Aug. 21, 1956 W. E. DEAN 2,759,324

METHOD AND APPARATUS FOR TWIST DETECTION AND DETWISTER CONTROL

Filed June 17, 1954 3 Sheets-Sheet 1

Fig. 1.

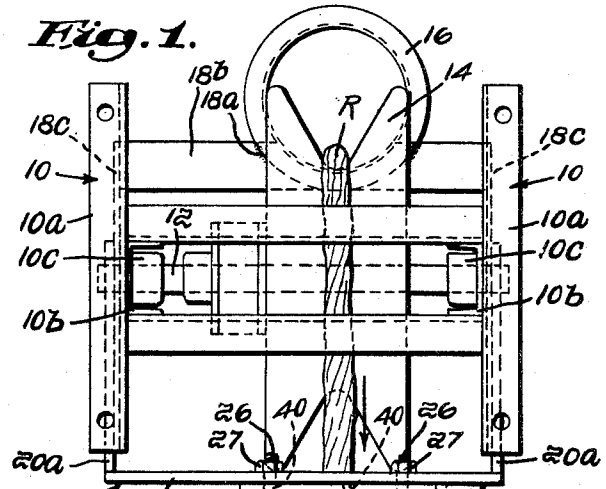
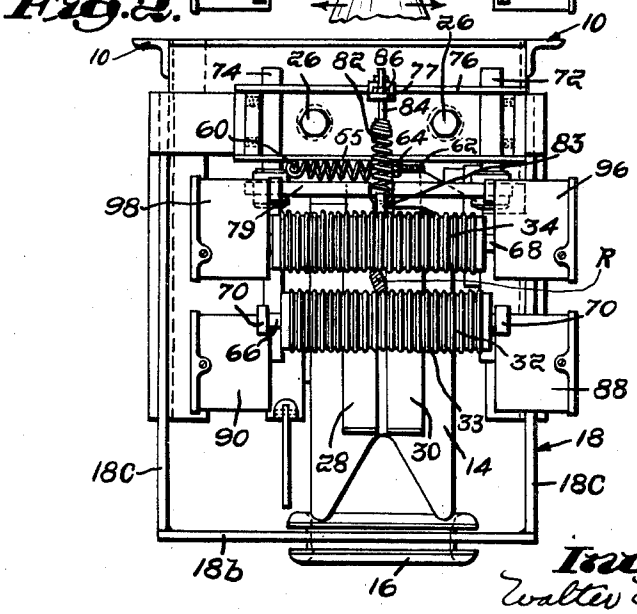


Fig. 2.



