Aug. 30, 1955 J. T. MacISAAC, JR., ET AL 2,716,266

TOWEL STRAIGHTENING APPARATUS

Filed April 24, 1953 5 Sheets-Sheet 1

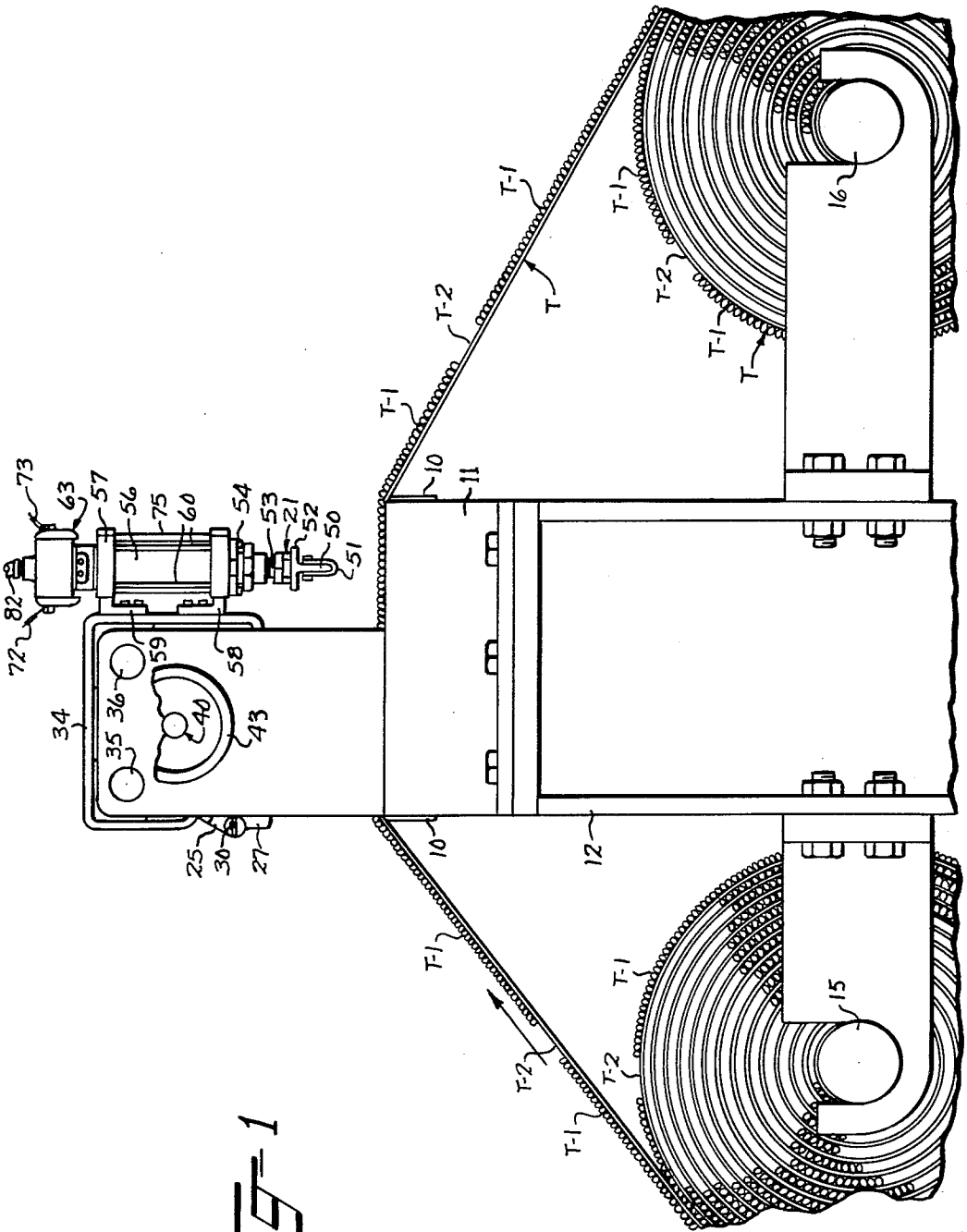


FIG. 1

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TOWEL STRAIGHTENING APPARATUS

Filed April 24, 1953 5 Sheets-Sheet 2

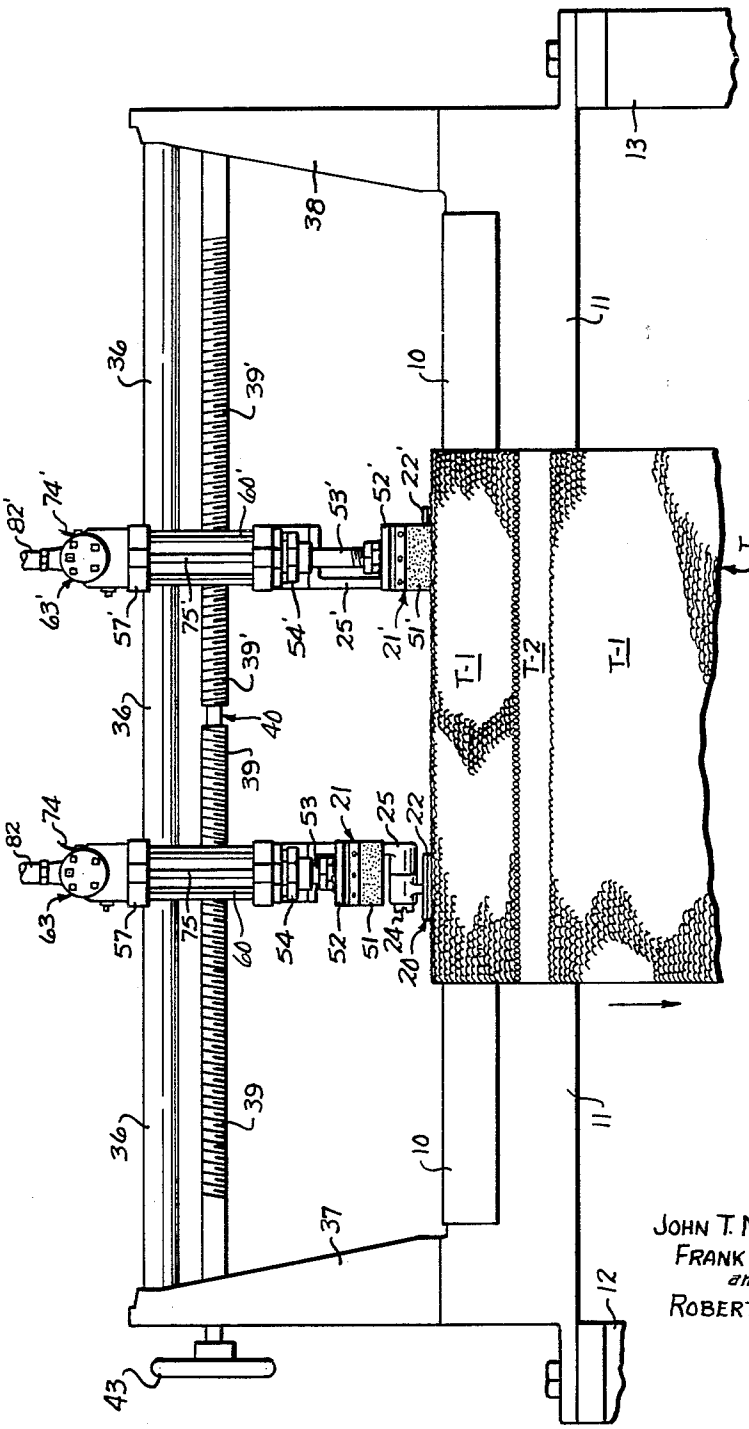


FIG. 2

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TOWEL STRAIGHTENING APPARATUS

