United States Patent [19]

Depuy et al.

[11] **3,774,271**

[45] **Nov. 27, 1973**

[54] **SHEET GUIDING AND WIDTH-CONTROL APPARATUS**

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[73] Assignee: **Mount Hope Machinery Company,** Taunton, Mass.

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[21] Appl. No.: **67,383**

[52] **U.S. Cl.** **26/66,** 26/63, 226/15

[51] **Int. Cl.** **D06c 3/06**

[58] **Field of Search** 226/15, 16, 17; 26/63, 66; 60/67, 105

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[57] **ABSTRACT**

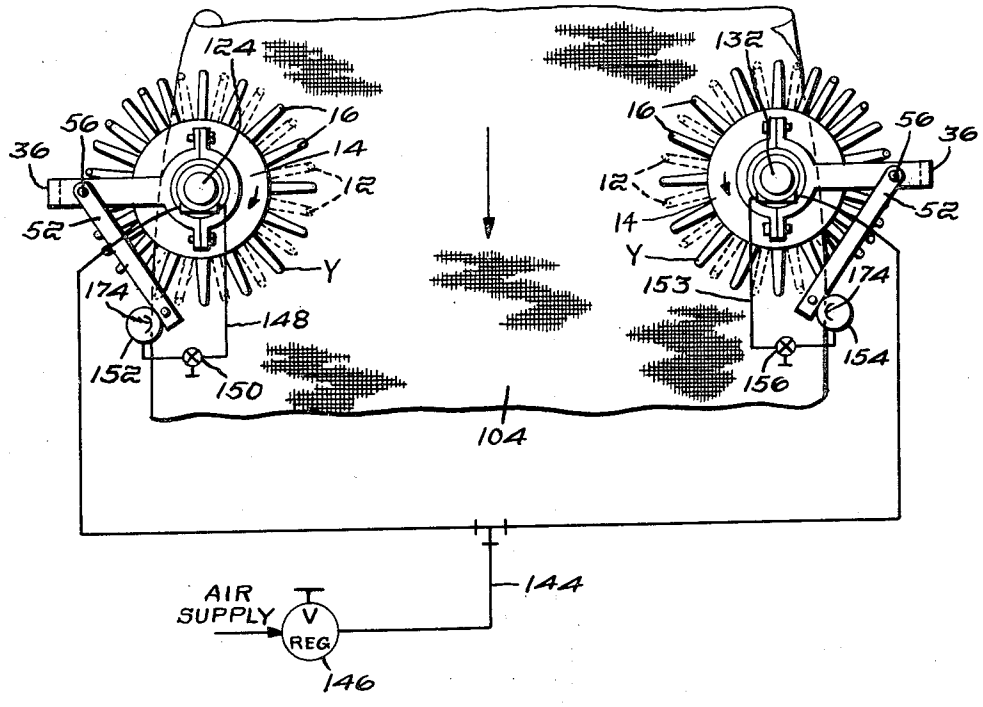
Apparatus for guiding an indefinite length of sheet or web material, such a cloth, in a predetermined path, and also for controlling the width of stretchable material.

In one form, a pair of scroll rolls are driven at differentiable speeds in response to the lateral positions of one or both edges of the sheet, to guide it laterally into a desired path and to retain its proper width. For guiding non-stretchable material, one roll is driven at a predetermined speed, and the speed of the other is controlled by the position of one edge of the sheet.

A guider control system is also provided in which the exhaust rate from fluid-operated motors driving a pair of rotatable sheet-stroking means is adjusted by edge-sensing means to control the relative speeds of the rolls. This control system can also be used with selvage uncurlers of a rotary disk type.

Another guider control system employs a constant-speed motive means to drive one or both sheet-stroking means through variable-speed drive means at relative speeds controlled by the sheet-edge sensing means. The drive means may comprise variable-speed transmissions or clutches.

