Feb. 24, 1953 E. J. HEIZER 2,629,561

YARN TENSIONING DEVICE

Filed Dec. 30, 1949 2 SHEETS—SHEET 1

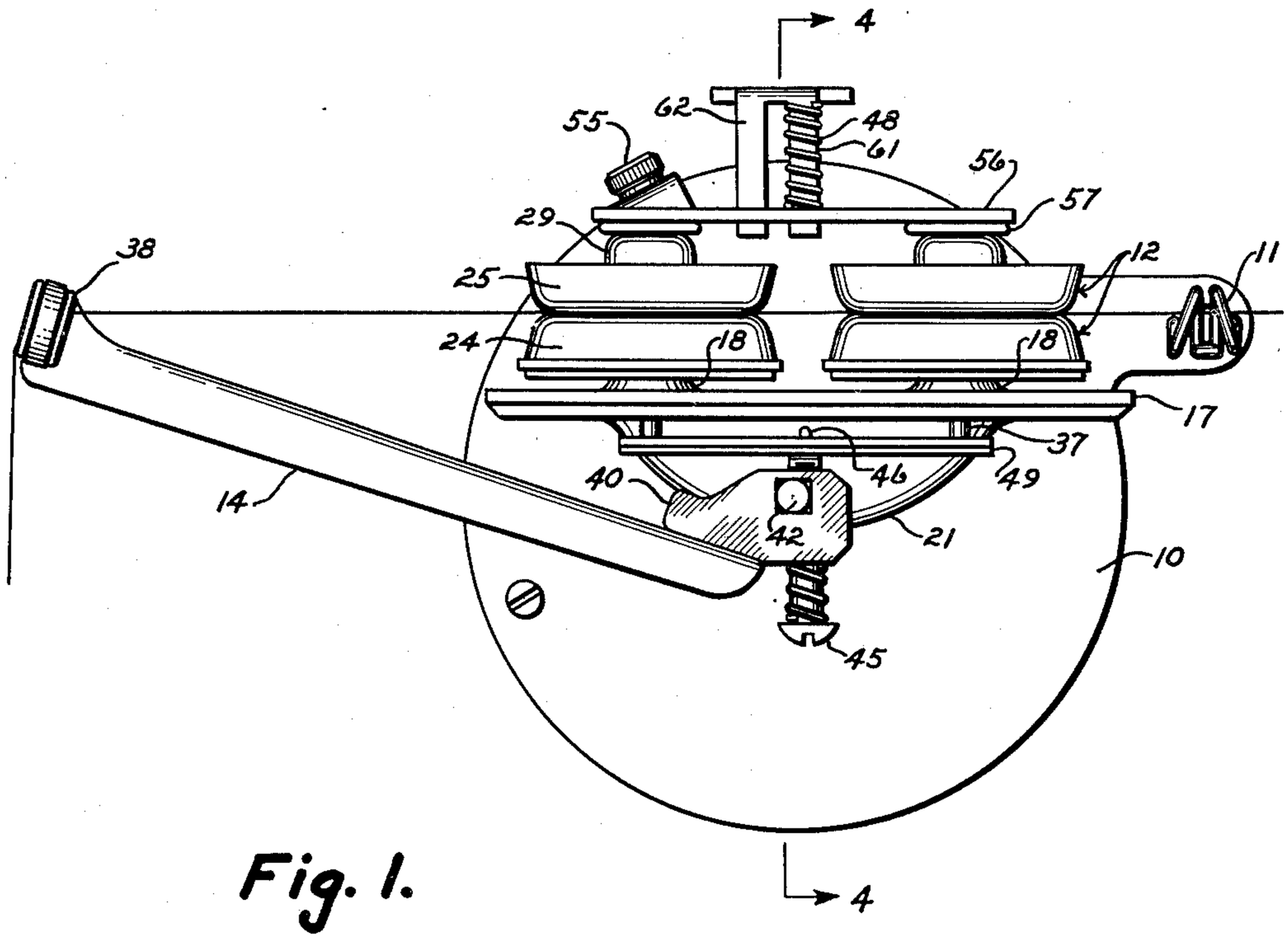

Fig. 1.

