Jan. 25, 1966 F. LEMARCHAND 3,231,216

THREAD TENSIONING DEVICE FOR TEXTILE MACHINES

Filed Jan. 15, 1963 6 Sheets-Sheet 1

Fig. 1

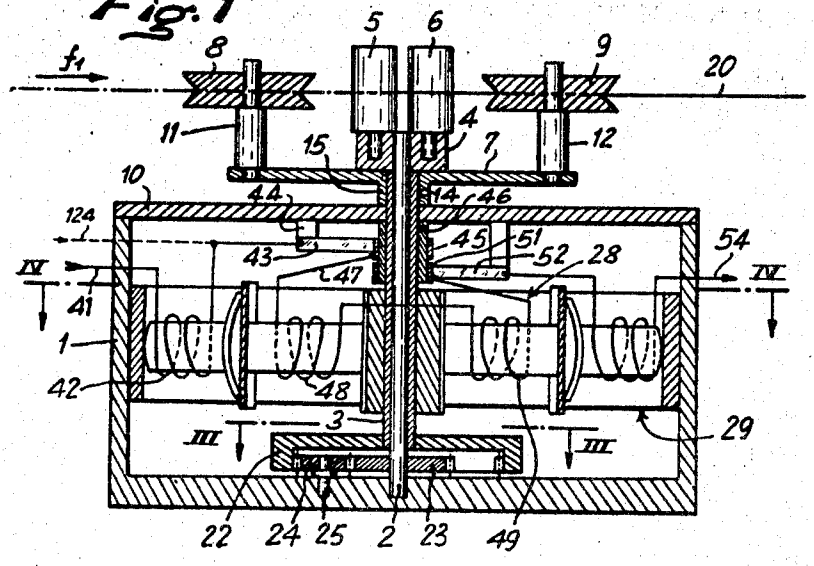


Fig. 2

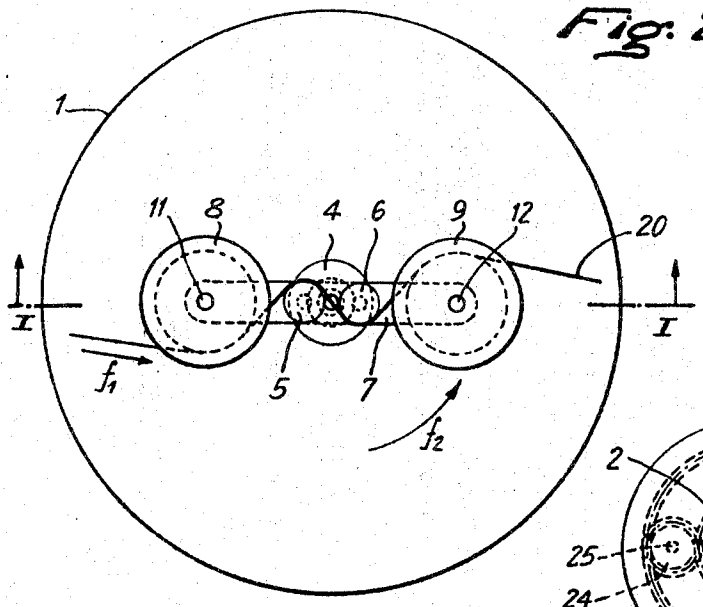
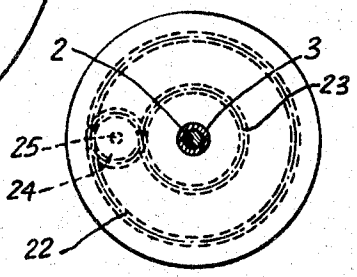


Fig. 3



INVENTOR
FRANCIS LEMARCHAND
BY MICHAEL S. STRIKER,
ATTORNEY

THREAD TENSIONING DEVICE FOR TEXTILE MACHINES

Filed Jan. 15, 1963 6 Sheets-Sheet 2

Fig. 4

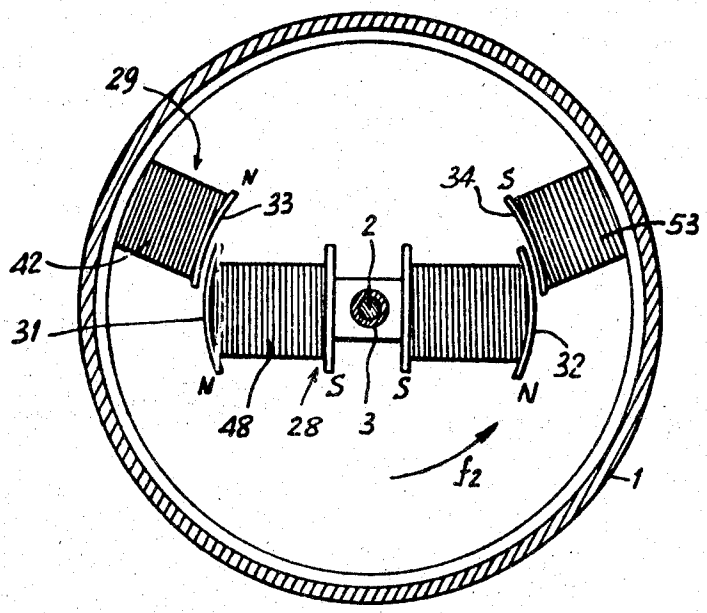
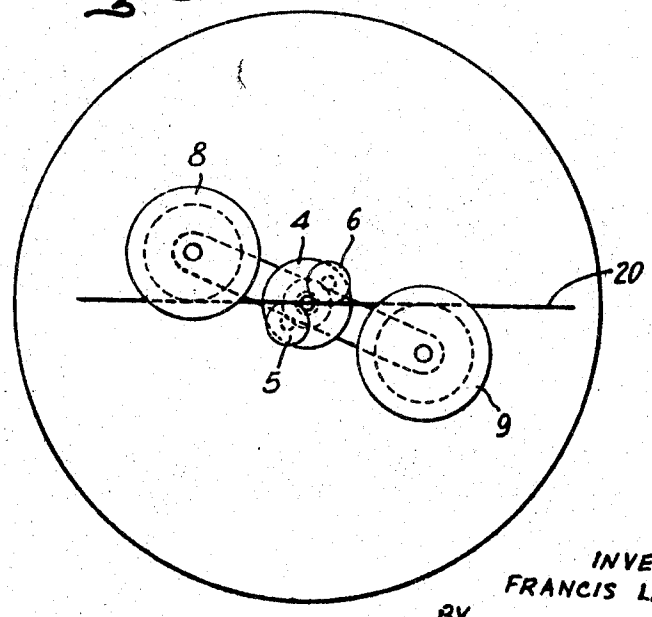


