# United States Patent [19]

**Hogendyk**

[11] **3,790,156**

[45] **Feb. 5, 1974**


[54] **TEXTILE FOLDING MACHINE**


[76] Inventor: **Warren Hogendyk,** 4017 Bell N.E., Grand Rapids, Mich. 49505



[22] Filed: **Feb. 1, 1971**

[21] Appl. No.: **111,257**

[52] **U.S. Cl.** ..... **270/30,** 270/79

[51] **Int. Cl.** ..... **B65h 29/46**

[58] **Field of Search** ..... 270/79, 30, 39; 53/117; 270/31



[56] **References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 3,697,062 | 10/1972 | Mones | 270/30 |
| 2,761,678 | 9/1956 | Cohn et al. | 270/79 |
| 2,098,427 | 11/1937 | Menschner | 270/79 |
| 3,165,311 | 1/1965 | Mitchell | 270/79 |
| 8,005 | 4/1851 | Boots | 270/30 |



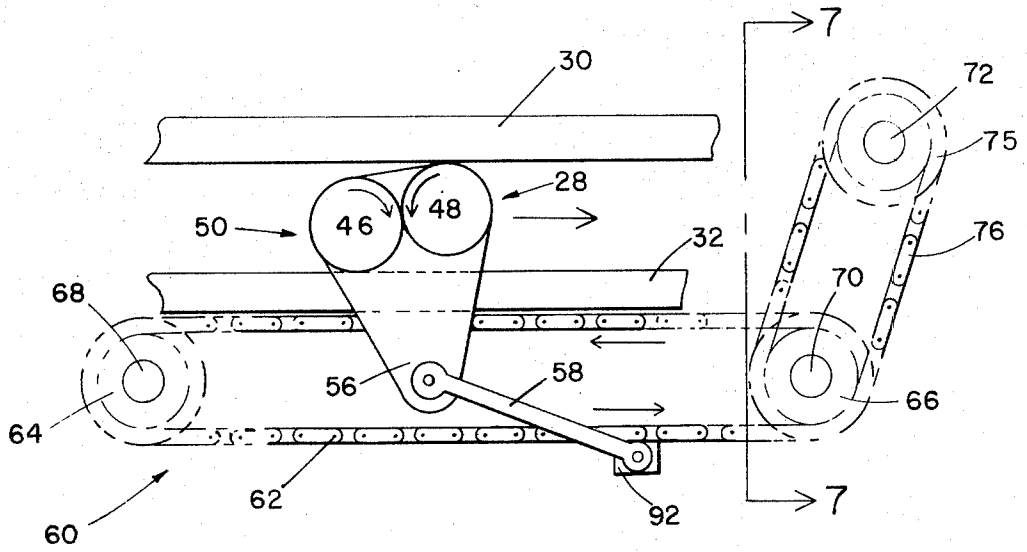
*Primary Examiner*—Robert W. Michell
*Assistant Examiner*—A. Heinz
*Attorney, Agent, or Firm*—Price, Heneveld, Huizenga & Cooper



[57] **ABSTRACT**

This disclosure relates to a folding machine and specifically to an apparatus for folding textile or like products in a serpentine or sinuous fashion. Textile products, after having been processed and normalized in the conventional fashion, may be folded for storage, shipment, or further processing purposes. This is accomplished in a folding machine having a pair of rollers arranged for reciprocating movement above a table surface to lay the fabric in a serpentine fashion on the table. The reciprocating rollers are driven by a pair of drive wheels at the ends of the rollers and mounted in horizontal track members having top and bottom drive wheel engaging surfaces. The drive wheels are pivotal within the track member on a yoke assembly so that the direction of travel of the rollers with respect to each other remains constant even as the direction of travel of the yoke assembly changes.


