June 22, 1965 H. NATHANSON 3,190,512

MULTIPLE-PLEAT FORMING AND FASTENING APPARATUS TO PREVENT STRETCHING AND TEARING

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FIG. 1.

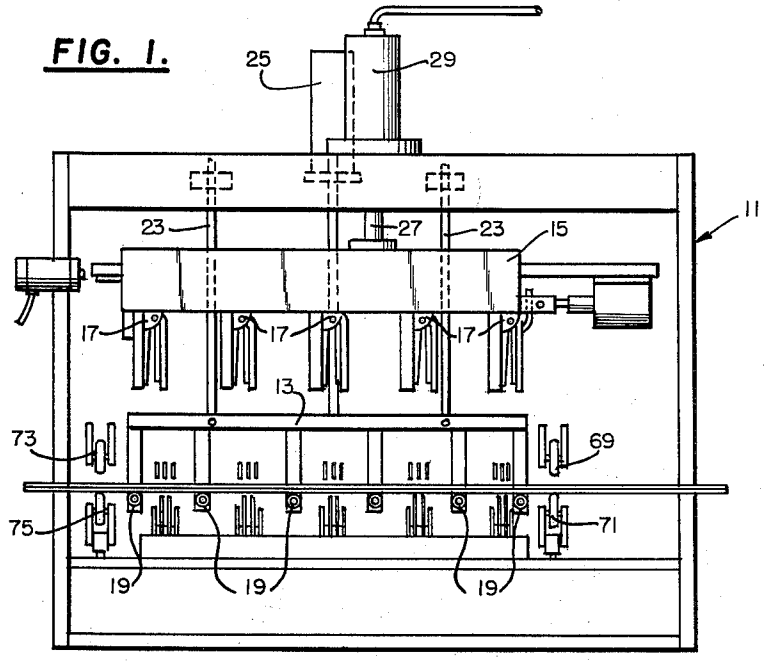
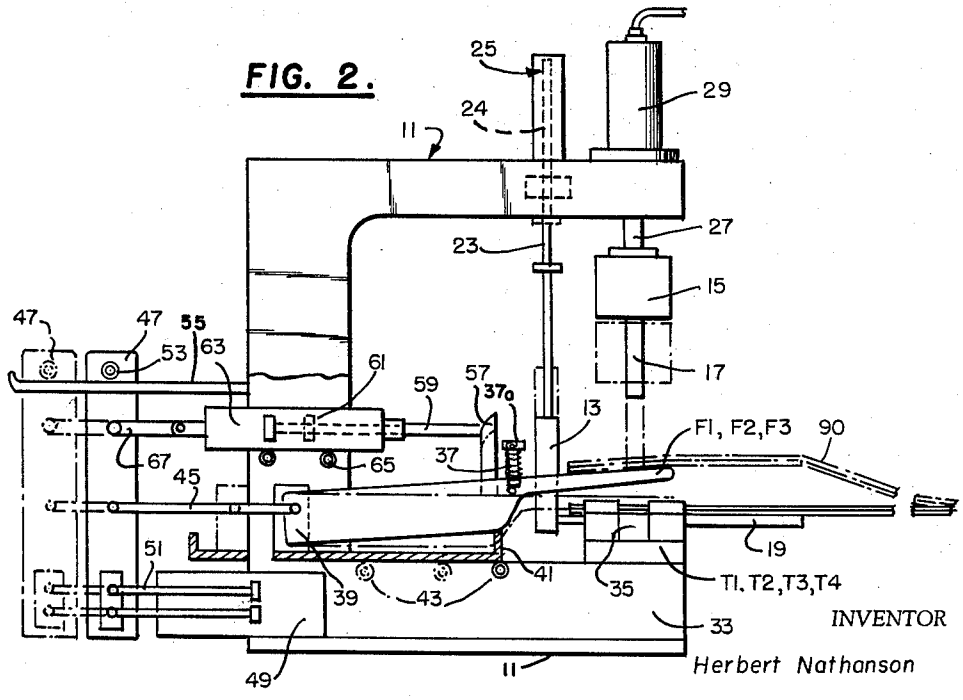


FIG. 2.



INVENTOR

Herbert Nathanson

BY

ATTORNEY

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FIG. 3.

