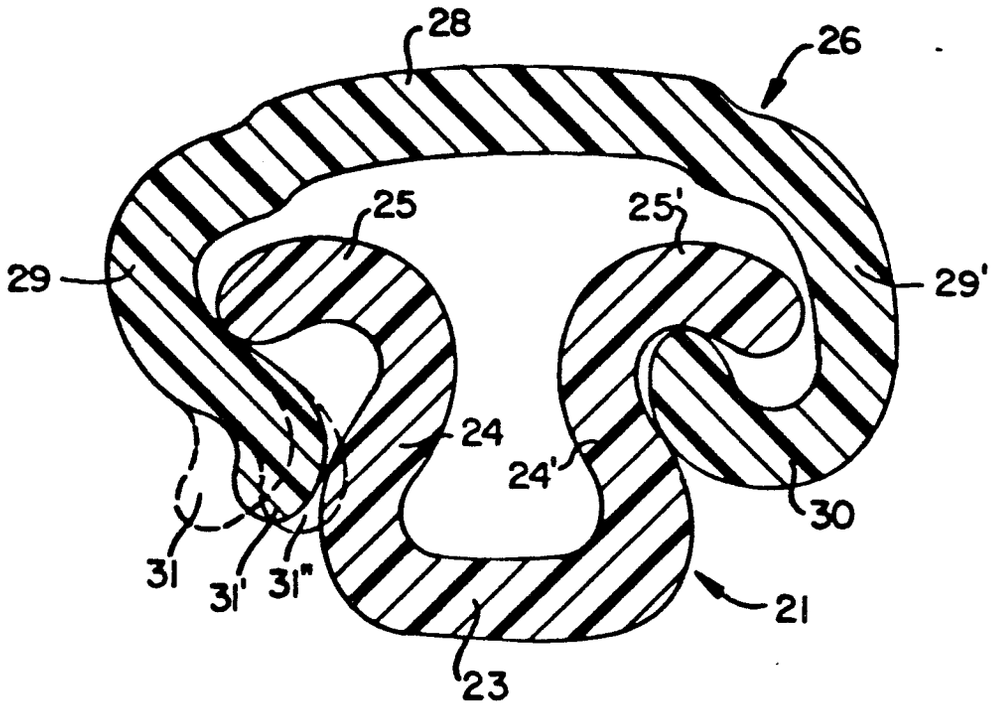


FIG. 3

