Sept. 2, 1969 K. SALWAY 3,464,235

RASCHEL WARP KNITTING MACHINE

Filed Dec. 5, 1967 5 Sheets-Sheet 1

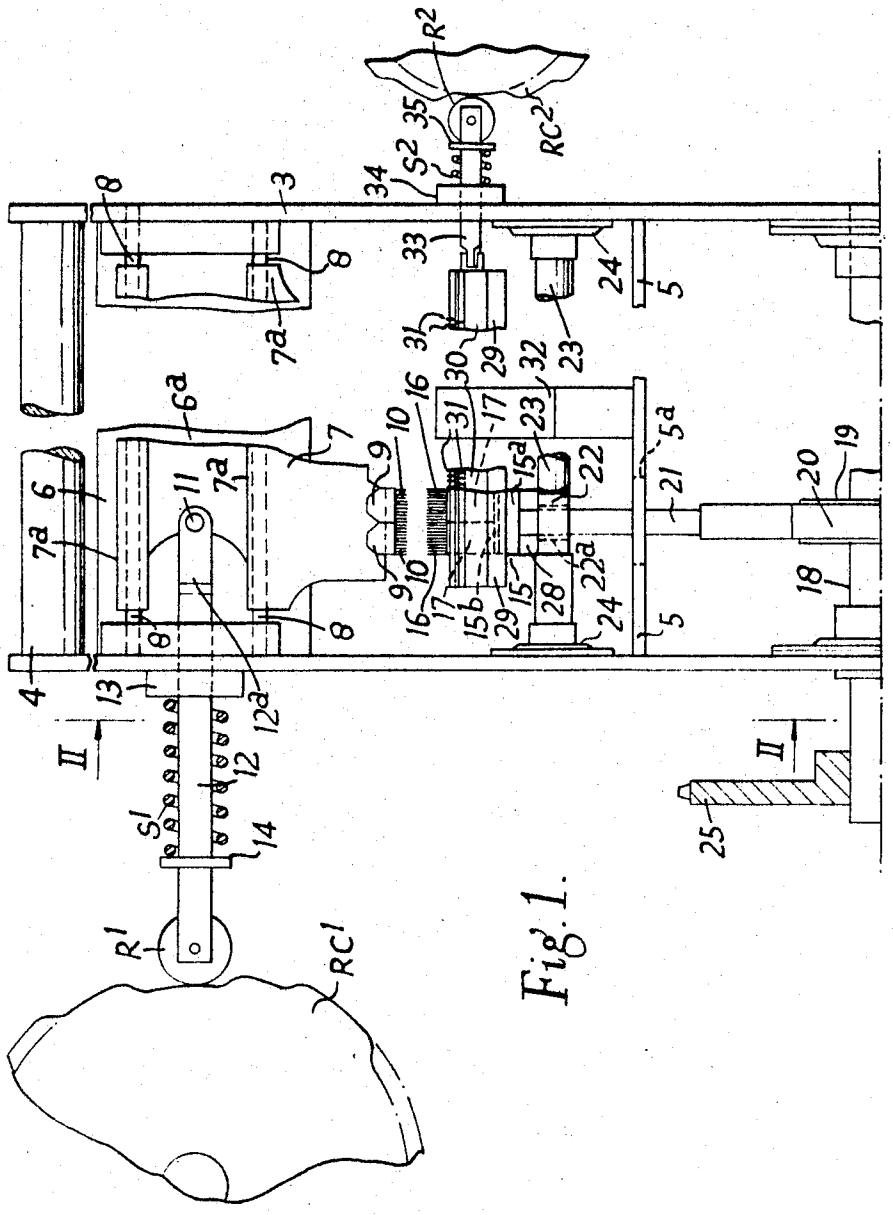


Fig. 1.

