United States Patent

Jackson

[15] **3,665,733**

[45] **May 30, 1972**

[54] APPARATUS AND METHOD FOR WARP KNITTING A SIMULATED WOVEN FABRIC

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[73] Assignee: **Union Carbide Corporation,** New York, N.Y.

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[21] Appl. No.: **55,490**

[52] **U.S. Cl.** **66/87,** 66/86, 66/121

[51] **Int. Cl.** **D04b 23/02**

[58] **Field of Search** 66/190–195, 84–86, 66/121

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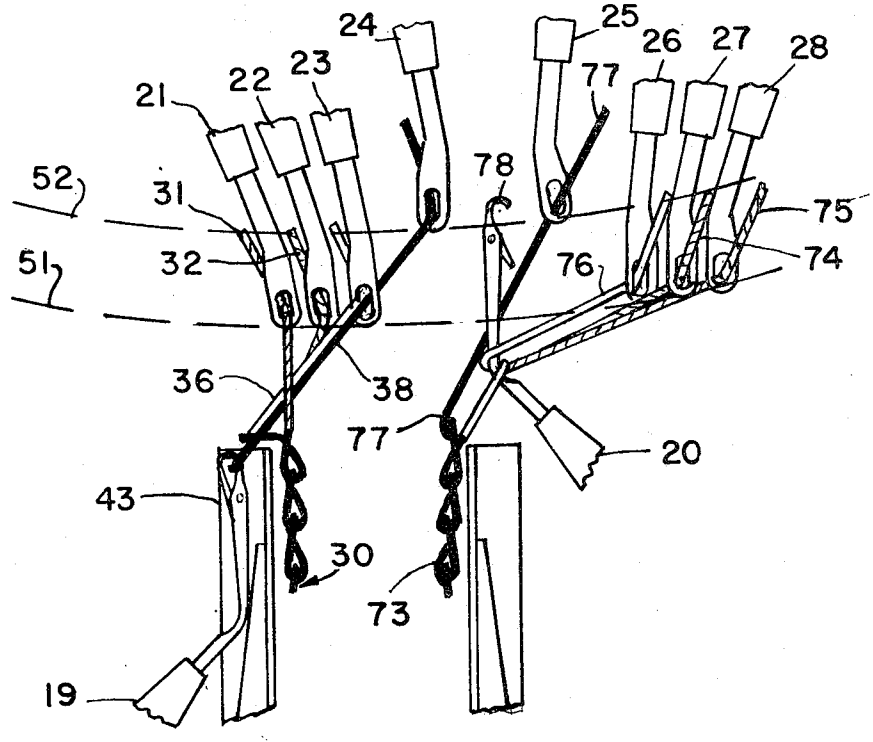
Primary Examiner—Ronald Feldbaum

Attorney—Pearson & Pearson

[57] **ABSTRACT**

A simulated-weave, warp-knit fabric is produced on a warp knitting machine by using short latch, long shank needles combined with a high rise needle bar motion. A chopper bar is eliminated, thus freeing guide bar space while avoiding impact, dwell and delay. Either a high set chain stitch guide bar, or a needle bar timing control, may be used as a collision avoidance means. The short latch needles are wrapped in one course and different short latch needles wrapped in the next course to produce the weft appearance. There is a double guide bar stroke for each needle bar stroke, but the provision of two needle bars restores production rate to that of a one to one ratio.

16 Claims, 25 Drawing Figures



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4 Sheets-Sheet 1

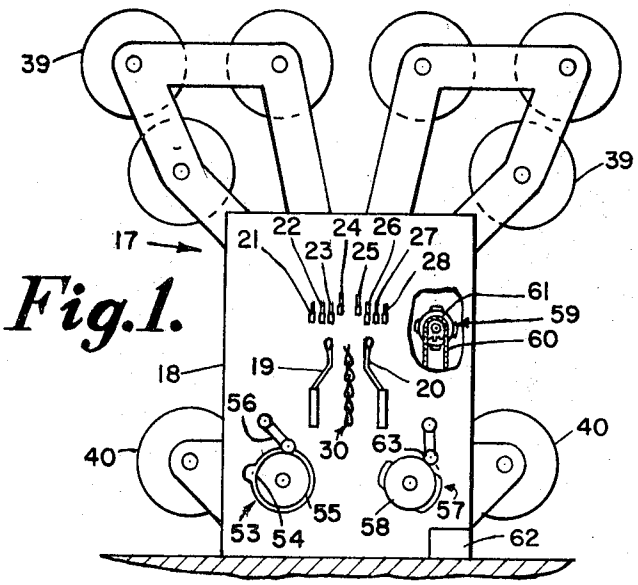
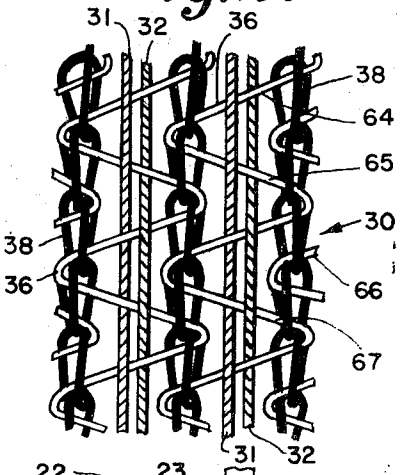


Fig. 1.



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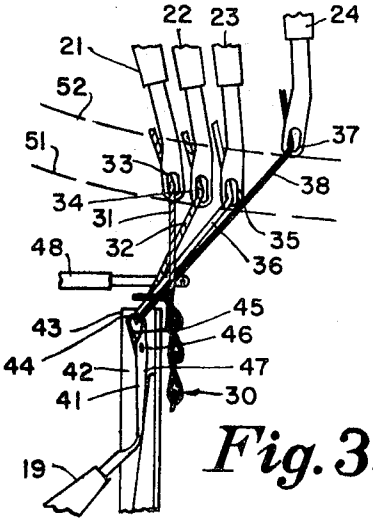

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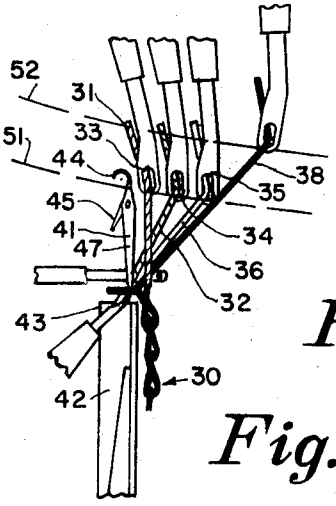

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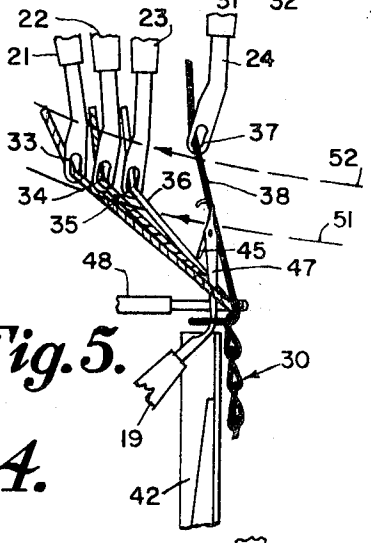

