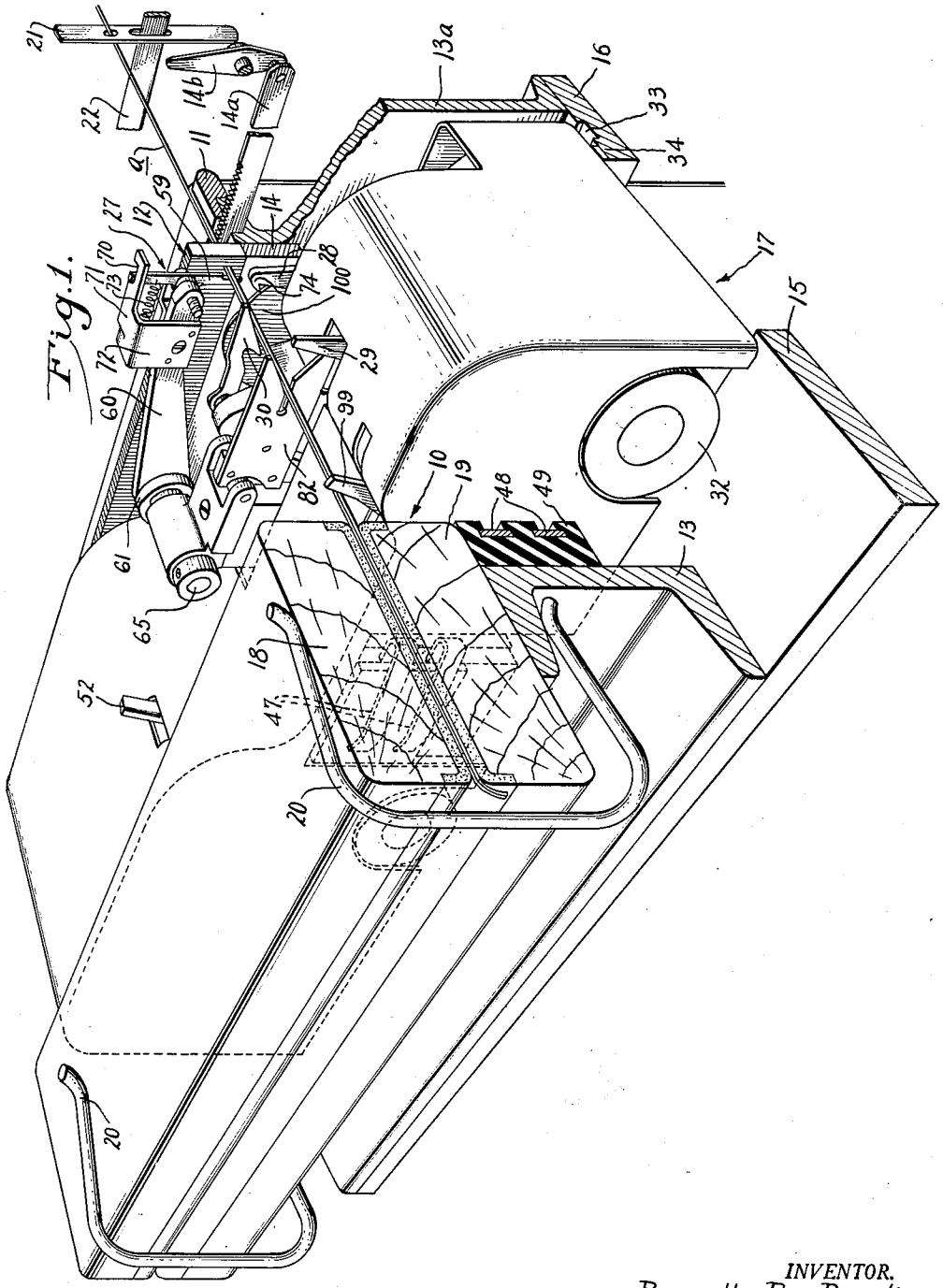
Nov. 11, 1952 R. P. DRAKE 2,617,173

WARP UNITING MECHANISM

Filed Aug. 31, 1948 4 Sheets-Sheet 1

Fig. 1.



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Nov. 11, 1952 R. P. DRAKE 2,617,173

