TENSIONER

Filed June 15, 1966 4 Sheets-Sheet 1

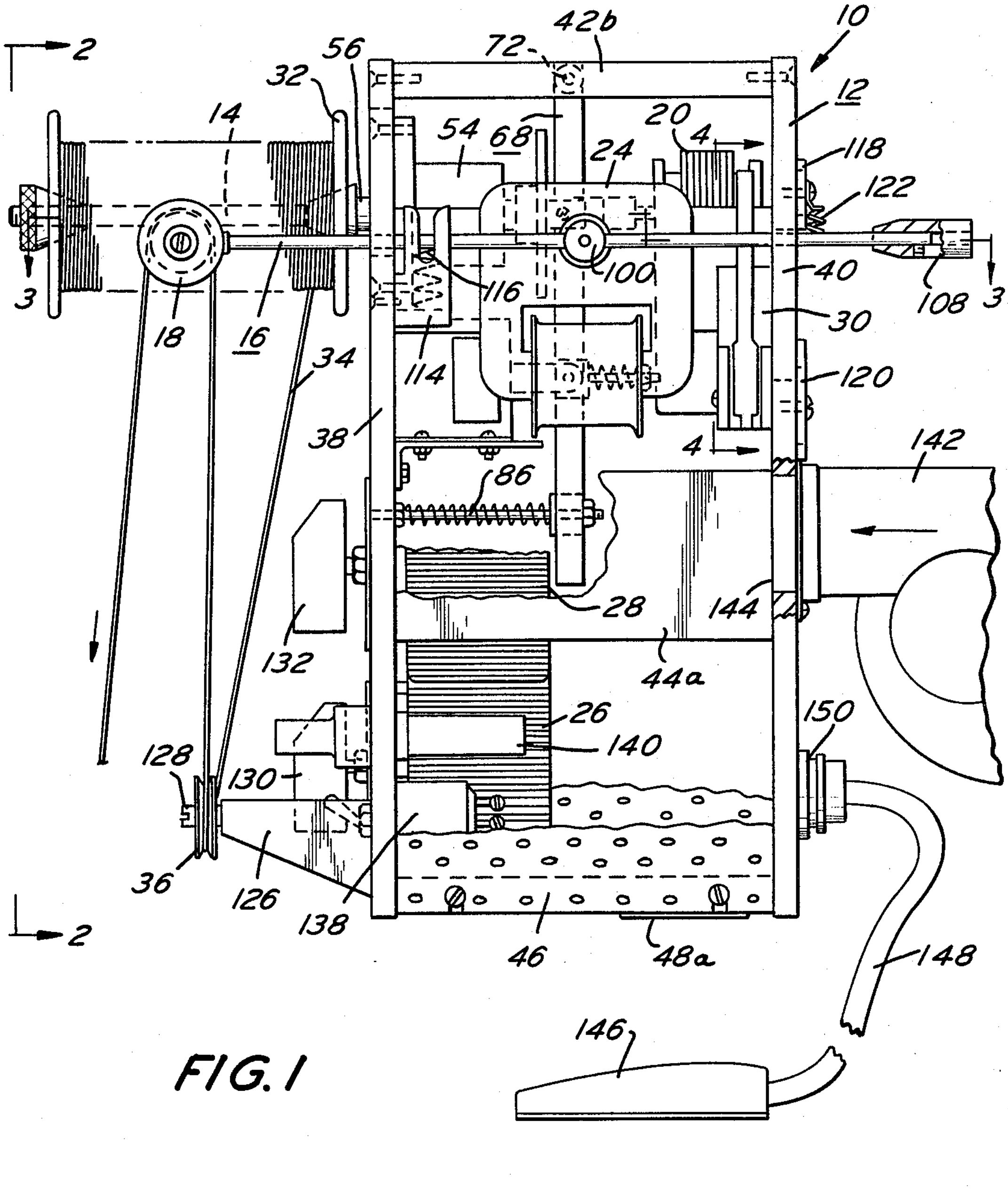

FIG. 1

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TENSIONER