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Fig. 3

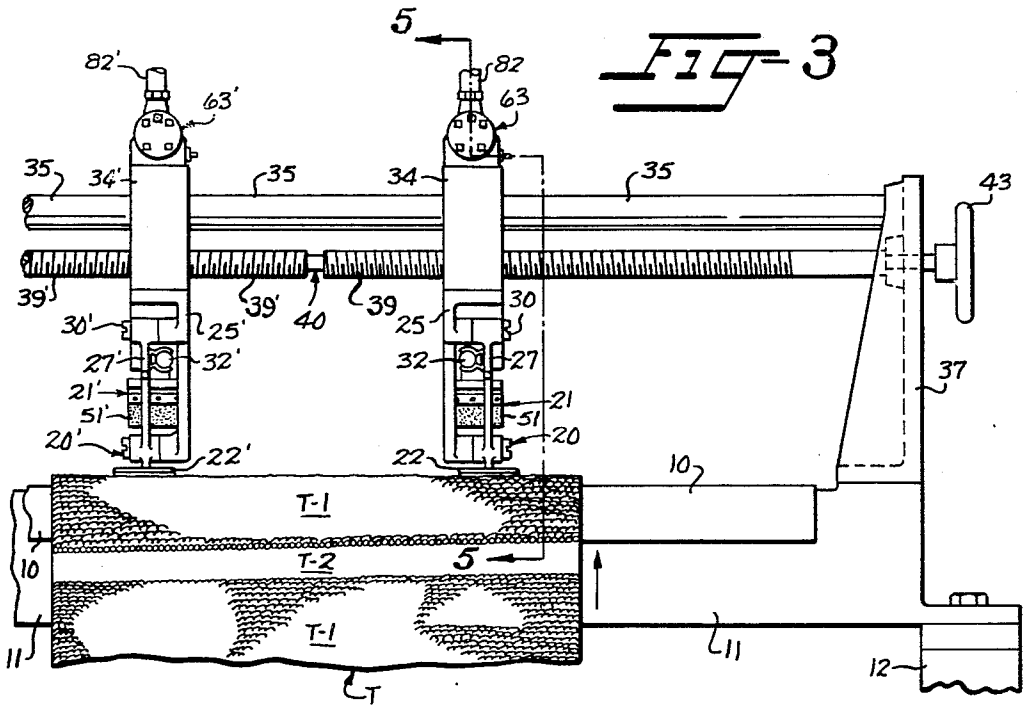
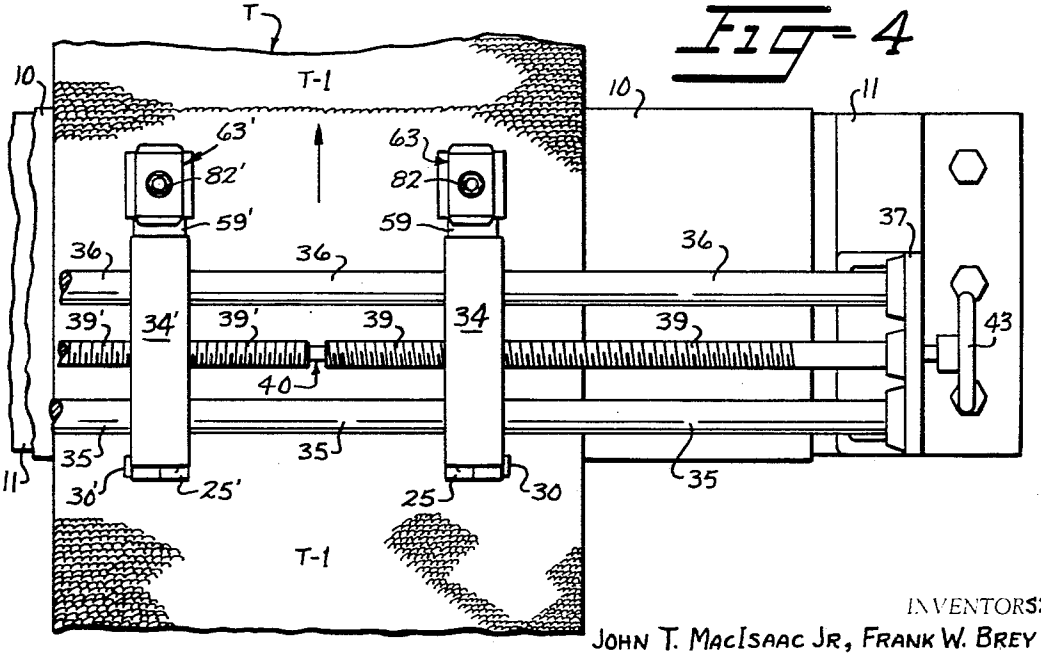


Fig. 4



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TOWEL STRAIGHTENING APPARATUS

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Fig. 5

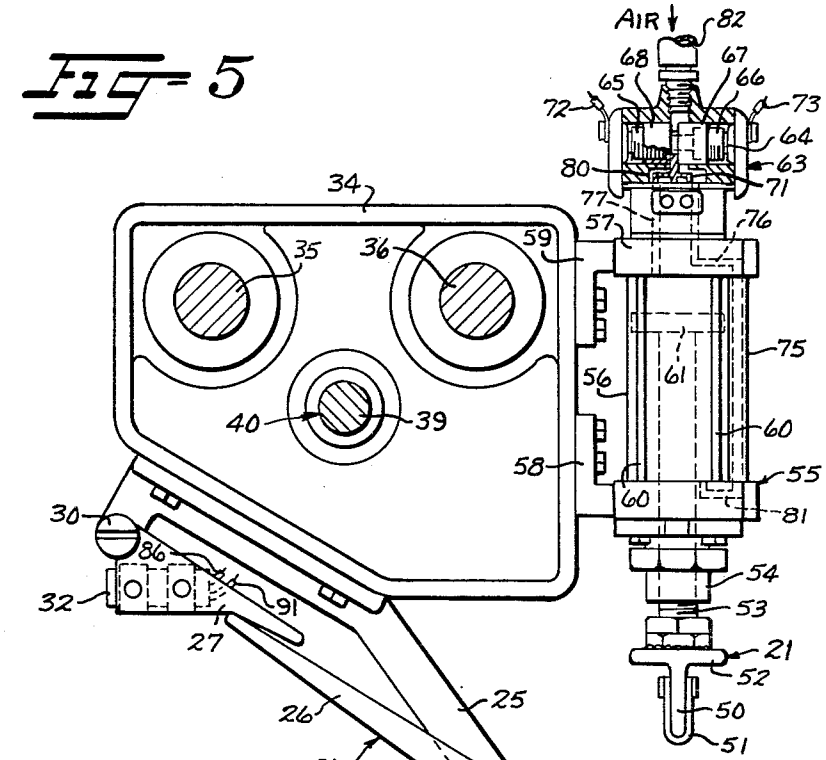


Fig. 6

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TOWEL STRAIGHTENING APPARATUS