Fig. 5



INVENTOR
FRANCIS LEMARCHAND
BY MICHAEL S. STRIKER,
ATTORNEY

Jan. 25, 1966 F. LEMARCHAND 3,231,216
THREAD TENSIONING DEVICE FOR TEXTILE MACHINES
Filed Jan. 15, 1963 6 Sheets-Sheet 3

Fig. 6

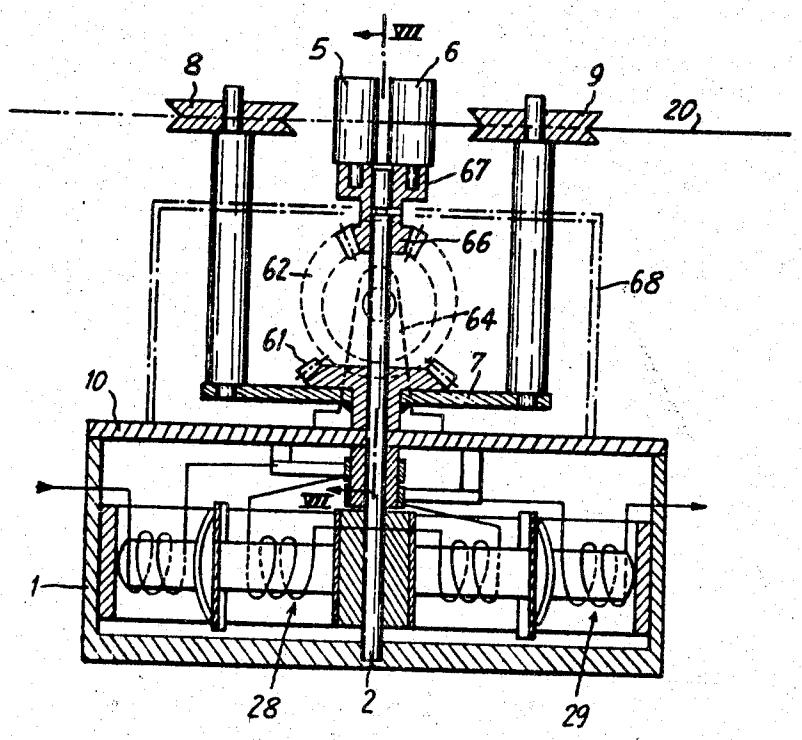
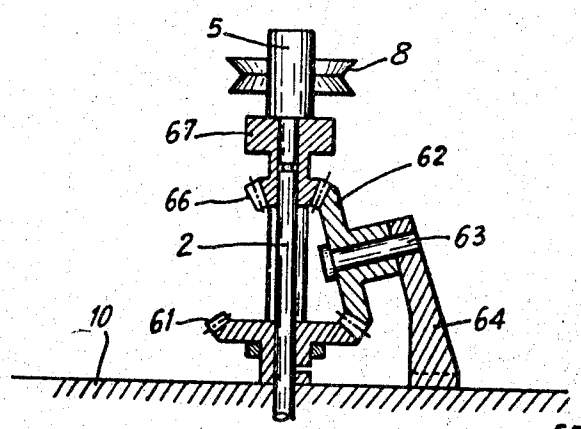


Fig. 7



INVENTOR
FRANCIS LEMARCHAND
BY MICHAEL S. STRIKER
ATTORNEY

Jan. 25, 1966 F. LEMARCHAND 3,231,216

THREAD TENSIONING DEVICE FOR TEXTILE MACHINES

Filed Jan. 15, 1963 6 Sheets-Sheet 4

Fig. 8

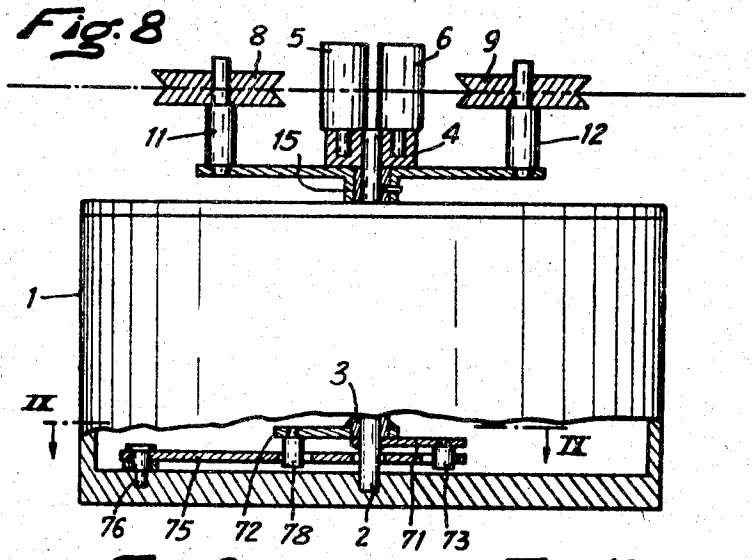


Fig. 9

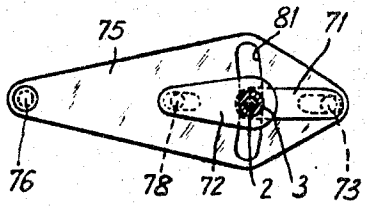


Fig. 10

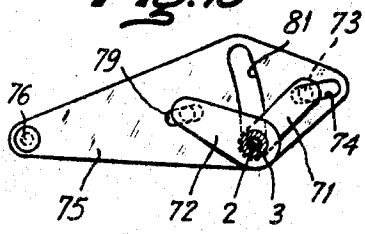
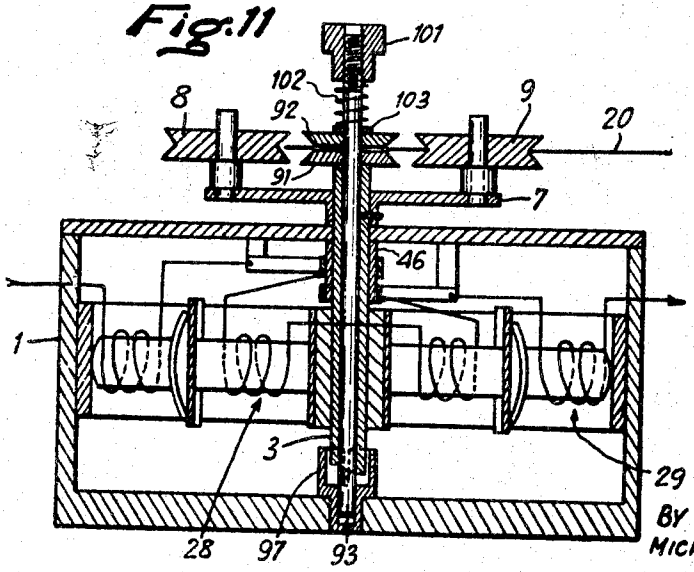