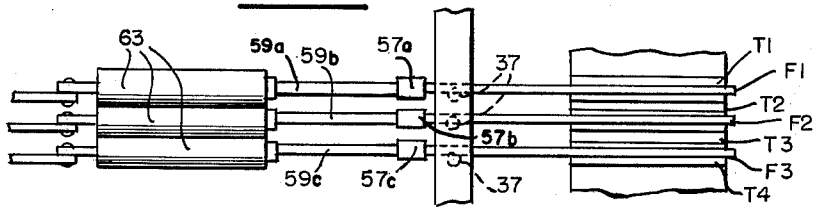


FIG. 4.

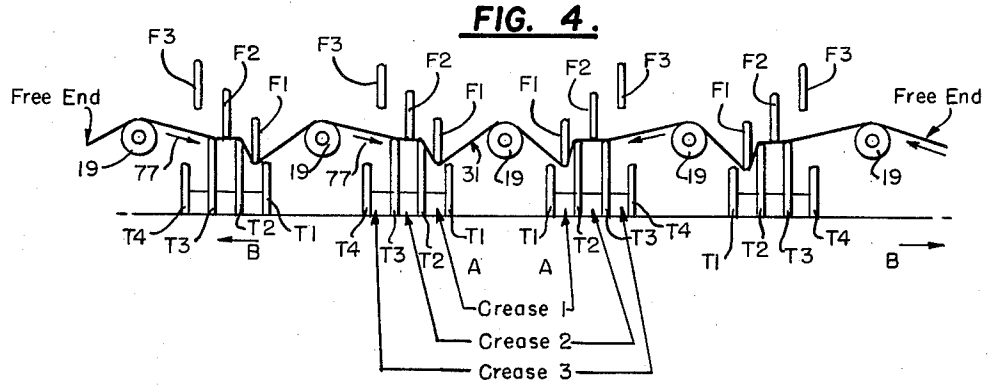


FIG. 5.

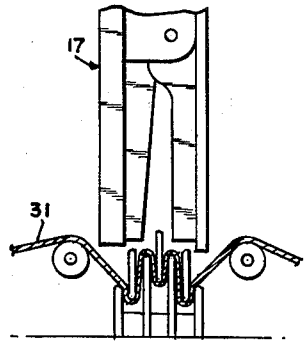
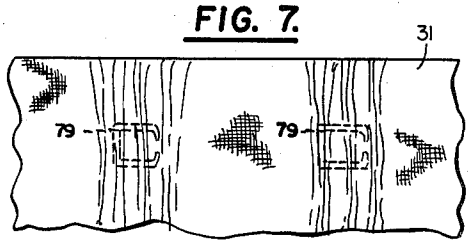


FIG. 6.



FIG. 7.



INVENTOR

Herbert Nathanson

BY

ATTORNEY

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MULTIPLE-PLEAT FORMING AND FASTENING APPARATUS TO PREVENT STRETCHING AND TEARING

Herbert Nathanson, 212 Beach 87th St., Rockaway Beach, N.Y.

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4 Claims. (Cl. 223—30)

The present invention relates to a new method and means for automatically forming multiple pleats in sheet material, and more particularly, relates to an arrangement whereby a sheet of material, such as a drapery, is rendered freely movable while a plurality of pleat-forming means are actuated in an ordered sequence to form the pleats without straining, tearing or unduly stretching the sheet material.

Prior art attempts for pleating material have resulted in complicated procedures requiring continual time-consuming manual alignment and resulting uncertainty of consistency in the finished product. This is because the pleats are customarily made one at a time by one working element, and the material must be very carefully fed to the one pleating element location and laboriously aligned and adjusted only at the station. Obviously, under such prior art teachings, pleating of draperies requires a lot of time, effort and expense.

By the present invention the above-indicated disadvantages and difficulties are overcome, with the results of a consistent end product and a minimum of manual effort. Briefly, according to the invention, a plurality of pleat-forming means are actuated in an ordered sequence to produce all of the pleats desired for a given drapery sheet size. Within each of said pleat-forming means, individual crease-producing elements are also actuated in an ordered sequence so that the respective successive folds and pleats are always drawn in from at least one free end of the sheet material. Thus, pleats can be formed as quickly as the material, depending on its physical characteristics, can be drawn in without causing binding or excessive holding of a free end. Consistency of pleat location is assured by means of holding elements which may be synchronized with the pleating action to hold the sheet material in place between successive pleating events. Unwanted tensioning in the sheet material is obviated by means of novel take-up members adjustable to pre-bias positions which draw the sheet material to a predetermined non-planar level.