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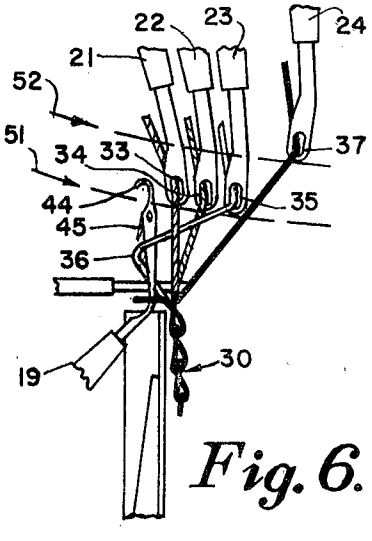

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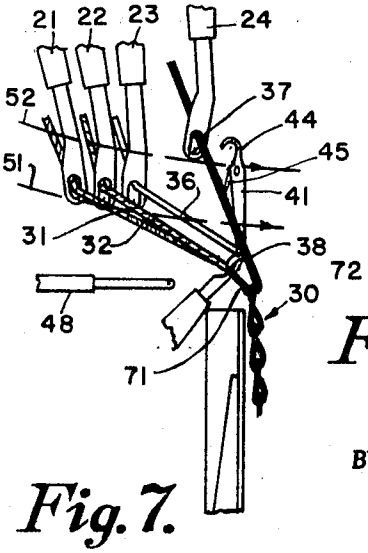

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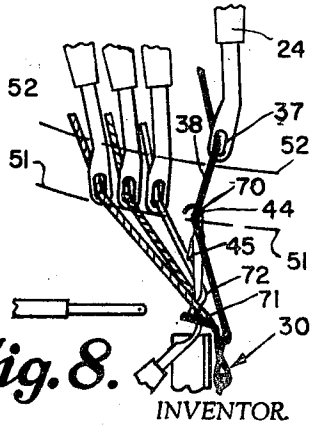

Fig. 8.

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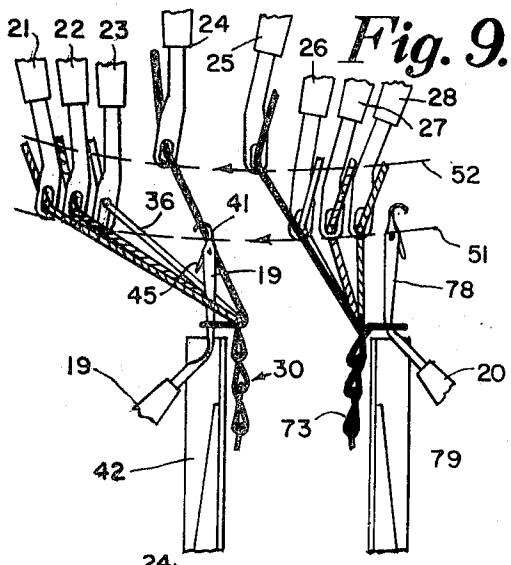

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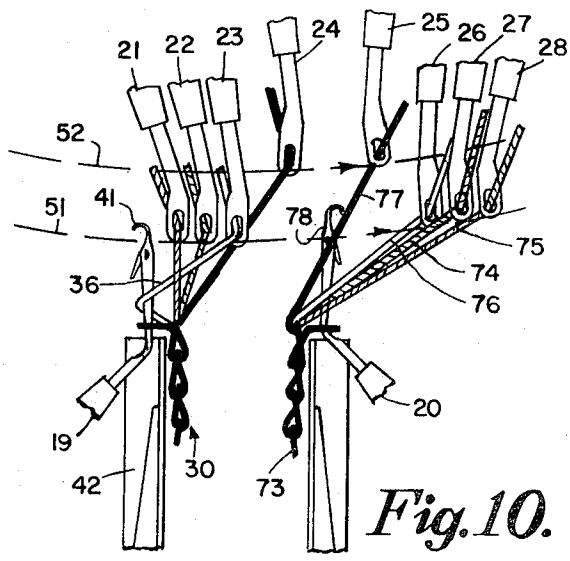

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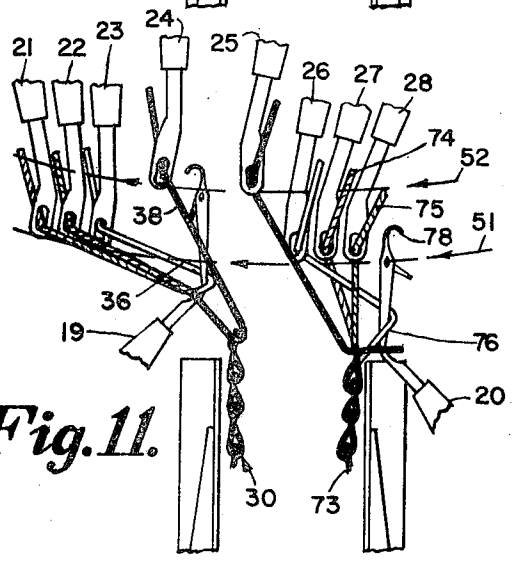

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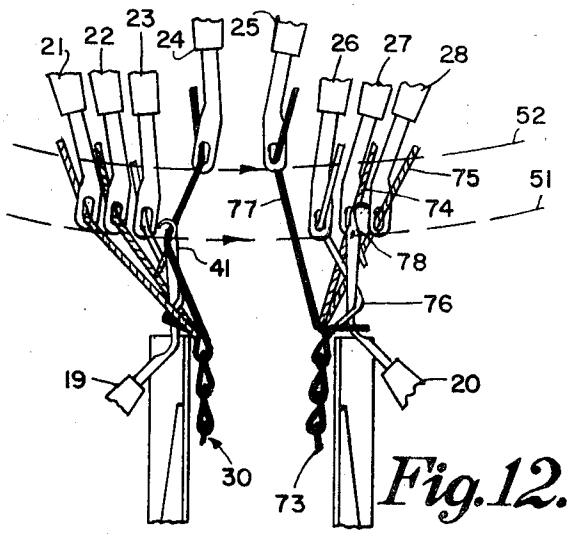

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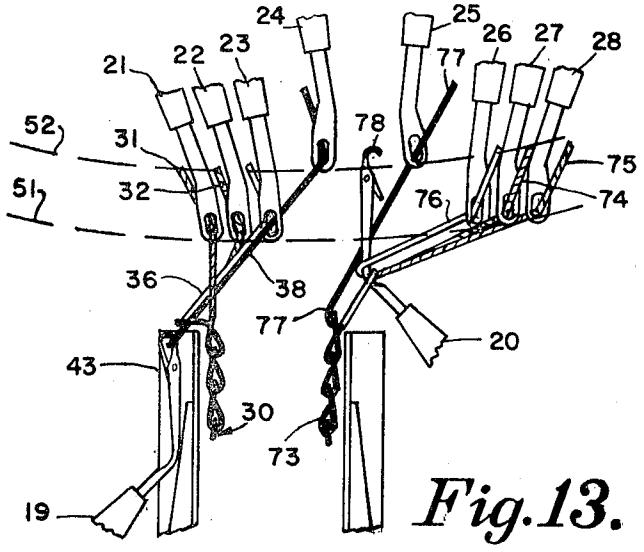

Fig. 13.

