United States Patent

Doring et al.

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[54] FLAT WARP KNITTING MACHINES

[72] Inventors: **Wolfgang Doring,** Crimmitschau; **Bertram Frenzel,** Karl-Marx-Stadt; **Hans-Dieter Heutschel,** Karl-Marx-Stadt; **Heinz Kemter,** Karl-Marx-Stadt; **Werner Mickenautsch,** Crimmitschau II; **Harry Schmidt,** Werdau, all of Germany

[73] Assignee: **VEB Wirkmaschinenbau Karl-Marx-Stadt,** Karl-Marx-Stadt, Germany

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[52] **U.S. Cl.** .....**66/84,** 28/1 CL

[51] **Int. Cl.** **D04b 23/06**

[58] **Field of Search** .....66/83–87, 125; 28/1 CL

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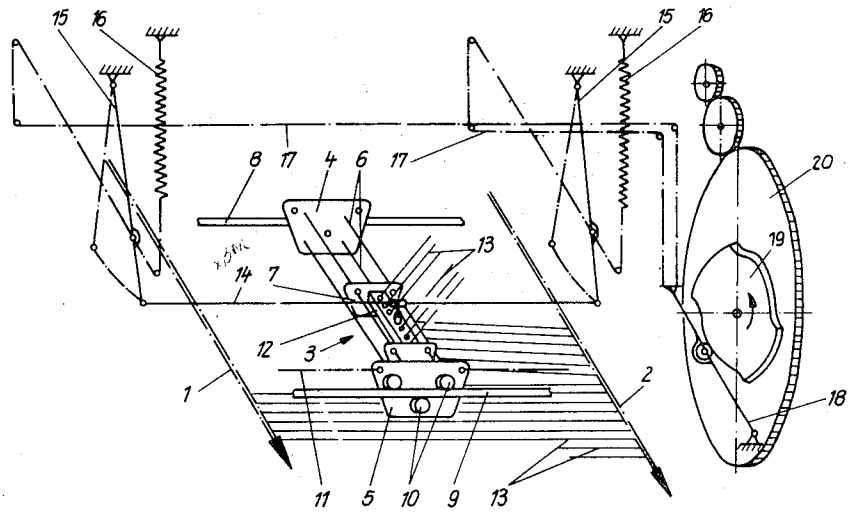
Primary Examiner—Ronald Feldbaum

Attorney—Nolte and Nolte

[57] **ABSTRACT**

A flat warp knitting machine comprising two continuously driven endless transport chains provided with hooks, weft thread laying means, means for moving the weft thread laying means back and forth transversely to the transport chains for inserting weft threads alternately into the hooks of the two transport chains and means for moving the weft thread laying means at least partially in the direction of motion of the transport chains for the insertion of the weft threads into at least approximately opposite pairs of hooks so that the weft threads extend at least approximately at right angles to the transport chains.

17 Claims, 14 Drawing Figures



Patented May 30, 1972 **3,665,732**

10 Sheets-Sheet 1

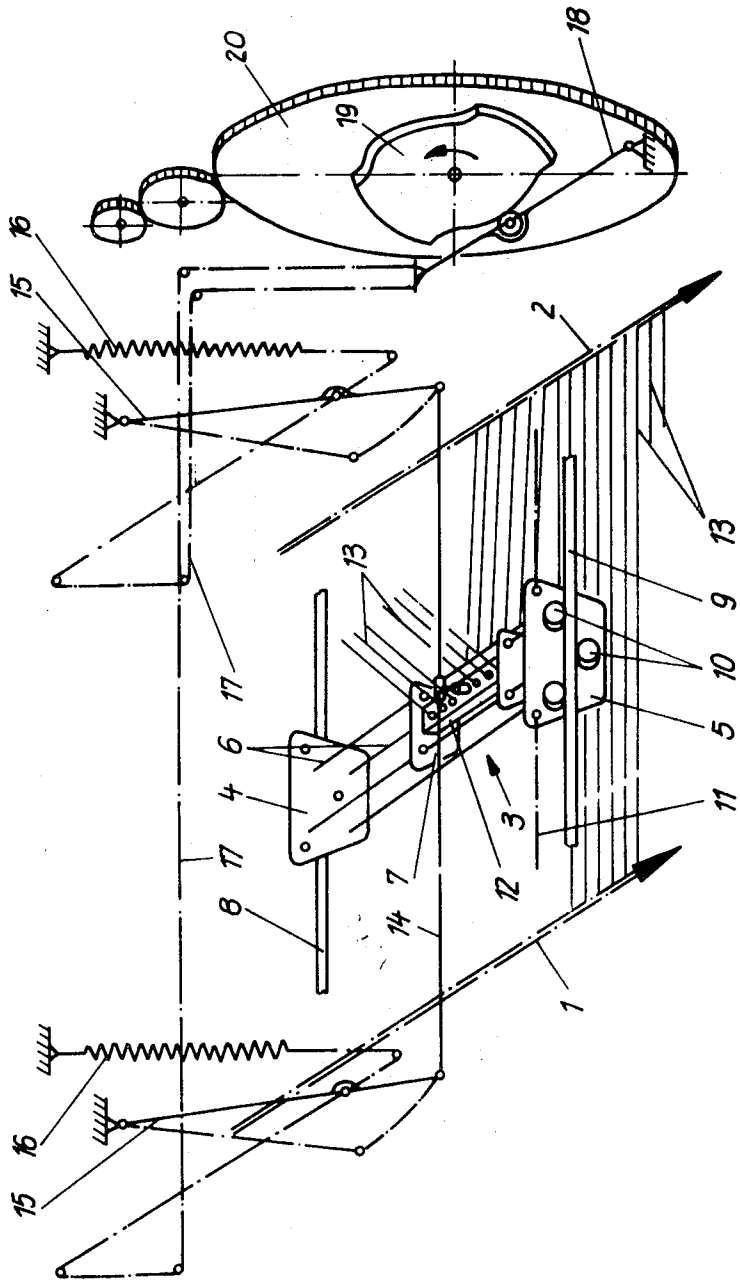


Fig.1

INVENTORS
Wolfgang DÖRING
Bertram FRENZEL
Hans-Dieter HENTSCHEL
Heinz KEMTER
Werner MICKENAUTSCH
Harry SCHMIDT

