

Jan. 11, 1955

P. N. SMITH ET AL

2,698,982

CONTROL SYSTEM FOR WEB HANDLING MACHINES

Filed Sept. 10, 1952

3 Sheets-Sheet 1

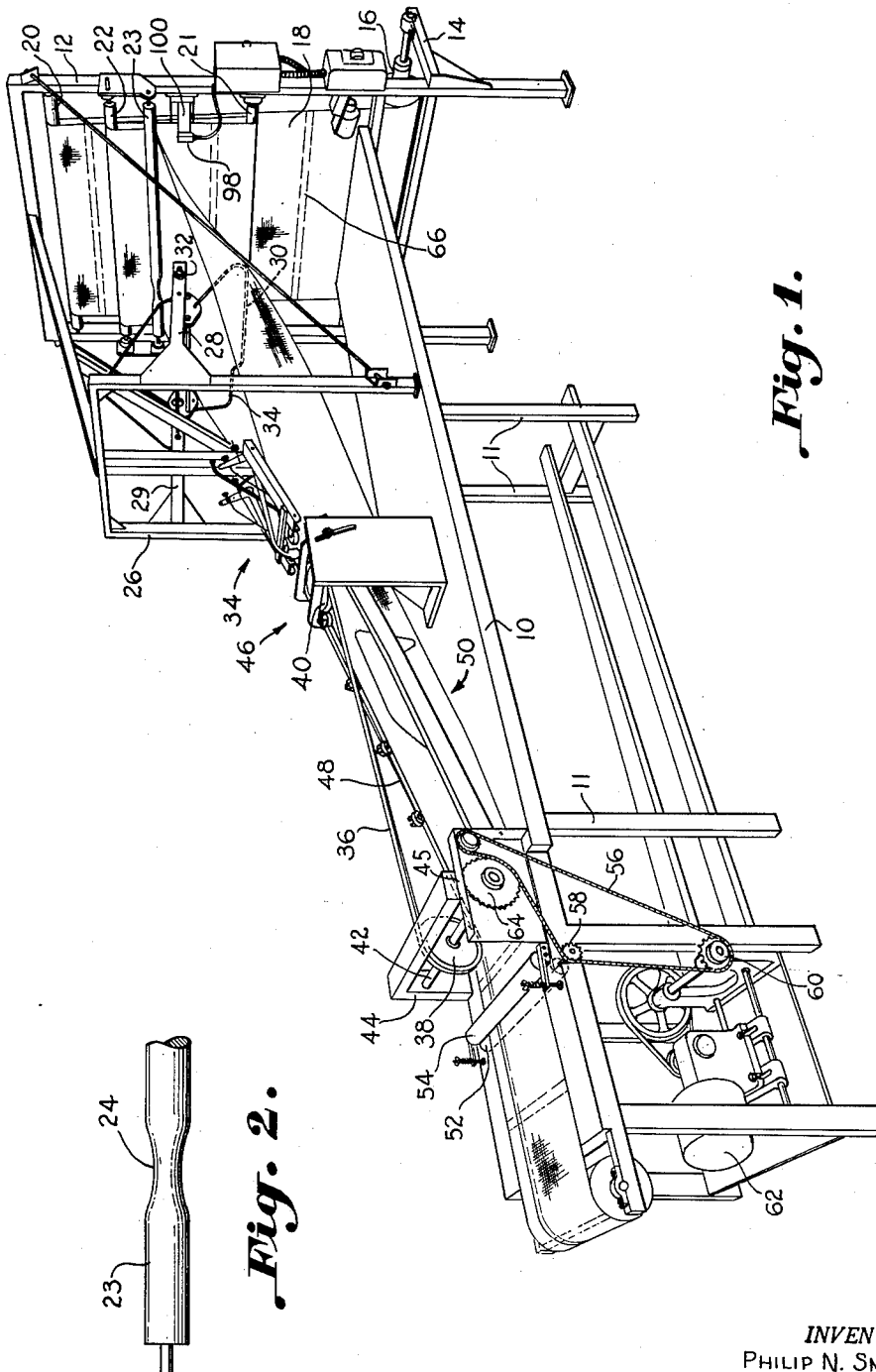


Fig. 1.

Fig. 2.