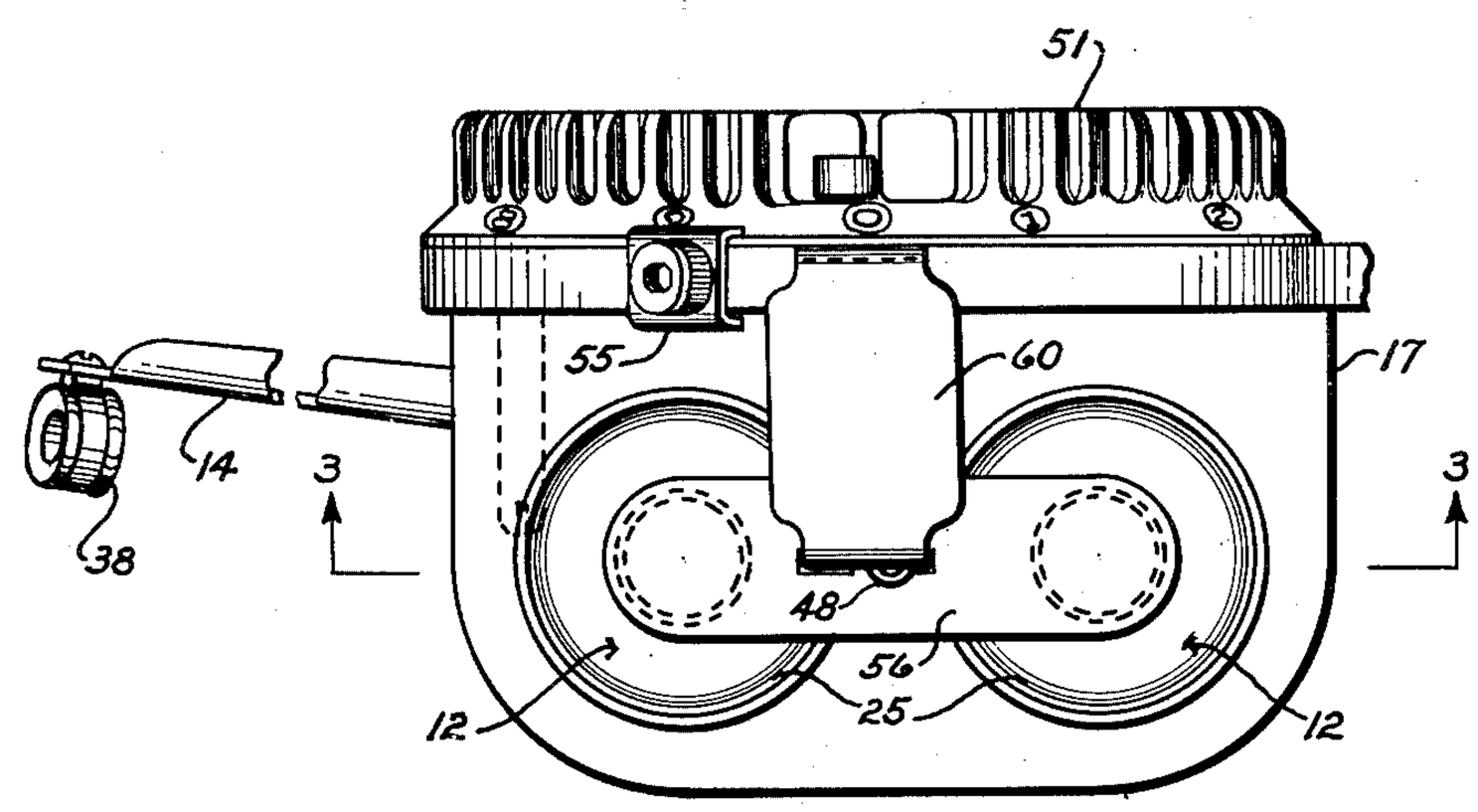

Fig. 2.

