April 30, 1957 J. M. MASSEY 2,790,611

YARN TENSION REGULATOR

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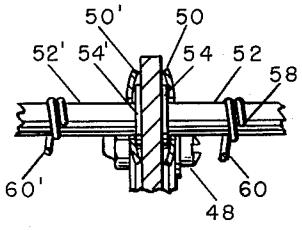

FIG.-4-

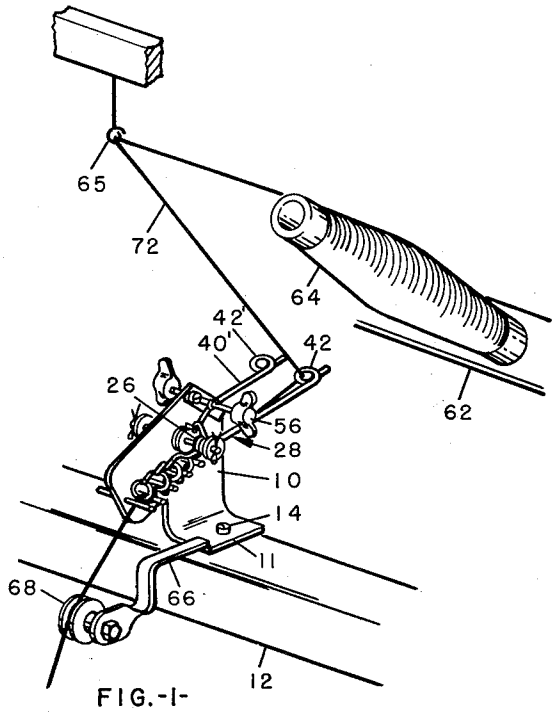

FIG.-1-

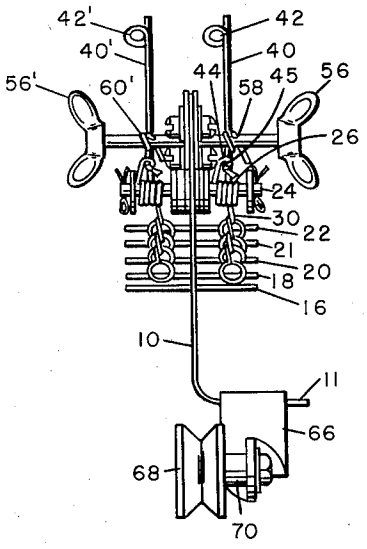

FIG.-3-

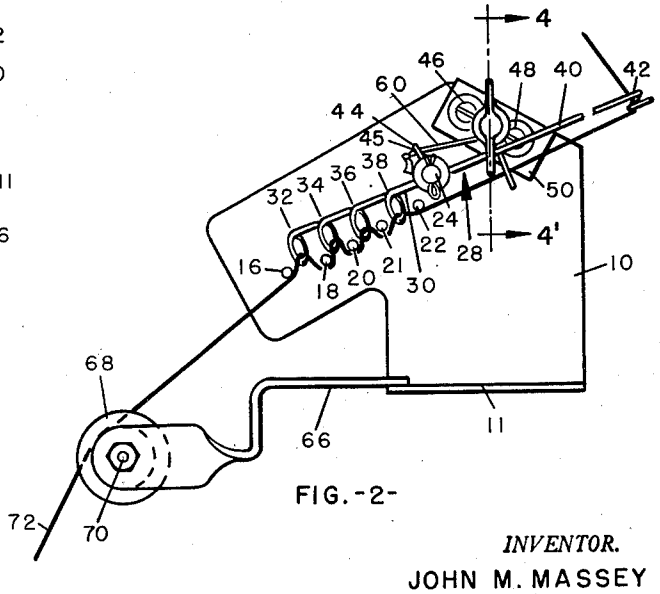

FIG.-2-

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YARN TENSION REGULATOR

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This invention relates to a device for regulating the tension in a lengthwise moving thread, strand of yarn or the like.