RASCHEL WARP KNITTING MACHINE

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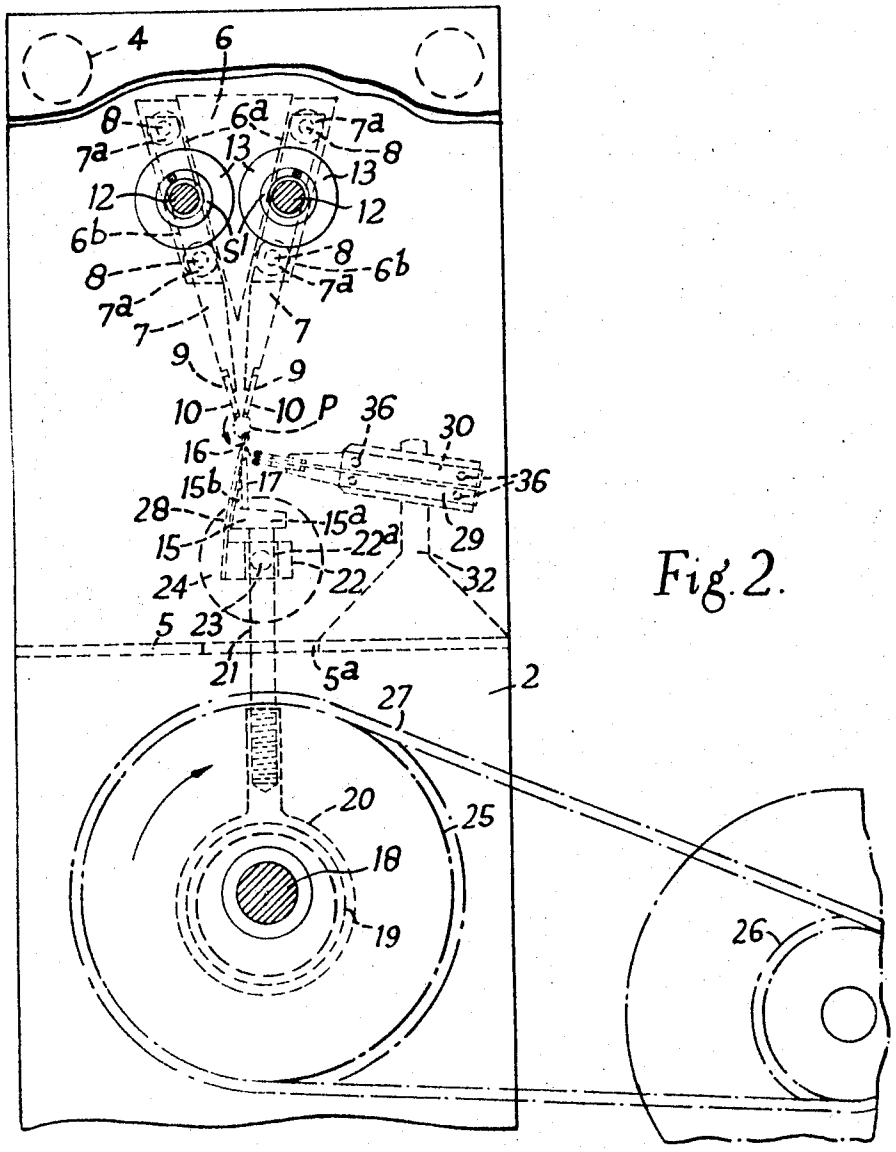


Fig. 2.

RASCHEL WARP KNITTING MACHINE

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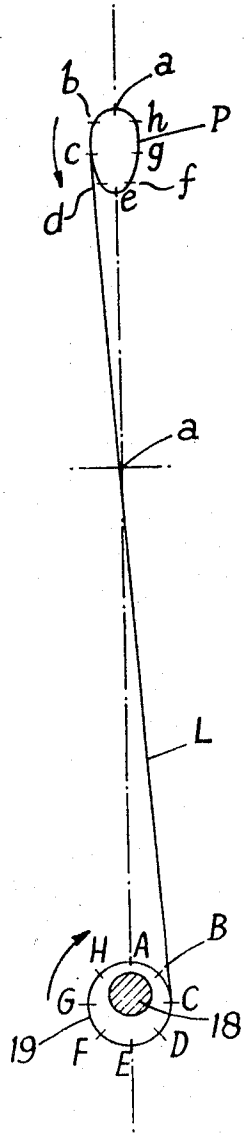


Fig. 3.