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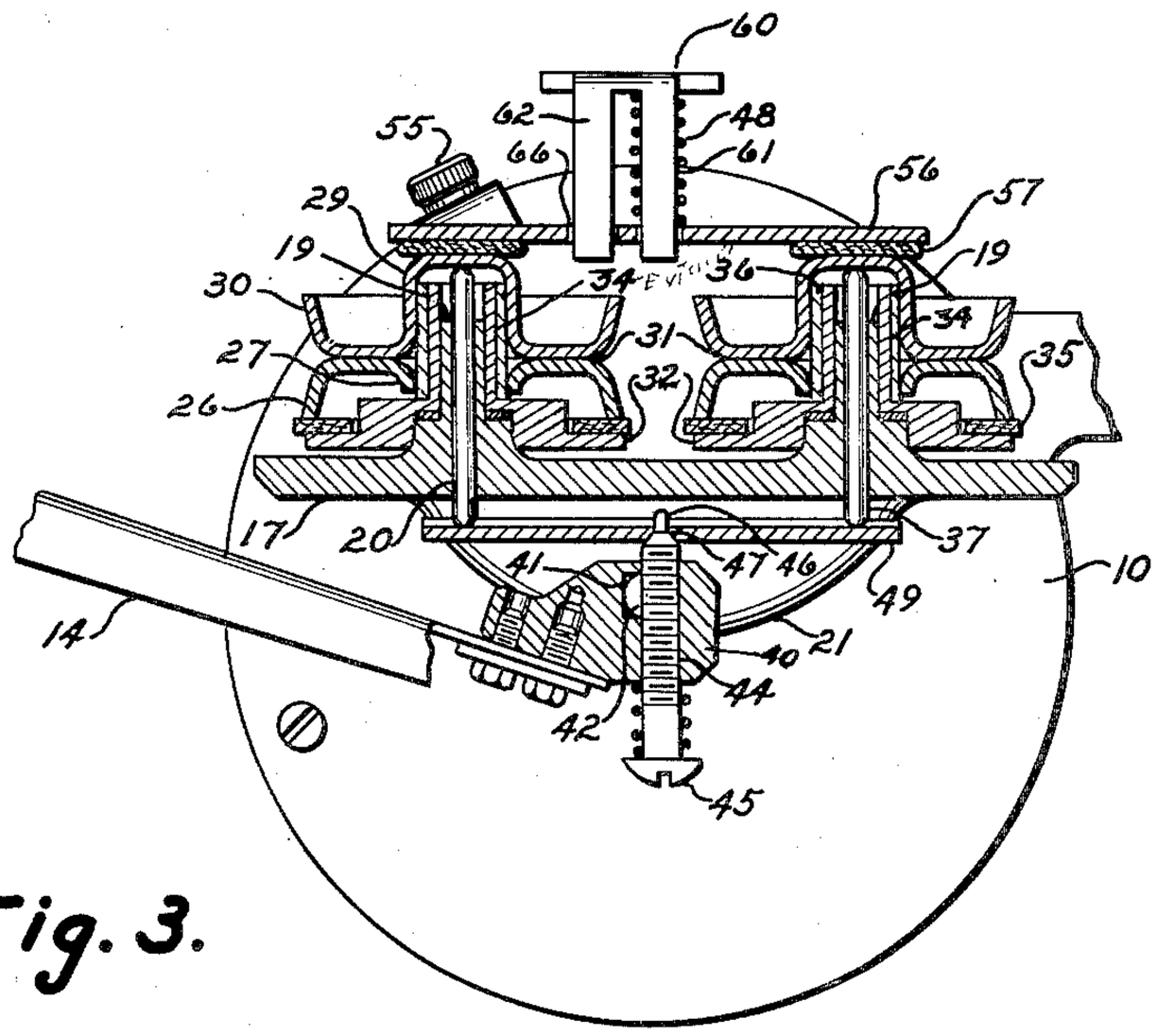

Fig. 3.