In many instances, it is necessary that a running length of thread, yarn or the like be uniformly tensioned for satisfactory processing. Many prior art devices are available for accomplishing this purpose but all suffer from one or more disadvantages including complexity, slow response due to inertia of moving parts, lack of provision for adjustment during operation and lack of sensitivity.

It is an object of this invention to provide a device, for uniformly tensioning a moving thread or the like, which is extremely simple and compact in construction.

It is another object of the invention to provide a yarn tension regulating device which can readily be adjusted to vary the tension imparted to a moving length of thread or yarn during such time as the device is in actual operation.

It is a further object of the invention to provide a yarn tension regulating device with an extremely rapid response and employing parts substantially devoid of operative inertia.

It is a still further object of the invention to provide a yarn tension regulating device with a greatly increased sensitivity as compared to that of prior art apparatus.

The above as well as other objects of the invention are accomplished by a device comprising a support plate carrying at least one row of yarn engaging members and an elongated arm pivotally movable about an axis intermediate the two ends thereof. On one end of the arm there are positioned a number of yarn engaging elements adapted to extend between and intermesh with the yarn engaging elements carried by the support plate when the arm is pivoted, and on the opposite end of the arm there is positioned a yarn engaging eye preferably of the common pig-tail variety. The arm is biased by a resiliently extensible member for movement about its pivot axis in a direction to result in separation of the yarn engaging elements carried by the arm and the yarn engaging elements carried by the support plate, and the resiliently extensible member has a flexible end portion which is adapted to be wrapped around a rotatable member carried by the support plate so that the force urging pivotable movement of the arm can readily be varied by rotation of the rotatable member. When a yarn end from a supply package is threaded at an angle through the eye on the pivotally mounted arm and thereafter alternately between the yarn engaging members carried by the arm and the yarn engaging members carried by the support plate, the output tension normally remains substantially constant but can be readily varied during actual operation by rotation of the rotatable member.

A preferred embodiment of the invention will now be described in greater detail with reference to the accompanying drawings in which:

Figure 1 is a view in perspective of a pair of yarn tension regulators utilizing a single support plate and illustrating a typical arrangement for supplying yarn to one of the regulators.

Figure 2 is a side elevational view of the device of Figure 1.

Figure 3 is an elevational view at right angles to that of Figure 2 and

Figure 4 is a cross sectional view of a portion of the regulator device taken substantially along the line 4—4' in Figure 2.

With reference to the drawings in greater detail, the reference numeral **10** indicates a support plate having a base section **11** which may be mounted on and secured to a frame member **12** by any suitable means such as by bolt **14**. The support plate **10** carries a row of rigid yarn engaging members **16, 18, 20, 21** and **22** which, in this instance, are illustrated as extending completely through the support plate **10** so as to furnish components of a yarn regulating mechanism to be carried on either side of the support plate. The pin members **16, 18, 20, 21** and **22** may be secured in position by any suitable means such as, for example, by being press-fitted into suitable orifices extending through the support plate **10**.

Carried by support plate **10**, to one end and slightly above the row of yarn engaging members, is a cylindrical member **24** extending through the support plate **10** to provide a stub shaft on either side of the plate. As will readily be seen by reference to Figure 3 of the drawings, the pin members **16, 18, 20, 21** and **22** and the shaft **24** serve as common elements of substantially identical tension regulator devices to be mounted on opposite sides of the support plate **10**. Inasmuch as parts not common to both regulators are substantially identical, corresponding parts will be correspondingly numbered with prime reference numerals being employed to designate parts of the tension regulator carried by the left-hand side of the plate **10** as viewed in Figure 3 of the drawings.