8 Claims, 9 Drawing Figures



5 Sheets-Sheet 1

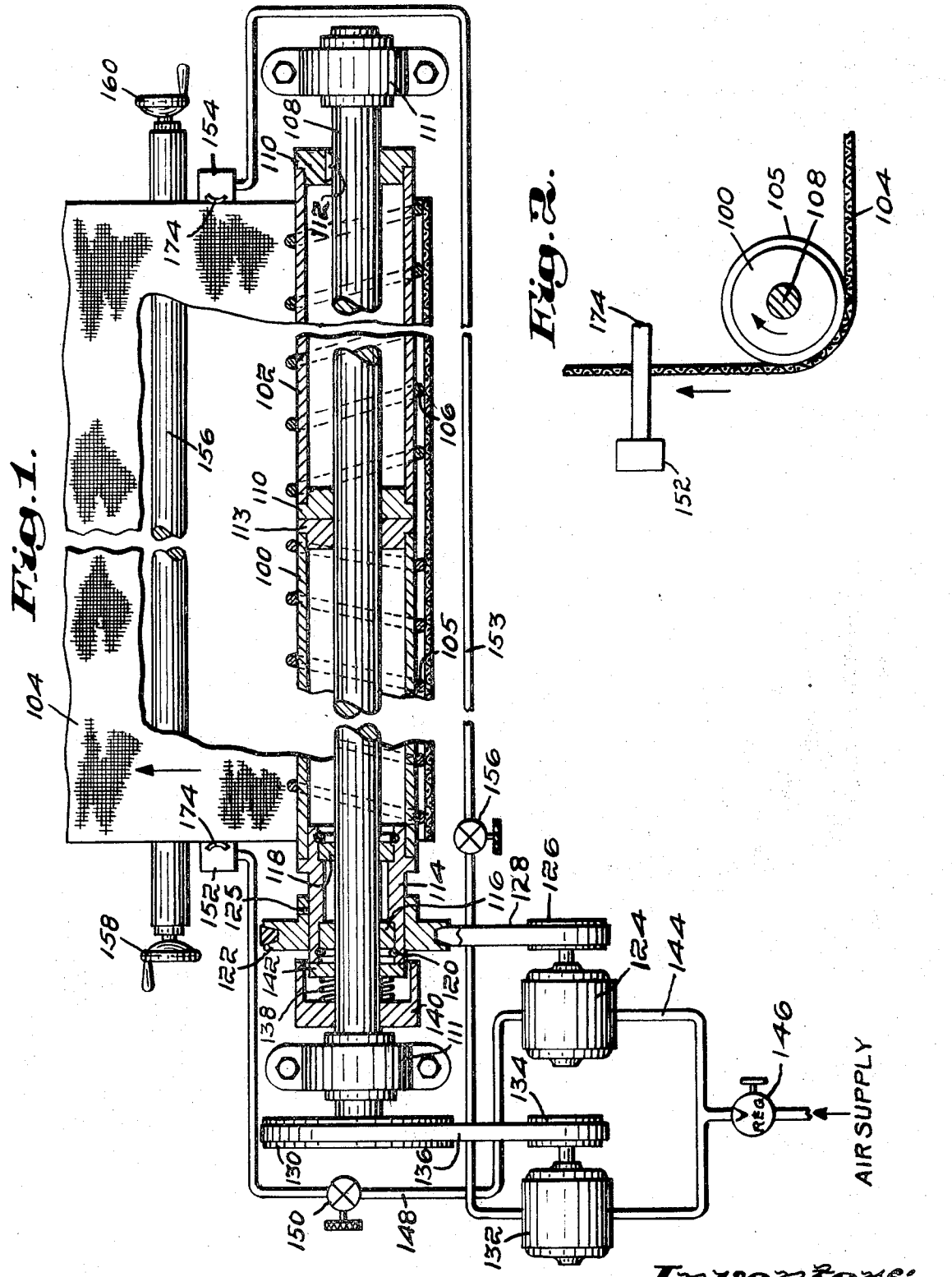


Fig. 1.

Fig. 2.

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Fig. 2.

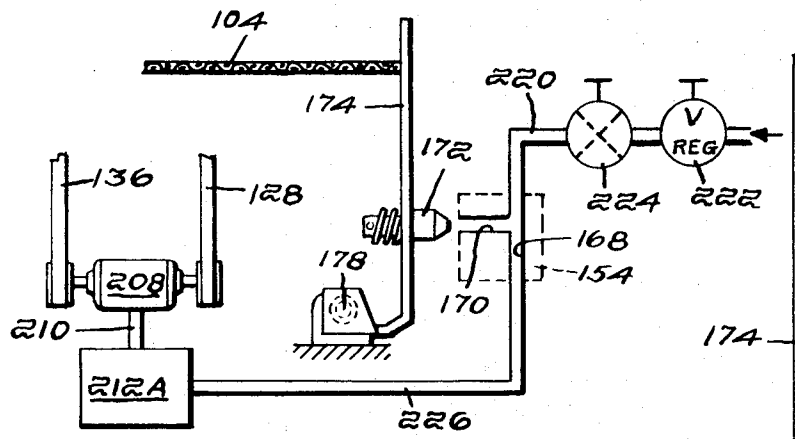


Fig. 3.

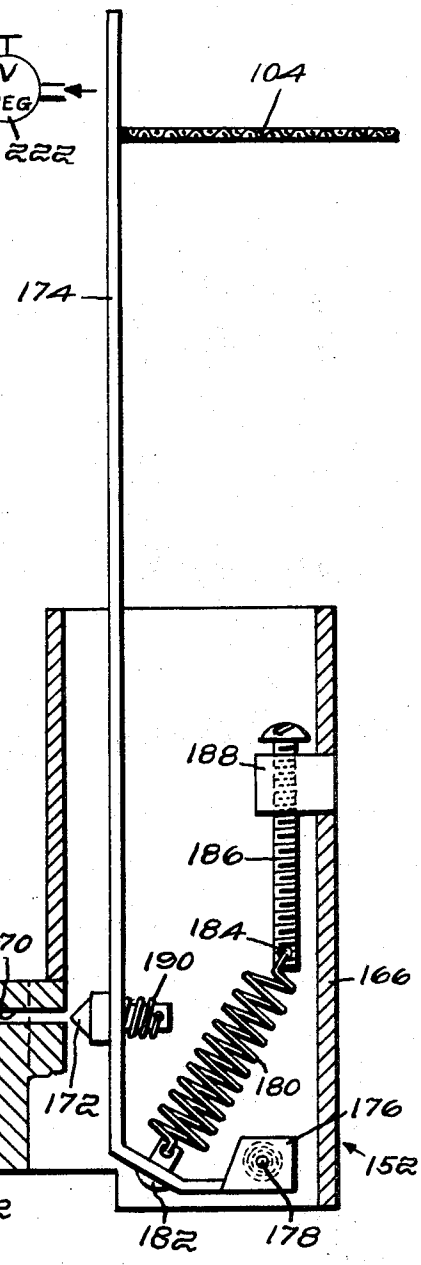
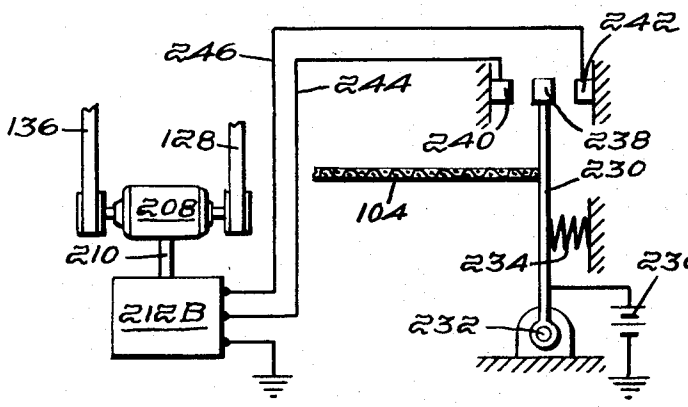


Fig. 8.



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Fig. 4.