INVENTORS
PHILIP N. SMITH
JOHN W. HICKS, JR.
BY
Walter E. Mueller
ATTORNEY

Jan. 11, 1955

P. N. SMITH ET AL

2,698,982

CONTROL SYSTEM FOR WEB HANDLING MACHINES

Filed Sept. 10, 1952

3 Sheets-Sheet 2

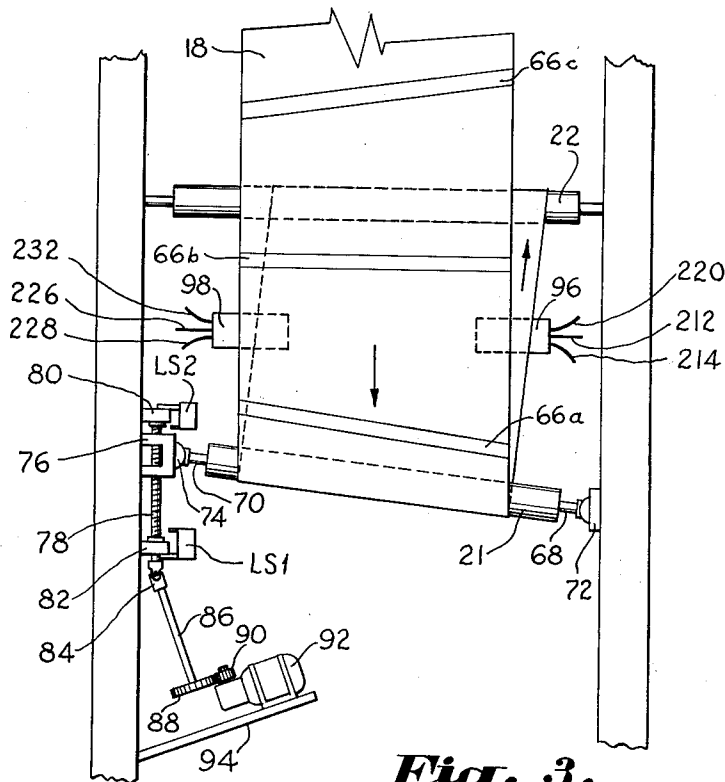


Fig. 3.

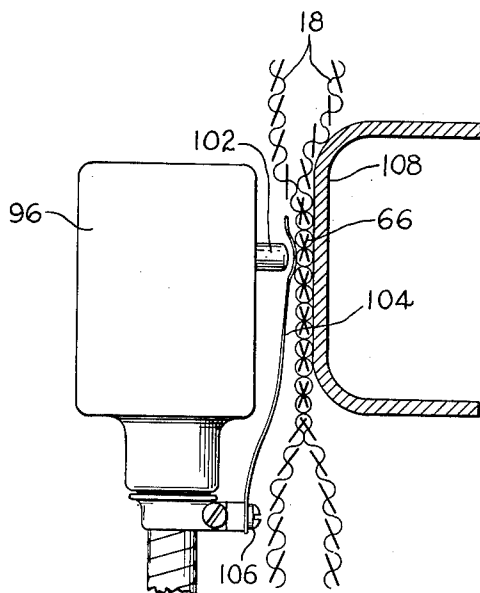


Fig. 4.

INVENTORS

PHILIP N. SMITH

JOHN W. HICKS, JR.

BY

Walter E. Mueller

ATTORNEY

Jan. 11, 1955

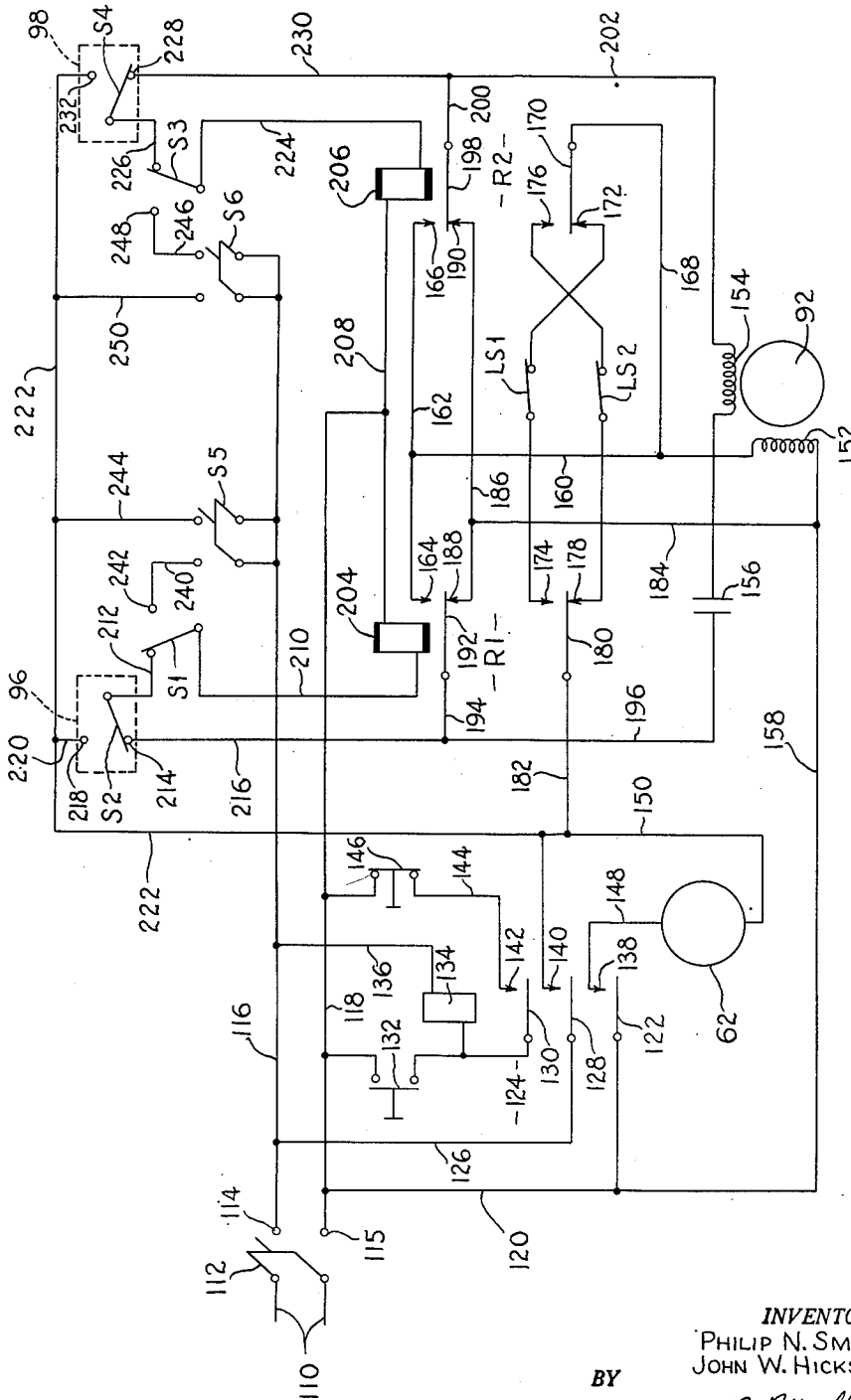
P. N. SMITH ET AL

2,698,982

CONTROL SYSTEM FOR WEB HANDLING MACHINES

Filed Sept. 10, 1952

3 Sheets-Sheet 3



INVENTORS

PHILIP N. SMITH
JOHN W. HICKS, JR.

