July 20, 1965 R. E. TABER 3,195,616

CORRUGATED, MULTI-CONVOLUTED SELF-RECOILING SHEET

Filed June 1, 1962 3 Sheets-Sheet 1

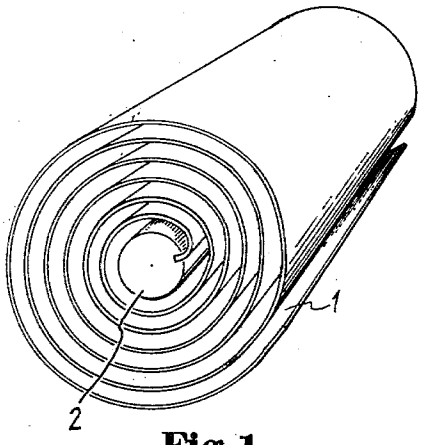


Fig. 1

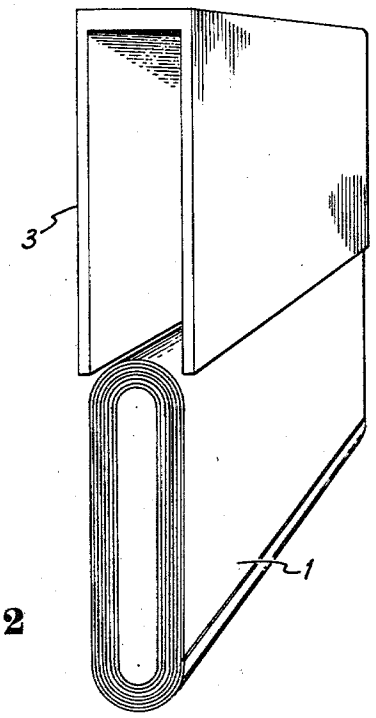


Fig. 2

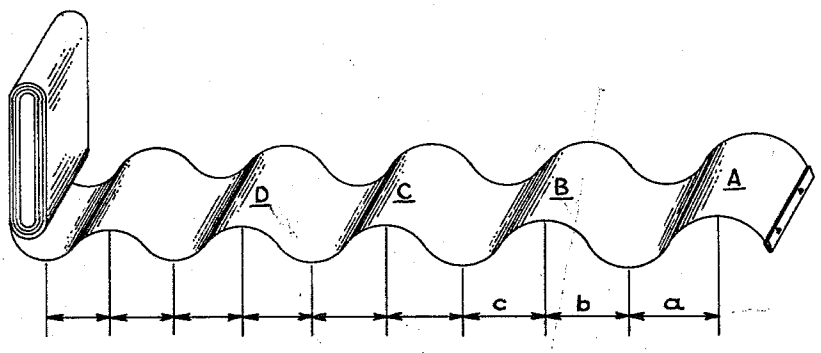


Fig. 3

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CORRUGATED, MULTI-CONVOLUTED SELF-RECOILING SHEET

Filed June 1, 1962 3 Sheets-Sheet 2

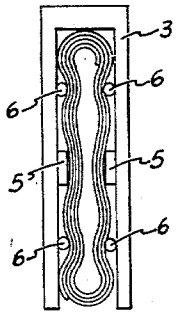


Fig. 4

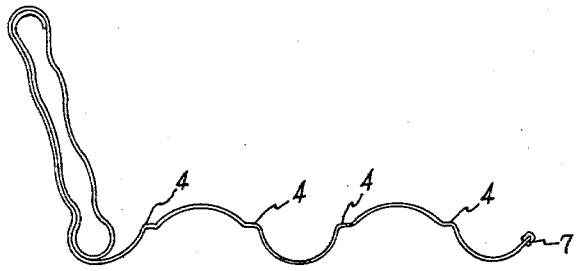


Fig. 5

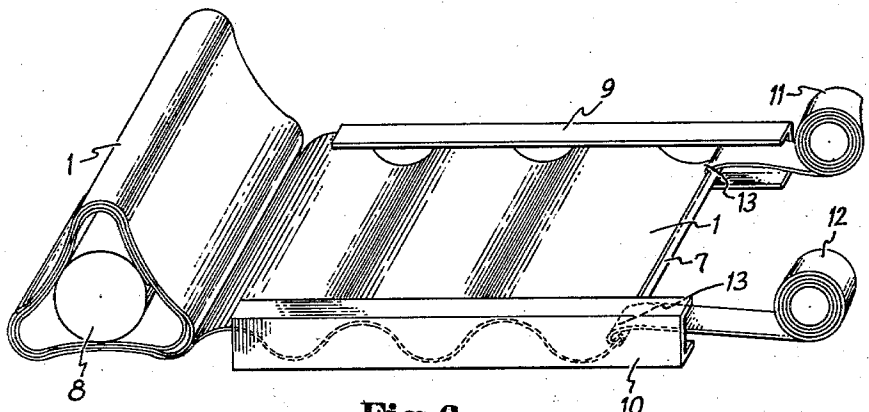


Fig. 6

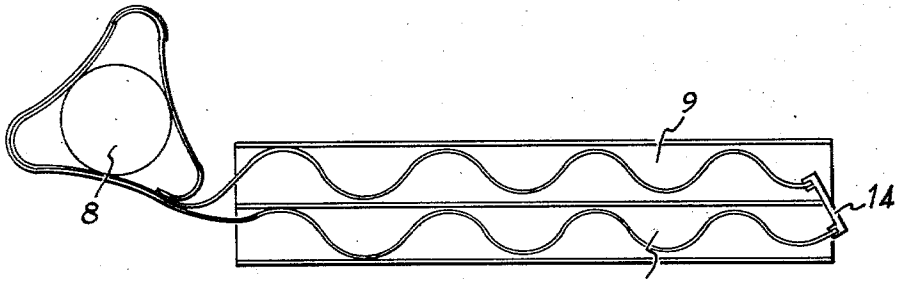


Fig. 7

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CORRUGATED, MULTI-CONVOLUTED SELF-RECOILING SHEET