WARP UNITING MECHANISM

Filed Aug. 31, 1948 4 Sheets-Sheet 2

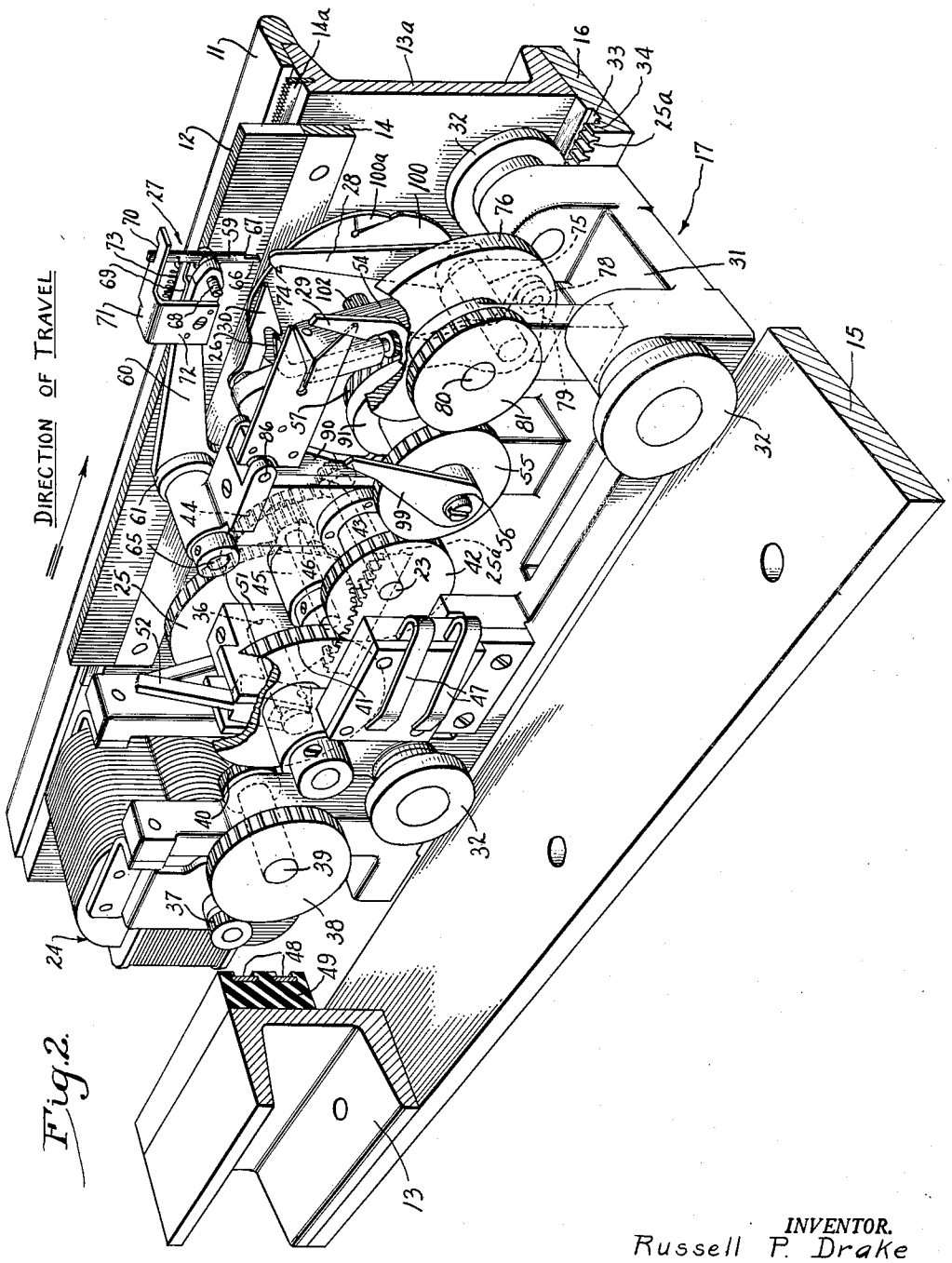


Fig. 2.

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Nov. 11, 1952 R. P. DRAKE 2,617,173

WARP UNITING MECHANISM

Filed Aug. 31, 1948 4 Sheets-Sheet 3

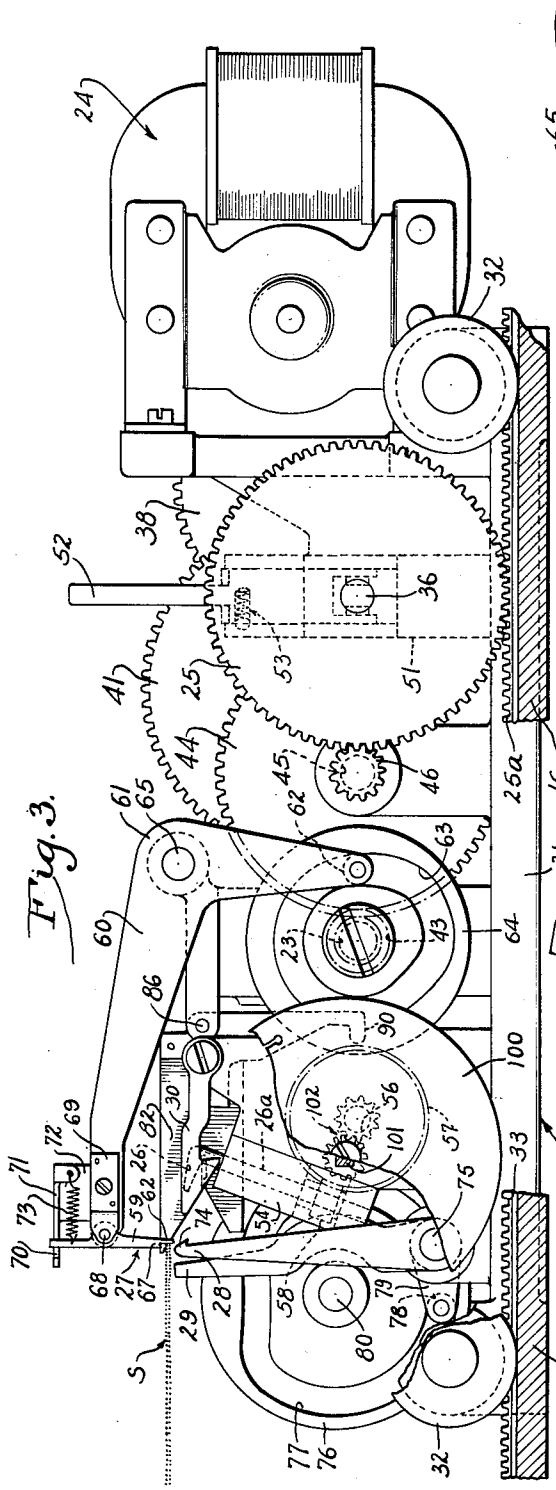


Fig. 3.

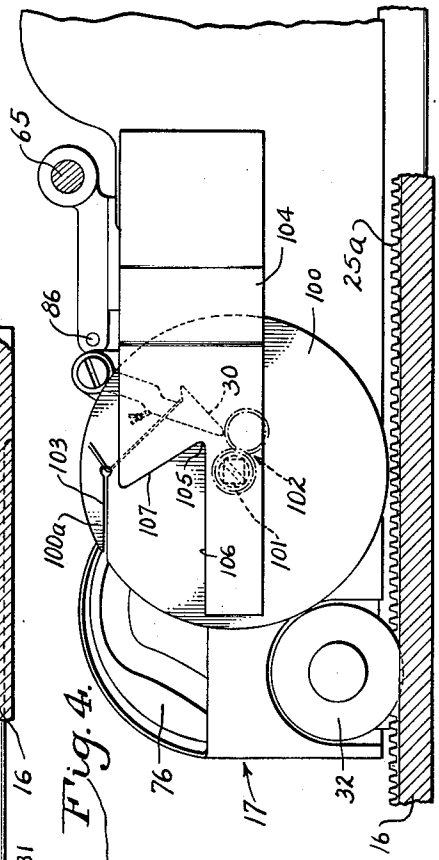


Fig. 4.

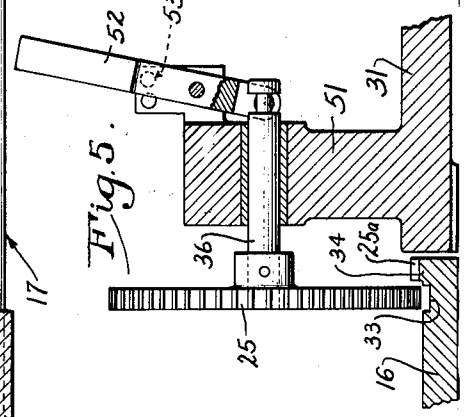


Fig. 5.