**19 Claims, 10 Drawing Figures**



PATENTED FEB 5 1974

3,790,156

SHEET 1 OF 4

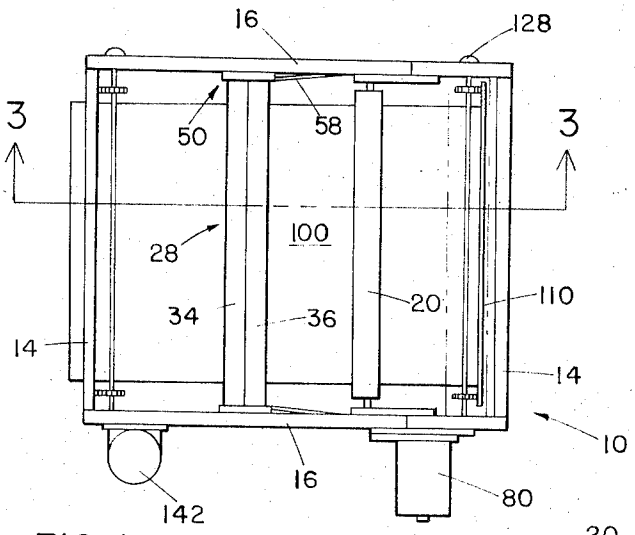



FIG. 1

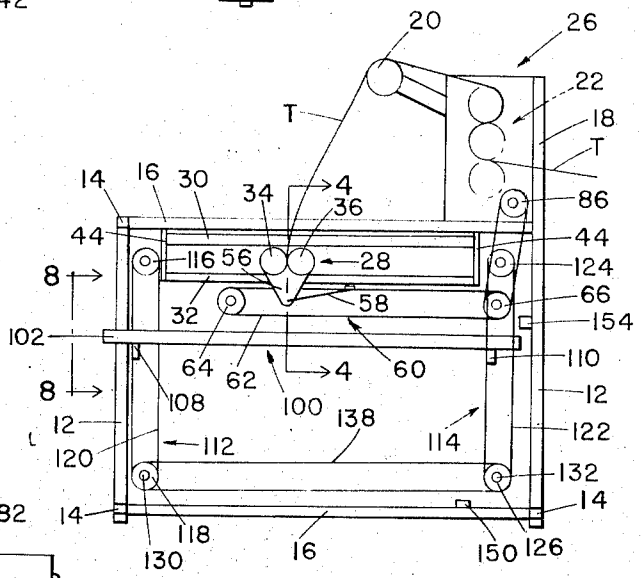



FIG. 3

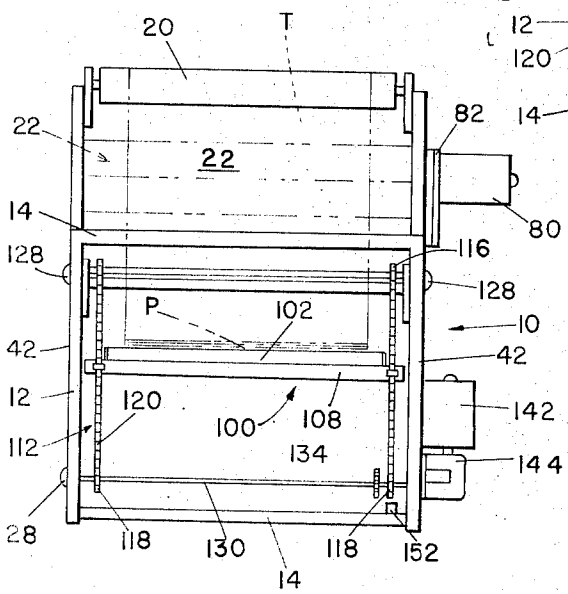



FIG. 2

INVENTOR.
WARREN HOGENDYK
BY Price, Heneveld, Huizenga & Cooper
ATTORNEYS

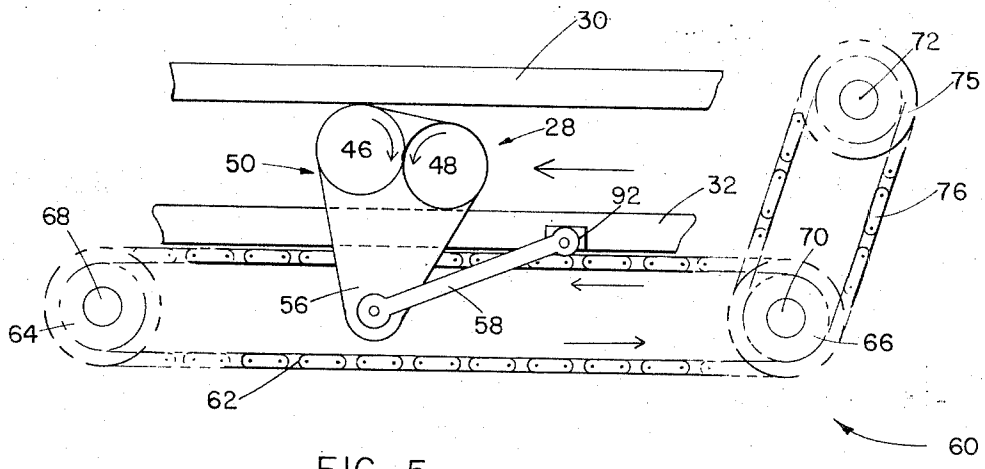



FIG. 5

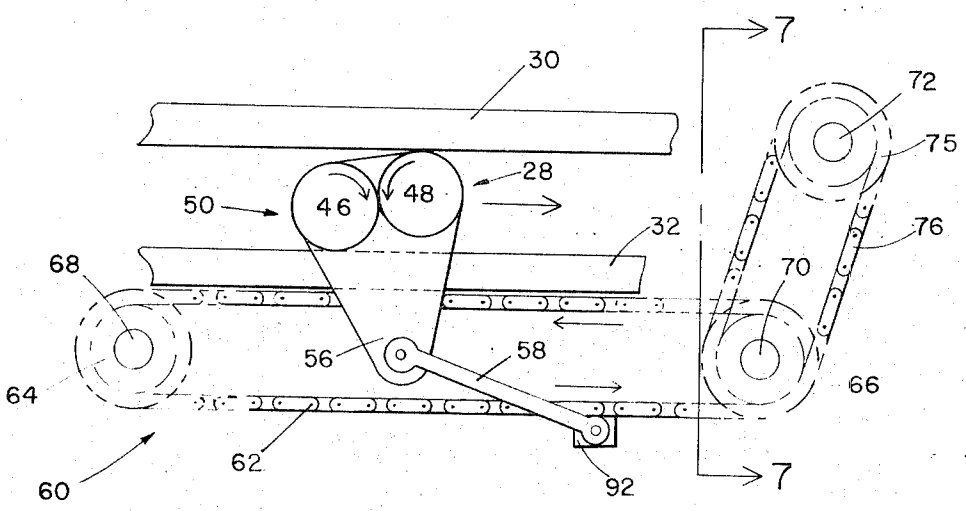



FIG. 6

INVENTOR.
WARREN HOGENDYK
BY Price, Heneveld, Huizenga & Cooper
ATTORNEYS

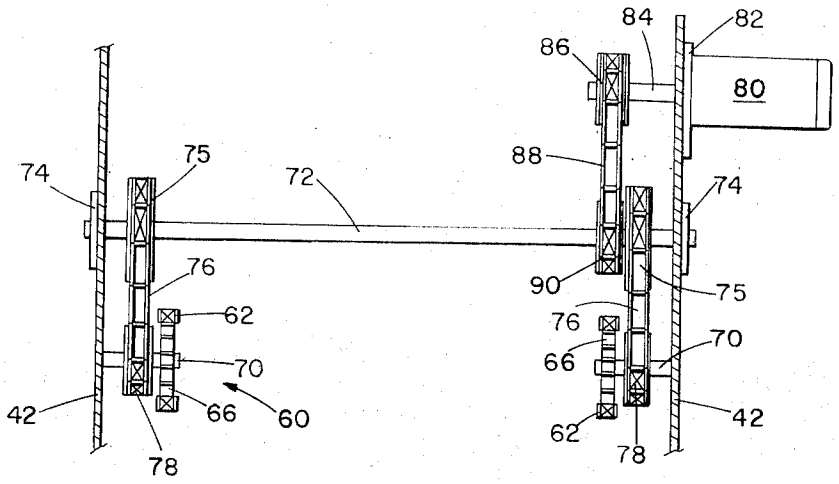



FIG. 7

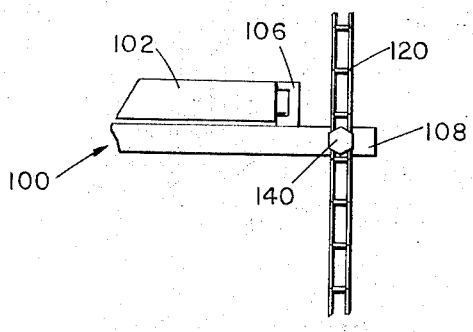



FIG. 8

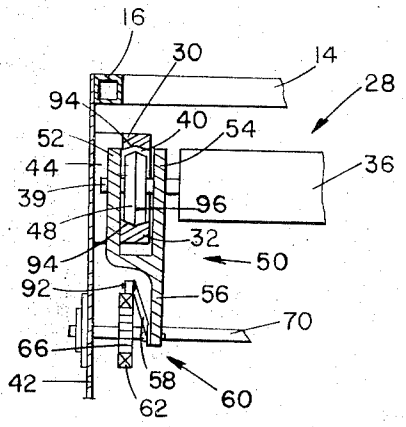



FIG. 4

INVENTOR.
WARREN HOGENDYK
BY Pierce, Howard, Hulbert & Cotter
ATTORNEYS

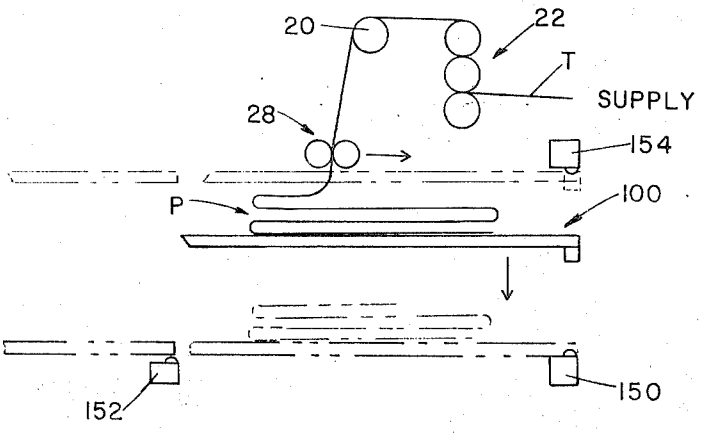



FIG. 9

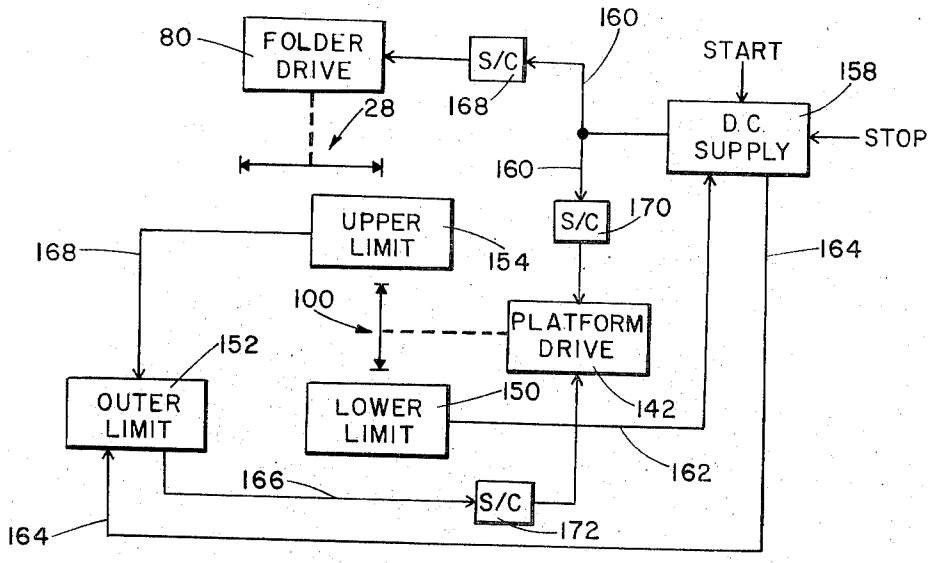



FIG. 10

INVENTOR.
WARREN HOGENDYK
BY Price, Heneveld, Huizenga & Cooper
ATTORNEYS

# TEXTILE FOLDING MACHINE

## BACKGROUND OF THE INVENTION

When processing textile products, prior to their use in the manufacture of finished articles of clothing or similar articles, the textile is generally processed by calendering and then either rolled into a large roll or folded in serpentine fashion into flat packages.

When patterns are to be cut from the fabric, the material is placed on a long table in many layers, and a plurality of patterns are cut at one time. It has been found that material which has been stored on rolls tends to stretch, thereby causing registration problems when the cut patterns are matched. Obviously, the most desirable method of storing and transporting material, then, is to have it in folded form.

Most convenient prior art folding machines generally comprised a pair of rollers on a vertical support fixed above a table which traveled in a back and forth reciprocating motion under the rollers. The material was drawn through the rollers at a constant rate and as the table moved from one direction to another, the material was deposited, layer on layer, in serpentine fashion. As the material piled higher on the table and as the direction of travel changed, the inertia of the piled material would cause the pile to slip from side to side, resulting in uneven piles. Flapper boards were sometimes provided at the ends of the table to hold the