United States Patent

Koster

[15] **3,673,647**

[45] **July 4, 1972**

[54] SHEET GUIDING AND OPENING APPARATUS

[72] Inventor: **Klaus Koster**, Am Pferdekamp, Germany

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

[22] Filed: **Jan. 7, 1971**

[21] Appl. No.: **104,577**

[52] **U.S. Cl.** **26/54**, 26/66, 226/17, 226/22

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

[58] **Field of Search** 26/54, 65, 66; 226/17, 22

[56] **References Cited**

UNITED STATES PATENTS

1,002,156	8/1911	Kay	26/66
3,071,157	1/1963	Robertson et al.	226/22 X
3,324,525	6/1967	Knapp et al.	26/54
3,419,944	1/1969	Santore	26/54

Primary Examiner—Robert R. Mackey
Attorney—Rich & Ericson

[57] **ABSTRACT**

Apparatus for opening and uncurling sheet or web material, and for guiding the material along a given path, includes first and second pairs of rotatable selvage uncurlers arranged in serial order. The uncurlers of each pair engage opposite edges of the material. The lateral pull exerted by each uncurler is controlled by position sensors at either edge of the material. These are connected to react to an outward lateral shift of a first edge of the sheet by reducing the lateral pull applied to it by one of the first pair of uncurlers, and also by increasing the lateral pull on the other edge of the sheet by one of the second pair of uncurlers. This causes an inward lateral shift of the first edge that produces opposite results, increasing the pull of the first-mentioned uncurler and decreasing the pull of the second. The two remaining uncurlers are similarly affected by lateral shifts of the second edge of the material. The apparatus guides the material with a quickly responsive continuous hunting action, while opening and uncurling the material into a flat form.

10 Claims, 7 Drawing Figures

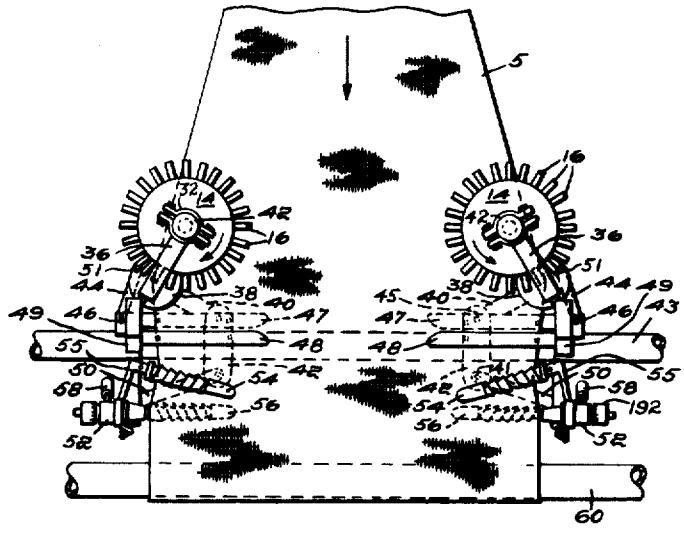


Fig. 2.

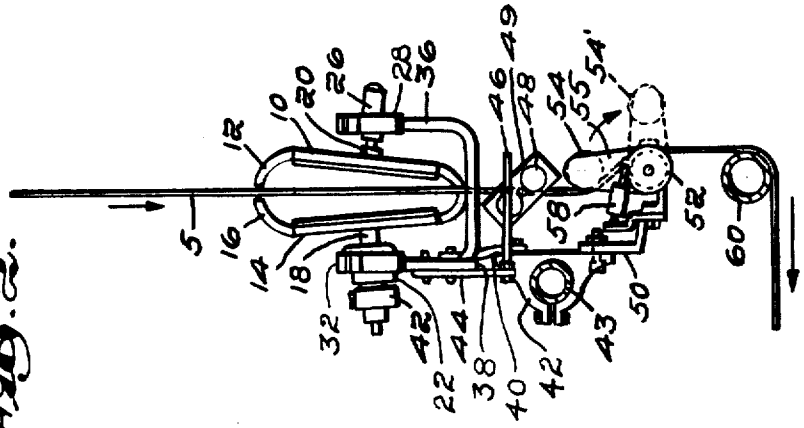
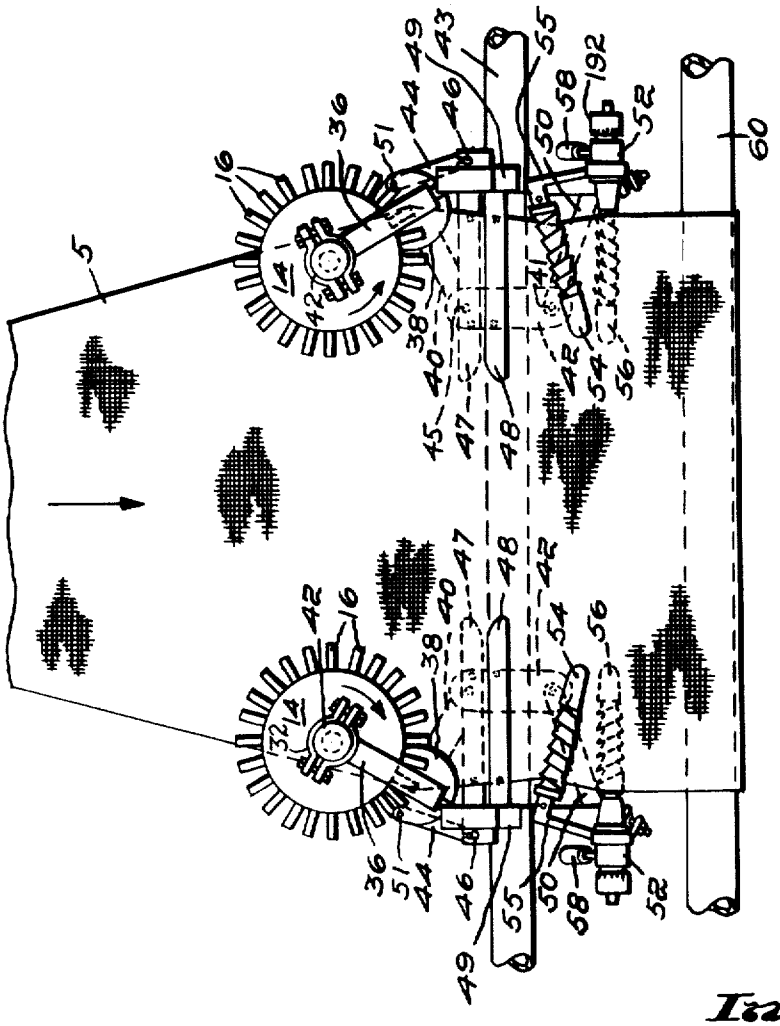