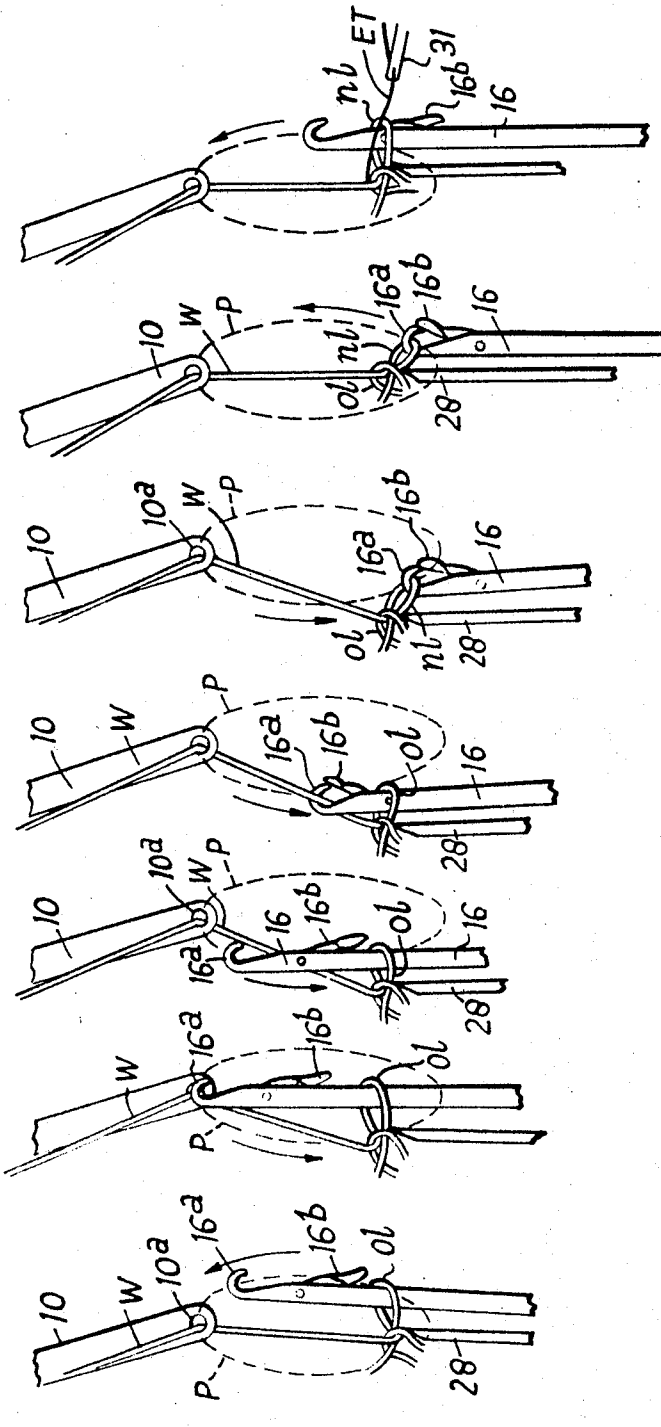


Fig. 10.
Fig. 9.
Fig. 8.
Fig. 7.
Fig. 6.
Fig. 5.
Fig. 4.

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RASCHEL WARP KNITTING MACHINE

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Fig. 17.

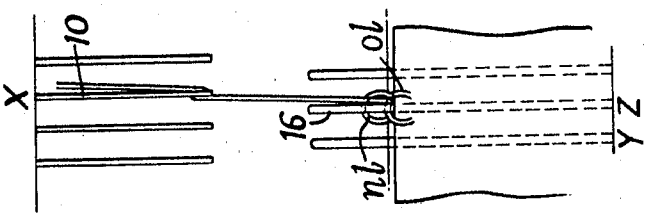


Fig. 16.

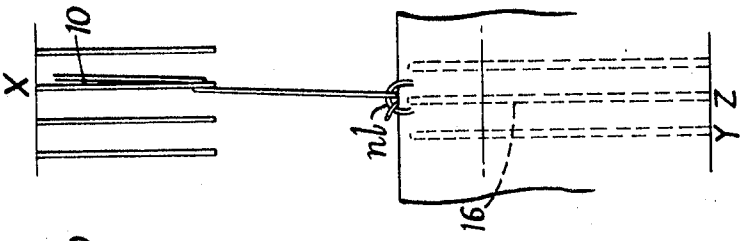


Fig. 15.

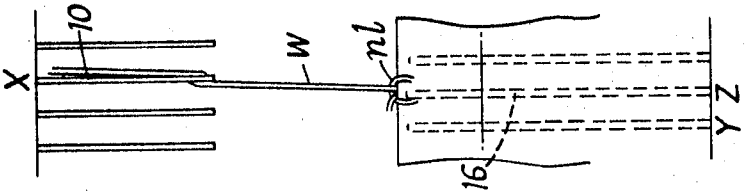


Fig. 14.