BY

Walter E. Muller

ATTORNEY

1

2,698,982

CONTROL SYSTEM FOR WEB HANDLING MACHINES

Philip N. Smith and John Wilbur Hicks, Jr., Clemson, S. C., assignors to Deering Milliken Research Trust, near Pendleton, Oconee County, S. C., a nonprofit trust

Application September 10, 1952, Serial No. 308,854

8 Claims. (Cl. 26—51.4)

This invention relates to improvements in machines for continuously handling a web of material wherein it is necessary to initially feed the material thereto in open width and maintain it straight and free from skew. More specifically, the invention relates to a control system for straightening woven fabrics, such as plaids, shade cloth, diaper cloth, and the like, which, during normal handling following removal from the loom, may become distorted in that the filling no longer runs normal to the warp.

The improvements covered by this invention are particularly applicable to machines for continuously folding gauze diaper cloth, as more specifically shown in the application for Letters Patent of John W. May et al., Serial Number 298,604, filed July 12, 1952, and assigned to the assignee of this application. Gauze diaper cloth, for example, is preferably woven with a double or tubular weave and at appropriate intervals along its length with a single weave portion to form a band of given width. These bands are spaced so as to determine the length of a finished diaper and, also, provide a strip along the center of which the material may be cut from the piece, leaving the ends of the double woven layers properly joined to each other.

The machine forming the subject matter of the aforesaid May et al. application is adapted to continuously fold diaper cloth in a particular manner so that a double fold produces a centrally located panel section containing four layers and bordered on each side with marginal sections of only two layers of fabric. In accomplishing this folding operation, it is essential that the fabric be fed into the folding machine in open width, and any marked deviation of the filling yarn in the band portions from normal will not permit the band portions to be brought into registration when the folding operation is completed.

It is, therefore, a principal object of our invention to provide in machines for continuously handling a web of material an arrangement for correcting skew in such material.

Another object of the invention is to provide an improved and simple method for correcting the warpwise distortion of woven fabrics so as to facilitate further handling operations of the fabric requiring registration of portions of transverse elements or bands in the fabric.

Other objects and advantages relate to the structural arrangement of the skew correcting system and will become apparent as the description thereof proceeds.

In general, the arrangement and operation of our invention is best illustrated in connection with a folding machine for fabrics of the type shown and described in the aforesaid May et al. application. In such machine, provision is made for supporting a rolled web of cloth of desired width in horizontal position. As the web is rolled off, it is directed under guide rods terminating in a guide plate and simultaneously has its opposed selvage edges brought upwardly around the rods and towards each other in contacting matching engagement. The matching selvages are held in contact by suitable mechanism as the web is drawn through the machine. Other folding means in the form of guide rods also terminating in a guide plate deflect the once folded web to produce a second fold. The second folding means are so disposed that the double fold occurs above the first guide plate and laterally displaced inwardly from one marginal edge thereof. In like manner, the selvage gripping device is aligned laterally inwardly from the other marginal edge of the first guide plate so that when the web is released from the selvage gripping means the completely folded web will have mar-

2

ginal portions of double ply and a portion intermediate the marginal portions of four-ply cloth.

In order that the folded material emerging from the machine may be cut through the central portion of a band, it is essential that a band throughout its length be brought into registration during the folding operation. This is accomplished by the use of an array of skew correcting rolls, about which the web of cloth is caused to pass in entering the folding machine. In the event that the bands in the web become skewed from normal, the skew correcting rolls are tilted with respect to each other so as to progressively lengthen or shorten, from side to side, the path of travel of the web to bring the bands into normal position transversely of the web. A pair of thickness sensing devices placed on directly opposite sides of the web detect the position of the band in that the band is of single thickness whereas the body of material between bands is of double thickness. Each sensing device actuates a sensitive switch, in turn actuating a relay for controlling a motor-operated mechanism for changing the position of the skew correcting rolls in such manner that the transverse bands are brought into proper alignment.

The invention is more specifically described hereinafter in connection with the accompanying drawings, in which:

Figure 1 is a perspective view of a folding machine embodying the skew correcting system of our invention;

Figure 2 is an enlarged detail view of an element of the machine shown in Figure 1;

Figure 3 is a schematic elevation view showing the skew correcting roll array and its motor-operated actuating mechanism;

Figure 4 is an enlarged elevation view of one of the thickness sensing devices of the invention; and

Figure 5 is a circuit diagram of the electric control circuits for the folding machine embodying the skew correcting controls.

In Figure 1, the reference numeral 10 designates a platform supported by a plurality of legs 11 and an end frame 12. The end frame 12 carries a pair of horizontally extending brackets 14, only one of which is shown, for rotatably supporting a cloth roll 16 on which is wound the web 18 to be folded. The web 18 is adapted to be unrolled and fed into the machine about a series of guide rolls 20, 21, 22 and 23 rotatably mounted on the end frame 12, as shown. The web 18 is first passed upwardly and then about the roll 20, downwardly around the roll 21, upwardly about the roll 22, again downwardly and under the roll 23, and then proceeds in a direction inclined with but toward the platform 10. The rolls 20 to 23, inclusive, collectively constitute a skew correcting array, the operation of which will be more fully described hereinafter.