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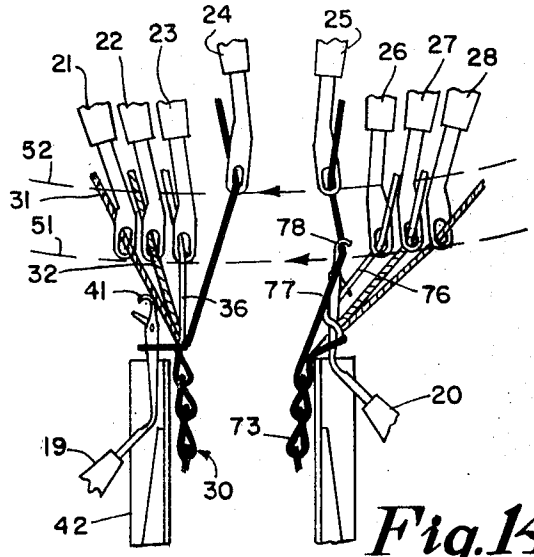

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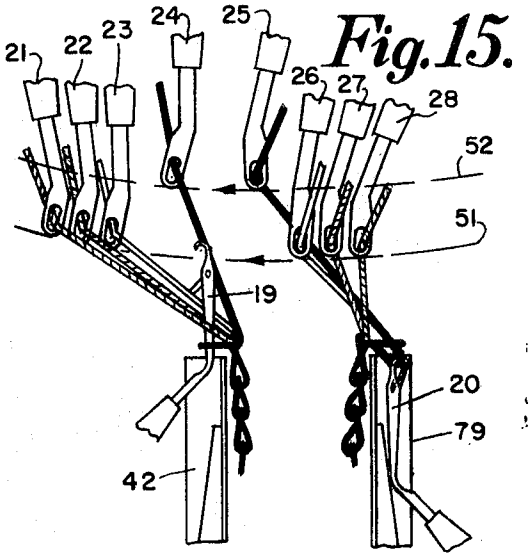

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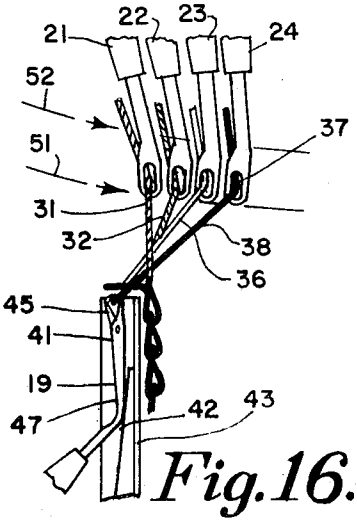

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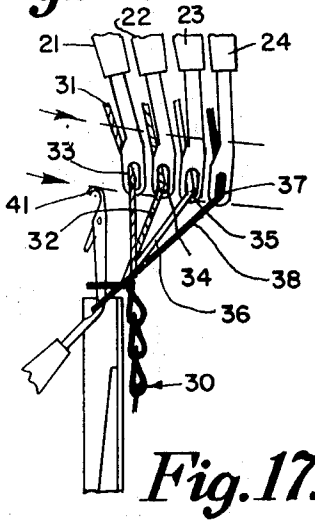

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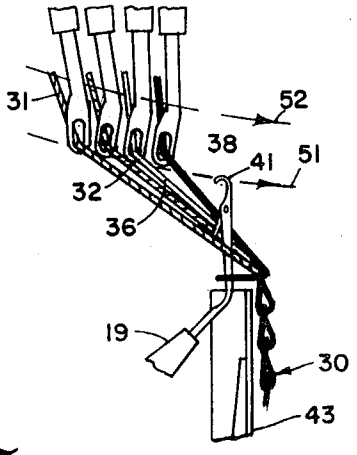

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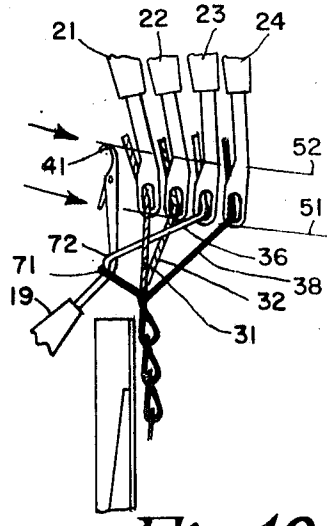

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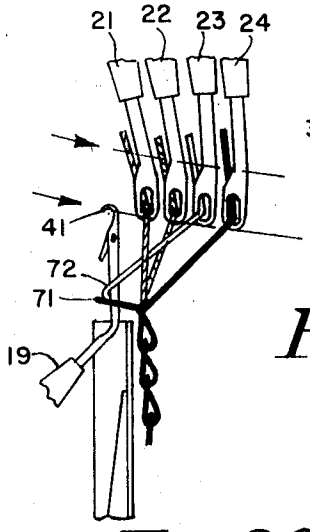

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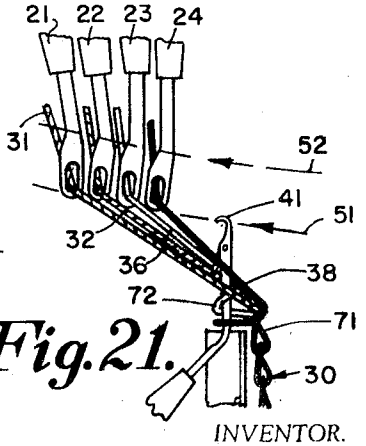

Fig.21.

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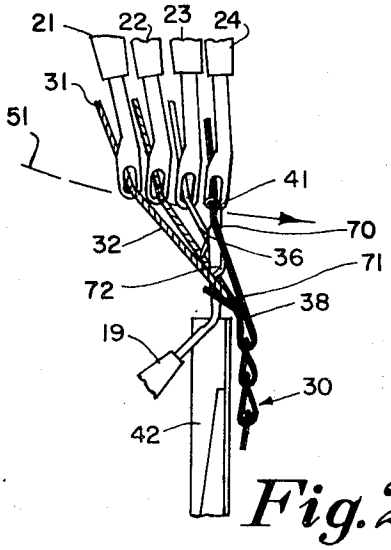

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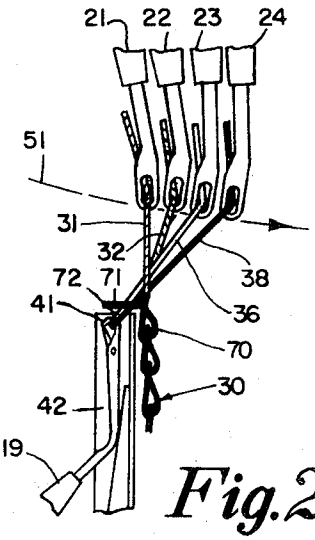