Fig. 11



INVENTOR
FRANCIS LEMARCHAND
BY
MICHAEL S. STRIKER,
ATTORNEY

Jan. 25, 1966 F. LEMARCHAND 3,231,216

THREAD TENSIONING DEVICE FOR TEXTILE MACHINES

Filed Jan. 15, 1963 6 Sheets-Sheet 5

Fig:12

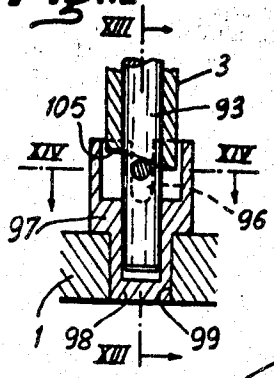


Fig:13

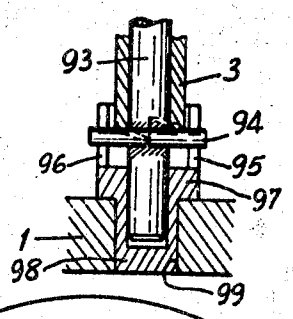


Fig:14

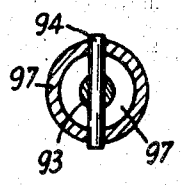


Fig:15

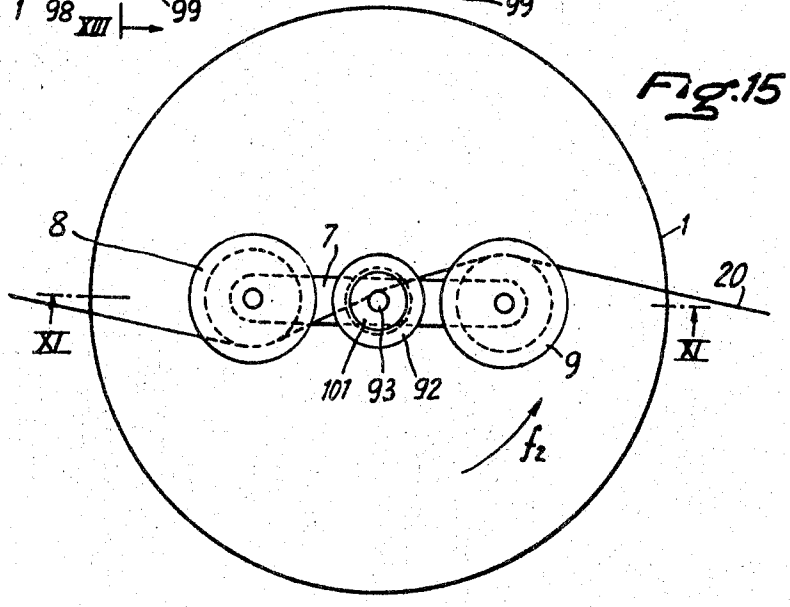
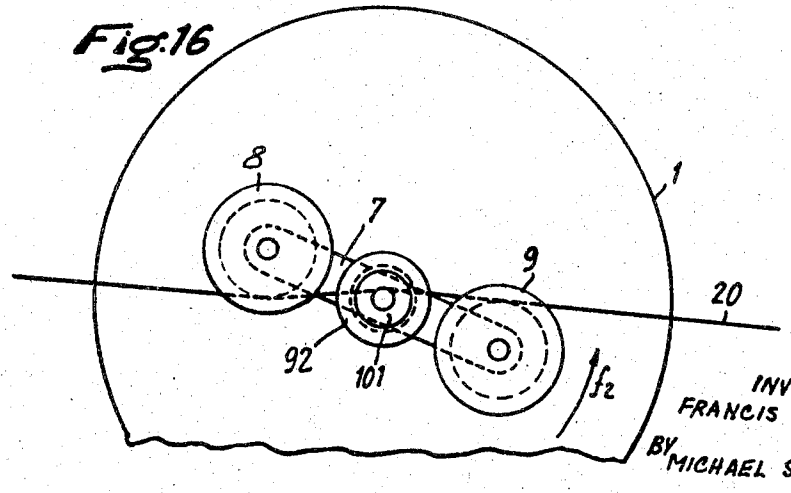


