WEB PLEATING APPARATUS AND PACKAGED WEB ARTICLE


Filed July 26, 1968, Ser. No. 747,912

Int. Cl. B65b 63/04

U.S. Cl. 53—117

8 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for packaging web material of a stiff, resilient nature by feeding a web longitudinally, accordion-pleating it along longitudinal fold lines, holding the pleated form and cutting to desired length. The resultant article is a compact pleated form of the web, which may be further compacted by rolling about a transverse axis and secured by confining in a package sheath.

This invention relates to pleating web materials of stiff nature, such as polyester or other plastic films or film laminates, which cannot take a so-called dead-fold (compare, e.g., paper webs which do readily take a dead-fold). The invention also has application to other materials of similar resilient properties such as certain textiles woven from synthetic plastic fibers.

BACKGROUND

Accordion pleating apparatus is known for packaging paper and cloth webs to realize the inherent advantages of accordian folding in easy unfolding (U.S. Pat. 5,286,435) and for longitudinally pleating paper and cloth webs to expedite later processing (U.S. Pat. 2,538,671 and 3,260,639). See also U.S. Pat. 2,494,431, 2,862,542 and 2,876,824.

OBJECTS

It is an object of the invention to provide an improved apparatus particularly suitable for pleating stiff, resilient webs pleats folded along longitudinal fold lines.

It is a further object of the invention to provide such apparatus capable of continuously pleating very wide webs, particularly of stiff resilient material, in excess of two feet width and typically five feet wide with protection against the marked tendency of such webs to lose the pleat form in the course of pleating.

It is a further object of the invention to provide the foregoing apparatus in combination with structure for securing the pleated article by packaging or other restraining means.

It is a further object of the invention to provide a compactly packaged article of such web materials which is readily opened up.

The invention accordingly comprises an improved web pleating apparatus, an improved web handling apparatus combination containing the pleating apparatus as a subcombination or portion of a subcombination thereof, intermediate apparatus subcombinations such as the elements of pleating apparatus and particular driving means therefor and a compacted web article of manufacture with longitudinal accordian pleats which may be made with the foregoing apparatus.

It is a particular advantage and distinct feature of the apparatus that it can handle very wide webs, very stiff webs, slippery surface webs, webs containing scratch-vulnerable metal coatings on the surface thereof or webs having any combination of such characteristics and it is a particular advantage and distinct feature of the article that it may consist of any such web material and still be compacted in a manner which includes longitudinal accordion pleats.

Other basic objects, features and advantages will in part be set forth in the following description and will in part be obvious from this disclosure.

In general the pleating apparatus comprises, basically, an arc forming means for the unpleated web and a point of initial compression of the pleated web which is the focus or center of the arc. The web converges essentially continuously from the arc to the focus. The web is pulled through the compression means at a constant pre-set tension, which is very low—one pound per inch of web width or less and at very high speeds—tens to several hundred feet per minute. The pleating apparatus may also comprise moveable radial guide means, such as rollers nesting in the web pleats between the arc and arc focus and moveable side guide means to control web edges and additonal fixed springs to restrain web depleating without continuous contact with the web.

The web handling apparatus additionally comprises drive motors and tension setting means for the web and an outlet station for final processing of the web in the nature of cutting to length and securing of the fully pleated web.

The pleated web can be secured by stitching or heat setting the pleated web along the fold lines to make the pleats permanent or by simply clipping or sheathing the pleated web or by folding along transverse lines (as in Pat. 3,286,435) and securing or by rolling about a transverse center line to form a spiral of the pleated web and securing.

In the latter case, a unique article is produced which is readily unfoldable to the full web width and length (or to portions of length and full width by partially unrolling the spiral and letting the exposed pleated length portion open up along its accordian folds to form a fan shape). The spiral is a coreless one and it may be flattened and secured in a restraining sheath package.