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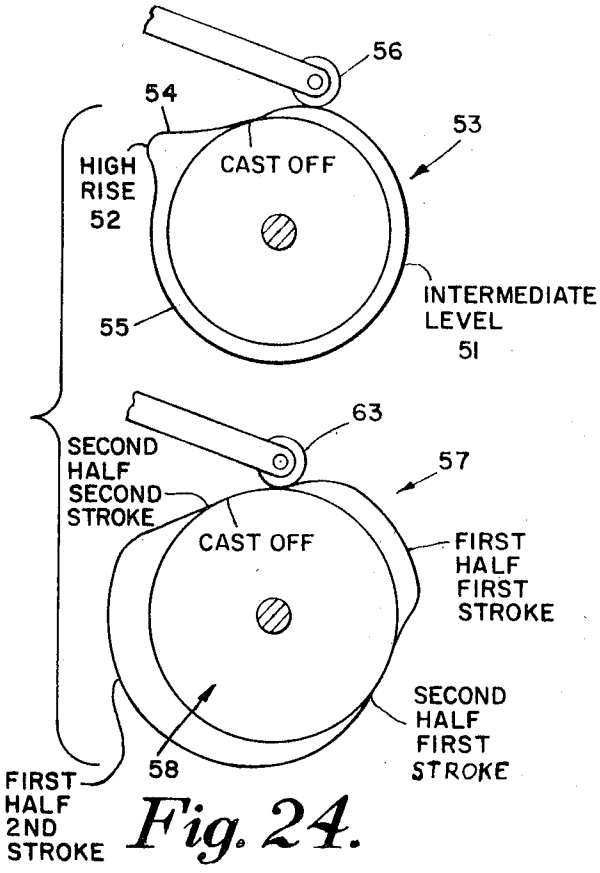

Fig. 24.

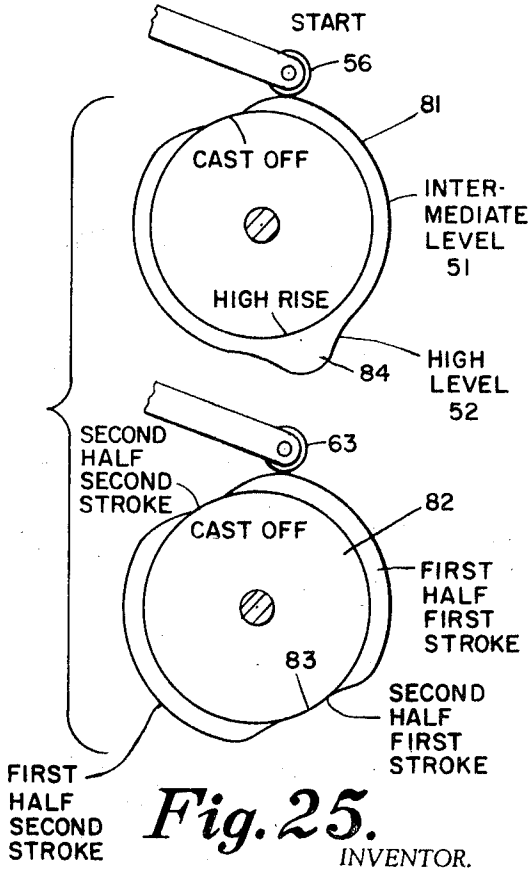

Fig. 25.

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APPARATUS AND METHOD FOR WARP KNITTING A SIMULATED WOVEN FABRIC

BACKGROUND OF THE INVENTION

Warp knitting machines, of the Raschel, or other, types are well known and used for producing warp knit fabric at high speed, several times greater than the rate of production of woven fabric on a power weaving loom. It has long been considered desirable in the trade to be able to produce warp knit fabric not only with the multiplicity of individual, parallel warp strands, but also with either a weft-wise extending strand, or a warp strand having weft appearing sections so that simulated weave patterns were achieved. Such a product must be distinguished from the conventional weft knit fabric made by running the strands circumferentially as in a circular knitting machine, such products having a weft appearance without corresponding warp appearance.

To take advantage of the warp knitting machine speed, while attempting a weft-like woven appearance, it has been known to run a shuttle type member weft-wise of the warp needles as in a Burson machine, but production is necessarily slow on such machines. Typical thereof is the device of U. S. Pat. No. 3,145,549 to Siccardi of Aug. 25, 1964 wherein a carriage runs transversely of the warp yarns to carry a weft yarn the full width of the fabric.

It has also been proposed to provide a series of long weft yarns, cut at each end, and to insert, or lay, these filling yarns, into the needles of a warp knitting machine to achieve a woven effect, as in the "Weftamatic" machine of J. P. Stevens & Co., Garfield, New Jersey.

In addition to the full width shuttle action of Siccardi, the lesser width transverse "laying-in" of the "Weftamatic" device, it has further been proposed to simply shift one warp yarn, designated as a "weft" yarn, sidewise only one or two needle spaces, to create a weft float while overlaying and underlaying certain warp yarns to give an interwoven appearance to the weft floats, thereby retaining normal warp knitting speeds. This latter system is termed the "Co-We-Nit" process of Karl Mayer Co., Obertshausen, Germany described in detail in "Knitted Outerwear Times" June 17, 1968, July 1, 1968, July 22, 1968 and Sept. 16, 1968, and in U.S. Pat. No. 3,520,155 to Koppenburg of July 14, 1970.

The Karl Mayer "Co-We-Nit" process is practical only with a single needle bar machine, and is quite dependent on the use of a thin chopper bar, or fall plate, centrally of the guides to push the weft yarn loops down the shanks of the needles, all four guide eyes being at conventional height setting and the uppermost position of the bills of the needles being at that height. Without the fall plate the Co-We-Nit process would not create a simulated weave because the fall plate is required to insert the "weft" yarn to obtain the correct condition for "evasion" of the warp yarns so that they can be caused to come over the "weft." A double swing of the guide bars for each needle bar stroke is required by the Co-We-Nit process to permit the fall plate yarns to be pushed below the opened latches without also pushing down the loops of the ground fabric yarns. The double swing of the guide bars must be halted to create a dwell, while the chopper bar acts, thereby slowing production and producing impacts.

SUMMARY OF THE INVENTION

In the method and apparatus of this invention, a simulated-weave, warp-knit fabric is achieved by means somewhat similar to the above mentioned Co-We-Nit process but with the chopper bar, or fall plate, eliminated. Thus the space normally occupied by the chopper bar can be used for additional warp yarn guide bars to produce more intricate, close meshed woven patterns.

In this invention, a minimum of four guide bars are mounted to make a double swing, or stroke, for each single reciprocatory stroke of the needle bar, the guide bars being free of a chopper bar and the needle bar having short bill, short latch, long shank needles plus collision avoidance means in the form of a specially timed, high level needle bar position for lowering the weft yarn loops down onto the needle shanks. In one embodiment, the chain stitch, or ground yarn, guide bar may be set high at a predetermined level while the other three guide bars for warp and "weft" have their guide eyes set low at normal level. Normal level is the level of the conventional, uppermost level, or position, of the bills of the needles of the needle bar, this being about the level of the arcuate oscillatory path of the conventional guide eyes of a warp knitting machine. The needle bar of this invention is mounted to reciprocate from normal lowermost position within the trick plate grooves, upwardly beyond normal uppermost position to an uppermost, or "high rise" position wherein the bills are well above the guide eyes of the guide bars. When the chain stitch yarn guide eye is set high, it will be approximately at the level of the needle bills in "high rise" position.