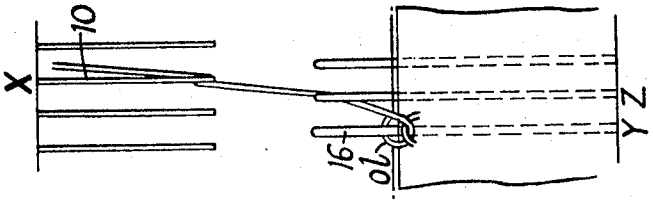


Fig. 13.

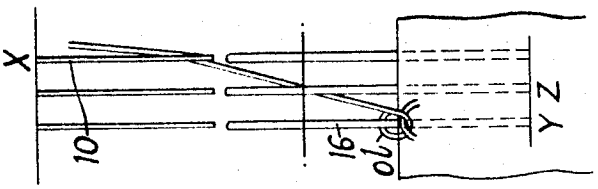


Fig. 12.

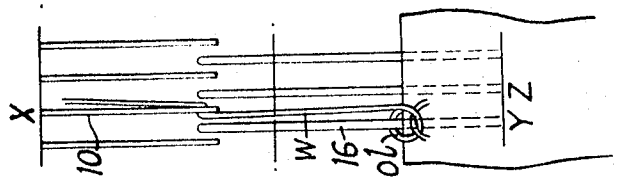
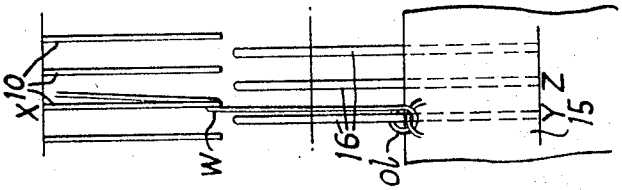


Fig. 11.



United States Patent Office 3,464,235 Patented Sept. 2, 1969

3,464,235

RASCHEL WARP KNITTING MACHINE

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Claims priority, application Great Britain, Dec. 14, 1966, 55,954/66
Int. Cl. D04b 23/00
U.S. Cl. 66—86 6 Claims

ABSTRACT OF THE DISCLOSURE

A raschel warp knitting machine in which the guide bars fitted with guides for individual warp threads are not swung backwards and forwards to move the guides between the latch needles, as heretofore, but are solely shogged laterally. To enable lapped warp threads to be taken and engaged by the latch needles in this loom the needle bar has imparted to it from eccentrics on a rotary shaft a compound motion whereby the needle heads are caused to move in unidirectional endless and substantially elliptical paths disposed in planes perpendicular to the guide bars and located between the guides.

This invention relates to raschel knitting machines, or "warp looms" as they are usually called, and has reference more particularly to such knitting machines for producing single needle bed work.

Such a warp knitting machine basically includes, in combination, a needle bar which carries leads into which needles with pivoted latches are cast, a plurality of guide bars each furnished with a set of guides co-operable with the latch needles and having eyes through which are passed individual warp threads of a sheet of warps drawn from a beam, and operating and controlling means adapted to impart motions to the needle bar and to the guide bars respectively whereby warp threads become looped, i.e. lapped, around the needles and the latter produce from these threads laterally connected wales of knitted loops. Thus, in such a warp knitted fabric, adjointing vereical wales of knitted loops are laterally connected either in successive or in spaced courses or "laps" as they are called.

In a raschel warp knitting machine of conventional form, the needle bar is controlled from a cam shaft and has a vertical up and down motion to perform the knitting action. The set of latch needles operates through the tricks of a fixed trick plate which retains and supports the old fabric loops during the knocking over operation. Such trick plates are complicated and expensive. The vertical stroke of the needle bar is normally fixed so far as the amount of movement is concerned, and variation of the amount of knock-over is usually achieved by adjustment of the trick plate.

The guide bars in a conventional raschel warp knitting machine are both collectively swung backwards and forwards between the needles, and also individually shogged laterally in either direction (both in front of and behind the needles) to varying extents in accordance with pattern requirements.

For single needle bed work the movements have heretofore usually been as follows:

(1) The guide bars are shogged to make the necessary lateral movements for the underlap.

(2) The needle bar is raised to its highest position.

(3) The guide bars are swung to the rear of the machine, the guides passing between the needle heads.

(4) Then the guide bars are shogged again to impart thereto the lateral movements for the overlap.

(5) Next, the guide bars are reversely swung to the front of the machine, leaving the warp threads around the needle stems and on the latches.

(6) And finally, the needle bar is caused to descend to its lowest position to form a new course and knock over the old loops.