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Nov. 11, 1952 R. P. DRAKE 2,617,173

WARP UNITING MECHANISM

Filed Aug. 31, 1948 4 Sheets-Sheet 4

Fig. 6.

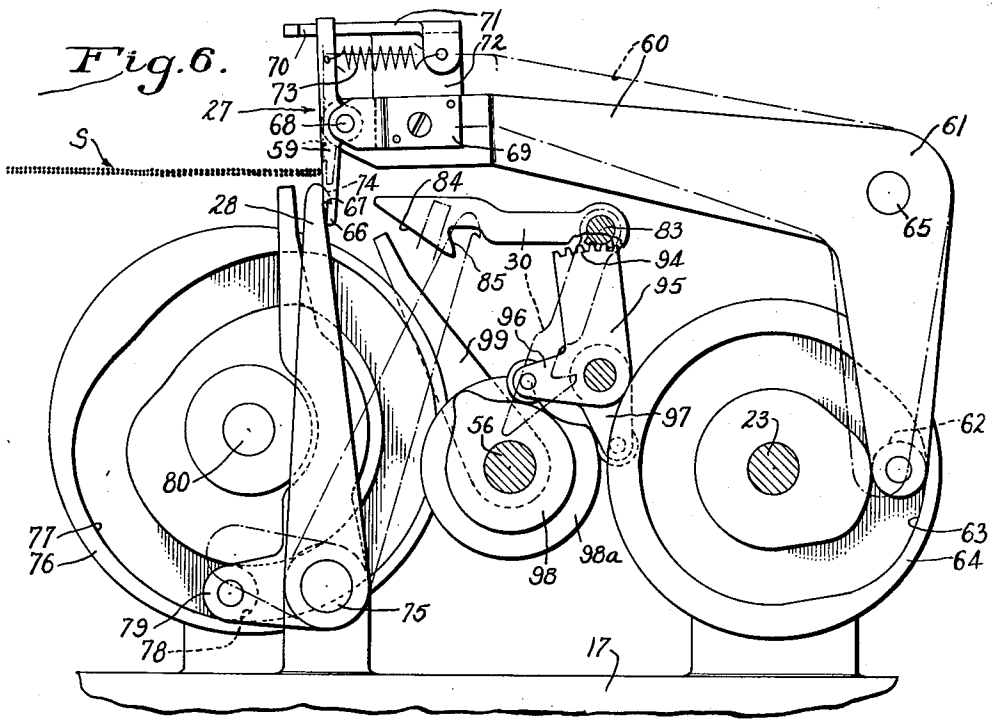


Fig. 7.

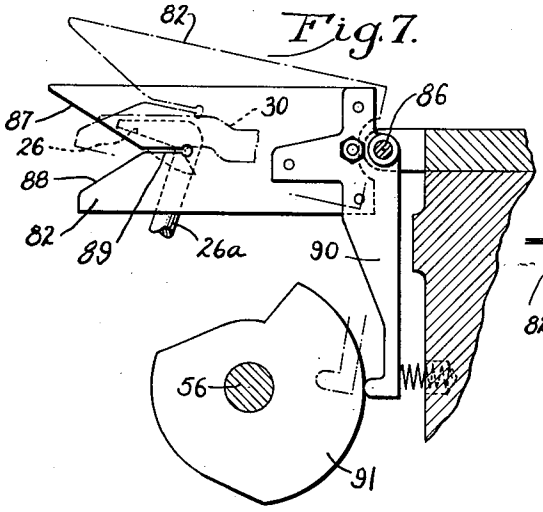
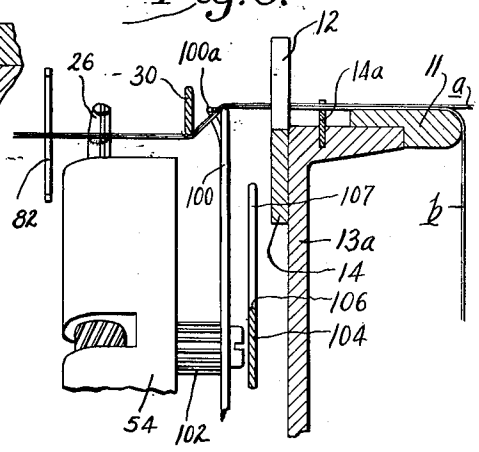


Fig. 8.



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Patented Nov. 11, 1952

2,617,173

UNITED STATES PATENT OFFICE

2,617,173

WARP UNITING MECHANISM

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Application August 31, 1948, Serial No. 47,115

16 Claims. (Cl. 28—49)

1

The invention pertains to a mechanism for tying warps and has particular reference to a tying mechanism especially adapted for use in connection with a warp knitting machine. In such machines, the warp beam constituting a source of supply for the yarn periodically becomes exhausted so that it is necessary to sever the running strand from the exhausted beam and to unite the ends to the ends on a new beam.

With the foregoing in view, the primary object of the present invention is to provide a warp tying mechanism capable of operating at high speed and yet with a high degree of certainty to tie the thread ends of a new warp to the ends of the old warp after having severed the same from the whole warp beam.

A further object is to provide a simple and effectual warp tying mechanism arranged for operation upon old and new warps the threads of which are held in closely spaced parallel relation with threads from the respective warps arranged contiguously in pairs, and the paired strands operated upon in successive cycles of a tying means advancing continuously and at a uniform rate across the two warps.

Another object is to provide a tying mechanism of the character set forth in which each pair of strands to be tied is first separated from the remaining pairs by a separator moving transversely of the warps and then carried to a knotter device in timed relation to the travel of the tying mechanism.

In warp knitting machines it is common to employ drop wires on the strands running to the knitting needles for the purpose of detecting the breakage of the strands. A further object of the present invention is to provide a warp uniting mechanism operative upon the paired strands in a manner such as to avoid rethreading of the strands running to the knitting needles through the drop wires.

The objects of the invention thus generally stated together with other and ancillary advantages are attained by the construction and arrangement shown by way of illustration in the accompanying drawings, in which:

Figure 1 is a fragmentary perspective view of a warp tying mechanism embodying my invention constructed and arranged for association with a warp knitting machine, the mechanism being viewed from its outer or forward side.

Fig. 2 is a fragmentary perspective view of the improved warp uniting mechanism shown in Fig. 1, but with certain covers removed to expose the mechanism.

2

Fig. 3 is a rear elevational view of the tying mechanism with portions broken away and other portions of the supporting frame shown in section.