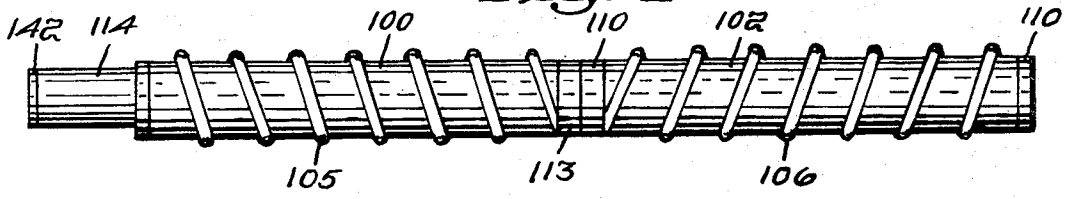
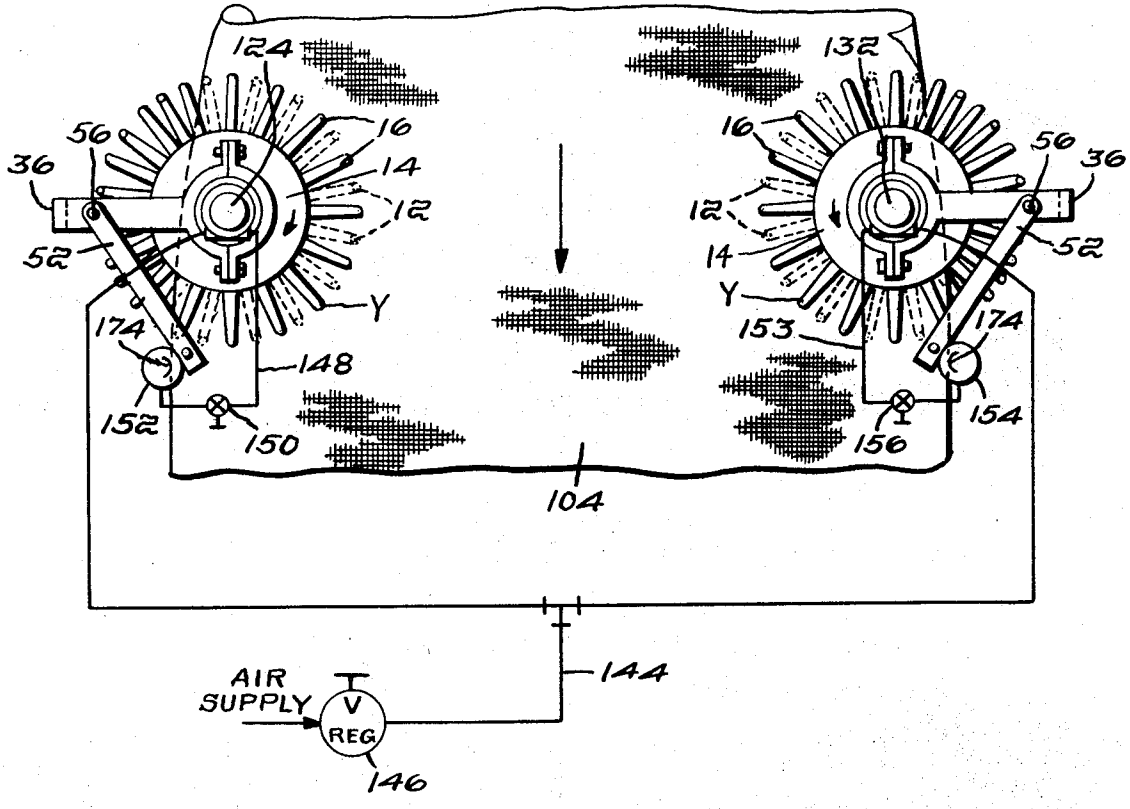
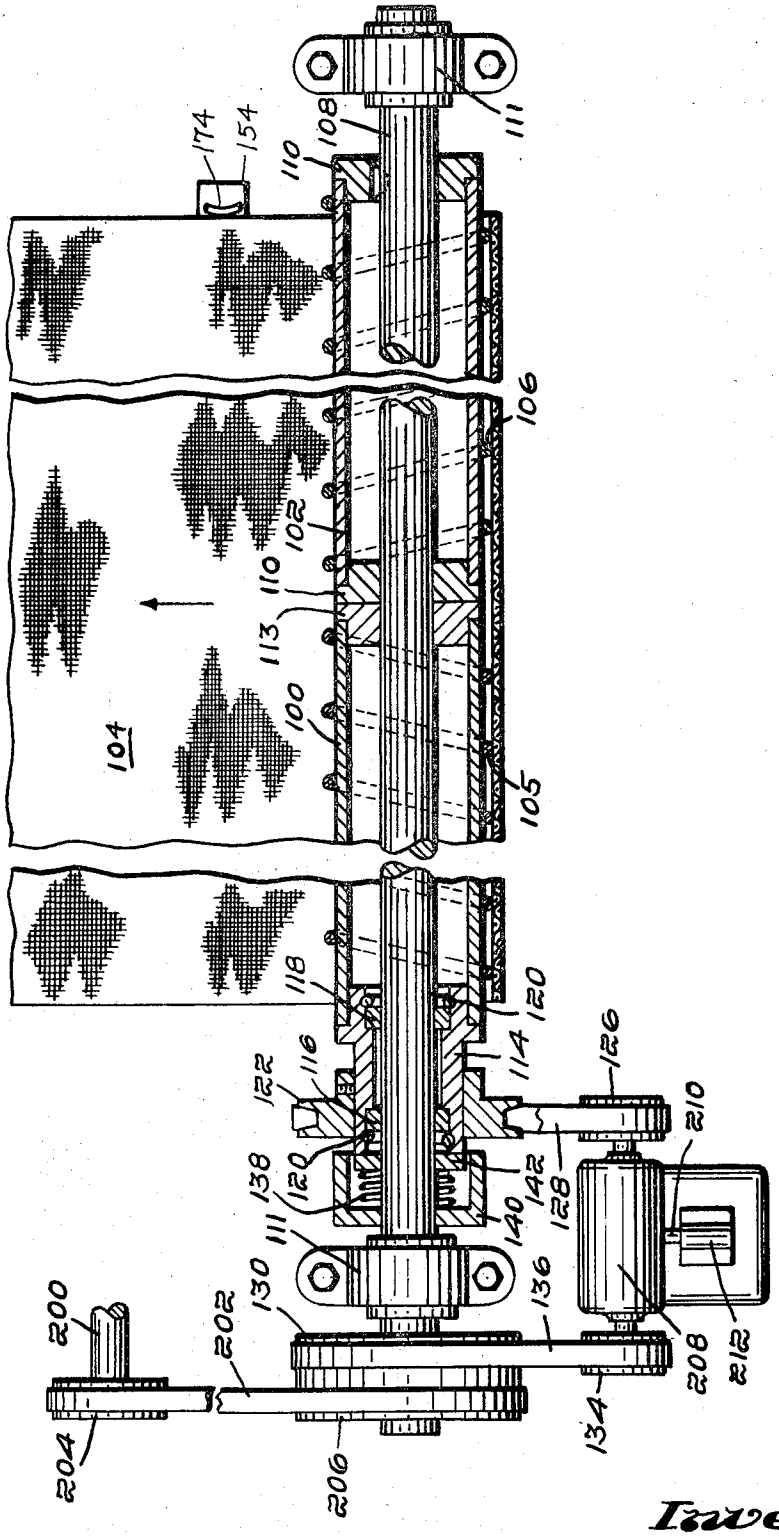


Fig. 5.