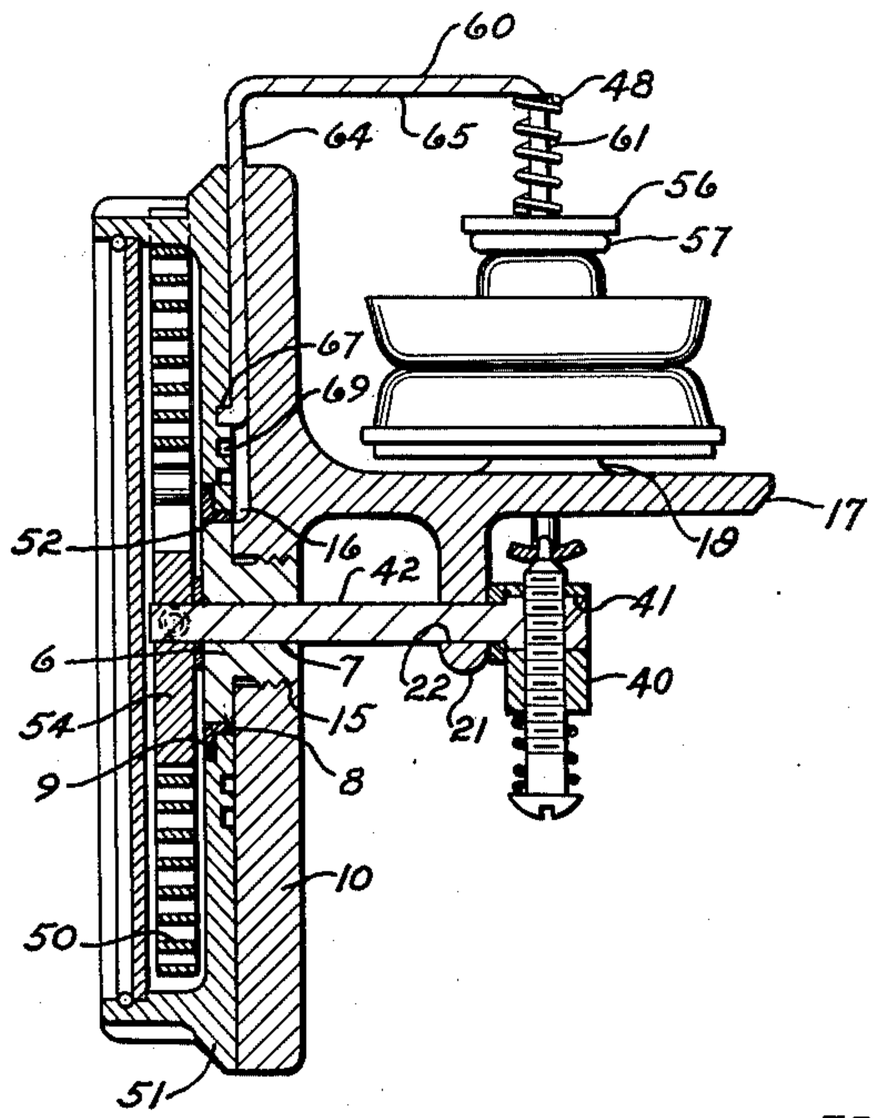

Fig. 4.

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Patented Feb. 24, 1953

2,629,561

UNITED STATES PATENT OFFICE

2,629,561

YARN TENSIONING DEVICE

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Application December 30, 1949, Serial No. 135,910

16 Claims. (Cl. 242—45)

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The present invention relates to yarn tensioning devices particularly adapted for use in conjunction with machines for winding yarn on a package, tube, cone or bobbin, and is more particularly concerned with a yarn tension compensating device which is an improvement over the device shown in my copending application for United States Letters Patent, Serial No. 770,021, filed August 22, 1947, now Patent No. 2,554,493, issued May 29, 1951.

One of the difficulties heretofore encountered with devices of the foregoing character when handling yarn at high speeds, was that the output tension in the yarn could not be controlled as accurately as desired. For example, a yarn tensioning device adjusted to put into the yarn an average output tension of about 100 grams was tolerated even though in some cases the tension varied between about 85 and about 115 grams. Such high amplitude of tension variation, particularly when occurring frequently, is detrimental to the winding of high quality packages and the like and induces overstressed yarn.

Accordingly, an object of the present invention is to provide a device for tensioning yarn which eliminates tension surges and reduces the amplitude of variation in tension to a minimum.

Another object is to provide such a device wherein breakage due to knots in the yarn is eliminated.

Another object is to provide such a device which facilitates winding yarn at a predetermined substantially constant maximum tension regardless of the speed, back drag or friction of the yarn.

A further object is to provide a device of the foregoing character which is adapted for handling yarn at extremely high speed.

A still further object is to provide a relatively simple and inexpensive device which is easy to thread and pre-set for a desired tension, is fast in compensation, is durable in construction and has a low maintenance cost.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

In accordance with the invention, the foregoing objects are generally accomplished by providing a device comprising a pair of members, such as friction discs, for receiving the yarn therebetween; means, such as a spring, for causing one of the members to be urged towards the other member; a control arm operable by the yarn passing between the members; means, such as a spring, for resisting operation of the control arm; and means operated by the control arm for causing one of the members to move away from the other member. The springs may be adjustable independently, but preferably are simultaneously adjustable to proportionately vary the effectiveness thereof; and the discs preferably are adjustable independently of the springs to normally position the same for accommodating yarns of different diameters.

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The present invention further contemplates providing such a device wherein a plurality of sets or pairs of discs are utilized which are loaded by a common spring or other force applying means and are under the control of a single yarn tension responsive arm.

A preferred embodiment of the invention has been chosen for purposes of illustration and description, and is shown in the accompanying drawings, forming a part of the specification, wherein:

Figure 1 is a front elevational view of a yarn tensioning device in accordance with the present invention.

Figure 2 is a plan view of the device shown in Figure 1.

Figure 3 is a sectional view taken substantially along the line 3—3 on Figure 2.

Figure 4 is a sectional view taken substantially along the line 4—4 on Figure 1.

Referring to the drawings in detail, there is shown a yarn tension compensating device generally comprising a body member 10, a guide 11 and two pairs of friction discs 12 through which the yarn passes, as shown in Figure 1, and a control arm 14 responsive to yarn tension for effecting separation of the discs to vary the tension applied to the yarn by the discs in the manner described hereinafter.