Fig. 4 is a fragmentary rear side elevational view of the warp uniting mechanism and illustrating in particular the operation of stripping the tied strands from the knotter.

Fig. 5 is a fragmentary vertical sectional view illustrating a disengageable driving connection between the warp tying mechanism and its supporting frame.

Fig. 6 is a side elevational view illustrating the strand separating means together with means for carrying the separated strands to the knotter and for stripping the united strands from the knotter.

Fig. 7 is a fragmentary vertical sectional view illustrating the construction and mode of operation of a thread guiding means forming part of the tying mechanism.

Fig. 8 is a fragmentary detail view partially in transverse cross section, illustrating a means for operating on the tied strands to prevent entanglement.

The improved tying mechanism is shown for purposes of illustration in connection with a warp knitting machine. It will be understood, however, that such mechanism may well be capable of other uses and its utility is therefore not confined to such machines.

Referring to Figs. 1, 2 and 8 of the drawings, means is provided for supporting pairs of strands *a* and *b* at longitudinally spaced points with the strands arranged in closely but uniformly spaced relation so as to form in effect a substantially flat sheet *s* (Fig. 6). As herein shown, the supporting means comprises in one instance, a front clamp **10**, and in the other a smooth flat bar **11** with which is associated a comb generally designated **12**, for positioning paired strands in closely spaced relation. The supports **10** and **11** are mounted upon frame members **13** and **13***a* adapted to be supported in any suitable way upon a warp knitting machine.

The comb **12** may be of any suitable or preferred construction. As shown it comprises a bar **14** secured to the frame member **13***a* and carrying a series of thin flat reed elements to form uniformly spaced dents for the reception of the paired strands. To position the strands in the dents of the comb in uniformly spaced relation, I provide a ribbon bar **14***a* mounted on the bar **11** for movement by a hand lever **14***b*. The bar **14***a* is serrated for engagement with the strands so that movement of the bar carries

the strands against the comb teeth forming the right hand side of the dents as viewed in Figs. 1 and 2.

Secured to the frame members 13 and 13a are plates 15 and 16 providing tracks upon which is supported a carriage, generally designated 17, for the tying mechanism, the arrangement being such that the carriage is supported upon the tracks 15 and 16 for traveling movement transversely of the strands supported by the bar 11 and clamp 10. In the present instance, the strands are yieldably held by the clamp 10. The latter is therefore in the form of the well-known plush clamp, comprising two clamping blocks 18 and 19 of which the lower one rests upon the frame member 13, the two blocks being secured to the frame member 13 by means of spring clips 20.

As shown in Fig. 1, the strand *a* constituting a thread of the old warp leads rearwardly from the warp tying mechanism to the needles of the knitting machine. The strand *b* leads downwardly from the bar 11 to the new warp beam (not shown). It will be understood that preliminary to the tying operation, the old warp represented by the strand *a* in Fig. 1 is severed from its warp beam when the latter approaches the point of exhaustion and the ends secured in the clamp 10 together with the strands of the new warp represented by the strand *b*, with the strands of the two warps arranged in the dents of the comb 12 so as to be positioned by the latter in uniformly spaced substantially contiguous relation. The old warp leading to the knitting machine is threaded through drop wires for the purpose of detecting the breakage of the strands. In Fig. 1, I have shown somewhat schematically a drop wire 21 slidable vertically on a bar 22 and apertured for the passage of strand *a*.

Referring now to Fig. 2, the mechanism carriage 17 incorporates a drive means for advancing the same continuously and at a uniform rate as well as for actuating the various elements of the tying mechanism. This drive means comprises, in general, a driven shaft 23 having on the one hand a gearing connection with the drive shaft of an electric motor 24, and on the other hand a gearing connection with a drive gear 25 meshing with a rack 25a on the frame. The shaft 23 also constitutes the driver for the various elements of the tying means including a rotary tying bill 26, a strand picking or separating device 27 operative in successive cycles to engage a pair of strands to shift them out of the plane (herein downwardly) of the warps, means including a pair of arms 28 and 29 for seizing and moving the separated strands rearwardly into proper position with respect to the tying bill 26, and means including a stripper device 30 operative when the strands have been tied together to strip the knot from the tying bill.

In the present illustrative embodiment, the carriage 17 comprises a frame 31 equipped with rollers 32 engaging the track members 15 and 16, the latter being provided with a groove 33 for the reception of the rollers on the rear side of the mechanism so as to guide the carriage in a rectilinear path. Adjacent the groove 33 is a rib 34 cut to form the rack 25a with which meshes the carriage drive gear 25 (Fig. 3) the latter being mounted on a shaft 36 suitably journalled in the frame 31. Gear 25 constitutes the terminal element of a speed-reducing gear train of which the other terminal element is in the form of a pinion 37 on the drive shaft of motor 24. In the present instance, pinion 37 meshes with a gear 38 on a stub shaft 39 with which is rigid a pinion 40 meshing with a spur gear 41, the latter in turn meshing with a gear 42 on the driven shaft 23. This shaft also carries a pinion 43 meshing with and driving a spur gear 44 on a stub shaft 45, the latter having rigid therewith a pinion 46 meshing with the terminal drive gear 25.

The motor 24 is of the shaded pole induction type operating at constant speed, and it will be understood that the speed-reducing drive train is so designed with respect to the speed of the motor as to impart to the carriage 17 a continuous traveling movement with the rate of advance determined by the spacing of the paired strands which in turn is determined by the dents of the comb 12. As above indicated, the strands are very closely spaced, the spacing being in the present instance on the order of 30 pairs to the inch.

Electric power may be supplied to the motor in any suitable way. As herein shown, the carriage is provided with a trolley consisting of a pair of spring contact fingers 47 coacting with conducting strips 48 suitably mounted in a rail 49 of insulating material and secured to the frame member 13, the strips 48 being connected with a suitable power source.

The speed-reducing gear train for driving the carriage preferably includes means providing a disengageable driving connection between the carriage and its supporting frame. As shown in Fig. 5, the terminal drive gear 25 is mounted on stub shaft 36 which is mounted for axial sliding movement in a frame standard 51 so as to be movable into and out of engagement with the rack 25a. For sliding the shaft 36 endwise, a hand lever 52 is in the present instance, pivoted on the standard 51 and operatively connected with the shaft 36 in any suitable or convenient manner. Means such as a ball detent 53 may be provided to hold the hand lever 52 and therefore the shaft 36 in either engaged or disengaged relation to the rack 25a.