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Fig. 6.



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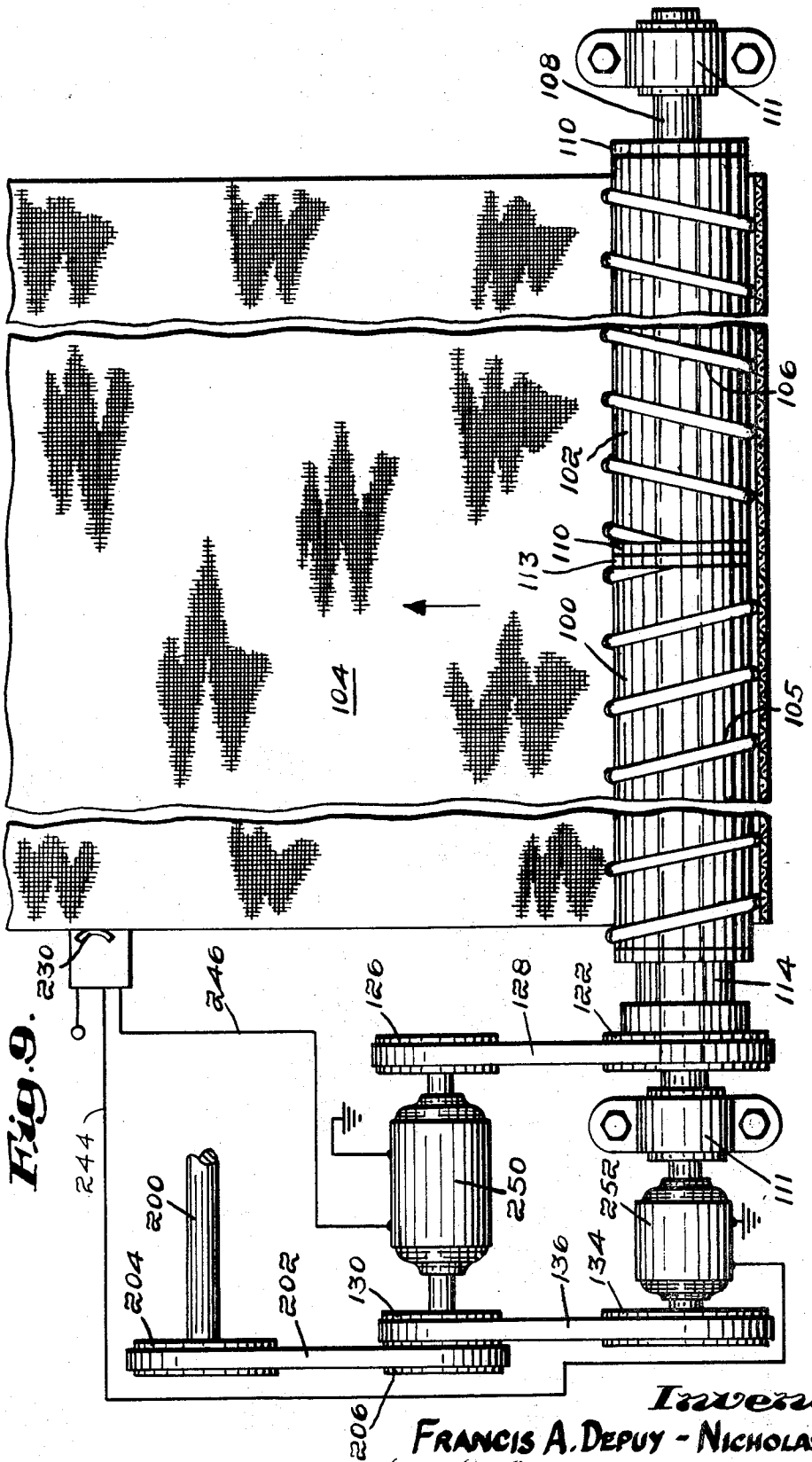


Fig. 9.

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SHEET GUIDING AND WIDTH-CONTROL APPARATUS

BACKGROUND AND BRIEF DESCRIPTION OF THE INVENTION

U.S. Pat. No. 3,419,944, issued Jan. 7, 1969 to Nicholas T. Santore for "Combined Web Guider and Selvage Uncurler," and assigned to the same assignee as this application, describes and claims guiding apparatus which is especially useful for handling fragile or stretchable goods which must not be subjected to heavy longitudinal tension. That apparatus employs selvage uncurlers of the rotary disk type, which comprise pairs of opposed inclined wheels with interengaged circular rows of teeth. Two uncurlers engage opposite edge portions of a traveling length of sheet material, and are driven independently by a pair of variable-speed motors to control the relative amounts of lateral pull that the uncurlers exert on the sheet. The uncurlers are normally driven at equal speeds while the sheet continues in its proper path. The lateral positions of each edge of the sheet are detected by sensors, which act through speed control means to decrease the relative rate of rotation of either uncurler toward which the sheet may tend to wander, with the result that the lateral pull toward the uncurler is reduced. Since the other uncurler maintains its normal speed it exerts a greater pull and restores the sheet to the normal path and proper width, at which time the uncurlers are caused to resume equal speeds.

The control system described by U.S. Pat. No. 3,419,944 employs bleed valves to control independently the pressure supplied to the two air motors, and thus control their speeds. The sensors are fingers which rest against the opposite edges of the sheet, each controlling the rate of bleeding from one of the valves according to the position of a corresponding edge. Although this system functions satisfactorily, there are two respects in which improvement is desired. First, an increase in the load imposed on the motors by the sheet, as for example by a change in the feed rate or back tension of the sheet, results in a substantial drop in uncurler speed. Secondly, the air bled from the system by operation of the controlling bleed valves does no useful work, and is wasted.

It is the general object of the present invention to improve sheet guiding and width-control apparatus of a type which acts to regulate the position and width of the sheet by controlling the relative speeds of a pair of rotatable stroking means, such as disks or rolls, which engage opposite edge portions of the sheet. Further objects and advantages of the invention will appear as the following description proceeds.

According to one aspect of the present invention, the stroking means are driven by fluid motors which are supplied with fluid at a predetermined pressure; their relative speeds are controlled by valves which affect the rate of fluid exhaust from the motors, and which are adjusted by edge-sensing means. In applications to stretchable sheet material, I may use sensing means at both edges of the sheet, to control independently the exhaust rates and thus the speeds of two variable-speed motors each driving one of the sheet-stroking means, thereby not only to guide but also to control the width of the sheet. In guiding non-stretchable material, however, only one edge can be guided, and I prefer to drive one motor at a constant speed, and control the other motor through a single sensing means and exhaust valve.

