

Oct. 18, 1966

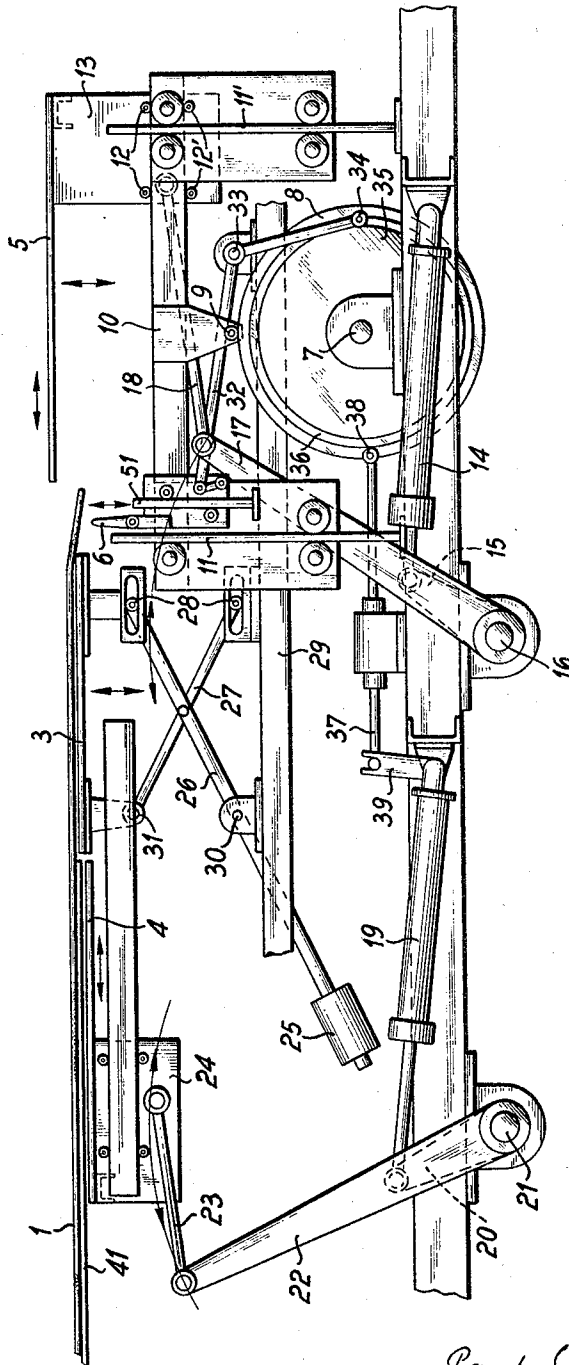
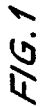
P. SCHWENDINGER

3,279,784

FOLDING APPARATUS HAVING LATERALLY MOVING PLEATING MEMBERS

Filed Nov. 10, 1964

2 Sheets-Sheet 1



INVENTOR

Paul Schwendinger

By Richard Hunt
Ag't

Oct. 18, 1966

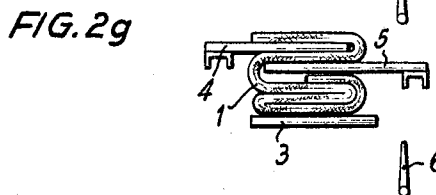
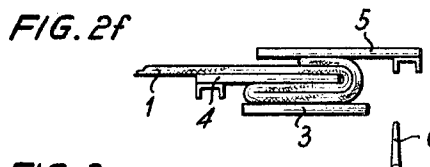
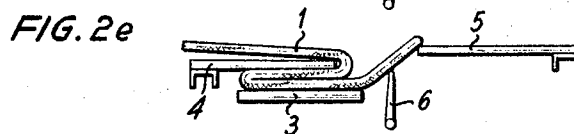
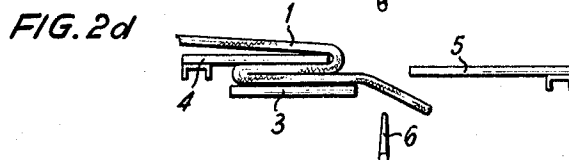
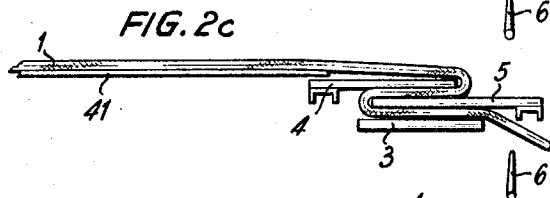
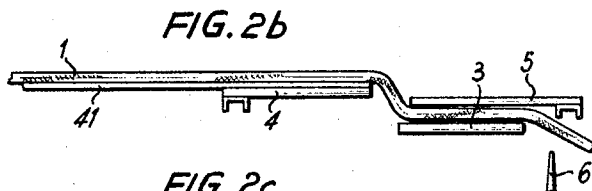
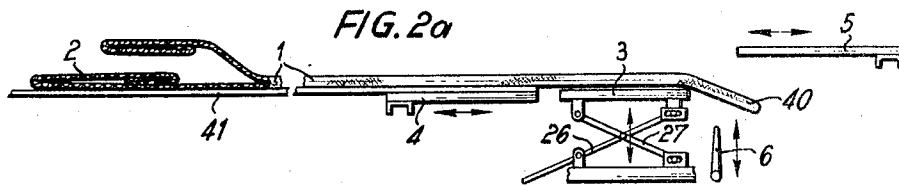
P. SCHWENDINGER