Fig. 1.



Inventors:
Klaus Köster:
by Rich & Ericson
Attorneys

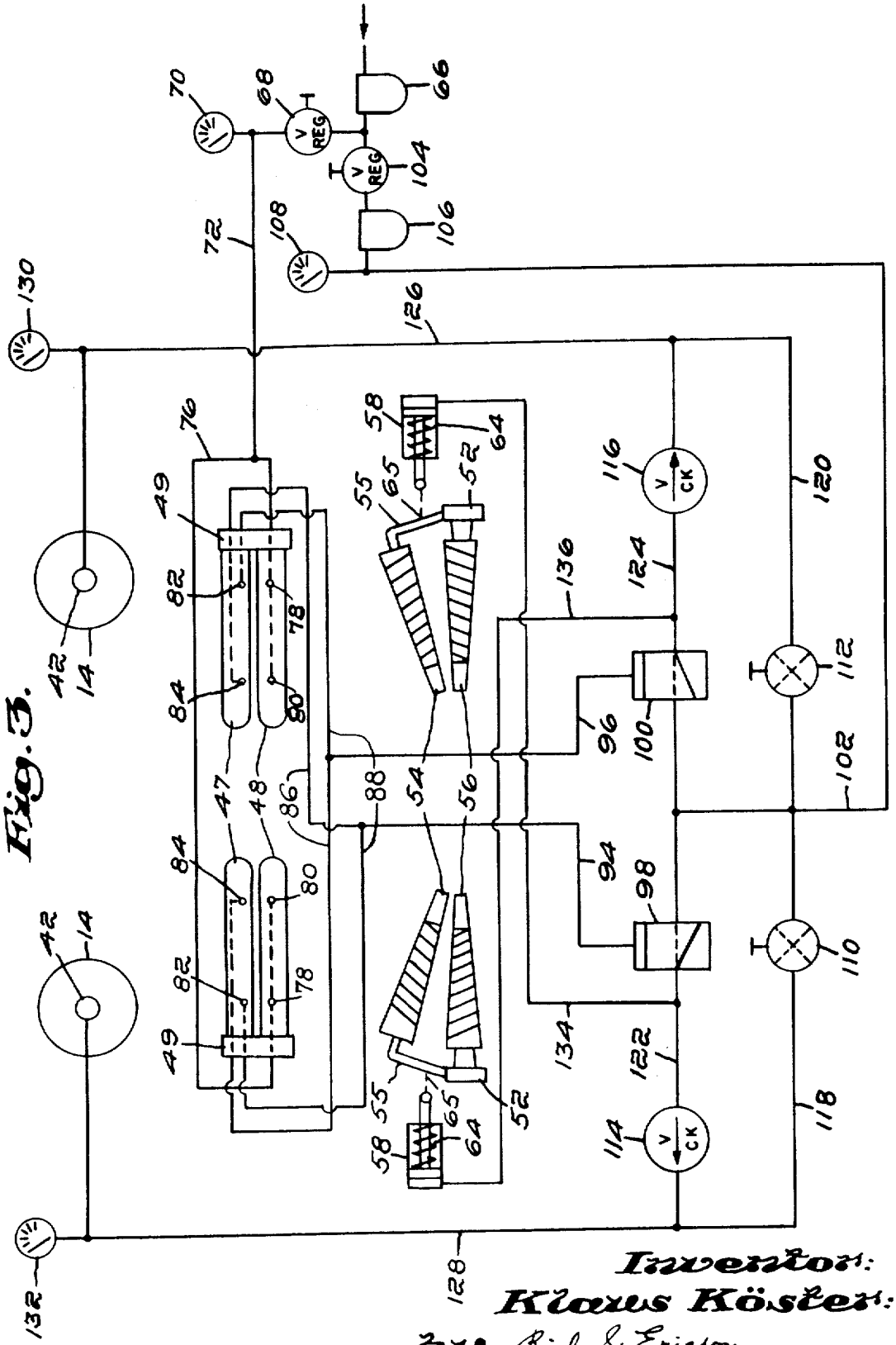


Fig. 3.