The base member 10, as shown, is a generally circular plate formed with a threaded central aperture 15 and with a radial slot or recess 16 on its rear face which extends upwardly from the aperture (Figure 4). A bushing member 6 is threaded into the aperture 15, comprising a central aperture 7 and a flange 8, of larger diameter than the aperture 15, which is positioned outwardly of the rear face of the plate and has secured thereon an outwardly extending flanged ring 9, the purpose of which will become apparent hereinafter.

A bracket or shelf 17 is formed integral with

or is secured to the base member 10 on the front face thereof, and is provided with a pair of bosses 18 on its upper side. Each boss is formed with an upright sleeve 19 having a vertical aperture 20 extending therethrough. The shelf further is provided with a depending flange or lug 21 at the underside formed with a horizontal aperture 22 in alignment with the bushing aperture 7.

Each pair of discs 12, as shown in Figures 1 and 3, comprises a lower disc 24 and an upper disc 25 supported on its lower disc. The lower disc has an outer peripheral depending flange 26 and has an inner depending flange 27 which is somewhat shorter than the flange 26 and defines a central aperture. The upper disc has an upwardly extending, downwardly facing cup-shaped portion 29 provided with an inner diameter about equal to the diameter of the aperture of the lower disc, and has an outer upwardly extending flange 30. The upper and lower discs each have an annular surface 31 between which the yarn passes for applying tension thereto.

The discs are mounted on the bracket 17, which serves as a base therefor, by suitable means, preferably, comprising a disc 32 having a central recess for receiving the boss 18 and a sleeve portion 34 telescoped over the sleeve 19, cushion means such as a felt washer 35 or the like supported on the disc 32 on which the outer flange 26 of the lower disc 24 is seated, and a collar 36 telescoped over the sleeve portion 34 and extending through the central aperture of the lower disc and into the cup-shaped portion 29 of the upper disc to provide a central bearing about which the upper and lower discs may rotate freely and move upwardly and downwardly.

Each of the upper discs 25 is adapted to be moved upwardly and away from its lower disc to relieve the tension applied to the yarn by a pin 37 extending through one of the apertures 20 and engaging the underside of the upper end of the cup-shaped portion 29. Simultaneous movement of the pins 37 is adapted to be effected by the control arm 14 in response to tension in the yarn as it passes through the guide 38 at the free end of the control arm, as about to be described.

The control arm 14 is secured to a block 40 having a horizontal aperture 41 through which one end of a shaft 42 extends. This shaft extends through the aperture 7 of the bushing member 6 and through the aperture 22 and is rotatably supported therein. The block also has a vertical threaded aperture 44 partially intersecting the aperture 41 and eccentrically disposed thereof through which a screw 45 extends.

Preferably, the screw 45 (by reason of the eccentric location of the aperture 44) is offset a predetermined distance from the center of the shaft 41 in relation to the effective length of the arm 14 (which is the distance from the center of the shaft 41 to the outer end of the yarn guide 38 at the free end of the arm), so that the arm provides a mechanical advantage for the screw as will become apparent hereinafter. For example, the arm and screw may be arranged to provide a fifty-to-one leverage for the latter.

The upper end of the screw 45 has a projection or pin portion 46 thereon extending into an aperture 47 centrally formed in a transversely upwardly concave bar 49 for supporting the lower ends of the pins 37. In this manner downward movement of the arm 14 about its pivot shaft 42 effects raising of the bar 49, the pins 37 and the upper discs 25.

In the foregoing described construction, the

screw 45 serves to key the block 40 on its shaft and to adjust the position of the upper discs 25 with respect to the lower discs for accommodating yarns of different diameters.

The upper discs 25 are adapted to be urged against the lower discs 24 by suitable means and movement of the control arm in a direction to raise the discs 25 is adapted to be resisted by suitable means. These functions may be advantageously accomplished by a compression spring 48 and a spiral spring 50, respectively, which may be simultaneously adjusted, as about to be described.

The spring 50 is adapted to be housed in a generally circular casing member 51 which has a central bearing aperture 52 for rotatably mounting the same on the hub 8 of the bushing 6 and which is held against the rear face of the body member 10 by the flange 9 of the bushing. The outer end of the spring 50 is connected to the casing member in any suitable manner, for example, by anchoring the free end thereof in a slit formed in the outer wall of the casing member. The inner end of the spring 50, as shown, may be connected to a disc 54 secured to the shaft 42 for rotation therewith (Figure 4), whereby rotation of the casing member relative to the body member varies the loading of the spring 50. The casing member is adapted to be held in positions of adjustment by a set-screw operated clamp 55 mounted on the body member (Figures 2 and 3) which also serves as an index for indicia on the casing member adapted to visually indicate the magnitude of the loading of the spring.