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METHOD AND APPARATUS FOR TWIST DETECTION AND DETWISTER CONTROL

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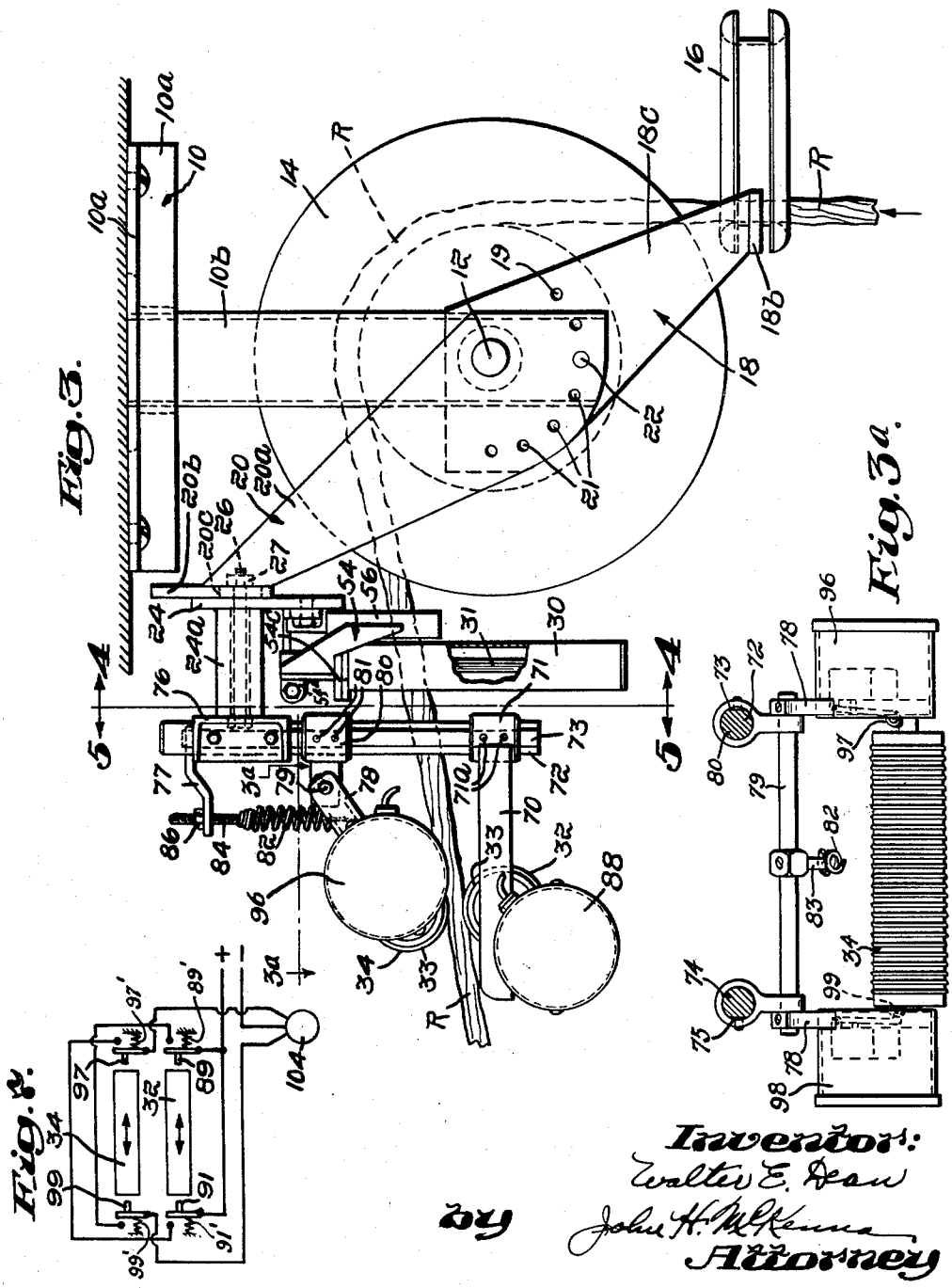


Fig. 3.

Fig. 3a.

Fig. 4.

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Fig. 4.

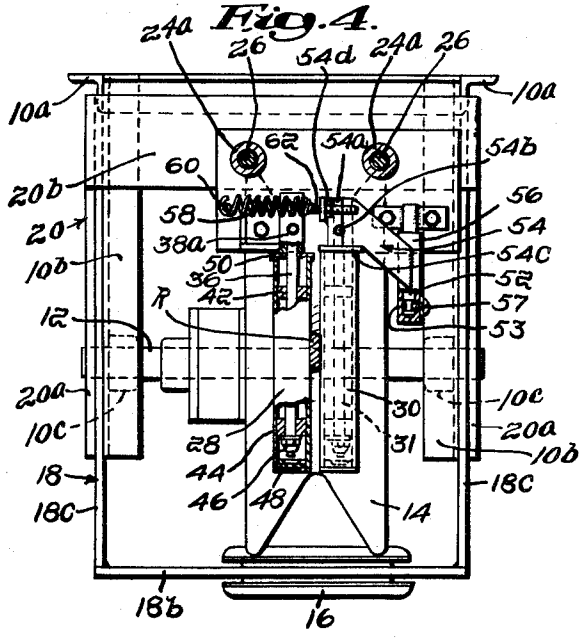


Fig. 5.