These movements are made once during each cam shaft revolution, and to produce the accelerations, decelerations and dwells heretofore necessary to allow the guide bars to swing through and between the needles, complex systems of cam-operated levers have previously had to be employed.

The individual lateral shogging movements of the guide bars have heretofore usually been imparted by means of a Dawson Wheel and pattern chains, although continuously-driven pattern wheels or cams may be, and sometimes are, used.

Moreover, a raschel warp knitting machine working on only one needle bed, is customarily equipped with a series of web holders (sometimes called "sinkers") in the form of blades fixed in a horizontal bar, the said bar being adapted to be brought forward at each course as the needles begin to rise, and this movement being such that the blades enter between the needles and retain the fabric by holding it down at the level of the trick plate. When the old loops on the latches had been knocked over, the web holder bar was withdrawn to allow the needles to be lapped and to knit again. Heretofore, the motion of the web holder bar has been controlled by a cam assembly or eccentrics and timed in relation to the movements of the needle bar.

Again, a conventional raschel warp knitting machine as heretofore constructed is usually furnished with complex latch control mechanisms.

The object of the present invention is to provide an improved form of raschel warp knitting machine, particularly for single needle bed work, involving novel principles of construction and operation, whereby the necessity for certain of the moving parts is obviated, and a machine of much simpler construction and adapted to operate at higher speeds than heretofore results.

One aim is to provide a raschel warp knitting machine of this improved form designed to produce elastic warp knitted fabrics, i.e. warp fabrics in which elastic warp threads are laid in.

In accordance with the principal feature of the improved raschel warp knitting machine, the guide bars are solely arranged to be individually shogged to move the guides for the individual warp threads laterally, i.e. the said guides are not swung backwards and forwards between the needles as heretofore, and to enable the lapped warp threads to be taken and engaged by the latch needles the needle bar has imparted thereto a compound motion comprising to and fro as well as vertical up and down components of movement whereby the needle heads are caused to move unidirectionally in endless paths disposed in planes perpendicular to the guide bars and located between the guides.

Advantageously, each of the said paths is in part elliptical, or substantially so, being somewhat wider at its upper end than at its lower end.

Thus, as will be appreciated, instead of the guide bars executing all the necessary movements to wrap the warp threads around desired latch needles as heretofore, the said needles in the improved machine themselves execute such motions as to enable them to catch the warp threads positioned by simple shogging movements of the guide bars.

The elimination of the conventional swinging movements of the guide bars obviates any attendant vibration.

According to a further feature of the generally im-

proved raschel warp knitting machine of this invention, a suitably curved verge plate may conveniently be attached to an oscillatory component or components through which freely extend rods which carry the needle bar and are operable to impart thereto the desired compound motion, this plate replacing the expensive trick plate of prior knitting machines.

In order that the invention may be more clearly understood and readily carried into practical effect, one specific layout of the improved raschel warp knitting machine incorporating the aforementioned and other features, and the movements of the latch needles and guides necessary to cause warp threads to be caught by desired ones of the needles will now be described with reference to the purely schematic drawings, wherein,

FIGURE 1 is a fragmentary rear view of the said knitting machine,

FIGURE 2 is an end view of the same, partly in section taken on the line II—II of FIGURE 1,

FIGURE 3 is a diagram illustrating the ovoidal path in which each needle head moves,

FIGURES 4–10 constitute a series of greatly enlarged detail side views illustrating successive stages in the relative movements of a latch needle and of an associated warp thread guide to cause a warp thread to be caught and knitted into a loop by the said needle, FIGURE 10 additionally illustrating the laying-in of an elastic thread, and

FIGURES 11–17 are front views of needles and guides corresponding to the side views of FIGURES 4–10 respectively.

Like parts are designated by similar reference characters throughout the drawings.

Referring to FIGURES 1–3, it will be seen that the main framework of the knitting machine includes two suitably spaced vertical end frame members **2** and **3** which are connected together both by horizontal rods such as **4** or similar frame members as well as by a flat horizontal plate **5** extending longitudinally of the machine. The rods **4** and the plate **5** are arranged in parallel relationship. At a location above the plate **5** but below the two upper rods **4** is a still further and particularly robust horizontal frame member **6** of triangular shape in cross-section—disposed apex downwards. The member **6** serves to support a laterally movable guide bar **7** on each of its angularly disposed faces **6***a*. Thus, as shown in FIGURES 1 and 2, each of the opposite ends of the horizontal member **6** is formed integrally with a pair of cheeks or lugs **6***b* which protrude laterally from the angularly disposed faces **6***a*. These four cheeks or lugs **6***b* are drilled to receive the the opposite ends of two pairs of horizontally disposed and parallel guide rods **8** along which the two guide bars **7** are respectively arranged to slide. Each guide bar **7** is formed with parallel tubular bearings **7***a* through which the rods **8** extend.