Not only are the space limitations and mechanical disadvantages of a chopper bar eliminated, but a more positive assurance that the weft yarn will be slid below the opened latches is obtained. In addition, while the double swing of the guide bars slows production slightly, production rates are regained and increased in spite of the double swing by using eight guide bars and interposing a second needle bar back to back to the first needle bar. Thus a pair of simulated weave, warp knit fabrics are produced in the same time required to make one fabric, utilizing the double swing motion of the machine. The method of the invention is thus continuous and high speed, with no chopper bar dwell and no requirement that existing warp knit machines be equipped with chopper mechanism.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a diagrammatic side elevation of a typical two needle bar warp knitting machine.

FIG. **2** is a front elevation of the simulated weave warp knit fabric of the invention.

FIGS. **3** to **8** are enlarged diagrammatic side elevations in section showing the short latch, long shank needles, and the initially high-set, chain stitch, guide bar, of one embodiment of the invention, showing the needle bar path from bottommost position within the trick plate, through intermediate needle position, at conventional guide eye level, to uppermost position, at the high set guide eye level and showing the knitting cycle through the double stroke of the guide bars of the invention.

FIGS. **9** to **15** are views similar to FIGS. **3** to **8** showing the double production of fabric in the same time period by providing two needle bars and eight guide bars in the apparatus of the invention.

FIGS. **16–23** are views similar to FIGS. **3** to **8**, showing the preferred embodiment in which the chain stitch guide bar is not set high but the needle bar rise is specially timed to achieve the simulated weave.

FIG. **24** is a diagrammatic view of the relationship of the needle bar cam and the guide bar swing cam when the chain stitch guide bar is set high as in FIGS. **3–15**; and

FIG. **25** is a similar view of the cams when the chain stitch guide bar is at conventional level as in FIGS. **16–21**.

DESCRIPTION OF AN EMBODIMENT

As shown in FIG. **1**, the numeral **17** designates a typical, single, or double, needle bar warp knitting machine of the Raschel type. The warp knitting machine **17** includes a frame **18**, supporting at least one needle bar **19**, and at least four guide bars **21**, **22**, **23** and **24**, and preferably also supporting a second needle bar **20** and four additional guide bars **25**, **26**, **27** and **28**.

The apparatus and method of this invention may be arranged to knit a single, simulated weave, warp knit fabric **30**, such as shown in FIG. **2** and which is substantially identical with the corresponding product of the above mentioned Co-We-Nit process. As shown, the fabric **30** is formed by repeats

of at least four guide bars each having a yarn threaded in the eye thereof. FIGS. 3 to 8 show the single fabric 30, produced by the single needle bar 19, and it will be noted that guide bars 21 and 22 each have a warp yarn 31 or 32 threaded in the eyes 33 or 34 thereof, which yarns are "laid in," as shown in FIG. 2, and indicated by cross hatching.

The eye 35 of guide bar 23 is threaded with a warp yarn 36, which is designated the "weft" yarn while the eye 37 of guide bar 24 is threaded with the chain stitch, ground, or base yarn 38, indicated in block to distinguish from the white "weft" yarn 36.

In FIGS. 3 to 8 the individual needles 41 of needle bar 19 are shown as vertically reciprocable in the grooves 42 of trick plate 43, each needle having a bill 44, latch 45, pivoted at 46, on the shank 47, there also being suitable sinkers 48 and other well known parts, some not shown for clarity.

In this invention no chopper bar, or fall plate interferes with the four guide bars and the three guide bars 21, 22 and 23 have their guide eyes 33, 34 and 35 set at conventional height. This is termed "low," or "deep" set herein because in this embodiment the chain stitch guide 24, and its guide eye 37 are mounted at a substantially higher level termed "high" set herein. The arcuate path of guide eyes 33, 34 and 35 is illustrated at 51 as "low set" while the arcuate path of guide eye 37 is illustrated at 52 as "high set."

The needle bar 19 is vertically reciprocable from normal lowermost fixed position with the needles 41 within the grooves 42 of trick plate 43, as in the "cast off," "knocking over" position of FIG. 3, to the normal uppermost fixed position of FIG. 4 with the bills 44 about at the level of the path of the eyes 33, 34 and 35 of guide bars 21, 22 and 23 on arcuate "low set" path 51.

However, in this invention, needle bar control means 53 is provided including "high rise" mechanism 54 which may be a suitable face cam 55 and cam follower 56 (FIG. 24) which periodically lifts the needle bars 19 or 20, to a level well above normal uppermost position so that the bills 44 are substantially at the level of the guide eyes 37 of guide bars 24 on "high set" path 52 as in FIG. 7. I call this the "high rise" level of the needle bars, and, in this embodiment it occurs at the end of the first half just before the second half of the second guide bar stroke (FIG. 7).

Guide bar control means 57 is provided for swinging, or oscillating, the guide bars 21, 22, 23 and 24 transversely relative to needle bars 19 while shifting certain guide bars longitudinally in parallelism with the row of needles, means 57 comprising suitable guide bar oscillation, means such as cam 58 and follower 63 (FIG. 24) and shift means 59 including pattern chains 60 and rod followers 61, all of a type well known in the trade for the purpose.

As in the Co-We-Nit process, the guide bar control means 57 of this invention oscillates the guide bars through two full cycles, or strokes, for each single vertical reciprocatory stroke of needle bar 19, by suitable synchronization with powered actuation means 62, the first swing stroke wrapping the "weft" yarn around the needles at the level of the opened latches and the second swing stroke permitting the lowering of the loops below the latches and the completing of the chain stitch knitting operation.

Suitable warp beams 39 and wind-up rolls 40 are provided for supplying the warp yarns 31, 32, 36 and 38 to the guide bars and winding the resulting fabrics 30.

OPERATION SINGLE NEEDLE BAR

FIG. 3, the needle bar 19 is shown in lowermost position, with the four guide bars in front of the needles and the needles 41 in "cast off" position.

In FIG. 4, the four guide bars remain in front of the needles, while needle bar control means 53 lifts the needles 41 to intermediate level, with the bills 44 about at the level of the low set guide bars at 51, this being normal uppermost position in prior devices.

It has been found essential and preferable that the latches 45 be unusually short, for example, about one-eighth of an inch in length, so that the diameter of their semi-circular path is about one-half inch and the shank 47 of each needle 41 is unusually long, for example, one-half inch in length. Thus, as shown in the drawings, the needles 41 are of a commercially available type with short bills 44, short latches 45 and long shanks 47.

In FIG. 5, the guide bars are shown swung to the rear of the needles, on the bill, or hook, side thereof, by guide bar oscillation cam means 58 of guide bar control means 57. Upon completing this first half of the first stroke, or cycle, the guide bar shift means 59, shifts the "weft" yarn guide bar 23 at least one needle space so that weft yarn 36 is in position to be wrapped around a needle about at the level of the opened latch 45.