The apparatus and article are more particularly described in the following specific description which includes reference to the accompanying drawings wherein

FIG. 1 is a schematic illustration of the web handling apparatus in the nature of a side view drawing;

FIG. 2 is another schematic illustration of the apparatus as a top view;

FIGS. 1A, 2A, 2B and 2C are schematic illustrations of alternatives to some of the components of the apparatus, and

FIG. 3 is an illustration of the compacted web article being packaged.

Referring to FIGS. 1 and 2 together, a roll supply of web material—e.g. metallized polyester film in roll form, 5 feet wide—is indicated at 10. Film 11 from the roll is fed out over idlers 12 and fed to means 20 for forming and guiding the accordian pleats and then to a final outlet processing station 30 for securing the pleated web which in fully pleated form is referred to by the number 111 and after cutting by the number 112. The web length dimension referred to herein as indicated by the arrows L and the web transverse dimension (width) is indicated by arrows T.

The pleating means 20 comprises a pair of pinch rolls 21 for compressing the pleated web. The pleats can be initially set by hand and passed through the rolls. The pleating means further comprise an arc forming guide 22 which is a steel plate having a lubricating Teflon coated edge which is shaped to form an arc substantially equal in transverse dimension (width) to the web and focused on the compression point between rollers 21. Advantageously, the arc is circular with the compression point as its center of curvature. The radius of curvature R is se-
lected as equal to the desired length of the final product, provided that this is sufficiently long—at least in excess of half the web width and preferably in excess of web width. The pleated web is guided over intermediate movable guide means which comprise arrays of rollers 24 which are individually arranged essentially in a radial direction between the arc 22 and its radial center 21. The rollers are grouped in lines extending transversely with respect to the web and at least two such lines are at the same radial location and disposed above and below the web to prevent the laterally adjacent pleats of the pleated product forming an interleaved array corresponding to the desired pleat pattern. The rollers are all thin metal discs with rubber boots on their edges which engage the moving pleated web with a high coefficient of friction and are driven thereby with no slip.

The guide means can also be partially eliminated for certain web materials. It is possible to eliminate the guide means entirely if the stiffness of the web material is substantially less than that of polyester film (e.g. polyethylene film is substantially softer than polyester film and can be pleated in the apparatus without guide means). Common synthetic textiles are intermediate in stiffness between polyethylene film and polyester film.

The guide means advantageously include edge rolls 25 which are located adjacent end wheels of one or more of the lines of wheels 24 to restrain the side edges of the web so that the web will not contract transversely or produce an outer web 48 which is out of register with the innermost pleats of the web. Generally the roller 25 is flat as shown in the drawings. If the edge begins to creep from its desired position, the roller can be tilted to apply a restoring component of reaction force. The observation of the edge can be accomplished by a photocell and controlled servomotor for tilting immediate. Like wheels 24, wheels 25 are driven by the web to avoid scratching or snagging and to hold pleat alignment.

The pleating means includes a drive system for continuously pulling the web through the above-described guide structure and for setting and maintaining a constant tension. The drive is a group of synchronized motors simultaneously driving the source roll 10, the compression rollers 21 and moving parts of the final processing station at corresponding speeds. The tension is set by a metal rod 27 resting in a loop formed in the web 11. The preset tension must be one ounce per inch of web width or less. The web speed feed is 10-100 feet per minute for polyester film. The total tension is set by rod weight divided by 2. A 2 pound rod has been successfully used. The roller 10 is designed for a 56-Inch polyester film web and a 7-pound rod for a 56-inch polyethylene film web. In general, it is desirable to make the speed very fast for all webs—in any event greater than 10 feet per minute—since this helps in avoiding loss of pleat alignment. In general the above pleating apparatus and the final processing station apparatus described below are constructed to minimize slippage and provide positive drive without slip at substantially all points of contact between the apparatus and web with the apparatus component driving the web or the web driving the component.