Journaled about the shaft **24** is a rotatable collar **26**, in this instance illustrated as comprising several turns in a length of wire, and extending in either direction from the collar **26**, so that it can be pivoted about a point intermediate the two ends thereof, is an arm generally indicated by the reference numeral **28**. The arm **28** has a first section **30**, formed of steel wire or the like, which extends generally toward the row of pin members **16** to **22** and which is shaped to result in a number of arcuate protrusions or loops **32, 34, 36** and **38**. The loops **32** to **38** inclusive serve as a second series of yarn engaging members and are so positioned along the length of arm **28** as to extend between and intermesh with pin members **16** to **22** inclusive when collar **26** is pivoted in a counter-clockwise direction as viewed in Figure 2 of the drawings. A second section **40** of the arm **28**, extending from collar **26** in a direction generally opposed to that of section **30**, is also formed of steel wire or the like and carries a yarn engaging eye **42**, preferably of the pig-tail variety, at its outer end.

In addition to the arm **28**, the collar **26** carries a short arm **44** extending at an angle to the longitudinal axis of the longer arm. The arm **44** is provided with a small eye **45** the purpose of which will be made clear in subsequent paragraphs.

Positioned on the upper edge of support plate **10** and secured in position by any suitable means, such as by bolts **46** and **48**, is a flexible plate indicated by the reference numeral **50**. Resting with its inner end against plate **10** and extending through a suitable orifice in plate **50** is a rotatable cylindrical member **52** having a flange **54** which bears against the inner surface of plate **50**. The outer end of member **52** is illustrated as carrying a wing nut **56** and the tension of plate **50** against flange **54** is such that member **52** can easily be rotated by means of

wing nut 56. The member 52 is also provided with a transverse bore 58 adapted to receive one end of a resiliently extensible member 60 having flexible end portions and in this instance illustrated as comprising a portion of a common rubber band. The rubber band 60 extends from the eye 45 of arm 44 to the bore 58 with one end being knotted to prevent it from passing through the eye 45 when placed under tension and the opposite end being secured in position by several turns around the cylindrical member 52.

It will be noticed that the arm 44 is so positioned that it is at a right angle to the longitudinal axis of extensible member 60 when the yarn engaging elements carried by the arm 28 are separated from the yarn engaging elements carried by plate 10, and that when the yarn engaging elements are in full intermeshing relationship, this angle is considerably less than 90°. This results in the force urging rotation of arm 28 acting through an effective lever arm of decreasing length as the yarn engaging elements approach full intermeshing relationship. By proper positioning of the arm 44, the rotational force acting on arm 28 by virtue of extensible member 60 can be made to remain relatively constant over the arc that the arm will normally traverse during operation or can even be made to decrease as the arm approaches full intermeshing relationship. Such an arrangement is generally desirable and results in more efficient operation of the tension regulator device.

Positioned above the yarn tension control device and carried by a suitable support member 62 is a supply of yarn, thread or the like indicated by the reference numeral 64. A pig-tail guide 65 is positioned axially of the supply 64 for withdrawing the yarn in the usual manner.

A support arm 66 is carried by the base 11 of plate 10 and acts as a support for a roller 68 which is positioned substantially in line with the row of pins 16 to 22 inclusive. The roller 68 is journaled about a stub shaft 70 and is preferably carried by an anti-friction bearing so as to be as freely rotatable as possible.

In operation, a yarn end 72 from supply 64 is threaded through the eye of pig-tail guide 65 and thereafter through the eye 42 of arm 28. Arm 28 is pivoted until loops 32 to 38 inclusive are in full intermeshing relationship with pins 16 to 20 inclusive and the yarn end is then threaded through the loops so that when the arm 28 is released, it is rotated in a counter-clockwise direction as viewed in Figure 2 of the drawings by rubber band 60 acting through arm 44. The yarn end 72 is thereby forced to follow a tortuous path as it passes alternately between the yarn engaging members carried by the arm 28 and the yarn engaging elements carried by plate 10. The yarn end is then passed over roller 68 and ultimately to a take-up means.