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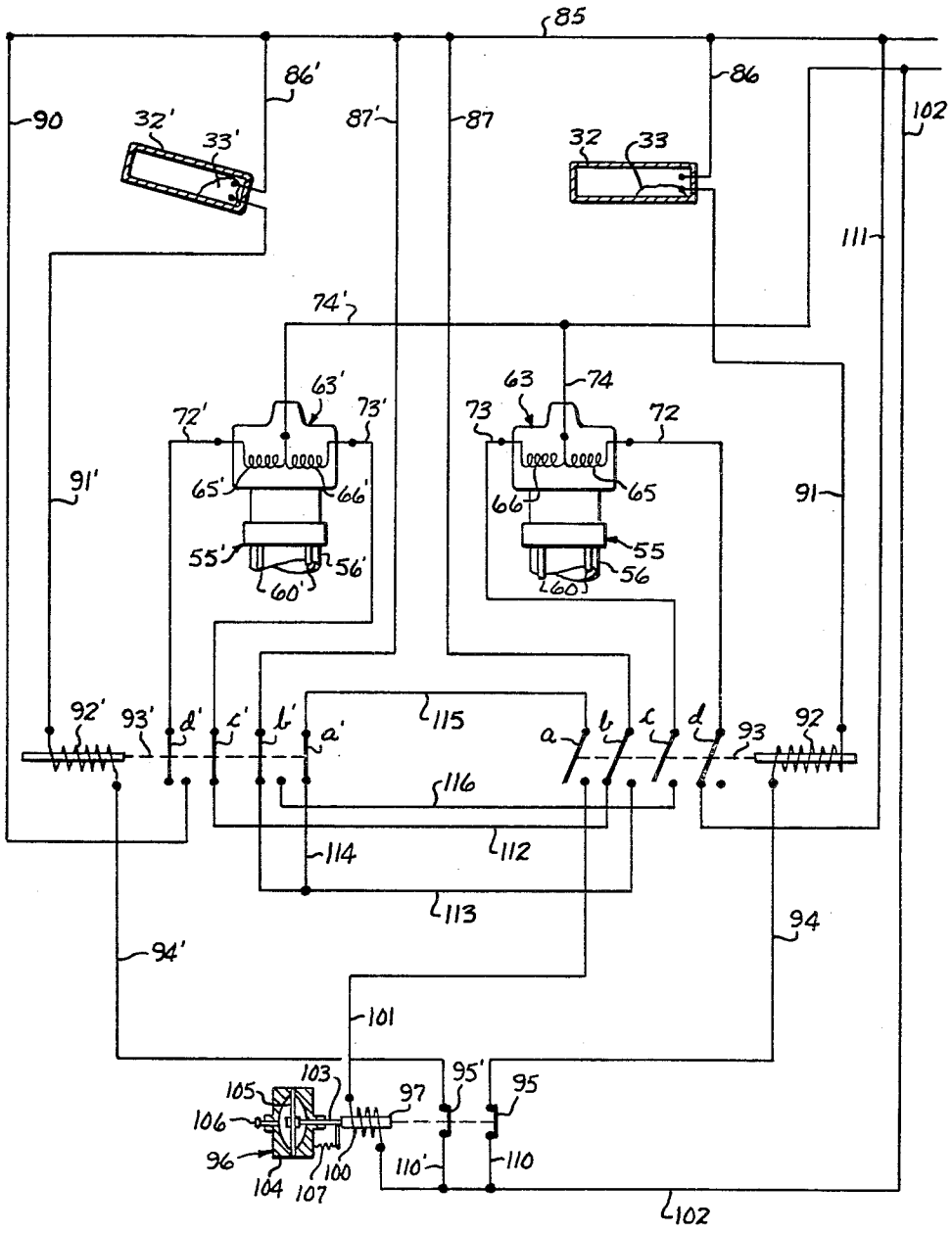


Fig. 7

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United States Patent Office 2,716,266
Patented Aug. 30, 1955

2,716,266

TOWEL STRAIGHTENING APPARATUS

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Application April 24, 1953, Serial No. 350,942

18 Claims. (Cl. 26—51.4)

This invention generally relates to weft straighteners and, more especially, to an improved apparatus for maintaining recurrent transverse lineal areas of a web material, such as toweling and the like, perpendicular or at right angles to the path of travel of the web material, and wherein the transverse areas are of a greater or lesser thickness than the intervening areas.

In view of the fact that the present invention is particularly provided for straightening relatively thin transverse areas in toweling, reference will be predominantly made to toweling throughout the specification, although it is to be understood that any type of web material having recurrent transverse lineal areas of a thickness varying with respect to the intervening areas may be straightened weft-wise to prevent skew therein, by means of the present apparatus.

It is well known that most towels, known as terry towels, are predominantly formed with relatively thick pile areas and opposite ends of each towel are formed with transverse lineal areas which are devoid of the pile and are thus relatively thin as compared to the pile areas of the towels. When terry towels are woven, they are formed in a relatively long strip of web material which has recurrent relatively narrow transverse or crosswise lineal areas on which there is no pile and these lineal areas are provided to facilitate locating the line along which the individual towels are severed, as well as providing a neat hem at opposite ends thereof.

It is therefore the primary object of this invention to provide means controlled by the variations in thickness of the toweling or other web material for controlling the skew of the web material.

More specifically, it is an object of this invention to provide feelers which rest upon a moving sheet or strip of toweling or other web material and means controlled by each feeler for restraining the corresponding portions of the toweling from movement in the event that all of the feelers are not disposed in a common position. For example, in the preferred embodiment of the invention, there is disclosed a table over which the web material passes and, in the event of a relatively thin lineal area in the web material being biased or skewed, one of a pair of feelers adjacent one selvage of the web material would assume a lower or higher position than the other of the pair of feelers disposed adjacent the other of the selvages of the web material.

Each of the feelers is connected to a corresponding clamping means by an electrical circuit arranged in series between the feelers so that, in the event of both of the feelers being either raised or lowered by the presence or absence of pile on the toweling, neither of the feelers will actuate its corresponding clamping means. On the other hand, upon either of the feelers being lowered in advance of the other of the feelers, then, the clamping means corresponding to the lowered feeler would be operated thereby to move downwardly and clamp the corresponding portion of the web material or toweling against the upper surface of the table. This occurs in event of the relatively thin lateral or transverse lineal area being askew relative to the longitudinal center of the toweling and wherein the relatively thin area would approach one of the feelers before it did the other of the feelers.

Assuming that one selvage of the toweling is advancing ahead of the other, the feeler at said one selvage would be lowered and the clamping means would thus clamp the corresponding selvage of the toweling against the table until the opposite selvage of the toweling had moved to where the relatively thin transverse area registered with the other of the feelers. It is evident that the other of the feelers would then also move downwardly to thus break the circuit to the clamping member which had previously been moved to clamping position, causing the same to release the toweling so that the entire width of the toweling may then continue its movement across the table.