Inventor:
Klaus Köster:
by Rich & Ericson
Attorneys

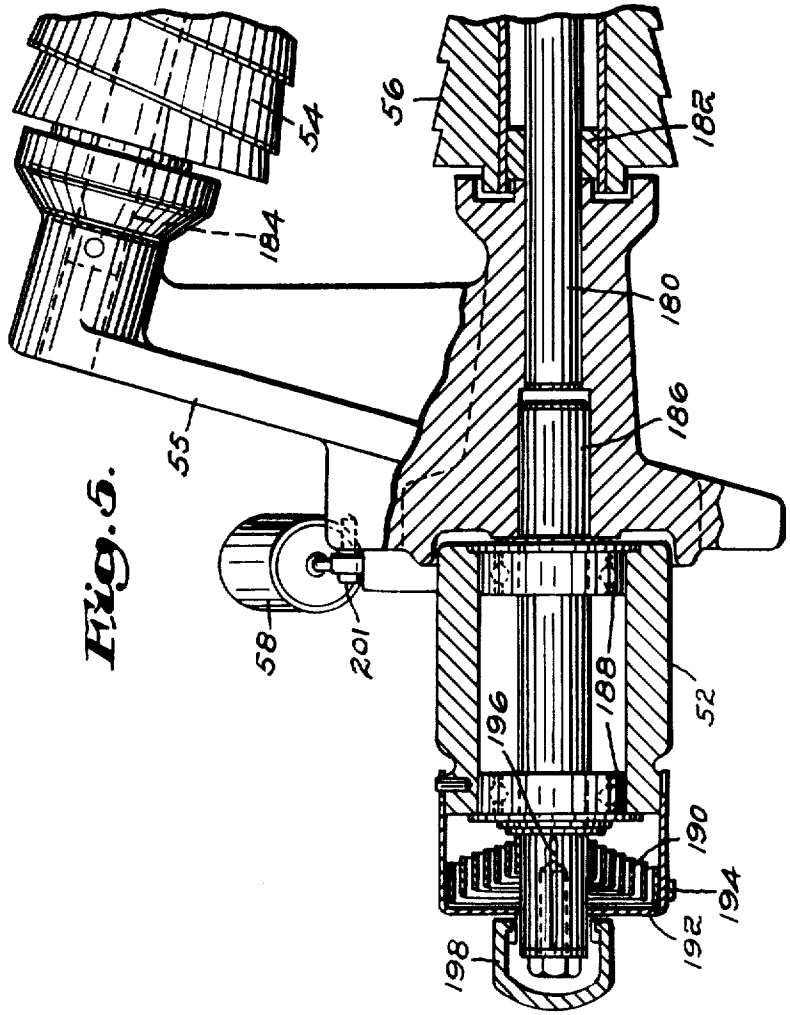


Fig. 5.

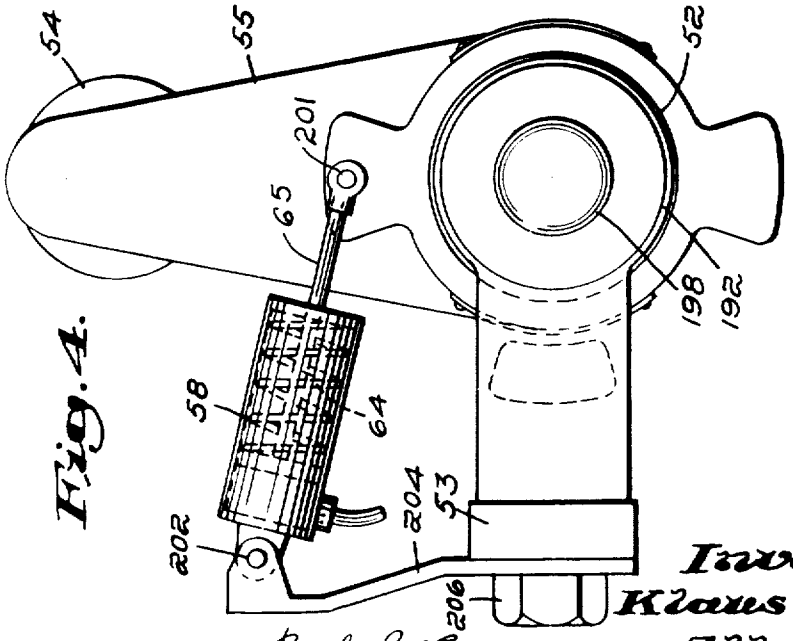


Fig. 4.

Inventor:
Klaus Köster,
Attorneys

by Rich & Ericson

Fig. 5.