Filed June 15, 1966 4 Sheets-Sheet 2

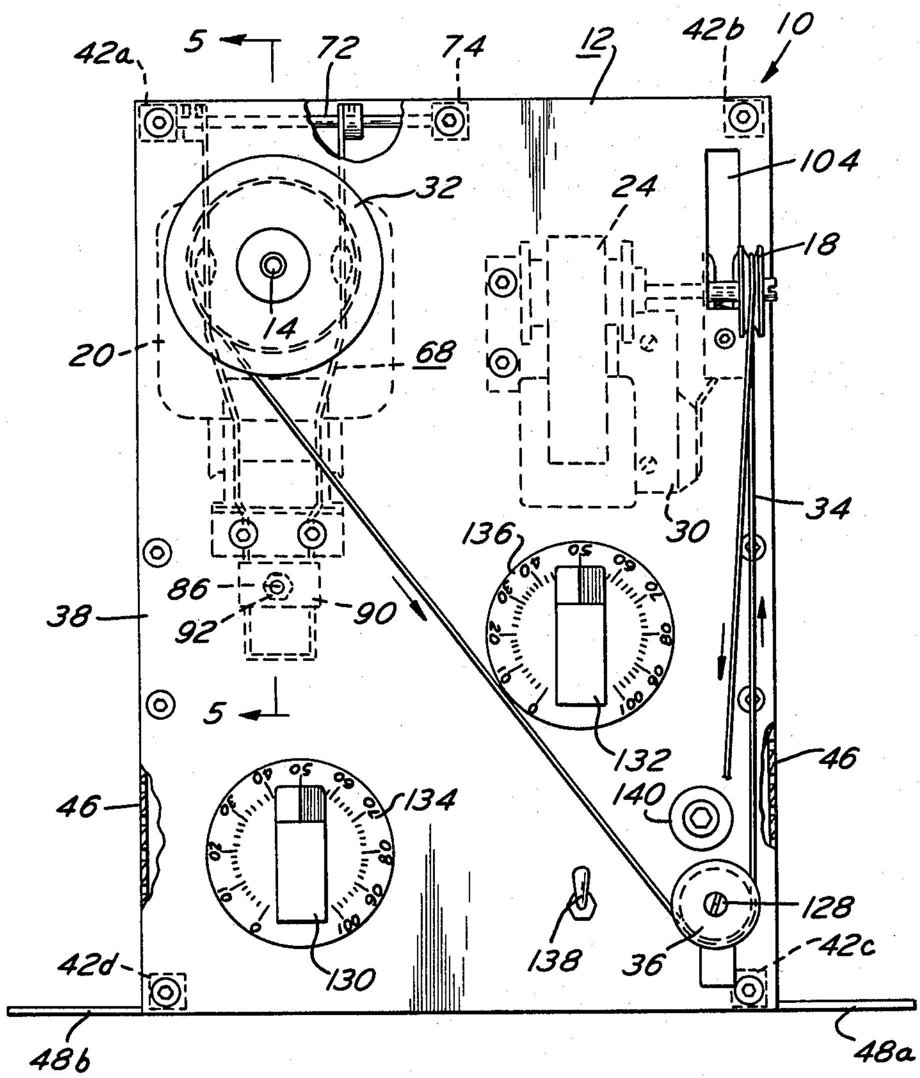

FIG. 2

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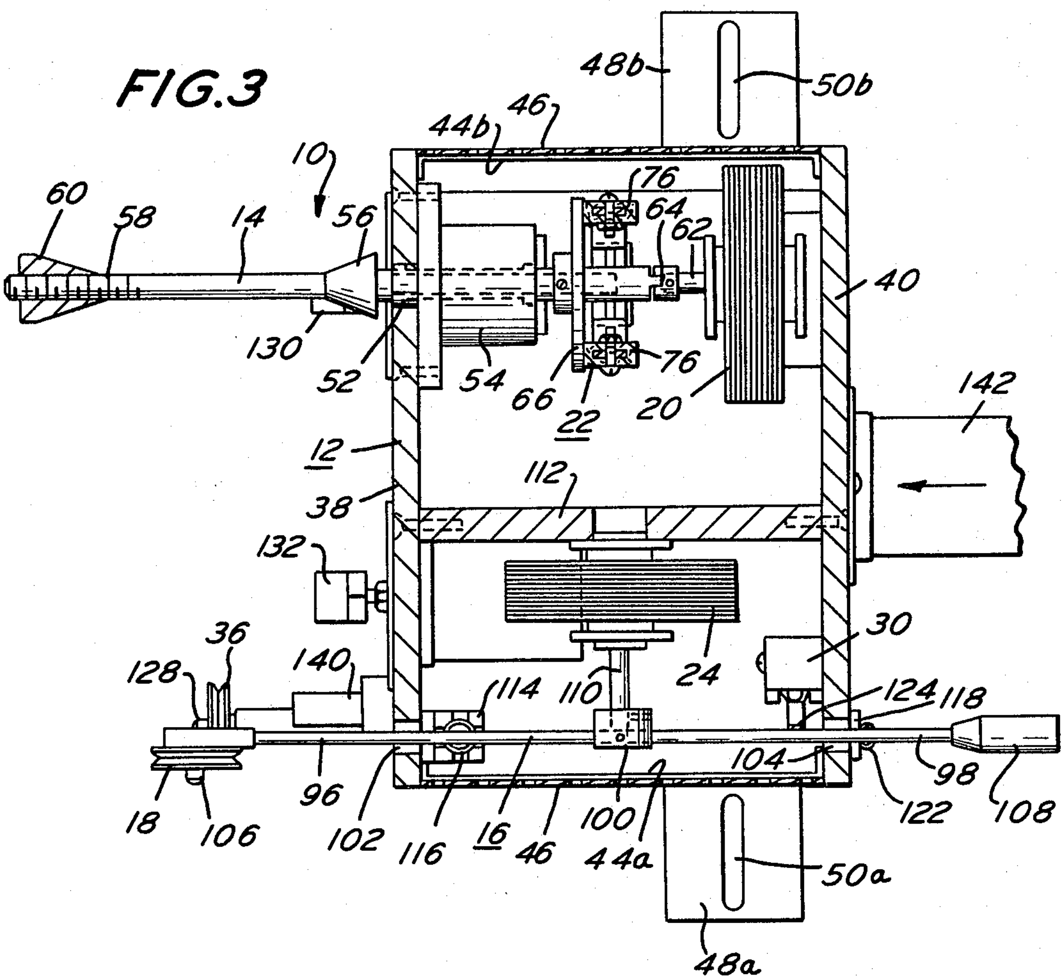
FIG.3