Thus, the relatively thin transverse lineal areas are maintained at right angles or perpendicular to the path of travel of the toweling to thereby insure that the usual automatic severing devices to which the toweling may be directed from the improved straightening apparatus will accurately sever the toweling along a line perpendicular or at right angles to the longitudinal axis of the moving web or strip of toweling.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds, when taken in connection with the accompanying drawings in which—

Figure 1 is a side elevation of a table showing a let-off roll and a take-up roll with a table therebetween and between which the toweling or web material passes, and showing the improved towel straightening apparatus in association therewith;

Figure 2 is a view looking at the right-hand side of the upper portion of Figure 1, but showing one of the clamping devices in lowered or operative position for restraining movement of the right-hand portion of the toweling toward the observer in Figure 2;

Figure 3 is a view looking at the opposite side of the towel straightening apparatus from that shown in Figure 2, omitting the left-hand portion of the apparatus in Figure 3 and showing both of the clamping devices in inoperative position;

Figure 4 is a fragmentary top plan view of the structure shown in Figure 3;

Figure 5 is an enlarged vertical sectional view taken substantially along the line 5—5 in Figure 3 and showing the clamping means in raised or inoperative position;

Figure 6 is a view similar to the lower portion of Figure 5, but showing one of the feelers in lowered position and the lower portion of the corresponding clamping means is also being in lowered or operative position;

Figure 7 is a schematic wiring diagram of the electrical circuit for the improved towel straightening apparatus.

Referring more specifically to the drawings, the numeral **10** indicates a suitable platform or table, across the upper surface of which a strip of toweling or other web material T is passed. The table **10** is carried by a suitable horizontally disposed frame member **11** supported on legs **12** and **13**. Suitably journaled rearwardly and forwardly of the legs **12** and **13** are a let-off or feed roll **15** and a suitably driven take-up roll **16** and the strip of toweling T is withdrawn from the roll **15** by the roll **16**.

In its course, the sheet or strip of toweling T passes upwardly from the roll **15**, horizontally across the table or platform **10** and then downwardly and about the roll **16**. The roll **16** may be driven in any desired manner and an illustration of the driving means therefor, is deemed unnecessary. As a matter of fact, the roll **16** is merely exemplary of any type of take-up mechanism

and the toweling, in its course past the take-up mechanism, may pass through a suitable severing means, not shown, if so desired.

In the present instance, the strip or sheet of web material T is shown in the form of a strip of terry toweling having recurrent thick or pile areas T–1 thereon whose junctures are defined by intervening relatively thin transverse lineal areas T–2. These areas T–2 may also be termed as non-pile areas. Now, it is necessary that the transverse lineal areas T–2 extend perpendicular or at right angles to the longitudinal axis of the strip of toweling or web material T as the toweling is taken up by the take-up mechanism embodied in the roll **16**, or as the toweling is directed to a subsequent severing operation, to thereby insure that the toweling may be severed transversely thereof along lines substantially bisecting each of the relatively thin transverse lineal areas T–2, to provide for the forming of a neat hem on opposite ends of each individual towel and wherein the hem extends perpendicular or at right angles to the selvages or longitudinal axis of each individual towel.

To this end, we have provided an improved towel or web straightening apparatus comprising a pair of transversely spaced feeler devices broadly designated at **20** and **20'** which control respective clamping devices broadly designated at **21** and **21'**. Each of the feeler devices **20** and **20'** and their respective clamping devices **21** and **21'** are adjustable transversely of the path of travel of the web material or sheet of toweling T and are positioned above the table or platform **10** and should be so adjusted that the feeler devices engage the upper surface of the sheet of toweling at points adjacent, but inwardly of, the respective selvages or longitudinal side edges of the strip or sheet of toweling or web material T. Since both of the feeler devices **20** and **20'** are identical and both of the clamping devices **21** and **21'** are identical, only the feeler device **20** and the clamping device **21** will be described in detail and like parts associated with the feeler device **20'** and the clamping device **21'** will bear the same reference characters with the prime notation added.

The feeler device **20** is in the form of a lever or bell crank having a relatively broad flat bottomed feeler foot **22** which is preferably curved upwardly and outwardly at its front and rear ends with respect to the direction of travel of the toweling T and which rests upon the toweling T as it passes over the table or platform **10**. The feeler foot **22** is fixed to a relatively short arm **23** of the lever **20** and is pivotally connected, as at **24**, to a bracket **25**. The lever **20** also has a relatively long arm **26** which serves as a weight means to cause feeler foot **22** to bear against the upper surface of the strip or sheet of toweling or web material T.

The upper end of the arm **26** has a pivoted switch supporting member **27** resting thereon which is pivotally mounted, as at **30**, on the rear portion of the bracket **25**. The member **27** rests upon the arm **26** so that, when the corresponding feeler foot **22** is resting upon a relatively thick or pile area T–1 of the strip or sheet of toweling or web material T, the member **27** will cause a switch **32** to be opened while, on the other hand, upon a relatively thin area T–2 passing beneath the feeler foot **22**, the arm **26** of the lever **20** will move downwardly whereupon the member **27** is adapted to close the switch **32**. In this instance, the switch **32** is shown in the form of a mercury switch and is suitably secured to the switch supporting member **27**. The ball of mercury or other liquid conductor material in switch **32** is indicated at **33** in Figure 7. The switches **32** and **32'** are interposed in an electrical circuit to be later described for controlling operation of the corresponding clamping devices **21** and **21'**.

The bracket **25** is suitably secured to a block **34** mounted for lateral sliding movement, with respect to the longitudinal axis of the strip or sheet of toweling or web material T, on a pair of guide rods **35** and **36**, opposite ends of which are fixed to standards **37** and **38** supported by the frame member **11**. The blocks **34** and **34'** are threadably penetrated by respective threaded portions **39** and **39'** of a common adjustment shaft **40** rotatably mounted in the standards **37** and **38** and being suitably restrained from end-wise movement therein. One end of shaft **40** has a suitable hand wheel **43** fixed thereon to facilitate manually rotating the adjustment shaft **40** and to thereby vary the distance between the feeler devices **20** and **20'** and the clamping devices **21** and **21'**.

As heretofore stated, only the clamping device **21** will be described in detail and like parts associated with the clamping device **21'** will bear the same reference characters with the prime notation added. There are various ways in which the clamping device **21** may be constructed and made electrically responsive to variations in the position of the corresponding feeler **20** and, in the preferred embodiment of the clamping device, we have provided a relatively thin vertically disposed clamping head **50** which is disposed forwardly of the corresponding feeler device **20** and extends transversely of the path of travel of the sheet or strip of toweling or web material T. Of course, the length of the clamping head **50** is relatively short as compared to the width of the sheet of toweling T and is adapted to, at times, clamp the sheet of toweling T against the table adjacent the corresponding selvage or longitudinal side edge thereof.

The clamping head **50** preferably has a strip of resilient material **51**, such as rubber or the like, suitably secured thereto and which is formed in the shape of the letter U and fits against the rounded edge of the clamping member **50** to thereby present a relatively narrow rounded and resilient surface for clamping the sheet of toweling T against the table or platform **10**. It is also preferable that the outer surface of the U-shaped pressure applying member **51** is roughened or stippled as shown in Figures 2 and 3 to thereby insure that the strip or sheet of toweling T will not slip past the U-shaped member **51** when it is in lowered position although the member **51** may be forced downwardly under a minimum amount of pressure.