stack at the end of each stroke of the machine. Because of mechanical considerations, the speed of the table was generally limited. At best about 27 yards per minute was the maximum processing speed. As greater demand for textile products has increased, new processing machinery has been developed for the production of textiles. Synthetic materials capable of being processed in extremely rapid fashion have also been introduced. Obviously, the slow reciprocating tables in folding machines of times past must be replaced. Folding rates of 50, 60, or even more yards per minute have become desirable.

## SUMMARY OF THE INVENTION

I have solved the problem of the prior art machines and have now provided a folding machine having relatively few moving parts as compared to the old style machines.

Basically, my invention comprises a pair of horizontally mounted rollers mounted for reciprocation above a table. The rollers are driven by each other and draw the material between them to lay it on the table in serpentine fashion. The rollers are mounted at their ends along the sides of the table on a pair of yoke members which also hold drive wheels connected by a shaft to the center shaft of the rollers. The yoke assembly is connected through a linkage to a driving mechanism to impart reciprocating motion to the rollers and a pivotal motion to the yoke.

As the assembly travels in a first direction, one of the drive wheels is driven along the lower portion of the track member while the other of the drive wheels is driven along the upper portion. The rolls are constantly counter-rotated toward each other from the center downwardly to draw the material between them and deposit it on the table. As the direction of travel of the assembly is reversed, the yoke assembly pivots causing the drive wheels to reverse positions with respect to the upper and lower track members. This maintains the direction of roller rotation in the same direction to continuously lay the material in a folded fashion on the table.



As a further feature of my invention, I have provided a means for automatically lowering the table as the material is piled thereon. The table lowers and as it reaches the lower limit of travel, a limit switch stops the operation of the reciprocating rolls. The table is additionally mounted on a track so that it may be slid out from under the rollers and automatically raises for ease in unloading. The table may then be slid back in the housing below the reciprocally mounted rollers and another pile of material may be folded thereon.