The spring 48 urges the upper discs 25 against the lower discs 24 by means of a pressure bar 56 having a pair of felt pads 57 or the like seated on the top of the cup-shaped portion of the upper discs. In order to mount the spring 48 to facilitate varying the force thereof and to support the bar 56 in operative position, a bracket member 60 is provided which comprises a pair of spaced apart depending arms 61 and 62, a depending arm 64 slidably mounted in the slot 16, and a horizontal portion 65 connecting the arms 61 and 62 with the arm 64. The arms 61 and 62 extend through openings 66 formed in the pressure bar 56 whereby the bar is retained in alignment with upper discs 25 and is adapted to be raised and lowered while so held. The spring 48 is telescoped over the arm 61 (Figures 3 and 4), and its upper end engages the bracket portion 65 and its lower end engages the pressure bar to urge the same downwardly. The arm 61 and the opening 66 through which it extends, preferably, are at the midpoint between the upper discs 25 and are in alignment with the screw 45, whereby the spring 48 urges both of the discs 25 downwardly with substantially equal pressure and the pin 46 applies a force to the bar 49 for equally opposing the spring 48 through both of the pins 37.

The force exerted by the spring 48 on the bar 56 may be adjusted simultaneously with the adjustment of the spring 50, as previously indicated, by raising or lowering the arms 61 and 62 with respect to the bar 56. This, preferably, is accomplished by providing the lower end of the arm 64 with a projection 67 which extends into a spiral groove 69 (Figure 4) formed in the face of the casing member 51 abutting the rear face of the body member 10, whereby rotation of the casing member will effect raising or lowering of the bracket member 60 and consequent loading of the spring 48 in definite relation to the loading of the spring 50.

In operation, the yarn to be tensioned by the device is threaded through the guide 11, the pairs of discs 12 and the guide 38 at the free end of the arm 14, and is passed downwardly, as viewed, to a winding machine or the like. The screw 45 is adjusted to enable the yarn to pass between the discs 24 and 25 with the latter frictionally engaging the yarn to tension the same. The casing member 51 is then positioned to adjust the springs 48 and 50 to respectively provide a force acting downwardly on the upper discs 25 and a torque acting in a direction to resist downward movement of the free end of the arm 14.

By reason of the manner in which the elements of the device are constructed and arranged, this force and torque are in a definite relation to each other at any setting of the casing member 51. In this manner, an output tension in the yarn moving downwardly from the free end of the arm, which exceeds the desired output tension, causes the arm to raise the discs 25 and thereby lessen the tension they put into the yarn to compensate for the excessive tension, so that the output tension in the yarn is quickly restored to its predetermined value.

In utilizing the device in accordance with the invention, it has been found, that when the yarn is passed through the guide 38 and is led downwardly, the tension in the yarn due to friction increases approximately 50%. Thus, if the output tension of the yarn is to be about 100 grams, the tension of the yarn after leaving the discs and before passing through the guide 38 should be about 66.7 grams, whereby a 50% increase in tension in passing through the guide 38 will provide an output tension of about 100 grams. It also has been found that a desired tension can be put into the yarn by applying a force to urge the discs together which is 50% greater than the desired tension. For example, about 66.7 grams tension are put into the yarn by causing the spring 48 to exert a net force of 100 grams acting to urge the discs together.

Assuming that the input tension of the yarn before passing through the discs is zero or negligible, the discs are urged together to put the desired 66.7 grams tension in the yarn by adjusting the spring 48 to apply a force of about 150 grams and adjusting the spring 50 to apply a torque force of about 99 grams at the end of the control arm 14, whereby the yarn leaving the guide 38 exerts a one gram downward force on the arm. This force acting on the control arm, due to the fifty-to-one mechanical advantage about the pivot of the control arm, causes the screw 45 to apply a 50 gram force in opposition to the 150 gram force of the spring 48, whereby the spring applies a net force of about 100 grams to the discs.

In the event tension is applied to the yarn while being delivered to the device with the device adjusted as described, such input tension immediately affects the output tension of the yarn to slightly increase the same, whereby a slightly greater force is applied to the end of the control arm by the yarn and the control arm acts to further decrease the net force applied by the spring 48 to urge the discs together.

For example, it has been found that an input tension of about 10 grams causes the control arm to respond in a manner to apply a force of about 65 grams opposing the spring 48, thereby reducing the net force of the spring acting on the discs to about 85 grams. The discs then put less

tension in the yarn than when the input tension is zero to compensate for the increase in input tension, whereby the output tension does not increase appreciably. Under the foregoing conditions the output tension has been found to increase about 0.5 gram. This variation from the preset output tension is so slight that the yarn is not subjected to sudden strains or tension surges and is taken up by the winder under a substantially uniform tension.