In this instance, the clamping head **50** has a flange **52** on the upper end thereof which is suitably secured to the lower end of a ram or piston rod **53**. The piston rod **53** slidably penetrates a cylinder base **54** of a cylinder assembly broadly designated at **55**. The cylinder assembly **55** also comprises a cylinder tube **56** and a cylinder head **57**, the cylinder base, cylinder tube and cylinder head **57** being suitably secured together, as by tie rods **60**. Disposed within the cylinder tube **56** is a suitable piston **61** to which the upper end of the piston rod **53** is suitably secured. The cylinder base **54** and the cylinder head **57** have angle portions **58** and **59** integral therewith, or suitably secured thereto, which are, in turn, suitably secured to the front surface of the corresponding block **34**.

There are various means by which fluid under pressure, such as compressed air, may be alternately directed into the upper and lower ends of the cylinder tube **56**, the means shown being of a type such as is manufactured by the Bellows Company of Akron, Ohio, and which is known as their model EV electroaire valve and is clearly illustrated in their Manual entitled "Specifications and Dimensional Data (revised March 30, 1951) Bellows model BEM air-powered electrically-controlled non-rotating air motors and electroaire valves." Accordingly, only so much of the control means for the fluid under pressure will be described as is necessary to a clear understanding of the present invention.

The fluid pressure control units for the two cylinder assemblies **55** and **55'** are generally designated at **63** and **63'**. Since both of the control units **63** and **63'** may be identical, only control unit **63** will be described in detail and like parts of the control unit **63'** shall bear

the same reference characters with the prime notation added.

The housing of the control unit **63** has a rod **64** fixed therein which is surrounded by a pair of spaced magnetic coils **65** and **66**. The proximal portions of the coils **65** and **66** in Figure 5 are surrounded by a pair of closely spaced innerconnected substantially cup-shaped metallic members **68** and **67**, respectively, between the proximal surfaces of which the stem of a movable valve member **71** is positioned. It will be observed in Figure 7 that the distal ends of the coils **65** and **66** have respective wires or conductors **72** and **73** connected thereto and the proximal ends of the coils **65** and **66** are connected to a common wire **74**. The cylinder base **54** and cylinder head **57** have opposite ends of a tubular member **75** connected thereto and the head member **57** is provided with a pair of passageways **76** and **77** therein. One end of passageway **77** communicates with a chamber **80** in which the valve member **71** is disposed and the other end of passageway **77** communicates with the interior of the cylinder tube **56** at the upper end thereof.

The passageway **76** communicates with the tubular member **75** and the cylinder base **54** has a passageway **81** therein which establishes communication between the lower end of the tubular member **75** and the lower end of the cylinder tube **56**. A pipe **82** leads from a suitable source of fluid under pressure or compressed air, not shown, to the upper end of the housing of control unit **63** (Figure 5). Suitable means are usually provided with such control units, as those disclosed in said Bellows Manual, for controlling the rate at which the compressed air flows into either end of the cylinder tube **56**. However, since the means for controlling the rate at which the compressed air is directed to either end of the cylinder tube **56** is not essential to the present invention, an illustration and description thereof is deemed unnecessary.

The valve member **71** is so arranged, that, upon energization of the coil **66**, the valve member **71** will shift to the right in Figure 5 to prevent compressed air from entering passageway **76**, but to be exhausted therefrom as compressed air is directed from pipe **82**, through the control unit **63** and, thus, through the passageway **77** and into the upper end of the cylinder tube **56** to cause the clamping head **50** to occupy substantially the position shown in Figure 6 and to thereby clamp the corresponding portion of the sheet of toweling or web material T against the upper surface of the platform or table **10**.

Of course, as the piston **61** and piston rod **53** move downwardly, the air displaced thereby is exhausted through the passageway **81**, tubular member **75**, passageway **76**, valve member **71** and, thus, through a suitable discharge port, not shown, which then registers with the valve member **71**.

On the other hand, upon energization of the coil **65** and de-energization of the coil **66**, the cup-shaped members **67** and **68** and the valve member **71** are shifted to the left to occupy substantially the position shown in Figure 5, whereupon compressed air will pass from the pipe **82**, through the housing of the control unit **63** and will be directed by the valve member **71** into the passageway **76**, through tubular member **75** and through passageway **81** into the lower end of the cylinder tube **56**. It is evident that this will cause the piston **61**, piston rod **53** and the clamping head **50** to move upwardly to occupy substantially the position shown in Figure 5.

It is evident that the air displaced by upward movement of the piston **61** will be exhausted through the passageway **77** and through the discharge port, not shown, since the valve member **71** then establishes communication between said discharge port and the passageway **77**.

Now, in order that both of the clamping heads **50** and **50'** will remain in raised or inoperative position, as shown in Figures 1 and 5, when both of the feeler feet **22** and **22'** are in either a raised position or a lowered position and to also cause either of the clamping heads **50** or **50'** to move downwardly to occupy the operative position in which the clamping head **50** is shown in Figure 6, or in which the clamping head **50'** is shown in Figure 2, in the event of only one of the feeler feet **22** being in a lowered position while the other of the feeler feet is in a raised position, we have provided a unique electrical circuit for the apparatus which will now be described.

It will be observed in Figure 7 that the wire or conductor **74'** serves as one of a pair of lead wires, the other of which is indicated at **85**. Corresponding ends of lead wires **74'** and **85** may be connected to a suitable source of electrical energy, not shown. The lead wire **85** has corresponding ends of wires or conductors **86**, **86'**, **87**, **87'** and **90** connected thereto. The other ends of wires **86** and **86'** are connected to corresponding sides of the respective mercury switches **32** and **32'** and the sides of the mercury switches **32** and **32'** opposite that to which the wires **86** and **86'** are connected have corresponding ends of respective wires **91** and **91'** connected thereto.

The other ends of the wires **91** and **91'** are connected to one end of respective solenoid or magnetic coils **92** and **92'** which are parts of magnetic or solenoid relays **93** and **93'**, respectively. The ends of the coils **92** and **92'** opposite those to which the wires **91** and **91'** are connected have one end of respective wires **94** and **94'** connected thereto whose other ends are connected to terminals of a pair of normally closed switches **95** and **95'**, respectively. The switches **95** and **95'** are parts of a time-delay-relay mechanism broadly designated at **96**.

There are many different types of time-delay-relay mechanisms which may be employed to serve the purpose of the mechanism **96** and the particular mechanism shown may be of a type such as is manufactured by American Gas Accumulator Co., Elizabeth, New Jersey, under their type No. NE–12 and which is commonly known as an Agastat time-delay switch.

The switches **95** and **95'** are fixed on a common rod or solenoid plunger **97** which is surrounded by a coil **100** to opposite ends of which wires **101** and **102** are connected. The other end of wire **102** is connected to the lead wire **74'** and the other end of wire **101** is connected on one of a plurality of terminals or contacts associated with the relay **93**. The plunger **97** has a stem **103** integral therewith which enters a diaphragm housing **104** in which a suitable flexible diaphragm **105** is positioned. The housing **104** is provided with suitable jets **106**, only one of which is shown, for controlling the flow of air into and out of the housing **104**. A suitable spring **107** normally urges the switches **95** and **95'** to closed position and, upon energization of coil **100**, the switches **95** and **95'** are opened and the diaphragm retards the return movement of the switches **95** and **95'** to closed position, as influenced by the compression spring **107**.

