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Elsworth

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[54] **REELING AND UNREELING DEVICE**

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[73] Assignee: **General Electric Company,** Waterford, N.Y.

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[52] **U.S. Cl.** **242/75.51**
[51] **Int. Cl.** **B65h 25/02**
[58] **Field of Search** 242/75.5, 75.52, 242/75.53, 75.51, 75; 226/195

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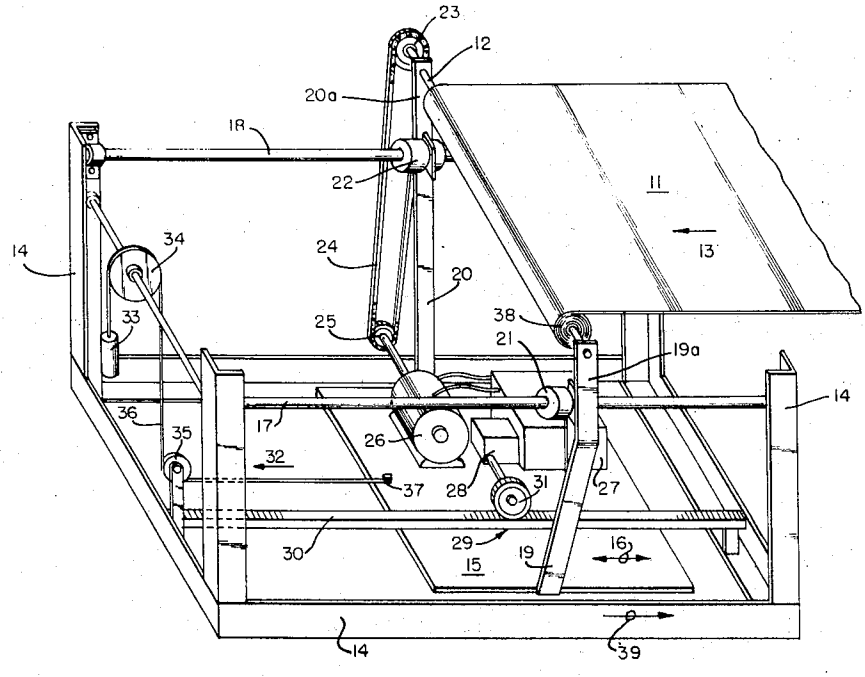
[57] **ABSTRACT**

The disclosure relates to a device for reeling and unreeling a web or filiment under constant tension. The reeling mandrel is mounted on a sliding frame which is positively biased. The mandrel is driven by an electric motor mounted on the frame and any movement of the frame varies the rotational speed of the motor, whereby the speed of the motor is reduced as the diameter of the roll increases. This assures a constant tension on the web as it is reeled or unreeled.

10 Claims, 3 Drawing Figures



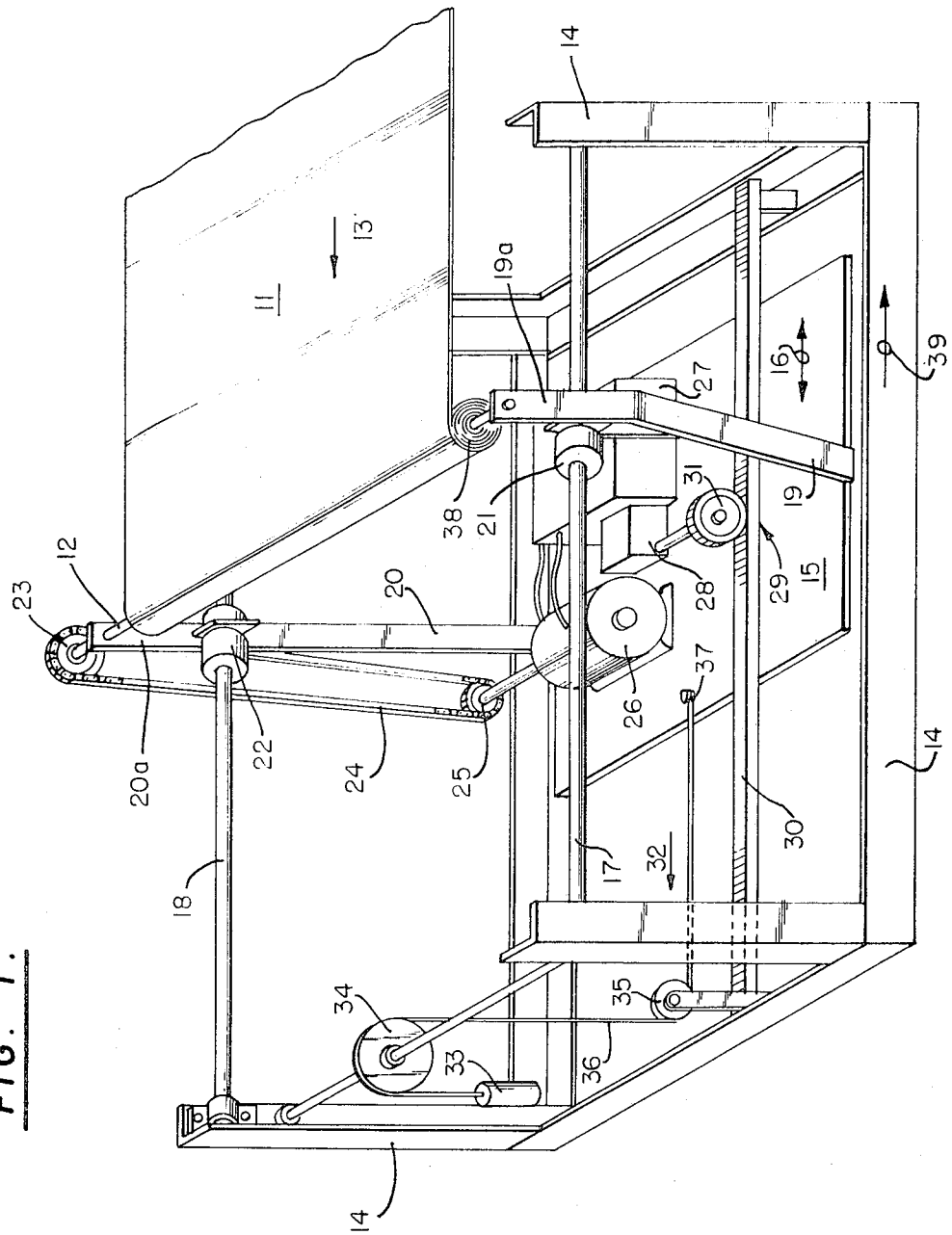

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FIG. 1.

FIG. 2.

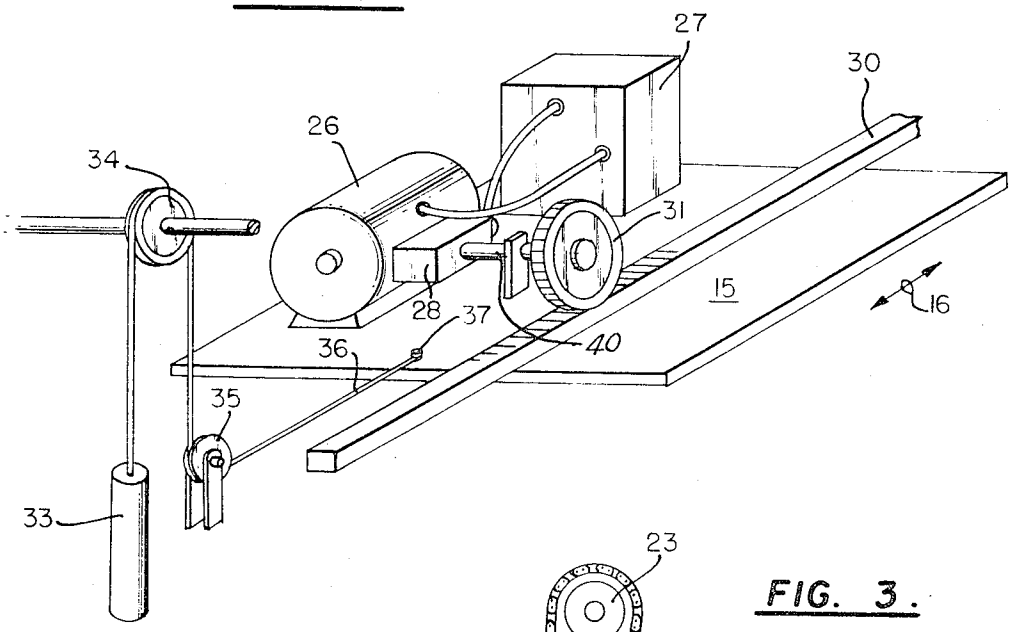
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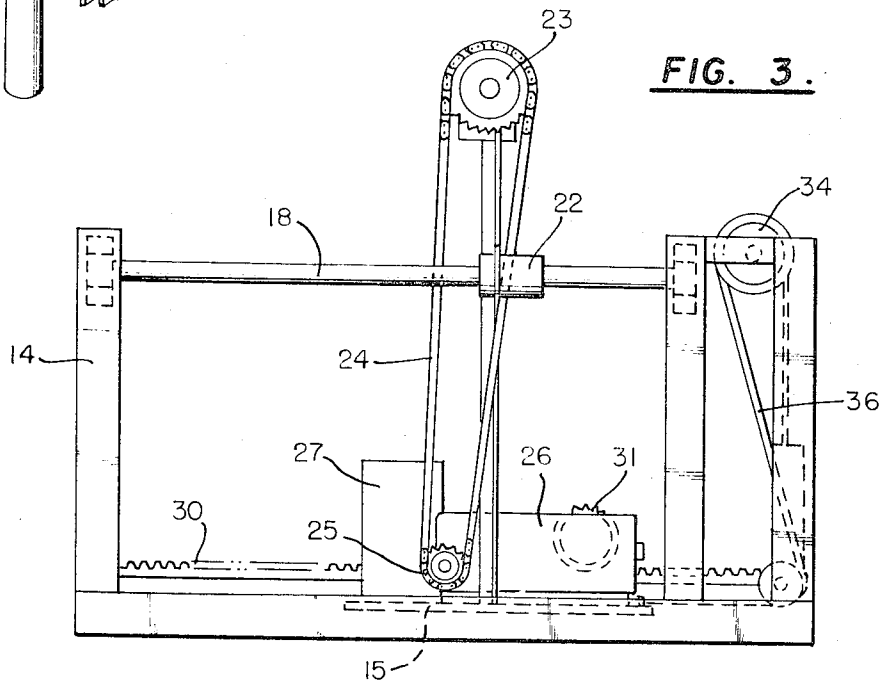
FIG. 3.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REELING AND UNREELING DEVICE

BACKGROUND OF THE INVENTION

This invention relates to those devices which are intended to insure a constant tension on a web that is being reeled or unreeled during the processing or handling of a long indeterminate length of material. As the material is wound about a mandrel or other reeling device, its diameter increases, and although the rotational speed of the mandrel or other reeling device remains constant in terms of revolutions per minute, the speed of the winding in feet per minute at the periphery of the roll continues to increase. Therefore some means is necessary to constantly reduce the rotational speed of the mandrel as the size of the roll increases. Conversely, when unreeling the material, it is also necessary to gradually increase the rotational speed of the mandrel as the material web is paid out.

Reeling and unreeling devices currently in use in the prior art involve elaborate electrical equipment to attempt to synchronize the feeding and take-up speeds of the reeling and unreeling devices. This is usually done by attaching a selsyn generator to the output or calendar rolls and a selsyn receiver to the take-up or wind-up rolls. Electronic torque sensing circuits then attempt to superimpose corrections to hold the torque constant at a given speed.

The present invention, however, maintains a constant tension on the web that may be controlled at any rotational or peripheral speed. It is the tension on the web that is of paramount importance, not the torque or the wind-up or calendar rolls.

OBJECTS OF THE INVENTION

It is therefore an object of this invention to provide an automatic device which will receive and roll up material for an indeterminate length with an inexpensive and simple control. The device regulates the winding speed to provide a controlled wind-up tension regardless of the diameter of the roll or speed of rotation. If the delivery of the indeterminate web is increased, the machine will accommodate the change in velocity while maintaining a constant tension on the material itself. The device is equally applicable to calendar or pay-out rolls as it is to the wind-up roll. The conversion from one to another is made by simply reversing the polarity of the drive means.

It is another object of this invention to provide a device for reeling and unreeling a web wherein the mandrel or spool is mounted on a sliding frame which is positively biased in a direction opposite to the direction of the pay-out or incoming material. It is another object of this invention to provide an electric drive means for the mandrel that is mounted on the sliding frame wherein any movement of the frame will vary the rotational speed of the drive motor. The positively biased sliding frame maintains a constant tension on the web itself. Any movement of the frame itself varies the rotational speed of the motor to reduce the peripheral speed of the material as the diameter of the roll increases.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagramatic and isometric view of a reeling and unreeling device constructed in accordance with my invention.

FIG. 2 is a detailed diagramatic and isometric view of the transmission means and tension means coupled to the sliding frame.

FIG. 3 is a diagramatic side view of a reeling and unreeling device constructed in accordance with my invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, a web **11** of indeterminate length is being wound on a mandrel **12** in the direction indicated by arrow **13.** The reeling and unreeling apparatus consists of two frames, a first fixed frame **14** and a second frame **15** which is mounted for reciprocal movement within frame **14** in the direction indicated by arrow **16.** The second frame means **15** is guided by and suspended from a pair of parallel guides **17** and **18** which are firmly and fixedly attached to frame **14.** The second frame means is suspended from brace members **19** and **20** from a pair of low friction bearings **21** and **22.** While the parallel guides **17** and **18** have been indicated in FIG. **1** as case hardened steel shafts, and while the bearing means **21** and **22** have been indicated as low friction bearings of the Thompson variety, it would be apparent to anyone skilled in the art to substitute a different type of guide means and low friction bearing means to allow for reciprocal movement of the frame means **15** within stationary frame **14.** An example of such a guide would be conventional track and roller car assembly wherein the tracks would be mounted on the stationary frame **14** and the roller cars on movable frame **15.**

Mandrel **12** is securely mounted for rotation within the upper portions **19a** and **20a** of the frame members **19** and **20.** Any conventional bearing means may be employed to provide for the rotation and support of mandrel **12.**

Mandrel **12** is driven by means of a sprocket **23,** drive chain **24,** and drive sprocket **25.** The drive means for the assembly in this embodiment is an electric motor **26.** The speed of motor **26** is controlled by a power supply and control device **27,** translator **28** and transmission assembly **29** as will be hereinafter explained.

Transmission assembly **29** is comprised of a rack **30** and pinion gear **31** which cooperate in a conventional manner to turn reciprocal movement into rotary movement. The rack **30** is aligned parallel to the parallel guides **17** and **18.**

The second frame means **15** is positively biased in the direction indicated by arrow **32.** This is directly opposite to the direction of the reeling or unreeling web of material. Biasing means described in accordance with the preferred embodiment comprises a weight **33,** a pair of pulleys **34** and **35,** and wire rope member **36** which is fixedly attached to frame **15** at point **37** and securely attached to the weight **33.** Thus, it is apparent that the tension maintained on web **11** is constant regardless of the position of the movable frame **15.** This tension is exerted by the weight of member **33** and may be varied depending upon the material to be reeled or unreeled, and the speed at which the reeling or unreeling is to take place.

Alternately, it would be possible to employ a constant torque spring means to positively bias the frame means **15** in one direction. The constant torque spring would provide a specific amount of pull or torque regardless of the elongation of the spring, and would

therefore provide for constant tension regardless of the location of frame means **15**.

FIG. **2** is a perspective view of the speed control means used in this embodiment of the invention. The movable frame means **15** is mounted for reciprocation along the paths indicated by arrow **16**. As the movable frame **15** reciprocates back and forth, the transmission means **30** and **31** translate that reciprocal movement into rotary movement at shaft **40**. Translator **28** is a variable impedance device actuated by shaft **40**. In the instant embodiment, it comprises a wire-wound variable resistor which regulates the power supply means **27**. While a wire-wound variable resistor has been disclosed in the preferred embodiment, it is understood that any suitable type of variable impedance device could be used to translate the rotary motion of shaft **40** into a variable impedance for the control circuitry of the motor **26**.

Motor **26** in the preferred embodiment is a compound or interpole DC motor which has a normally fixed voltage across the field coil, and a variable voltage impressed upon the windings of the armature. When a motor is running, the coils of the armature cut the lines of force from the field coils to generate an internal voltage or counter-emf. The sum of the counter-emf and the resistance drop through the armature equals the impressed voltage from the external circuitry supplied from the power source **27**. Consequently, the current taken is much larger when the motor is revolving slowly than when it is at its maximum speed. In order to increase the speed of the motor, the armature current is increased by decreasing the dampening of the silicon rectifier control circuitry and this causes the armature to increase its speed since the field is held constant. This produces more torque which increases the speed until the back voltage allows just the right current to flow to carry the existing load. The control circuitry for varying the voltage supplied to motor **26** is contained within the power supply **27**, and is regulated by the translator **28**. The direct current for the motor is also supplied by power source **27**.

