

Dec. 6, 1932.

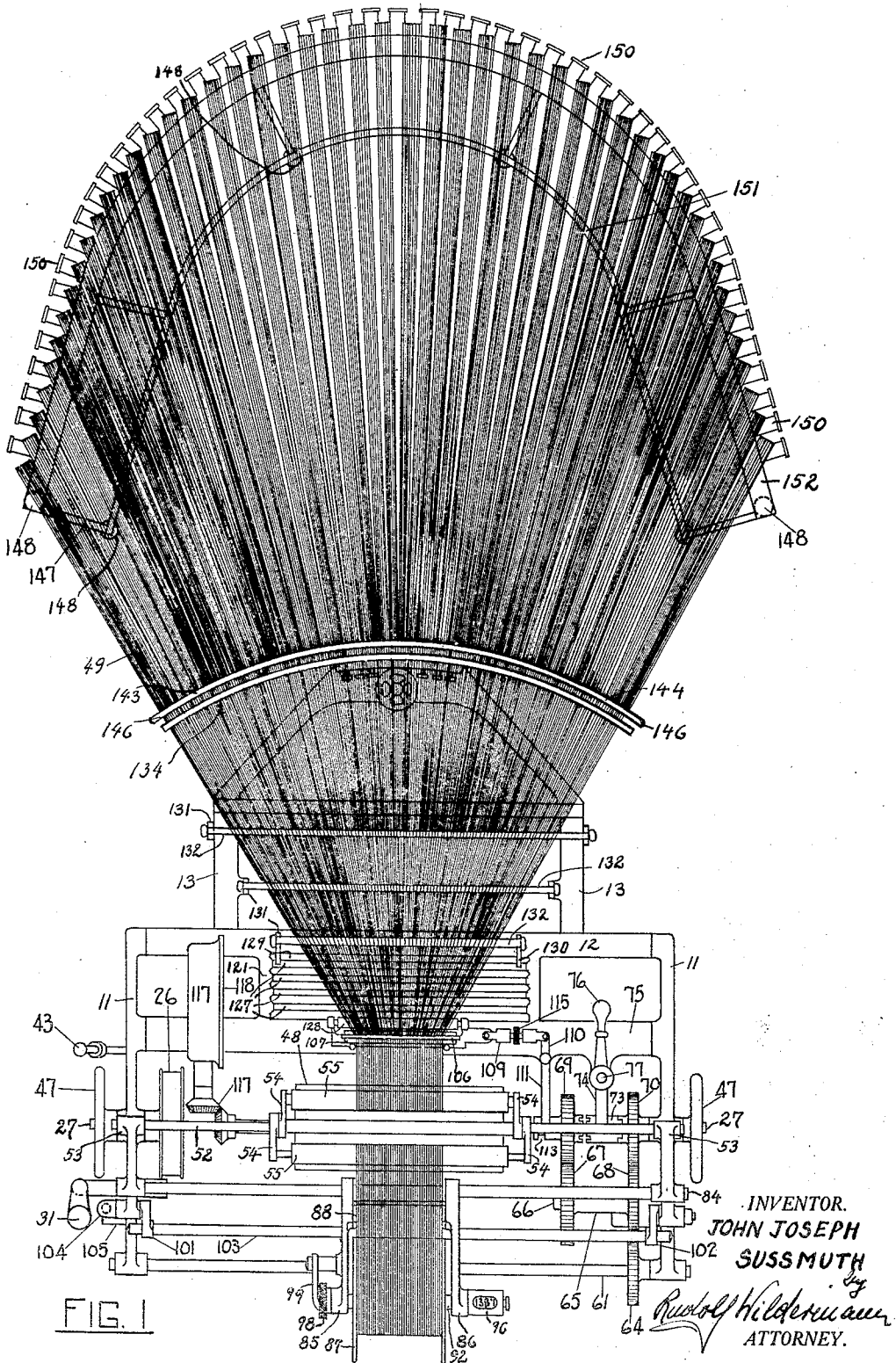
J. J. SUSSMUTH

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WARPER

Filed Jan. 13, 1930

3 Sheets-Sheet 1



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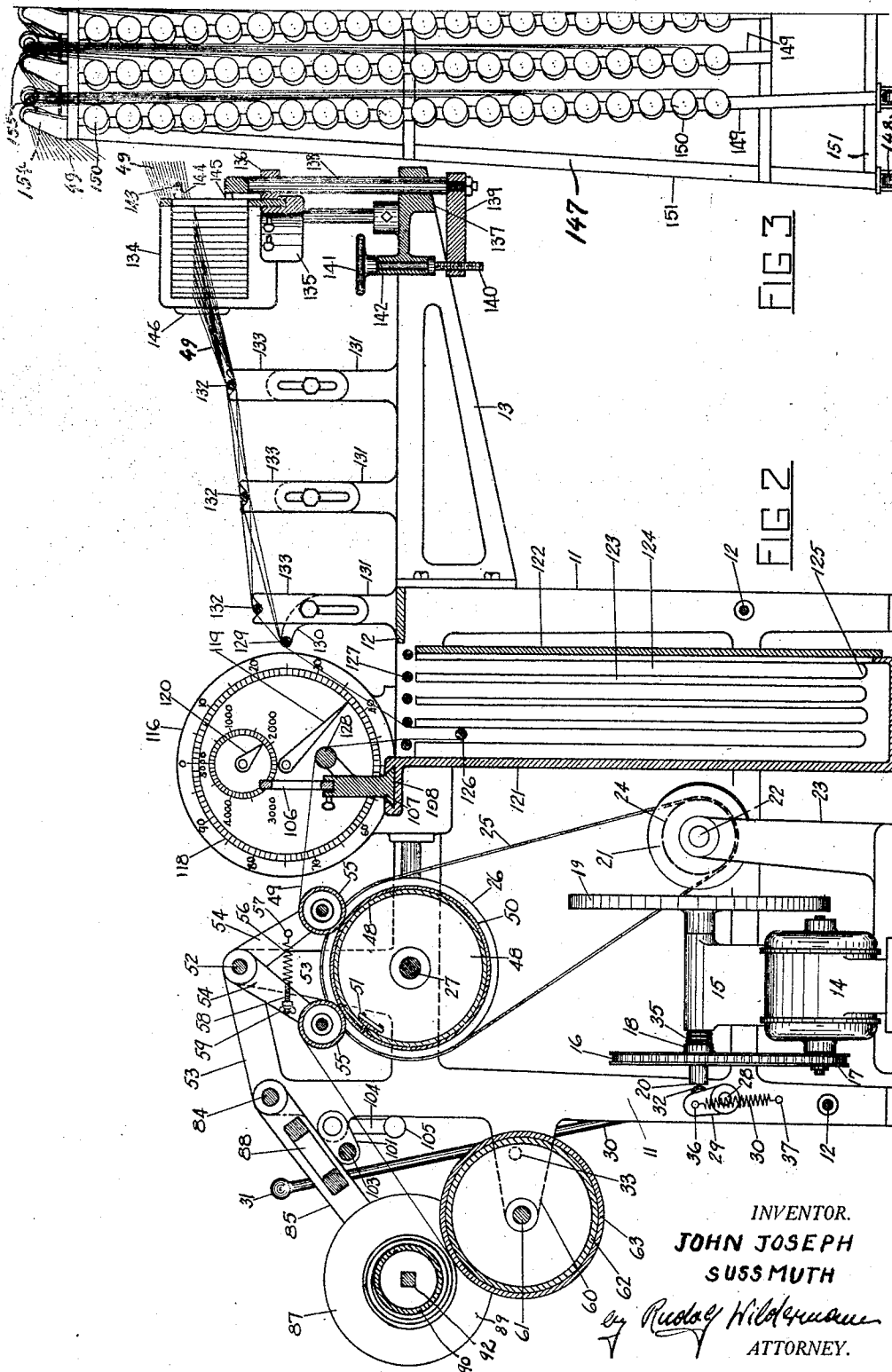
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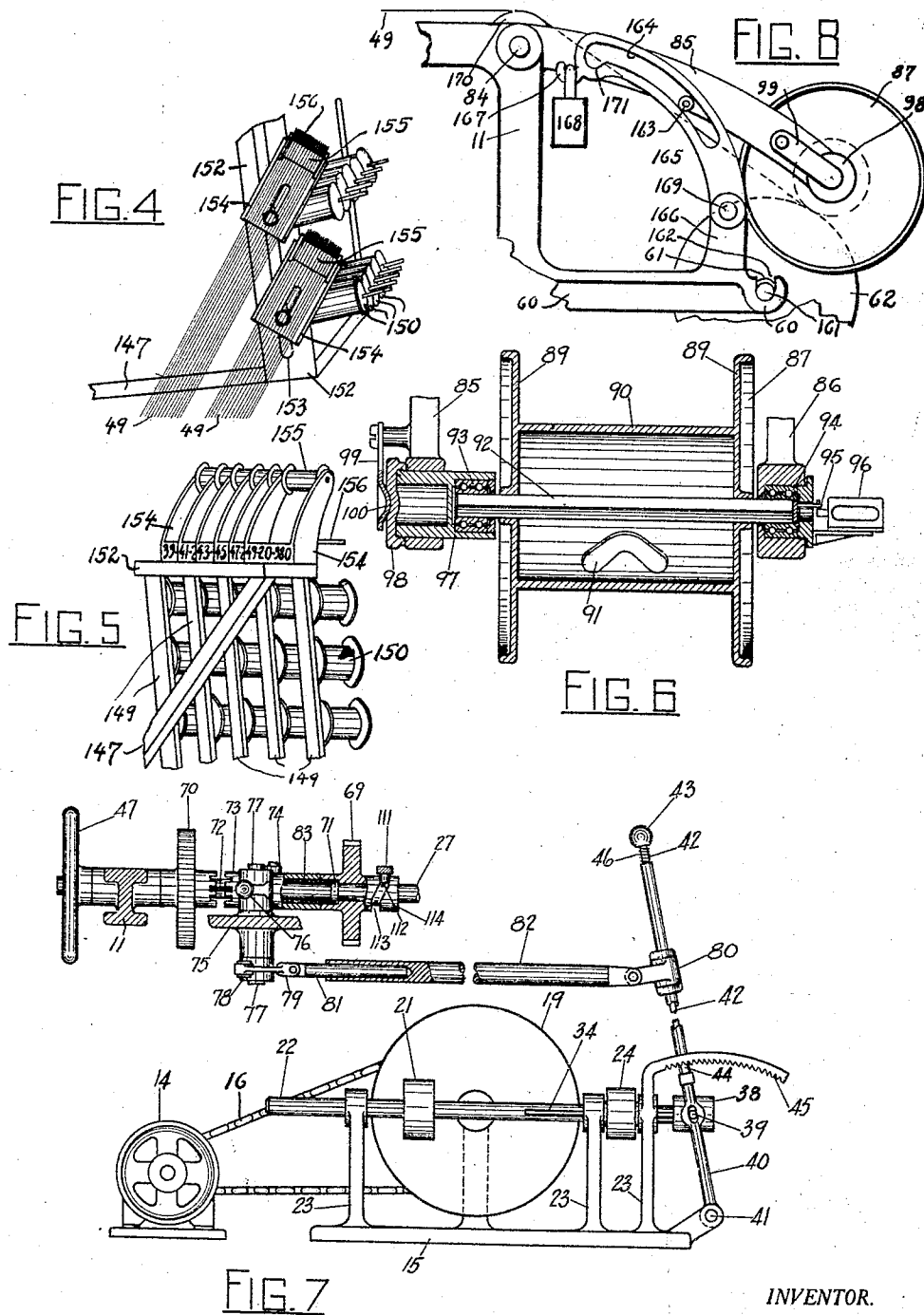
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WARPER

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My invention relates to the textile industries; it concerns a warper for all kinds of yarns and is in particular adapted for the warping of rayon.

A multitude of objects have influenced the development of this machine, some of which are the following:

First, to provide a step in rayon manufacture by which sections which make up a beam for the sizing operation are synchronously wound, directly from a creel. For the textile industry, in general, I have thereby provided a so-called "direct beaming" method.

Second, to warp a yarn directly from a creel onto a beam section, corresponding layers of yarn which are successively wound on different beam sections containing substantially the same length of yarn.

Third, to provide, in connection with a warper, a creel, from which a multitude of threads are led into the warper under substantially equal tension.

Fourth, to provide, in connection with a warper, a creel, from which a multitude of threads enter upon the warper in substantially the direction in which they are warped, without subjecting the threads or some of the threads to excessive friction in guide means.

Fifth, to provide novel means for taking the lease on the lease reed through which the threads radially enter from a creel upon the warper.