They relay **93** is provided with spaced switches or bars *a*, *b*, *c* and *d* and the relay **93'** is provided with spaced switches or switch bars *a'*, *b'*, *c'* and *d'*. Upon the solenoid **92** being energized, the switches *a*, *b*, *c* and *d* are caused to move from left to right in Figure 7 and upon the coil **92'** being energized, the switches *a'*, *b'*, *c'* and *d'* are caused to move from right to left in Figure 7.

Corresponding ends of wires **110** and **110'** are connected to terminals opposite from the terminals to which wires **94** and **94'** are connected at the switches **95** and **95'** and the other ends of the wires **110** and **110'** are connected to the wire **102**.

The mercury switch **32'** is shown as being tilted in Figure 7 and, thus, the coil **92'** is energized while, on the other hand, the mercury **33** in the switch **32** does not engage both of the wires **86** and **91** and, therefore, the coil **92** is de-energized. When the coil **92** is deenergized, current is permitted to flow from the lead wire **85**, through a wire **111**, through the switch *d* and wire **72** to the coil **65** and thus through wires **74** and **74'** to thereby cause the clamping head **50** to assume the raised or inoperative position as shown in Figure 5. Also, when the coil **92** is

de-energized, the circuit is completed from wire **87** to a wire **112** and, the coil **92'** being energized, the circuit will be completed at the other end of wire **112** through the switch *c'* and, thus, through the wire **73'**, coil **66'** and lead wire **74'** to energize the coil **66'** and to cause the clamping member **50'** to assume the operative or lowered position as shown in Figure 2.

When the coil **92** is energized, the switch *d* is open, switches *a* and *c* are closed and switch *b* serves as a conductor between the wire **87** and a wire **113** which is also connected to the terminal of switch *b'* opposite the terminal to which the wire **87'** is connected. A wire **114** extends from wire **113** to one side of switch *a'* and the opposite side of switch *a'* has a wire **115** extending therefrom to the terminal of switch *a* opposite the terminal to which wire **101** is connected.

When switch *c* is closed, due to energization of coil **92**, it serves as a conductor between wire **73** and a wire **116** whose other end is connected to a terminal which is engaged by the switch *b'* when the coil **92'** is de-energized. It will be noted that, when the coil **92'** is de-energized, switch *d'* serves as a conductor between wire **72'** and wire **90**.

Method of operation

It has already been described how the sheet of toweling or web material T moves across the table or platform **10** and during the course of which the feeler feet **22** and **22'** rest upon the toweling or web material T. Now, when both of the feeler feet **22** and **22'** are resting upon a relatively thick or pile area T–1, the mercury switches **32** and **32'** are held in raised or open position to prevent current from flowing between the wires **86** and **91** and **86'** and **91'**. Thus, both of the coils **92** and **92'** of the respective relays **93** and **93'** would be de-energized and the switch bars or switches *d* and *d'* would thus supply current to the respective coils **65** and **65'** thereby causing the clamping devices **50** and **50'** to remain in raised or inoperative position.

Assuming that the next adjacent relatively thin transverse lineal area T–2 is biased or askew relative to the longitudinal center of the toweling or web material T, so the relatively thin transverse lineal area T–2 reaches the feeler foot **22'** before it reaches the feeler foot **22**, the feeler foot **22'** is then permitted to move downwardly slightly while the feeler foot **22** remains in its original position. Thus, the switch **32'** would be tilted and the electrical parts would occupy substantially the position shown in Figure 7; that is, the coil **92'** of relay **93'** would be energized and the coil **92** of relay **93** would remain de-energized. Thus, the circuit to coil **65'** of the control unit **63'** would immediately be de-energized and the coil **66'** would be energized, in the course of which current flows from the lead wire **74'**, through coil **66'**, wire **73'**, switch *c'*, wire **112**, switch *b* and wire **87** to the lead wire **85**.

As heretofore stated, upon energization of the coil **66'**, compressed air is admitted to the upper end of the cylinder tube **56** to cause the corresponding clamping head **50'** to move downwardly and to clamp the corresponding portion of the web material or toweling T, adjacent the right-hand selvage thereof in Figure 2, against the platform or table **10** while permitting the opposite side portion of the toweling or web material T to continue its forward movement until the corresponding portion of the relatively thin transverse lineal area T–2 registers with the feeler foot **22**.

The feeler foot **22** is then permitted to move downwardly to also occupy the lowered position shown in Figure 6 and to momentarily energize the coil **92** of relay **93**. At this point, both of the coils **92** and **92'** are energized. However, immediately upon energization of the coil **92**, the switch *a* causes energization of coil **100** of the time-delay-relay mechanism **96**. This energization of coil **100** is caused by current flowing from the lead wire **85**, through wire **87'**, switch *b'*, wire **113**, wire **114**, switch *a'*, wire **115**, switch *a* and wire **101** to the coil **100** of the time-delay-relay mechanism **96**. Current then flows from the coil **100** through wire **102** to the lead wire **74'**.

Immediately upon energization of coil **100**, it is evident that both switches **95** and **95'** are opened to immediately de-energize both coils **92** and **92'** of the respective relays **93** and **93'**. As a result, the coil **66** of the control unit **63** would not be energized for a sufficient length of time to permit the clamping member **50** to be fully lowered to operative position or into engagement with the toweling or web material T. Of course, upon de-energization of both of the coils **92** and **92'** by opening switches **95** and **95'**, this has the same effect as the opening of both of the switches **32** and **32'** and the circuit would then be completed to both of the coils **65** and **65'** to cause both of the clamping heads **50** and **50'** to assume a raised or inoperative position.

The time-delay-relay mechanism should be so adjusted that the sheet of web material or toweling T will have moved sufficiently to raise both of the foot members **22** and **22'** after the skew in the web material has been corrected before the switches **95** and **95'** again assume closed position, as influenced by the tension spring **107**.

Now, in the event of the feeler foot **22** being lowered in advance of the feeler foot **22'**, due to the right-hand portion of one of the transverse lineal areas T–2 in Figure 4 reaching the feeler foot **22** in advance of reaching the feeler foot **22'**, the circuit also is effected in substantially the same manner as heretofore described. In order to clarify this point, however, a description of the circuit completed by the lowering of the feeler foot **22** in advance of the feeler foot **22'** will now be described.

Of course, the switch **32** is tilted due to the downward movement of the feeler foot **22** to complete the circuit to the solenoid coil **92** and, since the coil **92'** is not energized at this time, the circuit cannot be completed to the coil **100** of the time-delay-relay mechanism **96**. Thus, upon energization of coil **92**, the clamping head **50** is caused to move downwardly, since current then flows from the lead wire **85**, through the wire **87'**, switch *b'*, wire **116**, switch *c*, wire **73**, coil **66** and wire **74** to the lead wire **74'**, thereby energizing the coil **66** of control unit **63** which, as heretofore stated, will cause compressed air to enter the upper end of cylinder tube **56**.