A frame 26 rises vertically from the platform 10 and has a pair of horizontal support arms 28 and 29 adjacent the upper end thereof. The arms 28 and 29 provide support means for a cloth guide 30 of generally elliptical shape, about which the web 18 is adapted to be drawn as it leaves the lower side of guide roll 23. Cloth guide 30 is preferably formed of round rod stock and is mounted for adjustment laterally of the web. Inasmuch as the adjustable feature of the guide 30 does not per se constitute a part of the instant invention, it will suffice to say that lateral adjustment of the guide is obtained by rotating in the desired direction a threaded traverse rod 32 operatively associated with the support 28. For a more detailed description of this particular feature, reference may be had to the aforesaid May et al. application.

Guide rod 30 has a deformed portion 34 at one end thereof, the purpose of which will be more fully explained hereinafter. As the web 18 leaves the guide member 30, it is directed toward and through a selvage matching device generally indicated at 34. From the selvage matching device, the opposed selvage edges of the web 18 are brought together and fed into a selvage gripping and advancing arrangement. This arrangement comprises a tenter belt 36 operative about a grooved drive pulley 38 and an idler pulley 40.

The drive pulley 38 is mounted on a shaft 42 for rotation therewith in a generally vertical plane. The shaft 42 is journaled preferably at its ends in upright supports

3

44 and 45 carried by the platform 10. The idler pulley 40 is mounted for rotation in a transverse plane slightly inclined with respect to the horizontal, as shown, and is carried by an adjustable support generally indicated at 46. Associated with the tenter belt 36 is a belt guide rail 48, one end of which is secured to the support 46 and the other end terminating adjacent to the lower side of drive pulley 38. The belt guide rail serves as a backing member for the tenter belt 36 to enable the two matching selvage edges of the web 18 to be held in matching engagement during movement throughout the folding operation. The folding operation of the web is accomplished by passing the web about a plurality of guide rods and plates generally disposed below the tenter belt 36 in the region indicated at 50. Inasmuch as the particular manner in which the folds are performed is of no patentable significance in the instant application, no further description of the folding operation need be given.

It is significant, however, to state that since the web is manipulated so as to form a double fold, the inner layers at the second fold have a tendency to lag as the web is advanced, causing misalignment transversely of the web. We have discovered that this tendency may be overcome by reducing the warpwise tension at the region wherein the lag occurs. The required reduction in tension is accomplished by reducing the diameter of guide roll 23 adjacent one end thereof, as shown at 24 in Figure 2. The reduced section 24 of roll 23 is also positioned in alignment with the indented portion 34 of guide rod 30, which further assists in reducing the warpwise tension on the web in the region where the traverse distortion occurs.

As the folded material emerges from between the tenter belt 36 and the guide rail 48 adjacent the drive pulley 38, it is engaged by a pair of feed rolls 52 and 54. In this instance, the roll 52 may be driven by an endless chain 56 engaging a sprocket 58 secured to the end of the roll shaft 52. The chain 56 is driven by a sprocket 60 forming a part of a suitable gear reduction mechanism driven by the motor 62. The chain 56 also engages sprocket 64 secured to the shaft 42 for driving the tenter belt 36.

The skew correcting system of our invention as applied to a diaper cloth folding machine of the type above generally outlined will now be described. The web 18, as shown in Figures 1, 3 and 4, has a succession of transverse bands 66 therealong of single weave construction whereas the portions intermediate the band 66 are of double weave construction. Such fabric construction, as is well-known in the art, is schematically illustrated in cross section in Figure 4. After a piece of cloth is taken off the loom, it is preferably rewound on a roll such as that shown at 16, Figure 1. Even though great care is taken to maintain the band 66 in alignment normal to the warp direction of the fabric, considerable skew may take place.

In order to correct any skew in the web before it reaches the folding mechanism, the rolls 20, 21, 22 and 23 are so adjusted with respect to each other that the length of path of travel of the respective warp ends from selvage to selvage during passage about these rolls is varied in a manner to cause the bands 66 to enter the folding mechanism in proper alignment. The structure whereby this is accomplished is more clearly illustrated in Figure 3.

For the sake of clarity only rolls 21 and 22 of the web straightening array are shown. Roll 22 is preferably mounted for rotation in suitable bearings as shown in Figure 1 carried by the upright members of the end frame 12 and is generally parallel to the guide rolls 20 and 23. The roll 21 is preferably provided with shaft ends 68 and 70 respectively. The shaft end 68 is axially slidably and rotatably mounted in a rockable bearing 72 whereas the shaft end 70 is rotatably mounted in a rockable bearing 74 carried by a U-shaped trunnion block 76. The trunnion block 76 makes threadwise engagement with a captive threaded actuating rod 78 journaled at its respective ends against axial movement in well-known manner to brackets 80 and 82. The brackets 80 and 82 are secured to the inside of the frame 12. The lower end of rod 78 has a projection extending below the bracket 82 to which is secured a universal coupling 84. The coupling 84 connects the rod 78 with a drive rod 86 having a gear 88 secured thereto. A small pinion gear 90 meshes with the gear 88 and is in turn adapted to be driven by a gear

4

motor 92. Gear motor 92 may be supported on a suitable bracket 94 attached to the frame 12.