Sixth, to provide a system for arranging and aligning spools on a creel and for marking the means guiding threads from said spools, thus facilitating the arrangement of the correct number of spools in the most suitable location on said creel and for enabling the operator to locate the origin of a broken thread, or of a thread which is to be followed up from the warper to the spool from which it comes for other purposes.

Seventh, to wind substantially aligned layers of threads from a creel onto a beam section in substantially the same relative arrangement in which those threads are taken from a creel.

Eighth, to wind threads from a creel through a drawing device, which takes the threads from a creel by a positive feeding

operation, subjecting all threads to substantially equal tension.

Ninth, to combine exact measuring means with the drawing means of the warper.

Tenth, to feed threads in a warper from positive drawing means under substantially equal tension onto a beam section.

Eleventh, to provide means for spreading a layer of threads onto a beam section, said layers being substantially uniform in width, thickness, and in respect to the tension of the threads making up each layer.

Twelfth, to provide a very light transverse movement in the operation of feeding layers of threads onto a beam section in order to keep each layer perfectly leveled.

Thirteenth, to provide return means on a warper, by means of which one or more layers wound onto a beam section may be unwound, the unwound threads of the layers being retained in substantially the same respective alignment.

Fourteenth, to provide return means on a warper, by means of which one or more layers, wound onto a beam section, may be unwound therefrom, the tension of the threads of the layers, when said layers are unwound, being kept substantially uniform and equal to the tension at which they had been wound onto said beam section.