Upon subsequent downward movement of the other feeler foot **22'**, the switch **32'** will also be closed to momentarily energize the coil **92'** of relay **93'** whereupon the switches *a'*, *b'*, *c'* and *d'* will occupy the position shown in Figure 7. Thus, the circuit will again be completed to coil **100** of the time-delay-relay mechanism **96** in the identical manner heretofore described and, although the coil **66'** of the control unit **63'** will be momentarily energized, it will not be energized for a sufficient length of time to permit the clamping head **50'** to move downwardly to fully operative position. Of course, as heretofore stated, upon the switches **95** and **95'** being opened, the circuit is broken to the coils **92** and **92'**, whereupon the coils **65** and **65'** will again both be energized to cause both of the clamping heads **50** and **50'** to assume the raised or inoperative position and to permit the web material or toweling T to continue its normal movement across the table or platform **10**.

It is thus seen that we have provided means for correcting skew in relatively thin transverse lineal areas of a moving sheet of toweling or web material including feeler or detecting devices which rest upon the sheet of toweling or web material for detecting the transverse lineal areas and wherein normally inoperative clamping means are provided adjacent opposite selvages or longitudinal side edges of the sheet of toweling or web material which will automatically operate to clamp the corresponding selvage portion of the web material in the event of a relatively narrow transverse lineal area adjacent one of the selvages moving in advance of the opposite side of

the relatively thin transverse lineal area to thereby clamp the web material or toweling adjacent one selvage thereof until the other side of the transverse lineal area has moved to where the transverse lineal area extends perpendicular or at right angles to the path of travel or to the longitudinal center of the sheet of web material or toweling.

It might be stated that the delay-relay mechanism **96** is provided to insure that neither of the clamping heads **50** or **50'** will be lowered prematurely in the event of the leading edge of a subsequent pile area T–1 causing one of the levers **20** or **20'** to close its respective switch **32** or **32'** in advance of the other of the switches being closed. Although only two sets of feeler devices and clamping devices are shown, it is evident that this embodies the use of a plurality of sets of such devices and more than two sets of devices may be used for a broad sheet of material to rectify bowed transverse relatively thin areas.

In the drawings and specification, there has been set forth a preferred embodiment of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only, and not for purposes of limitation, the scope of the invention being defined in the claims.

We claim:

1. Apparatus for maintaining transverse relatively thin lineal areas on a moving sheet of web material, having intervening relatively thick areas between said thin areas, substantially at right angles to the path of travel of the moving sheet comprising a member over which the sheet is moved, at least two feeler devices resting upon the sheet above said member and being disposed adjacent opposite selvages of the moving sheet and being adapted to move downwardly upon engagement by said transverse areas, a normally inoperative clamping device disposed adjacent and controlled by each of said feeler devices, and means responsive to downward movement by one of the feeler devices in advance of downward movement by the other of the feeler devices for causing the clamping device corresponding to said one of the feeler devices to clamp the corresponding selvage portion of the sheet of web material against said member until the feeler devices are both simultaneously in downward position in engagement with a common transverse lineal area.

2. Apparatus for maintaining alternately arranged transverse thick and thin lineal areas on a moving sheet of web material at uniform angular relationship to the path of travel of the moving sheet comprising a pair of transversely spaced feeler devices one pressing against the sheet adjacent each selvage thereof and being adapted to move inwardly and outwardly against the sheet to detect the presence of said respective thin and thick transverse areas, a normally inoperative clamping device normally spaced from one side of the sheet adjacent each selvage thereof and being controlled by a corresponding one of said feeler devices, a stationary member engaging the opposite side of the sheet relative to the clamping devices, and means responsive to the detection of the leading edge of one of said transverse lineal areas by one of the feeler devices in advance of detection of said leading edge by the other of the feeler devices for causing the clamping device corresponding to said one of the feeler devices to clamp the corresponding selvage portion of the sheet of web material against said stationary member until the feeler devices are both simultaneously in engagement with a common transverse lineal area.

3. Apparatus for maintaining transverse lineal areas of a thickness varying with respect to intervening areas on a moving sheet of web material at right angles to the path of travel of the moving sheet comprising a pair of relatively movable transversely spaced feeler devices, one urged against the sheet adjacent each selvage thereof for detecting the presence of said transverse areas, a clamping device normally spaced from the sheet adjacent each selvage thereof, and means responsive to the detection of the leading edge of one of said transverse areas by one of the feeler devices in advance of the other of the feeler devices for causing the clamping device corresponding to the said one of the feeler devices to move into engagement with and clamp the corresponding selvage portion of the sheet of web material until the feeler devices are both simultaneously engaged by the transverse lineal area.

4. Apparatus for maintaining transverse lineal areas on a moving sheet of web material substantially at right angles to the path of travel of the moving sheet comprising a plurality of feeler devices arranged above the web material and in a row extending substantially at right angles to the path of travel of the web material, each feeler device adapted to detect the presence of each successive transverse area, a separate normally elevated clamping device disposed adjacent and controlled by each of said feeler devices, means responsive to the detection of the leading edge of one of said transverse areas by at least one of the feeler devices in advance of detection of the leading edge of the transverse area by any other of the feeler devices for causing the clamping device corresponding to said one of the feeler devices to move downwardly and clamp the corresponding portion of the sheet of web material, and means operable automatically when the feeler devices are all simultaneously in engagement with the transverse lineal area for releasing the web material from any previously lowered clamping device.

5. Apparatus for correcting skew of relatively narrow and thin transverse lineal areas in a moving sheet of web material having intervening relatively thick areas between the relatively thin areas comprising a table across which the web material is drawn, first and second feeler devices having respective first and second feeler feet resting upon the web material adjacent opposite longitudinal side edges thereof, first and second electrically controlled reciprocable clamping devices disposed adjacent respective longitudinal side edges of the web material and adjacent the respective first and second feeler devices, means responsive to downward movement of the first feeler foot in advance of downward movement of the second feeler foot, resulting from engagement of the first feeler foot with a relatively thin area of the web material, for energizing the electrically controlled first clamping device to cause the same to clamp the corresponding portion of the web material while permitting the opposite longitudinal side edge of the web material to continue its movement, and means operable automatically upon subsequent lowering of the second feeler foot for de-energizing the previously energized clamping device and to release the web material therefrom.

6. In a structure according to claim 5, a time-delay mechanism interposed in an electrical circuit connecting the feeler devices with the clamping devices and being operable to maintain both said clamping devices inoperative for a predetermined period following each time either clamping device is energized and subsequently de-energized.

7. Apparatus for correcting skew of relatively narrow and thin transverse lineal areas in a moving sheet of pliable web material having intervening relatively thick areas between the relatively thin areas comprising a table across which the web material is drawn, a row of feeler devices arranged transversely of the path of travel of the web material and each having a feeler foot resting upon the web material, an electrically controlled normally inoperative reciprocable clamping device disposed adjacent each feeler device, means responsive to downward movement of any of the feeler feet in advance of downward movement of any of the other feeler feet resulting from engagement of any of said feler feet with a relatively thin area for energizing the electrically controlled clamping device associated with each lowered feeler foot to cause the same to clamp the corresponding portion of the web material while permitting the unclamped portion

of the web material to continue its movement, and means operable automatically upon subsequent lowering of all the remaining feeler feet for de-energizing all the formerly energized clamping devices to thereby release the web material therefrom.

8. In a structure according to claim 7, means for maintaining all of said clamping devices inoperative for a predetermined period following each time any of said clamping devices may be energized and subsequently de-energized.