Referring now to the knot tying mechanism, the rotary tying bill 26 has a shank 26a journalled in a block or frame member 54 so as to be inclined upwardly and rearwardly with respect to the direction of travel of the carriage 17. The tying bill is driven continuously and directly from the driven shaft 23 by the gear 42 meshing with a gear 55 fast on a shaft 56. Also fast on this shaft is a spiral gear 57 meshing with a pinion 58 rigid with the tying bill. It will be understood that the tying bill is of the conventional type embodying means for clamping and cutting off the ends of the strands after they have been tied.

An important feature of the knotter mechanism resides in the presentation of successive pairs of strands to the tying bill. As shown in Fig. 3, the tying bill is disposed somewhat below the plane of the sheet of strands and substantially rearward thereof. In presenting them to the tying bill, the separator 27 is actuated in timed relation to the advance of the carriage once for each cycle of operation of the tying bill and its function is to separate successive pairs of strands, one pair for each cycle, from the sheet *s* and to position the same for engagement by the fingers 28, 29 which operate to carry the strands into position for engagement by the tying bill.

As best shown in Fig. 6, the separator 27 comprises a picker finger 59 mounted upon the forward end of one arm 60 of a bell crank 61, the other arm of which has a roller follower 62 engaging in a groove 63 of a face cam 64. The latter is mounted on the driven shaft 23 and therefore operates continuously in the advance of

the mechanism carriage. The bell crank 61 is supported on a pivot pin 65 suitably mounted in the carriage frame.

At its lower end the picker finger 59 is shaped (see Fig. 2) to provide a relatively narrow tip portion 66 and a shoulder 67, the latter being formed on the forward side of the finger. When the finger is in its extreme elevated position, the tip portion 66 engages with the first pair of strands and as the finger moves downwardly serves to separate this pair of strands from the sheet *s* carrying the strands downwardly for engagement by the positioning finger 28. The finger 59 is preferably mounted so as to be capable of yielding slightly in a direction parallel to the plane of the sheet of strands to be tied together. Such yieldable mounting is employed so as to compensate for slight inaccuracies in the gear drive for the carriage and particularly in view of the difficulty of making the rack 25*a* sufficiently accurate to insure a proper relationship at all times between the finger 59 and the paired strands. As shown, the finger 59 is mounted on a pivot pin 68 carried by the forward end of the arm 60 of bell crank 61 and by a bracket 69 secured to the arm (Fig. 2). The upper end of the finger is received in a slot 70 cut in a plate 71 having a depending portion 72 secured to the arm 60. The slot is of a width somewhat greater than the width of the upper end of the finger and its rear edge forms a stop against which the finger is held by a coiled contractile spring 73. It has been found that by this construction, the finger is capable of yielding slightly to compensate for slight irregularities in the advance of the carriage.

To receive and retain pairs of strands successively separated from the sheet *s*, the upper end of the arm 28 is rounded and shaped to form a rearwardly projecting hook 74 so that when the arm is in the position shown in Figs. 2 and 6 the separated strands are carried downwardly over the upper rear surface of the arm, the strands finally snapping rearwardly due to the tension thereon, into engagement with the hook so as to retain the strands in position when the finger 59 is withdrawn.

Arm 28 is fixed on a rockshaft 75 and is disposed in a longitudinal plane between the finger 59 and the tying bill. Also fast on the rockshaft, but on the opposite side of the tying bill is the arm 29. These arms 28 and 29 are arranged for actuation by the cam 76 in timed relation to the rotation of the tying bill for the purpose of positioning the paired strands for the tying operation. Cam 76 is a face cam having a groove 77 for the reception of a roller follower 78 on an arm 79 rigid with the rockshaft 75. Herein the arm 79 is formed integral with the thread-positioning arm 29, being shown in broken lines in Fig. 2. Cam 76 is carried by a shaft 80 also having thereon a spur gear 81 driven from shaft 23 through the medium of spur gears 42 and 55 (Fig. 2). It will be understood that the groove of cam 76 is appropriately shaped to impart a rearward movement to the thread-positioning arms 28 and 29 immediately following the operation of the separator device 27, that is to say, upon the movement of a pair of strands downwardly from the sheet *s* into engagement with the hook 74 of the arm 28.

In their rearward movement by the arms 28, 29, the strands are guided into position with respect to the tying bill by means comprised, in the present instance, of two guides respectively disposed on opposite sides of the tying bill. One of these guides is formed by a notched plate 82 positioned inwardly of the tying bill and the other guide is formed by the stripper hook 30. As shown in Fig. 6, this hook is mounted upon a rockshaft 83 for actuation in a manner presently to be described for the purpose of withdrawing the knotted strands from the tying bill upon the completion of the operation. However, at the time the strands are engaged by the arms 28 and 29 for movement rearwardly into position for engagement by the tying bill, the stripper hook 30 occupies a generally horizontal position. As best shown in Fig. 6, the forward portion of the arm is provided with a downwardly and rearwardly inclined guide surface 84 disposed somewhat downwardly and rearwardly with respect to the upper end of arm 28, which surface terminates in a shoulder 85 forming a hook for the reception of the strands as the latter are moved downwardly and rearwardly by the arm 28.

Guide plate 82 (Fig. 7) is mounted upon a rockshaft 86 for a purpose presently to appear, but when the strands are carried rearwardly by the arms 28, 29 this plate occupies a generally horizontal position, as shown in said figure. At its forward end it is provided with a relatively large V-notch formed by converging guide surfaces 87 and 88 which terminate in a narrow forwardly opening notch 89 having its rear end disposed somewhat rearwardly of the apex of the angle formed by the tying bill 26 with its supporting shank 26*a*. It will be understood that the extent of rearward movement of the paired strands by the arms 28, 29 is sufficient to carry the same into engagement with the tying bill for seizure in the rotation of the latter, in the conventional manner.

In the present illustrative embodiment of my invention, the knotter mechanism operates to unite the paired strands in a knot of the so-called figure 8 type, the mechanism operating in the general manner disclosed in Noling Patent No. 2,234,190 issued March 11, 1941. In tying such a knot, the tying bill equipped with the usual cam actuated shear blade is rotated through three revolutions for each tying cycle. During the initial (idle) revolution, the strands are carried rearwardly into position adjacent the bill; in the second revolution they are twisted about the bill; and in the final revolution they are seized, tied and severed in the conventional manner. It is accordingly necessary that the strands be shifted with respect to the bill so as to position them properly relative to the bill in each revolution thereof. It is for this reason that the guide plate 82 is mounted on the rockshaft 86. To govern the position of the guide, and therefore of the strands to be united, the guide plate, in the present embodiment, has rigid therewith a depending arm 90 bearing upon a cam 91 which is shaped to position the guide plate variously in order that a knot of the figure 8 type will be formed. Inasmuch as this particular type of knotter forms no part of the invention, it is deemed unnecessary to describe the same in detail. Suffice it to say that the cam 91 is fast on the shaft 56 and driven in proper timed relation to the tying bill.