It will, thus, be seen that as the motor 92 drives the threaded shaft 76 in one direction so as to move the trunnion block downwardly, as viewed in Figure 3, the roll 21 will be rocked about its bearing 72 and cause the roll to be tilted away from its companion roll 22, which rotates in fixed position. Rotation of the motor in the opposite direction consequently will cause the trunnion block 76 to be moved upwardly to tilt the roll 21 in the opposite direction or in a direction toward the fixed rotating roll 22.

The web 18 from the roll 16 is fed upwardly about the roll 20 and then downwardly and under the roll 21 and thence upwardly about the upper side of roll 22, from which position it proceeds again downwardly and emerges from the lower side of roll 23.

Again, with reference to Figure 3, a band 66 that has become distorted with respect to its normal lateral position as shown at 66a will require a tilting action of the roll 21 toward the roll 22, as shown. It will be seen that the degree of tilt required is somewhat proportional to the degree of deviation of the band 66a from its normal position. It is further apparent that by tilting the roll 21 toward the roll 22 the paths of travel for the warp ends from the left-hand selvage to the right-hand selvage, as viewed in Figure 3, are progressively lengthened so that as the band 66a approaches the roll 22 the band will gradually change its position laterally with respect to its original skewed position and approach a normal position. In a similar manner, it will be observed that should the band 66 be skewed in the opposite direction, as shown at 66c, it will be necessary to tilt the roll 21 downwardly or away from the roll 22. During such action, the paths of travel for warpwise threads from the right-hand selvage to the left-hand selvage are being progressively lengthened so that as the band 66c approaches the roll 22 it will gradually be brought into lateral registration.

In order to cause roll 21 to be tilted automatically in response to a requirement to correct the skew of a particular band 66 we have provided a skew detecting arrangement consisting of a pair of thickness sensing devices 96 and 98 mounted on suitable brackets 100 secured to the end frame 12 and extending inwardly into the path of travel of the web 18. One of the sensing devices is more specifically illustrated in Figure 4 and comprises a highly sensitive snap acting switch such as is known in the trade as a "Microswitch" having a plunger actuating member 102 extending therefrom. The plunger 102 may be actuated by a leaf spring type feeler 104 mounted at its lower end as by a screw 106 to the lower portion of the switch casing 96. A backup bracket 108 is mounted on the upright frame members 12 across which the web 18 is adapted to be drawn. The thickness feeling devices 96 and 98 are respectively mounted closely adjacent to the backup brackets 108 only one of which is shown, but spaced therefrom a distance sufficient to permit a sensing of the difference in thickness between the band portion 66 and the intermediate portion between adjacent bands. Thus, as a band is passed between the leaf feeler 104 and the backup bracket 108 the plunger 102 of the switch 96 will be permitted to move to the right, as viewed in Figure 4. This limited movement causes actuation of the switch mechanism inside the switch casing in a manner which is well-known in the art, and needs no further illustration or description of its operation. The two sensitive feeling devices 96 and 98 are preferably mounted on directly opposite edges of the path of travel of the web 18 so that when a band 66 passes the feeler devices both feeler switches will be actuated simultaneously if there is no skew. However, when a band 66 passes the region of the feeler devices 96 and 98 that is out of transverse alignment, the switch devices will be actuated in sequence. The precise order of actuation will, obviously, be determined by the direction of skew from the normal position.

By connecting the sensing devices 96 and 98 in a control circuit, as shown in Figure 5, automatic operation of the skew correcting system is achieved. In Figure 5, a suitable source of electric power is designated by the conductors 110 connected to a disconnect switch 112 having terminals 114 and 115. To the terminals 114 and 115 are connected main conductors 116 and 118.

A branch connection 120 from conductor 118 is connected to the armature 122 of a normally de-energized relay 124. A second branch circuit connection 126 leads from the line 116 to an armature 128 of relay 124. Relay 124 has a third armature 130 connected to the line 118 through a push button starting switch 132. An actuating coil 134 of the relay 124 is also connected on one side to the line 118 through the switch 132 and to the other side by a connection 136 to the line 116.

When push button starting switch 132 is closed, holding coil 134 will be energized attracting armatures 122, 128 and 130 to closed circuit position and making respective contact with contacts 138, 140 and 142. Contact 142 is connected by conductor 144 through a push button stopping switch 146 to the line 118. Thus, after starting switch 132 is closed, the circuit through holding coil 134 will be established at the armature 130 and contact 142 thereby permitting release of the push button switch 132. Relay 124 will, thus, remain energized until the circuit is broken through the coil 134 by opening of the stop push button 146. The electric driving motor for the folding machine is connected on one side by the conductor 148 to the relay contact 138 and on its other side by a conductor 150 to the relay contact 140. Thus, motor 62 will be energized upon the closing of start switch 132 and remain in operating condition until the circuit is broken by the opening of relay 124 at its contacts 138 and 140 as a result of opening of the push button stopping switch 146.

Motor 92, which drives the tilting mechanism for roll 21, is of the split phase reversing type having two coil group windings 152 and 154, the latter having a capacitor 156 connected in series therewith. One end of the coil 152 is permanently connected by a conductor 158 through conductor 120 to the line 118. The other end of coil 152 is connected by conductor 168 to the armature 170 of a relay R2. Armature 170 normally engages back contact 172 of relay R2 and is connected through a limit switch LS1 to a front contact 174 of a relay R1. In the energized position, armature 170 is adapted to engage a front contact 176 of relay R2 which is connected through a limit switch LS2 to back contact 178 of relay R1. The back contact 178 normally engages armature 180 of relay R1 and makes connection through armature 180 and a conductor 182 with conductor 150. Conductor 150 is connected to line 116 through conductor 126 and contact 140 and armature 128 of relay 124. The latter relay also controls energization of coil 152 of motor 92. Relay 124 thus serves as a lock-out relay permitting energization of motor 92 only when driving motor 62 is energized.