Nolte & Nolte
ATTORNEYS

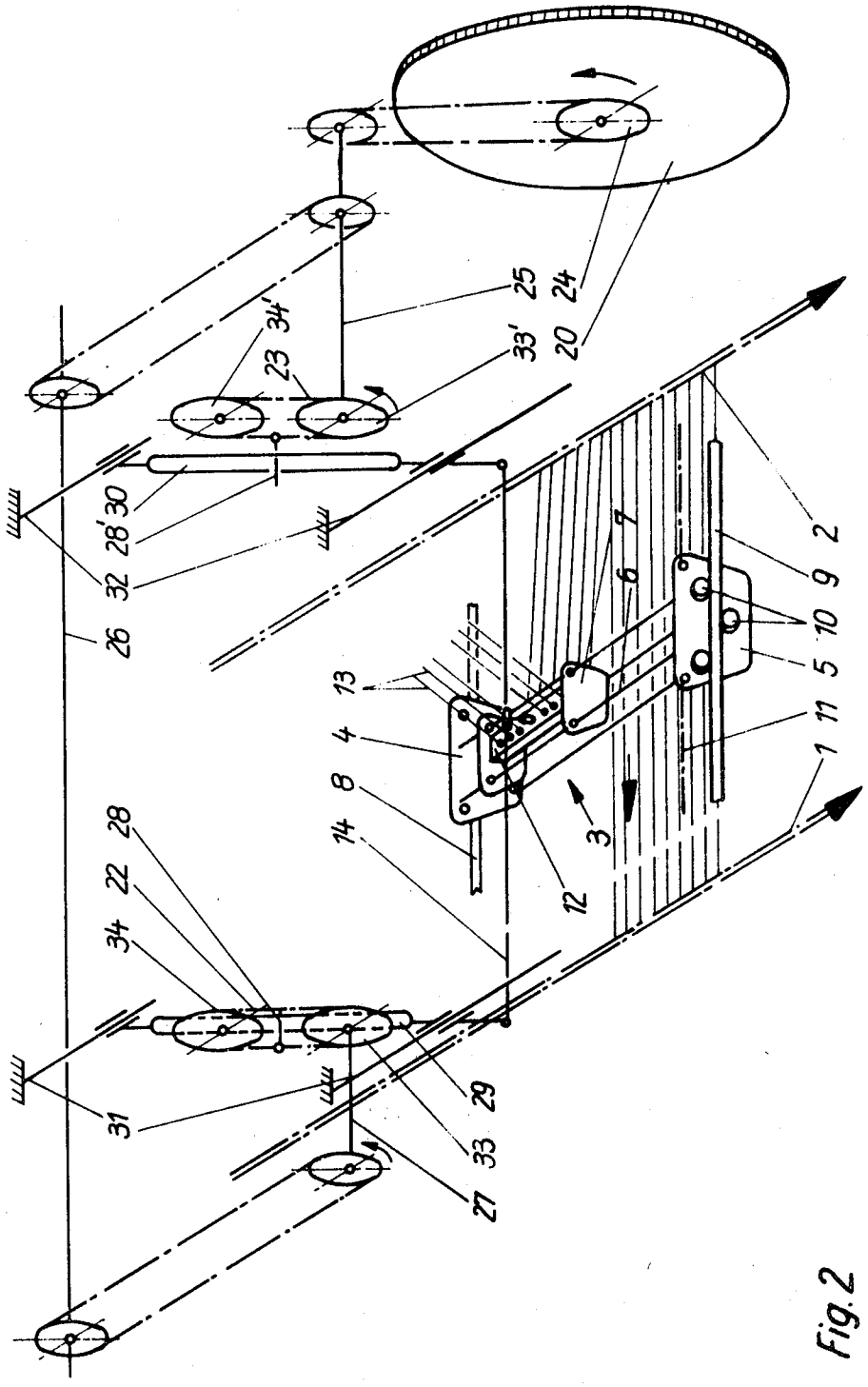

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Fig. 2

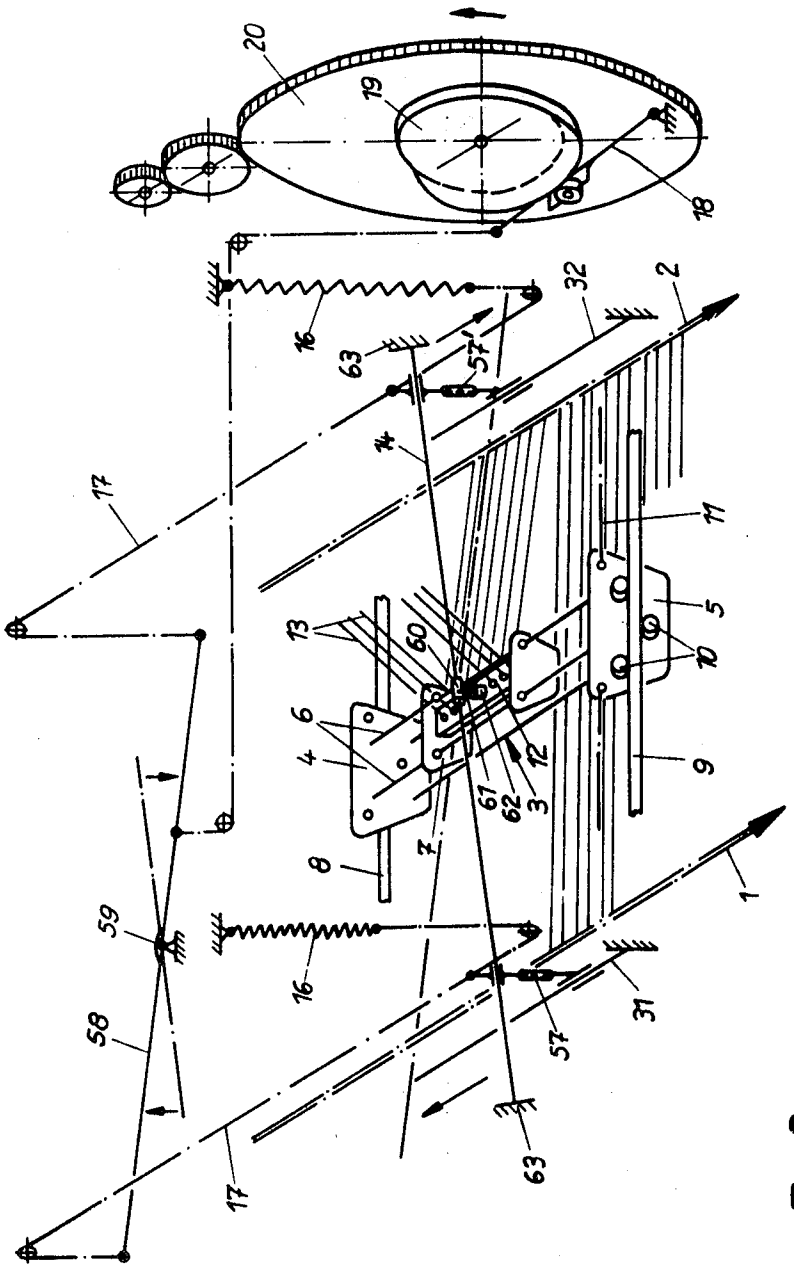
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Fig. 3