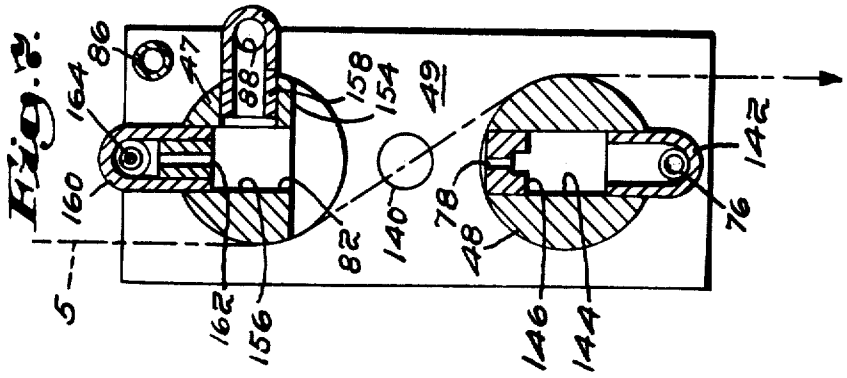
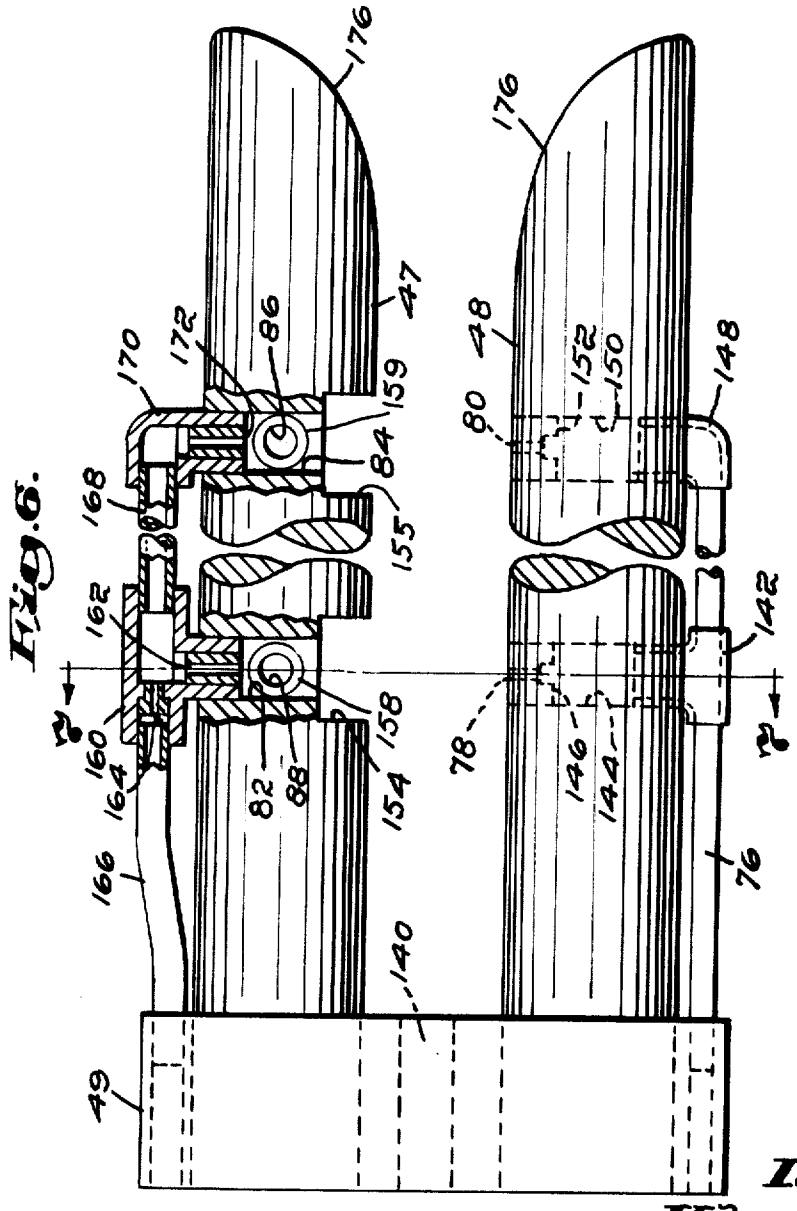


Fig. 6.



Inventor:
Klaus Köster,
by Rich & Ericson Attorneys

SHEET GUIDING AND OPENING APPARATUS

BACKGROUND AND BRIEF DESCRIPTION OF THE INVENTION

A combined web guider and selvage uncurler is disclosed and claimed by U.S. Pat. No. 3,419,944 issued to Nicholas T. Santore on Jan. 7, 1969 and assigned to Mount Hope Machinery Company. That apparatus utilizes rotary selvage uncurlers of a kind which is disclosed and claimed by U.S. Pat. No. 3,324,525 issued to George P. Knapp et al. on June 13, 1967, of the same assignee. This uncurler comprises a pair of opposed disks having circular rows of teeth; the disks are mounted on relatively inclined rotational axes so that their teeth interengage one another through the edges of a travelling sheet or web. Uncurling is brought about by components of tooth motion which are lateral to the sheet and stroke the selvages out flat.

According to U.S. Pat. No. 3,419,944 a pair of these uncurlers are driven at independently variable speeds under the control of sheet edge sensors, which normally cause the uncurlers to rotate with linear tooth velocities slightly greater than the speed of the sheet. When either edge of the sheet tends to wander laterally outwardly toward one of the uncurlers, however, the speed of that uncurler is reduced, with the result that its lateral pull is decreased. At the same time, the uncurler working on the opposite selvage maintains a normal rate of rotation, and therefore exerts a relatively greater lateral pull on the sheet. This tends to restore the sheet to its original path. When the lateral displacement of the shifted edge has been corrected, the speed of the slower-running uncurler is increased to normal, and the lateral pull on the opposite selvages is once again in balance. The apparatus guides the two edges of the sheet independently in predetermined tracks, and thereby not only uncurls and guides the sheet, but also tends to maintain a fixed sheet width.

It is a primary object of my invention to provide an improved guiding and opening apparatus which affords very rapid and positive corrections of the lateral deviations of a longitudinally traveling sheet from a desired path. It is another object to provide an improved opening and uncurling apparatus which facilitates rapid re-threading of the sheet when a poor seam, a substantial change in sheet width, or other factors cause it to become disengaged from the uncurlers. Further objects and advantages of the invention will appear as the following description proceeds.

Briefly stated, according to a preferred embodiment of the invention, I utilize first and second pairs of rotatable uncurlers, each of which is of such character that the lateral pull which it exerts on the material may be adjusted at will between two values, i.e. the degree of pull need not be a continuously variable function. I adjust the uncurlers in response to signals produced by sensors which detect the position of each edge of the sheet. Control means respond to the sensors to adjust the relative degree of pull exerted by the uncurlers in such a manner that when one edge of the sheet wanders laterally outwardly, the lateral pull exerted by that one of the first pair of uncurlers which grips the outwardly shifted edge is temporarily reduced. At the same time, the lateral pull of that one of the second pair of uncurlers which grips the second edge is increased. The concurrent laterally inward shift of the second edge causes the pull of the remaining member of the first pair on that edge to attain its strongest value; it also causes the pull of the remaining member of the second pair on the first, outwardly shifted edge to decrease.

Rapid correction of the sheet deviation is attained because both uncurlers acting on the inwardly shifted second edge are exerting maximum pull, while both uncurlers acting on the first outwardly shifted edge are pulling at their feeblest. This results in a rapid movement of the entire sheet in opposite direction to the edge deviation that induced the control operation. The mode of operation of the apparatus involves a continuous alternation of the net pulling effort on the sheet, first in one lateral direction and then in the other.