Consequently, the more salient objects of the present invention are to provide: finished pleated sheets of high uniformity produced automatically with a minimum of manual monitoring; novel means for producing pleated sheets of material, such as draperies having end and near-end pleats; a simple and expeditious method of producing pleated draperies; novel means and method of producing end pleats in draperies, the ends of which may have a variety of physical characteristics (e.g., thicknesses, stiffness, pliability), such as, for example, a three ply reinforced drapery end in which the tip has been folded back over a reinforcing planar element.

For a better understanding of the invention, reference is made to the following detailed description and to the accompanying drawings in which like numerals refer to like parts and in which:

FIG. 1 is a front view in elevation of the automatic creasing and stapling apparatus as seen from an operator's station;

FIG. 2 is an end view in elevation of the automatic creasing and stapling apparatus of FIG. 1;

FIG. 3 is an overhead view of a portion of the apparatus of FIG. 2;

FIG. 4 is a diagrammatical side view in elevation of the crease-forming apparatus of the invention;

FIG. 5 is a side view in elevation illustrating the stapling apparatus according to the invention;

FIG. 6 is a diagrammatical overhead view of the stapled, creased material formed according to the invention, and

FIG. 7 is a view of pleated and stapled material formed according to the invention.

Referring to FIGS. 1–4, the pleating apparatus is composed of a foundation-supported frame 11 carrying a vertically reciprocating take-up roller frame 13 and a similarly movable frame 15 carrying a plurality of horizontally spaced staple guns 17. The take-up frame 13 has a plurality of horizontally spaced rollers 19. The roller frame 13 may be resiliently mounted for limited vertical movement. The staple guns 17 are actuatable by means of a remotely controllable and microswitch-controllable pneumatic unit (not shown).

The take-up frame 13 is movable via rod-like resilient support members 23 and a rack and pinion mechanism shown diagrammatically as 24, this mechanism furnishing an up and down movement by means of a pneumatic unit which is shown diagrammatically by reference numeral 25.

Alternatively, instead of employing resilient support members, the rollers 19 may be individually resiliently mounted for yielding up and down movement on the take-up frame 13.

The staple gun carriage is also movable up and down via a support member 27 by means of a pneumatic unit 29. Both pneumatic units 25 and 29 may be of any suitable design controllable remotely or by microswitch means, and may be located atop the frame 11.

The take-up rollers 19 provide yieldable support for a drapery 31 to be pleated. The drapery 31 is in the form of a sheet of material and is placed on a table or other suitable support means (not shown) so that one end thereof is beneath the staple guns 17. The end of the drapery to be pleated may be a single sheet, or a laminated or hemmed sheet, such as, for example, a buckram reinforced, hemmed sheet.

The crease-forming apparatus of the invention employs a plurality or set of fixed tines and movable fingers or tines at each of a plurality of pleating stations along the front of the frame 11, each station being located beneath a different one of the staple guns 17. As shown in FIGS. 1 and 4, a plurality of pleating stations are provided and the "A" stations are located interiorly of the "B" stations.

The respective sets or pluralities of movable tines or fingers at each pleating station are moved in the same manner, but at different times in a synchronized relation to be later described. At each pleating station there are four lower fixed tines T–1, T–2, T–3, T–4 supported by a lower extension 33 of the frame 11 and extending underneath the take-up rollers 19 and the sheet 31. The central lower tines T–2 and T–3 at each station extend above the outer shorter tines T–1, T–2, and all of the lower tines T–1 to T–4 at each station have a recess 35 into each of which one of the staple guns 17 may be positioned.

For each plurality of four tines T–1 to T–4 there are three movable tines or fingers F–1, F–2, F–3 which are held in normally upper positions by tension springs 37 (FIG. 2), and which are movable to lower positions (dashed lines, FIG. 2) in ordered sequence for interleaving relation (FIGS. 4 and 5) with the lower fixed tines T–1 to T–4. The interleaving of the fingers F–1 to F–3, respectively, between respective tines T–1 to T–4 forces the end or near end of the sheet 31 into several folds or creases, as shown in FIGS. 4 and 5.

The means employed for moving the fingers F–1 to F–3 to their down positions and also away from recesses 35 to enable stapling is shown in FIG. 2. Each of the fingers F–1 to F–3 is pivotally mounted on a bracket 39 carried by a carriage 41 horizontally movable on a track or rollers 43 located on the frame 11. The bracket 39 is connected via a link 45 to a horizontally movable common mounting plate 47.