It is, therefore, a primary object of my invention to provide an automatic folding machine for textile products.

It is another object of my invention to provide a folding machine wherein the material to be folded is moved back and forth along the surface upon which it is to be folded.

It is yet another object of my invention to provide a pair of rolls mounted for reciprocation in a track which rollers are driven toward each other in the same direction regardless of direction of reciprocation.

A further significant object of my invention is to provide a horizontally mounted vertically movable table to receive the folded material.

Another object of my invention is to provide a horizontally mounted, vertically movable table to receive the folded material which moves downwardly as the material is folded and piled thereon.

Another object is to provide, in a folding machine, horizontally mounted, reciprocating material carrying and depositing rollers having a variable speed.

It is another object of my invention to provide a folding machine considerably simplified and having many less parts than prior folding machines.

These and other objects of this invention will be readily understood with reference to the following specification and accompanying drawings wherein:

FIG. 1 is a top plan view of my invention;

FIG. 2 is a front elevational view thereof;

FIG. 3 is a cross sectional view taken along plane 3—3 of FIG. 1;

FIG. 4 is a cross sectional view taken along plane 4—4 of FIG. 3 showing the roller drive mechanism;

FIG. 5 is a somewhat schematic view illustrating the roller and driving mechanism in a first material depositing position;

FIG. 6 is a view similar to FIG. 5 showing the roller and drive mechanism in a second material depositing position;

FIG. 7 is a cross sectional view taken along line 7—7 of FIG. 6 showing the drive mechanism for the reciprocating roller assembly;

FIG. 8 is a view taken along line 8—8 of FIG. 3 illustrating the mounting of the material receiving platform;