Filed June 1, 1962 3 Sheets-Sheet 3

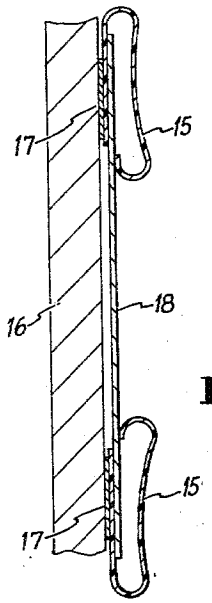


Fig. 8

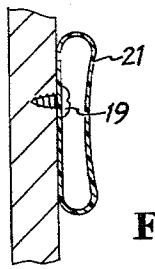


Fig. 10

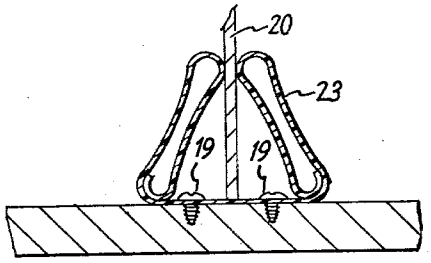


Fig. 9

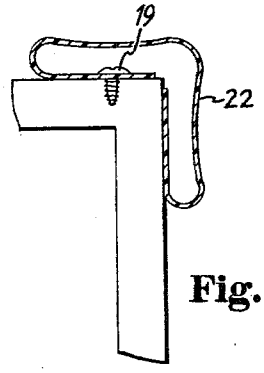


Fig. 11

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United States Patent Office 3,195,616 Patented July 20, 1965

3,195,616
CORRUGATED, MULTI-CONVOLUTED SELF-RECOILING SHEET

Russell E. Taber, 510 Dogwood Valley Drive NE., Atlanta, Ga.

Filed June 1, 1962, Ser. No. 199,504
7 Claims. (Cl. 160—121)

This invention relates to a multi-convoluted self-recoiling sheet which has a higher degree of transverse rigidity than has heretofore been attainable, and to certain specific applications of such a sheet.