Fig:16



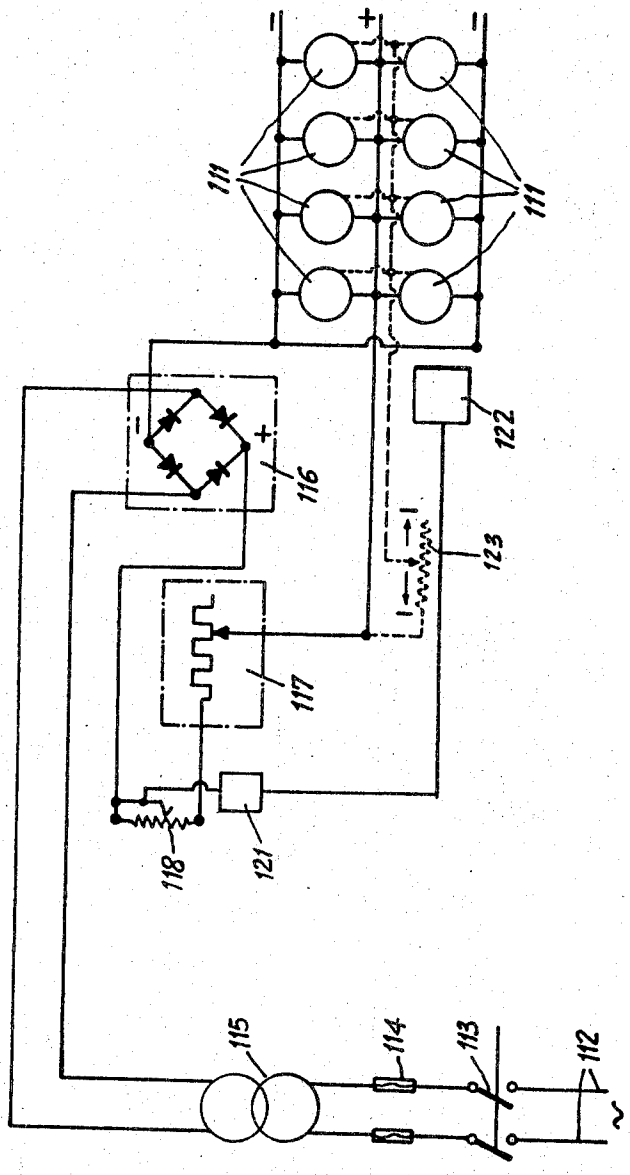
INVENTOR
FRANCIS LEMARCHAND
BY MICHAEL S. STRIKER,
ATTORNEY

Jan. 25, 1966 F. LEMARCHAND 3,231,216

THREAD TENSIONING DEVICE FOR TEXTILE MACHINES

Filed Jan. 15, 1963 6 Sheets-Sheet 6

Fig. 17



INVENTOR
FRANCIS LEMARCHAND
BY MICHAEL S. STRIKER,
ATTORNEY

United States Patent Office 3,231,216 Patented Jan. 25, 1966

3,231,216

THREAD TENSIONING DEVICE FOR TEXTILE MACHINES

Francis Lemarchand, Rouen, France, assignor to Machines Bourgeas Pain, Valence, Drome, France, a French company

Filed Jan. 15, 1963, Ser. No. 251,554
Claims priority, application France, Jan. 19, 1962, 885,294, Patent 1,319,433
9 Claims. (Cl. 242—150)

The invention relates to thread-tensioning devices for textile machines such as, for example, creels, reeling-machines, spoolers, winders, false-twist machines, etc.

In the majority of known thread-tensioning devices, the thread passes over two tension cylinders which are positionally adjustable at the outset but which remain stationary during the operation of the machine, the thread being guided, at least on the output side of the said tension cylinders, by means of a roller or like guiding member which is subjected to the action of an adjustable counterweight.

In the case of devices of this type, it is difficult to adjust the tension of the thread during operation of the machine and it is in any case necessary to carry out this adjustment individually by hand on each thread-tensioning device, with the result that, in order to adjust all the thread-tensioning devices of a same machine, a relatively substantial amount of time has to be spent.

The purpose of the invention is to construct a thread-tensioning device which not only ensures that the thread tension is automatically regulated to a constant pre-determined value, but also makes it possible to modify the value of this tension at any desired moment during the operation of the machine, either by manual control means or by automatic means, as a function of time or of a pre-determined programme, for example in response to the diameter of the bobbins of thread which are undergoing formation on the machine, and finally, which makes it possible to effect a simultaneous adjustment of all the tensioning devices of a same machine, starting from a single common adjustment unit.

To this end, in accordance with the invention, the thread tension regulating device comprises a feeler element with a roller which is elastically urged against the thread with a constant pressure which can preferably be regulated, and a thread tension regulating system controlled by the said feeler element in such manner that, depending on whether the thread tension tends to increase or decrease, the feeler roller is thrust back either in one direction by the thread or in the opposite direction by the elastic means actuating the said feeler element and produces action on the thread tension regulating system in the direction of a reduction or increase respectively, so as to compensate incipient variations in tension.

By virtue of this constructional arrangement, and in view of the fact that the feeler element acts upon the thread tension regulating system so as to compensate possible variations in tension, it will be understood that a very flexible and very effective regulation of tension is thus obtained and that it is possible to effect a modification of the value of the thread tension simply by varying the pressure applied by the feeler element on the thread.

The invention also has for its object forms of embodiment which comprise at least one of the following characteristic features:

(a) The thread tension regulating system is constituted by two parallel tension cylinders around which the thread passes in an S, the said cylinders being carried by a support which pivots about a shaft mounted parallel to the axes of the tension cylinders and which is coupled to the feeler element.

(b) The thread tension regulating elements are constituted by two discs between which the threads pass, the said discs being urged towards each other by the feeler element by means of a coupling comprising a spring, the degree of compression of which determines the pressure with which the discs are applied against the thread.

(c) The feeler system comprises two rollers mounted on an arm which is adapted to pivot at its centre co-axially with the thread tension regulating system.

(d) The tension cylinders are carried by a support which is adapted to pivot co-axially with the arm which carries the two feeler rollers, in the direction opposite to the said arm and preferably in a speed ratio which is greater than unity, especially of the order of 2:1.

(e) The coupling between the arm which carries the feeler rollers and the support which carries the tension cylinder is constituted by two toothed wheels which are respectively integral with the said arm and with the said support, the said two toothed wheels being in mesh with a common intermediate toothed wheel, the shaft of which is stationary.

(f) The arm which carries the feeler rollers and the support which carries the tension cylinders are connected together by means of a coupling comprising two crank-pins which are respectively integral with the coaxial shafts of the said arm and the said support and which are coupled at two points of an intermediate pivotal lever which are located at distances from the fulcrum of this latter which are respectively proportional to the angular speeds of the arm and of the support.

(g) The two discs of the disc-type tensioning device are respectively coupled axially to two coaxial shafts which are movable one with respect to the other, both axially and in rotation, one of the said two shafts being designed to carry the pivotal arm which supports the feeler roller whilst the other shaft is secured against rotation and a cam transmission produces the relative sliding of the two shafts under the action of the pivotal motion of that shaft which carries the feeler roller.

(h) The feeler roller is urged against the thread by means of an electromagnetic device such as, for example, an electric motor of the type known as a "torque-motor."

(i) The electromagnetic device comprises a pivoting system which is secured to the arm fitted with the feeler roller and which carries two pole pieces adapted to move in front of two stationary pole pieces which are displaced angularly in such manner that, when the area of the air-gap between two oppositely facing pole pieces decreases, the area of the air-gap between the two other oppositely facing pole pieces increases, two of the opposite faces having the same polarity whilst the two other opposite faces have different polarities in order that the torque provided by the moving system may be substantially constant, irrespective of the angular position thereof.

(j) The circuit supplying current to the electromagnetic device which applies the feeler roller against the thread is placed under the control of a device such as a rheostat which comprises a moving element coupled to a member, the displacements of which are dependent on the value of the diameter of the bobbin of thread which is undergoing formation.

The invention will be more closely understood from a perusal of the following description and from a study of the accompanying drawings which show by way of non-limitative examples a few forms of embodiment of the invention.