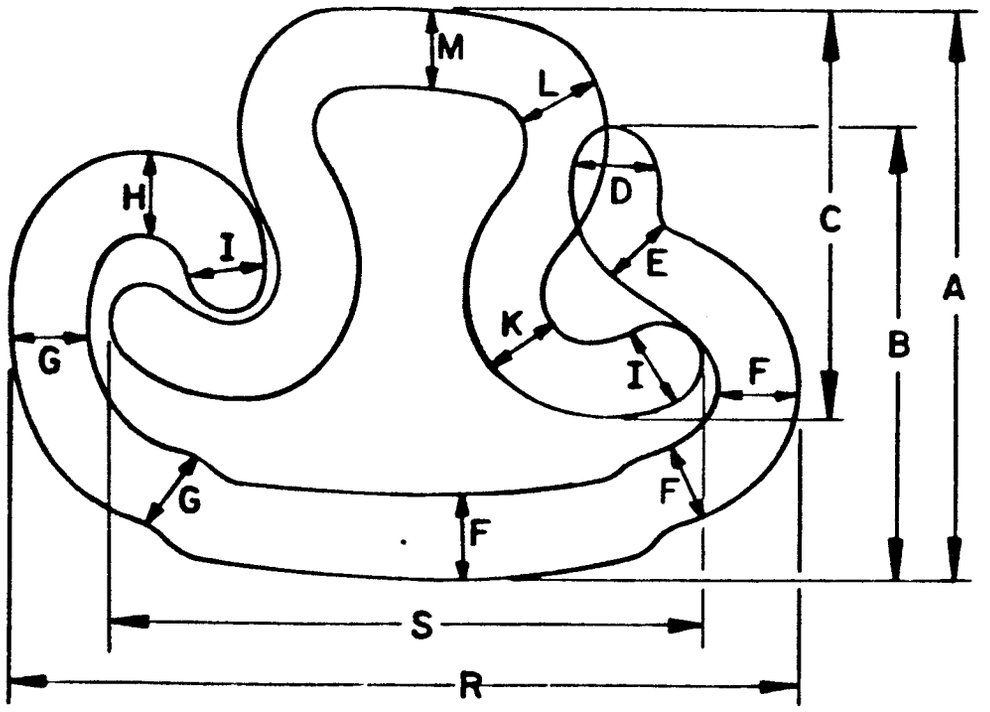
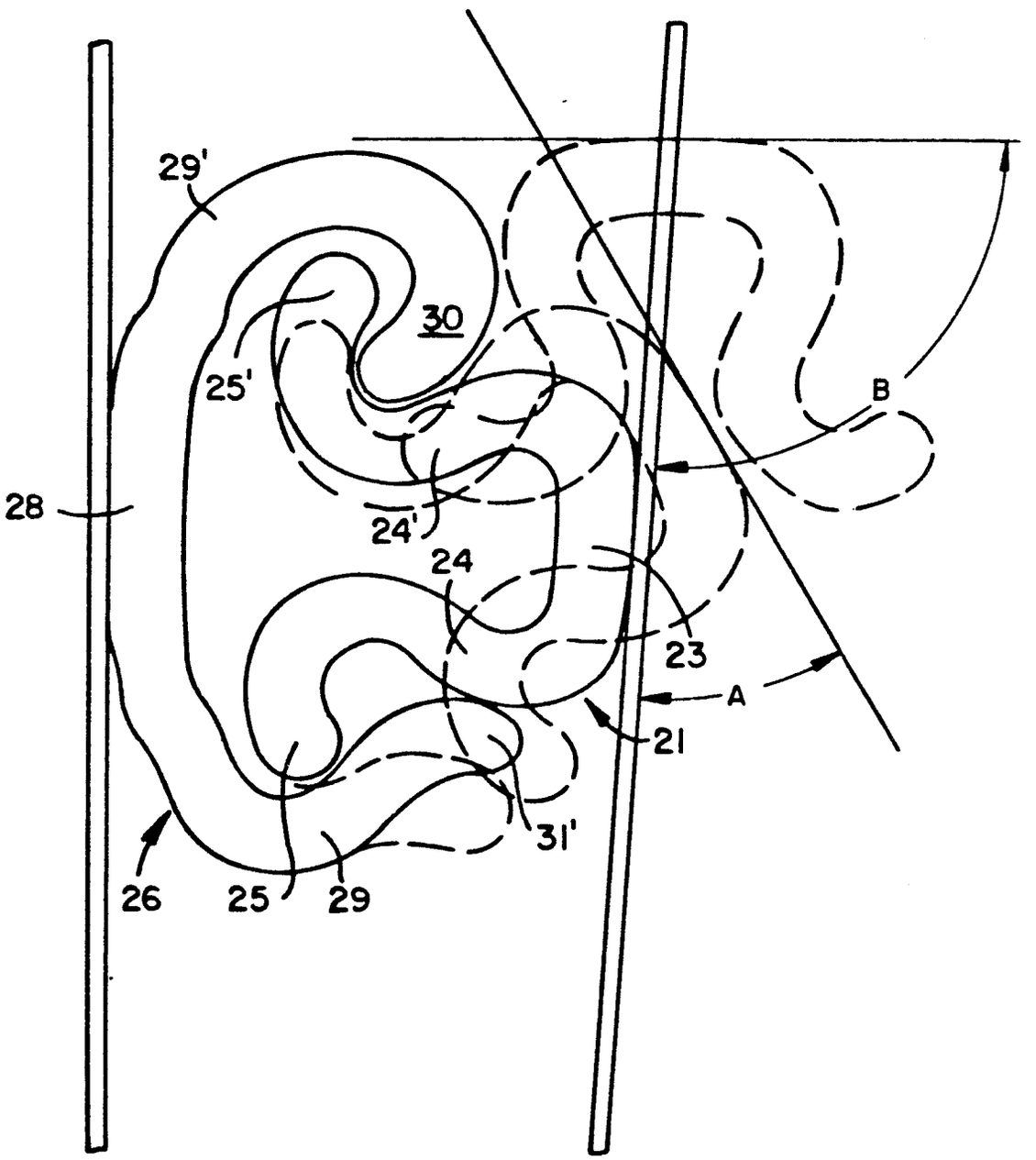