The individual exhaust valves are fully opened when the controlling sheet edge is running inward from its proper path, so that the corresponding motor has a minimum exhaust restriction, and runs at its top speed. This affords the sheet-stroking means a maximum of outward lateral pull on the sheet, causing the errant edge of the sheet to return to the proper track. To limit the top speed of the motors, I prefer to interpose adjustable throttling valves in the fluid exhaust conduits. A shift of a sheet edge outwardly from its path causes the sensing means to progressively close the corresponding exhaust valve, slowing the driving motor to reduce the outward lateral pull of the corresponding sheet-stroking means, and thereby permit the edge to draw inwardly to the proper track.

A particular advantage of the improved control system is that it tends to maintain a more uniform motor speed as the load imposed on the sheet-stroking means by the longitudinal cloth tension varies. This is the result of controlling motor speed by adjusting the rate of fluid flow, as opposed to adjusting the pressure of the fluid supply; an increased load merely raises the pressure drop across the motor, and therefore increases the driving torque to compensate, with no substantial loss of speed. Another advantage of the system is that all of the pressure fluid supplied to the system passes through the motor and performs useful work, improving the cost efficiency of operation of the guider.

According to another aspect of the invention, a novel sheet guider incorporates a pair of scroll rolls, corresponding to a scroll roll of a type which is known per se, but divided into two parts. These rolls are driven at controllably-differentiable speeds to guide the sheet by exerting variable opposed lateral pulls upon it. It is conventional to form a scroll roll by wrapping the surface of a cylinder with wire helices which have opposite threads on the two ends of the roll; and to rotate this roll against the surface of cloth in order to spread it laterally, and also improve its feel or hand by flexing it. I drive two divided scroll rolls in the same direction of rotation but at differentiable speeds, under the control of sheet edge-sensing control means which adjust the speed ratio of the rolls in a manner to guide the sheet, and to control the width of stretchable sheet material.

According to still another aspect of the invention, control of the relative speeds of a pair of rotatable sheet-stroking means is obtained by driving one or both of them through variable-speed drive means comprising variable-speed transmissions or clutches. The speed ratio of one or two variable-speed transmissions, or the engagement of one or two clutches, is controlled in response to the edge sensing means. In one form, an edge-sensing finger is arranged to control a valve, which regulates a fluid pressure acting on a servomechanism connected for adjusting a variable-speed transmission, or which controls the engagement of clutches. In another form, the edge-sensing finger is arranged to engage alternate contacts corresponding to edge-position deviation limits, thereby selectively to energize an electrical pilot motor which controls the speed ratio of a transmission, or selectively to control the engagement of clutches.

DESCRIPTION OF THE DRAWINGS

While the specification concludes with claims partic-

ularly pointing out the subject matter which we regard as our invention, it is believed that a clearer understanding may be gained from the following detailed description of preferred embodiments, referring to the accompanying drawings, in which:

FIG. 1 is a fragmentary view in elevation, and partially in section, of a first form of the improved guiding apparatus;

FIG. 2 is a sectional end view of a portion of the apparatus;

FIG. 3 is a sectional view on an enlarged scale of an edge-position sensor and exhaust valve forming a part of the apparatus of FIG. 1;

FIG. 4 is a view in elevation of a pair of scroll rolls forming parts of the apparatus of FIG. 1;

FIG. 5 is a schematic plan view of a second form of the guiding apparatus;

FIG. 6 is a fragmentary view in elevation, and partially in section, of another form of the improved apparatus;

FIG. 7 is a schematic view of an alternative speed control system;

FIG. 8 is a schematic view showing another alternative speed control system; and

FIG. 9 is a fragmentary view in elevation of another embodiment.

Referring to FIGS. 1–4, a first form of the guiding apparatus includes a pair of scroll rolls **100, 102,** each of which comprises a hollow cylinder wound with a wire helix **105** or **106.** The rolls are partially wrapped by an indefinite length of web or sheet material **104,** which is fed in the direction shown by the arrows in FIGS. 1 and 2 by other means (not shown), forming portions of any conventional processing range in which the improved guider is to be used. The helices **105** and **106** have opposite threads on the two rolls, so that when rotated in the same direction as the sheet moves, each helix tends to draw the sheet laterally outwardly in opposition to the other. For rolls intended to rotate in the illustrated direction, the roll **100** has a right-hand thread helix, while the roll **102** has a left-hand thread helix.

The rolls **100** and **102** are supported on an axle **108,** which extends in a direction normal to the length of the sheet and is rotatably mounted in stationary bearings **111** near its ends. The ends of the roll **102** are affixed by a pair of annular disks **110** upon the shaft **108,** and one of these disks is keyed at **112** to the shaft. The roll **100** is free to rotate on the shaft **108,** being supported at one end by a disk **113,** and at the other by an attached drive collar **114,** in which bearings **116** and **118** are secured by retaining rings **120.** The disk **113** may provide a plain bearing as shown, or may include a roller thrust bearing. Thrust is applied axially to the roll **100** by means of a compression spring **138,** acting between a cup **140** mounted on the shaft **108** and a disk **142** at one end of the collar **114.** Thrust bearings may be provided to reduce the friction applied by this spring loading arrangement, if desired.

The collar **114** has a drive sheave **122** secured to it by a set screw **125.** The roll **100** is driven by a variable-speed air motor **124,** or other fluid motor, through a sheave **126** and a drive belt **128,** which is trained around the sheave **122.** The shaft **108** has a sheave **130** secured to one end, and is driven by a variable-speed air motor **132,** or other fluid motor, through a sheave **134** and a belt **136.** The speed ratios of both belt drives **128** and **136** are the same, so that the speeds of the rolls **100** and **102** will be in the same ratio as those of the motors **124** and **132.**

The motors **124** and **132** are supplied with air pressure through a branched conduit **144,** in which an adjustable pressure-regulating valve **146** is placed. An exhaust conduit **148** extends from the motor **124** through an adjustable-orifice valve **150** for the purpose of limiting the maximum speed of this motor, and thence through an exhaust control valve **152,** which is shown in detail in FIG. **3.** Similarly, an exhaust conduit **153** extends from the motor **132** through an adjustable-orifice valve **156** to limit the maximum speed of this motor, and thence through an exhaust control valve **154** which is identical with the valve **152.** The exhaust valves **152** and **154** are supported on a transverse bar **156,** and the spacing between them is adjustable by means of hand-cranks **158** and **160** to accommodate sheets of various widths.