In these drawings:

FIG. 1 is an axial cross-section taken along the line I—I of FIG. 2, of a device for regulating thread tension in accordance with the invention,

FIG. 2 is a corresponding plan view,

FIG. 3 is a partial transverse cross-section taken along the line III—III of FIG. 1,

FIG. 4 is a transverse cross-section taken along the line IV—IV of FIG. 1,

FIG. 5 is a plan view which is similar to FIG. 2 and which shows the members in another position,

FIG. 6 is an axial cross-section of a first variant of the form of embodiment of FIGS. 1 to 5,

FIG. 7 is an axial cross-section taken along the line VII—VII of FIG. 6,

FIG. 8 is an axial cross-section of a second variant,

FIG. 9 is a partial transverse cross-section taken along the line IX—IX of FIG. 8,

FIG. 10 is a view which is similar to FIG. 9, and which shows the members in another position,

FIG. 11 is an axial cross-section of another form of embodiment taken along the line XI—XI of FIG. 15,

FIG. 12 shows on a larger scale a detail of FIG. 11,

FIGS. 13 and 14 are cross-sections taken respectively along the lines XIII—XIII and XIV—XIV of FIG. 12,

FIG. 15 is a plan view which corresponds to FIG. 11,

FIG. 16 is a view which is similar to FIG. 15 and which shows the members in another position, and

FIG. 17 is an electric circuit diagram of an installation for the control of a series of tensioning devices in accordance with the invention which are mounted on a textile machine.

The thread-tensioning device which is illustrated in FIG. 1 comprises a box **1** inside which are mounted two vertical co-axial shafts, namely: an internal shaft **2** and an external tubular shaft **3** which support respectively at the top extremities of the said shafts a bracket **4** which carries two tension cylinders **5**, **6** and an arm **7** which carries two rollers, namely, a feeler roller **8** and guide roller **9** (see also FIG. 2).

The two tension cylinders **5** and **6** have their axes parallel to the shaft **2** and are rigidly fixed to the bracket **4**, that is to say, the said tension cylinders do not rotate about their own axes. The two rollers **8** and **9** are grooved rollers which are, on the contrary, mounted for rotation on shafts **11** and **12** which are respectively fixed on the two extremities of the arm **7**. The said arm is fixed on the tubular shaft **3** by means of a clamping screw **14** which passes through a hub **15**, the said hub being integral with the said arm.

The thread **20**, the tension of which it is desired to adjust, passes in the direction of the arrow *f1*, first over the input guide roller **8**, then over the two tension cylinders **5** and **6** so as to form an S and lastly over the output guide roller **9**.

The pivotal arm **7** which carries the feeler rollers and the bracket **4** which carries the tension cylinders are coupled for rotation by means of a step-up system which comprises an internally toothed ring gear **22** and an externally toothed wheel **23** which are respectively secured to the tubular shaft **3** which carries the rollers and to the internal shaft **2** which carries the tension cylinders, whilst the internally-toothed ring gear **22** and the externally toothed wheel **23** are both in mesh with an intermediate toothed wheel **24** which is mounted to rotate freely on a pin **25** which is rigidly secured in the bottom of the box **1**. The pitch diameter of the ring gear **22** is, in this example, substantially double the diameter of the toothed wheel **23**, with the result that the angular displacement of the bracket which carries the tension cylinders is approximately double the angular displacement of the pivotal arm which carries the feeler rollers, and takes place in the opposite direction.

The pivotal arm **7** which carries the feeler rollers is induced to perform a pivotal movement in the direction of the arrow *f2* (as shown in FIG. 2) and, in consequence, the bracket which supports the tension cylinders is induced to rotate in the opposite direction with an amplitude and an agular speed which are double, under the action of a device which, in this example, is of the

electromagnetic type comprising a rotor which is generally designated by the reference **28**, and a stator which is generally designated by the reference **29**.

The rotor **28** which is mounted on the tubular shaft **3** comprises two pole pieces **31**, **32** which are intended to co-operate respectively with two pole pieces **33**, **34** of the stator. In order that the total reluctance of the air-gap between the stator and the rotor should remain substantially constant, there has been given to the two pole pieces of the stator a suitable angular displacement which is different from that of the pole pieces of the rotor. In this manner, when one of the two air-gaps decreases in area, the other air-gap increases, thereby making it possible to retain a substantially constant torque, while steps are taken to ensure that the two oppositely facing pole pieces, for example the pole piece **31** of the rotor and the pole piece **33** of the stator both have like poles, for example north-seeking or positive poles, whereas the two opposite faces of the two other pole pieces **32** and **34** have unlike poles, in order to ensure that two pole pieces repel each other while the other two pole pieces attract each other and that their combined action should consequently be in the same direction, that is to say, in the example, the direction of the arrow *f2*.

There has been diagrammatically illustrated in FIG. 1 the electric circuit for the excitation of the pole pieces of the rotor and of the stator. The electric current flows into the box **1** through a supply lead **41** and passes successively through the coil **42** of the pole piece **33** of the stator, through a brush **43** which is secured to the box cover **10** by means of an insulating member **44**, through the brush-contact **43** to a collecting-ring **45** which is mounted on an insulating tube **46** fixed on the tubular shaft **3**, through a supply lead **47**, through the coil **48** of the pole piece **31** of the rotor, the coil **49** of the pole piece **32** of the rotor, through another collecting-ring **51**, a brush **52**, and through the coil **53** of the pole piece **34** of the stator, whereupon the current finally passes out of the box through a lead **54**.

The operation of the device takes place as follows:

It is assumed that the apparatus is at present in stable condition of operation. Accordingly, the thread **20** has a tension which balances the pressure with which the feeler and guide rollers **8** and **9** as well as the tension cylinders **5** and **6** are applied against the thread under the action of the constant torque provided by the electromagnetic device.

If for any reason the tension of the thread shows a tendency to decrease, for example, the pivotal arm **7** which carries the feeler rollers will pivot in the direction of the arrow *f2* under the action of the predominant torque of the electromagnetic device, with the result that the tension cylinders **5** and **6** will pivot together in the direction opposite to the arrow *f2* and that consequently, the arc over which the thread is wound onto the said tension cylinders will increase; this results in an increase in the tension of the thread, which tends to cause the feeler rollers **8** and **9** to move back to the same extent as they had moved forward under the action of the predominant driving torque of the electromagnetic device.

In the contrary case, that is to say if the tension of the thread tended to increase, the feeler rollers would be thrust back in the direction opposite to the arrow *f2*, with the result that the tension cylinders would perform a pivotal movement in the direction of the said arrow while producing a decrease in the length of the arc over which the thread rubs against the said cylinders, which would have the effect of reducing the tension of the thread and of initiating the return of the pivotal systems to their position of stable operation.

In FIG. 2, there have been illustrated the moving systems in a mean position in which it is effective and, in FIG. 5, in a position which corresponds to the maximum tension of the thread in which the device is not effective

until the tension produced by the delivering and receiving machines is reduced.