9. Apparatus for straightening askewed transverse relatively thin linear areas in a moving sheet of web material having intervening relatively thick areas between said relatively thin areas comprising a platform over which the web material passes, first and second feeler devices spaced transversely of the path of travel of the web material and having means for detecting the presence of thick and thin areas adjacent opposite selvages of the web material passing therebeneath, first and second clamping devices disposed adjacent opposite longitudinal side edges of the web material and adjacent the respective first and second feeler devices, means responsive to the detection of relatively thick areas by said feeler devices for maintaining the clamping devices in inoperative position, means responsive to the detection of a relatively thin area by either of the feeler devices in advance of detection of a relatively thin area by the other of the feeler devices for operating the respective clamping device to thereby clamp the corresponding side portion of the web material to restrain movement thereof as the opposite side portion of the web material continues its movement, and means responsive to subsequent detection of a relatively thin area by the other of the feeler devices for rendering the previously operative clamping device inoperative.

10. In a structure according to claim 9, means for maintaining both clamping devices inoperative for a predetermined period following detection of a relatively thin area by both feeler devices to thereby prevent subsequent operation of either clamping device in the event of one feeler device subsequently detecting a thick area in advance of the other feeler device.

11. Apparatus for straightening skewed or bowed transverse relatively thin lineal areas in a moving sheet of pliable web material having intervening relatively thick areas between said relatively thin areas comprising a platform over which the web material passes, a plurality of feeler devices spaced transversely of the path of travel of the web material and each having separate means for detecting the presence of thick and thin areas in the web material passing therebeneath, a separate vertically reciprocable clamping device disposed adjacent each feeler device and above the web material, means responsive to the detection of relatively thick areas by said feeler devices for maintaining the clamping devices in raised position, means responsive to the detection of a relatively thin area by any one or more of the feeler devices in advance of detection of a relatively thin area by any other of the feeler devices for lowering the corresponding clamping device to thereby clamp the corresponding portion of the web material against the platform to restrain movement thereof as the unclamped portion of the web material continues its movement, and means responsive to subsequent detection of a relatively thin area by the remaining of the feeler devices for raising the previously lowered clamping device.

12. In a structure according to claim 11, means for maintaining said clamping devices in raised position for a predetermined period following each cycle in operation of any one or more of the clamping devices to thereby prevent the lowering of any of the clamping devices in the event of one or more feeler devices being raised in advance of another feeler device.

13. In a structure according to claim 11, each of said clamping devices having a relatively thin and short transversely extending clamping head on its lower end, and a resilient pressure applying member on the lower end of each clamping head.

14. In a structure according to claim 13, each of said resilient pressure applying members having a roughened outer surface to maintain traction between the same and the web material while in lowered position.

15. Apparatus for straightening skewed transverse relatively thin lineal areas in a moving sheet of web material having intervening relatively thick areas between said relatively thin areas comprising a platform over which the web material passes, first and second feeler devices spaced transversely of the path of travel of the web material and having means for detecting the presence of thick and thin areas adjacent opposite selvages of the web material passing therebeneath, first and second vertically reciprocable clamping devices disposed inwardly of and adjacent opposite longitudinal side edges of the web material, means responsive to the detection of relatively thick areas by said feeler devices for maintaining the clamping devices in raised inoperative position spaced above said sheet, means responsive to the detection of a relatively thin area by either of the feeler devices in advance of detection of a relatively thin area by the other of the feeler devices for moving the corresponding clamping device downwardly to thereby clamp the corresponding side portion of the web material to restrain movement thereof as the opposite side portion of the web material continues its movement, and means responsive to subsequent detection of a relatively thin area by the other of the feeler devices for returning the previously lowered clamping device to raised position.

16. Apparatus for maintaining spaced relatively thin transverse lineal areas of a moving web perpendicular to the path of travel of the web and wherein the web is provided with intervening relatively thick areas between said relatively thin areas comprising a platform across which the web is moved, first and second clamping devices normally spaced above and inwardly of opposite longitudinal side edges of the web, each of the clamping devices being provided with a first electrically operable means for raising the same, each of said clamping devices also having a second electrically operable means for lowering the same for clamping the corresponding portion of the web against the platform, first and second feeler devices disposed adjacent the respective first and second clamping devices, each of the feeler devices including a feeler foot resting upon the web adjacent the corresponding longitudinal side edge thereof, means responsive to a relatively thin area reaching the first feeler device in advance of reaching the second feeler device for energizing the second electrically operable means of the first clamping device to thereby clamp the corresponding side portion of the web to restrain movement thereof while the opposite side portion of the web continues its movement, means responsive to the relatively thin area subsequently reaching the second feeler device for de-energizing the second electrically operable means of the first clamping device and for substantially simultaneously energizing the first electrical operable means of both the first and second clamping devices to cause the first clamping device to release the web, and means responsive to relatively thick areas passing beneath the feet of the feeler devices for maintaining the first electrically operable means of both the first and second clamping devices energized while rendering the second electrically operable means of both clamping devices de-energized to thereby maintain both the first and second clamping devices in raised position.

17. Apparatus for maintaining spaced relatively thin transverse lineal areas of a moving web substantially perpendicular to the path of travel of the web and wherein the web is provided with intervening relatively thick areas between said relatively thin areas comprising a platform

across which the web is moved, first and second clamping devices normally spaced above and inwardly of opposite longitudinal side edges of the web, each of the clamping devices being provided with a first electrically operable means for raising the same, each of said clamping devices also having electrically operable means for lowering the same for clamping the corresponding side portion of the web against the platform, first and second feeler devices disposed adjacent the respective first and second clamping devices and each of the feeler devices including a feeler foot resting upon the web adjacent the corresponding longitudinal side edge thereof, means responsive to the relative vertical movement of the feeler devices for energizing the second electrically operable means of the clamping device adjacent the then lowermost of the feeler devices to thereby clamp the corresponding side portion of the web to restrain movement thereof while the opposite side portion of the web continues its movement, means responsive to the subsequent lowering of the other of the feeler devices to substantially the level of said lowermost feeler device for de-energizing the previously energized second electrically operable means and for substantially simultaneously energizing the first electrically operable means of both the first and second clamping devices to cause the previously lowered clamping device to release the web, and means for maintaining the first electrically operable means of both the first and second clamping devices energized while rendering the second electrically operable means of both clamping devices de-energized for a predetermined interval following the lowering of both feeler devices to substantially the same level to prevent energization of either of the second electrically operable means in the event of one of the feeler devices subsequently being raised in advance of the other during said interval.

18. Apparatus for maintaining transverse lineal areas of a thickness varying with respect to intervening areas on a moving sheet of web material at right angles to the path of travel of the moving sheet comprising a stationary member past which one side of the sheet moves, a pair of relatively movable transversely spaced feeler devices, one urged against the sheet adjacent each selvage thereof for detecting the presence of said transverse areas, a clamping device normally spaced from the side of the sheet opposite from the stationary member and adjacent each selvage of the sheet, and means responsive to the detection of the leading edge of one of said transverse areas by one of the feeler devices in advance of the other of the feeler devices for causing the clamping device corresponding to the said one of the feeler devices to clamp the corresponding selvage portion of the sheet of web material against said stationary member until the feeler devices are both simultaneously engaged by the transverse lineal area.

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