FIG. 9 illustrates in schematic form the operation of the invention; and,

FIG. 10 is a block diagram illustrating the electrical system of the invention.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings and to FIGS. 1 through 3 in particular, the framework indicated gener-

ally by the numeral **10** forms a boxlike structure closed at the sides and opened at the top and front end. The framework **10** is best shown in FIG. **2** as having a plurality of upright support members **12** and upper and lower horizontal bracing members **14** spacing the sides apart. Transversely extending horizontal bracing members **16** extend along the length of the framework at the top and bottom of the sides. At the rear of the machine (to the right as viewed in FIG. **3**), the upright support members **12** may for convenience be extended upwardly as indicated at **18** above the top surface of the apparatus and forms a back support for an idler roller **20** and a calender roll assembly **22** which may be used in conjunction with the folding machine. The calender roll assembly **22** is (shown in phantom in FIGS. **1** and **2**) supported in a frame assembly **26** (FIG. **3**) extending from and supported on the back support **18.** It is understood, of course, that the calender assembly **22** forms a convenient adjunct to the invention but is not necessarily a part thereof.

The material depositing roller assembly **28** is mounted for reciprocation along the length of the framework **10** on pairs of upper and lower track members **30** and **32** respectively, located on the sides of the framework. As shown in FIGS. **3** and **4**, the track members are held in a parallel spaced apart relationship and from the sidewalls **42** of the framework by vertically extending brackets **44** which are fixed to the sidewalls and to the track members in any convenient fashion. The individual rollers **34** and **36** are preferably made of a polyurethane material formed around their respective shafts **38** and **39.** The shafts extend from the ends of the roller and are supported for rotation between the track members **30** and **32** on drive wheels **46** and **48** (FIGS. **4, 5,** and **6**), which preferably are also formed of polyurethane. As shown in FIG. **4**, the drive wheels have a diameter slightly smaller than the distance between the upper and lower track members leaving, when in an at rest position, a slight gap **40** between the wheel and the upper track member **30.**

The rollers **34** and **36** are held in a frictionally engaging position by their respective shafts **38** and **39** which are supported with their respective drive wheels in a yoke support assembly **50.** The yoke comprises a member having upstanding sidewalls **52** and **54** forming a U-shape. An arm member **56** depends from the bottom and side of the U for pivotal connection with a connecting link **58.** The drive wheels **46** and **48** are positioned between the U-shaped sides of the yoke and are fixed to the shaft. As they are moved along the track members, they cause a corresponding rotation of the rollers **34** and **36.**

The rollers **34** and **36** are arranged to be driven along the length of the framework in a reciprocating motion. This reciprocating movement is accomplished by means of a drive mechanism **60** which comprises an endless chain **62** (FIGS. **3, 5,** and **6**) passed over a pair of sprocket wheels **64** and **66** which are rotatably mounted on a pair of shafts **68** and **70** fixedly mounted to the sidewalls **42** of the framework.

It is understood, of course, that all mechanisms described in connection with the depositing roller assembly **28** are located on each side of the apparatus and for convenience are being described with respect to one side (as shown, for example in FIG. **3**) only.

The drive assemblies **60** located on either side of the frame are driven from a common driveshaft **72** (FIG. **7**) extending across the framework and fixed in bearings **74** in the sides **42** of the framework. A pair of sprocket wheels **75** fixed to and rotatable with the driveshaft **72** are connected by a drive chain **76** to drive sprockets **78** fixed to the drive assembly shaft **70.** A variable speed drive motor **80** is fixed to one sidewall **42** of the framework **10** and drives, through a gear reducer **82,** shaft **84** extending inside the framework. The sprocket wheel **86** is fixed to the shaft and is connected through a drive chain **88** to a sprocket wheel **90** fixed on shaft **72.**

A connecting link **58** is pivotally attached at one of its ends to the arm **56** of the yoke assembly **50.** The other end of the link **58** is pivoted to a block **92** which is fixed to the chain **62** of the drive mechanism **60.**

As the variable speed motor **80** is energized, the rotary motion is transmitted from the motor through gear reducing unit **82** (FIG. **7**), driveshaft **72,** through the drive chain **76** to turn shaft **70** upon which is fixed the drive sprocket **66** of the reciprocal drive mechanism **60.** Idler sprocket wheel **64** is rotatable on shaft **68** and supports the chain **62** as it rotates. As the drive mechanism **60** (FIG. **5**) is rotated in a counterclockwise direction as indicated by the arrows on the drawing, the depositing roller assembly **28** is urged to the left through the link **58** connected to the chain **62** by block **92.** As the block on the chain passes over the idler sprocket **64,** the drive chain continues to move in the same direction as indicated by the arrows in FIG. **6.** The roller assembly **28,** however, reverses its direction and moves toward the right. As the block **92** passes over the drive sprocket **66,** the roller assembly will again reverse direction and travel toward the left.

Obviously, as the direction of travel of the depositing roller assembly changes, it would be normal for the direction of rotation of the individual rollers and drive wheels **46** and **48** to also change. In my invention, however, it is necessary to maintain the rotation of the depositing rollers in the same direction, that is, toward each other from the top through the center and downwardly to draw the material to be folded through them in the same direction as the assembly is reciprocated.