The final processing station 30 comprises means for securing the pleated web 111 in some fashion. In a preferred embodiment this involves passing it over a guide roller 31 and mounting it at the spine 32 with a bladed web 34, a flexible endless belt 32 forcibly confines the pleated web against the roll guide 31 and where the belt is not performing this function, as in the region of the blade 34, air jets from nozzles 35 blowing against the pleated web or suction means within the guide roller are provided to supplement the confining function of belt 32.

Rollers 31 and belt 32 are synchronously driven with the web pleating means described above.

The cut web 112 is taken up on a collapsible mandrel 33 driven by an independent motor 261 and rolled up about an axis parallel to the transverse axis of the web. The mandrel can be collapsed to allow removal of the pleated and rolled web.

The resultant product is shown in FIG. 3. It is folded flat in small accordion pleats (pleat width 15/6, or less of total web width) along fold lines substantially parallel to the web length direction and spirally rolled up about an axis parallel to the web transverse direction into the form of a straight coreless spiral.

Once removed from the final processing station 30, the compacted form must be forcibly continued to prevent it from springing open. This is preferably done by flattening the pleated and spirally rolled article into a block-like form and inserting it into a plastic sheath package 9.

Alternatively, the forcible confinement can be a rubber band slipped around the rolled-up article of FIG. 3 or a spring clip or tape.

The article of FIG. 3 is easily unrolled and unpleated in whole or part as applied to a stiff web, the stiffness which makes it so difficult to pleat causes it to easily open up when removed from its package. It is therefore particularly useful as an emergency or rescue blanket when made of thermal insulating, metalized polyester film with a width of about 5 feet when spirally unrolled fully and a length of 7 feet when fully unpleated. Partial unrolling affords a fan like unpleating of the unrolled section allowing use of a limited area of the blanket. In connection with this application, the compacted article of FIG. 3 can have the size of a package of cigarettes when folded although about 5 feet by 7 feet by 1/2 inch is the most convenient size.

Other articles can be processed in the apparatus of FIGS. 1-2. For instance, plastic fabrics and films can be rendered suitable for drapery use by the addition of means for building a forcible confinement into the pleated web such as stitching means or heat setting means, indicated at 40 in FIG. 3 or for lifting means. Like wheels 24, wheels 25 are driven by the web to avoid scratching or snagging and to hold pleat alignment.

For instance, the slipping surface defined by the curving edge of arc member 22 may be defined by a curving roller which can be driven by the moving web. Another variation of the apparatus is shown in FIG. 1A wherein fixed spring wires 241 or other fixed restraining means are added to the movable guide means to improve the resilience of the web to de-pleating of a film 11 which may have such tendency if the web is wide or stiff or both. When a trenched pleat starts to collapse, it bounces against the restraining member. Through this restraining process the web finds its proper trough level and pressure between the spring rods and web is very light and, in some instances, intermittent or bouncing. Substantial sliding contact is thus avoided. This is particularly important in handling webs with metal coating to avoid excessively scratching the coating.

Referring to FIG. 2, additional restraining means in the form of fixed guides 242 are shown for arresting transverse motion of the web edges which may occur when a very stiff web is processed. An additional variation of the apparatus is the addition of a torque motor (not shown) which is interconnected with the motors 26 to drive a central one of the roller guides 24 in any of the transverse arrays of such guides, but particularly in the last array of such guides. The driven roller imparts positive drive to the roller to guard against relative slippage which may occur across the width of a metalized polyester web (e.g. Mylar film of about 1/2 mil thickness vacuum coated with aluminum on one side) which tends to be very slippery as well as stiff and resilient.

Referring to FIG. 2A, there is shown a variant of the initial compression means in the form of gear shaped rolls 211 which is large enough to carry the pleated web 111 to assure that there is no slip between the innermost and outermost pleats of the web. This area contact embodiment is particularly advantageous, in comparison
with the tangent line roll contact of the FIG. 1-2 rolls 21, in handling wide polyester film and other stiff and/or very wide webs.