The lower horizontal margin of each such guide bar is recessed to receive leads **9** fitted with depending guides **10**. As illustrated in FIGURES 4–10 each guide **10** has formed in its lower end an eye **10***a* through which a warp thread W can be threaded.

Since the robust member **6** of triangular cross-section is rigid and immovable it follows that the guide bars **7** supported thereby cannot be swung backwards and forwards. The said bars are, in fact, solely arranged to be individually shogged laterally, i.e. to and fro longitudinally of the machine, for the underlaps and overlaps. As the guide bar **7** in front of the member **6** is shogged in one direction the other guide bar at the back of this member is shogged in the opposite direction. The means to effect these shogging movements of the guide bars **7** are shown in the upper portions of FIGURES 1 and 2. Thus, the left-hand end of each such bar has connected to it by a pin **11** the forked inner end **12***a* of an actuating rod **12**. This rod extends horizontally through a bearing **13** provided at the outer side of the vertical end frame member **2**. The outer end of each rod **12** is provided with a cam follower roll R^1 arranged to be in contact with the appropriately contoured periphery of a rotary cam RC^1. A helical compression spring S^1 is interposed between each bearing **13** and a spring abutment collar **14** rigid with the corresponding rod **12**.

The needle bar in the illustrated example is generally designated by the numeral **15** and comprises a horizontal portion **15***a* and an upwardly directed lip **15***b* both extending practically the full length of the machine. The latch needles **16** are fitted into leads **17** which are supported upon the portion **15***a* and secured to the lip **15***b* of the needle bar. The main rotary shaft **18** of the knitting machine from which the latch needles **16** are operated has mounted at regular distances apart thereon a plurality of eccentrics such as **19** each encircled by a yoke **20** having extending from it an upwardly directed rod **21**. The rods **21** serve to carry the neeedle bar **15** and extend freely through guide holes **22***a* formed in blocks **22** which are integrally combined with a common solid shaft **23**. The latter is disposed beneath and is co-extensive with the bar **15**. The shaft **23**, moreover, is permitted to oscillate freely for which purpose its opposite ends are mounted to turn to and fro within bearings **24** secured to the inner sides of the vertical end frame members **2** and **3**. The pivotal axis of the shaft **23** thus extends lengthwise of and parallel with respect to the needle bar **15**. The rods **21** also extend up freely through comparatively large holes **5***a* formed in the plate **5**.

Alternative, the blocks having therein the holes through which the rods **21** freely extend may be wholly separate from one another in which case each may be provided with axially aligned trunnions by means of which it is pivoted.

As a further alternative, a common oscillatory tube having pairs of registered holes formed therein may be provided in the place of the solid shaft **23** and its integral blocks **22**.

In the specific example shown in FIGURES 1 and 2, the rotary shaft **18** is furnished with a chain wheel **25** around which and a drive motor sprocket **26** is passed a drive-transmitting chain **27**. The drive arrangement is such that needle bar **15** has imparted thereto a compound motion comprising to and fro as well as vertical up and down components of movement. As a consequence, the needle heads are caused to move unidirectionally in ovoidal paths like that represented by the letter P in the diagram constituting FIGURE 3. In this diagram, the rotary shaft **18** and one of the eccentrics **19** are shown, and the longitudinal axis of the oscillatory shaft **23** is designated *a*.

The line L represents the axis of one of the rods **21**, and the upper end of the said line terminating at the path P coincides with the position of the head of one of the latch needles **16**. Thus, with the eccentric **19** rotating clockwise and the needle head moving in the opposite direction, the equi-spaced peripheral points A, B, C, D, E. F. G and H on this eccentric correspond respectively to the points *a b, c, d, e, f,* and *g* and *h* in the path P. As will be seen this path is shaped somewhat like the major cross-section of an egg.

An upwardly directed verge plate plate **28** which is slightly curved in transverse cross-section, is attached to the backs of the blocks **22**. Thus, as the needle bar **15** moves downwards, the verge plate **28** pushes up the old loops on the needles **16** which old loops close the pivoted latches around newly drawn loops. Naturally, being attached to the blocks **22** carried by the oscillatory shaft **23**, the verge plate **28** follows the rocking motion of the needle bar **15**.