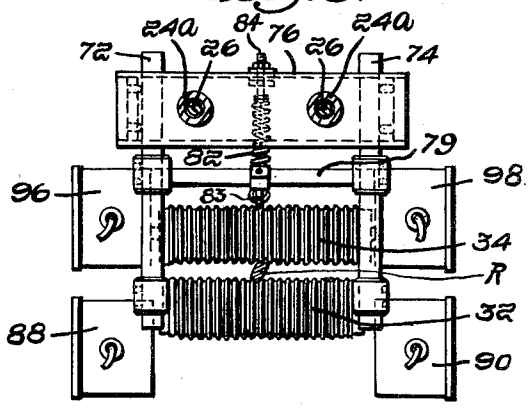
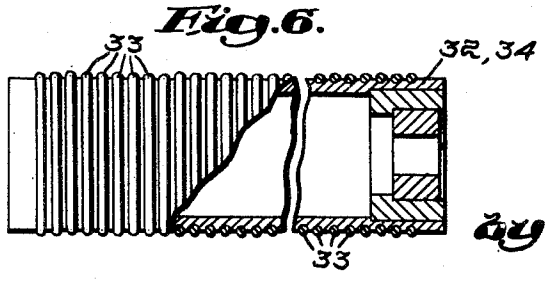


Fig. 6.



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2,759,324

METHOD AND APPARATUS FOR TWIST DETECTION AND DETWISTER CONTROL

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Application June 17, 1954, Serial No. 437,381

9 Claims. (Cl. 57—1)

This invention relates to an improved method and apparatus for ensuring absence of any appreciable twist in flexible sheet material which is travelling in a rope-form condition to a means for opening the sheet material to a fully spread condition. More particularly the invention provides for detecting the presence and direction of twist in a travelling rope of textile fabric, or other flexible sheet material, and for initiating proper operation of means for eliminating any detected twist prior to opening of the rope and spreading of the fabric, or other flexible sheet material, to its full width.

In many types of processing of textile fabrics, for example, such as bleaching, dyeing, washing and transporting of certain fabrics, it is a common practice to process them in rope form in preference to processing them in the open width. During such processing of fabrics in the rope form, it is difficult to prevent the fabric from being twisted unintentionally. Following such a rope-form processing, it is necessary to subject the fabrics to other processes, such as for drying them on drying cylinders or on tenter frames, in the open width.

Prior to opening of the fabrics from the rope-form to open width, it is conventional practice to conduct the rope through a detwister mechanism designed to free the rope from twist to facilitate spreading of the fabric to open width.

Various devices have been proposed heretofore for detecting twist in an advancing rope of fabric and for controlling the operation of detwister mechanism in response to any detected twist.

The invention provides an improved twist-detecting method and means whereby the presence and direction of twist is detected with greater sensitivity and accurateness as compared with the prior comparable devices, and whereby a more effective and simpler automatic control of a detwister mechanism is attained.

It is an object of the invention to provide an improved method of twist detection which effects its detection of twist, and the direction thereof, by the response of two axially movable rolls between and in engagement with which the travelling rope of sheet material passes, the said rolls being actuated in opposite axial directions when twist is present in the travelling rope, and the direction of axial travel of any particular roll due to twist being indicative of the character of the twist.

Another object of the invention is to provide an improved twist-detecting method wherein a travelling rope of sheet material is caused to travel between and in engagement with axially movable rolls which travel in opposite axial directions in response to any rotational force transmitted to them by the advancing rope, any said axial travel of the rolls being adapted to effect operation of a detwister mechanism in one direction when one of the rolls travels axially in one direction due to twist, and to effect operation of said detwister mechanism in the opposite direction when said one roll travels axially in the opposite direction due to twist.

A further object of the invention is to provide twist-detecting means wherein a pair of axially movable rolls engage a travelling rope of sheet material and are actuated in opposite axial directions if and when twist is present in the engaged rope, the direction of axial travel of one of the oppositely moving rolls being indicative of the character of the detected twist in the rope.

Yet another object of the invention is to provide detwister control means wherein a travelling rope of flexible sheet material is compressed to a generally flattened condition and conducted on edge between and in engagement with a pair of axially movable rolls whereby the crosswise pulls applied to the flattened rope mass by a rope-opening mechanism causes the flattened rope mass to rotate between the said rolls in direction to tighten any twist in the rope mass thereby to actuate the rolls in opposite axial directions for energizing a detwister mechanism which operates in one direction if the axial travel of one of said rolls is in one direction and which operates in the opposite direction if the axial travel of said one roll is in the opposite direction.

It is, moreover, my purpose and object generally to improve twist-detecting methods and apparatus and detwister control methods and means, and more especially such methods, apparatus and means for ensuring the absence of any substantial twist in a travelling rope of textile fabric, or the like, as the rope enters a region in which the fabric is to be opened out into fully spread condition.