From the foregoing description, it will be apparent that motor winding 152 may be energized through connections across lines 116 and 118 through relays R1 and R2 only when one of the relays is energized. If relay R1 only is energized, current from line 116 may flow through conductor 182, armature 180, front contact 174, switch LS1, back contact 172, armature 170, conductor 168 to coil 152 which is connected to the other line 118 by conductors 158 and 120. If relay R2 only is energized, current from line 116 flows through conductor 182, armature 180, back contact 178, switch LS2, front contact 176, armature 170 and conductor 168 to the coil 152. In the event both relays R1 and R2 are de-energized, the circuit to coil 152 is broken by the front contact 176 and armature 170. Should both relays be energized, the current to coil 152 will be broken between armature 180 and back contact 178.

Motor winding 154 and its serially connected capacitor 156 are also adapted to be energized from lines 116 and 118 through connections controlled by relays R1 and R2. These connections, however, are so arranged that, when relay R1 is energized, current will flow in a given direction through the coil 154 and, when relay R2 is energized, the flow will be in the opposite direction. Consequently, since the current flow through coil 152 is always in the same direction, the reversal of current in coil 154 will cause a reversal of rotation of the motor 92.

More specifically, connections to coil 154 are made from line 118 through conductor 120, conductor 158, conductor 184 to a bridging connection 186 connecting the back contacts 188 and 190 of relays R1 and R2, respectively. Back contact 188 normally engages an armature 192 of relay R1 which, in turn, is connected by con-

ductors 194 and 196 to one side of the capacitor 156. The back contact 190 normally engages an armature 198 which is connected by conductors 200 and 202 to one side of motor winding 154. Relays R1 and R2 also have front contacts 164 and 166, respectively, bridged by conductor 162 which conductor makes connection by conductor 160 to the upper terminal of coil 152 and, consequently, makes connection with line 116 by way of conductor 168.

When relays R1 and R2 are in normal position, coil 154 and its capacitor 156 are short-circuited by back contact 188, bridging conductor 186 and back contact 190. Should relays R1 and R2 be energized simultaneously, coil 154 and its capacitor 156 will then be short-circuited through front contact 164, bridging conductor 162 and front contact 166. Upon energization of relay R1, while relay R2 remains in normal position, the closing of armature 192 with front contact 164 completes the connection from line 116 by way of conductor 168, conductors 160 and 162, contact 164, armature 192, conductors 194 and 196 to capacitor 156, coil 154, conductors 202 and 200, armature 198, back contact 190, conductors 186, 184, 158 and 120 to the line 118.

The energization of relay R2, while relay R1 remains in normal position, completes the circuit connection from line 116 by way of conductor 168 through conductors 160 and 162, front contact 166, armature 198, conductors 200 and 202 to the motor winding 154 and its series capacitor 156 and then from the capacitor to the line 118 by way of conductors 196 and 194, armature 192, back contact 188, and conductors 186, 184, 158 and 120. Current flow through motor winding 154 and its series capacitor 156 is therefore directionally controlled in accordance with the energization of either relay R1 or relay R2. The selective energization of relays R1 and R2 consequently determines the direction of rotation of motor 92 to cause tilting of the roll 21 either toward or away from roll 22.

Relays R1 and R2 are respectively actuated by coils 204 and 206, having a common connection through conductor 208 to the line 118. The other side of coil 204 is connected by conductor 210 through a manually operable single pole double-throw switch S1 and conductor 212 to a single pole double-throw switch S2 forming part of the thickness-sensing device 96. In the normal position as shown in Figure 5, switch S2 is closed through contact 214, in turn connected by conductor 216 to the junction of conductors 194 and 196. When actuated as by the passing of a band 66 between the feeler 104 and back-up bracket 103, switch S2 is moved into engagement with contact 218 connected by a conductor 220 to the conductor 222, in turn connected to the junction of conductors 150 and 182, the latter being connected through relay 124 to the line 116.

Thus, when switch S2 is actuated by the passing of a band 66 to close the circuit through contact 218, relay coil 204 is energized as a result of being connected across the lines 116 and 118, thereby causing relay R1 to be closed. As soon as the band 66 passes the sensing device 96, switch S2 returns to normal position to complete a holding circuit for the relay coil 204 through contact 214, conductors 216 and 194, armature 192, front contact 164, conductors 162, 160 and 168, armature 170, contact 172, switch LS1, contact 174, armature 180, conductor 182 to the line 116 through relay 124. The coil 204 of relay R1 remains energized until the circuit is broken between armature 170 and back contact 172 occasioned by energization of relay R2.