To attain these and other objects I make use of the apparatus illustrated in the accompanying drawings in which,

Figure 1 shows in a top view, my warper and a creel aligned behind it.

Figure 2 shows a side elevation of a warper, the warper being substantially bi-sectioned longitudinally, so that substantially only the left half of the warper of Figure 1 is seen.

Figure 3 shows, in a side view, the right end (Figure 1) of the creel. This view of the creel corresponds to the view of the warper shown in Figure 2, so that the parts shown by these two figures may operate in unison when they are suitably spaced apart laterally.

Figure 4 shows a top view of the end of the creel, which is shown in Figure 3.

Figure 5 shows, in a corresponding front view, the respective upper end of the creel.

Figure 6 shows in an enlarged front view

the manner in which a beam section is mounted in the warper.

Figure 7 shows, in a rear view, some parts of the drive, of the speed change, of the main shaft and of the shifting means which connect the speed change to the clutch on the main shaft.

Figure 8 shows, in a sectional view, taken from the left side of the machine, a modification of the warping means and of tension means which I use in connection therewith.

Similar numbers refer to similar parts throughout the various views.

The warper consists of a frame, which arises from the floor to a convenient operating level and which is indicated in the drawings by two substantially similar sides 11, which by tie rods and members 12 are solidly spaced apart, and between which the operating parts of the machine are suspended and mounted. The frame 11 has in the back an extension 13 which carries the lease parts of the warper.

As driving means for the mechanism of my warper I show a motor 14, which is belted or otherwise operatively connected to a speed change 15, such connecting means being indicated in the drawings by a chain 16 connecting a sprocket 17 on the end of the motor shaft to a sprocket 18 on the speed change 15. The sprocket 18 drives a friction disc 19, which is mounted on a common shaft 20 therewith. A friction pinion 21 is mounted upon a traverse shaft 22, which is rotatable in the three brackets 23 on the speed change, at right angles to the shaft 20. Slidable on shaft 22 along a keyway 34, laterally retained between two of the three brackets 23, is arranged the pulley 24, from which an endless belt 25 transmits power to the driving pulley 26 on the main shaft 27 of the warper.

A certain amount of axial play is provided in the shaft 20 and it incorporates tension means 35 which lightly tension it, normally, away from the friction pulley 21. A stud 28 is rotatably mounted in one side 11 of the frame. It carries on the inside of the frame an arm 29 extending vertically upward from the stud 28, and, on the outside of said frame, a handle 31 which extends upwardly, substantially in alignment with the arm 29, and by the shifting of which a ball 32 which is rotatably retained in arm 29, can be brought to bear against the ends of the shaft 20. When the ball 32 rests upon the end of shaft 20, the spring 30 extending between hook 36 on arm 29 and pin 37 on frame 11 provides tension, so that the friction disc 19 is frictionally and operatively engaged by the friction pinion 21. When the handle 31 is shifted away from the speed change 15, it rests against a stud 33 outwardly extending from one of the sides of the frame, and the endwise pressure of shaft 20, which brought about the frictional engagement be-

tween friction disc 19 and friction pinion 21, is released.

On the end of shaft 22 is mounted a collar 38 which has an annular groove around its periphery upon which slidably engage the pins 39 extending thereinto from a forked part of shift lever 40. The lever 40 is fulcrumed at its lower end upon a pin 41. A rod 42 with a handle 43 on its end is slidable in the upper hollow end of shift lever 40. A peg 44 is mounted upon a lateral extension of the lower end of the rod 42 and it is adapted to engage in notches on a segment 45 which extends from one of the brackets 23 and which extends concentrically around fulcrum 41. The compression spring 46, extending around the rod 42 between the handle 43 and the upper end of the shift lever 40, tensions the rod 42 upwardly, so that normally the peg 44 engages upon the notches segment 45, the peg 44 being disengaged from those notches, when the operator presses down the handle 43 for the purpose of axially shifting the shaft 22 by means of lever 40. The friction speed change operates in the manner known to those acquainted with the respective art: a shift of lever 40 will bring about a traverse movement of friction pinion 21 in front of the friction disc 19. When friction pinion 21 is engaged upon friction disc 19, it will rotate faster or slower, while the disc 19 is rotating at a fixed rate of speed, according to whether said friction pinion 21 is frictionally engaged by the friction disc 19 at a point further away from or closer to the shaft 20. The main shaft 27 is journaled in the sides of the frame 11 and is endwise retained by the hand wheels 47 on the ends thereof, which permit the operator to rotate the main shaft, when it is to be turned to any desired position. Upon said shaft is mounted the cylindrical drawing drum 48. The periphery of the drum is adapted to hold in frictional engagement yarn or a layer of yarn 49, which is fed around it. Means for thus firmly engaging upon the yarn are indicated in the drawings by a covering of baize 50, which is evenly spread over the cylindrical surface of the drawing drum and the ends of which are fastened in a longitudinal slot in said drawing drum or are pulled therethrough and clamped onto the inside of the cylindrical drawing drum by a clamp 51.

Substantially vertically above the shaft 27 a rod 52 extends transversely to the machine and is fixedly mounted in extensions 53 of the sides of the frame. Onto shaft 52 are swingably hinged two pairs of levers 54, which carry at their ends the two idler rollers 55 which are rotatably disposed substantially parallel to the drawing drum 48 and which remain parallel to said drum, when they are swung towards or away from it. The two rollers 55 are pulled in a direction towards each other by springs 56, one end of which

is fastened upon hooks 57 on one pair of said levers 54. The other ends of the springs are connected to the ends of threaded studs 58 which are slidable in ears upon the sides of the other pairs of levers 54. Wing nuts 59 retain the threaded studs 58 in said ears and rotation of the wing nuts upon the threaded studs serves to increase or decrease the tension with which the spring 56 pulls the two sets of levers 54 towards each other; this permits regulation of the pressure with which the idler rollers 55 rest upon the surface of the drawing drum 48.

A pair of extensions 60 which frontwardly protrude from the sides of the frame, rotatably and removably support the shaft 61, upon which is fixedly mounted, near its center, a cylindrical friction drum 62 the surface of which is covered with a concentrically disposed layer of rubber 63. The shaft 61 is connected, by a train of gears 64, to a gear unit 65, which is rotatably supported by stud 66, mounted upon the inside of one of the sides of the frame. The gear unit 65 consists of a larger and a smaller gear 67 and 68; these are solidly connected to each other and they, respectively, mesh into a smaller gear 69 and a larger gear 70 which are freely rotatable upon the main shaft 27, but which are endwise retained upon said shaft by suitable collars 71 and by the adjoining parts arranged upon said shaft, against which they rest in slidable abutment.