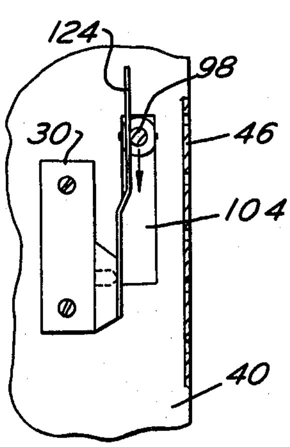


FIG.4

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FIG.5

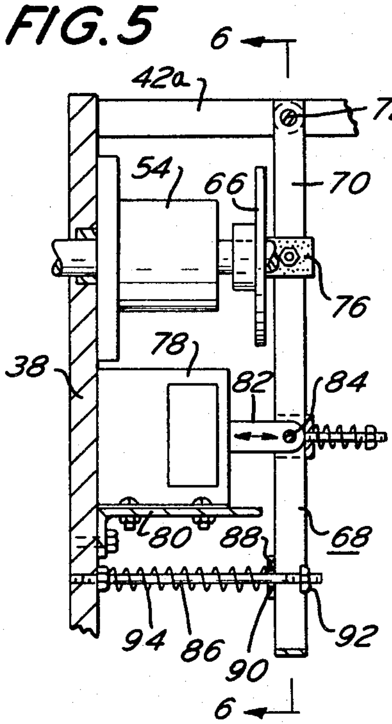


FIG.6

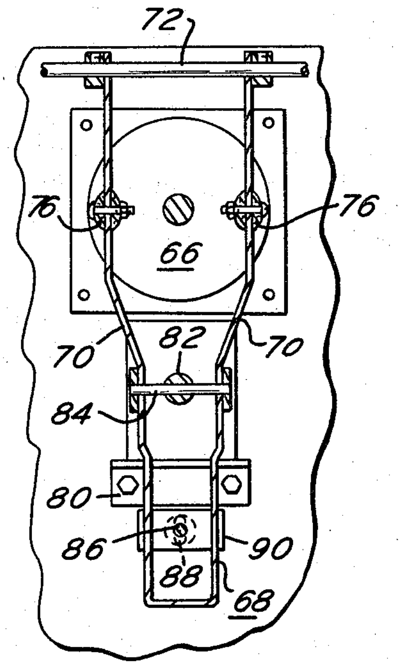
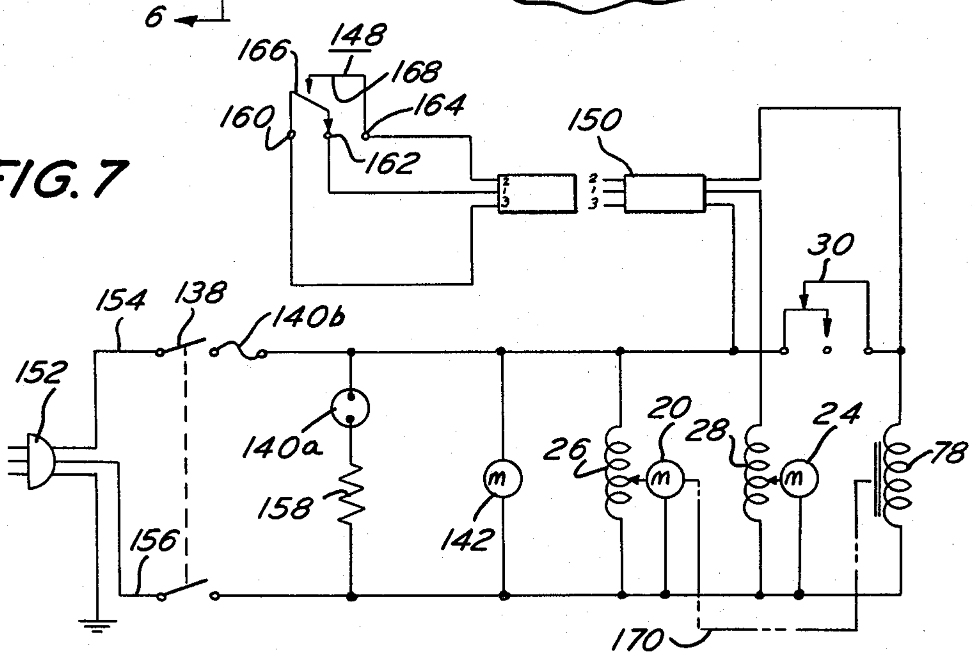