Upon the completion of the tying operation, the knot is stripped from the tying bill by the actuation of the stripper hook 30 which as above indicated is mounted on the rockshaft 83 (Fig. 6). This rockshaft has rigid therewith a pinion meshing with a segment 94 on the upper end of a bell crank 95. The latter is arranged for actuation by cam means of the double roller follower type. Thus the bell crank has two arms 96 and 97 carry-

ing roller followers for coaction respectively with cams 98 and 98a on shaft 56. The cams are so shaped that upon the completion of the tying operation the hook 30 is swung downwardly and rearwardly into the position shown in Fig. 4 and shown in broken lines in Fig. 6.

It will be understood that during the operation of the tying mechanism, the paired strands are gripped by the plush clamp 10 so as to maintain the strands under tension and yet be capable of slippage in an amount sufficient to provide the necessary slack required for the tying operation. At the completion of the latter operation, the strands are severed by the tying bill, so that the knotted portions may be drawn freely downwardly and rearwardly by the stripper 30, and the waste ends are withdrawn from the bill. The latter function is performed by a stripper arm 99 located on the side of the bill opposite the stripper 30. As shown (Figs. 2 and 6) it is mounted on the shaft 56 for rotation in a plane adjacent the plush clamp 10 (Fig. 1) so that when the waste ends have been severed by the bill, they are withdrawn into an out-of-the-way position adjacent the clamp.

To avoid snarling and entanglement of the knotted strands in the operation of the mechanism, means is provided for seizing the knotted strands after they have been stripped from the tying bill, and for carrying the same forwardly in the direction of travel of the mechanism into a position such as to insure that successive pairs of strands will slide past the knotter mechanism in the advance of the latter. Additionally, I preferably provide on the traveling mechanism a strand supporting or bearing surface upon which the knotted strands are placed by the aforesaid carrier.

Referring now to Figs. 3, 4 and 8, the carrier, in the present illustrative embodiment, is in the form of a notched disk 100 mounted on the carriage. It is disposed between the stripper 30 and the comb 12 and its peripheral surface is adapted to support the paired strands in vertically offset relation to the hook when the latter occupies the position shown in Fig. 3. The disk is mounted on a stub shaft 101 driven from the shaft 56 by means of spur gearing 102, the direction of rotation being counterclockwise as viewed in Figs. 3 and 4.

The disk 100 is formed with a chordal notch 103 which, when the disk is in the position shown in Fig. 4, opens forwardly for the reception of the strands whose knotted ends are held by the stripper 30. To assist in the entry of the strands into the notch, the portion of the disk immediately above the outer end of the notch is preferably bent toward the stripper 30 to form a thread engaging prong 100a (Fig. 8). Since the strands extend upwardly at an angle from the stripper to the disk, it will be seen that the bent portion, or finger, positively engages with the strands and serves to guide them into the notch, the arrangement being such that the strands are received in the notch just as the stripper hook starts downwardly and rearwardly.

The strand supporting or bearing member which, as above indicated, is operative to engage and support the strands as they are carried forwardly by the carrier disk 100, is herein in the form of a plate 104 mounted on the knotter carriage outwardly of but closely adjacent to the disk. This plate has a wide opening or V-notch 105 in its upper forward portion providing a bearing surface 106 and an upwardly and forwardly facing inclined surface 107. As the knotted strands are carried forwardly by the disk 100 they are laid upon the surface 106 sliding rearwardly thereon in the advance of the carriage and finally upon engagement with the surface 107 the knotted ends become disengaged from the plate. Experience has shown that by this construction and arrangement the knotted strands are effectually prevented from becoming snarled and tangled.

Assuming that the knotter mechanism is applied to a warp knitting machine, and that a warp beam is approaching the state of exhaustion, the operation may be summarized as follows:

The strands of the old warp are severed adjacent the beam and the thread ends wound upon a suitable core in an amount sufficient to provide the necessary slack length for placement in the tying mechanism. The core is temporarily placed on a suitable or convenient support, the old warp beam removed and a new warp beam placed in position. The thread ends of the new beam are then laid upon the bar 11 and extended across the mechanism and clamped in the clamp 10. In this operation, the strands b of the new warp are placed in the dents of the comb 12 which serves to hold the strands in closely spaced parallel relation. The strands of the old warp are then unwound from its core and similarly positioned upon the bar 11 and in the clamp 10, with one strand in each of the dents of the comb. Thus, the strands of the two warps are arranged in closely and uniformly spaced pairs and the strands of each pair in contiguous relation.

The carriage 17 of the typing mechanism has been positioned at the left (as shown in Fig. 2) of the combined warps and at the beginning of the operation the control lever 52 is operated to cause gear 25 to engage with rack 25a, the motor having previously been started. The tying mechanism operates in successive cycles upon successive pairs of strands of the warps to be united. The operation in each such cycle is as follows:

The separator finger 59 moves downwardly into engagement with the leading pair of strands (Fig. 3) and carries the latter downwardly causing them to slide over the nose of the positioning arm 28 and then rearwardly under the hook 74 thereof, permitting return movement of the separator. The arms 28 and 29 are then rocked rearwardly to present the paired strands to the tying bill 26. In this movement, the strands are guided by the inclined surface 84 of the notched stripper 30 and also by the notched guide plate 82. As shown in Fig. 7, the arms 28, 29 move rearwardly to an extent somewhat beyond the apex of the angle which the tying bill forms with its shank 26a and carry the strands into the hook of the stripper.

In the instant embodiment the tying bill makes three revolutions for each cycle of operation. At the beginning of the initial revolution, the guide plate 82 occupies its lowermost position shown in full lines in Fig. 7 and is thus positioned to receive the strands as they are presented to the underside of the tying bill. Thereafter the guide is raised sufficiently to present the strands for engagement by the bill so that in the rotation of the latter the strands are twisted or wrapped around the bill.