As the yarn is withdrawn from supply 64, variations in tension will be introduced, as will be well understood by those skilled in the art, so that the input tension in the yarn as it enters eye 42 will fluctuate, frequently in a very rapid manner. When the tension in yarn end 72 increases or decreases at the point of its passage through eye 42, there is a corresponding change in the force exerted on arm 28 by the yarn. If the input tension of the yarn increases, this results in a counter-clockwise rotation of the arm 28 against the bias of rubber band 60, thereby decreasing the area of contact of the yarn with the yarn engaging members 34 to 40 inclusive and 16 to 22 inclusive so that the output tension in the yarn end remains relatively constant, and if the input tension decreases, the arm 28 is rotated in a clockwise direction by the rubber band 60 thereby increasing the area of contact so that again the output tension remains substantially constant.

To increase or decrease the tension in the yarn end as it departs the tension regulator, one need only rotate wing nut 56 to thereby increase or decrease the tension in the resiliently extensible member 60 and thereby vary the force acting upon arm 28. As will be seen by reference to the drawings, the wing nut 56 is well out of the thread path and readily accessible while the device is in operation so that tension in the yarn can conveniently be changed at any time.

It will also be noticed that the collar 26 and the structures supported thereby are the only parts of the tension regulator proper that are in motion during normal operation and since these can be and preferably are formed of light weight wire or the like, the operative inertia is exceedingly low. This permits adequate control even when there are rapid variations in the input tension. Without increasing the operative inertia appreciably, section 40 of arm 28 can be made several times as long, if desired, as section 30 thereby increasing the sensitivity of the device to eliminate even the smallest variations in input tension.

Having thus described my invention what I desire to claim and secure by Letters Patent is:

1. In a yarn tensioning device, a support plate, a plurality of rigid pin members carried by said plate and extending from one surface thereof, an elongated arm carried by said plate and pivotally movable about an axis intermediate the two ends thereof, said arm carrying a yarn engaging eye on one end thereof and a plurality of yarn engaging elements on the opposite end adapted to extend between said pin members and intermesh therewith, a rotatable member extending from said plate, and a resiliently extensible member acting upon said arm to urge said arm to pivot so as to remove said yarn engaging elements from intermeshing relationship with said pin members, said extensible member having a readily flexible end portion secured to said rotatable member, whereby the force acting to pivot said arm can be varied by rotational movement of said rotatable member.

2. Apparatus according to claim 1 wherein said resiliently extensible member is a two-ended flexible elastic strand having one terminal end operatively connected to said rotatable member and the other terminal end operatively connected to said arm.

3. In a yarn tensioning device, a support plate, a row of rigid pin members extending from one surface of said plate, a stub shaft extending from said plate, a rotatable collar journaled about said stub shaft, a first arm extending from said collar and carrying a plurality of yarn engaging elements adapted to extend between and intermesh with said pin members, a second arm extending from said collar in a direction generally opposed to said first arm, said second arm carrying a yarn engaging eye adapted to receive a yarn end prior to its being passed alternately between said pin members and said yarn engaging elements, a third arm extending from said collar and adapted to retain one discontinuous terminal end of a two-ended flexible elastic strand, a rotatable member extending from said plate and adapted to receive the opposite discontinuous terminal end of said elastic strand, whereby when an elastic strand is extended between said last named arm and said rotatable member, the elastic strand can be variably tensioned by rotation of said rotatable member.

4. A device for tensioning a lengthwise moving thread comprising a support plate, a row of rigid pin members extending from one surface of said plate, a stub shaft extending from said plate, a rotatable collar journaled about said stub shaft, a wire member carried by said collar and having a plurality of arcuate protrusions adapted to extend between said pin members in intermeshing relationship therewith, a second wire member carried by said collar and extending in a direction generally opposed to said first wire, said second wire member carrying on its outer end a yarn engaging eye adapted to receive a yarn end prior to its being passed alternately between said pin members and said arcuate protrusions, a third arm extending from said collar, a rotatable member extending from said plate, a two-ended flexible elastic strand extending between and having its two discontinuous termi-

nal ends operatively connected to said rotatable member and said last named arm to urge rotation of said collar in a direction to separate said arcuate protrusions from said pin members, said elastic strand having a readily flexible discontinuous terminal end operatively connected to and adapted to be wrapped around said rotatable member upon rotation thereof, whereby the force with which said collar is urged to rotate can be varied by rotation of said rotatable member.