In a preferred embodiment, the first pair of uncurlers are of the rotary disk type described by the aforementioned U.S. Pat. No. 3,419,944. These are driven by adjustable-speed motive means, and have the characteristic that the amount of lateral pull which they apply to the sheet is a function of their speed of rotation. The second pair of uncurlers is preferably of a type known per se, each comprising a pair of rolls with helical surfaces, usually of a conical form. These rolls are not driven by motors, but are rotated by the longitudinal motion of the material, which is wrapped partially about their surfaces. These rolls are of such a character that they may be engaged or disengaged with the sheet to adjust the degree of lateral pull that they exert.

I provide a fluid control system which utilizes two air jet sensors for detecting the positions of the opposite edges of the sheet. When one jet is blocked by a displacement of the sheet which interposes one edge of the sheet, a first rotary disk uncurler acting on that edge is driven at a moderate rate of speed by an air motor supplied with air at a relatively low pressure, and so exerts its minimum traction. That one of the helical roll uncurlers which acts on the opposite edge of the sheet is engaged with the sheet, and exerts its maximum lateral pull. The remaining disk uncurler applies its maximum effort on the opposite edge while the remaining helical roll uncurler releases the first edge. The net difference in lateral traction pulls the sheet quickly away from the direction of its original displacement. This in turn exposes the first-mentioned air jet, which actuates a booster to increase the pressure of air supplied to the motor driving the first-mentioned disk uncurler. The resulting increase in speed of this disk uncurler then generates its maximum lateral pull. At the same time, the booster supplies air pressure to disengage the first-mentioned helical roll uncurler from the opposite edge of the sheet. The remaining uncurlers are oppositely adjusted during these events.

These concurrent and cooperating changes in relative lateral tractive effort by opposite members of both the first and second pairs of uncurlers causes the lateral position of the sheet to be reversed very promptly each time the edges either depart from or interfere with the air jet. Consequently, the sheet is shifted laterally back and forth, alternately interrupting one air jet sensor and then the other, thereby alternately accelerating and decelerating the opposed disk-type uncurlers, and de-nipping and nipping the opposed helical roll uncurlers. The amount of permitted deviation is limited by the effective widths of the air jets. Quite rapid and cyclically repeated corrections of edge deviations are characteristic of the system.

The processing rate of sheet goods may be detrimentally affected by the occurrence of poor seams between successive lengths, or by width changes, which sometimes cause the goods to slip out of engagement with the uncurlers. In conventional installations of helical uncurler rolls, it is necessary for the operator to first open or de-nip the rolls before he can reassert the material between them. According to a feature of this invention, reinsertion after a slipout occurs is facilitated by the incorporation of a second set of sheet edge sensors. These are located laterally inwardly, with respect to the centerline of the sheet, from the sensors previously described. These sensors may also comprise air jets which are normally interrupted by the cloth. When an edge of the material slips so far inwardly as to uncover either of the jets, it actuates one of the previously described boosters to de-nip or disengage the helical roll uncurler which previously gripped the edge that has slipped too far inwardly. It will be apparent that the opposite helical roll uncurler will have been opened in advance of this by the inward displacement of the same edge, as it slips out and first uncovers one of the laterally outer air jet sensors. Thus both sets of helical rolls will be de-nipped whenever a slipout occurs; the operator then has only to re-thread the goods between the open helical rolls, after which the feeding of the cloth can be recommenced without delay.

BRIEF DESCRIPTION OF THE DRAWING

While the specification concludes with claims particularly pointing out the subject matter which I regard as my invention, it is believed that a clearer understanding may be gained by the following detailed description of a preferred embodiment, referring to the accompanying drawings, in which:

FIG. 1 is a fragmentary view in front elevation of the opening and uncurling apparatus;

FIG. 2 is a fragmentary view in end elevation, looking from the left in FIG. 1;

FIG. 3 is a diagrammatic view showing a sensing and control system;

FIG. 4 is an end view of a helical roll uncurler assembly forming a portion of the apparatus;

FIG. 5 is a fragmentary view, partially in cross-section, of the assembly of FIG. 4;

FIG. 6 is a fragmentary view in front elevation of an air jet sensing head forming a portion of the apparatus; and

FIG. 7 is a sectional end view taken along line 7—7 in FIG. 6, looking in the direction of the arrows.

Referring to the drawings, a preferred embodiment of my invention incorporates a pair of rotary disk-type selvage uncurlers which are in themselves substantially as described in the aforementioned U.S. Pat. No. 3,324,525, but with the addition of variable speed motive means for driving them. Each uncurler comprises a pair of disks **14** and **10**, carrying circular rows of teeth **16** and **12**, respectively. The teeth are preferably formed of a flexible material such as rubber. The disks are mounted with their rows of teeth in opposed relationship, each pair in a U-shaped bracket **36** having spherical clamps **32** and **28** at the ends of its opposed legs. These clamps receive spherical bearing blocks **22** and **26**, which are adjustable in the clamps to permit the axles **18** and **20** of the disks to be inclined as shown, so as to interengage the rows of teeth **12** and **16** over an arcuate sector. The axles **18** and **20** are rotatably mounted in suitable bearings (not shown), which are in turn supported by the spherical clamps and bearing blocks for joint rotation of the disks.

The bracket **36** of each of these uncurlers is mounted in a desired relationship to a corresponding selvage of a sheet or web **5**, by means of an enlarged plate portion **38** cast in the bracket and bolted to an arm **40**. Each of these arms is bolted at a pivot point **45** (FIG. 1) to a clamp **42** mounted on a transverse bar **43** which forms a part of a stationary frame. The disk uncurlers **10**, **14** may be swung in or out laterally of the material by loosening the bolts at points **45**, and are adjusted to suit the width of any particular material to be treated. Ordinarily, the centers of the disks should fall near the edges of the sheet **5**.