In the accompanying drawings:

Fig. 1 is a top plan view of apparatus embodying features of the invention;

Fig. 2 is an end elevation of the apparatus of Fig. 1 looking at that end which is lower-most in Fig. 1;

Fig. 3 is a side elevation of the apparatus of Figs. 1 and 2;

Fig. 3*a* is a cross-sectional view approximately on line 3*a*—3*a* of Fig. 3;

Fig. 4 is a cross-sectional view approximately on line 4—4 of Fig. 3;

Fig. 5 is a cross-sectional view approximately on line 5—5 of Fig. 3;

Fig. 6 is an elevational view of one of the twist-detecting rolls with portions broken away and in cross-section; and

Fig. 7 is a diagrammatic representation of a simple form of electrical detwister-control circuit.

Referring to the drawings, the particular illustrated embodiment of the invention is adapted to be suspended from a ceiling, or other elevated support by a pair of hanger brackets **10**, **10** which support a shaft **12** on which the relatively large grooved wheel **14** is mounted for rotation. Each hanger bracket **10**, as illustrated, comprises an angle iron foot part **10***a* which may be secured to the ceiling, or other support, with the rigid depending channel iron part **10***b* extending down and providing, at its lower end, a bearing for one end portion of the shaft **12**, each channel part **10***b* preferably having a bearing element **10***c* welded, or otherwise secured thereto, within its channel.

A conventional variety of pot-eye guide **16** is adjustably supported on shaft **12** with its axis generally in the vertical plane of the center-line of grooved wheel **14**, for guiding into the groove of wheel **14** a rope of cloth R, or the like, which may come to the pot-eye guide from a conventional de-twister (not shown). The pot-eye **16** conveniently may be welded in a cut-out **18***a* of the bridge part **18***b* of a yoke **18** whose arms **18***c* are rotatably supported on the opposite end portions of shaft **12**.

A second yoke **20** has its arms **20***a* rotatably supported on the opposite ends of shaft **12**, outward of the yoke arms **18***c*, and the arms **20***a* have a series of holes **21** therein arcuately arranged about the axis of shaft **12** so that any particular hole **21** may be brought into register with any one of a similar series of arcuately ar-

ranged holes **19** in the arms of yoke **18**. Hence, the adjacent arms of the two yokes **18**, **20** may be pinned or bolted together and to the adjacent hanger bracket **10***b* by a pin or bolt **22** of which there is one at each pair of adjacent yoke arms. When the pins or bolts **22** are removed, the yokes **18** and **20** may be swung about the axis of shaft **12** to bring them into different angular relationships, and they may be pinned or bolted together and to the hanger brackets **10***b* with the pins or bolts extending through selected ones of the holes **21** and **19** and through single holes provided in the lower end portions of the depending channel iron bracket parts **10***b*.

The bridge part **20***b* of yoke **20** has a relatively large plate element **24** adjustable secured thereon as by the bolts **26**, each of which extends through a bearing boss **24***a* on the plate element **24** and through a slot **20***c* in bridge part **20***b* with a nut **27** on the threaded end of each bolt. The plate element may be adjusted on bridge part **20***b* by loosening the nuts **27**.

According to the invention, plate element **24** supports one pair of rolls **28**, **30** generally opposite the groove of wheel **14** with the axes of the rolls in general parallelism and disposed generally at right angles to the axis of shaft **12** on which the wheel **14** is mounted. The plate element **24** also supports another pair of rolls **32**, **34** whose axes are generally parallel and disposed generally at right angles to the axes of rolls **28**, **30**. The first mentioned pair of rolls **28**, **30** are adapted to engage and compress the rope R of cloth, or other material, which delivers between them from the grooved wheel **14**, thereby to generally flatten the rope mass, so that this generally flattened rope mass can deliver substantially on edge between the second pair of rolls **32**, **34**, and thence to mechanism (not shown) for opening the rope mass to a fully spread condition of the sheet material.