In FIG. 6, the guide bars are shown swung back to the front of the needles on the second half of the first stroke. Guide bar shift means 59 then shifts weft yarn guide bar 23 back at least one needle space which causes yarns 36 to be wrapped entirely around the needle, still at the level of the opened latches 45. Guide bar shift means 59 now shifts the warp yarn guide bars 21 and 22, through motions either to the right or left depending on the position the yarns are to assume in the fabric, each yarn 31 or 32 first overlying a pair of weft yarn sections 64 and 65 and then underlying the next pair of weft yarn sections 66 and 67 as shown in FIG. 2. Chain stitch guide bar 24 shifts one space as part of conventional chain stitch motions.

In FIG. 7 the oscillation means 58 has swung the guide bars again to the rear of the needles, on the first half of their second stroke, and during such movement as the weft yarn guide bar 23 is passing through the upraised needles 41 of needle bar 19, the cam 55 of needle bar control means 53 raises the needles 41 to the high set level 52. This raising of the needles causes the weft yarn 36 wrapped around the needles in the first oscillatory stroke to slide down the shanks 47 of the needles so that the weft yarn loops are well below the opened latches 45 and so that they will be cast off with the previous loops. As the guide bars completely pass over to the hook, rear, or bill, side of the needles, the needle bar 19 arrives at its highest position at proximate the level of high set guide eye 37. Guide bar 24 is now shifted back one space by shift means 59 to position chain stitch yarn 38 for wrapping on the needles 41.

In FIG. 8, oscillation cam means 58 is swinging the guide bar back to the front on the second half of the second stroke, while cam 55 of needle bar control means 53 is lowering the needles 41 into the lowermost, or "cast off" position in trick plate 43. The needle bar 19 starts its descent as soon as guide bar 24 is in the needles 41 and thereby hooks onto the chain stitch yarns 36 as the needles continue descending, whereby the new chain stitch loop 70 is pulled through the old chain stitch loop 71 and through the loop 72 formed by the weft yarn 36. Upon casting off, a new cycle is started as in FIG. 3.

The needle bar control means and the guide bar control means are so synchronized that the low set guide bars 21, 22 and 23 are never in the needles 41 when the needles are at the top of their stroke.

On the next cycle, the weft yarn 36 is wrapped around an adjacent needle, to produce the weft appearance of the fabric.

OPERATION DOUBLE NEEDLE BAR

In this invention, advantage is taken of the double swing motion of the guide bars, to interpose the second needle bar 20 back to back to the first needle bar 19, to produce a second fabric 73 identical with simulated weave, warp knit fabric 30 but back to back thereto. To do so the four guide bars 25, 26, 27 and 28 are used, the needle bar cams 55 have the same compound motion as described above to raise the needle bars 19 and 20 to the intermediate level 51 and high level 52 and the swing cams 58 for the guide bars are modified only slightly.

The double swing of the guide bars, by oscillation cam means **58**, can be considered wasted motion when only one needle bar and four guide bars are used as in FIGS. **3** to **8**. With two needle bars **19** and **20** and at least eight guide bars, it will be seen that when guide bars **21**, **22**, **23** and **24** are swung to the hook side of the needles on bar **19**, the guide bars **25**, **26**, **27** and **28** are to the front of the needles on the other needle bar **20** and vice versa. Conventional double needle bar machines make this double swing motion to some extent so that guide bars may make shifting motions on the front side of the needles for lay-in stitches. Since the needle bars are set rather closely together, the guide bars must be moved across the needle bar that they just passed through so that the required shifts (under laps) of the guide bars, may be made for the opposite needle bar. The guide bars are then swung to the rear of the needle (hook side) to enable knitting to take place.

As shown in FIG. **15**, at the end of a cycle, the needle bar control means **53** and the guide bar control means **57** are so synchronized that when rear needle bar **20** descends to its cast-off position, front needle bar **19** has been raised to its intermediate level **51**.

Thus in FIG. **9**, at the start of the next cycle, the guide bars **21** to **28** are at the machine front, the two chain stitch guide bars **24** and **25** are set high at level **52**, the needles **41** of front needle bar **19** are at intermediate level **51** ready to be wrapped by a weft yarn **36** of guide bar **23**, guide bar **23** is shifted longitudinally at least one needle space and rear needle bar **20** has been raised to intermediate level **51**.

In FIG. **10**, the guide bars are swung to the machine rear, which brings guide bars **21**, **22**, **23** and **24** to the rear of needles **41** of guide bar **19**, so that guide bar **23** may shift back to its starting position to complete the wrap of weft strand **36** on the needles **41** of needle bar **19**.

The warp yarns **74** and **75** of guide bars **27** and **28**, the weft yarn **76** of guide bar **26** and the chain stitch yarn **77** of guide bars **25** are now at the machine rear, at the end of the first half of the first oscillatory stroke, so that guide bar **26** is now shifted at least one needle space preliminary to wrapping on needles **78** of needle bar **20**. At this time also, guide bars **21** and **22** are shifted to right or left, depending on pattern to place them on the back or face of the fabric **30**.

In FIG. **11**, the guide bars are shown swung to the machine front to complete the first stroke. As guide bar **24** approaches needles **41** of needle bar **19**, needle bar control means **53** lifts the needle bar **19** to high set level **52** preliminary to hooking onto chain stitch yarn **38**. Upon completion of the first oscillatory stroke, guide bar **24** is shifted by shift mechanism **59** preliminary to creating a chain stitch in yarn **38**. At the same time warp yarn guide bars **27** and **28** are shifted to the right or left for underlaying or overlaying the warp yarns **74** and **75**.

In FIG. **12**, the front needle bar **19** is descending to cast off as the rear needle bar **20** is rising to high level **52** while the guide bars commence their swing to the machine rear on the first half of the second oscillatory stroke.

In FIG. **13**, the guide bars have completed the swing to the machine rear, the front needles **41** are within the trick plate **43**, for cast off, the rear needles **78** are at high level **52** as guide bar **25** passes therethrough and guide bar **25** is shifted one needle space preliminary to forming a chain stitch in yarn **77**. Needle bar **19** starts its descent for cast off the moment guide bar **24** passes through the needles.

In FIG. **14**, the guide bars are shown commencing the second half of the second oscillatory stroke back to the machine front with needle bar **19** beginning its rise to low set level **51** while needle bar **20** has started its descent to cast off position the moment chain stitch needle bar **25** has passed through needles **78** with yarn **77**.

In FIG. **15** needle bar **20** has descended into trick plate **79** for cast off, needle bar **19** is at low level **51** and the guide bars are at the end of the second half of their second oscillatory stroke ready to repeat the above described cycle.

It should be noted that guide bars **25** to **29** never pass through the needle bar **19** and that guide bars **21** to **24** never pass through the needle bar **20** in the apparatus and method of this invention.

It should also be noted that the needle bar control means **53** with its compound cam **55**, and the low set guide bars **21**, **22**, **23**, **26**, **27** and **28** are so arranged that these bars never enter the needles when the needle bar is in its uppermost position at level **52**.

The net effect of the invention is to double the number of stitches per cam shaft revolution.

As a result of increasing the production rate of the machine, the method of the invention produces two fabrics **30** and **73** simultaneously in the same amount of space required for one machine.