To accomplish this, I have provided a unique assembly for supporting the drive wheels **46** and **48** between track members **30** and **32** to maintain the direction of rotation of the rollers in a constant direction as they are reciprocated back and forth. Looking specifically at FIG. **5** as the roller assembly **28** is moved toward the left by drive chain **62** acting through pivoted link **58,** the yoke assembly is seen to tip or pivot slightly in a clockwise direction causing drive wheel **46** to engage the upper track member **30** while at the same time drive wheel **48** contacts the lower track member **32.** As indicated by the arrows on the figures, drive wheel **46** rotates in a clockwise direction while drive wheel **48** rotates in a counterclockwise direction. If the reciprocating motion were to be reversed at this point and the contact of drive wheels **46** and **48** were to be maintained with the track members **30** and **32** respectively, the rotation of the rollers would be reversed. Instead, however, as the block **92** travels with the chain **62** over the idler sprocket wheel **64** pushing the roller assembly **28** to the extreme right and continuing its travel in the opposite direction (that is, to the left), the yoke assembly pivots in the opposite direction as shown in FIG. **6.** As there indicated, the chain **62** continues to move in the same direction but block **92** is traveling on the

lower portion of the chain below the sprocket wheels 64 and 66 and is moving to the right. The yoke assembly by virtue of its pivoted connection through link 58 to block 92 is now being pulled to the right by the chain 62. The yoke 50 is seen to pivot or tip in the opposite direction from that shown in FIG. 5. Drive wheel 46 is moved downwardly to frictionally engage track member 32 and drive wheel 48 is urged upwardly thereby frictionally engaging upper track member 30. As indicated by the arrows on drive wheels 46 and 48 in FIG. 6, the direction of rotation of the drive wheels (and the rollers 34 and 36 to which they are attached) continues in the same direction, that is, toward each other from the top, and downwardly.

Turning again briefly to FIG. 4, the upper track member 30 and lower track member 32 are shown as having a V-shaped groove 94 machined into the surface which engages the drive wheels 46 and 48. The drive wheels are similarly shown to have a correspondingly shaped outer diameter 96 to match with the grooves in the track members. The groove in the tracks and the corresponding projections on the wheels are ideally approximately 10 degrees and provide a self-centering feature. The rollers 34 and 36 which are connected by their shafts 38 and 39 to the drive wheels are prevented from moving laterally with respect to each other.

Turning again to FIGS. 1 through 3 and 8, a horizontally mounted material receiving platform 100 is located below the reciprocating roller assembly 28. The platform 100 has a tablelike top surface 102 mounted in a conventional drawerlike fashion between a pair of channel members 106. The channel members 106 extend along the length of the table 102 and are supported by vertical cross support members 108 and 110 at the front and rear of the apparatus.

The cross support members 108 and 110 are each supported for vertical movement within the framework. Front cross support member 108 is fixed at the front of the apparatus on a chain assembly 112 and cross member 110 is supported on a similar chain assembly 114 at the rear thereof. Chain assembly 112 comprises an endless chain 120 vertically mounted at the front of the apparatus (to the left as viewed in FIG. 3) on sprocket wheel 116 located at the upper portion of the apparatus, and a sprocket wheel 118 located near the lower portion.

At the rear of the apparatus, (to the right in FIG. 3) chain assembly 114 similarly has an endless chain 122 mounted over a pair of sprocket wheels 124 and 126 located at the upper and lower portions of the apparatus respectively.

Each pair of sprocket wheels 116, 118, 124, and 126 are fixed to rotatable shafts which are mounted in bearings 128 on the sidewalls 42 of the framework 10. The lower rotatable shaft 130 at the front and shaft 132 at the rear rotate with each other and at the same speed by means of a sprocket wheel 134 fixed on the front lower shaft 130 and a similar sprocket fixed to the rear lower shaft 132. A chain 138 connects the two shafts through the sprocket wheels.

The cross support members 108 and 110 upon which the table surface is mounted are fixed by suitable fastening means 140 (FIG. 8) to the chains 120 and 122. A variable speed reversible motor 142 having a gear reducer 144 (FIGS. 1 and 2) is connected to shaft 130 to cause it to rotate. As shaft 130 is rotated, the sprockets 118 and 126 will travel with it causing the chains 120 and 122 to move over the upper sprocket wheels. The horizontal platform 100 because of its connection to the chains through cross brace members 108 and 110 will move with the chain vertically, either upwardly or downwardly depending upon the direction of rotation of shaft 130.

As the platform 100 moves vertically downwardly, a limit switch 150 fixed in the lower framework is contacted. The limit switch is connected in a circuit (to be described in greater detail in connection with FIGS. 9 and 10) with motors 80 and 142 and when contacted is opened to stop operation of both motors. At its lower limit, the table surface 102 may be pulled, drawerlike, horizontally out of the framework. A second switch 152 connected in a circuit with the platform controlling motor 142 is closed as the platform is moved outwardly from the framework 10 and energizes the motor 142 causing the platform to move upwardly. Limit switch 154 senses the upward travel of the platform 100 and is connected to platform motor 142 to stop the upward vertical travel of the platform 100 as it reaches its upward limit of travel.

A block diagram illustrating the electrical system of the invention is presented in FIG. 9. As shown, the folding and depositing rollers are illustrated by the horizontal arrows 28 driven in a reciprocating manner by variable speed drive motor 80. The material receiving platform is indicated by the vertical arrows 100 and is driven in a vertical direction by the variable speed and reversible drive motor 142. The platform is moved vertically between upper limit switch 154 and lower limit switch 150. Limit switch 152 is provided to sense the horizontal outward movement of the platform.