One of the advantages of evenly distributing the tensioning force on the yarn between two or more sets of discs is that a knot in the yarn can pass between each set of discs without offering as much resistance as in passing through a single set of discs urged together by the entire tensioning force. For example, when two sets of discs are under a spring pressure of about 150 grams, of which 50 grams are relieved by the control arm while acting normally as previously described, thus leaving a net pressure of about 100 grams, each set of discs is individually subjected to a pressure of about 50 grams. A knot or the like which is thicker than the yarn in passing through a set of discs tilts the upper disc against the full spring force effective thereon, but due to the construction of the disc and the arrangement of the bar 56, a four-to-one mechanical advantage is achieved, whereby the knot need only overcome a force of about 12.5 grams, which is partially compensated by the control arm. In this manner, the discs act as safety valves to allow knots or the like to pass therebetween without high increases in tension which might cause breakage of the yarn. Tests have indicated that knots cause an increase in output tension which does not exceed 10%. The yarn can safely withstand such occasional increases in tension without breakage or impairment thereof.

The device in accordance with the invention has been found capable of tensioning yarn composed of natural fibers or synthetic fibers or filaments and yarns varying over a wide range of diameter. Uniform tension can be applied to such yarn travelling through the disc at low and high lineal speeds. In practice, excellent compensation and substantially uniform output tension have been attained in yarns containing occasional knots and travelling at speeds of 1200 yards per minute, thereby rendering the device suitable for use in connection with extremely high speed automatic winding machinery.

From the foregoing description it will be seen that the present invention provides an improved compensating device which is simple and economical in construction, can be readily assembled and installed, and can withstand such rough usage to which it normally may be subjected. The device is readily adjusted for a desired tension setting, is easy to thread and is fast in compensation. The device provides for substantially uniform tension with any yarn at any reasonable speed, and permits winding at constant tension regardless of speed, normal back drag, yarn friction, or other variable inherent in yarn. By distributing the tensioning force between two or more sets of spring loaded compensating discs, the yarn can be handled at extreme speeds without breakages due to knots or rapid tension surges.

The term "yarn" is used herein in a generic sense, and is intended to include single filaments, assemblages of fibers or filaments, either natural or manufactured, twisted or laid together to form a continuous strand, and a plurality of such strands twisted or braided together.

As various changes may be made in the form, construction and arrangement of the parts herein, without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in any limiting sense.

I claim:

1. A device for tensioning yarn comprising a pair of disc members for receiving the yarn therebetween, yieldable means for causing one of said members to be urged towards said other member, a control member operable by the yarn passing between said members, means for resisting operation of said control member, means including a member positively operated by said control member for engaging one of said disc members to move the same away from said other disc member, and means for adjusting said last mentioned means with respect to said control member to position said pair of disc members with respect to each other to accommodate yarns of different diameters.

2. A device for tensioning yarn comprising a pair of members for receiving the yarn therebetween, yieldable means for causing one of said members to be urged towards said other member, a control member operable by the yarn passing between said pair of members, means for resisting operation of said control member, means including a member positively operated by said control member for engaging one of said members to move the same away from said other member, and mechanism for simultaneously and proportionately varying the effectiveness of said yieldable means and said control member operation resisting means.

3. A device for tensioning yarn comprising an upper and lower friction disc for receiving the yarn therebetween, a base for supporting said lower disc, a pin extending through said base and said lower disc for engaging said upper disc, a spring for urging said upper disc towards said lower disc, a control arm operable by the yarn passing between said discs, a spring for resisting operation of said control arm, and means operated by said control arm for raising said pin to move said upper disc away from said lower disc.

4. A device for tensioning yarn comprising an upper friction disc having a downwardly facing central recess, a lower friction disc having a central aperture, a base for supporting said lower disc, a sleeve on said base extending through said aperture and into said recess, a pin extending through said sleeve and into said recess, a spring for urging said upper disc towards said lower disc, a control arm, a spring for resisting operation of said control arm, and means operated by said control arm for raising said pin to move said upper disc away from said lower disc.

5. A device for tensioning yarn comprising a pair of friction discs for receiving the yarn therebetween, a spring for causing one of said discs to be urged towards said other disc, a control arm operable by the yarn passing between said discs, a spring for resisting operation of said control arm, means including a pin operated by said control arm for moving said spring urged disc away from said other disc, and means for adjusting said pin with respect to said control arm to position the discs with respect to each other to accommodate yarns of different diameters.