In the drawings, the rope R is travelling generally in vertical direction as it approaches the grooved wheel **14**, and is travelling generally in horizontal direction from the wheel **14** to and between the two pairs of rolls **28**, **30** and **32**, **34**. It should be understood, however, that the two pairs of rolls and the pot-eye **16** may be variously adjusted about the axis of wheel shaft **12** and be secured by the bolts or pins **22** with the rolls and the pot-eye in selected positions of adjustment. For example, the rolls may be swung counter-clockwise in Fig. 3 about wheel shaft **12** until the rolls **28**, **30** are generally parallel with the support on which brackets **10** are mounted, in which case the rope R would travel generally in vertical direction downward from wheel **14** to and between the two pairs of rolls **28**, **30** and **32**, **34**. Any such adjustment of the rolls around shaft **12** would require suitable adjustment of the roll springs **58**, **82**, due to the changed effects of gravity on the rolls in their new positions. The pot-eye **16** can be adjusted independently about the axis of shaft **12**, by means of pin **22** to accommodate any change in the line of approach of rope R toward grooved wheel **14**. Hence, the rolls may be set in any of various positions around the axis of shaft **12**. Also, obviously, the brackets **10** may, when desired, be secured to a vertical support or a support inclined to any degree between horizontal and vertical.

According to the invention, the rolls **32**, **34** are mounted for independent axial movements in response to any rotation of the flattened portion of the rope mass which is passing on edge between them, and a normally open electric switch adjacent to each end of each roll **32**, **34** has a spring-biased actuator in position to be engaged by the adjacent roll end only after the roll has moved axially toward it an adjustable predetermined distance. Following contact of the roll end with the switch actuator, further axial movement of the roll in the same direction is yieldingly opposed by the biasing spring which yields to permit ultimate closing of the switch and positive stopping of roll travel. Hence, the twist detecting means may be adjusted to provide for actual closing of a switch only after the actuating roll has moved an adjustable predetermined axial distance. This avoids unnecessary too frequent operations of the detwister.

When there is no appreciable twist in the flattened rope mass as it enters between the rolls **32**, **34**, there will be no appreciable rotation of the engaged mass and no appreciable axial movements of the rolls. In absence of twist, the flattened mass travels on edge substantially perpendicular to the axes of the rolls and the compacted mass opens beyond the rolls **32**, **34** in response to the generally equal and opposite cross-wise pulls of the opening mechanism, without any appreciable rotational effects on the roll-engaged mass. But, when twist is present in the flattened roll-engaged mass, the crosswise pulls of the opening mechanism then will have the effect of rotating the taut edges of the mass immediately after they are released by the nip between rolls **28**, **30** and rotation of the edges will continue until the edges reach the predetermined plane of spread-open travel of the sheet to the opening mechanism. Rotation of the mass while engaged between the rolls **32**, **34** causes these rolls to be urged in opposite axial directions. The character of any twist in the rope mass determines the direction of rotation of the mass, which latter will be in direction to tighten any twist therein.

It is important to avoid false signalling rotations of the flattened rope mass between the rolls **32**, **34**, such as might be caused by operation of the detwister in absence of means to prevent it. The compressing rolls **28**, **30** effectively prevent any rotation of the rope at the location of these rolls so that any rotation of the rope mass at rolls **32**, **34** necessarily will be entirely due to twist therein in response to the opening pulls of the opening mechanism. Also, the rolls **28**, **30** prevent these latter rotations from being transmitted beyond the rolls **28**, **30** in direction toward the detwister mechanism.

This actuation of two rolls in opposite axial directions when twist is present in a linear element or mass travelling between the rolls provides an effective means for controlling a conventional de-twister, or the like, to remove twist from the advancing rope of cloth or other material, before the travelling rope mass is opened beyond the rolls **32**, **34** to fully spread condition, as by sheet guiders, or other comparable mechanism. The axially movable rolls **32**, **34** are sensitively responsive to twists of relatively small magnitude, and their opposite movements are utilized to close an electric circuit for operating a de-twister, or the like, in the proper direction for removing the twist. On the other hand, if both rolls **32**, **34**, for any reason, move in the same direction, the de-twister circuit will not be energized.

In the illustrated embodiment of the invention, the compressing pair of rolls **28**, **30** depend from mounting means by which they are secured to plate element **24**. Roll **28** is rotatable on a shaft **36** (Fig. 4) whose upper end is removably secured, by any suitable means, in a bearing part **38***a* of a channel iron member **38** (Fig. 1) which may be secured to plate element **24** by screws **40**, or the like. Roll **28** may be a hollow open-ended shell, of brass, or aluminum, or any other suitable material. Two spaced bearing elements **42**, **44** are rigid on the roll shell, interiorly thereof, and the shaft **36** extends through the bearing elements and has its lower end reduced and threaded for reception of a nut **46** by which the shell is maintained on shaft **36**. The lower end of the roll shell preferably is closed by a plug **48**. The upper end of the shell is covered by a cap **50** which may be rigid on the bearing part **38***a* but out of contact with roll **28**.