Referring to FIG. **3,** one of the exhaust control valves **152** is shown in detail. The valve includes a block **162** having a threaded bore **164** for mounting the valve. A hollow housing **166** is affixed to the block for mounting the remaining elements. The exhaust conduit **148** extends through a passage **168** in the valve block into communication with a bleed passage **170,** whose outlet area is controlled by a conical valve element **172.** This element is borne by an edge-sensing finger **174** adapted to engage one edge of the sheet material **104.** The valve element **172** is flexibly mounted on the finger by means of a compression spring **190** to permit the element to seat accurately even though there might be some misalignment between the finger and the bleed orifice. The finger **174** is provided with mounting ears **176,** which are pivotally supported on cone points **178** threaded into the housing.

In the illustrated form the finger **174** is biased toward the edge of the sheet **104,** and away from seating engagement of the valve element **172** in the bleed passage **170,** by means of a tension spring **180** secured at one end in a rivet **182** mounted on the finger. The remaining end of the spring is received through an opening **184** in an adjusting screw **186,** which is threaded through a block **188** affixed to the housing **166.** The screw **186** may be set to apply an amount of tension to the spring **180** appropriate to the width and stiffness of the particular sheet material being processed. However, as the air pressure in the exhaust orifice **170** tends to open the valve by unseating the element **172,** it may be satisfactory to omit the tension spring and rely solely on this exhaust pressure to bias the finger against the edge of the sheet.

The edges of the sheet **104** are shown in FIGS. **1** and **3** in normal position, in a desired track. Under these circumstances, the valve element **172** of each valve **152** and **154** assumes a normal position, controlling the rate of exhaust from each of the air motors **132** and **124** so that they run at a normal rate of speed. This speed is set by the regulating valves such that the rolls **100** and **102** are driven with a linear surface velocity somewhat in excess of the rate of sheet feeding, perhaps 10 to 20 percent greater. This causes the rolls to exert a moderate and equal lateral spreading action on the goods, sufficient to hold it to the proper width and to remove any wrinkles that may develop. Because of the helical configuration of the roll surfaces, an increase in the speed would apply additional lateral spreading action to the goods, tending to pull the edges outwardly, while a re-

duction in speed would allow the edges to relax and contract in an inward direction.

Assuming that the left edge of the sheet **104** tends to shift to the right in FIG. **1**, the finger **174** of the valve **152** will tend to tilt clockwise as seen in FIG. **3**, increasing the area of the exhaust orifice **170**. This will increase the speed of the motor **124** and the roll **100**, tending to draw the left-hand portion of the sheet toward the left, and thus restore the left edge to its original track. In the event that the deviation of the left edge toward the right was occasioned by a decrease in the width of the goods, a similar increase in the speed of the motor **132** and the roll **102** will be instigated by the valve **154**, and this will correspondingly draw the right-hand portion of the goods toward the right. Thus both edges will be drawn outwardly to their original tracks, and the width of the cloth will consequently be held to the proper dimension. If, on the contrary, the displacement of the left edge of the cloth to the right was occasioned by a bodily motion of the goods to the right without a change in width, the right edge will pivot the finger **174** of the right hand valve **154** in a direction to reduce the area of the exhaust orifice leading from the motor **132**, correspondingly reducing the speed of this motor and of the roll **102**. This reduction in the speed of the roll **102** relative to that of the roll **100** will allow the sheet to be drawn bodily to the left as seen in FIG. **1**, without changing its width appreciably, until it is returned to the proper track.

Thus it will be seen that the exhaust control valves **152** and **154** act independently to hold the two edges of the sheet individually in their proper tracks, so that the apparatus serves both to correct lateral bodily displacements of the sheet as a whole, and also to correct deviations in width.

Because the speeds of the motors of the apparatus are controlled by adjusting the rate of flow of motive fluid from them, rather than the supply pressure, variations in the load imposed by the tension in the goods **104** do not substantially change the speeds of the motors. An increased load results in an increase in pressure drop across the motors, which tends to compensate by increasing their torque output and thus maintaining their original speeds. Correspondingly, a reduction in tension load reduces the pressure drop across the motors and the torque declines accordingly, to hold a uniform speed. There is normally some variation in the applied tension in many processing operations, and if this is allowed to cause a substantial variation in the speeds of the scroll rolls, random variations in the width of the goods would result.

An application of the same edge-responsive control system is shown in FIG. **5**, in which a guider employs selvage uncurlers **14** like those described by the aforementioned U.S. Pat. No. 3,419,944. Each of these uncurlers comprises a pair of opposed wheels between which the sheet **104** passes, and of which the front ones carry circular rows of radially-extending teeth **16**, while the rear wheels have similar rows of teeth **12** intercalated between the teeth **16**. These teeth are formed of a flexible material such as rubber. The wheels are mounted in brackets **36** for rotation on axes which are inclined laterally and longitudinally of the sheet **104**, in a manner to engage the teeth **12** and **16** around limited arcuate sectors, which are centered at about the points y in FIG. **5**. The teeth, rotating as shown by the arrows, first interengage at a point somewhat inside the edges of the sheet approaching the uncurlers, and disengage near the departing edges.

The speed of rotation of each uncurler **14** governs the amount of lateral pull that it applies to the sheet **104**. The front wheels of the uncurlers are driven by the fluid motors **124** and **132**, and the lower wheels are driven by the interengagement of the teeth **12** and **16**, so that both wheels of an individual uncurler run at the same speed. The motors **124** and **132** are supplied in common with air or other working fluid by a branched conduit **144**, the pressure being controlled by a regulating valve **146** as before. The exhaust conduit **148** of the motor **124** has an adjustable-orifice valve **150** to limit its maximum speed, and leads into an exhaust control valve **152** like that of FIGS. **1** and **3**, having a movable finger **174** engaging one edge of the sheet **104**. Similarly, the exhaust conduit **153** of the motor **132** has an adjustable-orifice valve **156** and an exhaust control valve **154**. The valves **152** and **154** are mounted on arms **52**, and their spacing is adjustable to equal various sheet widths by loosening screws **56** which mount the arms on brackets **36**. This apparatus operates on substantially the same principles as that of FIGS. **1–4**. The speed of each uncurler is individually governed by the location of a corresponding edge of the sheet, and the lateral pull exerted on the sheet by each uncurler is a function of its rotational speed. The edges are independently guided in tracks determined by the locations of the valves **152** and **154**.