6. A device for tensioning yarn comprising a pair of friction discs for receiving the yarn therebetween, a spring for causing one of said discs

to be urged towards said other disc, a control arm operable by the yarn passing between said discs, a spring for resisting operation of said control arm, means operated by said control arm for moving said urged disc away from said other disc in opposition to said first mentioned spring, and mechanism for simultaneously and proportionately varying the effectiveness of said springs.

7. A device for tensioning yarn comprising a plurality of pairs of friction discs for receiving the yarn therebetween, each pair including an upper and a lower disc, a base for supporting said lower discs, pins for engaging each of said upper discs extending through said base and said lower discs, means including a spring for urging said upper discs towards said lower discs, a control arm operable by the yarn passing between said pairs of discs, a spring for resisting operation of said control arm, and linkage means operated by said control arm and connected to said pins for raising said pins to move said upper discs away from said lower discs.

8. A device for tensioning yarn comprising a plurality of pairs of friction discs for receiving the yarn therebetween, each pair including an upper and a lower disc, a base for supporting said lower discs, pins for engaging each of said upper discs extending through said base and said lower discs, means including a spring for urging said upper discs towards said lower discs, a control arm operable by the yarn passing between said pairs of discs, a spring for resisting operation of said control arm, linkage means operated by said control arm and connected to said pins for raising said pins to move said upper discs away from said lower discs, and means for proportionally loading said springs.

9. A device for tensioning yarn comprising a plurality of pairs of friction discs for receiving the yarn therebetween, each pair including an upper and a lower disc, a base for supporting said lower discs, pins for engaging each of said upper discs extending through said base and said lower discs, means including a spring for urging said upper discs towards said lower discs, a control arm operable by the yarn passing between said pairs of discs, a spring for resisting operation of said control arm, linkage means operated by said control arm and connected to said pins for raising said pins to move said upper discs away from said lower discs, and means for proportionally loading said springs, said linkage means including an element for adjusting the position of said pins to position said upper discs with respect to said lower discs to accommodate yarns of different diameters.

10. A device for tensioning yarn comprising a pair of members for receiving the yarn therebetween, means for causing one of said members to be urged towards said other member, a control member operable by the yarn passing between said members, means for resisting operation of said control member, a pin for engaging said urged member and moving the same away from said other member, and means for supporting said pin including an element screw threadedly mounted on said control member.

11. A device for tensioning yarn comprising a pair of members for receiving the yarn therebetween, means including a spring for causing one of said members to be urged towards said other member, a control member operable by the yarn passing between said pair of members, means including a spring for resitsing operation of said control member, means operated by said

control member for causing one of said members to move away from said other member, means operable for varying the effectiveness of said second spring, and an element operable by said last mentioned means for varying the effectiveness of said first spring whereby the effectiveness of said springs is varied simultaneously and proportionately.

12. A device for tensioning yarn comprising an upper and lower friction disc for receiving the yarn therebetween, a base for supporting said lower disc, a pin extending through said base and said lower disc for engaging said upper disc, means for urging said upper disc towards said lower disc, a control member operable by the yarn passing between said discs, means for resisting operation of said control member, and means operated by said control member for raising said pin to move said upper disc away from said lower disc.

13. A device for tensioning yarn comprising a plurality of pairs of friction discs for receiving the yarn therebetween, means including a member engaging one disc of all of said pairs of discs and spring means engaging said member for causing all of said last mentioned discs to be urged towards the other disc of each of said pairs of discs, a control member operable by the yarn passing between said pairs of discs, spring means for resisting operation of said control member, and means operated by said control member for moving all of said spring means urged discs away from said other discs in opposition to said first mentioned spring means.

14. A device for tensioning yarn comprising a plurality of pairs of friction discs for receiving the yarn therebetween, each pair including an upper and a lower disc, means including a spring for urging said upper discs toward said lower discs, a control member operable by the yarn passing between said pairs of discs, a spring for resisting operation of said control member, pins

for engaging each of said upper discs, a member for supporting said pins, and an element adjustably mounted on said control member for supporting said last mentioned member.

15. A device for tensioning yarn comprising a plurality of pairs of friction discs for receiving the yarn therebetween, each pair including an upper disc and a lower disc, common means acting on each of said upper discs for urging the same against said lower discs including spring means, and means responsive to the tension in the yarn and operable for rendering said spring means at least partially ineffective, and spring means for resisting operation of said last mentioned means.

16. A device for tensioning yarn comprising a base, a plurality of pairs of friction discs for receiving the yarn therebetween, each pair including an upper disc and a lower disc supported on said base, spring means including a member engaging said upper discs for urging said upper discs against said lower discs, and means responsive to the tension in the yarn including means extending through said base operable for rendering said spring means at least partially ineffective.

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