Between the gears 69 and 70 the shaft 27 is provided with a feather keyway 72 in which, as well as upon the shaft 27, is slidable a clutch 73, the cylindrical circumference of which is provided with an annular groove upon which slidably engage studs mounted in the free ends of the forked bracket 74. That bracket is provided with a handle on the other end and it is fulcrumed by means of a vertical shaft 77 in a cross piece 75 extending from one side to the other side of the frame. The shaft 77 carries at its lower end a lever 78. The free end of lever 78 carries a universal joint or knuckle 79 and a similar knuckle 80 is rotatably mounted upon the shaft lever 40 at about the same height from the floor. By means of the knuckle 79 a rod 81 is hinged upon the free end of lever arm 78. The free end of that rod is slidable in a hole which longitudinally extends, to a certain depth, into a larger rod 82. The rod 82 is hinged, by means of the knuckle 80, upon the shift lever 40.

The faces of the two ends of the clutch 73 are provided with teeth extending endwise therefrom so that the clutch 73 may be called a double face tooth clutch. The faces of the hubs protruding from the ends of the gears 69 and 70 are similarly provided with teeth which are adapted to match the teeth of the clutch 73. Shifting the forked bracket 74 back and forth, either by the handle provid-

ed on the end thereof, or by shifting the handle 40, which is operatively connected therewith, the clutch 73 may be brought into positive engagement with the gear 69 or the gear 70, thus alternatively providing a positive gear connection between the shaft 27 and the shaft 61, either by way of the gears 67 of the gear unit 65 which is connected by the gear train to the gear 64 on shaft 61, or by way of the gears 70, 68, and by means of the same gear train from there to the gear 64. Gear 69 being smaller than gear 70 and gear 67 being correspondingly larger than the gear 68, a slightly slower speed will be imparted to shaft 61, when the clutch is engaged upon the gear 69, than is imparted thereto from the shaft 27, when the clutch 73 is engaged upon the gear 70.

A compression spring 83 is disposed around the shaft 27, is accommodated in countersunk holes in the clutch and in the hub of gear 69 and is compressed between the collar 71 on the shaft 27 and the clutch, resting upon the bottom of the hole countersunk into said clutch. The tension of this spring tends normally to shift the clutch 73 towards the gear 70, and to engage it thereupon. In the position shown in Figure 7 the clutch 73 is engaged upon the gear 69, being shifted into such engagement against the tension of spring 83. The clutch 73 is held in such engagement with the hub of the gear 69, since the shift lever 40 is swung clockwise to the left and held in the position shown by the peg 44 engaged in notches of segments 45. In this position of the lever 40 the friction pinion 21 faces the left half of the friction disc 19 and a reversed rotation is imparted by means of pulleys 24 and 26 to the drawing drum 48, if, in the position shown in Figure 7, friction pinion 21 and friction disc 19 are brought into frictional engagement. In this position of shift of the driving mechanism the peripheral speed of the cylindrical friction drum 62, the shaft 61 of which is positively geared to shaft 27 by way of gear 69, is slightly lower than the peripheral speed of drawing drum 48, which is mounted on shaft 27.

When the lever 40 is now shifted in clockwise direction, to the right, (Figure 7), the clutch 73 follows that movement, being pushed out of engagement with the teeth on the hub of gear 69 by the pressure of spring 83, and will be fully disengaged therefrom when the friction pinion 21 is in a substantially neutral position, substantially in alignment with a vertical center line of friction disc 19. When the lever 40 is now shifted further to the right, the clutch 73 engages upon the teeth on the end of the hub of gear 70, the friction pinion 21 moving at the same time to the right into a position in which it faces the friction plate 19. The clutch 73 being now engaged upon the gear 70, no

further lateral movement of clutch 73 to the left can take place; and the rod 82 will slide along rod 81, the latter one being partly withdrawn from the hole in rod 82, when the lever 40 is additionally shifted in clockwise rotation to the right, for the purpose of bringing the friction pinion 21 into alignment with a larger diameter of the friction disc 19. In other words, when the friction disc 21 is shifted to the right and to the left in front of the right half of friction disc 19 for the purpose of increasing and decreasing the speed at which the main shaft 27 is driven from the motor 14, such shifting does not affect the clutch 73, which remains engaged in the gear 70, the rod 82 sliding back and forth on the rod 81. Operation of lever 40 will again be transmitted to the clutch, when the lever 40 is shifted so far in counterclockwise direction, to the left, that friction pinion 21 passes from a position in front of the right half of friction disc 19 to a position in front of the left half of said disc and the rod 81 strikes the bottom of the hole in the end of rod 82, so that during further movement to the left of lever 40 the clutch 73 is disengaged again from gear 70 and comes into engagement with the gear 69, when the friction pinion 21 has been shifted into a position in front of the left half of friction disc 19.

During the normal operation of the warper the clutch 73 is engaged upon the gear 70, and the rotation of the shaft 27 is positively transmitted by means of said gear through the intermediate gear train to the shaft 61 in such manner that the peripheral speed of the cylindrical friction drum 62 is slightly higher than the peripheral speed of drawing drum 48. Therefore the peripheral speed of the cylindrical friction drum 62 leads or lags, respectively, in respect to the peripheral speed of drawing drum 48, when the warper feeds the yarn 49 to the front during its normal operation, or when its direction of rotation is reversed, which conditions, respectively, correspond to engagement of clutch 73 upon gears 70 or 69, and to a position of friction pinion 21 in front of the right half or of the left half of the friction disc 19 (Figure 7).

Upon a rod 84 which fixedly extends from side to side of the frame 11 of the machine, at the front and top thereof, are hinged the lever arms 85 and 86 which are adapted to rotatably support the section drum 87. The levers 85 and 86 are fixedly disposed in respect to each other by a spacing yoke 88, removably clamped therebetween. That yoke may be replaced by wider and narrower yokes, according to the width of the section drum to be rotatably supported for winding purposes between the levers 85 and 86. It may also be replaced by heavier or lighter yokes according to the weight with which

the section drum is supposed to rest upon, and to be frictionally engaged by, the cylindrical friction drum 62 below.

The flanges 89 of the section drum 87 are spaced apart by a tubing 90, which is carefully fitted against the inner sides of the rigid flanges and which is preferably substantially integrally connected thereto. The distance between the flanges 89 is substantially equal to the width of the rubber layer 63 covering the cylindrical friction drum 62. If wider or narrower section drums are to be beamed, correspondingly wider or narrower cylindrical friction drums 62 are mounted, in alignment therewith, in the brackets 60. If a certain number of section drums of different width are to be used in the warper, the corresponding cylindrical friction drums may be mounted upon similar shafts 61 and the one corresponding to the width of the section drum to be used may be mounted in alignment therewith, the respective shaft 61 being rotatably suspended between the two brackets 62 of my machine.

A suitable slot 91 is provided in the tube 90 to allow the end of a warp 49 to be fastened thereupon. To be able to determine, after a number of layers have been placed onto the tube 90, the exact starting point, from which they have been wound onto the section drum, I place a mark upon the outside of one of the flanges 89 in substantially radial alignment with slot 91.