FIG 3A

FIG. 4



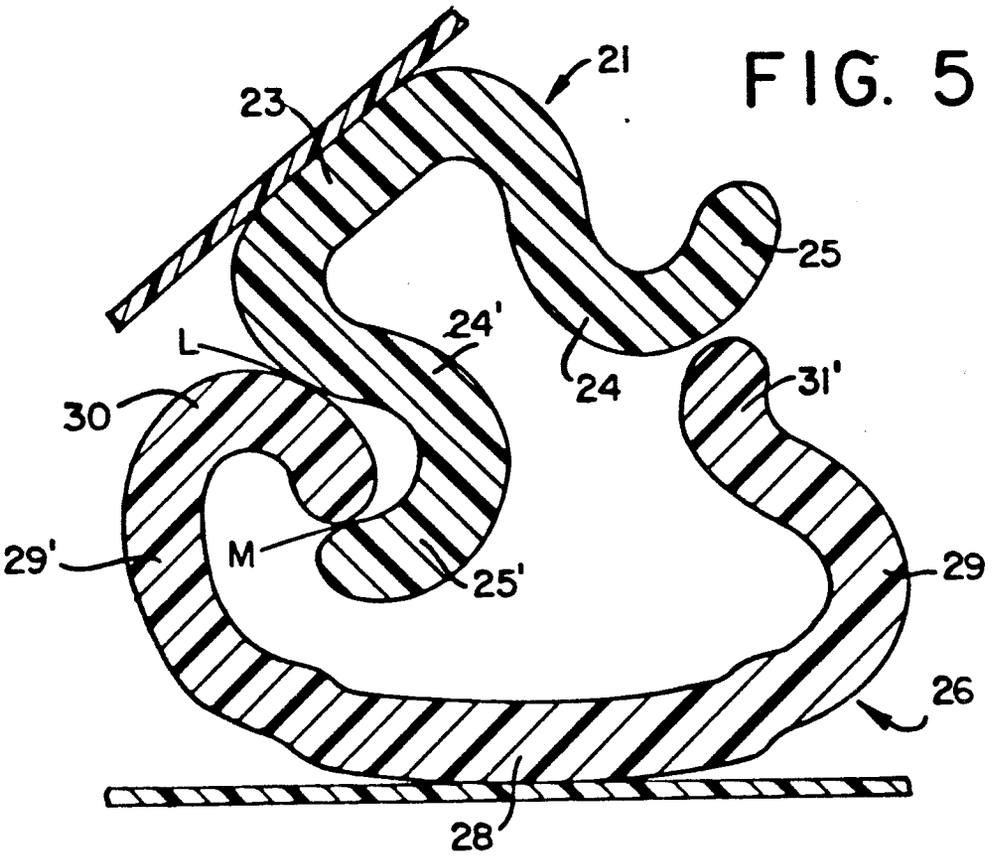

21
23
25
24'
L
24
31'
30
29'
M
25'
29
26
28

FIG. 5

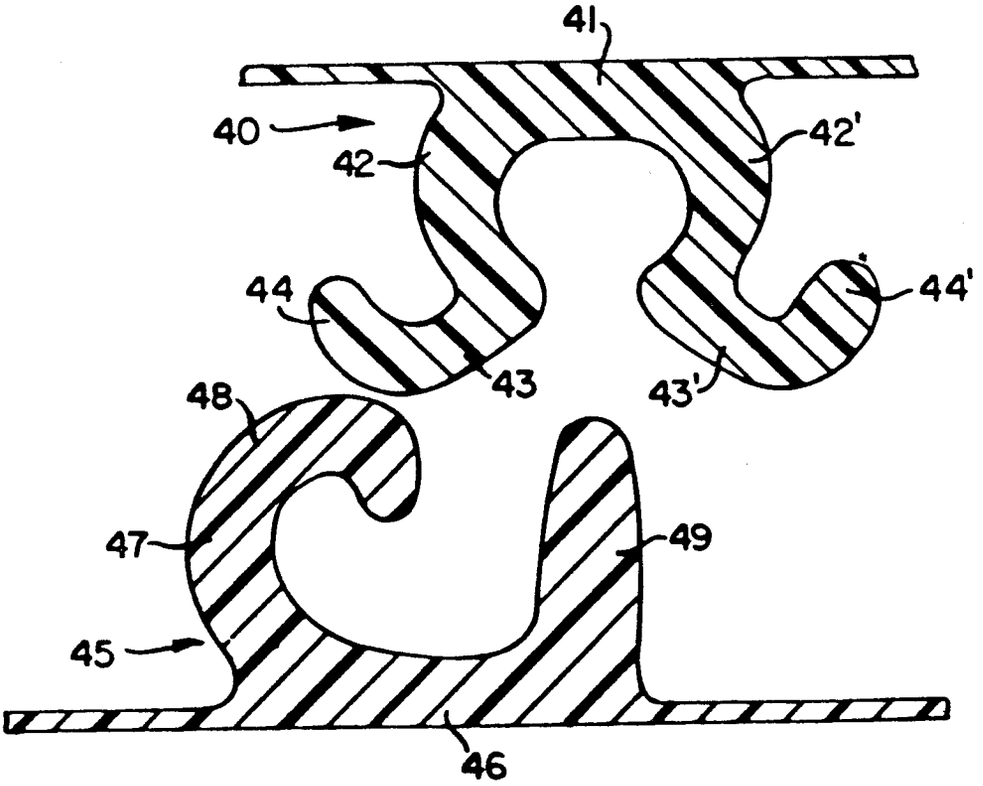

41
40
42
42'
44
44'
43
43'
48
47
49
45