During the second revolution of the tying bill the guide plate is lowered to a mid position such

as to place the strands in the path of the open bill for seizure thereby. As the bill continues its rotation, the strands are clamped and then severed as the bill closes. The knot is then formed and the stripper **30** operates to pull the formed knot from the bill. In the third or idle revolution of the bill, the guide plate is returned to its lowermost position preparatory to the next tying cycle.

Upon the completion of the tying operation, the waste end stripper **99** operates to carry the waste ends (now severed) and held by the clamp **10** into an out-of-the-way position, and the stripper **30** is moved by its cams **98** and **98***a* downwardly and rearwardly so as to strip the knot from the tying bill. In this latter operation, the strands are in engagement with the shoulder **85** of the stripper and the stripper moves into the broken line position shown in Fig. 6.

As the stripper starts its rearward and downward movement, the knotted strands enter the slot **103** in the carrier disk **100** which is rotating in a counerclockwise direction as seen in Fig. 4. The entry of the knotted strands into the slot **103** is insured by the fact that the stripper hook occupies a downwardly offset position relative to the periphery of the carrier disk, as shown in Fig. 8, so that the strands extend upwardly at a rather sharp angle from the stripper to the top of the disk and are thus disposed in the path of the lip **100***a* bent laterally from the plane of the disk. As the stripper approaches its rearward position, the knotted strands are carried forwardly by the disk (Fig. 4) and withdrawn from the stripper hook. At the same time, they are laid upon the bearing surface **106** of the member **104** on the carriage. The strands, sliding rearwardly upon this surface, finally become disengaged and are laid in an orderly manner along the side of the mechanism.

It will be observed that the tying mechanism travels continuously at a uniform rate determined by the pitch of the strands, and that the tying means is driven continuously in such advance of the mechanism, the various parts thereof operating in timed relation to the advance so as to perform all the various operations necessary upon the successive pairs of strands. Due to the fact that the paired strands are very closely spaced (on the order of 30 pairs to the inch) the paired strands must be successively separated from the combined warps and transferred to the positioning finger **28** for subsequent presentation to the tying means. It will be understood that the size of the shoulder **67** on the separator finger **59** is so chosen with respect to the pitch of the warp that only one pair of strands will be engaged in each separating operation.

When the final pair of strands has been tied, the control lever **52** is operated to disconnect the drive for the carriage and the latter returned manually to its initial or starting position.

I claim as my invention:

1. In an apparatus for operating upon two warps supported in a substantially common plane with the strands thereof arranged in closely and uniformly spaced pairs, a knotter mechanism comprising a carriage having drive means for advancing the same continuously at a uniform rate correlated with the pitch of the paired strands and tying means on the carriage including a rotary tying bill driven continuously in timed relation to the advance of the carriage, said tying bill being disposed at one side of the plane of the combined warps rearwardly thereof, a separator movable in successive cycle into engagement with successive pairs of strands to shift them out of the plane of the warps transversely of the latter, and a thread positioner operatively connected with said driving means for movement thereby in timed relation to the rotation of the tying bill and in a rearward direction substantially parallel to the warp, said positioner acting upon the separated strands to carry the same rearwardly into operative association with the tying bill.

2. In a warp uniting machine, a pair of spaced parallel supports for supporting two warps in a substantially common plane, a comb adjacent one of said supports for positioning the warp strands in closely and uniformly spaced pairs, a tying mechanism comprising a carriage mounted for traveling movement between said supports and having drive means for advancing the same continuously at a uniform rate correlated with the pitch of the paired strands, a rotary tying bill on the carriage disposed at one side of the plane of the combined warps and having a driving connection with the carriage drive means to cause rotation of the tying bill in successive knot tying cycles, a separator active in each tying cycle to shift a pair of strands out of the plane of the warps, a strand positioner operative to seize the shifted strands and carry them in a direction substantially parallel to said warps, and means for guiding the strands in the last mentioned movement thereof to position the same with respect to the tying bill.

3. In an apparatus for operation upon two warps supported in a substantially common plane with the strands thereof arranged in closely and uniformly spaced pairs, a tying mechanism comprising a carriage having drive means for advancing the same continuously at a uniform rate correlated with the pitch of the paired strands, a rotary tying bill on the carriage disposed at one side of the plane of the combined warps and having a driving connection with the carriage drive means to cause rotation of the tying bill in successive knot tying cycles, a strand positioner, a separator acting in each tying cycle to shift a pair of strands out of the plane of the warps and to transfer the same to said positioner, the positioner being operative to carry the shifted strands in a direction substantially parallel to said warps, means for guiding the strands in the last mentioned movement thereof to position the same with respect to the tying bill, and means for stripping the knotted strands from the tying bill.

4. In an apparatus for operating upon two warps supported in a substantially common plane with the strands thereof arranged in closely and uniformly spaced pairs, a tying mechanism comprising a carriage having drive means for advancing the same continuously at a uniform rate correlated with the pitch of the paired strands, a rotary tying bill on the carriage disposed at one side of the plane of the combined warps and having a driving connection with the carriage, drive means to cause rotation of the tying bill in successive knot tying cycles, a separator active in each tying cycle to shift a pair of strands out of the plane of the warps, a strand positioner operative to seize the shifted strands and carry them in a direction parallel to said warps, means for guiding the strands in the last mentioned movement thereof to position the same with respect to the tying bill, and means for stripping the knotted strands from the tying bill, the last

mentioned means including a stripper member having a guide surface forming a part of said guide means.

5. In an apparatus for operation upon two warps supported in a substantially common plane with the strands thereof arranged in closely and uniformly spaced pairs, a tying mechanism comprising a carriage having drive means for advancing the same continuously at a uniform rate correlated with the pitch of the paired strands, a rotary tying bill mounted on the carriage, means for seizing successive pairs of strands and presenting them to the tying bill, means for stripping the knotted strands from the tying bill, and means driven in timed relation to the stripping means and operative to withdraw the knotted strands therefrom.

6. In an apparatus for operation upon two warps supported in a substantially common plane with the strands thereof arranged in closely and uniformly spaced pairs, a tying mechanism comprising a carriage having drive means for advancing the same continuously at a uniform rate correlated with the pitch of the paired strands, a rotary tying bill mounted on the carriage, means for seizing successive pairs of strands and presenting them to the tying bill, a hook for seizing and withdrawing the knotted strands rearwardly from the tying bill, and a rotating disk having a peripheral bearing surface for supporting the strands adjacent the hook with means for seizing the strands to carry them forwardly out of engagement with said hook.