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2 Sheets-Sheet 2



INVENTOR

Paul Schwendinger

By Richard L. ...
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FOLDING APPARATUS HAVING Laterally MOVING PLEATING MEMBERS

Paul Schwendinger, Wiesental, Germany, assignor to
Spinnerei und Webereien Zell-Schonau Aktiengesellschaft, Wiesental, Germany, a corporation of Germany
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Claims priority, application Germany, Nov. 11, 1963,
S 88,239

5 Claims. (Cl. 270—79)

This invention relates to textile processing apparatus, and particularly to an apparatus for automatically folding substantially flat pieces of textile material.

The invention is more particularly concerned with the folding, prior to wrapping and shipment, of bending and similar textile goods which are sequentially released from automatic sewing plants in large numbers and are of uniform shape and size. Known folding arrangements rely at least in part on manual operation. Fully automatic folding apparatus has heretofore not been found practical because the known automatic devices cause distortion of the fabric during folding.

It is an object of the invention to provide fully automatic folding equipment for sequential folding of substantially flat pieces of textile material, such as sheets, pillow cases, and the like, which avoids distortion of the fabric during folding.

With this object and others in view, the invention, in one of its aspects provides a supporting table whose face is bounded by a horizontally elongated edge. A carrier which has an upwardly directed face is movable in a vertically extending path toward and away from a position in which the table face and the carrier face are substantially aligned on a common level and the carrier face is horizontally spaced from the table edge. The path of the carrier defines a folding station, and the carrier is yieldably biased upwardly in its path toward the aforementioned position.

A pleating member is arranged for movement in a horizontal path below the aforementioned common level between an operative position in the folding station and a retracted position. An operating edge of the pleating member faces toward the folding station in the retracted position, and two opposite horizontal faces extend from the edge in a direction away from the folding station.

A pressure member having an edge parallel to the edge of the pleating member, and two opposite horizontal faces connected by the edge is arranged for movement between a plurality of vertically spaced retracted positions remote from the folding station and a plurality of vertically spaced operative positions in the folding station. When in the retracted position, the pressure member is spaced from the folding station in a direction away from the supporting table, and its edge faces toward the table.

Synchronized movements of the pleating member and the pressure member are actuated by a common drive and control mechanism.

Other features and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description of a preferred embodiment in connection with the accompanying drawings wherein:

FIG. 1 shows a folding apparatus of the invention in side elevational section; and

FIG. 2 illustrates seven successive positions of a work piece and of the essential operating elements of the apparatus of FIG. 1 during the operation of the same.

Referring now to the drawing in detail, and initially to FIG. 1, there is shown a supporting table 41 which is a part of the stationary frame of the folding apparatus, the frame not being fully illustrated. The folding station

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of the apparatus is located adjacent one edge of the table 41. A horizontal carrier plate 3 is vertically movable at the folding station toward and away from the illustrated position in which the supporting faces of the table 41 and of the plate 3 are spacedly aligned in a common horizontal plane. A work piece 1 is placed on the two supporting faces and overhangs the carrier plate 3 in a direction away from the table 41.

A horizontal pleating plate 4 is mounted below the level of the table 41, and is horizontally movable between the illustrated retracted position in which the plate 4 is positioned under the table 41 and an operative position in which the plate 4 projects into the folding station.

A horizontal pressure plate 5 is arranged for vertical movement and also for horizontal movement from the illustrated inoperative position toward the table 41 into an operative position in which the plate 5 is located in the folding station.

The operating elements at the folding station further include a lifting comb 6 adjacent the edge of the carrier plate 3 remote from the table 41, and movable in a vertical direction only on a guide rod 51.

The mechanism for actuating the movements of the several operating elements in proper timed sequence is controlled by a main drive shaft 7 which rotates continuously at uniform speed during operation of the folding apparatus. The shaft 7 carries disk cams of which only three are illustrated in a conventional manner, and the actual contours of the cam faces of the three illustrated cams 8, 36, 35, and the nature of non-illustrated additional cams will readily be apparent from the operation of the apparatus, as described hereinafter.

A cam follower roller 9 is held in engagement with the cam 8 by the weight of a frame 10. Vertical movement of the frame is guided by guide rods 11, 11', of the stationary machine frame. Guide rollers 12, 12' travel on horizontal faces of the frame 10 and are attached to a bracket 13 which carries the pressure plate 5. Vertical movement of the plate 5 is thus actuated by the cam 8 during rotation of the shaft 7.

Horizontal movement of the plate 5 is actuated by a double-acting hydraulic cylinder 14 one end of which is pivoted to the machine frame. The piston rod which projects from the other end of the cylinder 14 is hingedly attached to the shorter arm 15 of a rocker whose shaft 16 is journaled in the machine frame. The longer arm 17 of the rocker is hingedly connected by a coupling rod 18 to the bracket 13.

The operation of the hydraulic cylinder is controlled in a manner conventional in itself by a slide valve which is connected by a cam follower to a disk cam on the shaft 7, the valve, follower, and cam not being shown for the sake of simplicity. The drawing also does not show the pump and sump tank of the hydraulic system.

The horizontal movements of the pleating plate 4 are actuated by a hydraulic cylinder 19 whose operation is controlled in a non-illustrated manner by a slide valve, cam follower, and cam as described hereinabove with reference to the cylinder 14. The closed end of the cylinder 19 is tiltably attached to the machine by engagement with a bearing rotatably arranged in a pillow block for movement about an axis spaced from the bearing axis, as not shown in detail in the drawing. The piston rod projecting from the open end of the cylinder 19 is linked to the shorter arm 20 of a rocker whose shaft 21 is journaled in the machine frame, and whose longer arm 22 is connected by a coupling rod 23 to a carriage 24. The carriage travels on horizontal tracks of the machine frame during operation of the cylinder 19, and the pleating plate 4 is fixedly mounted on the carriage.

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The carrier plate 3 is urged toward the illustrated position by a lazy-tong arrangement in which a counterweight 25 is mounted on one arm of a lever 26 pivoted on the machine frame by a pin 30. The center of the other arm is pivotally fastened to the center of another lever 27. Rollers 28 on respective free ends of the levers 26, 27 are guided in horizontal slots of guide plates respectively mounted on a beam 29 of the machine frame and on the underside of the carrier plate 3. The other free end of the lever 27 is hingedly attached to the plate 3 by a pivot 31. This arrangement guides the carrier plate 3 in a vertical straight path, and the counterweight 25 yieldably urges the plate 3 to move upward until movement is stopped in the illustrated position by an abutment (not shown).

Movement of the bearing which supports the cylinder 19 is actuated by the cam 36 on the shaft 7 which cooperates with a cam follower roller 38 on a rod 37. The rod is horizontally guided on the machine frame and its free end engages an arm 39 fixedly attached to the bearing for shifting the axis of angular movement of the cylinder 19. Tilting movement of the arm 39 thus shifts the range of reciprocating movement of the pleating plate 4 a small distance toward or away from the folding station.

The actuating mechanism of the comb 6 which is slidably mounted on the vertical guide rod 51 mainly consists of a rocker 33 pivotally mounted on the beam 29, a cam follower 34 on one arm of the rocker engaging the cam 35, and a linkage 32 which connects the rocker to the comb 6.

The several cams are contoured and arranged on the drive shaft 7 to actuate movements of the pleating plate 4, the pressure plate 5, and the lifting comb 6 in the manner evident from the following description of a folding cycle performed by the machine of FIG. 1 and illustrated in FIG. 2.

The work piece 1 is a bag of textile material such as a pillow case which is placed on the table 41 and the carrier plate 3 in such a manner that the closed bottom 40 of the bag overhangs the plate 3, whereas the open top 2 of the bag which is provided with hems rests on the table 41. The starting positions of the folding apparatus and of the work piece are shown in FIG. 2 at *a*.

In a first step, the pressure plate 5 moves horizontally into the folding station and then downward until it depresses the portion of the work piece located on the carrier plate 3, and the carrier plate itself against the resistance of the counterweight 25 to a level below the horizontal path of the pleating plate 4. The lower end of the workpiece is thus clamped between the carrier plate 3 and the pressure plate 5 under the force exerted by the counterweight 25, and an adjacent portion of the work piece extends upward to the level of the table 41 across the path of movement of the pleating plate 4, as shown at *b*.

The pleating plate 4 is next moved horizontally into the folding station while the bearing of the cylinder 19 is shifted toward the left, as viewed in FIG. 1, from its normal position. When the cylinder 19 completes its retracting stroke, the pleating plate 4 is located in the folding station, as shown at *c*, but not as far away from the table 41 as it would be if the cylinder supporting bearing had been in its normal position. Because of the clamping engagement of the carrier plate 3 and the pressure plate 5 on the lower end of the bag, the front edge of the pleating plate 4 folds the work piece over the front edge of the pressure plate 5, thereby pulling the remainder of the workpiece on the table 41 toward the folding station.

The pressure plate 4 may now be withdrawn, as shown at *d*, and the counterweight 25 lifts the carrier plate 3 approximately by the thickness of the pressure plate 5 to clamp a folded double layer of the workpiece to the underside of the pleating plate 4.

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The comb 6 next is raised sufficiently so that its discontinuous top edge lifts the bottom 40 of the bag above the horizontal path of the pressure plate 5 which is simultaneously lifted above the fixed horizontal path of the pleating plate 4, as is illustrated at *e*.

While the comb 6 returns to its starting position, the pressure plate 5 moves horizontally into the folding station, and downward to press the bottom 40 of the bag 1 against the top layer of the partly folded material, as shown at *f*.

As not illustrated in detail, the pleating plate 4 is next retracted, and the three stacked layers of the bag 1 and the folded bottom 40 are pushed downward together with the carrier plate 3 against the resistance of the counterweight 25 until a position analogous to that of position *b* is reached, and a portion of the workpiece 1 extends vertically across the fixed horizontal path of the plate 4. Movement of the pleating plate 4 inward of the folding station produces another pair of folds in the manner described with reference to stage *c*, but the pivot of the cylinder 19 is in its normal position during the last-mentioned movement of the plate 4 so that the terminal position of the front edge of the pleating plate is farther away from the edge of the table 41 than is shown in stages *c* to *f*. The last-formed fold is therefore vertically aligned with the fold of the tucked-in bag bottom 40, as is evident from the showing at *g*.

The remainder of the bag is laid into stacked layers connected by folds in as many operating cycles as are needed, each cycle including the following sequence of steps:

- (1) Downward movement of the pressure plate 5 in the folding station against the biasing force of the counterweight 25 to a level below that of the fixed horizontal path of the pleating plate.
- (2) Horizontal movement of the pleating plate into the folding station.
- (3) Horizontal retraction of the pressure plate 5 from the folding station, followed by upward movement beyond the path of the pleating plate, and movement into the folding station into engagement with a layer of fabric on top of the pleating plate.
- (4) Retraction of the pleating plate from the folding station.

While the bag bottom 40 was tucked-in between the third and fourth layer of the folded material in the illustrated mode of operation of the apparatus, it will be appreciated that such tucking-in may be omitted, if so desired, or that an overhanging end of a workpiece may be tucked into the stacked layers of material at any other suitable stage of the folding operation. The cams on the shaft 7 are preferably designed to perform all the operations on one workpiece during a single revolution of the shaft. When the first workpiece is finished, the plates 4, 5 are retracted and the workpiece is replaced by another piece which is located as shown in FIG. 2 at *a*.

The width of the table 41 and of other elements of the folding apparatus, not evident from the drawing, is selected greater than that of the workpiece, and the stacked and folded piece obtained after completion of the illustrated operations may next be turned 90° and again placed on the table 41 and the carrier plate 3 for one or more additional folding steps transverse to the illustrated folds. In commercial operations, it is generally more economical to employ a second folding apparatus for the transverse folds for long runs. But for relatively short runs, the disk cams on the shaft 7 of a single machine may be contoured to control consecutive folding in two directions.

The plates 3, 4, 5 and the table 41 have been shown in the drawing to be imperforate sheet elements, but it will be appreciated that continuity of the top and bottom faces and of the operating edges of these elements is not necessary. They may be slotted to constitute combs similar to the lifting comb 6, and the slots may extend in the direc-

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tion of their horizontal movement or in any other direction. Conversely, the comb 6 may be replaced by a solid plate without affecting the basic operation of the apparatus. It is advantageous to provide the pressure plate 5 with slots elongated in the direction of horizontal plate movement, the slots being positioned and dimensioned to receive the teeth of the comb 6. In such an arrangement, the comb 6 does not interfere with the movements of the pressure plate 4, and the movements of the comb can be controlled more freely.