I find it most convenient to convert the power into a direct current supply for the operation of variable speed and reversible motors. This, of course, may be done in any convenient and conventional fashion, for example, through the use of silicon controlled rectifiers.

When started, the table 100 is normally in an upward position. As the platform drive motor 142 and folder drive motor 80 commence their respective operation, DC power is supplied through line 160 from the supply 158. Motor speed may be adjusted by varying the voltage supplied thereto through the use of conventional variable resistence devices 168, 170, and 172. As the folder operation progresses, the platform 100 is moved downwardly until contact is made with lower limit switch 150. A signal from the limit switch is supplied via line 162 to the power supply, cutting off the current supplied to the drive motors 80 and 142.

The table may then be moved horizontally outwardly out of the framework and contacts limit switch 152 to supply a reverse polarity current imput from the DC supply source 158 via line 164 through the switch 152 and line 166 to vertical drive motor 142. By virtue of the reversed polarity, drive motor 142 operates in a reverse direction moving the platform upwardly until it contacts the upper limit switch 154. When contact is made with upper limit switch 154, a signal through line 168 to limit switch 152 removes the power from the reversible drive motor 142 and the apparatus is in readiness for the next folding and depositing cycle.

## OPERATION

The folding pattern and basic operation of the apparatus are illustrated somewhat schematically in FIG. 9.

The textile indicated by the letter T is funished from a supply either in bulk form from rolls or from the knitting and weaving machine itself.

The material is passed between the rolls of the calender assembly **22** over the idler roll **20** and downwardly through the depositing roller assembly **28** where it is laid in a folded, serpentine fashion on the platform **100.** As the depositing rolls reach the end of their travel in a first horizontal direction, the material is folded over on itself as the horizontal movement of the rollers continues in the opposite direction. The speed of the reciprocating movement of the depositing rolls **28** is, as previously mentioned, variable with the drive motor **80.** The speed at which the machine will be operated, of course, is dependent upon the particular textile which is being folded. When the apparatus is operated in conjunction with calender rolls such as those shown at **22,** the motor **80** may also be utilized to drive the calender rolls so that the speed of the depositing rolls and calender rolls **22** are at the same rate to prevent stretching of the fabric.

As the depositing roller assembly **28** continues its reciprocating movement, laying and folding the material on the platform, the platform is slowly, moving vertically downwardly to prevent the pile (indicated at P) from building up into the roller assembly **28.** The vertical travel of the table is also variable and is normally moved downward at a rate proportional to the depositing rate so that the distance between the top of the folded pile P and the depositing rollers **28** remain reasonably constant.

As the depositing rollers **28** complete their reciprocating motion back and forth above the platform **100,** folding the textile thereon, the platform moves downwardly until contact is made with limit switch **150.** When switch **150** opens, both platform drive motor **142** and reciprocating drive motor **80** are stopped. The material may then be cut below the rollers **28** and the table surface **102** with the textile piled and folded thereon be slid horizontally outwardly (to the left as viewed in FIG. 3). As the table is moved outwardly, contact is made with switch **152** closing the circuit to reversible vertical drive motor **142.** The motor reverses its direction from that described previously causing the table to be moved upwardly as shown in phantom until the platform cross support member **110** contacts limit switch **154** which again opens the circuit to drive motor **142** stopping the upward movement of the platform.

At this point, the pile and folded material has been moved upwardly to a convenient working level and may be removed from the extending table **102.** After the textile has been removed, the table may be pushed back into the framework on channel members **106** of the platform. The apparatus may then be once again started and the depositing and folding cycle begins again.

In view of the foregoing description, it should be readily apparent to those skilled in the art that I have provided a folding machine which is relatively simple in construction, utilizing far fewer parts than prior art folding machines, is fully automatic in operation and which additionally may be operated at folding speeds far in excess of those now obtainable in present day machines.

While the preferred embodiment of this invention has been illustrated in detail, it will be apparent to those skilled in the art that many modifications may be made without departing from the concepts disclosed herein. Such modifications are to be considered as included in the following claims unless these claims by their language expressly state otherwise.

I claim:

**1.** Apparatus for folding sheet material in serpentine fashion onto a support surface comprising, in combination: a support frame; upper and lower longitudinal guide rails mounted on said support frame and spaced from each other in a common plane; a carriage movable along and intermediate said guide rails, said carriage including a pair of material feeding rollers interconnected to each other by a yoke means, said rollers forming a nip through which said sheet material is fed, the vertical spacing between the upper and lower guide rails exceeding the diameter of each individual roller, said yoke means and rollers being pivotal relative said guide rails whereby when said carriage is moved along said rails in one direction, one of said rollers frictionally engages the upper guide rail for driving engagement therewith while the other of said rollers frictionally engages the lower guide rail for driving engagement therewith and when said carriage is moved along said rails in the opposite direction, the other of said rollers is in friction engagement with said upper rail while said one of said rollers is in friction engagement with said lower rail whereby said rollers are counter-rotated toward each other in a constant direction regardless of the direction of movement of said carriage; and drive means for driving said carriage reciprocally back and forth along said guide rails.

**2.** The apparatus according to claim **1** wherein said upper and lower guide rails each includes a pair of laterally spaced tracks supporting end members of said rollers whereby as each of said rollers is driven intermittently by said upper and lower pairs of tracks, the frictional driving force for each of said rollers is imparted evenly at each end.