The common mounting plate 47 is movable back and forth by means of a pneumatic reciprocating unit 49 of any suitable design, via piston actuated motion transmitting arms 51. The common mounting plate 47 is further constrained to horizontal back and forth movement by means of rollers 53 riding on a track 55 as shown in FIG. 2.

Each of the fingers F–1 to F–3 has a cam follower 57 upstandingly mounted on the top thereof. The fingers are forced down against the bias of the tension spring 37 by means of a horizontally reciprocatable cam 59 driven by a piston 61 mounted in a pneumatic unit 63 in a well-known manner. The pneumatic unit 63 itself is movable back and forth on rollers 65 located on the frame 11, or by any other suitable means. The pneumatic unit 63 is connected via a link 67 to the movable common mounting plate 47.

The sheet 31 is further held in place by means of outer aligning rollers composed of a pair 69, 71 near one end of the sheet 31 and rollers 73, 75 near the other end of the sheet. The rollers 69 and 73 are positioned above respectively associated lower rollers 71 and 75 so that the sheet 31 may be placed therebetween as well as on take-up rollers 19. Each of the rollers 69, 71, 73, 75 has smoothly rounded edges so that when the rollers are brought together, they grasp the sheet 31 in a slidably yielding manner. Any suitable means, including manual means, may be employed for lowering the upper aligning rollers 69, 73 against the sheet 31. The lower rollers 71, 75 may be provided with yieldable mounts such as, for example, spring mounted roller axles.

All of the pneumatic units 15, 25, 29, 49 and 63 may be operated in an ordered manner by any suitable means, such as by microswitches, remote control units, a programmed tape-controlled sequencing unit, and the like, for the purpose of carrying out the following sequence of operational events now to be described.

The sheet 31 is placed in position so that its end or near end to be pleated is seated on the take-up rollers 19. The aligning rollers 69 and 73 are lowered to hold the sheet 31 in place in a yielding manner so that the sheet 31, which will necessarily "shrink" in its dimension through the pleats, may slide easily therethrough.

Assuming that an even number of pleats is to be made, further reference is made to FIGS. 3 and 4 to explain the creasing sequence of the respective tines at each pleating station, and of the pluralities of tines in relation to each other. The pneumatic unit 49 is actuated to bring the common mounting plate 47 to its forward position so that the finger-carrying carriage 41 places the respective fingers F–1, F–2, F–3 over the spaces between tines T–1, T–2, T–3, T–4 at each of the plurality of pleating stations, one of which is shown in FIG. 3. In FIG. 4 the two innermost pleating stations are designated by the letters A at the crease 1 and the adjacent outer stations are designated by the letters B which are provided at the right and left sides of the figure.

As shown in FIG. 4, the take-up frame 13 is raised upon actuation of pneumatic unit 25 so that the take-up rollers 19 lift up the sheet 31 in those portions not held down by the sets of fingers F–1 to F–3. The innermost pair of fingers F–1 in the A stations are lowered simultaneously or in succession by actuation of pneumatic unit 63 pushing piston 61 forward so that the respectively associated cam 59 pushes against the cam follower 57 for each said finger. After fingers F–1 are lowered to form a crease No. 1, the fingers F–2 at the inner pleating stations at A are lowered followed by the fingers F–3, thus forming a pleat having crease Nos. 1, 2, 3. The pleats fastened with staples are shown in FIGS. 6 and 7.

Thus it is seen that the innermost fingers are always lowered prior to the adjacent outward fingers at each pleating station. Consequently, the drapery material or sheet 31 is always pulled inwardly as indicated by arrows 77 in FIG. 4 toward the crease being made. The movement of the sheet 31, as shown in FIG. 5, is in a direction which starts from at least one of its free ends yieldingly held by end alignment rollers 69, 71, 73, 75 and passing over take-up rollers 19.

In the same manner as for stations A—A, pleats are formed at stations B—B by the downward action of the fingers from the innermost ones F–1 successively outwardly to the outermost fingers F–3.

In the situation where an odd number of pleats are to be formed, the pleats may be formed as described for the even number situation except that the last odd pleat (e.g., station C of FIG. 1) is formed after all of the previous even pleats, the sheet 31 being drawn from the one free end adjacent the remaining odd pleating station.