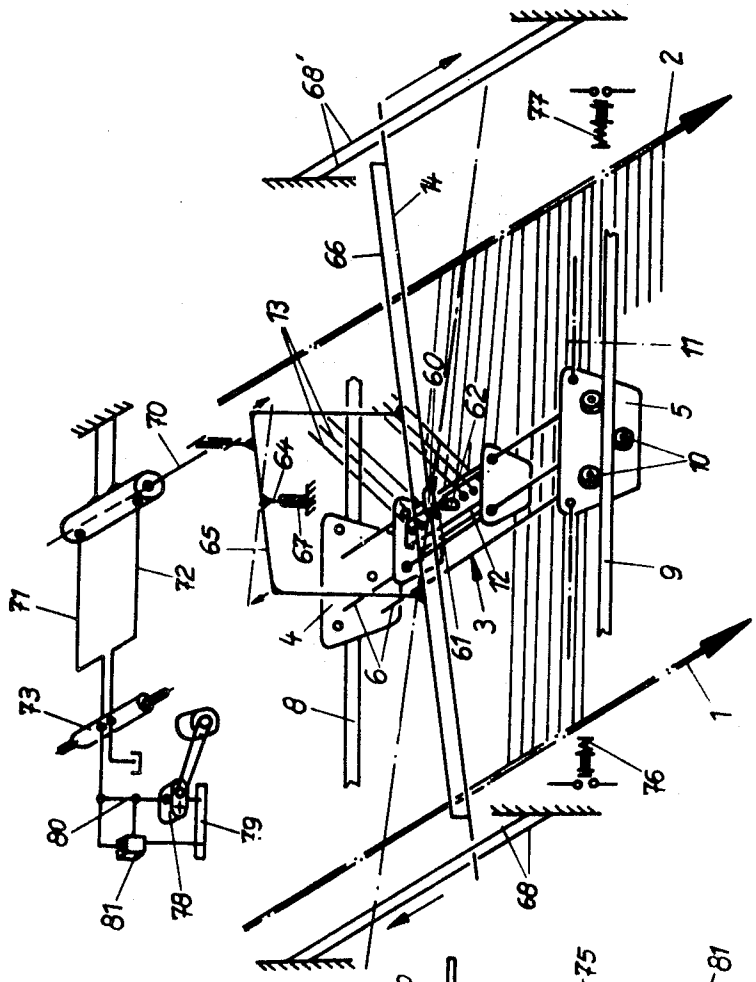
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Fig. 4

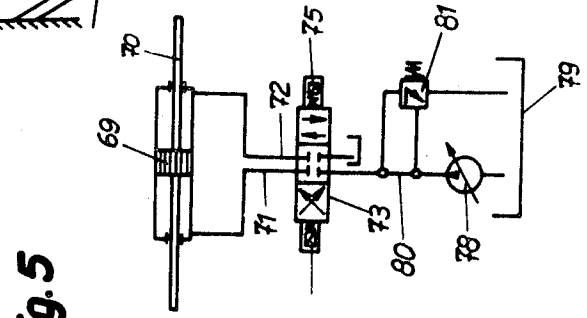
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Fig. 5