FIG.7



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United States Patent Office

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3,384,322

TENSIONER

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5 Claims. (Cl. 242—156.2)

ABSTRACT OF THE DISCLOSURE

A tensioner for controlling the tension applied to a continuous filament, such as a thread or wire, as it is dereeled from a spool, comprising a support having a filament supply spool arbor rotatably mounted thereon. An electrical motor is mounted on the support and drivingly connected to the arbor. The motor is rotatable in a direction to rotate the arbor in a direction opposite to the direction the filament tends to rotate the arbor as the filament is dereeled from the supply spool so as to apply a tension on the filament. A dancer arm is mounted on the support for pivotal movement about a point on the dancer arm intermediate its ends. A filament guide is provided on one end of the dancer arm over which the filament passes as the filament is dereeled from the supply spool. Another electrical motor is mounted on the support and is drivingly connected to the dancer arm at the point of pivotation of the dancer arm. The dancer arm motor is rotatable in a direction to pivot the dancer arm in a direction opposite to the direction the filament tends to pivot the dancer arm as the filament passes over the filament guide so as to apply a tension on the filament. Brake means is provided for stopping the rotation of the arbor. The brake means is actuated by the dancer arm when slack appears in the filament for applying the brake means for rotation of the arbor. Each of the motors includes means for varying the torque of the motor so as to control the tension applied to the filament.

The present invention relates to a tensioner, and more particularly to a tensioner for controlling the tension applied to a continuous filament, such as a thread or wire, as it is de-reeled from a spool.

In the winding of a continuous filament, such as a thread or wire, on a winding form, such as a spool or bobbin, it is desirable to maintain a uniform tension on the filament to achieve a smooth and uniform winding on the winding form. The amount of tension which can be applied to a filament without exceeding the yield strength of the filament depends on the thickness of the filament and the strength of the material of the filament. Thus, the tension which can be applied to very fine filaments is much less than that which can be applied to heavier filaments. Also, the uniformity of this tension applied to the filament is more critical than that applied to the heavier filaments. Therefore, in addition to being able to maintain a uniform tension on the filament as it is wound on the winding form, it is also desirable to be able to accurately set the tension being applied so that the filament is under the optimum tension according to its thickness and strength.

Another problem in winding a filament on a winding form arises when the winding operation is stopped. During the winding operation, the rotating supply spool from which the filament is de-reeled builds up sufficient momentum that it will continue to rotate even though the rotation of the winding form has stopped. This decreases the tension on the filament and allows slack to develop in the filament. Such slack can cause a loosening of the turns of the filament on the winding form and disrupt the smooth, uniform winding which is desired. Therefore, it is desirable for the supply spool to stop rotating

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at the same time that the winding operation stops and that the tension applied to the filament during the winding operation be maintained.

It is an object of the present invention to provide a novel filament tensioner.

It is another object of the present invention to provide a novel tension for controlling the tension applied to a continuous filament as it is de-reeled from a supply spool.

It is still another object of the present invention to provide a filament tension which applies a continuous, uniform tension on the filament as it is de-reeled from a supply spool.

It is a still further object of the present invention to provide a tension for controlling the tension applied to a continuous filament as it is de-reeled from a supply spool which will maintain the desired tension on the filament when the de-reeling is stopped.

Other objects will appear hereinafter.

For the purpose of illustrating the invention, there is shown in the drawings a form which is presently preferred; it being understood, however, that this invention is not limited to the precise arrangements and instrumentalities shown.

FIGURE 1 is a side elevational view, partially broken away, of the filament tensioner of the present invention.

FIGURE 2 is a front elevational view of the filament tensioner of the present invention taken along line **2—2** of FIGURE 1.

FIGURE 3 is a sectional view taken along line **3—3** of FIGURE 1.

FIGURE 4 is a sectional view taken along line **4—4** of FIGURE 1.

FIGURE 5 is a sectional view taken along line **5—5** of FIGURE 2.