The roll **30** is mounted for swinging movements about the axis of a hinge pin **52** which is secured at its upper end to the plate element **24**. A roll-carrying bracket, indicated generally at **54**, has a sleeve **56** thereon which is rotatably mounted on hinge pin **52**, the hinge pin having an anuular groove **53** adjacent its free end, and the

sleeve **56** having a retaining screw **57** whose inner end engages in the groove **53** of the hinge pin. Arms of the bracket **54** extend obliquely from sleeve **56** to a bearing part **54***a* at their free ends, and the upper end of the shaft **31** on which roll **30** rotates is secured to bearing part **54***a* as by the set screw **54***b*. Bearing part **54***a* has a cap part **54***c* rigid thereon for covering the upper open end of the roll shell **30** which may be similar to the roll shell **28**. An adjustable tension spring **58** constantly biases roll **30** toward engagement with the roll **28**, one end of the spring being anchored at **60** on plate element **24** and the other end of the spring being secured over a head portion of a screw **62** which extends loosely through an ear **54***d* on bearing part **54***a* of the hinged bracket **54**, with an adjusting nut **64** on the screw engaging back of ear **54***d*. The tension of spring **58** will be adjusted to provide substantial compression of the rope R of cloth or the like travelling between the rolls **28**, **30** from the grooved wheel **14**.

The twist-detecting rolls **32**, **34** are rotatably and slidably mounted on the shafts **66**, **68** respectively. Shaft **66** for roll **32** extends between and has its ends secured to the generally parallel spaced arms **70** each of which is adjustably mounted on a different one of two supporting rods **72**, **74** whose upper end portions are secured to a channel iron member **76** which in turn is secured on the outer ends of the two bearing bosses **24***a* of plate element **24**. As shown, each of the spaced arms **70** has a sleeve **71** at its end which is secured to a supporting rod **72** or **74**, and the lower end portion of a rod **72** or **74** extends through the sleeve **71**. Each sleeve **71** may have two set screws **71***a* therein for securing the arms **70** in selected positions along the supporting rods **72**, **74**, each of which latter preferably has a flat portion **73** or **75** thereon positioned to be engaged by the set screws **71***a*.

The shaft **68** for the other twist-detecting roll **34** extends between and has its ends secured to the free ends of two generally parallel arms **78** whose other ends are suitably fixed to a pivot shaft **79** whose ends are rotatably supported in projecting ears on supporting sleeves **80** of which there is one adjustably fixed on each supporting rod **72**, **74** by means of the set screws **81**. A spring **82** acts on roll **34** in opposition to gravity and may be adjusted to support a considerable amount of the weight of the roll so that the travelling rope R will be engaged relatively lightly by the rolls **32**, **34** as the rope passes between them. As shown, the spring **82** has one end connected to a projection **83** which is rigid on pivot shaft **79** and has its other end secured over a head portion of a screw **84** which extends loosely through a projection **77** which is rigid on channel iron member **76**, with an adjusting nut **86** on the screw engaging back of projection **77**. Spring **82** ordinarily will be adjusted to support the weight of roll **34** and its appurtenances with roll **34** resting lightly on rope R so that the rolls **32**, **34** will relatively lightly engage the opposite edge portions of the compressed rope as said rope advances on edge between them.

The roll shafts **66**, **68** are sufficiently long to permit appreciable axial travel of the rolls thereon, and the surfaces of the rolls **32**, **34** preferably are annularly grooved, or otherwise treated to minimize slip therealong of the edge portions of a compressed rope of cloth, or the like, passing between the rolls. Conveniently, the roll surfaces may be annularly grooved and have an O-ring **33** arranged in each groove, as best seen in Fig. 6, to provide non-smooth roll surfaces of a nature to effectively utilize any untwisting tendency in the lightly engaged flattened rope to effect axial travel of the rolls **32**, **34** in opposite directions.