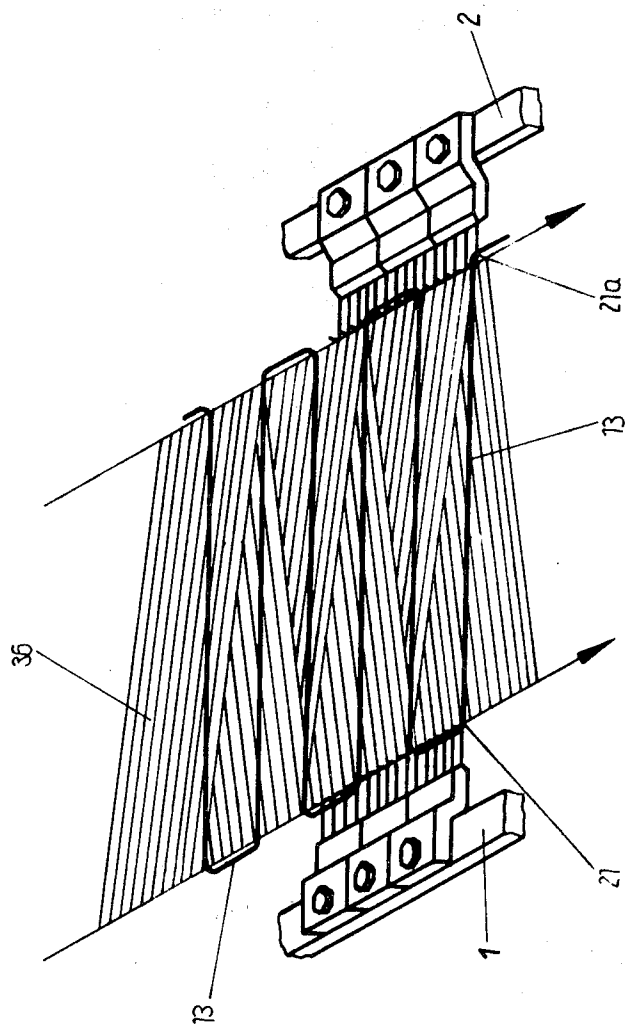


Fig. 6

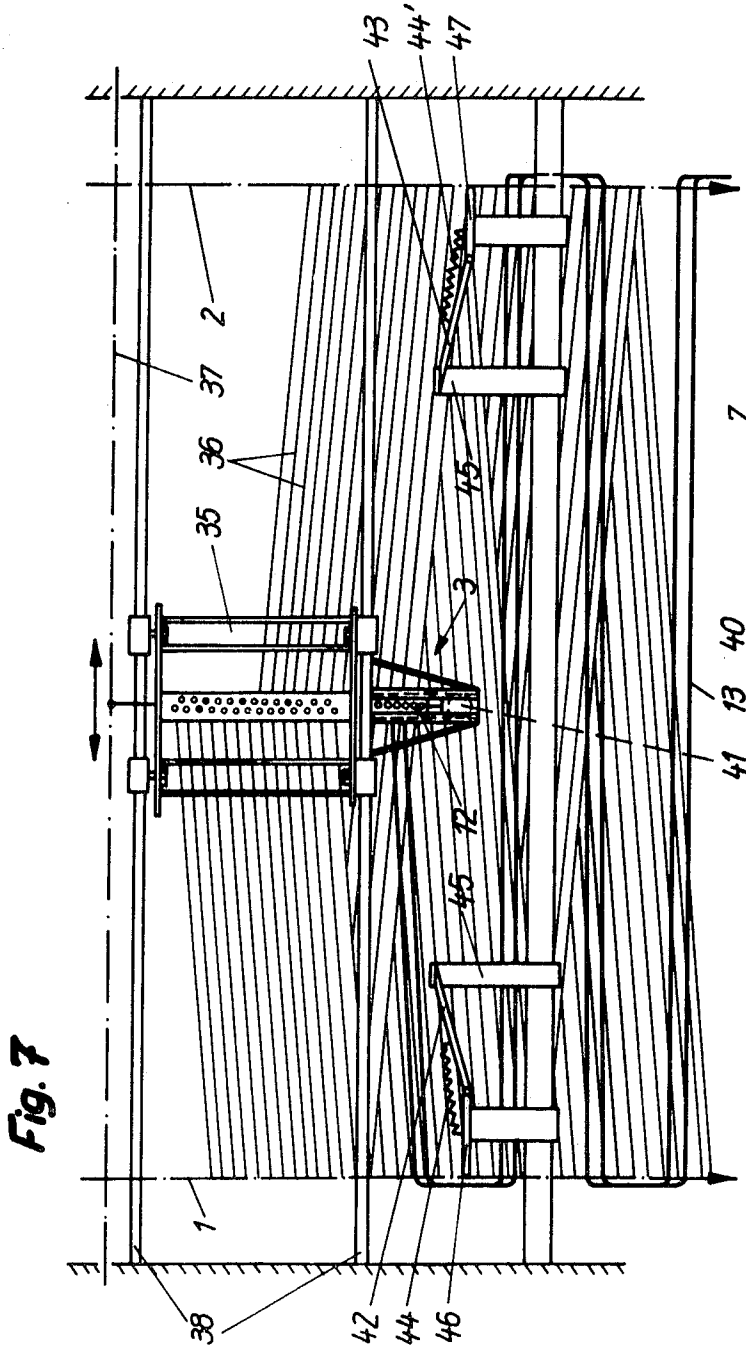


Fig. 7

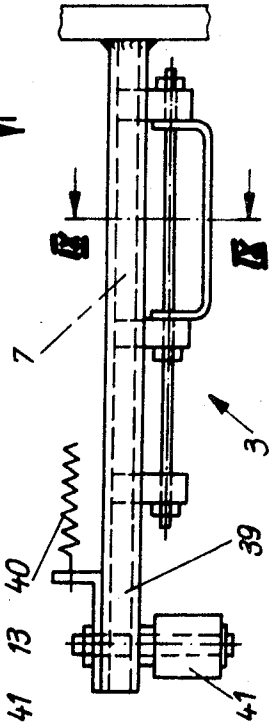


Fig. 8

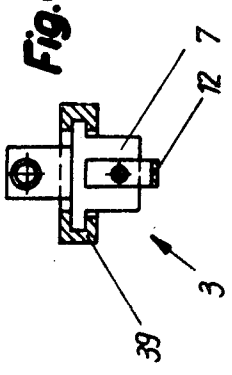


Fig. 9

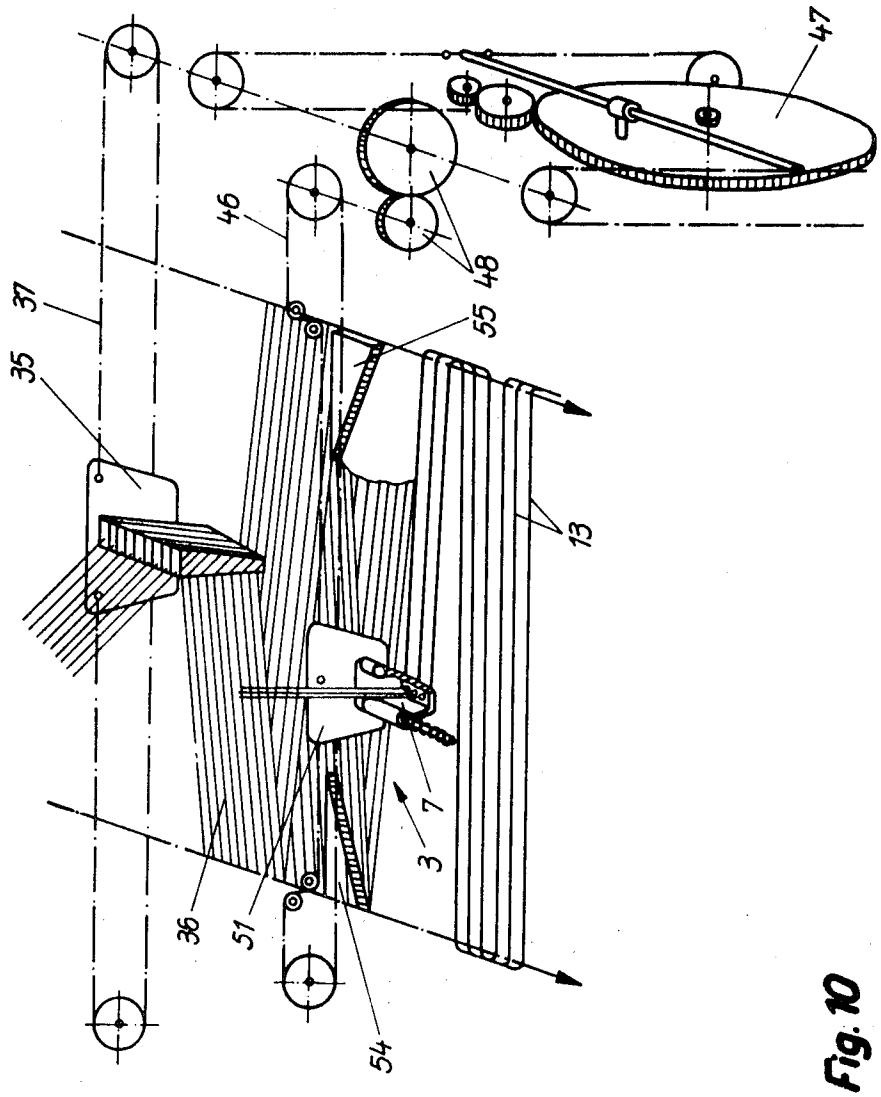


Fig. 10

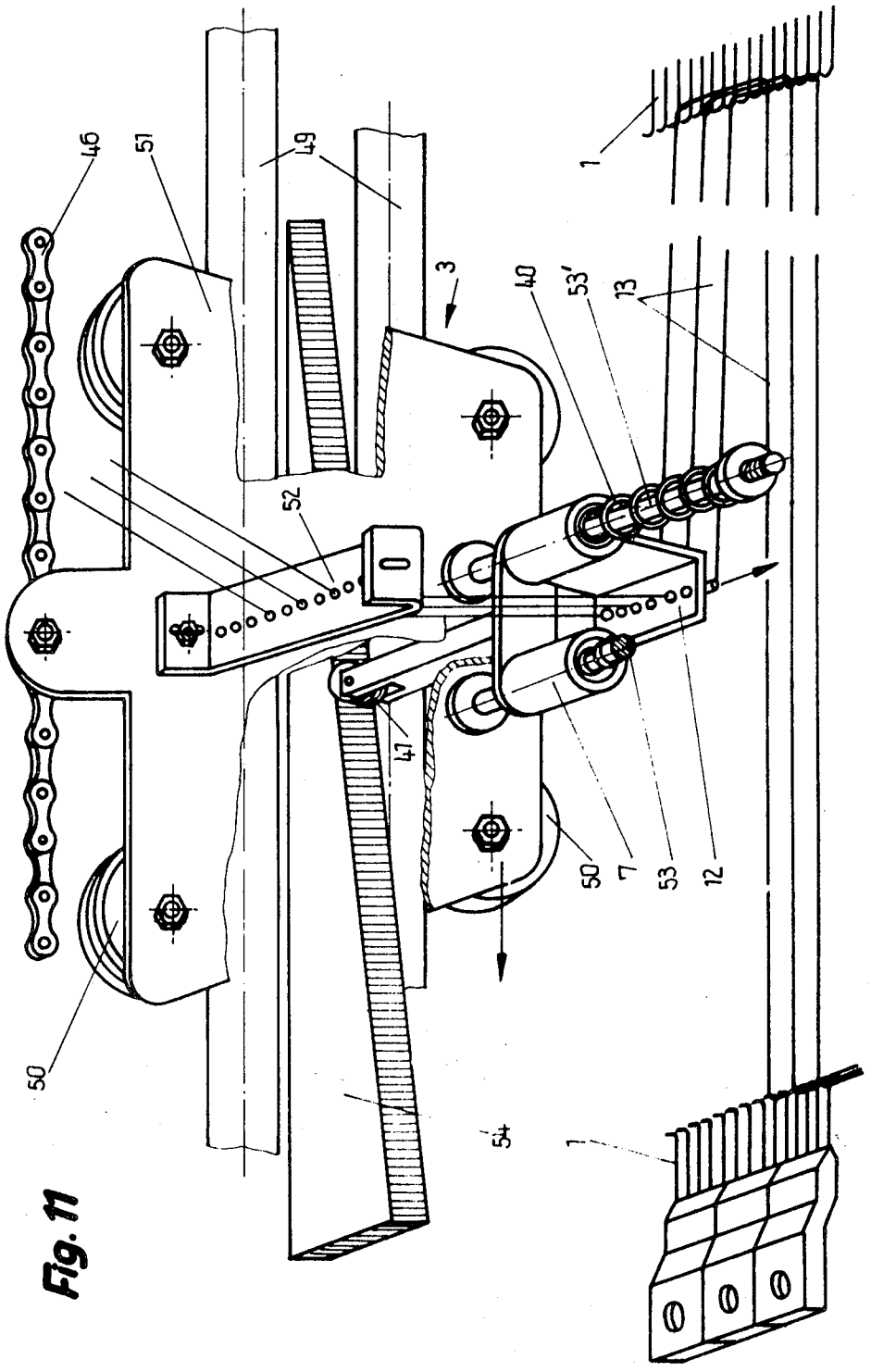


Fig. 11

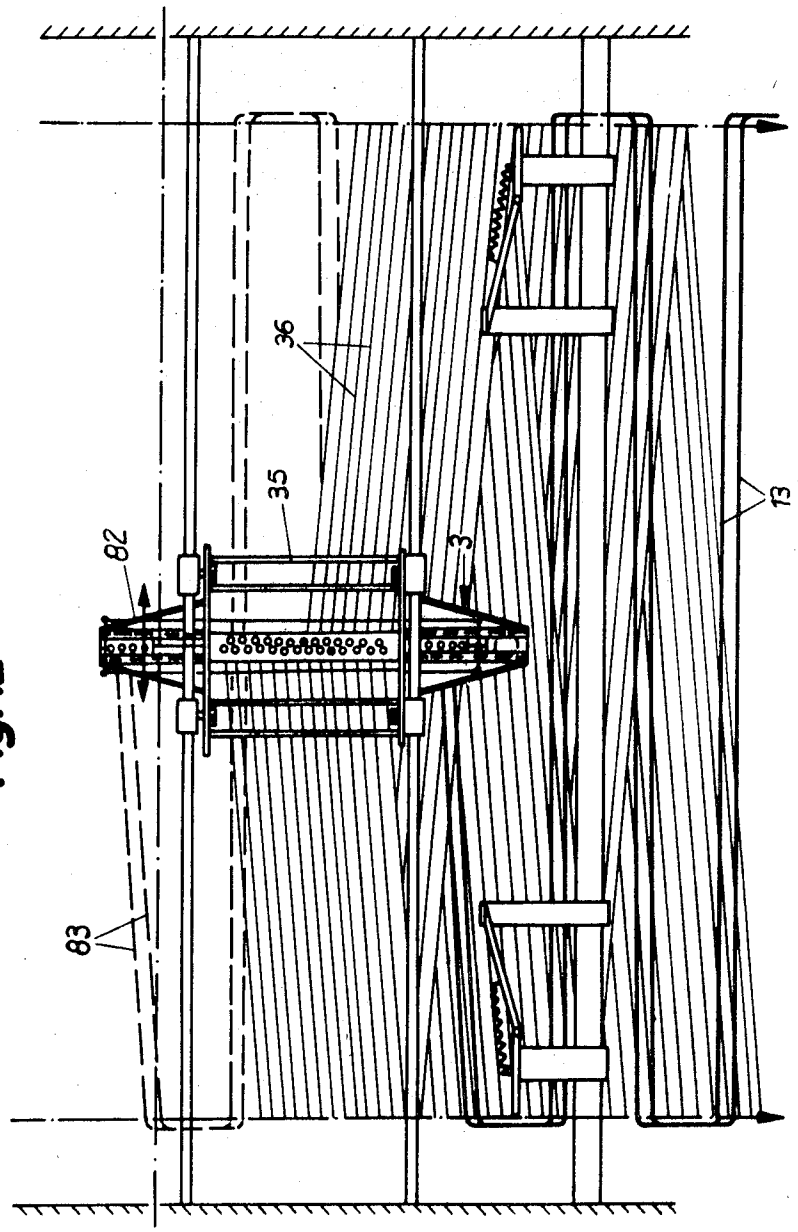


Fig. 12

Fig. 13

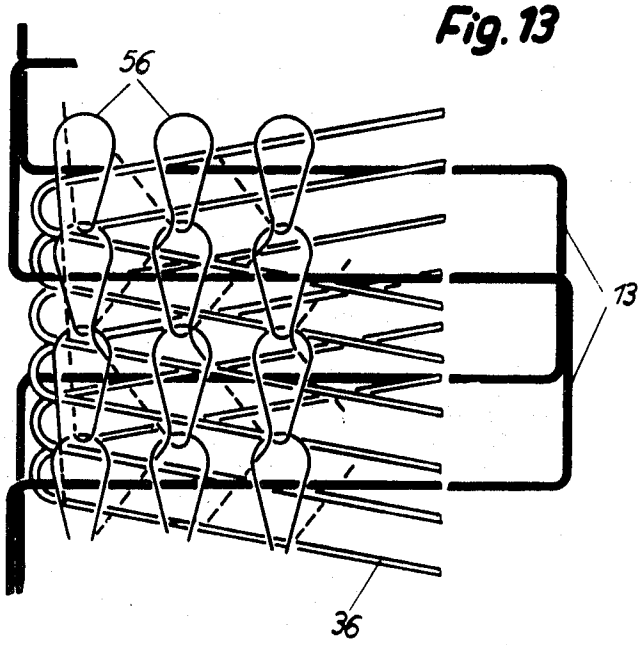
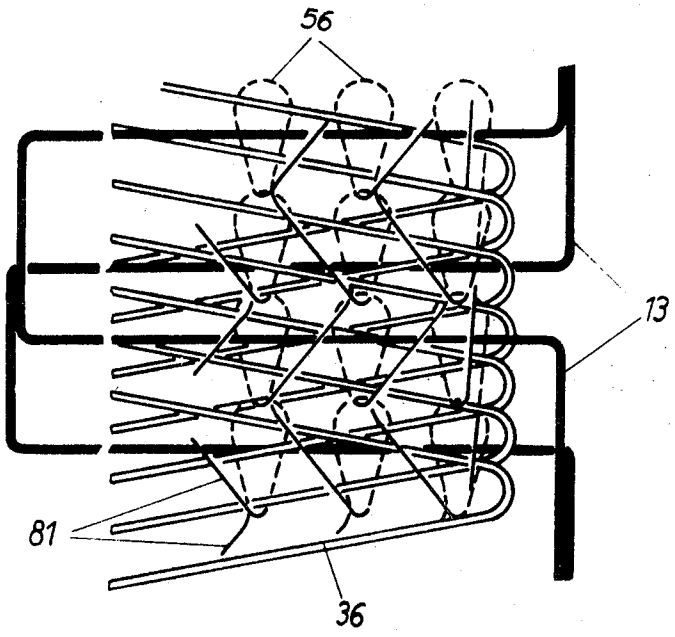


Fig. 14



FLAT WARP KNITTING MACHINES

The invention relates to a flat warp knitting machine, in particular, a sewing knitting machine which for the production of a textile material having weft yarns is provided with two continuously driven endless transport chains equipped with hooks as well as with a weft yarn laying device movable back and forth crosswise to the transport chains, the weft yarns being inserted by means of the weft yarn laying device in the hooks of the two transport chains and by means of them being fed to the stitch forming point.