In my co-pending application Ser. 164,372, filed on January 4, 1962, I have taught a method for imparting to a sheet of plastic material a permanent coil set. A sheet having such a "permanent coil set" may be extended into a flat or uncoiled state, but will have an inherent tendency to recoil into its coiled state. And of course, a coil so formed may be extended and recoiled almost indefinitely without losing its "coil set."

In my United States Patent No. 2,852,143, issued September 16, 1958, I disclose a display device utilizing a plurality of self-recoiling sheets, which was intended for soft drinks packed in the familiar six-pack cartons. In attempting to utilize or to adapt that display device for goods such as large size soda bottles and the like having relatively long thin necks such that the caps upon which the self-recoiling sheet rests, are relatively widely spaced apart, I was hindered by the lack of transverse rigidity.

Accordingly, in another co-pending application, Ser. No. 34,526, filed June 7, 1960, now abandoned, I taught the construction of a reinforced self-recoiling sheet which possesses excellent transverse rigidity. Bascially, the disclosure of that co-pending application contemplates the addition of a reinforcing or stiffening member such as a rod or wooden slat which may be secured to the self-recoiling sheet, or, the interweaving of such a self-recoiling sheet through a plurality of stiffening members. While a device made according to the teachings of that application does possess an extremely high degree of transverse rigidity, it is also somewhat bulky when in coiled form.

It is therefore a principal object of the present invention to provide a self-recoiling sheet which, while possessing a high degree of transverse rigidity, may be recoiled into a compact form.

Another object of this invention is to provide a self-recoiling sheet having a high degree of transverse rigidity when extended into its uncoiled state, which is both easy and economical to produce.

A further object of this invention is the provision of a simple and economical method of converting a resilient plastic film into a self-recoiling sheet having the characteristics enumerated above.

I shall now undertake to describe in greater detail the method by which I accomplish these and other objects of the invention which will become apparent upon a reading of this specification, and shall also describe several specific applications of a self-recoiling sheet so formed.

In the course of this discussion, I shall refer to the drawings forming part of this application in which:

FIGURE 1 is a perspective view of a sheet of polyester film as coiled on a slotted mandrel;

FIGURE 2 is a perspective view of a normal coil compressed into a flattened state and ready for insertion into a channel for heat treatment;

FIGURE 3 is a perspective view of a coil according to my invention in a partly extended condition;

FIGURE 4 is a cross-sectional view of a flattened coil placed in a channel having additional internal ribs;

FIGURE 5 is a side view of a partially extended coil according to my invention which is characterized by a plurality of secondary corrugations;

FIGURE 6 is a perspective view of a coil formed as taught by this disclosure rewound upon a rod and as adapted for use as a closure;

FIGURE 7 is a side view of an adaptation of my invention as an insulating closure utilizing a double coil;

FIGURE 8 is a cross-sectional view of an application of my invention for use as a picture or placard holder;

FIGURE 9 is a cross-sectional view of this invention utilized as a flexible channel which will accept materials of various thicknesses;

FIGURE 10 shows a cross-sectional view of my invention used as a decorative trim strip having a concealed fastening; and

FIGURE 11 is a cross-sectional showing of the invention used as a corner trim also having a concealed fastening.

With the foregoing objects in mind, I have conducted many experiments, centering primarily around attempts to corrugate the film itself. However, conventional corrugated materials are made with each corrugation having exactly the same dimensions, and with the individual corrugation spaced at substantially equal intervals. When a sheet with these conventional corrugations is rolled or coiled, the corrugations are incapable of nesting one into another, and therefore, such a coil necessarily becomes rather bulky.

Furthermore, as will be more fully described hereinafter, the conversion of a resilient plastic film into a self-recoiling sheet involves the application of considerable heat. This heating process would tend to destroy preformed corrugations through softening of the film unless some means were devised to hold each corrugation in its original shape until the film cooled.