FIGURE 6 is a sectional view taken along line **6—6** of FIGURE 5.

FIGURE 7 is a circuit diagram of the electrical circuit for operating and controlling the filament tensioner of the present invention.

Referring to FIGURES 1, 2 and 3 of the drawing, the filament tensioner of the present invention is generally designated as **10**. In general, filament tensioner **10** comprises a rectangular housing, generally designated as **12**, having a filament supply spool supporting arbor rotatably mounted therein and extending horizontally from the front thereof. A dancer arm **16** extends through the housing **12** spaced from and generally parallel to the arbor **14**. The dancer arm **16** is supported at a point between its ends for rotation about the supporting point in a vertical plane. A pulley **18** is rotatably mounted on the front end of the dancer arm **16**. A small A.C. electric motor **20** is mounted in the housing **12** and is drivingly connected to the back end of the arbor **14**. A solenoid operated brake mechanism, generally designated as **22**, is provided to stop the rotation of the arbor **14**. A small A.C. electric motor **24** is mounted in the housing **12** and drivingly connected to the dancer arm **16** at its point of rotation. A pair of autotransformers **26** and **28** are mounted on the housing **12** and connected to the arbor motor **20** and dancer arm motor **24** respectively so as to permit a control of the speed of the motors. A microswitch **30** is mounted on the housing **12** adjacent the back end of the dancer arm **16**. Microswitch **30** is connected to the brake mechanism **22** so that downward movement of the back end of the dancer arm **16** actuates the microswitch **30** to actuate the brake mechanism **22**.

In the use of the filament tensioner **10**, a spool **32** of filament **34** is mounted on and secured to the arbor **14** so that the spool and arbor will rotate together. The filament **34** is threaded around an idler pulley **36**, then over the dancer arm pulley **18** and then to a winding mechanism, not shown, for winding the filament on a winding form, such as a bobbin. The arbor motor **20** is operated to apply torque to the arbor **14** in the direction opposite to normal rotation of spool **32** and arbor **14** as they are rotated by the de-reeling of the filament **34** from the spool. For example, as the de-reeling of the filament **34** from the spool **32** rotates the spool and arbor counter-clockwise as viewed in FIGURE 2, the arbor motor **20** is operated to attempt to rotate the arbor clockwise. Thus, to de-reel the filament **34** from the spool **32**, a force must be applied sufficient to overcome the torque applied to the arbor **14** by the arbor motor **20**, thereby applying a tension on the filament **34**. This tension on the filament can be varied by varying the torque applied by the arbor motor **20** by means of the autotransformer **26**. The dancer arm motor **24** is operated to rotate the dancer arm **16** clockwise as viewed in FIGURE 1. This tends to lift the front end of the dancer arm **16** upwardly, whereas the de-reeling of the filament **34** from the spool **32** tends to pull the front end of the dancer arm downwardly. Thus, the dancer arm **16** also applies a tension on the filament **34** which can be controlled by controlling the torque of the dancer arm motor **24** by means of the autotransformer **28**. Thus, during the de-reeling of the filament **34** from the spool **32**, a desired uniform tension is applied to the filament so that the filament is wound on the winding form under uniform tension.

When the winding mechanism is stopped, such as at the end of a winding cycle, the rotating spool **32** has sufficient momentum to cause it to continue rotating in a counter-clockwise direction for an instant. Since the winding mechanism is stopped and is no longer taking up the filament from the spool, this continued rotation of the spool causes the tension in the filament to decrease and slack starts to develop in the filament. However, as the slack begins to develop in the filament **34**, the rotating dancer arm motor **24** lifts the front end of the dancer arm **16** upwardly and thereby takes up the slack so that the tension in the filament is maintained. This also lowers the back end of the dancer arm **16** so as to actuate the microswitch and thereby apply the braking mechanism **22**. Thus, the rotation of the spool **32** is stopped with the filament **34** maintained under the desired tension so that no turns of the filament on the winding form are allowed to become loose.

Referring again to the drawings for a more detailed description of the filament tensioner **10**, the housing **12** comprises a front plate **38** and a back plate **40** secured together in spaced, parallel relation by corner members **42*a***, **42*b***, **42*c*** and **42*d*** at the corners of the plates **38** and **40**. A pair of side plates **44*a*** and **44*b*** are connected between the front plate **38** and the back plate **40** at the side edges thereof. A perforated metal cover strip **46** extends between and along the side and top edge of the front and back plates **38** and **40** to cover the sides and top of the housing **12**. Mounting feet **48*a*** and **48*b*** are secured to the bottom corner members **42*c*** and **42*d*** respectively, and extend outwardly from the sides of the housing **12**. The mounting feet **48*a*** and **48*b*** are provided with elongated slots **50*a*** and **50*b*** respectively through which a screw or bolt can extend to secure the wire tension **10** to a suitable base, not shown.