7. In an apparatus for operation on two warps supported in a substantially common plane with the strands thereof arranged in closely and uniformly spaced pairs, a tying mechanism comprising a carriage having drive means for advancing the same continuously at a uniform rate correlated with the pitch of the paired strands, knot tying means mounted on the carriage and including a rotary tying bill and drive means therefore, means for seizing successive pairs of strands and presenting them to the tying bill, means for stripping the knotted strands from the tying bill, and means for withdrawing the knotted strands from the stripping means including a rotary element driven in timed relation to the stripping means and operative to engage the knotted strands and withdraw the same from the stripping means.

8. In a warp uniting machine, means for supporting and positioning two warps in a substantially common plane with the strands thereof arranged in closely and uniformly spaced pairs, a tying mechanism comprising a carriage having drive means for advancing the same continuously at a uniform rate correlated with the pitch of the paired strands, knot tying means mounted on the carriage and including a rotary tying bill having a driving connection with the carriage drive means for rotation thereby, means operative in the advance of the carriage to seize successive pairs of strands and present them to the tying bill, and means including a pair of members operative sequentially upon the knotted strands to withdraw them from the tying bill and position them at one side of the carriage.

9. In an apparatus for operation upon two warps supported in a substantially common plane with the strands thereof arranged in closely and uniformly spaced pairs, a tying mechanism comprising a carriage having drive means for advancing the same continuously at a uniform rate correlated with the pitch of the paired strands, a rotary tying bill disposed at one side of said warps rearwardly thereof and having a driving connection with the carriage drive means for rotation thereby, means operative in the advance of the carriage to seize successive pairs of strands and present them to the tying bill, means operative upon the knotted strands to withdraw them from the tying bill and to position the same at one side of the carriage, the last mentioned means including a stripper member movable rearwardly with respect to the travel of the carriage, and a member operative to withdraw the knotted strands from the stripper in a forward direction.

10. In an apparatus for operation upon two warps supported in a substantially common plane with the strands thereof arranged in closely and uniformly spaced pairs, a tying mechanism comprising a carriage having drive means for advancing the same continuously at a uniform rate correlated with the pitch of the paired strands, a rotary tying bill mounted on the carriage and having a driving connection with the carriage drive means for rotation thereby, means operative in advance of the carriage to seize successive pairs of strands and present them to the tying bill, means operative upon the knotted strands to withdraw them from the tying bill and to position the same at one side of the carriage, the last mentioned means including a stripper member movable rearwardly with respect to the travel of the carriage and a rotary disk having a notch therein for receiving the knotted strands coincident with the rearward movement of the stripper and serving to carry the same forwardly into an out-of-the-way position.

11. In a warp uniting machine, means for supporting and positioning two warps in a substantially common plane with the strands thereof arranged in closely and uniformly spaced pairs, a tying mechanism comprising a carriage having drive means for advancing the same continuously at a uniform rate correlated with the pitch of the paired strands, a rotary tying bill mounted on the carriage and having a driving connection with the carriage drive means for rotation thereby, means operative in the advance of the carriage to seize successive pairs of strands and present them to the tying bill and means operative upon the knotted strands to withdraw them from the tying bill and position the same at one side of the carriage, the last mentioned means including a stripped member movable rearwardly with respect to the travel of the carriage, a device operable upon the knotted strands coincident with the rearward movement of the stripper, and a member mounted on the carriage adjacent said device and providing a bearing surface, said device being operative to deliver the knotted strands onto said bearing surface.

12. In an apparatus for operating upon two warps supported in a substantially common plane with the strands thereof arranged in closely and uniformly spaced pairs, a tying mechanism comprising a carriage having drive means for advancing the same continuously at a uniform rate correlated with the pitch of the paired strands including a stationary rack and a drive gear mounted on the carriage and meshing with said rack, a rotary tying bill mounted on the carriage, and means for presenting successive pairs of strands to said tying bill including a separator finger mounted for movement transversely of the warp and having a tip end projecting into the plane of the warp and spring means acting upon said finger and tending to urge said tip end thereof in the direction of the warps.

13. In an apparatus for operating upon two

warps supported in a substantially common plane with the strands thereof arranged in closely and uniformly spaced pairs, a tying mechanism comprising a carriage having drive means for advancing the same continuously at a uniform rate correlated with the pitch of the paired strands including a stationary rack and a drive gear mounted on the carriage and meshing with said rack, and means for separating successive pairs of strands from the two warps preparatory to tying comprising a separator element reciprocated transversely of the warp and means yieldably pressing said element against the paired strands to compensate for irregularities in said rack.

14. In an apparatus for operation upon two warps supported in a substantially common plane with the strands thereof arranged in closely and uniformly spaced pairs, a tying mechanism comprising a carriage having drive means for advancing the same continuously at a uniform rate correlated with the pitch of the paired strands, a rotary tying bill mounted on the carriage, and means for presenting successive pairs of strands to said tying bill including a separator finger mounted for reciprocation transversely of the warps and having a portion projecting at all times into the plane of the warp, said finger having a shoulder portion of a width sufficient only to engage one pair of strands in the reciprocation of the member.

15. In an apparatus for operation upon two warps supported in a substantially common plane with the strands thereof arranged in closely and uniformly spaced pairs, a tying mechanism comprising a carriage having drive means for advancing the same continuously at a uniform rate correlated with the pitch of the paired strands, a rotary tying bill mounted on the carriage, and means for presenting successive pairs of strands to said tying bill including a separator finger mounted for reciprocation transversely of the warps and a positioning member movable substantially parallel to the warps and having a hooked end for seizing the separated strands and holding the same in withdrawn relation to the warps upon the return of said separator member.

16. A warp tying mechanism for warp knitting machines comprising, in combination, means for supporting two warps with the threads thereof in uniformly spaced relation including parallel supports for mounting on the machine in spaced relation lengthwise of the warps, one of said supports forming a guide for warp threads respectively leading to the knotter machine and to a supply source, the other one of said supports having associated therewith a stationary clamping means yieldably holding the end portions of the two warps, a comb adjacent the thread guiding support having dents for receiving pairs of threads from the respective warps and retaining the same in contiguous uniformly spaced parallel relation, a knotter carriage mounted for movement between said supports parallel thereto and having feed means for advancing the carriage at a uniform rate toward said warps, tying means on the carriage including a rotary tying bill, thread positioning means and means for actuating said tying bill and said positioning means in timed relation to the advance of the carriage, said positioning means being operative to carry successive pairs of threads into association with the tying bill and including a thread guide located between the tying bill and said stationary clamping means and actuated in timed relation to the rotation of the tying bill to shift the pairs of threads relative to the bill.

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