Where, as is primarily the intention, warp knitted fabric produced on the improved knitting machine is to incorporate laid-in elastic threads, then these threads, fed in and controlled by additional guide bars, may be led over the verge plate **28** at a right angle or at an even more

acute angle relatively thereto. Two such guide bars, arranged in superimposed relation, are designated by the numeral **29** and **30** in each of FIGURES 1 and 2. These bars are equipped with guides **31** for elastic threads and are mounted for shogging movements longitudinally of the machine, within suitably spaced upright supports **32** fixed upon the top of the plate **5**. At its right-hand end each of the guide bars **29** and **30** is connected to a horizontal rod **33** which extends outwardly through a bearing **34** mounted on the outer side of the vertical end frame member **3**. The outer end of each rod **33** is furnished with a cam follower roll R^2 arranged to be in contact with the appropriately contoured periphery of a rotary cam RC^2. A compression spring S^2 is interposed between the bearing **34** and a collar **35** rigid with the rod **33**. In a constructional arrangement, the guide bars **29** and **30** may, if desired, be made slidable along horizontal guide bars provided at the positions shown at **36** in FIGURE 2. In the arrangement just described the laid-in elastic threads may perform the fabric holding down function previously performed by the web holders or web-holding sinkers. Such an arrangement, therefore, not only obviates any necessity for a trick plate but also for a web holder bar and its associated cam assembly and related driving members.

It is, however, to be clearly understood that the improved knitting machine could, if desired, be equipped with web holders or web-holding sinkers but even in such a case these would be stationary and not driven.

As previously mentioned the movements of latch needles and warp thread guides necessary to cause warp threads to be caught by such needles are illustrated in the series of FIGURES 4–17.

Thus, in FIGURES 4 and 11 which correspond with one another, an underlap has been completed and the needles **16** (one only of which is depicted in FIGURE 4) are rising and moving forward with their hooks **16***a* in the ovoidal path P and their latches **16***b* open. In FIGURE 4, an old loop around the stem of the needle is designated *ol*, and a warp thread W is seen extending through the eye **10***a* of the guide **10** and downwardly to the fabric. At the stage illustrated in FIGURES 4 and 11 the warp thread guides **10** are stationary.

At the next stage shown in FIGURES 5 and 12 the needle hooks **16***a* are passing forwardly between the still stationary guides **10**.

The overlap commences immediately the needle hooks **16***a* are clear of the guides **10**. Thus, in FIGURES 6 and 13, the overlap has commenced, and the guide **10** has been shogged laterally rightwards to the position (see FIGURE 13) in which the warp thread W is safely under the needle hook **16***a* (see FIGURE 16). The needle has already started to descend.

In FIGURES 7 and 14 is illustrated the next stage in which the new underlap has commenced and the guide **10** has been shogged laterally to the left. The needle **16** is continuing to descend with its hook in the path P. The result of this, as will be seen in FIGURE 7, is that the old loop *ol* is acted upon by the verge plate **28** and pushed up along the stem of the needle so that it closes the latch **16***b*.

The needles thereupon continue to descend and commence to move forwardly until, as shown in FIGURES 8 and 15, the old loop *ol*, by virtue of its continued engagement by the verge plate **28**, has been knocked over. The new loop *nl* of the thread W has been drawn by the needle through the said old loop. At this stage the guide **10** may be stationary. If, at this stage, elastic threads are being laid-in, then such yarns will be traversed one needle space over the tops of the needles.

At the next succeeding stage depicted in FIGURES 9 and 16, the needles are commencing to rise between the newly traversed elastic threads such as that designated ET in FIGURE 10. Then, as such rise continues, the new loop *nl*, still in the hook **16***a* and about the stem of the needle **16**, acts and opens the latch **16***b* as shown in FIGURE 10. At this stage the elastic thread ET is trapped between the new loop *nl* (now to become an old loop) and the underlap corresponding to the next new loop to be drawn. FIGURE 10 thus illustrates the manner in which elastic thread may be laid. Although the guide **10** may be stationary at all three stages depicted in FIGURES 8 and 15, 9 and 16 and 10 and 17 this is not essentially so.