Referring to FIG. 2B there is shown an assembly of three compression rolls 21 providing more surface area of contact with the web 11.

Referring to FIG. 2C there is shown another form of wind-up device (to replace collapsible mandrel 33 of FIG. 2). In FIG. 2C the wind-up device is in the form of a tuning fork 331. The cut web 112 is passed through the center of the tuning fork for a length of a few inches. Then motor 261 is driven to rotate the fork and wind the cut web into the spiral of FIG. 3. After winding the spiral can be removed from the smooth surface of the fork.

Alternatively, the fork can be constructed so that its legs may be collapsed towards each other to facilitate removal of the spiralled pleated web.

Another modification which is desirable in handling stiff materials is to provide a clip (not shown) mounted on and rotating with the guide roller 31 and arranged to hold the pleated web 111 against the roller. Such a clip (oz. clips) should be compatible with the belt 32. The clip takes the place of air jets 35 which are satisfactory for softer webs but not for the stiff webs.

It will be apparent to those skilled in the art, once given the benefit of the present disclosure, that still other alternatives, variations in the details and uses for the apparatus and/or article can be made within the scope of the present invention as set forth in the following claims.

What is claimed is:

1. Apparatus for folding a long web, having characteristic length and transverse width dimensions, in a pattern of pleated accordion folds extending substantially parallel to the length dimension comprising:

   (a) means providing a source of said web and feeding it out along the length dimension thereof,

   (b) means for compressing the web when fully pleat folded and having a small cross-section area of initial compression,

   (c) means for driving the web, at a selected tension, from said source to said compressing means, and including means for setting a tension of said driven web and for holding said selected tension constant while the web is being driven, and

   (d) means located along the path of the web between said source (a) and compression means (b) and forming a curving arc with a length substantially equal to the transverse dimension of the web and which is concave towards and focussed on said small area of initial compression of the pleated web, the radial distance from the arc to the focal point being longer than half the web width.

   the said means (a)–(d) being constructed and arranged to hold the web taut in its width dimension along the arc formed by said means (d), the apparatus being constructed and arranged to provide positive drive substantially without substantial sliding contact at the various points of contact between the apparatus and web beyond the arc.

2. The apparatus of claim 1 further comprising (e) an outlet station with means for cutting the web along its transverse dimension to selected lengths after it passes through the compression means and means for forcibly holding the pleated form of the web at least up until the web is cut.

3. The apparatus of claim 2 further comprising means for spirally rolling up the web into a coreless spiral roll about a center line substantially parallel to its transverse dimension.

4. The apparatus of claim 1 further comprising means for permanently setting the pleat of the web after its first compression and restraining means for forcibly holding the pleated form of the web until the pleat is permanently set.

5. The apparatus of claim 1 further comprising movable guide means located along the path of travel of the web between said arc forming means and said point of initial compression, said guide means conforming generally to the desired pleat form and extending generally radially and focused on said point of initial compression, the guide means being constructed and arranged to move at the same speed as the web to avoid slippage between the web and guide means.

6. The apparatus of claim 5 wherein said guide means comprise at least one array of rollers spread across the transverse dimension of the web with alternate rollers interleaved with said rollers having high friction surfaces so that they are driven by the web.

7. The apparatus of claim 5 further comprising fixed restraining means in the troughs formed by the converging web between the arc and focus, the fixed means being constructed and arranged to resist spring-like unpleating of the web without continuous contact.

8. The apparatus of claim 5 further comprising additional movable guide means for preventing the side edges of the web from creeping inwardly along the transverse dimension of the web, said additional guide means being driven by the web and controlling the transverse movement of the web edge by exerting a reaction force on the web.

References Cited

UNITED STATES PATENTS

2,196,006 4/1940 Benedict 156—594
3,286,435 11/1966 Weinberger 53—117

TRAVIS S. McGEHEE, Primary Examiner

U.S. Cl. X.R.

156—594; 206—59; 270—94