A known warp knitting machine, in particular a sewing knitting machine of this kind (German Pat. No. 1,059,608), serves to produce a weft-warp knit fabric, of which the weft yarns represent the ground material, which is bound in between the sinker and needle stitches of the warp knit fabric. With respect to the means serving to grip the preparatorily laid weft yarns and to bring them to the stitch-forming point, this machine is outstanding for its particular simplicity. The two transport chains having hooks merely need a very simple epicyclic gear, and to this, moreover, a part of the high efficiency of this machine is attributable. Because of the continuous drive of the transport chains, however, the weft yarns can be gripped only in the form of overlapping zig-zag weft thread layers, thus resulting in a weft-warp knit fabric in which the weft yarns extend obliquely to the longitudinal axis of the material and hence also obliquely to the stitch rows. At variance therewith, in classic weft-warp knit fabrics the weft yarns run exactly parallel to the stitch rows.

Weft-warp knit fabrics are practically without transverse stretchability. If they are furthermore equipped with stretched longitudinal warp yarns, such warp knits practically attain the dimensional stability of woven fabrics. The classic weft-warp knit fabrics resemble woven fabrics also in their weave-like pattern, although because of the oblique weft yarns this does not apply to weft-warp knit fabrics made on the above described machine.

It is an object of the invention to provide a warp knitting machine, in particular a sewing knitting machine, of the kind mentioned initially, on which can be produced fabrics the weft threads of which, following the pattern of woven fabrics, extend at right angles to the longitudinal axis of the fabric and hence parallel to the stitch rows.

This problem is solved according to the invention in that the weft thread laying device, for the insertion of the weft yarns into two hooks facing each other in a line extending at least approximately at right angles to the transport chains, is movable at the same time crosswise to its fundamental movement. By means of the invention it is not only possible to produce outright weft-warp knit fabrics in which the weft yarns are functionally the ground material. It is possible also to produce textile fabrics in which the wefts serve purely a pattern forming function. In this case there may serve as the ground material, for example, a fiber mat to which the pattern weft threads are tied by means of a warp knit fabric consisting of individual wales. Such a machine is evident in principle from British Pat. No. 552,754, although there the weft yarns are not directed at right angles to the longitudinal axis of the fabric and also are not pattern threads. The weft yarns of the textile fabric produced on the machine of this patent can, therefore, also be bound into the fabric at right angles to the longitudinal axis of the fabric by means of the invention.

Furthermore, it is feasible according to the invention to provide a weft-warp knit fabric the ground material of which consists of overlapping, zig-zag weft yarn layers with pattern weft yarns which extend parallel to the stitch rows and hence at right angles to the longitudinal axis of the fabric. Such an embodiment of the invention is characterized in that there are at least two weft thread laying devices, of which only one is movable back and forth crosswise to its fundamental movement.