Square holes are centrally disposed in the flanges 89 of the section drums 87; into those holes removably fits a square arbor 92; the ends of said arbor 92 are removably placed into correspondingly square holes in the inner races of the ball bearings 93 and 94, which retain said arbor in alignment with the rotative operating parts of the warper. The ball bearing 94 is fixedly mounted in the lever 86 and means 95 extend from its inner race which engage upon a revolution counter 96. That counter is mounted in alignment with arbor 92 upon the lever 86 and it is of the set-back type which allows the counter to be set back to a zero position whenever a new beam section is to be warped. The ball bearing 93, which retains the other end of the square arbor 92, is mounted in a plug 97 which is slidably supported by lever 85. The plug 97 has a flange 98 at its outer end, by means of which the plug may be gripped by the hand of the operator and which allows the plug to be inserted in the lever 95 to a fixed distance.

A tension member 99 is swingably pivoted upon the lever 85; its free end 100 may be swung onto and away from the flange 98 at the end of plug 97, said tension member serving to tensionally retain the plug in position in lever 85, the flange 98 abutting upon said lever. When the plug is thus positioned in the lever 85, the ball bearings 93 and 94 are

in alignment with each other and at a fixed distance from each other in which a suitable transverse play is allowed for the section drum 87 upon the arbor 92, so that the section drum may align itself with the cylindrical friction drum 62 below.

A pair of cranks 101 and 102 are rotatably retained upon the two sides of the frame 11. An off-set rod 103 solidly connects the free ends of said cranks and a handle 104, which is provided upon the outside of the frame, is operatively connected to crank 101. Since the weight of the off-set rod 103 imparts a counterclockwise momentum (Figure 2) to the cranks, a horizontal arm 105, inwardly extending from handle 104, normally rests against frame 11. When the off-set rod 103 is in its lowest position, as substantially shown in Figure 2, it clears the levers 85 and 86, so that the weight of said levers together with the section drum supported therebetween normally rests upon the cylindrical friction drum 62 below. But when a warp has been finished, the off-set rod 103 is swung upward, the handle 104 being rotated in clockwise direction by the operator (Figure 2). When thus swung upward, the rod 103 engages upon the bottom edge of levers 85 and 86 and swings them upward, in clockwise rotation around shaft 84, the section drum being lifted off the cylindrical friction drum 62. When swung as high as possible, the rod 103 lodges or wedges between the levers 95 and 96, and the frame and retains the section drum in a raised position. The section drum 87 now being disengaged from the cylindrical friction drum 62, the end 100 of the tension member 99 is swung away from the flange 98 and the operator withdraws the plug 97 from the lever 85 whereupon he can take the section drum 87, together with the square shaft 92 located therein, off the warper.

The front reed 106 is arranged in substantially transverse alignment with the cylindrical friction drum 62; the warp passes from said front reed around one of the rollers 55; it is slung around the lower extent of the drawing drum 48, and it passes over the second roller 55 onto the lower extent of the section drum 87, which is in frictional engagement with the cylindrical friction drum 62. The front reed 106 is mounted in the front reed support 107, which is transversely slidable in a dove-tail slide 108; that slide forms part of the cross piece 75 extending between the two sides of the frame 11.

A turn buckle 109 is hinged upon one side of the front reed support 108. The free end of the turn buckle is hinged upon a short arm of lever 110 which is fulcrumed upon the cross piece 75. The long arm 111 of the lever 110 carries a roller 112 at its end. That roller is disposed vertically downward and

it is engaged upon a groove 113 of the cylinder cam 114. The groove 113 around the cam 114 consists of two oppositely disposed helical halves so that rotation of shaft 27 imparts an evenly reciprocating traverse motion to the front reed 106, said motion extending over a comparatively short traverse distance because the lever arm 111 is very much longer than the arm of lever 110 which connects by means of turn buckle 109 to the front reed support 108. Rotation of the knurled wheel 115 lengthens and shortens the turn buckle and offers means for an accurate adjustment of the front reed 106 in alignment with the cylindrical friction drum 62.

The diameter of the baize covered drawing drum 48 is substantially such that one turn of the main shaft 27 draws one yard of the warp through the machine. The counter 116 is geared at a ratio of 100/1 by means of intermediary gearing 117 to the main shaft 27 so that one division of the graduations of dial 118 is registered by the hand 119, when the shaft 27 is turned once. A smaller dial and hand 120 which is geared to the counting mechanism, serve to compound the registrations of dial 118, so that the total yards of a complete warp may be conveniently read off the counter 116.

According to the practice commonly followed in an accurate linear measurement of goods going through a manufacturing process, the hands 119 and 120 may be set at any angle, because they are frictionally engaged upon the positive gearing operating the counter.

For the purposes of finding the ends of yarns, which owing to a breaking of the yarn or due to inadvertence of the operator have been wound onto the beaming drum, it is at times necessary to unwind a certain number of layers of the warp, which have been wound onto the section drum. Means for reversing the driving mechanism for this purpose have been described above. But it is advisable to provide special means for taking up the warp which is wound off the section drum and which has to be accommodated in some manner between the creel and the drawing drum. It has been the practice heretofore to roll up the returned warp onto the hands of the operator, or to wind it around a bobbin. Such handling and rewinding may be injurious to the yarns and it is invariably injurious to the filaments of rayon—if the machine is used for the warping of rayon. To prevent handling of the yarn or other damage which may be inflicted thereupon during the return operation I have invented a return device as part of my warper:

A closet-like fixture 121 is arranged below the machine which is substantially closed upon four sides and at the bottom, one of said sides being closed by a door 122 which enables

the operator to approach the inside of this fixture. Rails 123 are arranged upon the insides of said fixture, near the sides of the frame 11. These rails form vertically disposed troughs 124 which are closed at their lower ends 125. The opposite sides, upon which these troughs are arranged being substantially parallel, rods 126, of substantially a diameter of the width of the troughs and of a length equal to the distance between the bottoms of troughs registering with each other on opposite sides of the fixture, may slide or roll up and down between said sides. Above the upper ends of the rails 123 the rolls 127 extend, parallel to each other, across the fixture; they are rotatably supported upon the opposite sides of the fixture in anti-friction means. The rollers 127 are substantially of the width of the rails 123, so that the rods 126 may be introduced therebetween into the fixture from the top thereof. Substantially above the front wall of the fixture 121 a roller 128 is anti-frictionally supported upon the front reed support 107. In substantial alignment with the back wall of the fixture a rod 129 is transversely mounted between extensions 130 of one set of the lease rod stands 131.

When the operator reverses the driving mechanism of the warper to find a lost end which has been wound onto a section drum, he lays a rod 126, substantially at right angles to the direction in which the warp is wound, onto the warp, next to the anti-friction roller 128. While the warp is returned from the drawing drum 48, the rod 126 pulls the warp, upon which it rests, downward between the rod 129 and the roller 128, the warp running into said space over the rotating roller 128, and the operator guides the rod 126, as it descends, into the space between two rollers 129 at the top of fixture 121. The rod 126 is guided by the troughs 124 as it descends in the fixture. When it approaches the lower ends 125 of the troughs and the lost end of the yarn has not been unwound yet from the section drum, the operator places a second rod 126 across the warp above the fixture and allows that rod to descend between two other rollers 129, and between the respective, oppositely disposed troughs 124. A considerable length of the warp may thus be accommodated in the return device. When the lost end has been found and the respective yarn coming from the creel has been tied thereto, the rods 126 are automatically lifted out of the return device by the pull of the drawing drum, as soon as the warper is caused to resume its normal frontward operation and the operator lifts the rods 126 off the warp, when they have been lifted by the warp to substantially a height at which the warp normally passes from the lease rods through the front reed onto the drawing drum.