DESCRIPTION OF PREFERRED EMBODIMENT.

In FIGS. **16** to **23**, a warp knitting, simulated weave method and apparatus is shown which requires no chopper bar and requires no high set chain stitch guide bar, but relies on short bill, short latch, long shank needles, and a high rise level of the needle bar, or bars, at a predetermined critical portion of the double guide bar stroke. While a high rise needle bar level is relatively uncomplicated and inexpensive to achieve on existing, or new, single, or double, needle bar machines by including a suitable rise in the face cam which actuates the needle bar, it will be understood that the needle hooks must not be raised into the path of the guide eyes, or a jam-up collision will take place.

Therefore, as shown in FIG. **25**, in this embodiment of the invention, the needle bars are raised to high rise position and lowered out of the way of the guide bars, at the end of the first guide bar stroke and while the guide bars are in a dwell at the front of the needles, as a collision avoidance means. In the previously described embodiment the three low set guide bars swing past the needles before the needles start their rise, so that they have passed through and cannot collide. The high set chain stitch bar is set high so that it cannot strike the needles when the latter are at intermediate level, thereby constituting an alternative collision avoidance means.

Only a single needle bar machine is shown in FIGS. **16–23**, but it will be obvious that production may be doubled by using a second needle bar and a second set of guide bars as clearly illustrated in FIGS. **9** to **15**.

In FIG. **16**, the needle bar **19**, the needles **41**, short bills **44**, short latches **45**, long shanks **47**, guide bars **21**, **22**, **23** and **24**, chain stitch yarn **38**, weft yarn **36** and warp yarns **31** and **32** are all identical with the parts previously described, except that the eye **37** of chain stitch guide bar **24** is low set at conventional level. The guide bars **21**, **22**, **23** and **24** are all at the front of the needle bar **19**, with the needles **41** in "cast off" position down in the grooves **42** of the trick plate **43**.

In FIG. **17**, as in FIG. **4**, the four guide bars remain in front of the needles, while needle bar cam **81** raises needles **41** to conventional level, which in this invention is intermediate level **51**.

In FIG. **18**, as in FIG. **5**, the four guide bars are now swung to the rear of the needles, in the first half of the first stroke, by the guide bar swing cam **82**, whereupon the guide bar shift means **59** causes the "weft" yarn guide bar **23** to shift laterally one needle space to permit the next yarn to be wrapped around the needles. It will be understood that in the next cycle, or course, the weft yarns will be shifted laterally in the other direction to wrap another set of needles, preferably, but not necessarily adjacent thereto.

In FIG. **19**, the guide bars are swung back on the second half of the first stroke, to in front of the needles, by guide bar swing cam **82**, and remain there by reason of the dwell at **83**. While so held, needle bar cam **81**, by means of the high rise protuberance **84**, lifts the needle bar **41** to high rise level **52** to thereby lower the loops of the weft yarns **36** from the opened latches **45** down onto the long shanks **47**. During this dwell also, the warp yarn guide bars **21** and **22** are shifted laterally left or right by pattern chains **60**, in accordance with the weave pat-

tern, and guide bar **23** shifts weft yarn **36** back to starting position to complete the wrap, or loop, around the needles.

In FIG. **20**, the needle bar **41** is shown lowered to intermediate level **51**, still during the dwell of the guide bars, so that the needles are out of the way of the next swing of the guide bars.

In FIG. **21**, the guide bars **21**, **22**, **23** and **24** have been swung to the rear of the needles, on the first half of the second stroke, so that the chain stitch guide bar **24** may shift laterally one needle space to wrap chain stitch yarn **38** around the needles.

In FIG. **22**, the guide bars are swung to the front of the needles, on the second half of the second stroke, while the needles **41** are lowered into the trick plate, to draw the hooked chain stitch yarn loop **70** through the preceding loop **71** for cast off with loop **72**.

In FIG. **23**, the needles are entirely down in cast off position, as in FIG. **16**, to start another knitting cycle.

What is claimed is:

1. In a warp knitting machine having at least one needle bar vertically reciprocable between a normally fixed lowermost position and a normally fixed uppermost position and having at least four guide bars laterally swingable and longitudinally reciprocable relative to said needle bar, one said guide bar for chain stitch yarn, two said guide bars for warp yarns and one said guide bar for a "weft" yarn and means for actuating said bars, the improvement comprising:

short bill, short latch, long shank needles on said needle bar,

guide bar control means for transversely swinging said guide bars through two complete forward and rearward strokes; longitudinally shifting said weft yarn guide bar across at least one needle space and longitudinally shifting said warp yarn guide bars left or right during each single upward and downward stroke of said needle bar for wrapping said weft yarns around the opened latch portions of the shanks of said needles when said needles are in said normally fixed uppermost portion in one course and for wrapping said weft yarns around other needles in the next course, and

needle bar control means including high rise mechanism for lifting said short bill, short latch, long shank needles of said needle bar to a level well above said normally fixed uppermost position for sliding said weft yarn loops down below said opened needle latches onto the long shanks of said needles to be cast off with the loops of each successive course of said chain stitch yarns and including timing means, synchronized with said guide bar control means for actuating said high rise mechanism at the end of the second half of the first stroke of said guide bars.

2. A warp knitting machine as specified in claim **1**, plus

a second needle bar, back to back to said first needle bar, and having short bill, short latch, long shank needles thereon,

a second set of said four guide bars, cooperable with said second needle bar,

second guide bar control means for said second set and second needle bar control means for said second needle bar, including second, high rise lifting mechanism for raising said second needle bar to said high level, and including second said timing means for actuating said high rise mechanism at predetermined times,

whereby a pair of back to back simulated weave warp knit fabrics are simultaneously produced by said machine during each double stroke of said guide bars, thereby doubling production rate of said machine.

3. In warp knitting apparatus, for making warp-knitted, simulated woven patterns, said apparatus including at least one needle bar; a chain stitch yarn guide bar, two warp yarn guide bars, a warp yarn guide bar designated as a "weft" yarn guide bar; and powered actuation means for reciprocating said needle bar, transversely oscillating said guide bars and longitudinally shifting said guide bars, the combinations of:

guide bar control means including guide bar oscillation means for oscillating said guide bars through two forward and rearward strokes for each single upward and downward stroke of said needle bar,

guide bar shift means for shifting said weft yarn guide bar to wrap said weft yarns around said needles in one course, and then around the needles to at least one space to one side thereof in the next course, and then again around said needles while shifting said warp yarn guide bars to lay in said warp yarns alternately over and under each successive pair of said weft yarns and shifting said chain stitch guide bars to knit chain stitch pillars on said needles:

short latch, short bill, long shank needles on said needle bar;

needle bar control means cooperable with said guide bar control means including high rise lift mechanism for raising said short latch needles to a predetermined high level well above the level of the eyes of said guide bars to locate the loops of said weft yarns, which are wrapped around said needles, down below the opened latches onto the long shanks thereof to permit said loops to be cast off with the loops of said chain stitch yarn,

and collision avoidance means for preventing said guide bars from striking said needles in high rise level position.