The multiplication of the amplitude of the movement and of the speed of the feeler rollers with respect to the tension cylinders provides the apparatus with great sensitivity, a small response time and rapid compensation of variations in tension for small angular displacements of the feeler rollers, thereby preventing troublesome time-lags and considerably increasing the range of adjustment provided by the apparatus.

In order to regulate the thread tension to the desired value, it is merely necessary to regulate the current intensity in the electromagnetic device to the value which corresponds to the torque which is necessary for the purpose of applying the feeler rollers against the thread with the corresponding pressure.

The form of embodiment which is illustrated in FIGS. 6 and 7 resembles the form of embodiment of FIGS. 1 to 5 and the same members have been designated by the same reference numerals; it essentially differs only in the fact that the step-up gear device, instead of being constituted by straight-tooth gears, is constituted by bevel-gears.

The arm **7** which carries the feeler rollers is mare integral with a bevel-gear **61** which is secured to shaft **2** and in mesh with an intermediate bevel-gear **62** which is mounted to rotate freely on a shaft **63**, the said shaft being carried by a support **64** which is mounted on the cover **10** of the box, the said bevel-gear **62** being in turn engaged at the same time with a bevel pinion **66**, the pitch diameter of which is substantially one half the pitch diameter of the bevel-gear **61**. In this form of embodiment, the bevel pinion **66** is provided with a collar **67** in which are directly mounted the two tension cylinders **5**, **6**. The said pinion and its collar rotate freely on the shaft **2** which in this case, is directly coupled to the rotor **28** and is journalled in the box casing and box cover, the tubular shaft of the previous form of embodiment being no longer provided in this alternative form.

A casing **68** protects the reduction gear unit.

The said device obviously operates in the same manner as the device which is described with reference to FIGS. 1 to 5.

The form of embodiment which is illustrated in FIGS. 8 to 10 also differs from the form of embodiment of FIGS. 1 to 5 solely in the structure of the step-up gear device which, instead of being in the form of gears, is designed in the form of levers which are pivotally coupled to each other.

The internal shaft **2** which carries the tension cylinders at the top extremity thereof is rigidly fixed at the bottom extremity thereof to a crank-pin **71** whilst the bottom extremity of the tubular shaft **3** which carries the feeler rollers is fitted with a crank-pin **72** having substantially the same length as that of the crank-pin **71**, the two crank-pins being substantially diametrically opposite in the central position of adjustment of the device. The stud **73** of the crank-pin **71** is engaged inside an elongated slot **74** which is formed in the free extremity of a lever **75** (see also FIGS. 9 and 10) which pivots at the other extremity thereof about a pin **76** which is made integral with the bottom of the box **1**. The stud **78** of the crank-pin **72** is housed in a similar manner inside as elongated slot **79** which is formed in the lever **75** at a distance from the pin **76** which is substantially equal to one half the distance between the elongated slot **74** and the said pin.

Accordingly, any angular displacement of the intermediate lever **75** corresponds to an angular displacement of the crank-pin **71** which is substantially equal to double the angular displacement of the crank-pin **72**. The same effort-multiplication ratio is thus found between the pivotal arm which carries the feeler rollers and the bracket which carries the tension cylinders as in the forms of embodiment which have been described in the foregoing. For constructional reasons, provision has been made in the lever **75** for an elongated slot **81**, the centre of which is located in the axis of the slot **74**, and which permits the pin **2** to travel across the said lever in all the angular positions of this latter.

In the form of embodiment which is illustrated in FIGS. 11 to 16, the device which supports the feeler rollers is the same as in the system of construction of FIGS. 1 to 5, but the system of adjustment of the thread tension, instead of being designed in the form of two tension cylinders, is designed in the form of two discs **91**, **92** which are applied elastically one against the other with a pressure which can be regulated.

Further reference will not be made to the method of assembly of the feeler rollers or to the manner in which these latter are urged against the thread as a result of the torque which is produced by the electromagnetic system.

The bottom thread-tensioning disc **91** is fitted freely on an internal shaft **93** which is mounted inside the tubular shaft **3** which carries the feeler rollers. A locking-pin **94** passes through the bottom extremity of the internal shaft **93**, the extremities of the said locking-pin being adapted to slide in two longitudinal slots **95**, **96** formed in a socket **97** provided with a cylindrical extended portion **98** which is force-fitted in a hole **99** formed in the base of the box **1**. The internal shaft **93** can therefore slide vertically but cannot rotate about its own axis.

The top extremity of the shaft **93** is threaded and is fitted with a knurled regulating knob **101** by means of which it is possible to compress to a greater or lesser extent a spring **102**, one end of which is applied against the bottom end of the said knob whilst the other end of the spring is applied against a washer **103** which bears on the upper face of the top disc **92** provided for the purpose of regulating the thread tension.

The end annular face of the bottom extremity of the tubular shaft **3** is cut in the shape of a cam **105** in such manner that, when the said shaft is caused to perform a pivotal motion about its own axis, the internal shaft **93** is thereby compelled to move downwards under the action of the pressure applied by the said cam against the locking-pin **94** which is made integral with the internal shaft.

The external tubular shaft **3** is retained axially by the ring **46** which bears against the inner face of the cover of the box **1**.

The thread **20**, the tension of which it is desired to regulate, is guided between the two feeler rollers and tightly held between the two discs **91**, **92**.

The operation of this device is similar to that of those forms of embodiment which have been described above and differs therefrom solely in the fact that the increase in tension of the thread, instead of taking place under the effect of an increase in the length of the arc over which the thread is wound onto the tension cylinders, is obtained as a result of an increase in the pressure applied by the two discs **91**, **92** under the action of the downward movement of the shaft **93** which produces a slightly greater compression of the spring **102** which applies the top disc against the bottom disc.

The said downward movement of the shaft corresponds to a pivotal movement of the system of feeler rollers in the direction of the arrow *f2* (as shown in FIG. 15), which in turn corresponds to a tendency towards initial reduction in thread tension. The said reduction in thread tension will accordingly be compensated by a corresponding increase which is in turn due to the increase in the clamping pressure of the two discs.

As the knurled knob **101** is screwed down further on the top portion of the apparatus, so the pressure of the spring is increased and the tension of the thread is consequently also increased under stable operating conditions.

FIG. 16 shows the relative position of the members in the case of a substantially maximum tension setting.