The previously mentioned normally open electric switches at opposite ends of the detector roll **32** may be suitably mounted within the annular casings **88** and **90** respectively, with the actuator **89** of the switch in casing **88** opposite one end of roll **32** and with the actuator **91** of the switch in casing **90** opposite the other end of roll **32**. Similarly, the switches at opposite ends of the detector roll **34** may be suitably mounted within the annular casings **96**, **98** respectively, with the actuator **97** of the switch in casing **96** opposite one end of roll **34** and with the actuator **99** of the switch in casing **98** opposite the other end of roll **34**. Biasing springs **89′** and **91′** (Fig. 7) oppose closing movements of actuators **89** and **91**, and biasing springs **97′** and **99′** (Fig. 7) oppose closing movements of actuators **97** and **99**.

The switches in casings **88**, **90**, **96**, **98** will be in the electrical control circuit of a conventional de-twister apparatus or a comparable device capable of removing twist from a travelling rope of cloth, or other material. Fig. 7 diagrammatically represents a simple electrical control circuit wherein a reversible de-twister, or the like, is represented at **104** connected for operation in one direction if and when roll **32** shifts to the left and roll **34** to the right, and for operation in the opposite direction if and when roll **32** shifts to the right and roll **34** to the left. The de-twister will not become energized if the two switches of either roll become closed simultaneously, which may happen due to vibration or lateral translation of the rope R.

Following any operation of the detwister in response to opposite axial movements of rolls **32**, **34**, the biasing springs of the two switch actuators which had been closed react through the actuators to restore the rolls **32**, **34** nearly to their neutral positions. This return movement of the rolls will leave them short of their neutral positions an amount equal to the lost motion provided to avoid unnecessary starting and stopping of the detwister motor.

Various changes may be made in structural details of the apparatus within the scope of the appended claims, and it is intended that the patent shall cover, by suitable expression in the appended claims, whatever features of patentable novelty exist in the invention disclosed.

I claim as my invention:

1. The method of detecting the presence and direction of twist in a travelling rope-like body of flexible sheet material, comprising passing the travelling rope-like body between and in engagement with two generally parallel members which are independently movable in generally parallel axial directions, and pulling the opposite edges of the sheet material laterally in opposite directions as said rope-like body leaves said parallel members thereby to open said sheet material toward spread condition with said opposite pulls effecting rotation of said rope-like body between said parallel members in direction to tighten any twist that may be present in the rope-like body, and effecting opposite axial movements of said parallel members in response to any said rotation of the rope-like body.

2. The method of detecting the presence and direction of twist in a travelling rope-like body of flexible sheet material, comprising compressing the travelling rope-like body to a cross-sectional shape having appreciably greater depth between two opposite edge portions than width between two opposite flattened side surfaces thereof, and passing said compressed rope-like body edgewise between and in engagement with two generally parallel rolls which are independently movable in generally parallel axial directions whereby any appreciable rotation of the roll-engaged rope-like body causes said rolls to move axially in opposite directions, opening the rope-like body as it leaves said rolls by applying opposite lateral pulls to opposite edges of the sheet material, said pulls causing said roll-engaged rope-like body to rotate in direction to tighten any twist that may be present therein whereby said rolls move axially in opposite directions in response to a said rotation of the rope-like body with the direction of axial movement of any particular one of the rolls determined by the character of the twist in said roll-engaged rope-like body.

3. The method of controlling the operation of a detwist-

ing mechanism which is operatively engaging a travelling rope-like body of flexible sheet material, comprising passing the rope-like body between and in engagement with two axially movable rolls whereby any rotation of the engaged rope-like body actuates the said rolls in opposite axial directions, and effecting energization of detwister mechanism in response only to opposite axial movements of the rolls with the detwister mechanism being energized for operation in one direction when one of the oppositely moving rolls moves in one axial direction and being energized for operation in the opposite direction when said one of the oppositely moving rolls moves in the opposite axial direction.