It is assumed in FIGS. **1** and **2** that the sheet is feeding in the direction shown by the arrows, and is being opened by the apparatus from a twisted or rope form resulting from a prior process. Typically, a batch of twisted material may be drawn from a bin through a conventional detwister before passing to the opening equipment.

The axles **18** and **20** of the disk uncurlers are tilted in the downstream direction of sheet travel, and laterally inwardly toward the center of the sheet, so that the teeth **12** and **16** interengage over a limited arcuate sector, usually extending from a point inside the location where the selvage first encounters the disks, around to a point near the place where the selvage departs from the disks. In the downstream portion of this arc near the point of departure, the tooth motion has a large lateral component, and strokes the material laterally toward its edges. The disks **14** are driven separately by a pair of air motors **42**, and the rotation is imparted to the disks **10** by the engagement of the teeth **12** and **16**.

After leaving the disk uncurlers, the sheet **5** passes through a pair of sensing heads **49**, which are supported by arms **44** bolted to the brackets **36** at pivot points **51**, so that the spacing between the sensing heads can be adjusted readily to suit the width of the material.

Each sensing head bears a pair of parallel bars **47** and **48**, best shown in FIGS. **6** and **7**. The sheet **5** is threaded between these bars, slidably resting against them, so that it shields one from the other, as shown in FIG. **7**. The bars terminate in tapered tips **176** to avoid catching the material. The head has a central bore **140** for receiving a mounting bolt (not shown) to fix it in a suitable angular position with respect to the path of the sheet.

Air is supplied at a moderate pressure to each bar **48** by a conduit **76**, a tee **142**, and an elbow **148**. Bores **144** and **150** threadedly receive plugs **146** and **152**, respectively, which are provided with jet-forming orifices **78** and **80**. Separate air jets are directed by these orifices respectively toward receivers **82** and **84** formed in the bar **47**. The entrances to the receivers are enlarged by forming arcuate slots **154** and **155** in the surface of bar **47**. Plugs **158** and **159** are let into the receivers **82** and **84** to connect them respectively with signal pressure conduits **88** and **86**, which are led out through the head **49** for use in controlling the operations of the apparatus.

It will be observed that the pressure in the signal conduits will be atmospheric whenever the sheet interrupts the corresponding jets; however, an inward lateral shift of the selvage of the sheet which exposes either receiver **82** or **84** to the corresponding jet will produce an increased pressure signal in the corresponding conduit **88** or **86**.

Compressed air is also supplied to the receivers by a conduit **166** for the purpose of purging them of lint and dust, but its pressure is substantially reduced by a restrictor **164**, so that it does not interfere with the development of usable signal pressures. This purge air is delivered to the receiver **82** by a tee **160** and an orifice plug **162**, and to the receiver **84** by a tube **168**, elbow **170**, and orifice plug **172**.

Referring now to FIGS. **1** and **2**, a second pair of uncurlers each comprising helical rolls **54**, **56** engages the selvages of the sheet after it leaves the sensing heads **49**. These rolls have helically grooved conical surfaces partially wrapped by the sheet, which is threaded between them. The feeding of the sheet causes them to rotate and to stroke the edges of the material outwardly. The degree of lateral pull which they exert depends upon the pitch of the helical grooves, and also upon the extent of their engagement with the material.

As best shown in FIGS. **4** and **5**, the rolls of each helical roll uncurler are rotatably supported in an arm **55**, carrying a shaft **180** which supports the roll **56** on bearings **182**, and a shaft **184** which supports the roll **54** on similar bearings (not shown). The shafts **180** and **184** are preferably inclined to one another as shown, causing the rolls **54** and **56** to converge toward their tips. The arm **55** is pivotally mounted on a base **52** by means of a shaft **186**, fixed to the arm and received in bearings **188**, so that the roll **54** is movable between a position engaging the material, shown in solid lines in FIG. **2**, and a disengaged position shown in dotted lines at **54'**. When the uncurler is in the latter position, the roll **56** still engages the sheet, but the contact is too light to exert substantial lateral pull on the selvage.

The arm **55** is biased in a direction to engage the rolls with the sheet by means of a coil spring **190**, of which one end is engaged in a slot **196** of the shaft **186**, and the remaining end is fixed by a rivet **194** to a housing **192** pinned to the base **52**. The assembly is enclosed by a cap **198**.

The roll **54** is disengageable from the sheet by supplying air pressure to an actuating cylinder **58**, whose piston **65** is pivotally connected at **201** to the arm **55**. A return spring **64** aids the spring **190** in restoring the piston and arm to the position of FIG. **4** when the air pressure is released. The cylinder **58** is pinned at **202** to a bracket **204**, which is secured by a bolt **206** to a transverse boss **53** formed in the base **52**. The bosses **53** of the two helical uncurler units also serve to mount them on arms **50** which are bolted to the brackets **42** at pivot points **41**, so that the spacing between the uncurlers may be adjusted readily to suit any particular sheet width.

Referring now to FIG. **3**, the disk uncurlers **14**, the sensing heads **49**, and the helical uncurlers **54**, **56** are shown connected into a pneumatic control system. Compressed air is

supplied from any suitable source (not shown) to a filter **66**. Pressure for operating the uncurlers is taken through a pressure-regulating valve **104** and an oiler **106** to a supply conduit **102** having a gage **108**, and is delivered by branches to left and right adjustable needle valves **110** and **112**, as well as to left and right booster relay valves **98** and **100**.