The devices such as have been described above in var-

ious forms are very well suited to the adjustment, as effected both simultaneously and from a distance, of the tension of the threads in all the sections of a textile machine such as, for example, a multiple-spindle machine, either as a function of time or in compliance with any desired law. It accordingly follows, for example, that in FIG. 17, there have been shown a certain number of devices **111** for regulating the thread tension which are fitted with a control electromagnetic system of the same type as that which has been described above, for example, all such systems being fed in parallel from an electric circuit comprising the following essential elements: a power line **112** supplying alternating current, a general switch **113**, fuse units **114**, a transformer **115**, a rectifier **116**, an initial-setting rheostat **117** and a rheostat **118** for the automatic adjustment of the thread tension in response to a system **121** which is connected to a unit **122**, the displacements of which are dependent on the diameter of each bobbin of thread which is undergoing formation. In this manner, the adjustment of thread tension is effected simultaneously on all the spindles as a function of the diameter of the bobbin which is undergoing formation.

It accordingly follows, for example, that, although two feeler rollers have been illustrated in the drawings, especially for reasons of symmetry and primarily of balancing, it would be sufficient to provide one roller only at the output end.

It will be understood that the rheostat **118** can be replaced by any other device by means of which the terminal voltage can be varied, the said device being inserted, for example, in the alternating current circuit before the rectifier **116**, and consisting of a transformer or multiple-tapping autotransformer, variable-core inductance and, generally speaking, any means which makes it possible to produce action on the current intensity simultaneously in all the apparatuses which are in service on one machine or on a part of one machine.

By way of example, the following numerical data can be given in the case of an apparatus which is constructed for a winding machine:

Speed of winding machine: 5500 r.p.m.
Mean diameter of receiving bobbin: 40 mm.
Speed of spindle: 460 r.p.m.
Average intake speed: 60 meters/min.
Reciprocating motion: 60 strokes per min.
Travel: 78 mm.
Cross-over: 1.25 turn per cm.
Average speed of delivery roll (Diam.=40 mm.): 460 r.p.m. variable.
Average speed of motor driving delivery roll: 1500 r.p.m. variable.
Distance covered by the thread between the delivery roll and the receiving bobbin (test zone): 700 mm.
Time of passage of the thread through the tensioning device (this latter being located in the mean opening position): 8/100 sec.
Diameter of the tension cylinders: 9 mm.
Angle of total displacement of the feeler rollers: 45°.
Angle of total displacement of the tension cylinders: 90°.
Supplemental length of thread gripped between arms in the closed position of the tension cylinders as compared with the open position of the tension cylinders: 40%.
Thread employed for test purposes: Cotton, Nm 28/2, twisted to 500 turns per metre.

When the tensioning device comprises a control system consisting of an input feeler member and an output feeler member, it is advantageous in the case of certain applications which can concern, for example, the use of reeling machines, winding machines, spoolers, etc., to make the elastic means which act upon the tensioning device dependent not upon a constant torque but on a decreasing torque. In other words, if the tension of the thread on the input feeler member were to decrease, thereby reducing its opposing action against the elastic actuating means which are applied to the said input feeler member and thus producing a preponderance of the said actuating means, the resulting effect of which is an angular displacement of the control system, the driving torque applied on the control system would finally decrease as a function of the said angular displacement.

There has been given in the foregoing description an explanation of the manner in which the said displacement produces action on the tension-regulating system so that the tension of the thread at the output end does not undergo any decrease in spite of the reduction in tension at the input end.

This variation in the value of the driving torque of the apparatus as a function of the amplitude of angular displacement of the tensioning device is determined in such manner that, in any position of the control system, the driving torque balances the sum of tensions both at the input and output end, whilst the output tension is maintained substantially constant.

Depending on the nature of the variations in the tension to be controlled and compensated, namely, frequency, amplitude, speed of the thread considered, or depending also on the characteristics of the threads employed, namely, the nature, size, elasticity, fragility, twist, etc., or finally according to whether the thread, the tension of which it is desired to control, is delivered freely or by means of a delivery roll, or through a false-twist spindle or at the output of a device fitted with fins or rings or of a single-twist or double-twist spindle, etc., the effectiveness of compensation and the stability of the tension of the thread at the output end of the apparatus are obtained either by making use of a constant driving torque or a decreasing driving torque.

Furthermore, it can be found that, on a same machine, an optimum tension-setting of the threads is obtained in certain cases by means of constant-torque tensioning devices, and in other cases by means of tensioning devices in which the torque decreases in time and also decreases according to the angular displacement of the control system. The apparatus in accordance with the invention is designed to carry out all these functions at will.

Moreover, the ratio of decrease in torque as a function of the position of the tensioning device can be remote-controlled by means of an adjustment unit or regulator which can be common to all the tensioning devices of a machine.

This adjustment can be either manual or automatic, and can, for example correspond to a pre-arranged programme in which the return to constant torque at any given moment can be both directed and obtained.

This range of possibilities is given to the apparatus by the operation of a variable shunt which branches the internal electric circuit of the constant-torque electromagnetic control in such manner that the current intensity can decrease in those coils in which the pole pieces repel each other while the intensity increases in those coils in which the pole pieces attract each other. The said shunt is represented in broken lines in FIG. 17.

A single rheostat **123** can, for example, carry out this function for the combined assembly of tensioning devices which are mounted on one machine.

On the tensioning device itself, a third lead terminal at **124** (as shown in FIG. 1) is alone sufficient to endow the apparatus with this possibility of instantaneous modification of the nature of the driving torque, namely either constant torque or decreasing torque.

On the basis of the above data, it will be understood that the adjustment of the tension of the threads on either one or a number of machines can comply with any law of constancy or of variation.

The association of a number of tensioning devices which act upon a same thread remains within the scope of the present invention, the same applying in the case

of all combinations of the forms of embodiment which have been described and which make provision, for example, for the remote control, either manually or automatically, of the tension-regulating devices, while these latter can comprise a unit which is separate from the electromagnetic control or the like, for the purpose of controlling the feeler system.

It will naturally be understood that the invention is not limited to those forms of embodiment which have been described and illustrated and which have been given solely by way of example, and that numerous modifications can be made therein without consequently departing either from the scope or the spirit of the invention.

What I claim is:

1. A thread tensioning device comprising supporting means; a feeler element mounted on said supporting means for turning movement and adapted to engage a thread; a thread tensioning element movably mounted on said supporting means and adapted to engage the thread for increasing or decreasing the tension of the same; transmission means connecting said feeler element with said thread tensioning element so that said thread tensioning element and said feeler element move opposite to each other for increasing or decreasing the tension of the thread; torque creating means including a stationarily mounted member and a turnable member, said members being mechanically unconnected for torque transmission, and electromagnetic means creating between said stationary and said turnable member an electromagnetic torque the force of which is independent of the position of said turnable member, said turnable member being connected to one of said elements for urging the same against the thread at a torque which is independent of the position of said elements, whereby both said elements exert a selected torque on the thread irrespective of the relative position of said elements and of the tension of the thread.

