April 5, 1966 J. E. BALLMER ETAL 3,244,383

FIBER CONTROL DEVICE

Filed Sept. 19, 1963 2 Sheets-Sheet 1

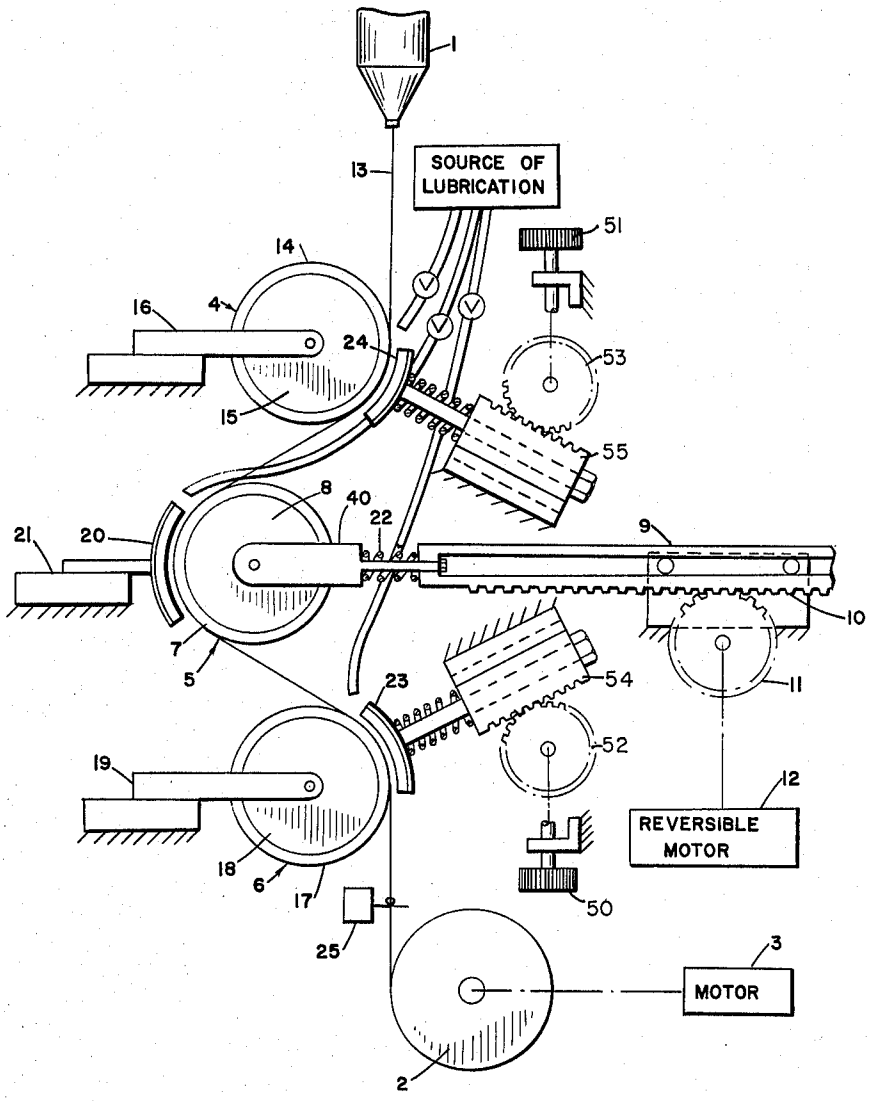


FIG. 1

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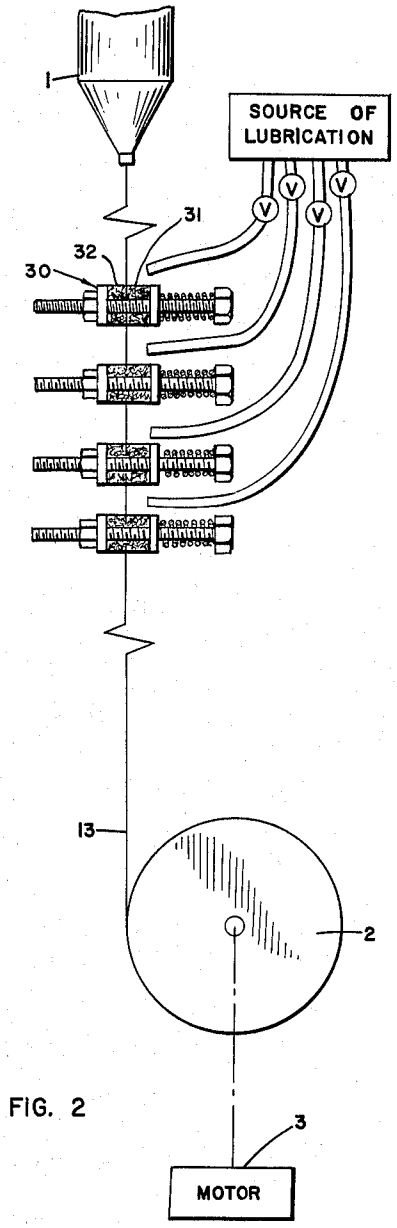


