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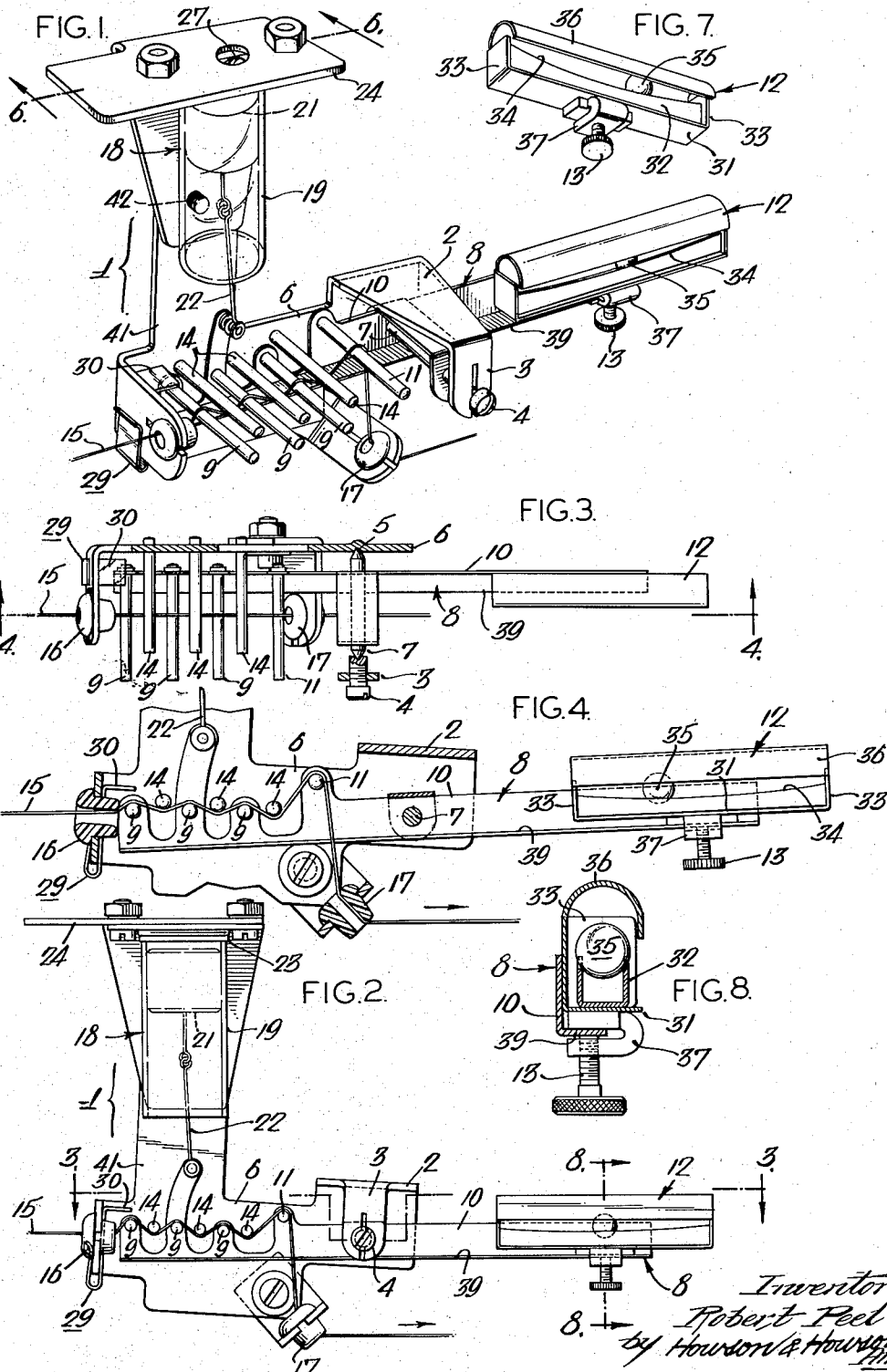
R. PEEL