For a correcet understanding of FIGURES 11–17 in their relation to FIGURES 4–10 respectively, it must be realised that in every instance the guide **10** having a warp thread W extending through its eye **10***a* in each of FIGURES 4–10 is the particular guide represented at the position marked X in each of FIGURES 11–17. Moreover, whereas the latch needle **16** shown in each of FIGURES 4 and 5 is intended to be the needle at the position marked Y in each of FIGURES 11–17, the needle **16** in each of FIGURES 6–10 is the needle at the position marked Z in each of FIGURES 11–17.

Furthermore, according to the present invention, the heretofore conventional latch control mechanisms are no longer necessary, since the latch needles **16** automatically approach and recede in the ovoidal paths P, so that a taut metal wire or a rigid plastic thread or the like, suitably positioned, is all that is required to exercise control over the needle latches. Naturally, elimination of the usual complex latch control mechanisms is a factor contributing to simplification and cheapening of the construction of the improved raschel warp knitting machine.

The warp threads taken and knitted by the latch needles **16** are "rigid" threads, this term being used to denote both natural and man-made fibres such as cotton, rayon, nylon and the like which, although having a relatively small degree of extensibility are nevertheless rigid in contradistinction to true elastic threads such as those made from rubber or a synthetic rubber or elastomeric threads such as so-called spandex threads based on polyurethane.

A raschel warp loom in accordance with the invention has the advantage of being able to work at a high speed. This is because, inter alia, swinging movements of the guide bars are eliminated. In addition, the elimination of a sinker bar drive contributes towards the achievement of a higher speed. Finally, in a case where web holder blades or web-holding sinkers are also eliminated, the needles can be made substantially shorter than before because whereas on a conventional machine the latch needles had to penetrate the depth of the trick plate and the web holder blades, the needles in a form of the improved machine which obviates the use of a web holders or sinkers are required to negotiate only a little more than the thickness of the elastic threads.

Again, in a case where web holder or sinker blades are eliminated, no unsightly "sinker" lines appear on the warp knitted fabric as produced. The absence of a trick plate also minimises thread breakages and obviates faults due to interference of needles by bent tricks.

I claim:

1. A raschel warp knitting machine comprising, in combination: a needle bar; leads carried by said bar and into which are cast needles with pivoted latches; a plurality of guide bars each furnished with a set of guides which are co-operable with said latch needles and have therein eyes through which individual warp threads can be fed, and operating and controlling means for imparting motions to the said needle bar and to the said guide bars respectively whereby warp threads are lapped around the needles and the needles are caused to produce from the threads laterally connected valves of knitted loops: said warp knitting machine being characterized in that it includes a framework including spaced vertical end frame members; a horizontally disposed rigid frame member extending between said end frame members; guide bars slidably supported on the rigid frame member, each of

said bars being movable longitudinally to shog the guides associated therewith laterally but being incapable of being swung backwards and forwards; a main shaft rotatably mounted in and extending between said end frame members; a plurality of eccentrics mounted on said rotary shaft; yokes encircling the eccentrics and including, extending therefrom, members for carrying the needle bar; at least one component pivotally mounted for oscillatory movement within the framework and having therein guide holes through which the aforesaid needle bar carrying members freely extend such that the heads of the needles are caused to move in endless substantially elliptical paths disposed in planes perpendicular to the guide bars and located between the guides, so that the needles move vertically up and down as well as to and fro from front to back and back to front of the guides; and a verge plate attached to the oscillatory component so as to follow the rocking motion of the needle bar, said plate acting to knock-over old loops from the needles.

2. A raschel warp knitting machine according to claim 1, wherein the heads of the needles follow endless paths each of which is wider at the upper end thereof than at the lower end thereof.

3. A raschel warp knitting machine according to claim 1, wherein the horizontally disposed rigid frame member is of triangular shape in cross-section, disposed apex down, and a guide bar is slidably supported on each of the two angularly disposed faces of said members.

4. A raschel warp knitting machine according to claim 1, wherein each slidable guide bar is formed with parallel tubular bearings through which extend guide rods secured at the ends thereof in members protruding from the angularly disposed faces.

5. A raschel warp knitting machine according to claim 1, wherein each guide bar supported on the horizontally disposed frame member is shogged from a rotary cam through the medium of a spring-controlled slidable actuating rod.

6. A raschel warp knitting machine according to claim 1, which includes additional guide bars fitted with guides for elastic threads required to be incorporated into fabric by laying-in; means mounting said additional guide bars adjacent to the verge plate, and means operating the last-mentioned bars to lead the elastic threads over he said plae at an angle relatively thereto.

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RONALD FELDBAUM, Primary Examiner