**3.** The apparatus according to claim **2** wherein said yoke means includes a pair of yokes interconnecting each end members of said rollers, said drive means including a pair of spaced linking bars, one linking bar being operatively interconnected to one of said yoke and roller end members, the other of said linking bars being interconnected to the other of said yoke and roller end members whereby each of said rollers is counter-rotated intermittently by said upper and lower pairs of tracks, the frictional driving force being imparted evenly at each end to eliminate any lateral moment on said rollers.

**4.** The apparatus according to claim **3** wherein said rollers include first and second pairs of drive wheels fixed to the ends thereof, said yokes holding said drive wheels between said track members, the diameter of said drive wheels being less than the spacing between said upper and lower pairs of tracks.

**5.** The apparatus according to claim **4** wherein in response to movement of said carriage in a first direction, said first and second drive wheels engage said upper and lower tracks respectively to drive the rollers in said counter-rotational directions, and in response to movement of said carriage in a second direction, said first and second drive wheels contact said lower and upper tracks respectively to drive said rollers in the same counter-rotational directions to thereby maintain the rotational directions of said roller means constant.

6. The apparatus according to claim 1 wherein said drive means further includes a linking bar pivotally connected to said yoke means, whereby said carriage is pulled in one direction and pushed in the opposite direction during each reciprocation cycle of said drive means.

7. The apparatus according to claim 6 wherein during both the pushing and pulling cycle of said drive means, said yoke means is pivoted and urged rotationally by said linking bar such that the forward roller relative the direction of travel is frictionally engaged with the upper guide rail and the rearward roller relative the direction of travel is frictionally engaged with the lower guide rail regardless of the direction of movement of said carriage, the frictional driving force imparted on said rollers being increased as the loading increases due to the material being fed through said rollers.

8. The apparatus according to claim 7 wherein said drive includes an endless chain movable about a pair of spaced sprockets, said linking bar being connected to said chain means and positioned along one side thereof, whereby during the pushing portion of said chain means cycle, said linking bar extends entirely beyond the space between said sprockets as the carriage direction is reversed and during the pulling cycle of said chain means, said linking bar is positioned entirely intermediate said sprockets as the carriage direction is reversed to the pushing cycle.

9. The apparatus according to claim 1 wherein said support surface is characterized by a platform in said frame for receiving said folded material, said platform being mounted for vertical movement below said carriage; and second driving means for said platform to move said platform downwardly as the material is deposited and folded thereon.

10. The apparatus according to claim 9 further characterized by means sensing the downward movement of said platform; said first and second drive means being responsive to said sensing means to stop the movement thereof as said platform moves to a predetermined downward position.

11. The apparatus according to claim 10 wherein said platform is mounted for horizontal movement in and out of said frame.

12. The apparatus according to claim 11 and further including second means sensing the horizontal movement of said platform, said second drive means being responsive to said horizontal sensing means to raise said platform to an up position.

13. The apparatus according to claim 12 and further including third means sensing the upward movement of said platform, said second drive means responsive to said third upward sensing means to stop the movement thereof as said platform is moved toward a predetermined upward position.

14. An apparatus as claimed in claim 12 and further comprising: variable speed control means associated with said second drive means to variably control the speed of the upward movement of said platform.

15. The apparatus according to claim 9 and further including variable speed control means associated with said second drive means to variably control the speed of the downward movement of said platform.

16. Apparatus as claimed in claim 1 and further including variable speed control means associated with said driving means to variably control the speed of said carriage.

17. Apparatus for folding sheet material in serpentine fashion comprising, in combination: a support frame, a pair of endless driven chains spaced laterally from each other on said frame, said chains moving endlessly in a forward and rearward path; a pair of upper and lower guide tracks spaced in a common plane and extending longitudinally with and adjacent said chains; a pair of rollers forming a nip roll assembly extending intermediate said guide tracks through which the sheet material is fed, said rollers being movable along said guide tracks, the diameter of said rollers being less than the spacing of said tracks and means interconnecting said roller assembly to said chains whereby said rollers are pivotal relative to said chains and guide tracks so that one of said rollers is in friction driving engagement with one of said guide tracks during the forward movement of said rollers by said chain while the other of said rollers is in friction driving engagement with the other of said guide tracks whereby said rollers are counter-rotated toward each other, said rollers being pivotally reversed when moved in the rearward path so that the counter-rotation of said rollers is in a constant direction regardless of the direction of movement.

18. The apparatus according to claim 17 wherein said spaced guide tracks include a pair of laterally spaced upper guide tracks and a pair of laterally spaced lower guide tracks, said means interconnecting the ends of said rollers together and to said chains comprising a plate at each end of said rollers interconnecting said rollers in close proximity to each other and a pair of linking bars spaced from each other along each of said chains, said linking bars being pivotally connected at one end to said plate and pivotally connected at the other end to said chain whereby said rollers are pulled by said chain and linking bars during movement along one of said forward and rearward paths and pushed by said linking bar and chain during movement along the other of said forward and rearward path.

19. Apparatus according to claim 18 wherein said linking bar pivots said plate and rollers during the transition from one of said forward and rearward paths to the other so that the frictional engagement of said rollers with said guide tracks is reversed.

* * * * *