2. A thread tensioning device comprising supporting means; a feeler element mounted on said supporting means for turning movement and adapted to engage a thread; a thread tensioning element movably mounted on said supporting means and adapted to engaged the thread for increasing or decreasing the tension of the same; transmission means connecting said feeler element with said thread tensioning element so that said thread tensioning element and said feeler element move opposite to each other for increasing or decreasing the tension of the thread. said transmission means turning said thread tensioning element at a different speed than said feeler element; torque creating means including a stationarily mounted member and a turnable member, said members being mechanically unconnected for torque transmission, and electromagnetic means creating between said stationary and said turnable member an electromagnetic torque the force of which is independent of the position of said turnable member, said turnable member being connected to one of said elements for urging the same against the thread at a torque which is independent of the position of said elements, whereby both said elements exert a selected torque on the thread irrespective of the relative position of said elements and of the tension of the thread.

3. A thread tensioning device comprising a casing; a feeler; a support for said feeler turnably mounted on said casing for causing engagement of a thread by said feeler; torque creating means mounted in said casing and including a stationarily mounted member and a turnable member, said members being mechanically unconnected for torque transmission, and electromagnetic means creating between said stationary and said turnable member an electromagnetic torque the force of which is independent of the position of said turnable member, said turnable member being connected to said support for urging said feeler against the thread at a torque which is independent of the position of said elements, whereby

both said elements exert a selected torque on the thread irrespective of the relative position of said elements and of the tension of the thread; thread tensioning means engaging the thread and movably mounted on said casing to increase or decrease the tension of the thread; and transmission means operatively connecting said support with said thread tensioning means for increasing the tension of the thread as said feeler element is moved by said torque creating means against the action of the decreasing thread tension or is moved back by the thread when the thread tension increases to such extent as to overcome the constant torque of said torque creating means.

4. A thread tensioning device comprising a casing; a feeler; a support for said feeler turnably mounted on said casing for causing engagement of a thread by said feeler; torque creating means mounted in said casing and including a stationarily mounted member and a turnable member, said members being mechanically unconnected for torque transmission, and electromagnetic means creating between said stationary and said turnable member an electromagnetic torque the force of which is independent of the position of said turnable member, said turnable member being connected to said support for urging said feeler against the thread at a torque which is independent of the position of said elements, whereby both said elements exert a selected torque on the thread irrespective of the relative position of said elements and of the tension of the thread; thread tensioning means including a carrier mounted on said casing for turning movement about the turning axis of said support arm, and a pair of tension cylinders having parallel axes parallel to said turning axis, said tension cylinders engaging the thread to increase or decrease the tension of the thread; and transmission means operatively connecting said support with said thread tensioning means for increasing the tension of the thread as said feeler is moved by said torque creating means against the action of the thread tension when said thread tension decreases to such an extent as to be overcome by the constant torque of said torque creating means or to decrease the tension of the thread when the feeler is moved back by the thread when the thread tension increases to such extent as to overcome the constant torque of said torque creating means.

5. A thread tensioning device as set forth in claim 4 wherein said support includes an arm having said feeler on the end thereof, and a tubular shaft secured to said arm and mounted in said casing for turning movement, said tubular shaft being driven by said torque creating means; an inner shaft located in said tubular shaft and mounted for rotation in said casing, said inner shaft being secured to said carrier.

6. A thread tensioning device as set forth in claim 5 wherein said transmission means includes two crank arms secured to said tubular and inner shafts, respectively, pins carried by said crank arms, and an intermediate lever pivotally mounted in said casing and having two slots spaced different distances from the pivot axis of the intermediate lever and respectively receiving said pins whereby said thread tensioning means and said support and feeler move at different selected angular speeds.

7. A thread tensioning device comprising a casing; a feeler; a support for said feeler turnably mounted on said casing for causing engagement of a thread by said feeler; torque creating means mounted in said casing and including a stationarily mounted member and a turnable member, said members being mechanically unconnected for torque transmission, and electromagnetic means creating between said stationary and said turnable member an electromagnetic torque the force of which is independent of the position of said turnable member, said turnable member being connected to said support for urging said feeler against the thread at a torque which is independent of the position of said elements, whereby both said elements exert a selected torque on the thread

irrespective of the relative position of said elements and of the tension of the thread; thread tensioning means including a pair of discs located on opposite sides of the thread, spring means urging one of said discs toward the other, said one disc being mounted on said casing for movement toward and away from the other disc; and transmission means operatively connecting said support with said one disc for moving the same toward said other disc for increasing the tension of the thread as said feeler is moved by said torque creating means against the action of the thread tension when said thread tension decreases to such an extent as to be overcome by the constant torque of said torque creating means or to decrease the tension of the thread when the feeler is moved back by the thread when the thread tension increases to such extent as to overcome the constant torque of said torque creating means.

8. A thread tensioning device as set forth in claim 7 wherein said support includes an arm having said feeler at one end, and a tubular shaft secured to said arm and mounted in said casing for turning movement, said other disc being secured to said tubular shaft, an inner shaft located in said tubular shaft for axial and turning movement, means mounting said inner shaft on said casing non-rotatably and axially movable; wherein said spring means is a helical spring surrounding said inner shaft and abutting said one disc; a projection on said inner shaft on which said spring abuts; and wherein said transmission means includes cooperating camming means on said tubular shaft and on said inner shaft, respectively, for moving said inner shaft and said one

disc against the action of said helical spring when said tubular shaft is turned.

9. A thread tensioning device as set forth in claim 3 wherein said torque creating means includes a rotor having two diametrically arranged rotor pole pieces extending the same angular distance, and a stator having two stator pole pieces each of which extends the same angular distance as said pole pieces of said rotor, said stator pole pieces being angularly spaced an angle equal to 180° less the angular extent of any one pole piece, one of said rotor pole pieces cooperating with a stator pole piece of like polarity while the other rotor pole piece cooperates with a stator pole piece of opposite polarity.

References Cited by the Examiner

UNITED STATES PATENTS

1,459,332	6/1923	Hineline	242—154
2,326,714	8/1943	Whalton	242—154
2,554,493	5/1951	Heizer	242—150
2,685,417	8/1954	Bartelson	242—154 X
2,833,491	5/1958	Carroll	242—154

FOREIGN PATENTS

915,401	7/1946	France.
22,908	11/1900	Switzerland.

MERVIN STEIN, *Primary Examiner.*

RUSSELL C. MADER, *Examiner.*

S. N. GILREATH, *Assistant Examiner.*