These booster valves are of a type which is normally closed, and either may be opened by applying a signal pressure through a corresponding control conduit **94** or **96**. Opening the left booster **98** admits air at full pressure to a conduit **134** for actuating the right-hand air cylinder **58**, to disengage the corresponding helical rolls **54, 56** from the sheet; at the same time, full pressure is supplied to the motor **42** of the left-hand disk uncurler through a branch conduit **122** having a check valve **114**, and a conduit **128** equipped with a gage **132**. Opening of the right booster **100** similarly supplies full pressure through a conduit **136** to disengage the left-hand helical uncurlers **54, 56**, and through a branch conduit **124**, check valve **116**, and a conduit **126** equipped with a gage **130**, to the motor **42** of the right-hand disk uncurler **14**.

When either booster relay valve **98** or **100** is permitted to close, air under a pressure reduced by the needle valves **110** or **112** is furnished by conduits **118** and **128**, or **120** and **126**, to the corresponding air motor **14**, driving the connected disk uncurler at a reduced speed, so that the lateral pull which is exerts on the sheet is correspondingly decreased. The supply of pressure to the actuator **58** at the opposite edge of the sheet is then cut off by the presence of the corresponding check valve **114** or **116**, so that the opposite helical roll uncurler **54, 56** engages the material and exerts its normal pull.

For controlling the uncurlers, air pressure is supplied to the jets **78** and **80** of the sensing heads **49** by a regulating valve **68**, a supply conduit **72** having a gage **70**, and the branch conduits **76** previously described. The spacing between the heads **49** is adjusted so that the sheet just spans the distance between the outer receivers **82** of the two heads, one selvage lying over each receiver. The sheet is then fed forwardly as previously explained. As the sheet wanders to left or right, it uncovers one of the receivers **82**, and the associated jet **78** delivers a pressure signal to the corresponding one of the two signal conduits **88**.

A pressure signal at the left receiver **82**, brought about by a shift of the material to the right, is delivered by a conduit **94** to open the booster **98**. This increases the speed of the left disk uncurler **14**, enhancing its leftward pull on the material, while disengaging the right helical roll uncurler **54, 56** to discontinue its rightward pull. At the same time, the left helical roll uncurler maintains engagement and full pulling effort, while the right disk uncurler rotates at the lesser of its two speeds and exerts relatively little effort on the goods. Thus both of the left-hand uncurlers pull their best, while both right-hand uncurlers relax their efforts jointly. The result is a rapid shift of the material to the left, and this very quickly corrects the rightward lateral deviation. The correction covers the left-hand receiver **82** and closes the booster **98**, which lowers the speed of the left disk uncurler **14** while re-engaging the right helical roll uncurler **54, 56**. The corrective movement is, however, quickly followed by an exposure of the right-hand receiver **82** as the cooperating selvage is shifted away. The resulting pressure signal opens the booster valve **100**, and produces increased pulling effort by the right disk uncurler, while disengaging the left helical roll uncurler.

The control action is cyclically repeated, and causes the sheet to be guided within limits of lateral deviation that are determined by the effective widths of the air jets **78**. Lateral shifts of the goods are corrected with great rapidity, so that the permitted limits of lateral deviation are asserted with little latitude.

In practice, it occurs that poor seams between successive lengths of material, or pronounced changes in the width of these lengths, causes the sheet to escape altogether from the uncurlers at one or both selvages. To expedite the resumption of processing after this occurs, the laterally inner jets **80** and receivers **84** cooperate to supply pressure signals through their signal conduits **86**, each of which is cross-connected to the booster **98** or **100** which is normally controlled by an outer receiver **82** located at the opposite edge of the goods. This causes the helical roll uncurler **54, 56** at the edge that has slipped out of the uncurlers to disengage from the sheet. It will be observed that the helical roll uncurler acting on the opposite selvage must necessarily have been disengaged before complete loss of the slipping edge has taken place, through uncovering of the receiver **82** which cooperates with the slipping edge. Thus both helical roll uncurlers are automatically opened when a slip-out occurs, and the operator can easily reinsert the material and re-start the sheet-feeding apparatus with a minimum of effort and delay.

What I claim is:

1. Apparatus for opening and uncurling the selvages of a longitudinally traveling sheet and for guiding the sheet in a given path within predetermined limits, comprising, in combination:

a first pair of rotatable uncurling means constructed and arranged for engaging and stroking the opposite edge portions of the sheet to pull them laterally outwardly, and of such character that the amount of lateral pull which they apply is controllable;

a second pair of rotatable uncurling means constructed and arranged for engaging and stroking the opposite edge portions of the sheet to pull them laterally outwardly, and of such character that the amount of lateral pull which they apply is controllable;

said first and second pairs of uncurling means being spaced apart lengthwise of the sheet to engage the edges of the sheet serially;

control means constructed and arranged for controlling the amount of lateral pull exerted on the sheet by each of said first pair of uncurling means independently of one another, and also for controlling the amount of lateral pull exerted on the sheet by each of said second pair of uncurling means independently of one another, said controlling means including sensing means for detecting lateral shifts of the opposite edges of the sheet;

said control means being constructed and arranged to react to an outward lateral shift of either edge of the sheet by reducing the amount of pull exerted by that one of said first pair of uncurling means which strokes the outwardly shifted edge, and by increasing the amount of pull exerted by that one of said second pair of uncurling means which strokes the opposite edge of the sheet;

and said control means further being constructed and arranged to react to an inward lateral shift of either edge of the sheet by increasing the amount of pull exerted by that one of said first pair of uncurling means which strokes the inwardly shifted edge, and by decreasing the amount of pull exerted by that one of said second pair of uncurling means which strokes the remaining edge of the sheet.