The lease rods 132 are supported, upon both sides of the machine, by brackets 133, which

are adjustably mounted upon the lease rod stands 131. The cross reed 134 has an arcuate shape and it is mounted upon a stand 135 at the rear end of the warper, substantially centrally, so that the yarns pass from the creel to the warper substantially radially through said reed. The cross reed 134 is adjusted at the height at which the yarns pass from the creel to the warper over the rear end of the warper. In the rear of the stand 135 is a lug 136 with a hole, which registers with a similar hole in a lug 137 at the rear of the extension 13 of the machine below. In these two holes the rod 138 is adapted to slide up and down. From the lower end of the rod a cross arm 139 extends towards the front of the machine. The free end of arm 139 has a tapped hole upon which engages the thread of a screw 140.

This screw 140 extends from the lower end of a hand wheel 141 which is vertically rotatably mounted in a hub 142 extending up and down from the extension 13. Rotation of the hand wheel 141 will raise and lower the rod 138 and with it the frame 143, which it carries at its upper end. The frame 143 is substantially a rod bent into an endless loop, the upper and lower members 144 and 145 of which extend in substantially horizontal alignment, parallel to each other and arcuately, concentric to the cross reed 134. Near the ends of the reed 134 the upper member 144 of the frame 143 connects to the lower member 145 by vertical members 146.

The crescent creel 147 is provided with casters 148, by means of which it may be moved from its position in the rear of the warper to a charging position, where the spools may be mounted thereon. The creel comprises a substantially hyperbolically disposed outer wall, which converges towards the top and which is substantially made up of a number of almost vertical, parallel flats 149 which carry upon suitably inclined pins the spools 150. Upon the inside of the creel a frame structure 151 extends substantially parallel and concentric to its outer wall and serves to give to it structural strength. The outer wall of the creel is topped off with a narrow platform 152, which extends along substantially the whole extent of said wall, and which is provided with longitudinal slots along which the brackets 154 may be adjusted in a position of alignment with the yarns passing thereover to the warper.

The brackets 154 freely rotatably support in their upper forked ends the rollers 155 over which pass the yarns from the spools to the warper. The flats 149 are slightly tilted to the left, (Figure 3), and the brackets 154 are arranged in the slots 153 in such a manner that the rollers 155 align with the threads, which are carried from the spools 150 on the flats 149 below, substantially vertically upward over said rollers.

At right angles to the plane, in which the yarns run upward from one row of spools onto the roller above, a comb 156 extends from the bracket 154. The teeth of the comb are disposed over an area of substantially the width of the face of the rollers 155 and they serve to guide the yarns in substantially evenly spaced fashion onto the rollers. Stop means may take the place of combs on the various brackets; such stop means give an alarm when a yarn breaks or has run off and are familiar to those acquainted with the art of textiles.

Each one of the brackets 154 is provided with two number plates mounted on the base of the bracket, in the front and in the back thereof. The numbers on these plates can be seen and read by the operator of the warper from his position in front of the warper and similar numbers may be read off on the different brackets from similar plates by a person standing on the sides and in the back of the creel, where the spools are mounted thereon. The yarns from the spools, which are aligned in a row upon a flat below a bracket, may be readily identified by an observer who stands in either of the above positions.

I number the different brackets, starting from the center of the creel, and using even numbers for the brackets which are disposed to the left from the center line of the warper and creel, and odd numbers for the brackets disposed to the right thereof. Next to these alternately consecutive numbers I mark on the number plates the number of ends which are fed over the roller 155 carried by the respective bracket, which number ordinarily corresponds with the number of spools mounted on the flat 149 below said roller. In the drawings I have arranged a row of twenty spools upon each flat 149 and the number 20 is therefore marked next to the alternatively consecutive number. Next to this spool number I mark on the number plate the total number of ends which have been allocated to the brackets, the consecutive numbers of which run below the alternatively consecutive number of the bracket considered. In this fashion, starting out from the center line of the creel, the number plates on consecutive brackets carry the following numbers:

Toward the left side	Toward the right side
2—20—40	1—20—20
4—20—80	3—20—60
6—20—120	5—20—100
8—20—160	7—20—140
etc.	etc.
50—20—1000	49—20—980

The last markings belong to the plates on the brackets to the extreme left and right of a creel which is equipped to carry a thousand spools.

The method of use of the creel may best be explained in connection with an example.

Assuming that a very narrow sample warp comprising 250 threads or ends is to be made, I charge on the creel the rows below the brackets 154, which are marked with the following consecutive numbers: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12. The number plate on the bracket corresponding to the last one of those rows reads 12—20—240, and indicates that 240 spools of yarn have been mounted upon the creel, after the corresponding row has been charged with spools. I then place ten spools upon the row below the bracket marked by the consecutive number 13, on the right side of the creel; and I thereby have placed 250 spools centrally, onto the creel. The ends of the various spools are now pulled up to pass, spacedly, between the teeth of the combs or through the stop means and from there they are slung,—over the rollers 155, which are freely rotatably supported by the brackets 154,—towards the inside of the creel. It will be noted that the rows of spools are spaced apart to such a distance and in such an alignment with the rollers 155 above, that none of the ends taken from consecutive spools interfere with each other, come into touch with the spools of the row of spools they are taken from, nor with those of the adjacent row of spools. The ends from the spools arranged in one row all pass over one roller 155, the circumference of which is engaged by the ends and it is rotated at a peripheral speed equal to the speed at which the drawing drum feeds the warp through the warper. But not only do those ends engage the circumference of the roller 155, but the converse takes place, the rotation of the roller is steadied thereby, and the various ends passing over one roller extend at substantially the same tension from said roller into the warper, whereas they extend at various degrees of looseness and tightness between said roller and the spools they are taken from, according to the manner and ease with which the ends runs off the various spools at various times.

The operator now walks into the space which is partly surrounded by the creel, takes the ends of the yarns which previously have been passed over the rollers 155 and feeds them through the cross reed 134. In this case again the operator preferably proceeds in his work by starting from the center, taking the ends hanging over the roller 155 supported by the bracket 154, which is identified on the respective number plate as 1—20—20. These ends he feeds through the cross reed directly to the right of the center line of the machine; then he feeds the ends hanging over the roller of bracket 2—20—40 directly to the left of the center line of the machine through the cross reed and continues to pull the rest of the ends hanging over the other

12 rollers proceeding outwardly, to the right and left through the cross reed.

Mounting the spools of yarn required for a certain warp on a creel requires a certain time, during which the warper may be in operation, the yarn being fed onto the warper from another crescent creel standing in alignment therewith. I have provided casters below the crescent creel by means of which it may be moved sideways, or in any other direction, to a space out of the way of the machine, where the spools for making a certain warp may be mounted thereon. The creel may later be returned into its position in alignment with the warper, when the particular warp, for which the spools were mounted on the creel, is to be made. But I may also mount the cross reed fixedly upon an extension of the creel, instead of mounting it on the back of a warper or I may fixedly attach all the parts carried by the extension 13, possibly even the front reed, upon an extension of the creel, so that the whole operation of charging the creel and of bringing the yarns up to the front reed and pulling them therethrough may be accomplished on a unit removed from the warper which is brought into alignment with the warper proper only for the purpose of actually making a warp.