As a result of further experimentation and observation, I have now discovered a way to simultaneously impart both built-in corrugations and a permanent coil set to a sheet of plastic material, and that is the subject of this application.

The material may be any suitable substance which may be given a permanent coil set according to the teachings of my co-pending application Ser. No. 164,372 noted above. I have used with a great deal of success a polyester film manufactured by the Du Pont Company under the trademark Mylar. While a piece of almost any size and thickness may be used, I have achieved very good results using a thickness of .0075 inch.

The first step in preparing a corrugated, multi-convoluted self-recoiling sheet is to roll a piece of film 1 into a normal coil of the desired diameter as shown in FIG. 1. This may be done either by hand, or with the aid of a slotted mandrel 2, which will engage one edge of the film.

Next the coil must be compressed into a flattened or oval shape as shown in FIG. 2, and fitted into a U-shaped channel 3. It should be understood that by the term "channel" I mean any device which will enclose the compressed coil on three sides. The channel may be of any width less than the diameter of the normal coil, and must be of a size sufficient to accommodate the coil's newly acquired height and width, and should be at least as long as the coil itself.

The flattened coil as held in its channel is then subjected to heat for a predetermined period of time. I have achieved satisfactory results for most purposes with an oven temperature of 350° F. with a dwell time of about 30 minntes. However, certain applications will require adjustments of the heat and dwell time in a range between 275° and 425° F., and from 5 minutes to an indefinite time period.

After the predetermined dwell time period, the coil must be cooled to its normal temperature and must remain in its channel during this cooling period. It may be cooled by allowing it to remain in the atmosphere, by a forced air circulation system, or by quenching in a cool liquid. Once fully cooled, the flattened coil may be removed from the channel, and it will be found that it will retain this flattened shape permanently, and has acquired a permanent coil set.

When extended, the resulting heat formed flattened coil becomes a transversely corrugated sheet, which unlike conventional corrugated materials, is characterized by progressive increments in size and spacing of the corrugated segments. FIGURE 3 of the drawing shows a coil so formed in its partly extended condition, with the changes in size of the corrugations somewhat exaggerated for clarification (e.g., note that dimension *a* is greater than dimension *b*, which in turn is greater than *c*, etc.). It will be understood that by virtue of the uniform, progressive differences in size, each corrugation will nest neatly over the corrugation beneath it, permitting the sheet to be recoiled into a very compact unit.

In FIGURES 4 and 5 of the drawings, I have shown a slight modification of my invention, whereby additional transverse corrugations **4** can be produced on the coil. It will be noted that I have provided ribs **5** and wire rods **6** on the inner side of the channel **3** in which the flattened coil is to be heated. Then as shown in FIG. 5, the resulting coil when extended may be characterized by a plurality of secondary corrugations **4**. Such secondary corrugations can be used either for their decorative effect, or to produce a change in the spring tension of the coil when extended or rewound.

For certain applications, it will be desirable to have a rigid member, such as the metal binding strip shown at **7** and often used on calendars, on the outer transverse edge of the coil. Such a rigid member could be applied with conventional machinery, either before or after coiling, and either before or after the heat treatment. It must be remembered however, that if the rigid member is added before heat treatment, this edge must be permitted to extend slightly outside the channel, so that it will not interfere with the final form of the coil.

It is obvious from the foregoing disclosure that great variations in the size and shape of the corrugations in a finished sheet may be produced by careful selection of the initial coil size and of the dimensions of the channels used for the heat treatment. Also the spring tension, and transverse rigidity of the corrugated sheet can be controlled within a wide range by variation of the type and thickness of the film used. And finally, many different decorative effects are available by utilizing either the opaque, the translucent, or the transparent Mylar films. I have also found that a layer of cloth may be secured to one surface of the film prior to coiling and heat treatment, and this will further extend the range of variations.

This new method and the resulting new articles which can be economically made thereby, will find commercially practical outlets in the form of many new and different products. I am particularly interested in two broad categories: the first is in the area of window closures in the form of awnings, shades, or thermo-barriers where the retractable self-recoiling feature of my invention will have obvious utility, and the second field contemplates the use of only a few coil convolutions as moldings or channels for light duty holding and clamping operations.