In a similar manner, the other side of coil 206 of relay R2 is connected by a conductor 224 to a manually operable single pole double-throw switch S3, in turn connected by conductor 226 to a single pole double-throw switch S4 forming part of the thickness sensing device 98. In its normal position as shown in Figure 5, switch S4 is closed through contact 228 which, in turn, is connected by conductor 230 to the junction of conductors 200 and 202. Switch S4 is adapted to be actuated by the passing of a band 66 between the feeler 104 and the back-up bracket 103 of the device 98, from its normal position in contact with conductor 228 to the position engaging contact 232. The latter contact is connected to conductor 222 so that when sensing device 98 is actuated by the passing of a band 66, switch S4 will be moved to circuit-closing position with contact 232

7

causing relay coil 206 to be energized as a result of being connected across lines 116 and 118 and thereby causing relay R2 to be closed. After the passing of a band 66 across the sensing device 98, switch S4 returns to normal position to complete a holding circuit for the coil 206 through contact 228, conductors 230 and 200, armature 198, contact 166, conductors 162, 160 and 168 and thence to line 116 as heretofore described. Coil 206 will remain energized until the circuit is broken by the armature 180 and contact 178 as a result of the energization of relay R1.

The manner in which the sensing devices 96 and 98 function to control the operation of motor 92 to effect tilting of the roll 21 in the proper direction to correct any skew of the bands 66 will now be described. It is assumed that the web 18 is traveling in the direction indicated by arrows in Figure 3, and a band has been skewed from normal position as shown at 66a. The right-hand side of the band 66a is leading the left-hand side and, consequently, actuates the sensing device 96 prior to the actuation of the device 98. Switch S2 will be actuated to close the circuit through contact 218 to energize coil 204 of relay R1. In the energized position relay R1 completes the circuit through its front contacts 164 and 174 to energize the windings 154 and 152 of motor 92, respectively. The closing of the circuit through contact 164 also establishes the holding circuit for relay coil 204 when the band 66 has passed beyond the sensing device 96 and switch S2 has returned to normal position as heretofore described. The direction of rotation of motor 92 is such that the threaded rod 78 driven by the motor causes the trunnion block 76 to be moved downwardly or to tilt roll 21 away from roll 22. This change of roll position momentarily increases the skew of band 66a. However, the left-hand end of band 66a soon thereafter comes into engagement with sensing device 98 to cause switch S4 to be actuated and closes the circuit through contact 232, in turn causing coil 206 of relay R2 to be energized. In the energized position, relay R2 initiates completion of the circuit to the motor windings 152 and 154 through front contacts 176 and 166, respectively. As armature 170 of relay R2 is raised to make contact with contact 176, it breaks contact with back contact 172, breaking the holding circuit for the coil 204 of relay R1, allowing the latter to return to normal position. In normal position armatures 180 and 192, respectively, complete circuits through back contacts 178 and 188 to the motor windings 152 and 164. However, with relay R1 in normal position and relay R2 in energized position, the circuit connections to winding 154 are reversed, therefore causing motor 92 to reverse its direction of rotation. A reversal of direction of rotation of motor 92 will cause the threaded rod 78 to drive trunnion block 76 upwardly to tilt the roll 21 toward the roll 22. The tilt in this instance is in the opposite direction so as to correct the skew of band 66a.

Once started by the energization of one of the relays R1 or R2, motor 92 continues to rotate in a given direction until reversed by the energization of the other of the relays. If the skew of band 66 has not been corrected, sensing devices 96 and 98 again detect the misalignment, and relays R1 and R2 are again energized in the same sequence, and the operation is repeated. In practice it has been found that greater stability has been obtained and the system is less likely to over correct if roll 21 is tilted slowly with respect to the linear movement of the web 18. It may therefore require the passage of two or three bands all of which may be skewed in the same direction to bring the bands into alignment.

When a condition of alignment has been reached, as illustrated by band 66b, sensing device 96 and 98 are actuated simultaneously, causing simultaneous energization of relays R1 and R2. As heretofore described, under such conditions, the circuits to motor windings 152 and 154 are broken, and the motor 192 is brought to rest.

Should a band 66 be skewed in the direction from normal, as shown at 66c in Figure 3, the left-hand end of the band will be first to engage the sensing device 98. The skew correcting action in such instance is identical to that previously described in connection with band 66a, except that relays R1 and R2 are actuated in inverse order.

In order to avoid jamming the trunnion block 76 against the brackets 80 and 82, the block is confined in its movement by the use of the limit switches LS1 and

8

LS2, more clearly shown in Figure 3. Switch LS1 is positioned adjacent to bracket 82 and is adapted to be actuated to open circuit position upon contact with the lower face of the block 76. Switch LS2 is similarly positioned adjacent to bracket 80 and is adapted to be actuated to open circuit position upon contact with the upper face of block 76. These limit switches are of conventional design and preferably spring-biased to closed circuit position.

As shown in Figure 5, switch LS1 is connected between front contact 174 of relay R1 and back contact 172 of relay R2. Switch LS2 is connected between back contact 178 of relay R1 and front contact 176 of relay R2. It will thus be seen that under abnormal conditions of skew tending to drive the trunnion block beyond its lower limit of travel will cause switch LS1 to be opened, breaking the holding circuit for relay R1 and, at the same time, interrupting the circuit to the motor 92 thereby stopping any further movement of the block 76 and roll 21. Even though switch LS1 is open, the control of relay R2 is not impaired, and reversal of the motor 92 can take place upon energization of relay R2. As soon as trunnion block 76 is moved upwardly out of engagement with switch LS1, the switch automatically closes, restoring normal circuit conditions. The operation of switch LS2 under conditions tending to drive the block 76 upwardly beyond its limit is similar to that described for switch LS1.

In order to effect manual operation of motor 92 in either direction, there are provided two double pole single-throw switches S5 and S6. Such operation is desirable in order to test the skew correcting arrangement independently of the operation of the folding machine. One side of each pole of both switches S5 and S6 is connected to line 116. One pole of the other side of switch S5 is connected by conductor 240 to contact 242 of switch S1. The remaining terminal of switch S5 is connected through a conductor 244 to conductor 222, and a similar one of the terminals on the other side of switch S6 is connected by conductor 246 to contact 248 of switch S3 and the remaining terminal of switch S6 connected to conductor 222 through a conductor 250.