5. Apparatus according to claim 4 wherein the longitudinal axis of said last named arm is at a right angle to the longitudinal axis of said elastic strand when said arcuate protrusions are removed from intermeshing relationship with said pin members, whereby the force urging separation of said arcuate protrusions from said pin members decreases as said arcuate protrusions approach full intermeshing relationship with said pin members.

6. A device for tensioning a lengthwise moving thread comprising a support plate, an elongated arm carried by said support plate and pivotally movable about an axis intermediate the two ends thereof, a row of rigid yarn engaging members carried by said support plate, a plurality of yarn engaging members carried by one end of said arm and adapted to intermesh with the yarn engaging members carried by said plate, whereby when a yarn end is threaded alternately between said members carried by said plate and said members carried by said arm the area of contact between said yarn end and the yarn engaging members can be varied by pivotal movement of said arm, a yarn engaging eye carried by said arm on the end opposite said yarn engaging members, whereby when a yarn end, prior to being passed between said yarn engaging elements, is passed into said eye from an angle to the longitudinal axis of said arm, any variation in tension in said yarn as it passes through said eye urges movement of said arm to change the area of contact between said yarn and said yarn engaging members to thereby result in a compensating change in yarn tension, a flexible friction plate having an aperture therein and being secured to said support plate, a pin having a flange at one end, said pin being rotatably mounted in extended position through said aperture and having its end flange frictionally held between said support plate and said friction plate, and a resiliently extensible member acting upon said arm to urge said arm to pivot so as to remove said yarn engaging elements from intermeshing relationship with said plate carried yarn engaging members, said extensible member having a readily flexible end portion secured to said rotatable pin, whereby the force acting to pivot said arm can be varied by rotational movement of said rotatable pin.

7. A device for independently tensioning two individual threads, comprising a support plate, two elongated arms carried by and on opposite sides of said plate and being each separately pivotally movable about a common axis intermediate the two ends thereof, a row of rigid yarn engaging members carried by said plate and extending therethrough to form a row of yarn engaging members on opposite sides of said plate, a plurality of yarn engaging members carried by one end of each of said arms and adapted to intermesh with the respective yarn engaging members carried by said plate on its respective side, a yarn engaging eye carried by each of said arms on the end opposite said yarn engaging members, two flexible friction plates, one of said friction plates being secured on each opposite side of said support plate and having an aperture formed therein, said apertures being in substantial alignment, a pair of pins each having a flange at one end, said pins being rotatably mounted in oppositely extending positions each through a respective one of said apertures and each having its end flange frictionally held between said support plate and its respective associated said friction plate, and a separate resilient extensible member acting upon each of said arms to urge said arms to pivot so as to remove said yarn engaging elements from intermeshing relationship with said plate carried yarn-engaging members, said extensible members each having a readily flexible terminal end portion operatively connected to a respective one of said rotatable pins.

8. In combination, a yarn supply means and a yarn tension device, said tension device including a plurality of stationary yarn engaging elements, a plurality of movable yarn engaging elements movable into intermeshing relation with said plurality of stationary elements, a pivotally movable arm having an integral extension on each side of its pivot point, means pivotally supporting said arm at its pivot point, a yarn guide formed on one said extension of said arm, said movable yarn engaging elements being formed on the other said extension, means resiliently biasing said arm toward yarn-engaging-element intermesh position, said one extension and yarn guide being arranged and disposed between said pivot point and said yarn supply means, and stationary guide means disposed between said yarn supply means and said yarn guide on said arm, whereby said one extension and yarn guide thereon serve as a yarn tension presensing and compensation actuation device for sensing the yarn tension prior to passing between said intermeshing elements and actuating said movable elements to compensate for tension variations occurring between said elements and said yarn supply means, and whereby the tension in yarn after it leaves said yarn engaging elements will be substantially constant without post sensing and feedback control.

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