FIG. 2

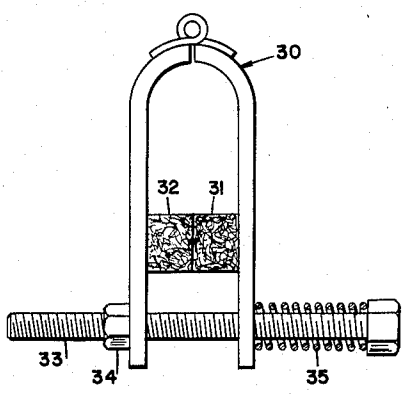


FIG. 3

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FIBER CONTROL DEVICE

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5 Claims. (Cl. 242—149)

This invention relates to manufacturing of a continuous fiber and more particularly to the tensioning of the fiber to facilitate winding.

The formation of a continuous fiber such as a glass fiber, the tensioning of the fiber, and the winding of the fiber is a delicate process due to the extremely small diameter of the fiber. Over-tension on the fiber may cause breakage, or lack of tension may reduce control sufficiently to prevent a precision winding operation. Accordingly this invention provides the tensioning means whereby a very slight friction may be applied to peripheral portions of the continuous fiber with a fine adjusting means to gradually increase the tension through increase of friction.

It is an object of this invention to provide a device for controlling the tension on a continuous fiber.

It is another object of this invention to provide adjusting means for varying the tension from a very slight frictional force to a gradual increasing degree of frictional force to provide a precision control for maintaining the desired tension on a continuous fiber.

It is a further object of this invention to provide a tensioning device to maintain any predetermined tension on a continuous fiber.

The objects of this invention are accomplished by using a plurality of primary shoes arranged in a manner so that at least one of the shoes may be shifted in its relative position to the other primary shoes and thereby deflect the fiber and cause the linear movement of the continuous fiber to change to a non-linear movement and apply a frictional component on at least a portion of the periphery of the fiber. Additional secondary shoes are positioned to engage the primary shoes and in this manner increase the frictional force on the continuously moving fiber intermediate each of the mating primary and secondary shoes. Any suitable means providing the relative movement between the shoes may be used to increase the tension on the fiber. A means for supplying a continuous fiber and for receiving the fiber in the winding operation are also shown in the illustrations.

The subsequent description and illustrations set forth the preferred embodiments of this invention.

FIG. 1 illustrates schematically the operation of the tension device.

FIG. 2 illustrates a modification using a caliper type supporting means for the shoes.

FIG. 3 illustrates in detail one of the caliper type supports for the shoes.

Referring to FIG. 1 a source of a continuous fiber **1** is positioned in the upper portion of the illustration. The source of fiber is positioned vertically above a winding drum **2** which is driven by a suitable motor **3**. The continuous fiber initially is drawn linearly between the source **1** and the winding drum **2** with the intermediate primary shoes retracted in a position to allow initial operation in this manner.

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Three primary shoes **4**, **5** and **6** are placed intermediate the source **1** and the winding drum **2**. The primary shoe **5** is cylindrical and includes a frictional material **7** on the periphery of a cylindrical base **8**. A cylindrical base **8** is supported by the reciprocating arm **40** on bracket **9**. The bracket **9** is formed with a rack **10** on its under surface which meshes with a pinion **11** operated by a reversible motor **12**. The reversible motor drives the bracket **9** in either of two directions and is initially in a retracted position to permit the fiber **13** to stretch between the source **1** and the drum **2**. As the primary shoe **5** is moved to the left the fiber **13** is caused to engage an arc on the periphery of the primary shoes **4**, **5** and **6**. The primary shoe **4** includes a frictional material **14** mounted on a cylindrical element **15** and supported on a bracket **16**.

The primary shoe **6** includes a frictional material **17** mounted on a cylindrical element **18** supported by a bracket **19**. The primary shoes as illustrated are of a cylindrical cross section but need only be a surface engaging the fiber without producing any stress concentration point which might tend to break the fiber during the tensioning of the fiber. The cylindrical configuration adapts itself well to this type of operation whereby a linear movement of the primary shoe **5** intermediate the primary shoes **4** and **6** causes the fiber to increase its arc of contact on the three shoes as the shoe **5** is moved in a left hand direction as illustrated. The frictional material **7**, **14** and **17** may be any suitable material providing the desired friction and durability necessary for a shoe of this type. "Teflon" wool has been used satisfactorily for this type of a shoe although the inventors do not wish to limit their invention to this type of material.

In the extreme left hand position the primary shoe **5** engages a secondary shoe **20** supported on a bracket **21**. The primary shoe **5** is spring biased and maintains a constant force between the primary shoe **5** and the secondary shoe **20** due to the resilient force of the spring **22** in the left hand position. The fiber produces an arcuate contact on the periphery of the primary shoe **5** and is also frictionally engaged by the shoe **20** causing a friction on the fiber. If additional tensioning is desired the secondary shoes **23** and **24** are manually moved to engage the mating primary shoes **6** and **4** respectively by means of the knobs **50** and **51**. The knob **50** operates the pinion **52** and rack **54** and the knob **51** operates the pinion **53** and rack **55**. The shoes **23** and **24** are also spring biased to maintain a uniform force on the primary shoes when in an actuated position. The fiber intermediate the primary and secondary shoes is frictionally engaged by the shoes to increase the tension of the fiber **13** as it is wound on the drum **2**. A suitable guide **25** may be provided to scan axially the periphery of the drum **2** to provide the desired level wind necessary on the winding drum **2**.

With the increase of frictional engagement of the fiber at the shoes it may be necessary to provide a lubrication of some type to smooth the increase of the frictional component. A suitable source of lubrication is illustrated with a valve on each of the conduits leading from the source to the secondary shoes engaging the primary shoes.

The degree of tension varies the firmness of the wind on the winding drum and is controlled by the friction on the fiber. It is necessary that an even tension be maintained on the fiber to prevent any unevenness in the

movement of the fiber which may cause breakage and unnecessary shut down of the apparatus.

Referring to FIG. 2 a similar device is illustrated wherein the caliper type of supporting mechanism is used for the shoes. The source of fiber **1** is positioned vertically above the winding drum **2** which is driven by the motor **3**. The fiber **13** is drawn in a linear manner intermediate the source and the winding drum. Four caliper type supporting devices **30** for the shoes **31** and **32** are illustrated. The shoes **31** and **32** are biased to a contacting position with the fiber **13** intermediate the shoes. The bolt **33** and nut **34** compress the spring **35** to firmly seat the shoes **31** and **32** on the fiber **13**. The tightening of the nut **34** on the bolt **33** increases the frictional component on the fiber. The device illustrated operates by compressing the shoes **31** and **32** around the periphery of the fiber to increase the friction and fiber tension as it passes intermediate the plurality of shoes. A source of lubrication is also illustrated with suitable valve and conduit means for lubricating each of the shoes.

The operation of the device will be described in the following paragraphs.

Referring to FIG. 1 a source of a continuous fiber **1** supplies the fiber which is wound on the winding drum **2**. The lateral movement of the primary shoe **5** relative to the primary shoes **4** and **6** causes an increase of arcuate contact of the fiber on the periphery of the primary shoes. With an increase of deflection of the fiber from a linear path a greater degree of friction is applied to a portion of the periphery of the fiber. In this manner a very limited degree of friction may be applied to the fiber without danger by breakage due to over-tension on the fiber. As the shoe **5** is moved to an extreme left hand position it engages the secondary shoe **20** which increases friction on the fiber. An increase in tension may be supplied by actuation of the secondary shoes **23** and **24** against their mating primary shoes **6** and **4** respectively.

The source of lubrication provides a means for smooth continuous movement of the fiber intermediate the primary and secondary shoes. Although lubrication is not always necessary it does tend to provide a smooth operation with a refinement in the increase of the frictional component. Some materials may be used without lubrication where the smoothness of operation is not affected by an increase in the frictional component. Accordingly the tension on the fiber may be gradually increased to provide the desired control of the fiber as it is wound on the drum **2**. A suitable scanning device **25** may be used to provide a level wind if necessary on the drum.

Referring to FIG. 2 a modification of the device is illustrated. An individual adjustment is provided with each of the caliper supported shoes and individual lubrication is also provided with each of the shoes. This device has accurate control on the tension of the fiber and the advantage of not causing any deflection of the linearly drawn fiber prior to the point of its winding on a circular drum.

The device is provided with an infinite variation of the frictional engagement on the periphery of the fiber to thereby facilitate winding of the fiber. It is necessary that an even tension be maintained to limit the wandering of the fiber to a minimum as it passes through the scanning device **25**. It is also necesasry that an infinite number of degrees of tension be provided so that the precise tension is available for an accurate wind. It is also imperative that no surging action be present in the movement of the fiber which may cause breakage of the fiber and unnecessary interruption of the winding operation.

The above description and operation sets forth the preferred embodiments of this invention. Other devices may be devised which may fall within the scope of this invention which is defined by the attached claims.

We claim:

1. A device for tensioning a continuous fiber drawn linearly between two points comprising, a plurality of primary shoes spaced along the fiber alternately frictionally engaging the fiber on opposite sides, means causing relative movement of at least one of the primary shoes relative to the other primary shoes and transverse with respect to the length of the fiber drawn between the two points for increasing the length of engagement and the frictional force on said fiber, a plurality of secondary shoes including means engaging said secondary shoes with mating of said primary shoes enclosing said fiber and increasing the friction on the fiber, thereby increasing the frictional force on the moving fiber to control the tension on said fiber.

2. A tensioning means for controlling the tension on a continuously moving fiber comprising a plurality of curved primary shoes spaced along said fiber alternately frictionally engaging a portion of the length of said fiber on opposing sides, means causing relative movement of at least one of said primary shoes relative to the other of said primary shoes and transverse relative to a line drawn between the last and first point of contact of the preceding and subsequent shoes respectively for increasing the contacting area of said shoes on said fiber, a plurality of secondary shoes mating and engaging said primary shoes for enclosing said fiber between said shoes and thereby increasing the frictional area and force of said shoes with said fiber and controlling the tension on the continuously moving fiber.

3. A tension device for controlling the movement of a continuous fiber comprising, a plurality of primary shoes spaced along said fiber for alternately frictionally contacting the fiber from opposite sides, means causing relative transverse movement relative to the general movement of the fiber of at least one of said primary shoes to increase the length of contact and pressure of contact of said fiber with said shoes and control the frictional force on said fiber, a plurality of secondary shoes mating and frictionally engaging said primary shoes enclosing said fiber for increasing the frictional force on said fiber intermediate the mating of said shoes, lubricating means associated with each of the pairs of mating primary and secondary shoes for lubricating said fiber to cause uniform friction of said shoes with said fiber thereby controlling the tension on said fiber.

4. A tension device in a fiber winding mechanism having a continuous source of fiber and a winding mechanism causing the fiber to pass through a substantially linear path, a plurality of cylindrical primary shoes having frictional material on their outer periphery spaced intermediate said source and said winding mechanism and engaging said fiber alternately on opposing sides, means producing movement of one of the primary shoes relative to the other of said primary shoes and transverse to the fiber path for increasing the arcuate contact of the fiber with the periphery of said primary shoes, an arcuate secondary shoe mating each of said primary shoes engaging the primary shoes for a lesser length of arcuate contact than the fiber and enclosing the fiber between said shoes thereby providing a means for increasing the frictional force on the fiber.

5. A tension device in a fiber winding mechanism having a continuous source of fiber and a winding mechanism causing the fiber to pass through a predetermined path, a plurality of cylindrical primary shoes carrying deformable friction pads positioned intermediate said source and said winding mechanism for alternately engaging said fiber on opposing sides, means producing traverse movement of one of said primary shoes relative to the predetermined fiber path thereby increasing the fiber engagement with a peripheral segment on said primary shoes, an arcuate secondary shoe carrying deformable friction pads mating each of said primary shoes including means engaging an arcuate segment on said primary shoe of lesser length than the contact of said fiber and enclosing said fiber to increase friction on said fiber, lubricating means providing lubrication of said pairs of

shoes to thereby provide a smooth frictional force tensioning of said fiber.

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