The arbor **14** extends horizontally into the housing **12** through an opening **52** in the front plate **38** adjacent the upper member **42*a***, and is rotatably supported by bearings in a bearing case **54** secured to the inner surface of the front plate **38**. A conical flange **56** is provided on the arbor **14** adjacent the outer surface of the front plate **38** with the flange tapering radially inwardly away from the front plate **38**. The free end **58** of the arbor **14** is threaded, and a conical nut **60** is threaded on the arbor. The arbor motor **20** is mounted on the inner surface of the back plate **40** at the back end of the arbor **14**. The shaft **62** of the arbor motor **20** is in alignment with the arbor **14** and is drivingly connected to the arbor **14** by a coupling **64**.

Brake mechanism **22** comprises a flat, annular brake disc **66** surrounding and secured to the back portion of the arbor **14** adjacent the bearing case **54**. A U-shaped brake member **68** extends substantially vertically across the back surface of the brake disc **66** with the brake member arms **70—70** extending across diametrically opposite sides of the arbor **14** (see FIGURE 6). The brake member arms **70—70** are pivotally supported at their upper ends on a rod **72**. As shown in FIGURE 2, the rod **72** extends parallel to the front plate **38** and is supported between the corner member **42*a*** and a supplemental member **74** secured between the front and back plates **38** and **40**. Leather brake pads **76—76** are secured to the brake member arms **70—70** and are positioned to engage the back surface of the brake disc **66**. As shown in FIGURE 5, a brake solenoid **78** is mounted on a bracket **80** beneath the bearing case **54**. The bracket **80** is secured to the inner surface of the front plate **38**. The solenoid plunger **82** is pivotally connected to a pin **84** which is connected between the brake member arms **70—70**. A rod **86** is secured to the inner surface of the front plate **38** beneath the solenoid bracket **80**. The rod **86** extends through a slot **88** in a plate **90** which extends across the front of the brake member arms **70—70**. A nut **92** is threaded on the free end of the rod **86**. A helical spring **94** surrounds the rod **86** and is compressed between the inner surface of the front plate **38** and the plate **90**. The spring **94** normally holds the brake pads **76—76** out of engagement with the brake disc **66**, and actuation of the brake solenoid **78** moves the brake pads **76—76** into engagement with the brake disc **66**.

Dancer arm **16** comprises a front rod portion **96** and a back rod portion **98** cannected to and extending diametrically from the periphery of a cylinder **100**. The front rod portion **96** and back rod portion **98** are in longitudinal alignment with the front rod portion **96** extending through avertically elongated opening **102** in the front plate **38** and the back rod portion extending through a vertically elongated opening **104** in the back plate **40**. The dancer arm **16** is positioned adjacent the upper corner member **42*b*** of the housing **12**. Pulley **18** is rotatably mounted on the front end of the front rod portion **96** of the dancer arm **16** by a horizontally extending shaft **106** which is perpendicular to the dancer arm. A weight **108** is mounted on the back end of the back rod portion **98** of the dancer arm **16**. The weight **108** is of a size to slightly overbalance the dancer arm **16** toward the back end of the dancer arm. Dancer arm **16** is mounted on the end of the shaft **110** of the dancer arm motor **24**. The motor shaft **110** is secured in an end of the cylinder **100** and extends horizontally therefrom. The dancer arm motor **24** is mounted on a motor mount **112** which extends between and is secured to the front plate **38** and the back plate plate **40**.

A spring holder **114** is mounted on the inner surface of the front plate **38** just below the opening **102** (see FIGURE 1). A helical spring **116** is seated in the spring holder **114**. The front rod portion **96** of the dancer arm **16** rests on the top of the spring **116** so that the spring is under a slight compression. A pair of stop plates **118** and **120** are adjustably secured to the outer surface of the back plate **40** above and below the dancer arm opening **104** to regulate the distance that the dancer arm **16** can rotate. A small helical spring **122** is secured to the upper stop plate **118** and is engageable by the dancer arm **16** to act as a shock absorber.

The microswitch **30** is mounted on the inner surface of the back panel **40** adjacent the dancer arm opening **104**. As shown in FIGURE 4, microswitch **30** has a leaf spring type activating arm **124** extending substantially vertically and tangentially across the back rod portion **98** of the dancer arm **16**. The actuating arm **124** is bent at its upper end to provide a camming surface which is engaged by the back rod portion **98** of the dancer arm **16** to open the microswitch 30 when the back rod portion 98 is rotated upwardly.