The two embodiments thus far described are particularly suitable for handling stretchable goods, in that they hold each edge in a given track independently of the other, and therefore impose width control on the sheet. For handling goods which are not substantially stretchable but have a stable width, it is appropriate to guide only one edge of the sheet. The lateral position of the unguided edge is determined by the width of the goods. The guiders of FIGS. **1** or **5** can be adapted to this mode of operation simply by omitting either one of the edge-sensing means **152** or **154**, and regulating the speed of the corresponding motor **124** or **132** at a substantially constant value by appropriate settings of the pressure-regulating valve **146** and the corresponding orifice valve **150** or **156**. The remaining edge-sensing means **152** or **154** continues to control the speed of its connected motor **124** or **132** in accordance with the previously-explained principles of operation.

Another construction suitable for guiding non-stretchable sheet or web material is illustrated in FIG. **6**. This apparatus employs scroll rolls **100** and **102** like those of FIGS. **1–4**, and other parts of a similar nature are also numbered alike.

The shaft **108** and the roll **102** are driven at a substantially uniform speed with respect to that of the sheet **104**, by motive means which include a drive shaft **200**, a belt **202**, and sheaves **204** and **206**, the latter being fixed on the shaft **108** adjacent to the sheave **130**. The shaft **200** may be driven by any convenient driving component, roll, or motor (not shown) which may be available as a component of the sheet-processing range in which the guiding apparatus is used. The belt drive ratio should be chosen to drive the roll **102** at a linear surface velocity somewhat greater than the velocity of the sheet **104**, perhaps 10–20 percent greater. This insures moderate spreading of both edges of the sheet at all times, and allows the speed of the roll **100** to be reduced below that of the roll **102**, when necessary for

guiding purposes, without being lower than the velocity of the sheet. Wrinkling could result if either of the rolls **100** or **102** were to be driven slower than the sheet is fed.

The belt **136** and sheave **134** serve to drive the sheave **126** and roll **100** through a variable-speed drive or transmission **208** of a conventional commercially-available type. The speed ratio of the drive **208** is adjustable from values of less than 1:1 to more than 1:1, by angular positioning of a control shaft **210.** A reversible servo-motor **212** serves to position the shaft **210** in response to control signals received from a single edge-position sensing element or valve **154,** whose finger **174** follows one edge of the sheet **104.**

The control system is so arranged that a displacement of the right-hand edge of the sheet **104** to the left, as viewed in FIG. **6,** moves the shaft **210** in a sense to reduce the speed ratio of the drive **208,** thereby slowing the roll **100** with respect to the roll **102.** This results in a net lateral pull on the sheet **104** toward the right, until it is restored to the proper track. Conversely, a displacement of the sheet to the right in FIG. **6** increases the speed ratio of the drive **208** and drives the roll **100** faster than the roll **102,** pulling the sheet toward the left into its proper position.

A fluid pressure control system is shown in FIG. **7** for controlling the speed ratio of the drive **208** in response to the position of the finger **174,** in accordance with the foregoing principles. Air pressure is supplied to a conduit **220** through an adjustable pressure-regulating valve **222** and a flow-limiting orifice valve **224.** The supply conduit **220** is connected to a passage **168** in a schematically-illustrated control valve **154,** which is similar to the valve **152** shown in FIG. **3** except that the passage **168** is connected both to a bleed orifice **170** and to a pressure-signal conduit **226.** The extent to which the bleed orifice **170** is opened by the valve element **172** depends upon the position of the sheet edge and the finger **174,** with the result that a signal pressure delivered to the conduit **226** is directly proportional to the edge position. A displacement of the sheet edge to the right in FIGS. **6** or **7** tends to close the orifice **170** and increase the signal pressure, while a leftward movement lowers the pressure, both in proportion to the amount of displacement from the normal edge position.

This signal pressure is delivered to a conventional, commercially available pneumatic servo-motor **212A,** which angularly positions the shaft **210** in a manner to reduce the speed ratio of the drive **208** in response to a reduction in the signal pressure in the conduit **226,** or to increase the speed ratio if the signal pressure rises. A pressure reduction reflects a leftward displacement of the sheet **104,** and the consequent decline in the speed of the belt **128** and roll **100** allows the sheet **104** to be drawn to the right by the roll **102.** Conversely, a pressure increase, arising from a deviation of the sheet edge toward the right, increases the speed of the belt **128** and the roll **100,** and draws the sheet **104** leftward into its proper position. The valves **222** and **224** should be adjusted so that the signal pressure will produce a 1:1 speed ratio of the rolls **100** and **102** when the right edge of the sheet is in the desired track.

An alternative electrically-operated control system is shown in FIG. **8,** in which parts similar to those of FIG. **7** are similarly numbered. An edge-sensing switch replaces the valve **154.** A switch lever or finger **230** is pivotally mounted at **232,** and is biased by a compression spring **234** against one edge of the sheet **104.** The finger is electrically conductive, and is connected to a voltage source **236.** It bears a contact **238,** which is engageable with either of two contacts **240** and **242** when the sheet edge devicates sufficiently far to left or right. The spacing between these contacts defines tolerance limits of edge displacement, between which no control action takes place and the sheet may wander freely. It will be understood that the spacing between the contacts may be chosen to bring about any desired compromise between the amount of lateral edge wandering that is tolerable in a given application, and the frequency of control actuation or hunting that may be considered acceptable.

The contacts **240** and **242** are electrically connected by leads **244** and **246,** respectively, with a conventional, commercially-available electrical servo-motor **212B.** The servo-motor is so arranged and connected that energization of the contact **240** results in a repositioning of the shaft **210** which reduces the speed ratio of the drive **208,** and energization of the contact **242** increases the speed ratio. Therefore a leftward motion of the sheet edge to the tolerance limit established by the contact **240** causes a reduction in the speed of the belt **128** and the roll **100,** which in turn permits the roll **102** to draw the sheet toward the right as viewed in FIGS. **6** and **8.** An excessive deviation of the sheet toward the right closes the contact **242** and increases the speed of the belt **128** and the roll **100,** pulling the sheet leftward.