I shall now develop certain specific applications of my new corrugated self-recoiling sheet, illustrating its use in each of the two broad categories mentioned above.

Referring now to FIG. 6, I have shown a corrugated self-recoiling sheet **1** according to the present invention rewound upon a dowel **8** having a diameter which is approximately one-half the height of the flattened coil. It will be noted that when so wound, the coil has assumed

a round-cornered triangular shape in cross section. This configuration will be automatically assumed so long as the dowel or rod on which the sheet is rewound has a diameter which is sufficiently greater than the thickness of the coil in its flattened state. I have found that this rewinding in a triangular shape is particularly desirable for applications of my invention which involve frequent extensions and retractions, for two reasons. In the first place, the distance from the center axis of the dowels to the coiled sheet is more uniform, and hence the extending and retracting operations may be performed more smoothly. In the second place, as I noted earlier in this specification, succeeding corrugations get progressively larger; when the coil is wound in its flattened state, alternate corrugations must nest within each other. However, when rewound into the triangular form, each corrugation must nest within the third next corrugation, so that the difference in size between for example the corrugations A and D is somewhat greater than the difference in size between the corrugations A and C, (FIGURE 3). I have found that this will improve the nesting qualities of the corrugations, particularly when the film is retracted at high speeds.

To utilize a device of this invention as a closure for a window frame or other opening, the dowel **8** about which the film **1** is wound is rotatably journaled in suitable bearings (not shown) at each end of its axis in a suitable mounting structure as exemplified by a conventional window frame. A pair of channels **9** and **10**, having an opening which is substantially equal to the height of the central corrugation will be secured to opposite edges of the frame members, and will be perpendicular to the coil's axis. As shown in FIG. 6, the edges of the film are slidably engaged in these channels, and a knob, handle, or other suitable device, may be added to the free end of the film to make an extensible and self-retracting closure. Because of the tendency of the film to recoil, it will tend to skew itself in the channels, and this will act to hold the film in place until such time as sufficient force is exerted to overcome this friction.

In FIG. 6 I have included a modification of the above described closure, for use as a cabinet door or the like that will tend to close itself automatically. In this modification, a pair of self-recoiling sheets **11** and **12**, formed without corrugations according to the teachings of my copending application, are positioned at the channel ends opposite from the corrugated coil. The outer or free transverse edges of these coils are fastened to the opposite ends of the outer transverse edge of the corrugated coil as at **13** in any suiltable manner. It will be understood that these latter self-recoiling sheets will be formed from considerably heavier gauge polyester film, such that there will be sufficient retractive tension in these coils to counteract the retractive tension of the corrugated coil and to cause it to extend to a closed position in the frame opening.

To adapt this closure construction for use as a thermo or other barrier, it will be necessary only to seal the area between the frame and the corrugated coil, and the edges of the corrugated film which are slidably engaged in the channels. This may be done by means of strips of plastic foam, each strip having sufficient thickness so that one surface thereof will be in constant contact with the channel or frame, while the other surface will be in constant contact with the undulating surface of the corrugated film.

A still more effective thermo barrier may be made by coiling two pieces of film the same size together, and processing them in this condition as taught in this application. As shown in FIG. 7, a double track channel is substituted for the channel **9**, and a similar double track channel is substituted for the channel **10**, and the edges of the two separate sheets are slidably engaged in their respective tracks. The outer transverse edges of the two sheets

may be fastened together with a shim or filler strip **14** between them which has a thickness approximately equal to the distance between the centers of the channels. By pulling on this filler strip and thereby extending the two sheets in their respective channels, an undulated, insulating air space of uniform thickness will be created between the films. As the two sheets are uncoiled together, the outer one, because of its slightly greater diameter, will extend somewhat farther than the inner one. However, a corrugated self-recoiling sheet made according to this invention may be stretched or compressed to some degree, thereby permitting the outer transverse edges of the two sheets to maintain a fixed relationship to each other.