2,964,259

YARN TENSION DEVICE

Filed Dec. 30, 1957

2 Sheets-Sheet 1



Dec. 13, 1960

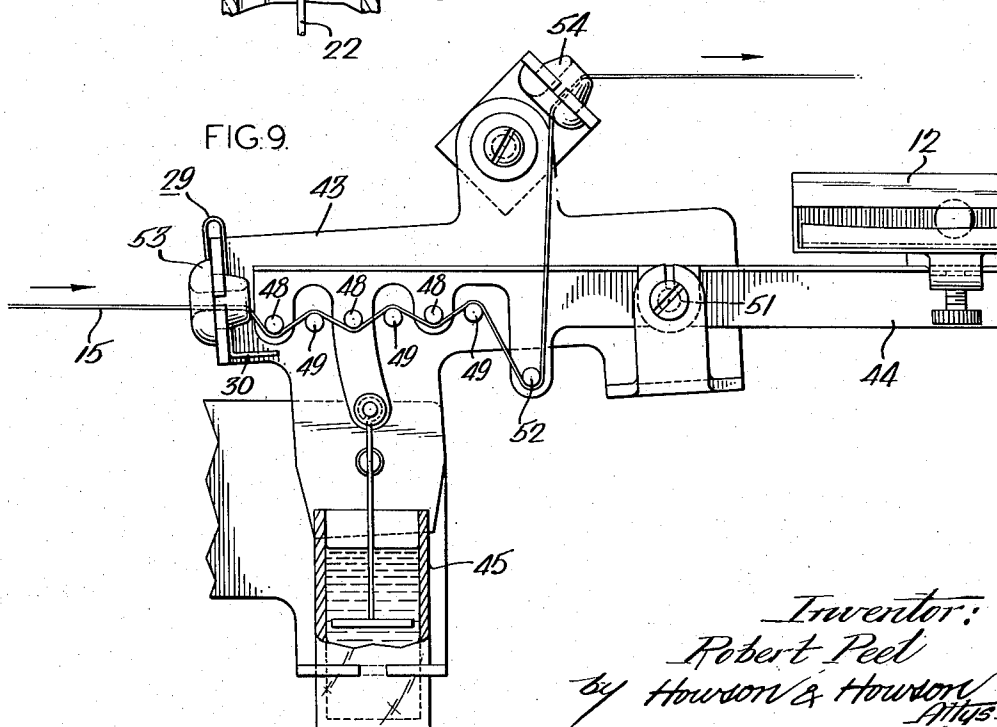
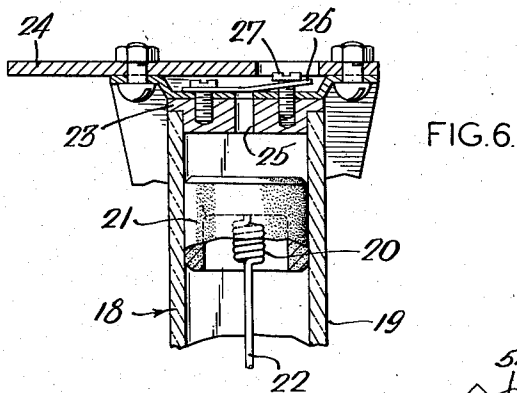
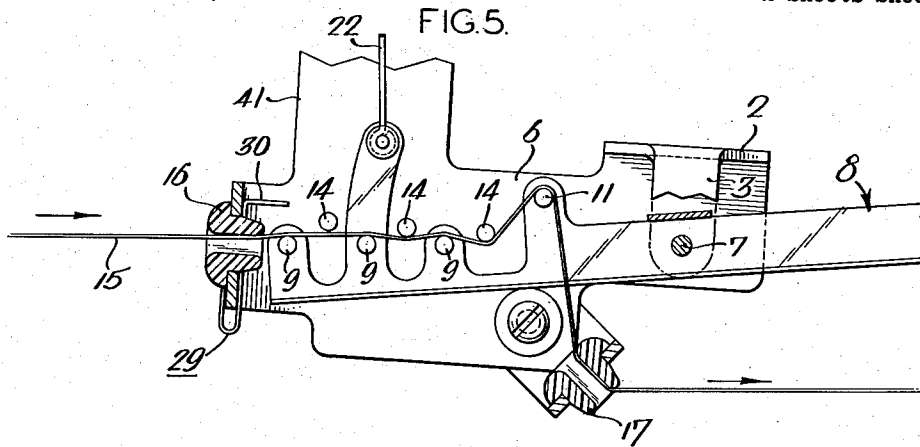
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2 Sheets-Sheet 2



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YARN TENSION DEVICE

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Filed Dec. 30, 1957, Ser. No. 706,146

11 Claims. (Cl. 242—154)

This is a continuation-in-part of application Serial No. 655,721, filed April 29, 1957, now abandoned.