A modification of the apparatus of FIGS. **1** or **5** for use with non-stretachable material includes a driving connection between one of the rolls **100** or **102,** or one of the uncurlers **14,** and a range-driven shaft like the shaft **200** of FIG. **6,** or other motive means whose speed is regulated at a substantially constant value relative to the rate of sheet feeding. The remaining roll or uncurler may be driven by its connected motor **124** or **132,** under the speed control of a single edge-sensing element **152** or **154;** or it may be driven by a fluid or electric variable-speed motor, under speed control by the edge-sensing means **154** of FIG. **7,** or the edge-sensing means **230–246** of FIG. **8.**

An embodiment shown in FIG. **9** utilizes a range-driven shaft **200** like that shown in FIG. **6,** in combination with electrically-operable normally-engaged clutches **250** and **252.** Parts similar to those of preceding embodiments are similarly numbered. Both of the rolls **100** and **102** are normally driven at a constant speed, somewhat greater than that of the sheet **104,** by the shaft **200** through a drive belt **202,** sheaves **204** and **206,** and the clutches **250** and **252.** A belt **136** is driven by a sheave **130** connected to the input shaft of the clutch **250,** and drives a sheave **134** connected to the input shaft of the clutch **252.** The latter clutch drives the roll **102** through the shaft **108,** while the clutch **250** drives the roll **100** through a belt **128** trained on sheaves **126** and **122.** The clutches **250** and **252** are normally engaged, but may be independently disengaged by energizing them through leads **246** or **244,** respectively. These leads are connected to an electrical edge sensor **230** like that shown in FIG. **8,** and the connections are arranged so that a displacement of the finger **230** to the left in the drawing energizes the lead **246,** while a displacement to the right energizes the lead **244.** A displacement of the sheet **104** to the right in the drawing will thus disengage the clutch **252,** mo-

mentarily interrupting the drive of the roll **102,** and allowing the roll **100** to draw the sheet toward the left. A deviation of the sheet **104** to the left, on the other hand, disengages the clutch **250,** momentarily interrupting the drive of the roll **100** and permitting the roll **102** to draw the sheet back into the proper path.

An alternative control arrangement adapted for controlling the width of stretchable sheet material may employ single electrical contacts each cooperating with a separate edge-sensing finger disposed at either edge of the sheet (not shown). Each contact is connected to one of the clutches **250** and **252,** and the contacts are so arranged that an outward movement of the left edge of the sheet in FIG. **9** temporarily disengages the clutch **250** and the roll **100,** while an outward displacement of the right-hand edge temporarily disengages the clutch **252** and the roll **102.** The resulting system is sensitive both to lateral bodily displacements of the sheet and to increases in its overall width. A lateral displacement without a change in width energizes only one contact, which disengages the roll toward which the sheet has shifted. An increase in overall width, on the other hand, causes both rolls **100** and **102** to become disengaged, discontinuing the spreading action of both rolls until such time as the sheet width contracts to the proper value. However, the system would not respond to a decrease in overall width of the sheet, since in that case both rolls **100** and **102** would continue to rotate at their original speeds. For that reason, this alternative arrangement is feasible only where the rolls are run at a speed sufficiently greater than the sheet, and exert sufficient spreading action, to ensure that the overall width of the sheet will at no time become less than the desired value.

What we claim is:

1. Apparatus for guiding a longitudinally-traveling indefinite length of sheet material, comprising:

a pair of rotatable means having peripheral surface portions constructed and arranged for engaging and stroking the opposite edge portions of the sheet laterally outwardly away from the longitudinal centerline of the sheet;

drive means constructed and arranged for driving said rotatable means with differentiable linear surface velocities, said drive means including means for supplying pressure fluid, variable-speed fluid-operated motive means connected to receive pressure fluid from said supply means and drivingly connected with said rotatable means, and at least one adjustable exhaust valve means connected to control the rate of fluid exhaust from at least a portion of said motive means, thereby to control the relative surface velocities of said rotatable means;

and sheet edge-sensing means constructed and arranged for detecting the lateral position of at least one edge of the sheet and operatively connected for adjusting said exhaust valve means to control the relative surface velocities of said rotatable means in response thereto; said edge sensing means maintaining a predetermined ratio between the surface velocities of said rotatable means while the sheet travels in a predetermined path, and being operative to adjust the ratio between the surface velocities of said rotatable means in response to a movement of at least one edge of the sheet away from said predetermined path, said adjustments in velocity ratio being made in a sense to guide the sheet in said predetermined path.

2. Apparatus as recited in claim **1,** said drive means being operable normally to drive said rotatable means with a surface velocity in excess of the velocity of travel of the sheet thereby to tend to spread the sheet laterally, and being operable to reduce the velocity of at least one of said rotatable means to a value which remains at least equal to the velocity of the sheet in response to a movement of the edge of the sheet engaged by said one rotatable means laterally outwardly from a predetermined path.

3. Apparatus as recited in claim **1,** said fluid-exhaust valve means being formed with an exhaust passage, and including a movable valve element valving said exhaust passage, said edge-sensing means being operable to adjust the area of said exhaust passage in response to a movement of an edge of the sheet laterally from said predetermined path.

4. Apparatus as recited in claim **3,** said edge-sensing means being operative to adjust the area of said exhaust passage in proportionate response to displacement of an edge of the sheet from said predetermined path.

5. Apparatus as recited in claim **1,** said drive means further including at least one adjustable flow control valve serially connected with said motive means and said exhaust valve means for limiting the rate of fluid exhaust from said motive means, thereby to limit the maximum velocities of said rotatable means in a fully-open position of said exhaust valve means.

6. Apparatus as recited in claim **1,** said motive means including a pair of variable-speed fluid-operated motors each drivingly connected with one of said rotatable means;

a pair of said adjustable exhaust valve means each connected to control independently the rate of exhaust from one of said pair of motors;

said edge-sensing means being constructed and arranged to detect the positions of each edge of the sheet and to adjust said exhaust valve means independently, each in response to the position of a corresponding edge of the sheet, whereby said apparatus guides both edges of the sheet and thereby controls its width.

7. Apparatus as recited in claim **1,** said drive means being constructed and arranged to drive one of said rotatable means at a predetermined surface velocity; and said exhaust valve means and motive means being operable to control the surface velocity of the other of said rotatable means at a value less than, equal to, or higher than said predetermined velocity, in response respectively to positions of an edge of the sheet engaged by said other rotatable means laterally outwardly of a predetermined path, in said path, or laterally inwardly of said path.

8. Apparatus as recited in claim **1,** said rotatable means comprising a pair of rotary selvage uncurlers one arranged to engage each edge portion of the sheet and comprising rotatable wheel means for stroking the edge portions outwardly away from the longitudinal centerline of the sheet when rotated in a direction such that portions of the wheel means engaging the sheet have components of linear velocity extending in the direction of sheet travel.

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