When either or both switches of S5 and S6 are closed armature 128 and contact 140 of relay 124 are by-passed to complete a connection from line 116 through a respective pole of these switches, either conductor 244 or 250, and through conductor 222 to conductor 182. Thereafter, switches S1 and S3 can be manually operated from normal automatic position as shown in Figure 5 to their respective circuit closing positions engaging either contact 242 or 248. As switch S1 closes with contact 242, the sensing device 96 is disconnected therefrom and is made inoperative. However, coil 204 is connected across lines 116 and 118, causing relay R1 to be energized. Operation of the motor 92 will then proceed as heretofore described but only under the manual control of switch S1. If it is desired to reverse motor 92 manually, switch S1 is returned to normal position and switch S3 is moved to close with contact 248. An alternate method of manually operating motor 92 may be achieved by setting switches S1 and S3 on their manual operating positions and then manipulating switches S5 and S6, respectively, to obtain the desired motor rotation. When the latter method is employed, it is desirable to tie switches S1 and S3 together in the form of a double pole, double-throw switch so that the control circuit for motor 92 is made operative for either automatic or manual operation by a single switching operation. It will also be apparent that when switches S1 and S3 are positively operated in unison, any malfunctioning of switches S5 and S6 are avoided during manual operation by insuring that switches S2 and S4 are both disconnected from the control circuit.

While we have disclosed a specific correcting arrangement as may be applied to a diaper cloth folding machine embodying an electro mechanical thickness sensing device for translating certain intelligence to the novel motor control circuits, it is to be understood that the use of other sensing devices, either photoelectric, or pneumatic, are to be considered within the scope of the instant invention. Neither is the invention to be limited in its application to skew correcting means in devices for handling continuous webs of fabric, since the principles thereof are equally applicable to the correction of skew or other misalignment of a wide variety of web

materials on which certain designs or other indicia are repeated in a predetermined pattern and in connection with which it is desired to effect alignment or registration. It is therefore to be understood that the specific disclosure herein is merely for the purpose of illustration and that changes and modifications may be made by those skilled in the art without departing from the spirit and scope of the appended claims.

The following is claimed:

1. In a machine adapted to feed a web of material therethrough which material comprises alternate transverse portions of different thickness generally perpendicular to the direction of travel of said material, the improvement comprising a plurality of rolls about which said web is drawn in open width, means mounting said rolls in spaced relationship with each other and with their axes of rotation generally parallel, and thickness responsive means actuated by said transverse portions for initiating control intelligence in accordance with deviations from the perpendicular position of said portions for causing the tilting of one of said rolls with respect to at least another of said rolls to restore the perpendicularity of said transverse portions.

2. The improvement according to claim 1 wherein the thickness responsive means actuates a plurality of electric switches to close in proper sequence, a plurality of branches of a control circuit and said tilting roll is provided with a tilting mechanism driven by an electric motor controlled by said circuit.

3. In a machine for feeding a web of cloth therethrough, said cloth having fillingwise bands thereacross at spaced intervals and differing in thickness from the body of material between said bands, the improvement comprising a pair of rolls disposed in generally parallel spaced relation and about which said web is adapted to be drawn in open width, means mounting at least one of said rolls for tilting movement toward and away from said other roll, an electric motor-operated mechanism for tilting said one roll, and means responsive to a deviation of said bands from registration with a direction normal to the path of movement of said web for energizing said motor to cause a tilt in said one roll in a direction to bring successive bands into registration with said normal direction.

4. The improvement, according to claim 3, wherein said electric motor is reversible and operative to cause said mechanism to tilt said one roll in one direction for

a given rotation and operative to cause said mechanism to tilt said one roll in the opposite direction for reverse rotation.

5. The improvement, according to claim 4, wherein said electric motor is energized through two branch circuits to respectively produce rotation thereof in either direction, and separate relay means for controlling each of said circuits in accordance with the position of said bands transversely of said web.

6. The improvement, according to claim 5, including a pair of thickness sensing devices positioned along transversely opposite edges of said web to detect the presence of a band in said web, and switch means actuated by said sensing devices to control said relays in sequence in accordance with the transverse position of said bands.

7. The improvement, according to claim 6, wherein said relay means include interlocking circuit connections operative upon the simultaneous actuation of said switch means by said thickness sensing devices to prevent energization of said motor.

8. In a machine for feeding a flexible web of material therethrough, said web having transverse bands thereacross at spaced intervals and differing in thickness from the body of material between said bands, the improvement comprising a pair of rolls disposed in generally parallel spaced relation and about which said web is adapted to be drawn in open width, means mounting at least one of said rolls for tilting movement toward and away from said other roll, a mechanism for tilting said one roll, thickness responsive means operative in response to a deviation of said bands from registration with a direction normal to the path of movement of said web to produce a control signal, and means responsive to said control signal for actuating said tilting mechanism to tilt said one roll in a direction to bring successive bands into registration with said normal direction.

References Cited in the file of this patent

UNITED STATES PATENTS

1,404,110	Gigliotti	Jan. 17, 1922
2,311,406	Mansfield et al.	Feb. 16, 1943
2,343,328	Robertson et al.	Mar. 7, 1944
2,492,737	Dunn	Dec. 27, 1949
2,623,262	Berry	Dec. 30, 1952
2,638,656	Tuttle et al.	May 19, 1953