An idler pulley mounting post 126 is secured to the outer surface of the front plate 38 adjacent the bottom corner member 42*c* and beneath the dancer arm 16. The idler pulley 36 is rotatably mounted on the end of the mounting post 126 by a shaft 128 which extends perpendicular to the front plate 38. Thus, the idler pulley 36 rotates about an axis which is perpendicular to the axis of rotation of the dancer arm pulley 18. The arbor motor autotransformer 26 and the dancer arm motor autotransformer 28 are mounted on the front plate 38 with their actuating shafts extending through the front plate. Knobs 130 and 132 are provided on the ends of the shafts of the autotransformers 26 and 28 respectively to actuate the autotransformers. Indicator plates 134 and 136 are provided on the outer surface of the front plate 38 for the autotransformers 26 and 28. An off-on switch 138 and a combination pilot light and fuse 140 are also mounted on the front plate 38. As shown in FIGURE 1, an air blower 142 is mounted on the back plate 40 at an opening 144 in the back plate. The air blower 142 provides cooling air through the housing 12. A foot switch 146 is connected through a cable 148 to a connector 150 on the back plate 40. As will be explained, the foot switch 146 is electrically connected to operate the brake mechanism 22 and the dancer arm motor 24.

FIGURE 7 is a circuit diagram of the electrical components of the filament tensioner 10. The filament tensioner 10 operates on standard 120 volt, 60 cycle A.C. current. A three terminal plug 152 is provided for connecting the circuit of the filament tensioner to the source of the A.C. current. One terminal of the plug 152 is connected to ground. The other two terminals of the plug 152 are connected to lines 154 and 156 across which the electrical components of the filament tensioner 10 are electrically connected. The off-on switch 138 is provided in both lines 154 and 156. The pilot light 140*a* is connected between the lines 154 and 156 and has a current limiting resistor 158 in series therewith. The fuse 140*b* is provided in line 154 between the off-on switch 138 and the remainder of the circuit. The air blower 142 and the arbor motor autotransformer 26 are also connected between the lines 154 and 156. The arbor motor 20 is connected between the variable terminal of the autotransformer 26 and the line 156. The dancer arm motor autotransformer 28 is connected between the line 156 and one terminal of the connector 150 for the foot switch 148, and the dancer arm motor 24 is connected between the line 156 and the variable terminal of the autotransformer 28. One terminal of the solenoid 78 is connected to the line 156 and the other terminal of the solenoid is connected to a second terminal of the connector 150. The solenoid 78 is mechanically connected to the brake mechanism for the arbor motor 20 as indicated by the line 170. The third terminal of the connector 150 is connected to line 154. The microswitch 30 is connected between the line 154 and the terminal of the solenoid 78 which is also connected to connector 150. Microswitch is normally in its closed condition until its actuating arm is depressed. Foot switch 148 is a three terminal, two contact switch. One terminal 160 of the foot switch 148 is connected to the line 154 through the third terminal of the connector 150. A second terminal 162 of the foot switch 148 is connected to the dancer arm motor autotransformer 28 through the one terminal of the connector 150. The third terminal 164 of the foot switch 148 is connected to the other terminal of the solenoid 78 through the second terminal of the connector 150. One contact 166 of the foot switch 148 extends between the terminals 160 and 162 and is normally closed. The other contact 168 of the foot switch 148 extends between the terminals 160 and 164 and is normally open. When the operator steps on the foot switch 148, the contact 168 is closed and the contact 166 is opened.

In the use of the filament tensioner 10, the operator removes the nut 60 from the arbor 14 and places the filament spool 32 on the arbor in such a manner that it will de-reel in a counterclockwise direction. The nut 60 is threaded back on the end 58 of the arbor and is tightened against the spool 32 until the spool is tightly clamped between the nut 60 and the conical flange 56. The filament 34 is then threaded around the bottom of the idler pulley 36 and up and over the dancer arm pulley 18 as shown in FIGURES 1 and 2. The autotransformers 26 and 28 are adjusted to the settings to provide the desired tension on the filament 34 depending on the size and yield strength of the filament. The tensions on the filament 34 are adjusted so that the arbor motor 20 provides a slightly greater tension on the filament than the tension provided by the dancer arm motor 24. The off-on switch 138 is then turned on.

To attach the filament 34 to the winding form on which the filament is to be wound, such as a bobbin, the operator pulls the end of the filament to the winding form. This pulls downwardly on the front end of the dancer arm 16 so that the back end of the dancer arm moves upwardly. This rotation of the dancer arm 16 opens the microswitch 30 so as to turn off the electrical current to the brake solenoid 78 and releases the brake mechanism 22. At the same time, the operator depresses foot switch 148. This turns on the current to the brake solenoid 78 as to apply the brake mechanism 22 and, at the same time, turns off the dancer arm motor 24. With the brake mechanism 22 applied and the dancer arm motor 24 off, there is no tension being applied to the filament 34 by the tensioner 10. The operator can then easily attach the end of the filament 34 to the winding form. When the filament 34 is attached to the winding form, the operator releases the foot switch 148 so as to restore current to the dancer arm motor and release the brake mechanism 22. This leaves the dancer arm 16 in a substantially horizontal winding position with the previously selected tension being applied to the filament 34.