While a direct current motor has been described with regard to the preferred embodiment, it would be entirely possible to substitute a wound-rotor or brush-shifting AC motor which would provide for the proper and variable speed control necessary for the invention. Alternately, it would be possible to connect the output of shaft **40** to a mechanical linkage and use that to regulate the speed of an internal combustion motor if the device were to be used in a remote location where electrical service was not convenient.

Referring back to FIG. **1**, when the device is set for normal operation, the variable impedance means **28** is placed in the middle of its impedance range, and the movable frame means **15** is placed midway between its outer limits of travel within frame **14**. As the drive motor **26** begins to drive mandrel **12**, a tension is exerted on web **11**. This tension is essentially equivalent to the tension exerted along the reciprocal path by cable **36** as indicated at arrow **32**. As indicated previously, if more tension is desired, the size of weight **33** is increased. As the diameter of the roll indicated at **38** increases, the speed of the motor is gradually reduced. This reduction in speed is brought about in the following manner. As the diameter **38** grows, the peripheral speed of web **11** will increase, thereby slightly increasing the tension on the material. This slight increase in tension will cause the movable frame means **15** to move in the direction indicated by arrow **39**, and this reciprocal movement of the frame means **15** will cause a slight rotary movement of the spur gear **31**. This change in rotary movement will vary the impedance presented by translator **28**, and thereby vary the speed of the DC motor **26** through the power supply means **27**.

If for some reason the web of material **11** should go slack, the tension exerted by weight **33** in the direction of arrow **32** will cause the movable frame means **15** to move in the direction indicated by arrow **32**. This change in reciprocal direction will again be reflected as the reciprocal movement is translated into rotary movement by means of the transmission means **29**. This rotary movement is again translated by translator **28** into a variable impedance for varying the speed of motor **26**. In this case, the speed of motor **26** would be increased to take up the slack in the material web **11**.

Limit switches may be provided in translator **28** at the extreme opposite ends of the rotary movement allowed by the rack and pinion transmission means **29**. Thus if the web goes completely slack and the movable frame means **15** is drawn beyond its predetermined limit in the direction of arrow **32**, the translator limit switch will interrupt the power supply to motor **26** and thereby stop the reeling operation.

Conversely, if the supply of material should suddenly stop, or if the unreeling device at the other end should suddenly freeze, the movable frame means **15** will be very quickly moved in the direction indicated by arrow **39** and the translator **28** would again interrupt the current supplied to motor **26**. The potentiometer thereby provides both a safety feature and an automatic shut-off device.

If it is desired to use the device as an unreeling machine rather than a reeling machine, it is only necessary to change the polarity of the current supplied to motor **26**. This is accomplished by means of a simple switch (not shown) attached to power supply **27**.

While specific means have been illustrated and specific examples and mentions given herein, it is to be understood that various modifications of the reeling and unreeling device would appear to one skilled in the art. Accordingly, it is understood that the present invention is not limited to the specific examples given for the specific examples given for the specific embodiment, but is to be limited only in accordance with the appended claims.

What is claimed is:

1. An apparatus for reeling and unreeling a web under constant tension comprising,

a. a first and second frame means, said second frame means being mounted for a substantially horizontal reciprocal movement within said first frame means,

b. a mandrel mounted on said second frame means for reeling and unreeling a web of material, said mandrel being rotated by a drive means,

c. sensing means for measuring the substantially horizontal reciprocal movement of said second frame means, said sensing means controlling said drive means and varying the rotational speed of said mandrel in accordance with said reciprocal movement.

2. The apparatus of claim **1** wherein said second frame means is positively biased along the path of said reciprocal movement substantially opposite to the tension direction of the web.

3. The apparatus of claim 1 wherein said sensing means comprises a transmission means adapted to translate the reciprocal movement of said second frame means to rotational movement.

4. The apparatus of claim 3 wherein said drive means comprises an electric motor.

5. The apparatus of claim 4 which further comprises means responsive to said rotational movement of said transmission means to vary the armature strength of said electric motor.

6. The apparatus of claim 3 wherein said transmission means comprises a rack and pinion gear in operable arrangement, said rack being parallel to said reciprocal movement.

7. The apparatus of claim 6 wherein said first frame means defines parallel guides, said second frame means being mounted on said guides for reciprocal movement.

8. The apparatus of claim 5 wherein said means responsive to said rotational movement comprises a variable impedance.

9. The apparatus of claim 8 wherein said impedance means comprises a variable resistor.

10. The apparatus of claim 2 wherein said means to positively bias said second frame means comprises an adjustable weight suspended from said first frame and adapted to exert a positive bias on said second frame means.

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