After all of the creases have been formed at the pleating stations A and B, the fingers F–1, etc. are simultaneously withdrawn from the creases by actuation of the pneumatic unit 49 so that its piston pushes the common mounting plate 47 rearwardly to its dotted line position shown at dashed line 90 (FIG. 2). This action also withdraws unit 63 and its cams 59*a*, 59*b* and 59*c* rearward of the cam followers 57*a*, 57*b* and 57*c*. With the rearward movement of the mounting plate 47, the fingers are withdrawn from the recesses 35 by the link 45 action thereon via bracket 39 and carriage 41. Of course, when withdrawn, the fingers F–1, etc. are lifted to their upper positions by the springs 37.

Upon withdrawal of all of the fingers F–1, etc. at all of the pleating stations, the recesses 35 are now cleared so that the creases may be stapled to form pleats. As best seen in FIGS. 5 and 6 in conjunction with FIG. 2, by virtue of any suitable means (e.g., remote control, microswitches), the pneumatic unit 29 is actuated to lower all of the stapling guns 17 into the recesses 35 (dashed lines 90 FIG. 2) for each plurality of tines T–1 to T–4.

As shown in FIG. 1, FIG. 2 and FIG. 6 and FIG. 7, the stapling guns 17 are actuated simultaneously by pneumatic unit 15 to force staples 79 through the creases formed over the central tines T–2, T–3 at each station. Any "shrinkage" of the sheet due to stapling is taken up by the yielding action of take-up rollers 19. The resulting pleated sheet 31 is shown in FIG. 7. The pleats may be formed at or near an edge of the sheet depending upon the artistic effect desired.

After the stapling and resultant pleating, the pneumatic unit 29 is actuated to withdraw the stapling guns to their upper positions shown in FIG. 2. The upper end aligning rollers 69, 73 are raised, and the take-up rollers 19 are then lowered so that the sheet just pleated may be easily withdrawn and so that another sheet may be positioned for stapling.

It is to be understood that in the crease forming action described in conjunction with FIG. 5, the speed of successive movement of the fingers F–1, etc. may be adjusted to be faster or slower depending upon the characteristics of the material comprising the sheet to be pleated, e.g. the thickness, stiffness, coefficient of sliding friction, of the sheet. In those situations where the thickness, etc. of the sheet would inherently cause more resistance to pleating, the upper end aligning rollers may be controlled for movement upward during each creasing act.

It will be obvious to those skilled in the art that the dimensions and shapes of the various elements described hereinabove may be modified in accordance with the expected characteristics of the sheets to be pleated. The invention as depicted in the drawings and as described is intended to be for purposes of illustration rather than limitation, it being understood that equivalents and modifications will occur to those skilled in the art. Accord-

ingly, the scope of the invention is limited only by the appended claims:

What is claimed is:

1. Apparatus for forming pleats in a sheet of drapery material and the like comprising a base member, a frame member in said base member having a plurality of spaced pleating stations mounted on said frame member, each of said pleating stations having a plurality of fixed crease-forming elements defining channels, and a plurality of movable creasing elements, one for each respective channel; reciprocating means mounted on said frame member for moving said movable creasing elements vertically into said channels in ordered relation beginning with an interior movable element location and progressing successively outward in opposite directions from the interior location, element by element and station by station, until a sheet interposed between the fixed and movable elements is impressed with creases at at least a plurality of said stations, and stapler fastening means mounted for reciprocating movement at each of said stations for securing the creases at each of said stations to form a pleat at the said station.

2. Apparatus according to claim 1 wherein said reciprocating means includes means for moving said creasing elements essentially laterally into and out of registration with the channels, whereby said movable creasing elements may be withdrawn from the channels during fastening of the creases to form pleats.

3. Apparatus according to claim 2 but further comprising a plurality of sheet-supporting take-up rollers, one roller positioned between each pair of adjacent pleating stations and also outwardly of the outermost pleating stations, and support means mounting said rollers for up and down movement.

4. Apparatus according to claim 3 but further comprising a plurality of end-aligning, upper and lower opposingly oriented rollers rotatably mounted about axes which are perpendicular to, but in a plane parallel with, the plane of said crease forming elements, the edges of said end-aligning rollers being rounded to enable the sheet to slide non-catchingly thereover when said upper and lower rollers are brought together to engage the sheet.

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JORDAN FRANKLIN, *Primary Examiner.*