The problem of creating constant and reliable tension in textile yarns used in knitting and weaving machines, especially with very fine yarns like 15 denier monofilament nylon, has never been satisfactorily solved. Of the tension devices previously proposed the so-called "gate" type has offered the greatest advantages and it is to the improvement and adaptation of tension devices of this general type, particularly to circular hosiery knitting machines, that the present invention is directed.

A principal object of the invention, therefore is to provide a yarn tension device that will afford a well controlled tension within the range from 1 to 5 grams in yarns of finer denier.

Another object of the invention is to provide a tension device of the stated type exhibiting a relatively high degree of automatic compensation for momentary fluctuations in yarn tension arising from variable yarn feed conditions.

Still another object is to provide immediate automatic compensation not only for variations in tension within a normal range, but also for the wider deviations which sometimes occur and for correction of which the conventional tension devices make no provision.

To this latter end the invention contemplates provision of a tension device having compensating means responsive to tension deviations with a predetermined normal range, and additional normally inoperative compensating means responsive only to deviations beyond the normal range.

Still another object is to provide a device of the stated character having relatively low production cost and a high degree of durability.

The manner in which these, and other objects herein-after appearing are attained will be more readily understood by reference to the attached drawings, wherein:

Figure 1 is a view in perspective of a tensioning unit made in accordance with the invention;

Figure 2 is a side elevational view of the unit;

Figure 3 is a sectional view of the unit on the line 3—3, Fig. 2;

Figure 4 is an enlarged sectional view on the line 4—4, Fig. 3;

Figure 5 is an enlarged sectional view corresponding to Fig. 4 showing the movable parts in different relative position;

Figure 6 is an enlarged fragmentary sectional view on the line 6—6, Figure 1;

Figure 7 is a view in perspective of an element of the device detached from the latter;

Figure 8 is an enlarged sectional view of the element shown in Figure 7 on the line 8—8, Fig. 2; and

Figure 9 is a side elevational view showing a modification within the scope of the invention.

With reference to Figures 1 to 8 inclusive of the drawings, 1 is a bracket constituting the frame of the unit. The frame has a forwardly extending arm 2 with depend-

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ing forward end 3, and threaded into this depending end is a screw 4. A socket 5 is formed in the rear wall 6 of the frame in axial alignment with screw 4, and the inner end of the screw is also socketed. These sockets receive and form bearings for the ends of a shaft 7. Attached to and carried by this shaft is a sub-frame or arm 8 which is thereby journaled in frame 1 in parallel alignment with the rear wall 6 of the latter.

This arm 8 has mounted in one end, at the left as viewed in the drawings, a longitudinally arranged series of pins 9, three in number in the present instance, which extend forwardly normal to the plane of the wall 6 from the upright flange 10 of the arm. Between the shaft 7 and the nearest pin 9 of the series the arm carries a fourth pin 11. This pin 11 is offset, upwardly in the present instance, from the common plane of the pins 9 and shaft 7 and its function will be described below. At the opposite side of shaft 7 from the pins 9 and 11, the arm 8 is formed as a guide for a counterweight 12 which may be adjusted longitudinally of the arm. A set screw 13 secures the weight in adjusted position. The structure and mode of operation of the counterweight will be described below.

Projecting forwardly from the wall 6 of frame 1 is a series of pins 14. The plane of these pins corresponds with the common plane of the pins 9 and shaft 7 when the arm 8 approximately horizontal, as shown in full lines in Figure 2. Recesses in the flange 10 of the arm between the pins 9 afford passage for the pins 14 as illustrated. When in or near this common plane the pins 14 are interspersed or meshed with pins 9. In practice, yarn 15 passes into the unit from a source not shown through an eyelet 16 on frame 1, the top of which in the foremost instance is aligned with the under sides of the pins 14 as best shown in Figure 4. The yarn passes under the pins 14 and over the pins 9; and from the inner pin 14 upwardly and over the pin 11. From this pin the yarn passes downwardly approximately at right angles to the common plane of the pins 14 and shaft 7 to and through an eyelet 17 also mounted in frame 1. The weight 12 tends to carry the end of arm 8 upwardly and brings the pins 9 into engagement with yarn 15 which is diverted between the pins from a normal straight line in a plurality of kinks, as illustrated in Figures 1 and 2 and in Figure 4. The positions of the pins 9 and 11 with respect to the pins 14, assuming no drag on the yarn at the source, will be a function in principal part of the position on arm 8 of the weight 12, and the tension imposed on the yarn by the unit will be proportional to the cumulative friction between the yarn and the pins and eyelets and may be regulated by adjustment of the weight to vary the magnitude of the kinks in the yarn and thereby the arcs of contact between the pins and the yarn.

In order to relieve the effect of momentary surges in tension arising from variable conditions at the source of the yarn or at other sources extraneous to the device and to preclude development of sympathetic vibrations in the arm, I provide a pneumatic dash pot 18 comprising an inverted cylinder 19, composed in the present instance of glass, a piston 21 fitted freely to the cylinder, and a jointed rod 22 which is attached to the piston by a spring 20 (see Figure 6), and which connects the piston to arm 8. As shown in Figure 6, the cylinder 19 is attached through medium of a cylinder head 23 to the under side of a flange 24 of frame 1. The head 23 is ported at 25, and the upper end of this port is restricted by a valve in the form of a leaf spring 26 which may be adjusted through screw 27 to vary the effective size of the port and thereby the retarding effect of the dashpot on the movements of the arm 8.

It will be noted that the design of the unit provides

for manufacture with precision of the two primary parts, i.e., the frame 1 and arm 8, from pressed metal. I have found that the pins 9, 14 and 11, and the eyelets 16 and 17, if made of Alsimag, a product of American Lava Corporation containing the oxides of aluminum and titanium, are highly resistant to wear by the traveling yarn and wear without sensible change in the surface characteristics. The bearings for the arm 8 on the frame 1 are simple, inexpensive and substantially free from wear. The unit therefor is not only low in initial cost but is substantially indestructible under normal conditions of use.

As previously described, the pins 9 and 14 are each in linear series in planes containing the axis of shaft 7, these planes coinciding therefor when the pins are full intermeshed as shown in Figure 3. This may be considered a normal working position in which the yarn 15 is made to assume a series of shallow kinks between the pins of the two series. The offset position of pin 11, however, creates a deeper and relatively sharp kink of lesser included angle. An increase in tension in the yarn will tend to straighten out the several kinks by angular displacement of arm 8, but will have a more immediate effect upon the pin 11 by reason of the more favorable resolution of forces inherent in the relative narrowness of its loop and the fact that the sides of the loop are more nearly parallel to the direction of the tension-relieving displacement of the arm.

Assume that the yarn is passing continuously through the device from a conventional source to a knitting or other machine and that the tension in the yarn as it leaves the device has been regulated as required by adjustment of the weight 12 on the arm 8. The tension in the yarn leaving the device will be the original tension, if any, plus that resulting from accumulated friction between the yarn and the pins 9, 14 and 11 and eyelets 16 and 17. Control of uniformity of tension will lie primarily in the offset pin 11 which in substantial part determines the sensitivity of the device to deviations from the established tension resulting from factors affecting the yarn at the source or at other points extraneous to the device.

Increased resistance at the source for example is reflected immediately in a depression of the pin 11 and a consequent downward movement of the arm 8 about the axis of its shaft as shown in Fig. 5. Such downward movement progressively reduces the area of frictional contact between the yarn and the pins 9 and 14 by reason of the depression of the pins 9 and the flattening out of the yarn pattern between the pins. This progressive reduction in friction occurs first in the pins relatively remote from the shaft 17 as illustrated. The progressive reduction of friction in the device reduces the tension in the yarn imposed by the device itself and compensates for the increased tension at the source. If on the other hand the tension at the source is reduced the weight 13 acts to elevate the arm 8 and the pins 9 with respect to the pins 14 thereby increasing the arcs of contact between the pins and the yarn and correspondingly increasing friction in the device so that the tension in the yarn leaving the device remains substantially constant.

The compensation provided by the device as described above is sufficient to compensate the deviations in tension at the source within an expected normal range of such deviation. In accordance with the invention I provide means for compensating also for those relatively heavy deviations which result from abnormal conditions. This device is incorporated in the structure of the counterweight 12 which, as previously described, is adjustable longitudinally of the arm 8. As illustrated in Figs. 7 and 8 the counterweight 12 consists of an elongated housing comprising a casing 31 within which is mounted a channel 32, the ends of the channel abutting the end walls 33 of the casing. As shown in the drawings the upper edges 34 of this channel are concave with the lower

portion of the arc at the longitudinal mid-section of the weight structure. Mounted on these edges and free to roll longitudinally thereon is a sphere 35, and this sphere is confined by an upper turned-over flange 36 of the casing as best illustrated in Fig. 8. To the underside of the casing 31 is attached a clamp 37 comprising the set screw 13 by means of which the entire weight structure may be detachably secured to the extending forwardly horizontal flange 39 of the arm 8.

This weight structure is adapted to assume, in the initial setting of the device, a substantially horizontal position in which the sphere 35 occupies a mid-position on the track provided by the upper edges of the channel 32. To this end after the weight structure as a whole has been adjusted longitudinally of the arm 8 as described above, to provide the desired basic tension in the yarn, the entire lower portion of the bracket 1 comprising the pin assembly described above, is adjusted so as to bring the weight structure to the desired horizontal position. To this end the lower portion 41 of the bracket 1 is made separate from and adjustable with respect to the upper portion which carries the dashpot 18, and is joined to the said upper portion by a screw 42 which not only secures the two parts of the bracket together but also provides a pivot about which the lower portion 41 of the bracket may be adjusted as described.

As previously described the device is designed and adjusted to compensate all normal variations in the tension on the yarn, such compensation being effective with only slight movement of the arm 8 about its pivot insufficient to affect the sphere 35 or to cause it to move from its normal position on the track. During this normal operation therefor the sphere 35 remains stationary at the approximate center of its track. Any extraordinary displacement of the arm 8 resulting from abnormal tension in the yarn as described, will result in tilting of the arm 8 about its pivot to an extent such that the sphere will be displaced by rolling on the tracks as shown in Fig. 4 thereby reducing the effective mass of the counterweight and correspondingly reducing the tension imposed on the yarn by the device. Obviously the compensating effect will be proportional to the amplitude of the angular displacement of the arm 8 under the effects of the increased tension in the yarn.

During periods of machine operation the arm 8 will tend to assume a position in which the pins 9 will be elevated and in a state of maximum mesh with the pins 14. If the machine is then restarted without adjusting the arm to normal tension position, the device may impose an initial undesirably high tension on the yarn. To stabilize the device in this respect I provide a clip 29 adjustably fitted to the end of the frame 1 which has a flange 30 overlying the proximate end of the arm 8 and functioning as a stop to limit the upward movement of that end of the arm. This clip will be adjusted to permit upward movements of the arm within a normal operational range while preventing the larger displacements mentioned above.

There may be modification in the structure of the unit without departure from the principle of the invention, and one such modification is illustrated in Figure 9. The unit comprises the base frame 43 and pivoted, adjustably counter-balanced arm 44. In this case a dashpot 45 of hydraulic type is used, and for convenience the cylinder 46 is arranged below the arm 44 with its open end uppermost. In this case also the yarn 47 is passed under the pins 48 of the arm 44 and over the relatively fixed pins 49 mounted on the frame 43. The relative arrangement of the two series of pins with respect to the shaft 51 is the same as in the previously described embodiment. The pin 52, which corresponds to pin 11 aforesaid, is in this case offset below the common working plane of the other pins so that angular displacement of arm 44 resulting from increasing yarn tension will be in clockwise direction as viewed in the drawings. The eyelets 53

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and 54 bear the same essential relationship to the pins 49 and 52 as do the eyelets 16 and 17 to the pin 14 and pin 11 of the embodiment of preceding figures of the drawings. The functional principle remains unchanged.

I claim:

1. In a yarn tensioning device of the stated type comprising a relatively fixed member and a second member pivotally connected to said relatively fixed member, yarn guide means on said fixed member comprising an entrance bushing to introduce a supply yarn into the device in a generally radial path toward the pivotal axis thereof, a first series of pins in parallel alignment with said pivotal axis and disposed at one side of said yarn, and an exit bushing to guide the yarn out of the device in a path substantially perpendicular to said radial path intermediate said first series of pins and said pivotal axis, guide means on the second member comprising a second series of pins in parallel alignment with said pivotal axis so as to mesh with said first series and disposed at the opposite side of said yarn whereby, upon pivotal displacement, said pins deflect the yarn from a normal straight line path radial to said pivot into a plurality of kinks around said pins to impart tension to the yarn, said latter guide means including a non-rotatable pin mounted on said movable member intermediate the final pin of the first series and the pivotal axis, said pin being parallel to said axis and set off from said second aligned series toward said one side of the straight line radial path opposite to said exit bushing and disposed to form a kink in the yarn of relatively great depth between said final pin of the first series and the exit bushing, said offset pin imparting tension to the yarn wrapped thereabout whereby upon increase in the tension of the supply yarn, the tensile forces in the legs of said last-mentioned kink act on said offset pin to displace said movable member and reduce the degree of mesh between said fixed and movable series and reduce the degree of wrap about said offset pin to thereby reduce the tension imparted to the yarn by the tensioning device.