4. The method of controlling the operation of a detwister mechanism through which extends a travelling rope-like body of flexible sheet material, comprising compressing the travelling rope-like body at the delivery side of said mechanism to a cross-sectional shape having appreciably greater depth between two opposite edge portions than width between two opposite flattened side surfaces thereof, passing said compressed rope-like body edgewise between and in engagement with two generally parallel rolls which are independently movable in generally parallel axial directions whereby any rotation of the roll-engaged rope-like body actuates said rolls in opposite axial directions, and effecting energization of said detwister mechanism in response only to opposite axial movements of said rolls with the detwister mechanism being energized for operation in one direction when one of the oppositely moving rolls moves in one axial direction and being energized for operation in the opposite direction when said one of the oppositely moving rolls moves in the opposite axial direction.

5. Apparatus for detecting the presence and direction of twist in a travelling rope-like body of flexible sheet material, comprising a pair of generally parallel members mounted for independent movements in generally parallel axial directions, means for guiding a said rope-like body between said members, means for moving said members relatively toward and from each other to position them in relatively light engagement with said rope-like body passing between them, whereby rotation of said rope-like body at the location of its engagement by said members effects opposite axial movements of said members with the directions of movement of said members determined by the direction of a said rotation of the rope-like body.

6. Apparatus for detecting the presence and direction of twist in a travelling rope-like body of flexible sheet material, comprising a pair of compression rolls mounted and arranged to engage and compress a said rope-like body to provide the body with a cross-sectional shape having appreciably greater depth between two opposite edge portions than width between two opposite flattened side surfaces thereof, a pair of generally parallel detector rolls having their axes disposed substantially at right angles to said compression rolls, said detector rolls being located in advance of said compression rolls in the direction of travel of the rope-like body, whereby said rope-like body may pass substantially on edge between and in engagement with said detector rolls after leaving said compression rolls, and means supporting said detector rolls for independent axial movements in response to forces applied thereto by the rope-like body, said detector rolls being urged in opposite axial directions in response to any rotation of said compressed rope-like members passing between them with the directions of opposite axial movement of the respective detector rolls determined by the direction of rotation of the rope-like body, and adjustable means for maintaining said detector rolls in relatively light engagement with the rope-like body.

7. Apparatus for detecting the presence and direction of twist in a travelling rope-like body of flexible sheet material, comprising a pair of generally parallel compression rolls for generally flattening a said rope-like body travelling between them, a pair of generally parallel detector rolls arranged to receive between them the generally flattened rope-like body which delivers from said compression rolls, said generally flattened rope-like body being on edge as it passes between said detector rolls, means supporting said detector rolls for independent movements in axial directions, and means maintaining said detector rolls in relatively light engagement with the edges of said generally flattened rope-like body passing between them, whereby said detector rolls are urged in opposite axial directions in response to any rotation of said generally flattened rope-like body between the detector rolls with the directions of axial movements of the respective detector rolls indicative of the direction of rotation of said rope-like body.

8. Apparatus for controlling the operation of detwister mechanism through which a travelling rope-like body of flexible sheet material is passing, comprising a pair of rolls between which a said rope-like body is guided at a location beyond said detwister mechanism in the direction of travel of said rope-like body, means maintaining said rolls in relatively light engagement with said rope-like body, each said roll being axially movable independently of the other roll, whereby the rolls are urged in opposite axial directions in response to any rotation of said rope-like body as it passes between and in engagement with said rolls, and switch means for effecting energization of an electric circuit to a said detwister mechanism, said switch means being operative to effect energization of said circuit for operation of said detwister mechanism in clockwise direction when one of said oppositely moving rolls moves in one axial direction, and to effect energization of said circuit for operation of said detwister mechanism in counter-clockwise direction when said one of the oppositely moving rolls moves in the opposite axial direction.

9. Apparatus for removing twist from a travelling rope-like body of flexible sheet material, comprising detwister mechanism for acting on said rope-like body and operable in one direction for removing twist of one character from said rope-like body and operable in the opposite direction for removing twist of another character from said rope-like body, a pair of rolls between which said travelling rope-like body is guided at a location beyond said detwister mechanism in the direction of travel of said rope-like body, means maintaining said rolls in relatively light engagement with said rope-like body passing between them, each of said rolls being movable axially independently of the other roll, whereby the said rolls are adapted to move in opposite axial directions if and when the roll-engaged portion of the rope-like body rotates due to twist therein when the rope-like body is opened by opposite lateral pulls applied to the opposite edges of the sheet material delivering from between said rolls, and means responsive to opposite axial movements of said rolls for effecting an operation of said detwister mechanism.

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