The surface finish of the plates 3, 4, 5 must be smooth enough to avoid undue friction between the fabric of the workpiece and the plate faces which would cause distortion of the fabric, and such a finish is readily achieved by polishing. The counterweight 25 is selected heavy enough to achieve secure clamping of the fabric between the smooth faces of the carrier plate 3 and the cooperating plates 4, 5.

It should be understood, of course, that the foregoing disclosure relates to only a preferred embodiment of the invention, and that it is intended to cover all changes and modifications of the example of the invention herein chosen for the purpose of the disclosure which do not constitute departures from the spirit and scope of the invention set forth in the appended claims.

What is claimed is:

1. A folding apparatus comprising, in combination:

- (a) support means having a horizontally elongated edge portion and defining a table face extending from said edge portion in a predetermined horizontal direction transverse of the direction of elongation of said edge portion;
- (b) a carrier member having an upwardly directed carrier face and movable in a path extending transversely of said carrier face toward and away from a position in which said table face and carrier face are spacedly substantially aligned on a common level in said predetermined direction, said path defining a folding station;
- (c) yieldable biasing means urging said carrier member to move upwardly in the path thereof into said position;
- (d) a pleating member having an operating edge elongated transversely of said predetermined direction and two opposite faces extending from said edge in said direction,
 - (1) said pleating member being arranged for movement in a path below said common level between an operative position in which said pleating member is in said folding station and a retracted position spaced from said operative position and the folding station in said predetermined direction;
- (e) a pressure member having an operating edge elongated transversely of said predetermined direction and two opposite faces extending from said edge in a direction opposite to said predetermined direction,
 - (1) said pressure member being arranged for movement between a plurality of retracted positions spaced from each other in the direction of movement of said carrier member and spaced from said folding station in said opposite direction, and a plurality of operative positions in said folding station and spaced from respective ones of said retracted positions thereof in said predetermined direction; and
- (f) actuating means connected to said pleating member and said pressure member for actuating said movements thereof between the respective positions thereof in timed sequence.

2. An apparatus as set forth in claim 1, wherein said actuating means include means for first moving said pressure member in the folding station downward toward the carrier member to a first operative position at a level below the path of said pleating member, while said pleating

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member is in the retracted position thereof; for thereafter moving said pleating member into the operative position thereof; for then moving said pressure member into a first retracted position spaced from said first operative position in said opposite direction; for thereafter moving said pressure member from said first retracted position toward a second retracted position upwardly spaced from said path of the pleating member, and thence toward a second operative position upwardly spaced from said common level.

3. An apparatus as set forth in claim 1, further comprising a lifting member having a horizontally elongated upper edge portion extending transversely of said predetermined direction and arranged for movement in a path spaced from said folding station in said opposite direction, and extending in the direction of said carrier member, said lifting member being connected to said actuating means for actuation of said movement of said lifting member by said actuating means in timed sequence with the movements of said pleating member and of said pressure member.

4. An apparatus as set forth in claim 3, wherein said lifting member and said pleating member are each formed with a plurality of slots elongated in the respective directions of movement of said members, the slots of one member being offset transversely of said directions of movement from the slots of the other member and dimensioned for interengagement of portions of each member with the slots of the other member during said movements thereof.

5. A folding apparatus comprising, in combination:

- (a) a supporting table having a substantially horizontal face;
- (b) a carrier having a substantially horizontal carrier face and arranged for movement in a vertically extending path toward and away from a position in which said carrier face and said table face are substantially aligned on a common level and spaced from each other, said path defining a folding station;
- (c) yieldably resilient means permanently urging said carrier to move upward in said path toward said position;
- (d) a pleating plate having two opposite substantially horizontal faces and an operating edge between said faces, said pleating plate being arranged for movement in a substantially horizontal path below said level between an operative position in said folding station and a retracted position in which said pleating plate is spaced from said station and at least partly arranged below said table, the operating edge of said pleating plate being elongated transversely of the path thereof and facing toward said folding station when the pleating plate is in said retracted position;
- (e) a pressure plate having two opposite horizontal faces and an operating edge between said faces and substantially parallel to the operating edge of said pleating plate, said pressure plate being arranged for movement in a vertical and horizontal direction between a plurality of operative positions in said folding station and a plurality of retracted positions spaced from the folding station in a direction away from the table, said operative and retracted positions being each vertically spaced from the other operative and retracted positions respectively; and
- (f) actuating means for actuating synchronized movement of said plates between the respective positions thereof.

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EUGENE R. CAPOZIO, *Primary Examiner.*