46

FIG. 6

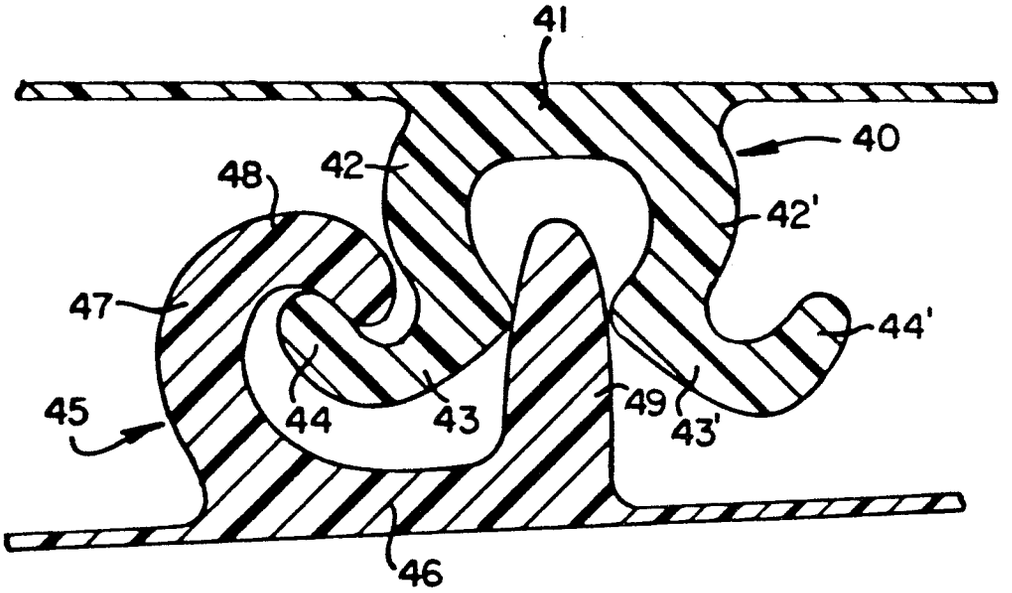

41
40
48
42
42'
47
44'
45
44
43
49
43'
46

FIG. 7

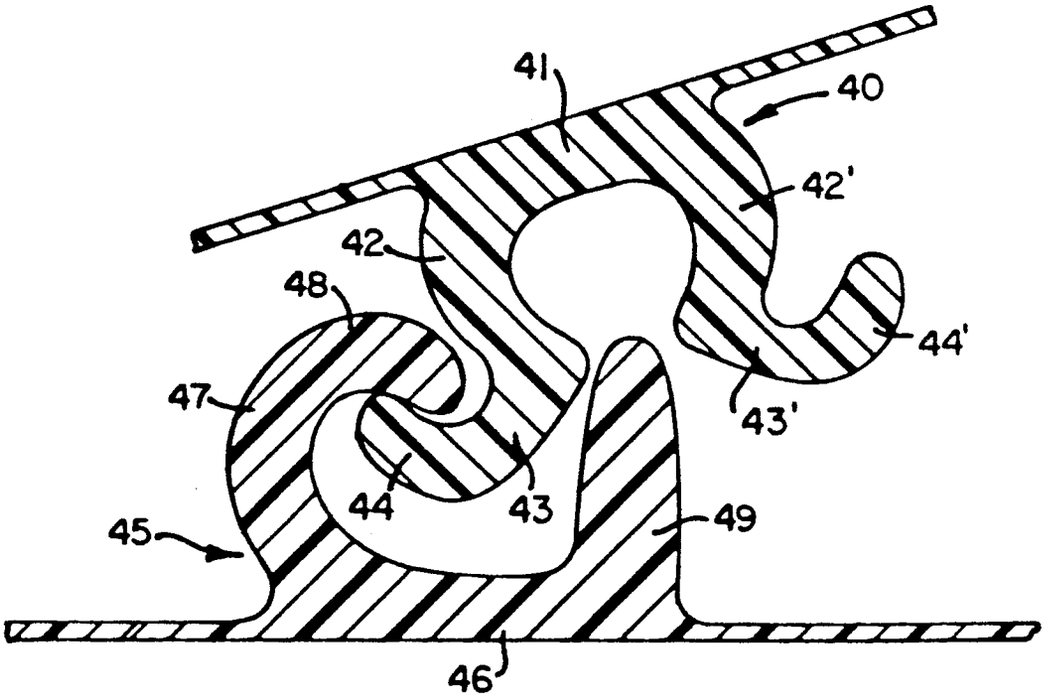

41
40
42'
42
48
44'
47
43'
44
43
49
45
46

FIG. 8