The exact shape of the crescent creel depends largely upon the distance at which it is normally placed to the rear of the warper. The legs of the hyperbolical curve are made substantially straight for reasons of simplifying the work of constructing the creel. The manner in which the curved part and the straight legs of the curve of the crescent creel are disposed is chosen in such a manner that the strands of yarns radially converging over the various brackets on top of the creel towards the front reed of the warper are spaced apart at substantially equal angles. Whereas the yarns passing from the center of the creel to the warper may ordinarily extend in substantially a straight line from the creel to the front reed, a slight kink, at the point of the cross reed, of the lines along which the yarns extend from the legs of the curve of the creel to the front reed may be necessary and in that case I choose the curvature at which the cross reed is disposed in such a manner, that the angle at which said yarn approaches a tangent to said curvature at the point where said yarn passes through the cross reed, is the same as the angle at which the yarn issues from there towards the front reed.

The height of the lease rods 132 is adjustable so that they may be brought into alignment with the yarns passing in an inclined plane from the creel to the back roller 55. The different yarns pass alternatively above and below the lease rods, so that after the removal of the lease rod, which is located at the

center, a perfect cross remains, and so that the yarns extend over the lease rods in sections of four, the manner in which each yarn of each section extends over the lease rods being different, whereas the various sections as such are similar.

The frame 143 is normally arranged at such a height that the upper and lower members 144 and 145 thereof clear the yarns passing through the cross reed 134. The frame can be raised or lowered by the rotation of hand wheel 141, the screw 140 being of a coarse pitch, so that a few turns thereof vertically shift the frame to such extent that its upper and lower bar 144 or 145 lifts some of the yarns off the rear lease rod or off the rear and center lease rods, for the purpose of laying alternate ends parallel to each other for inspection and for detection of lost ends by the operator.

From the lease rods the warp passes through the front reed 106 where it is aligned in the width in which it is to be fed onto the section drum. The front reed is adjustable in its position transversely to the warper and during the operation of the machine it slowly reciprocates in a traverse direction to prevent the piling of the ends at the sides of the section drum 87. This reciprocating motion also insures a better winding of the warp onto the section drum. The reciprocations of the front reed take place in fixed relation to the rotation of the friction drum 62, so that the reciprocations imparted to the yarn passing in a certain number of layers onto a section drum are substantially the same for a number of section drums, onto which warps are wound in rotation. The length of the stroke of the reciprocations of the front reed is substantially equal to the small difference between the width of the winding space on the section drum and the width of the warp.

The tension of the spring 56 between the pairs of levers 54 causes the rollers 55 to rest upon the baize by which the drawing drum is covered at substantially equal pressure. Each end or yarn of the warp is fixedly engaged by the drawing drum, as the warp passes therearound, from one roller 55 to the other.

After having passed over the front roller 55 the warp passes substantially tangentially onto the section drum 87. Shortly after having run tangentially onto the section drum, the warp comes into contact with and is engaged by the rubber covered friction drum 62, the warp being pressed into contact with the friction drum and onto the tubing 90 of the section drum or onto the layers of warp already wound onto said section drum by the weight of the arms between which the section drum is rotatably suspended. It thus appears that the warp coming from the front roller 55 comes to lay first upon the section drum or the layers of the warp already wound

onto said section drum and then it is engaged by the circumference of the friction drum which rotates in counterclockwise direction. The friction drum being geared to the drawing drum 48 in such a manner that the peripheral speed of the cylindrical circumference of the friction drum is slightly higher than the peripheral speed at which the warp is fed over the surface of the drawing drum, the surface of the friction drum engaged upon the outside layer of warp wound onto the section drum tends to rotate the section drum and to pull the warp onto said section drum at a speed slightly higher than that at which the warp passes thereonto from the drawing drum over the front roller 55. This brings about a fixed tension of the warp extending between the front roller 55 and the section drum, said tension remaining substantially the same, since a variation of said tension due to friction in the journals in which the arbor 92 rotates is practically overcome by the use of ball bearings 93 and 94, since the weight pressing the section drum into frictional engagement with the friction drum remains substantially the same and since the rubber covered surface of the friction drum is so uniform that it evenly slips, under the continuous excess warp tension, upon the surface of the warp, which it engages, after said warp has passed onto the section drum.

Adjustment of the weight, the reaction of which controls the frictional engagement of the friction drum upon the surface of the warp, has been discussed before. Small modifications in the design of my machine may serve for additional adjustment of the pressure under which the friction drum engages upon the warp. So for instance means may be provided for, which allow the lengthening or shortening of the leverage of lever 85, by providing means for adjusting the position of the fulcrum to a point along the length of those levers and by having the shaft upon which said levers are pivoted movable in relation to the frame instead of having it in the fixed location of rod 84. This may be brought about by having the rod, upon which said levers are swingably suspended, mounted at the free end of cranks, which are adjustably mounted upon the sides of the frame. Such an arrangement of the rod would be similar to the manner in which the rod 103 extends between the free ends of the cranks 101.

The specific modification of the arrangement of the tension with which the section drum 87 is pressed onto the friction drum 62 is indicated in Figure 8. The bracket 60 is shown to be provided with a slot 162 in the drawings, in which the receded end 161 of shaft 61 is rotatably and removably mounted. The end of shaft 61 is receded to such a distance that the unreceded length of said shaft fits into the frame between the bracket 60 on

both sides thereof, thus preventing lateral play of the friction drum. Friction drums of various widths mounted on similar shafts 61 may thus readily be substituted in the machine, being predeterminedly in alignment with section drums 87 which are removably mounted between the swing levers 85 and 86.

I show in Figure 8 a roller 163 on the side of the swing lever 85. Said roller fits into a slot 164 provided in the curved lever 165. That lever is swingably fulcrumed upon a pivot 169 in an extension 166 of bracket 60. This lever 165 is provided with a hook 167 at the free end thereof. From this hook a weight 168 is removably suspended.

A roller 170 is shown mounted upon the shaft 84, between the levers 85 and 86. Over this roller the warp 49 runs from the roller 55 onto the section drum 87. Roller 170 is an idler roller; its lateral play is limited by the abutting levers 85 and 86.

The weight 168 applies a counterclockwise momentum to the lever 165. This causes the upper, concave wall of slot 164 to rest upon the roller 163 so that the downward momentum of weight 168 is applied to exert a pressure upon the section drum 87, pressing said drum into frictional contact with friction drum 62.