The operator then starts the winding machine which pulls the filament 34 from the spool 32 against the torque of the arbor motor 20. This exerts a constant desired tension on the filament so as to provide a smooth, uniform winding of the filament on the winding form. By having the tension applied to the filament of the arbor motor 20 slightly greater than that applied by the dancer arm motor 24, the front end of dancer arm 16 is prevented from rotating upward to accidentally apply the brake mechanism during the winding operation. When the desired amount of the filament 34 is wound on the winding form, the winding machine is stopped. As previously stated, the rotation of the filament spool 32 during the winding operation develops a momentum in the spool which causes the spool to continue to rotate slightly after the winding machine has stopped. Since the winding machine is not taking up the filament 34, the tension in the filament 34 begins to decrease and slack begins to develop. However, at this instant, the dancer arm motor 24 rotates the front end of the dancer arm 16 upwardly so as to maintain the tension on the filament 34 and prevent any loosening of the turns of filament on the winding form. This rotation of the dancer arm 16 causes the back end of the dancer arm to release the depressed actuating arm 124 of the microswitch 30 and thereby close the microswitch 30 so as to apply the brake mechanism 22. Thus, the rotation of the filament spool 32 is immediately stopped so as to maintain the tension on the filament 34 and prevent any loosening of the turns of the filament on the winding form. The operator can then secure the other end of the filament to the winding form and repeat the winding operation on another winding form.

Thus, it can be seen that the tensioner 10 of the present invention provides for the winding of a filament on a winding form under a constant, uniform tension, so as to achieve a smooth and uniform winding on the winding form. Since the tension applied to the filament is dependent on the torque applied by the arbor motor **20** and the dance arm motor **24**, this tension can be easily and accurately adjusted to the desired tension required for the size and yield strength of the filament being used by means of the autotransformers **26** and **28**. When the winding machine is stopped, the tensioner **10** immediately stops the rotation of the filament spool **32** and maintains the desired tension on the filament **34** so as to prevent loosening of any of the turns of the filament on the winding form and maintains the smooth, uniform winding on the winding form.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification as indicating the scope of the invention.

I claim:

1. A filament tensioner comprising a support, an arbor rotatably mounted on said support, means for securing a filament supply spool on said arbor so that the spool rotates with said arbor, a dancer arm mounted on said support for pivotal movement about a point on the dancer arm intermediate its ends, a filament guide on one end of said arm over which the filament passes as the filament is de-reeled from the supply spool, an electric motor mounted on said support and drivingly connected to said dancer arm at the point of pivotation of the dancer arm, said motor being rotatable in a direction to pivot the dancer arm in a direction opposite to the direction the filament tends to pivot the dancer arm as the filament passes over the filament guide so as to apply a tension on the filament, a second electrical motor mounted on the support and drivingly connected to the arbor, said second motor being rotatable in a direction to rotate the arbor in a direction opposite to the direction the filament tends to rotate the arbor as the filament is de-reeled from the supply spool so as to apply a tension on the filament, brake means for stopping the rotation of the arbor, and means actuated by the dancer arm when slack appears in the filament for applying said brake means to stop the rotation of the arbor.

2. A filament tensioner in accordance with claim **1** including separate means for varying the torque of each of the motors so as to control the tension applied to the filament.

3. A filament tensioner in accordance with claim **1** in which the brake arm includes a flat, annular brake disc surrounding and secured to the arbor, a brake arm pivotally mounted at one end on said support and extending across a surface of said brake disc, a solenoid mounted on said support and connected to said brake arm, said solenoid being adapted to pivot said brake arm into engagement with said brake disc when the solenoid is electrically actuated so as to apply the brake, and spring means engaging said brake arm normally holding brake arm away from the brake disc.

4. A filament tensioner in accordance with claim **3** in which the means for actuating said brake means comprises an electrical switch mounted on the support adjacent the dancer arm and electrically connected to the solenoid, said switch being actuated by the dancer arm when slack appears in the filament so as to electrically actuate the solenoid and apply the brake.

5. A filament tensioner in accordance with claim **4** including a second switch electrically connected to the brake solenoid and to the second motor so that actuation of said second switch electrically actuates the solenoid to apply the brake and simultaneously turn off the second motor.

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STANLEY N. GILREATH, *Primary Examiner.*

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,384,322

May 21, 1968

Carl G. Reed

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading to the printed specification, line 4, "IRC, Inc., Philadelphia, Pa." should read -- TRW Inc., a corporation of Ohio --.

Signed and sealed this 3rd day of March 1970.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents