April 6, 1954 R. H. ROUGHSEDGE ET AL 2,674,110

WARP TENSION CONTROL MEANS

Filed Oct. 23, 1948

3 Sheets-Sheet 1

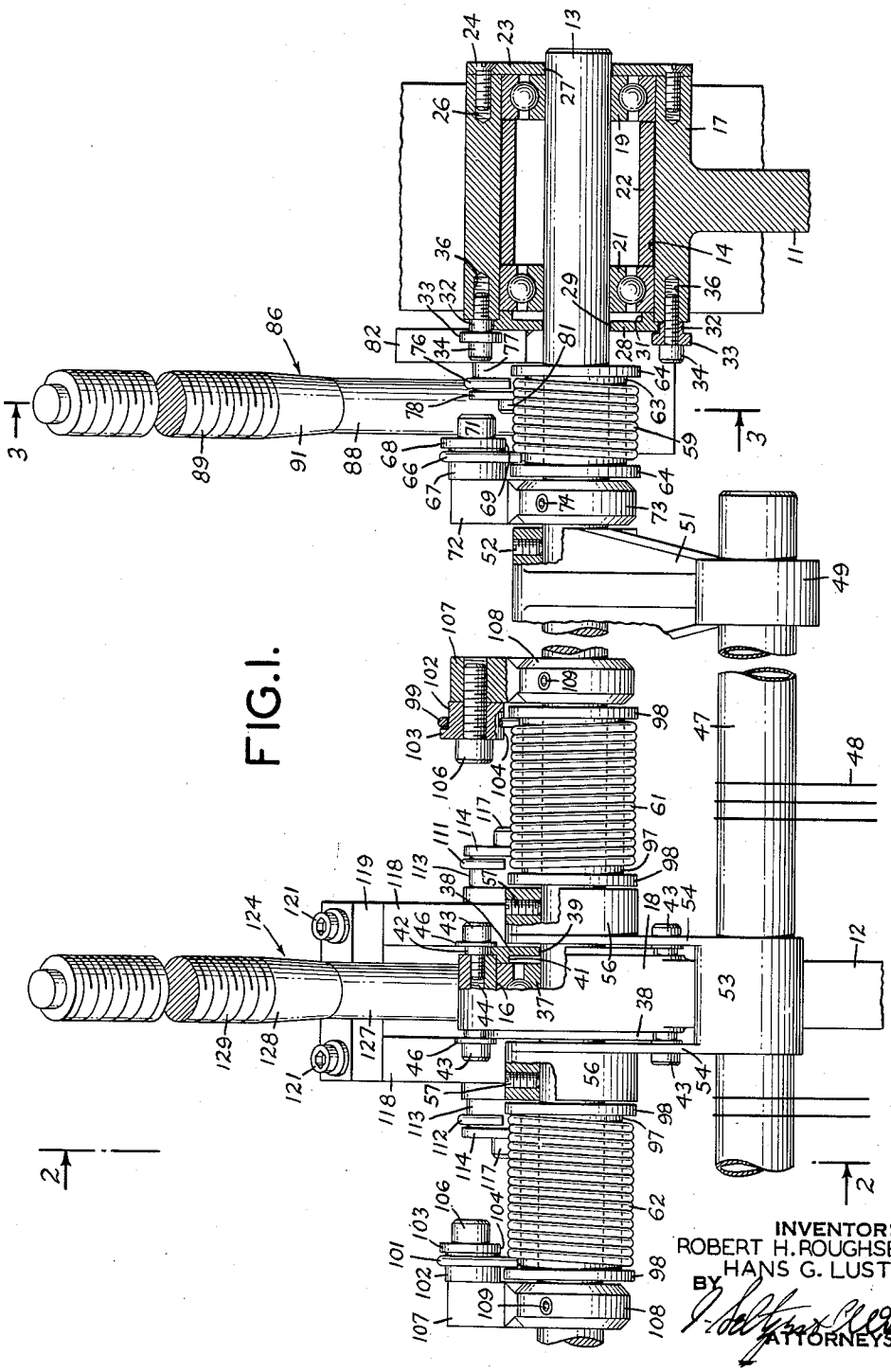


FIG. 1.

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3 Sheets-Sheet 2

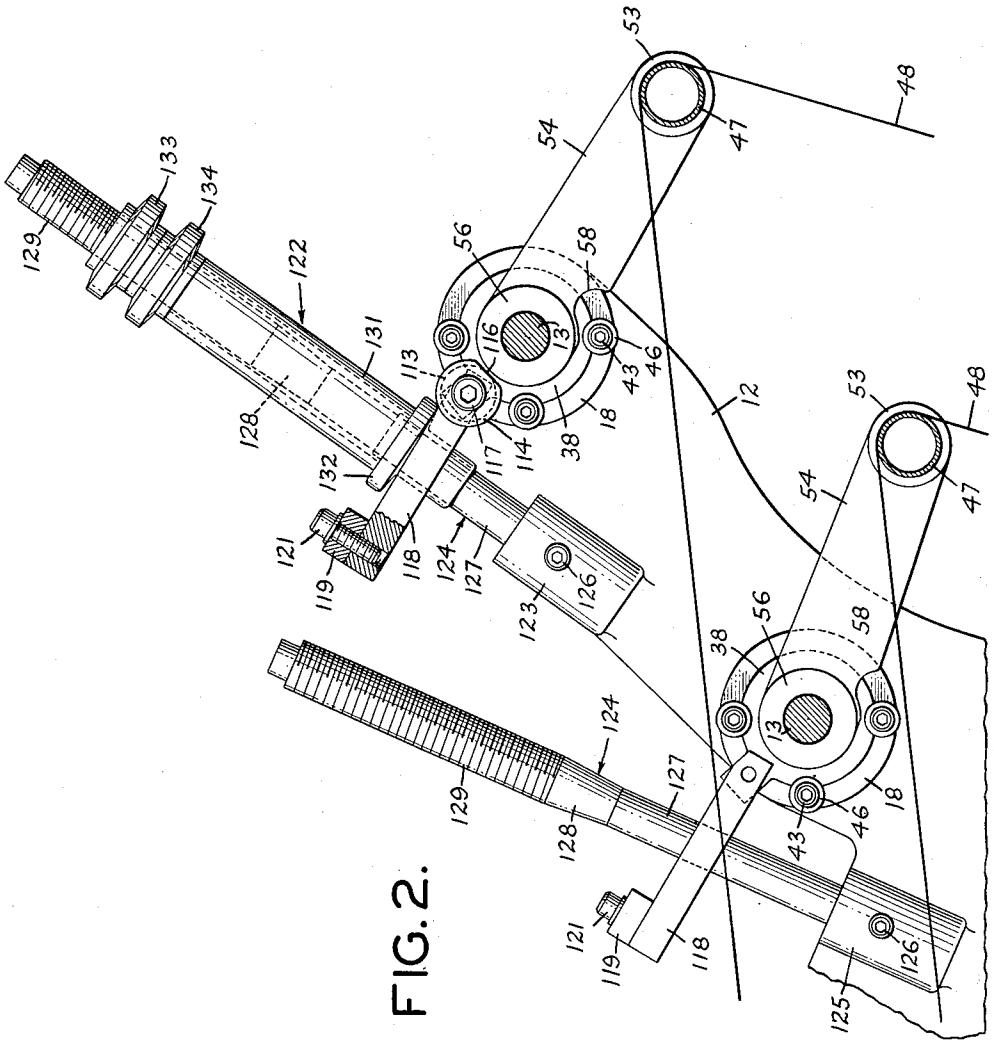


FIG. 2.

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FIG. 4.

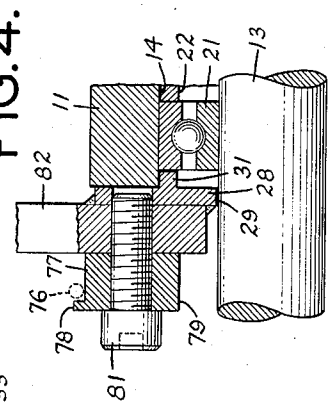


FIG. 3.

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UNITED STATES PATENT OFFICE

2,674,110

WARP TENSION CONTROL MEANS

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Application October 23, 1948, Serial No. 56,172

13 Claims. (Cl. 66—146)

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This invention relates to textile apparatus, and relates more particularly to warp tension control means and to warp-knitting machines in connection with which said warp tension control means are employed.

In the usual method of producing warp-knitted fabrics, that is, fabrics in which a number of warp threads are knitted together in each course; a number of warp threads are drawn from any suitable source of supply such as a warp beam or a number of sectional warp beams and are passed over a warp tension control means on their way to a knitting station. The tension control means generally comprises a movable tension bar, over which the warp threads are trained, carried by one or more pivotally mounted arms. The tension bar is spring-loaded and as the tension on the warp threads increases the tension bar moves in one direction stressing the loading springs, and as the tension on the warp threads decreases the tension bar moves in the opposite direction under the urging of the same springs. The movement of the tension bar is used to control the rate of let-off of the warp threads from the warp beam or beams, thereby insuring that the warp tension will not vary beyond a predetermined range.

In prior warp-knitting machines, helical springs were employed in compression to load the tension bar and it was found that the warp tension varied excessively when the speed of the warp-knitting machines was increased beyond a certain point, thus not only producing a defective fabric but also causing rapid wear of the machine parts. The excessive variation in warp tension apparently resulted from internal oscillations set up in the loading springs at high knitting speeds, and from the large effective inertia of springs employed in compression which made it difficult for said springs to adjust themselves to a rapidly varying warp tension. This limited the speed of the warp-knitting machines to a maximum of about 400 to 500 courses per minute.

It is an important object of this invention to overcome the foregoing and other disadvantages of the warp-knitting machines hitherto employed, and to provide a warp-knitting machine capable of being operated at substantially higher knitting speeds.

A further object of this invention is to provide a warp tension control means in which the material of the loading springs absorbs the stresses applied to said springs in tensile and compressive strains.

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Another object of this invention is to provide a warp tension control means in which a spring is employed in torsion to load the tension bar.

Other objects of this invention, together with certain details of construction and combinations of parts, will be apparent from the following detailed description and claims.

Our invention comprises a warp tension control means in which the loading springs are employed in torsion rather than in compression as has hitherto been customary. We have found that a warp-knitting machine incorporating this novel warp tension control means may be operated at substantially higher knitting speeds ranging from 600 to 700 or more courses per minute without excessive variation in the warp tension. Even at these higher knitting speeds, loading springs employed in torsion show no tendency to develop internal oscillations and exhibit a lower effective inertia as compared with springs employed in compression. As a result, loading springs employed in torsion can accommodate themselves readily to rapidly varying warp tension.

Springs employed in torsion and springs employed in compression differ from each other in that the material in springs employed in torsion absorbs applied stresses in tensile and compressive strains, whereas the material in springs employed in compression absorbs applied stresses in torsional strains. While we have found that loading springs employed in torsion permit of the highest operating speeds, we may also obtain improved results by employing the loading springs in other arrangements wherein the material in said loading springs absorbs the applied stresses in tensile and compressive rather than in torsional strains.

The number and the specific design of the loading springs will depend in large part on the layout of the warp tension control means and of the warp-knitting machine in which it is employed. However, in a warp tension control means having auxiliary loading springs between and in addition to the main loading springs adjacent the ends of the tension bar, it has been found that the best results are obtained when the auxiliary loading springs are employed in symmetrically positioned pairs, and each of said auxiliary loading springs has only one-half the stiffness of the main loading springs. In addition, if helically wound loading springs are employed, it is preferred that all of the loading springs be positioned in the warp tension control means so that their direction of winding

alternates. While other arrangements with loading springs employed in torsion will give results superior to those obtainable with loading springs employed in compression, this particular arrangement permits the highest knitting speeds to be attained without an excessive variation in warp tension.

Various expedients may be employed to produce auxiliary loading springs having one-half the stiffness of the main loading springs. For example, a spring wire of larger diameter may be employed in the main loading springs, or the auxiliary loading springs may have twice as many turns as the main loading springs when a spring wire of the same diameter is employed.

Means may be provided in the warp tension control means of this invention to vary the loading on the tension bar by altering the stresses applied to the loading springs. This permits of the adjustment of the warp tension for different types and weights of warp threads, for different fabric constructions, or for any other purpose.

The motion of the tension bar which results from the variations in warp tension may be employed to control the rate at which the warp threads are let off from the warp beam or beams. For example, the motion of the tension bar may control a positive let off of the type shown in the Fuhrer et al. U. S. Patent No. 2,486,525, issued November 1, 1949, to produce a warp-knitting machine capable of operating at the highest knitting speeds. The motion of the tension bar may also control other types of apparatus for regulating the rate at which the warp threads are let off from the warp beam or beams such as brakes operating on the warp beam or beams, clutches through which said warp beam or beams are driven, etc. in a manner well understood in the art.

The warp tension control means of this invention is particularly adapted for use with warp-knitting machines of all types and will be described in connection therewith. It may, however, also be used with other types of textile apparatus in which it is necessary to control the warp tension, such as slashers, for example. With such other types of apparatus the motion of the tension bar may control the rate at which the warp threads are taken up as well as the rate at which they are let off the warp beam or beams.

A preferred embodiment of our invention is illustrated in the accompanying drawings, in which

Fig. 1 is a front elevational view, partly in section, of a warp tension control means embodying this invention on one bar of a two-bar warp-knitting machine, with the other bar omitted in the interest of clarity,

Fig. 2 is a view, partly in section, taken on line 2—2 of Fig. 1 in the direction of the arrows, with certain parts omitted in the interest of clarity,

Fig. 3 is a view, partly in section, taken generally on line 3—3 of Fig. 1 in the direction of the arrows, with certain parts omitted in the interest of clarity, and

Fig. 4 is a detail view, partly in section and on an enlarged scale, taken on line 4—4 of Fig. 3 in the direction of the arrows.

Like reference numerals indicate like parts throughout the several views of the drawings.

Referring now to the drawings for a detailed description of our invention, there is shown a portion of a two-bar warp-knitting machine comprising a right-end main frame member 11 and an auxiliary frame member 12. In addition to the frame members 11 and 12, the warp-knitting machine will have a left-end main frame member and as many additional auxiliary frame members as are needed to support the various machine elements adequately. The left-end main frame member and the additional auxiliary frame members have been omitted from the drawings in the interest of clarity since they are identical in structure to the frame members 11 and 12, respectively. It is to be understood that the auxiliary frame members may be completely dispensed with when the warp-knitting machine is narrow enough so that the main frame members can provide adequate support for the various machine elements. In Fig. 1 of the drawings, one of the two warp tension control means which are needed in a two-bar warp-knitting machine has been omitted since both are of identical structure.

The warp tension control means comprises a shaft 13 extending through openings 14 and 16 in bosses 17 and 18 in the frame members 11 and 12, respectively. At its right end the shaft 13 is journalled for free rotation in ball bearings 19 and 21 which are separated from each other by means of an annular spacer 22. The ball bearing 19 is retained in position by means of an annular disk 23 which is fastened to the frame member 11 with screws 24 engaging threaded apertures 26 in the boss 17. The disk 23 is provided with a centrally located aperture 27 through which the shaft 13 extends. An annular disk 28 on the other side of the frame member 11 retains the ball bearing 21 in position, and like the disk 23 is provided with a centrally located aperture 29 through which the shaft 13 extends. The disk 28 is also provided with an integral circular bearing ring 31 extending into the opening 14, which bearing ring permits the disk 28 to be rotated without seizing or binding the shaft 13. The disk 28 is retained in position by means of sleeves 32 which abut the boss 17 at one end and which are provided with enlarged collars 33 spaced from said boss at their other end. The spacing between the boss 17 and the collars 33 is somewhat greater than the thickness of the disk 28, permitting the disk to rotate freely about an axis extending in the direction of the shaft 13. The sleeves 32 are fastened to the boss 17 by means of bolts 34 extending therethrough and engaging threaded apertures 36 in said boss.

At the auxiliary frame member 12, the shaft 13 is journalled for free rotation in a ball bearing 37 which is seated in the opening 16. The ball bearing 37 is retained in position by means of two identical annular disks 38 which are disposed on each side of the auxiliary frame member 12. Each of the disks 38 is provided with a centrally located aperture 39 through which the shaft 13 extends and, like the disk 28, is also provided with an integral circular bearing ring 41 extending into the opening 16. The disks 38 are held in position by means of sleeves 42 which are fastened to the boss 18 with bolts 43 that extend through said sleeves and engage threaded apertures 44 in said boss. Each of the sleeves 42 abuts the boss 18 and is provided with an enlarged collar 46, spaced from said boss, the spacing being somewhat greater than the thickness of the disks 38 to permit said disks to rotate freely about an axis extending in the direction of the shaft 13.

A tubular tension bar 47 over which warp threads 48 are trained is positioned in front of

and parallel to the shaft 13. At its right end the tension bar extends through a sleeve 49 which is integral with one end of main pivot arm 51. The other end of the pivot arm 51 encircles the shaft 13 being fastened thereto by means of set screws 52. Adjacent to the auxiliary frame member 12 the tension bar 47 extends through a sleeve 53 which is fastened to a pair of auxiliary pivot arms 54 positioned on each side of said auxiliary frame member. The pivot arms 54 are in turn fastened to sleeves 56 which encircle the shaft 13 and are fastened thereto by means of set screws 57. As is shown in Fig. 2, each of the pivot arms 54 is cut away at 58 to clear the head of the bolts 43. The shaft 13 and the pivot arms 51 and 54 rotate as a unit during operation permitting the tension bar 47 to move under the influence of changing warp tension.

The tension bar 47 is spring loaded by means of a main helical loading spring 59 positioned adjacent to the main pivot arm 51, and auxiliary helical loading springs 61 and 62 positioned adjacent to the auxiliary pivot arms 54. Each of the auxiliary loading springs 61 and 62 has sixteen turns, whereas the main loading spring 59 has only eight turns so that the auxiliary loading springs 61 and 62 have only one-half the stiffness of the main loading spring 59. The exact number of turns in the loading springs will depend upon the properties of the material making up the springs and the design of the warp tension control means and the warp-knitting machine in which said springs are employed. In all cases, however, each of the auxiliary loading springs 61 and 62 should have only one-half the stiffness of the main loading spring 59. Both the main loading spring 59 and the auxiliary loading springs 61 and 62 are preferably positioned in the warp tension control means with their windings disposed in alternately opposite directions. Thus, the auxiliary loading spring 61 has its winding disposed in a direction opposite to that of the main loading spring 59, the auxiliary loading spring 62 has its winding disposed in a direction opposite to that of auxiliary loading spring 61, and so forth to the left-end main loading spring (not shown).

The main loading spring 59 is supported on an oil-impregnated bushing 63 provided with shoulders 64, which bushing is mounted concentrically of the shaft 13. During operation, the bushing 63 provides a film of lubricant over the surface of the main loading spring 59 to reduce the frictional forces thereon. One end 66 of the main loading spring 59 is looped around a sleeve 67 which is provided with a collar 68 that is cut away at 69 to clear said spring. The sleeve 67 is fastened by means of a bolt 71 extending therethrough to a lug 72 integral with a ring 73 which encircles the shaft 13 and is fastened thereto with a set screw 74. The other end 76 of the main loading spring 59 is looped around a sleeve 77 (Fig. 4) provided with a shoulder 78 that is cut away at 79 to clear said spring. The sleeve 77 is fastened by means of a bolt 81 extending therethrough to a strap 82 which is in turn welded to the ring 28. Both the main loading spring 59 and the bushing 63 are omitted from Figs. 3 and 4 of the drawings in the interest of clarity.

The main loading spring 59 may be adjusted for a wide range of operating conditions by means of an adjusting assembly indicated generally by reference numeral 83. The adjusting assembly

83 comprises a socket 84 fastened to the frame member 11 in any desired manner, in which socket 84, a rod, indicated generally by reference numeral 86, is secured by means of a bolt 87. The rod 86 has a straight section 88 connected to a threaded section 89 of larger diameter by means of a tapered intermediate section 91. A sleeve 92 fits loosely over the rod 86 and has adjacent to its lower end a shoulder 93 which bears against the strap 82. Adjusting nuts 94 and 96 in engagement with the threaded section 89 of the rod 86 abut against the sleeve 92 permitting said sleeve to be forced downwardly by rotation of said nuts. This in turn forces the strap 82 downwardly rotating the disk 28 and varying the torsion in the main loading spring 59.

The auxiliary loading springs 61 and 62 are supported on oil-impregnated bushings 97 provided with shoulders 98 which are mounted concentrically of the shaft 13. Like the bushing 63, the bushings 97 provide a film of lubricant over the surfaces of the auxiliary loading springs 61 and 62 to reduce the frictional forces thereon during operation. Ends 99 and 101 of the auxiliary loading springs 61 and 62, respectively, are looped around sleeves 102 which are provided with shoulders 103 that are cut away at 104 to clear said springs. The sleeves 102 are fastened by means of bolts 106 extending therethrough to lugs 107 integral with rings 108 which encircle the shaft 13 and are fastened thereto with set screws 109. The other ends 111 and 112 of the auxiliary loading springs 61 and 62, respectively, are looped around sleeves 113 (Fig. 2) provided with shoulders 114 that are cut away at 116 to clear said springs. The sleeves 113 are fastened by means of bolts 117 extending therethrough to straps 118 which are secured as by welding to the disks 38 on each side of the auxiliary frame member 12. The straps 118 are fastened together to rotate as a unit by means of an end strap 119 and bolts 121. The auxiliary loading springs 61 and 62 and the bushings 97 are omitted from Figure 2 of the drawings in the interest of clarity.

The auxiliary loading springs 61 and 62 may be simultaneously adjusted for a wide range of operating conditions by means of an adjusting assembly, indicated generally by reference numeral 122. The adjusting assembly 122 comprises a socket 123 integral with the auxiliary frame member 12, in which socket a rod, indicated generally by reference numeral 124, is fastened by means of a bolt 126. The rod 124 is similar in construction to the rod 86 having a straight section 127, a tapered intermediate section 128, and a threaded section 129 of larger diameter than the straight section 127. A sleeve 131 fits loosely over the rod 124 and is provided with a shoulder 132 adjacent to its lower end which bears against the straps 118. Adjusting nuts 133 and 134 in engagement with the threaded section 129 of the rod 124 abut the sleeve 131 permitting said sleeve to be forced downwardly rotating the disks 38 and simultaneously varying the torsion in both of the auxiliary loading springs 61 and 62.

During operation, the warp threads 48 are trained over the tension bar 47 on their way from the warp beam or beams to the knitting station. As the tension on the warp threads 48 increases the tension bar 47 will be forced downwardly rotating the shaft 13 in one direction and stressing the loading springs 59, 60 and 61 in torsion. Conversely, as the tension on the warp threads 48

decreases the shaft 13 will be rotated in the opposite direction under the urging of the stressed loading springs 59, 61 and 62 thereby raising the tension bar 47. The rotation of the shaft 13 and/or the motion of the tension bar 47 may, as pointed out above, be employed to control the let off of the warp threads 48 from the warp beam or beams. The spring loading upon the tension bar 47 may be readily varied by means of the adjusting nuts 94, 96, 133 and 134 for different types of warp threads 48, for different fabric constructions, or for any other purpose.

It is to be understood that the foregoing detailed description is given merely by way of illustration and that many variations may be made therein without departing from the spirit of our invention.

Having described our invention, what we desire to secure by Letters Patent is:

1. In a warp tension control means, a movable tension bar over which the warp threads are trained, main spring loading means operatively connected to said tension bar adjacent the ends of said tension bar, and auxiliary spring loading means operatively connected to said tension bar intermediate said main spring loading means, each of said main spring loading means comprising a single loading spring, and each of said auxiliary spring loading means comprising a pair of loading springs.

2. In a warp tension control means, a movable tension bar over which the warp threads are trained, main spring loading means absorbing the stresses applied thereto in tensile and compressive strains operatively connected to said tension bar adjacent the ends of said tension bar, and auxiliary spring loading means absorbing the stresses applied thereto in tensile and compressive strains operatively connected to said tension bar intermediate said main spring loading means, each of said main spring loading means comprising a single loading spring, and each of said auxiliary spring loading means comprising a pair of loading springs.

3. In a warp tension control means, a movable tension bar over which the warp threads are trained, and a plurality of spring loading means absorbing the stresses applied thereto in tensile and compressive strains, said spring means having one end fixed and the other end operatively connected to said tension bar, the springs in said spring loading means having windings disposed in alternately opposite directions.

4. In a warp tension control means, a movable tension bar over which the warp threads are trained, main spring loading means employed in torsion operatively connected to said tension bar adjacent the ends of said tension bar, and auxiliary spring loading means employed in torsion operatively connected to said tension bar intermediate said main spring loading means, each of said main spring loading means comprising a single loading spring, each of said auxiliary spring loading means comprising a pair of loading springs and all of said loading springs having windings disposed in alternately opposite directions.

5. In a warp tension control means, a movable tension bar over which the warp threads are trained, main spring loading means operatively connected to said tension bar adjacent the ends of said tension bar, and auxiliary spring loading means operatively connected to said tension bar intermediate said main spring loading means, each of said main spring loading means comprising a single loading spring, each of said auxiliary spring loading means comprising a pair of loading springs, and each of the loading springs in said auxiliary spring loading means having one-half the stiffness of the loading springs in said main spring loading means.

6. In a warp tension control means, a movable tension bar over which the warp threads are trained, main spring loading means absorbing the stresses applied thereto in tensile and compressive strains operatively connected to said tension bar adjacent the ends of said tension bar, and auxiliary spring loading means absorbing the stresses applied thereto in tensile and compressive strains operatively connected to said tension bar intermediate said main spring loading means, each of said main spring loading means comprising a single loading spring, each of said auxiliary spring loading means comprising a pair of loading springs, and each of the loading springs in said auxiliary spring loading means having one-half the stiffness of the loading springs in said main spring loading means.

7. In a warp tension control means, a tension bar over which the warp threads are trained, main arms adjacent the ends of the tension bar for pivotally supporting the tension bar, auxiliary arms intermediate the main supporting arms for pivotally supporting the tension bar, a helical spring employed in torsion adjacent each of the main supporting arms for loading the tension bar, and pairs of helical springs employed in torsion positioned on each side of the auxiliary supporting arms for loading the tension bar.

8. In a warp tension control means, a pair of main frame members, auxiliary frame members intermediate said main frame members, a tension bar over which the warp threads are trained, main arms adjacent the main frame member for pivotally supporting the ends of the tension bar, auxiliary arms intermediate the main supporting arms and adjacent the auxiliary frame member for pivotally supporting the tension bar, a helical spring employed in torsion adjacent each of the main supporting arms for loading the tension bar, and pairs of helical springs employed in torsion positioned on each side of the auxiliary supporting arms for loading the tension bar, one end of each of said loading springs being operatively fastened to the supporting arm adjacent thereto, and the other end of each of said loading springs being adjustably fastened to the frame member adjacent thereto.

9. In a warp tension control means, a pair of main frame members, auxiliary frame members intermediate said main frame members, a rotatable shaft mounted between said frame members, a tubular tension bar over which the warp threads are trained positioned in front of and parallel to said shaft, main arms fastened to said shaft adjacent the main frame members for pivotally supporting the tension bar, auxiliary arms fastened to said shaft on each side of the auxiliary frame members for pivotally supporting the tension bar, a helical spring employed in torsion encircling the shaft adjacent each of the main frame members for loading said tension bar, said spring having one end fastened to said shaft and the other end adjustably fastened to the main frame member adjacent thereto, pairs of helical springs employed in torsion encircling the shaft on each side of the auxiliary frame members for loading said tension bar, said springs having one end fastened to said shaft and the other end adjustably fastened to the auxiliary frame member,

each of the loading springs adjacent said auxiliary frame members having twice as many turns as the loading springs positioned adjacent the main frame member, all of the loading springs having their windings disposed in alternately opposite directions, and oil-impregnated bushings mounted on said shaft internally of each of the loading springs for lubricating the loading springs.

10. In a warp tension control means, a movable tension bar over which the warp threads are trained, main spring loading means operatively connected to said tension bar, and auxiliary spring loading means operatively connected to said tension bar, each of said main spring loading means comprising a single loading spring, and each of said auxiliary spring loading means comprising a pair of loading springs.

11. In a warp tension control means, a rotatable shaft, spaced arms mounted on said shaft, a tension bar over which the warp threads are trained carried by said arms, and a helical spring encircling said shaft having one end fixed and the other end operatively connected to said shaft for loading said tension bar whereby the motion of the tension bar will apply a torsional stress to said spring.

12. In a warp tension control means, a rotatable shaft, supporting means fixed to said shaft, a tension bar over which the warp threads are trained carried by said supporting means, a helical spring encircling said shaft having one end operatively connected to said shaft for loading said tension bar whereby the motion of the tension bar will apply a torsional stress to said spring, a member engaging the other end of said spring and screw means for moving said member for adjusting the loading of the tension bar.

13. In a warp tension control means, a rotatable shaft, supporting means fixed to said shaft, a tension bar over which the warp threads are trained carried by said supporting means, a plurality of helical springs encircling said shaft and having their windings disposed in alternately opposite directions, each helical spring having one end fixed and the other end operatively connected to said shaft for loading said tension bar whereby the motion of the tension bar will apply a torsional stress to said springs, and screw means for shifting the relative position of the ends of the spring for adjusting the loading of the tension bar.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
410,505	Eck	Sept. 3, 1889
671,534	Bartlett	Apr. 9, 1901
745,240	Rolland	Nov. 24, 1903
745,449	Mayo	Dec. 1, 1903
1,790,201	Davis	Jan. 27, 1931
2,308,430	Bolden	Jan. 12, 1943
2,327,747	Sirmay	Aug. 24, 1943
2,448,035	Lambach	Aug. 31, 1948