As noted before, a few convolutions of a coil formed according to this invention may be used for various clamping and holding functions. For example, in FIG. 8, I have shown a picture or placard holder in cross section which comprises a pair of single-convoluted coils **15** formed according to this invention. Each coil is secured to a backing surface **16** by means of adhesive as at **17**, or in any other suitable manner. The edges of the coil may then be raised and a picture or poster **18** placed therein. Four such coil segments may be used to make a complete mitered corner frame, or short lengths may be positioned as desired at the edges of a picture.

In FIG. 9, I have shown another modification involving the use of several convolutions of a corrugated self-recoiling sheet **23**. This segment may be secured to any desired surface by means of fastenings shown at **19** or by any other suitable means, and a complete convolution on either side of the segments secured to the surface serve as a pair of spring loaded arms to form a flexible channel which will accept materials **20** of varying thicknesses.

In FIG. 10 I have shown the use of a single convolution of a flattened coil **21** for use as decorative trim with a completely concealed fastening **19**. And in FIG. 11, two convolutions of my corrugated coil **22** may be used as a corner trim strip, also having a concealed fastening **19**.

Modifications in the above disclosure will, of course, occur to the skilled worker in the art. For example, by rolling the same flat sheet into a tapered coil, one can produce a conical shape having tapered corrugations such as might be used for lamp shades and umbrellas. Accordingly, I do not intend to limit myself in any way other than as set forth in the claims which follow.

What is claimed as new, and what I desire to secure by Letters Patent is:

1. A sheet of polyester film in the form of a flattened, multi-convoluted coil, said sheet when extended forcibly under tension having a plurality of permanently set transverse corrugations aligned parallel to the coiling axis of said sheet, said sheet also having the property of returning to said flattened coil state when released from tension.

2. A multi-convoluted coiled sheet of polyester film, said sheet, when forcibly extended under tension, having a plurality of permanently set corrugations aligned paralled to the coiling axis of said sheet, and having the property of returning to said coiled state when released from tension, said corrugations progressively increasing in size as they get farther from the center of said coiled sheet, whereby alternate corrugations may nest within each other when the sheet is in its coiled state.

3. A coiled sheet according to claim **2**, said sheet being coiled about a dowel having a diameter greater than the thickness of the coil in its normal coiled state in the absence of said dowel, said dowel causing said sheet, in recoiling, to assume a generally triangular configuration in cross-section, with each corrguation nesting within the third-next corrugation.

4. In combination with a wall opening having on opposed sides thereof parallel tracks of channel-like configurations opening toward each other, a rotatably mounted rod extending across said opening at one end thereof, and a sheet of polyester film in the form of a multi-convoluted coil, said sheet when extended forcibly under tension having a plurality of permanently set corrugations aligned parallel to the coiling axis of said sheet, said sheet also having the property of returning to said coiled state when released from tension coiled about said rod, the edges of said sheet being engaged in said opposed tracks.

5. The combination claimed in claim **4** including means operative to forcibly extend said sheet under tension.

6. The combination claimed in claim **5** wherein said means for extending said sheet under tension comprises at least one multi-convoluted coiled sheet of polyester film having the property of self-recoiling when forcibly extended into the flat state, said last named sheet having a thickness greater than that of the first named sheet, whereby the retractive tension of said last named sheet is sufficient to overcome the retractive tension of said first named sheet.

7. In combination with a wall opening having on opposed sides thereof pairs of parallel tracks of channel-like configuration, said pairs of parallel tracks opening toward each other, a rotatably mounted rod extending across said opening at one end thereof, a double sheet of polyester film in the form of a multi-convoluted coil, said double sheet when extended forcibly under tension having a plurality of permanently set corrugations aligned parallel to the coiling axis of said double sheet, said double sheet also having the property of returning to said coiled state when released from tension coiled about said rod, the edges of said double sheet being engaged in said opposed pairs of track, and means joining the outer edges of said double sheet.

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