2. Apparatus for opening and uncurling the selvages of a longitudinally traveling sheet and for guiding the sheet in a given path within predetermined limits, comprising, in combination:

a first pair of rotatable uncurling means having surface portions constructed and arranged for engaging and stroking the opposite edge portions of the sheet laterally outwardly, and of such character that the amount of lateral pull which they apply to the cloth is a function of their speeds of rotation; variable-speed motive means for rotating said first pair of uncurling means at independently controllable rates of speed;

a second pair of rotatable uncurling means having surface portions constructed and arranged for engaging and stroking the opposite edge portions of the sheet laterally outwardly, and of such character that they may be engaged with the sheet to stroke the edges in opposite lateral directions, or disengaged to discontinue stroking; engaging means for releasably engaging each of said

second pair of uncurling means with the sheet independently of the other;

said first and second pairs of uncurling means being spaced apart lengthwise of the sheet to engage the sheet in sequence;

control means for controlling said motive means and thereby individually controlling the rates of rotation of each of said first pair of uncurling means, and for individually controlling the engagement and disengagement of each of said second pair of uncurling means with the sheet; said control means including a pair of sensor means for detecting lateral shifts of the opposite edges of the sheet;

said control means being constructed and arranged to react to an outward lateral shift of either edge of the sheet by adjusting said motive means to slow the speed of rotation of that one of the first pair of uncurling means which strokes the outwardly shifted edge, and by causing said engaging means to engage the sheet with that one of the second pair of uncurling means which strokes the remaining edge of the sheet;

and said control means further being constructed and arranged to react to an inward lateral shift of either edge of the sheet, by adjusting said motive means to increase the speed of rotation of that one of the first pair of uncurling means which strokes the inwardly shifted edge, and by causing said engaging means to disengage the sheet from that one of the second pair of uncurling means which strokes the remaining edge of the sheet.

3. Apparatus as recited in claim 2, in which each of said first pair of uncurling means comprises:

a pair of rotary disks each having a peripheral row of teeth, said disks being mounted for rotation on tilted axes to interengage said rows about a common arcuate sector thereof for passage of the sheet therebetween.

4. Apparatus as recited in claim 2, in which each of said second pair of uncurling means comprises:

a pair of rolls having helically grooved surface portions and being rotatable by engagement with the travelling sheet to stroke the edge portions of the sheet laterally outwardly, said rolls being supported in an adjustable degree of engagement with the sheet.

5. Apparatus as recited in claim 2, said variable-speed motive means comprising a pair of fluid-operated motors operable at speeds proportionate to the supplied pressure, and said engaging means including a pair of fluid actuators operable by fluid pressure one for disengaging each of said second pair of uncurling means from the sheet, said engaging means being operative to engage either of said second uncurling means when operation of a corresponding fluid actuator is discontinued;

said sensor means being operatively connected with said control means to deliver a greater fluid pressure to one of said motors connected with either of said first uncurling means which is associated with an inwardly displaced edge of the sheet, and also to deliver a greater fluid pressure to either of said fluid actuators connected with either of said second uncurling means which is associated with the opposite edge of the sheet;

and said sensor means being operatively connected with said control means to deliver a lesser fluid pressure to one of said motors connected with either of said first uncurling means which is associated with an outwardly displaced edge of the sheet, and also to interrupt delivery of fluid pressure to one of said fluid actuators connected with either of said second uncurling means which is associated with the opposite edge of the sheet.

6. Apparatus as recited in claim 5, said sensor means comprising:

a pair of receivers arranged at either edge of the sheet, together with fluid jet means for directing fluid jets toward each of said receivers, so arranged that laterally outward movement of either edge of the sheet interrupts communication between a corresponding one of said receivers and a jet, while laterally inward movement of either edge exposes a corresponding one of said receivers to a jet.

7. Apparatus as recited in claim 6, said control means comprising a pair of booster relay valves each controllable by fluid pressure in one of said receivers to deliver said greater fluid pressure, and each being normally closed in response to interruption of communication between a corresponding one of said receivers and a jet, said control means further including bypass means for delivering said lesser fluid pressure upon closure of a corresponding one of said booster relay valves.

8. Apparatus as recited in claim 6, said control means further including:

a second pair of receivers arranged between said first-mentioned pair of receivers, together with means for directing air jets toward each of said further receivers, so arranged that in the normal operation of said apparatus the sheet interrupts both of said further jets, while slippage of either edge of the sheet from said uncurlers exposes a corresponding one of said further receivers to a jet;

said control means being connected to said further receivers in a manner to deliver increased air pressure to one of said second uncurling means engaging the same edge portion of the sheet which is associated with either of said second receivers which is exposed to an air jet.

9. Apparatus as recited in claim 2, said sensor means comprising:

a pair of receivers arranged at either edge of said sheet, together with means for directing air jets toward each of said receivers, so arranged that laterally outward movement of either edge interrupts a corresponding one of said jets, while laterally inward movement of either edge exposes a corresponding one of said receivers to the corresponding jet;

said first pair of uncurling means being of such character as to respond to increased air pressure by increasing the lateral pull which each applies to the sheet;

said second pair of uncurling means being of such character as to respond to increased air pressure supply by decreasing the amount of lateral pull which each applies to the sheet;

said control means being operatively connected to deliver increased air pressure to either of said first uncurling means engaging an edge portion of the sheet which exposes a corresponding receiver to an air jet, and to deliver increased air pressure to either of said second uncurling means which engages the opposite edge of the sheet;

said control means further being operatively connected to deliver reduced air pressure to either of said first uncurling means engaging an edge portion of the sheet which interrupts a corresponding receiver, and to deliver reduced air pressure to either of said second uncurling means which engages the opposite edge of the sheet.

10. Apparatus as recited in claim 2, said control means further including a second pair of sensor means for detecting lateral slip-out of either edge of the sheet from engagement with said uncurling means;

said control means being constructed and arranged to disengage either of said second uncurling means from which the sheet edge has slipped out.

* * * * *