2. In a yarn tensioning device of the stated type comprising a relatively fixed member and a second member pivotally connected to said relatively fixed member, each member carrying a linear series of pins arranged so that when the members are moved together from opposite sides of the yarn path by relative movement about said pivot, said pins are brought into meshing relation to deflect the yarn from a normal straight line in a plurality of kinks to impart tension thereto, counter-balance means on said second member comprising a weight adjustable radially of said pivot, tending to maintain the members flexibly in the yarn deflecting relation, and being operative under increased tension in the supply yarn to move said second member relatively about the pivot so as to reduce the deflection of the yarn and reduce the tension imparted by the device, and being operative under reduced tension in the supply yarn to increase the deflection of the yarn, and increase the tension imparted by the device, and a weight-varying means cooperable with said weight and actuated in response to substantial motion of the second member about the pivot as a result of fluctuations in the supply yarn tensions to vary the effective counterbalancing weight of the weight means to augment the force tending to move said member.

3. A tensioning device according to claim 2 wherein the weight varying means comprises a supplementary spherical weight element movable in the weight means to vary its distance from the pivot.

4. A tensioning device according to claim 3 wherein the weight means comprises a concave track for the spherical element on which the said element is movable in a plane normal to the axis of the pivot, and means for adjusting the track angularly in said plane.

5. A tensioning means according to claim 4 wherein the said adjusting means comprises a movable part of the relatively fixed member forming a support for the

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pivot and angularly adjustable with respect to the other part in a plane normal to the pivot axis.

6. A tensioning means according to claim 5 wherein means is carried by the said other part of the relatively fixed member and attached to the relatively movable member of the device for damping the movements of the latter.

7. A tensioning means according to claim 6 including means for adjusting the damping means to regulate the damping force.

8. In a device for maintaining substantially constant tension in a yarn moving in a linear path, elements engaging the moving yarn and applying friction to the yarn in a succession of points along said path, movable means engaging said yarn and urging it into engagement with said elements with a given force, and movable in response to fluctuations in yarn tension arising from sources extraneous to the device and within a predetermined range of fluctuation for modifying the friction at said points progressively with the change in tension at the several points to compensate for the fluctuation, and to thereby maintain a substantially constant tension in the yarn within said range, and a second means cooperable with said movable means responsive only to fluctuations beyond said range, to modify said given force for further modifying the friction at said points for the additional compensation required by said latter fluctuations.

9. A device according to claim 8 wherein the movable means comprises a pivoted arm and elements carried by said arm for frictionally engaging the yarn in a second plurality of points intermeshed with said first succession of points, and counterbalance means for said arm adjustable to regulate said friction within said range, said second means including an element movable to modify the effective weight of said counter-balance means with respect to the pivot, and means for effecting movement of said element only under fluctuations beyond said range.

10. A device according to claim 9 including means for limiting angular displacement of the arm about the pivot under action of the counter-balance means.

11. In a device for maintaining substantially constant tension in a yarn moving in a linear path, a series of fixed pin elements engaging the moving yarn and applying friction to the yarn in a succession of points along said path, a pivoted arm, and a series of movable pin elements carried by said arm for frictionally engaging the yarn in a second plurality of points intermeshed with said first succession of points, weight means mounted for pivotal movement with the arm biasing said arm to urge said movable pins into meshed relation with said fixed pins with a given force, said given force moving said arm in response to fluctuations in yarn tension arising from sources extraneous to the device and within a predetermined range of fluctuation for modifying the friction applied at said points compensatively with the change in tension to compensate for the fluctuations and to thereby maintain a substantially constant yarn tension within said range, said weight means including a displaceable element adapted upon substantial change in said extraneous tension to be displaced to modify the effective mass of the weight means biasing said movable pins into meshed relation to thereby further modify the friction applied to the yarn by the device to compensate for said substantial change in extraneous tension.

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