It will be noticed that the roller 163 slides upwardly along the upper wall of slot 164, as the diameter of the warp wound onto the section drum 87 increases. The levers 85 swinging upward during this operation, the lever 165 slowly moves in clockwise direction, so that the weight 168 horizontally approaches the pivot 169 upon which the lever 165 is fulcrumed. The shortening of the horizontal distance between the weight 168 and pivot 169 brings about a decrease in the vertical component of the downward pressure momentum of weight 168. The pressure exerted by weight 168, which brings about frictional contact between the section and friction drums, is therefore decreased, substantially proportionately to the degree in which the diameter of the layers of warp wound onto the section drum 87 increases. It is readily seen that by an adjustment of the applied leverage, from the center of pivot 169, to the center of roller 163, may be controlled by the choice of the point at which said roller is attached to lever 85 and of the height and horizontal arrangement of the extension 166 of bracket 60. The manner in which slot 164 extends in arm 165, the point at which a weight is suspended from said lever 165, and the mass of said weight may also be changed to allow an adjustment of the pressure under which the section drum 87 is frictionally engaged by friction drum 62, and to allow also an adjustment of the ratio at which said pressure decreases as the diameter of the warp wound onto the section drum increases. By careful calculations and by

application of the results to the design of the above described pressure means, it is possible to provide a substantially uniform tension on the yarn 49, as it travels from the roller 55 onto the section drum 87.

A notch 171 is provided on the lower side of the upper end of the slot 164. When a complete warp has been wound onto section drum 87 the operator may swing the lever 165 in clockwise direction, roller 163 rolling upon the lower wall of said slot and the levers 85 and 86 being swung upwardly thereby. This lifts the section drum off the friction drum and the section drum laterally clears the friction drum when the roller drops into the notch 171 at the upper end of slot 164 after the operator has swung the lever 165 in clockwise direction as far as possible. The roller 163 resting in notch 171, the levers 85 and 86 are retained in their raised positions until the operator has replaced the fully wound section drum 87 by another section drum, whereupon he disengages the roller from the notch 171 at the end of slot 164 and allows levers 165, 85 and 86 to swing downward, until the section drum 87 comes to rest upon the friction drum 62 in a position of frictional engagement thereupon. The winding means of my apparatus are now in a position for making a new warp.

The tension at which the yarn extends between the front roller 55 and the section drum is also controlled by the lead of the peripheral speed of the friction drum over that of the drawing drum, a change in the chain of gears which operatively connects the respective shafts will allow an accurate adjustment of the tension at which the warp is warped.

The peripheral speed of the friction drum being normally in the lead, said speed will have to be caused to lag behind the peripheral speed of the drawing drum when the rotation of the machine is reversed for the return operation which has been described before. If such a change in the respective peripheral speeds is not brought about, the warp will slack between the front roller and the section drum during the return operation. To bring about the proportionate lag in the return operation the gear shaft is provided for; the clutch 73 automatically shifts the gear ratio between the shafts 27 and 61, to change the ratio between the peripheral speeds of the drawing and the friction drum. Such automatic shifting is brought about by the shift lever 40, when the rotation of the drive is reversed and the shifting may also be effected manually by means of the hand lever 76, the main shaft being rotated by means of one of the hand wheels 47.

The counter 116 registers the rotations of the main shaft 27. Giving to the drawing drum 48 a circumference equal to the length

of the unit to be used as a standard of measure, the counter registers the number of units passing, at a uniform tension, through the machine. Having made in my warper provisions for a uniform tension and for a fixed relation of peripheral speeds between the drawing and the section drum, and the various section drums, used for winding the warps, which later are assembled to a beam, being constructed substantially alike, a fixed length of the warp should be wound onto the various section drums for a specific number of turns of the section drum, which corresponds to the number of layers of warp on the section drum. The number of layers of warp on the section drum may be observed on the revolution counter 96 which is operatively connected with the arbor 92 and which is set to zero, whenever the winding of a warp onto a section drum is begun. Experience has shown that indeed the counter registers a substantially constant number of layers wound onto each of such section drums for a certain amount of yardage of warp, the passing of which through the warper is registered by the counter 116.

This makes it possible to mount a number of section drums, onto which substantially similar numbers of yards have been wound in corresponding numbers of layers, onto a common arbor for the purpose of performing on the warp successive operations, or to place the different section drums onto different arbors which are positively geared to each other to rotate at the same speed. Unwinding the section drums in unison and performing on the material unwound the sizing or any other operation, I may then wind the warps synchronously and coextensively taken from the different section drums onto a common beam.

The friction drive permits delicate adjustments of the speed at which the warper is operated, such a control being desirable to obtain the best results at a given adjustment of the tension or other retarding means which are of importance for a uniform function of my improvements. Starting and stopping of the machine may be brought about mechanically by the operation of handle 31, or by the operation of a circuit breaker or switch controlling the motor circuit.

Although I have shown and described one form of embodiment of my invention in detail, yet I do not wish to be limited thereby, except as the state of the art and the appended claims may require, for it is obvious that various modifications and changes may be made in the form of embodiment of my invention, without departing from the spirit and scope thereof.

I claim:

1. In combination with a warper in which a multitude of yarns are passed through said

warper by a drawing drum and are taken up by a section drum which is driven by a friction drum engaged in tangential contact thereupon, a drive which normally operates said friction drum at a peripheral speed slightly in excess of the peripheral speed of said drawing drum, means adapted operatively to connect said drawing drum to said friction drum at a peripheral speed of said drawing drum greater than the peripheral speed of said friction drum, and means for shifting the drive to a reverse rotation of said drawing drum and friction drum and simultaneously to shift the normal connection between said drawing and friction drums to said means adapted operatively to connect said drawing drum to said friction drum at a peripheral speed of said drawing drum greater than the peripheral speed of said friction drum.

2. In combination with a warper in which a multitude of yarns are passed through said warper by a drawing drum and are taken up by a section drum which is driven by a friction drum engaged in tangential contact thereupon, a frame arranged transversely to and below said multitude of yarns running onto said drawing drum, parallel troughs in said frame on both sides of said multitude of yarns and disposed in a plane substantially at right angles thereto, rods adapted to be lowered between said troughs their ends being guided thereby, rollers freely rotatably mounted near the upper ends of said troughs, extending therebetween, and spaced apart to such a distance as to allow said rods to be lowered therebetween into said troughs, means adapted operatively to connect said drawing drum to said friction drum at a peripheral speed of said drawing drum less than the peripheral speed of said friction drum and means for shifting the drive to a reverse rotation of said drawing and friction drums and simultaneously to shift the normal connection between said drawing and friction drums to said means adapted operatively to connect said drawing drum to said friction drum at a peripheral speed of said drawing drum greater than the peripheral speed of said friction drum.

3. The method of finding lost ends in a warp, wound from a creel through a positive feed onto a section drum by a friction drive tending to bring about said winding at a linear speed greater than that of said positive feed, by a return operation, consisting in reversing the winding and positive feed operations, said positive feed operating at a linear speed greater than that of said friction drive, compensating for the slackening of the returned warp and pulling it down by evenly weighting it, and storing said weighted warp substantially vertically folded in multiple layers, until the return operation is again

reversed to a normal warp winding operation.

Signed at Union City, in the county of Hudson and State of New Jersey this 8th day of January A. D. 1930.

JOHN JOSEPH SUSSMUTH.

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