4. Warp knitting apparatus as specified in claim **3**, wherein:

the said needle bar control means includes said collision avoidance means in the form of timing means lifting said needles to said predetermined upper level relative to the eyes of said guide bars, just before the second half of the second stroke of said guide bars, and said guide bar shift means shifts said chain stitch guide bar one needle space to be hooked by said needles.

5. Warp knitting apparatus as specified in claim **3**, wherein:

said chain stitch guide bar is set relatively high to form said collision avoidance means, said warp and weft guide bars are set relatively low and said guide bar control means and said needle bar control means are so synchronized that the low set guide bars are never in the needles when the needle bar is at the said predetermined high level of its stroke, thereby assuring that only the chain stitch yarn is formed into chain stitches.

6. Warp knitting apparatus as specified in claim **3**, wherein:

said chain stitch guide bar is set higher than said warp and weft guide bars and said needle bar control means lifts said needle bar to said predetermined high level just before the last half of the second stroke of said guide bars, to form said collision avoidance means,

whereby the loops formed around said needles by said weft yarn slide below the opened latches thereof, when said needles are raised to said higher level for casting off with the stitches of said chain stitch yarn.

7. Warp knitting apparatus as specified in claim **3**, plus:

a second needle bar having short bill, short latch, long shank needles thereon, mounted in said apparatus back to back to said first mentioned needle bar,

a second set of said chain stitch, warp and weft guide bars,

said second needle bar and set of guide bars being operably connected to said powered actuation means, guide bar control means and needle bar control means and having second collision avoidance means to produce a second simulated weave, warp knit fabric back to back and unconnected to the fabric produced by said first needle bar and guide bars.

8. A warp knitting machine for producing simulated weave, warp knit fabrics, said machine comprising:

a high set chain stitch guide bar, two low set warp yarn guide bars and a low set weft yarn guide bar;

a needle bar arranged to reciprocate one stroke between the lowermost position, with the needle bills proximate the trick plate, and an uppermost or high rise position, with said bills well above the eyes of said warp and weft guide bars, at proximate the level of the eyes of said chain stitch guide bars,

needle bar control means, including high rise mechanism for raising said needle bar to said high rise position at predetermined times,

short latch, short bill, long shank needles on said needle bar;

and control means in said machine for oscillating said guide bars two strokes for each single reciprocatory stroke of said needle bar, and for shifting said guide bars during each said two strokes to wrap said weft yarn around said adjacent needles in one course and around adjacent needles in the next course to produce an exposed weft yarn appearance, while alternating overlaying and underlaying said warp yarns to produce an interlaced warp yarn appearance and forming chain stitch pillars walewise of said fabric.

9. A method for making a simulated weave, warp knitted fabric on a warp knitting machine having mechanism for vertically reciprocating a needle bar, for oscillating a set of at least four guide bars relative thereto and shifting each said guide bar independently of the others, said method comprising the steps of:

supplying one of said guide bars with a chain stitch yarn, supplying two said guide bars with warp yarns, supplying another said guide bar with a warp yarn designated a weft yarn;

providing short latch, short bill, long shank needles on said needle bar;

oscillating said guide bars two full strokes, and reciprocating said needle bar one full stroke in each cycle of said machine,

during each said cycle, shifting said weft yarn guide bar to wrap said weft yarn around one needle in one course and around an adjacent needle in the next course to produce an exposed, course-wise, extending simulated weft yarn, while shifting said two warp yarn guides to alternately overlie and underlie said weft yarn and while shifting said chain stitch guide to form walewise chain stitch pillars in said fabric, and

during each cycle just before the second half of the second stroke of said guide bars, raising said needles to a predetermined high rise level to cause the weft yarn loops wrapped around said needles to slide below the opened latches thereof for casting off with the chain stitches formed by said needles.

10. A method as specified in claim **9**, plus

the step of setting said chain stitch yarn guide bar high and setting the other three guide bars low at conventional level.

11. A method as specified in claim **10**, wherein:

said step of causing said weft loops to be lowered below the opened latches of said needles is accomplished by lifting said needle bar, during said cycle, up to a high rise level in which the bills of the needles are proximate the level of the eye of said high set chain stitch guide bar, and

timing the oscillation of said guide bars during said cycle so that the eyes of the other three guide bars are never within the zone of the bills of said needles when said needles are in high rise position.

12. A method as specified in claim **9**, plus the steps of:

providing a second said needle bar and a second set of said four guide bars, and

actuating the same identically with said first mentioned bars to knit a second simulated weave fabric back to back with said first fabric during each said double stroke of said guide bars.

13. In a warp knitting machine having two needle bars and a set of four guide bars for each needle bar, one guide bar of each set for chain stitch yarn, two guide bars of each set for warp yarns, and one guide bar of each set for a warp yarn serving as a "weft" yarn, the combination of:

guide bar control means and needle bar control means synchronized for swinging each said set of four guide bars through two complete forward and rearward strokes during each single upward and downward stroke of the said needle bar associated therewith;

short bill, short latch, long shank needles on each said needle bar;

guide bar shift means synchronized with said guide bar control means for shifting the chain stitch guide bar of each set through chain stitch motions, shifting the "weft" yarn guide bar of each set to wrap around one needle in one course and around another needle in the next course to produce a simulated "weft" and shifting said warp yarns to alternately overlie a pair of "wefts" and then underlie a pair of "wefts;"

and high rise mechanism synchronized with said control and shift means lifting each said needle bar to high level at the end of each first stroke of its guide bar set, during a dwell thereof, for sliding said "weft" yarn wraps downwardly on said needles from a position encircling the opened latches thereof to a position encircling the shanks thereof,

whereby the time delay of two guide bar strokes for each needle bar stroke is compensated by simultaneous production of two simulated weave, warp knit single fabrics.

14. A warp knitting machine as specified in claim **13**, plus

a high set chain stitch guide bar in each said set, having its guide eye well above the level of the eyes of the other guide bars of the set, and

wherein said high rise mechanism periodically lifts each said needle bar to a high level during each double guide bar stroke, for hooking the needles thereof onto the chain stitch yarn carried by said high set chain stitch guide bar.

15. A continuous, high speed method for making a simulated weave, warp knitted fabric on a two needle bar warp knitting machine having a set of four guide bars for each needle bar, including a chain stitch, two warp, and one simulated "weft" warp yarn in each set, and having short bill, short latch, long shank needles on each said needle bar, said method comprising the steps of:

oscillating each set of said four guide bars through two full strokes for each single reciprocatory stroke of the needle bar associated therewith;

during said two strokes, shifting said chain stitch guide bar through chain stitch motions, shifting said "weft" yarn guide bar to wrap said yarns around said needles in one double stroke and around other said needles in the next double stroke, and shifting said warp yarns to alternately overlie and underlie said "weft" yarns in a simulated weave pattern; and

during each said double stroke of said guide bars, after said needles have been wrapped with said weft yarns, automatically lowering said wraps from the opened latch portions of said needles down onto the long shanks thereof by raising said short bill, short latch needles to a high rise level.

16. A continuous, high speed method as specified in claim **15**, wherein:

said lowering of said weft yarn wraps is accomplished by lifting said needles to said high rise level and lowering said needles during a dwell of said guide bars, thereby avoiding collision thereof.

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