The invention will now be further described by reference to specific embodiments thereof as illustrated in the drawings, in which:

FIG. 1 is an isometric view of a weft yarn laying device movable crosswise to the transport chains as well as crosswise to this fundamental movement, the laying device being provided for the drive in the last-named direction with a cross-bar which at its ends is in articulated connection with two co-directional rocker arms driven by a cam plate;

FIG. 2 is an isometric view of a similar weft yarn laying device, but with two endless chains being provided for the drive of the cross bar;

FIG. 3 is an isometric view of a weft yarn laying device likewise provided with a cross bar for the drive crosswise to its fundamental movement, which cross-bar can be set in pivotal movement by means of a cam plate;

FIG. 4 is an isometric view of a similar weft yarn laying device provided with a pivotally movable cross-bar which can be driven hydraulically;

FIG. 5 is a schematic diagram of the hydraulic drive by itself;

FIG. 6 is an isometric view of the two weft yarn transport chains onto which both ground and pattern weft yarns are hooked;

FIG. 7 is a plan view of a double weft yarn laying device for obtaining weft yarn layers according to FIG. 6;

FIG. 8 is a side elevation view of the pattern weft yarn laying device of FIG. 7 by itself;

FIG. 9 is a sectional view of the pattern weft thread laying device taken on section line IX—IX of FIG. 8;

FIG. 10 is an isometric view of another double weft yarn laying device, in which the pattern weft yarn laying device, at variance with FIG. 7, has its own drive crosswise to the endless transport chains;

FIG. 11 is an isometric view of the pattern weft yarn laying device of FIG. 10 by itself;

FIG. 12 is a plan view of a ground weft yarn laying device equipped with two pattern weft yarn laying devices;

FIG. 13 is a plan view of the back (left side) of a knit fabric produced with the weft thread laying device of FIG. 12; and

FIG. 14 is a plan view of the front (right side) of the same weft-warp knit fabric.

The present warp knitting machine, in particular sewing knitting machine, is provided, as is known and therefore not shown, with a knitting needle row and at least one laying rail for providing the knitting needles with warp yarns. From these warp yarns the knitting needles form, for example, a closed fabric (FIGS. 13 and 14).

Between the needle stitches **56** and the sinker stitches **81** of the warp fabric there are to be bound in, on the present machine, weft yarns **13** directed parallel with the stitch rows, which yarns serve as, for example, the ground material of a weft-warp knit fabric or serve to pattern a textile fabric which likewise consists of a warp knit fabric but may alternatively consist of a fiber mat, a woven fabric or the like.

In a manner also known in itself, the weft yarns **13** are inserted behind the stitch forming point of the machine into the hooks of two endless transport chains **1** and **2** (FIG. **6**), for which purpose for example, the weft thread laying device **3** shown in FIGS. **1** to **4** is used. It comprises in this case two end plates **4** and **5** arranged one behind the other, which are connected together by rods **6**, and a slide **7** guided on the rods **6**. The weft thread laying device **3** itself is guided on fixed rods **8** and **9** extending at right angles to the transport chains **1** and **2** and for which the plates **4** and **5** are provided with guide rolls **10**. To the front plate **5** a chain **11** is connected, by means of which the weft yarn laying device **3** is moved back and forth crosswise to the transport chains **1** and **2**, this representing the fundamental movement thereof. The rods **6** are directed at right angles to the bars **8** and **9**, so that slide **7** of the weft yarn laying device **3** can be moved also crosswise to its fundamental movement. Slide **7** is provided with an eyelet strip **12** the eyelets of which guide the weft yarns **13**. To slide **7** there is connected according to FIG. **1** a cross-bar **14**, the ends of which are articulated to two levers **15**. The levers **15** are co-directional and can be pivoted toward the stitch forming point

of the machine and back and are held in the forward end position by means of springs **16**. Connected to the levers **15** at a point spaced from the pivot point of each are cables **17** which are guided over rolls and are connected at their other end to a lever **18**. The latter cooperates with a cam plate **19**, which is connected fixedly to a continuously rotating sprocket **20**. From the latter there may be derived at the same time also the drive of chain **11**.

As stated above, it is intended by the invention to bind the weft yarns **13** parallel to the stitch rows of the warp knit fabric, that is, at right angles to the longitudinal axis of the fabric. For this purpose, the weft yarns **13**, which in the case of FIGS. **6**, **7**, **10** and **12** to **14** constitute pattern weft yarns, but which might just as well be ground weft yarns, are each to be inserted into two hooks **21** and **21***a* of the two transport chains **1** and **2**, which hooks face each other in a line extending at least approximately at right angles to the transport chains. Slide **7**, accordingly, must be displaced by a corresponding amount in the direction toward the stitch forming point before the weft yarn laying device **3** running toward one of the two transport chains **1** and **2** passes over the respective transport chain **1** or **2**. Slide **7** thus lags behind the two transport chains **1** and **2** alternately, for example until it has caught up with hook **21**a of the chain **2**, the hook **21***a* being opposite hook **21** of the other chain **1**. This lagging of slide **7** occurs by means of springs **16**, which for this purpose are released accordingly by cam plate **19**. When the weft yarn laying device **3** has passed over the respective transport chain **1** or **2**, cam plate **19** pulls slide **7** back again by means of lever **18** before the weft yarn laying device **3** starts its movement in the opposite direction.

In the case of FIG. **2**, slide **7** is driven positively in a direction parallel to the transport chains **1** and **2** in both directions, namely by means of two endless chains **22** and **23**, which are co-directional. The drive thereof again occurs from the toothed wheel **20**, to which a sprocket **24** is rotationally connected, the sprocket **24** by means of a chain and another sprocket driving a shaft **25**. From the latter is derived the drive of a second shaft **26**, which in turn drives a third shaft **27**. By means of shaft **25** there is set in motion the endless chain **23**, and by shaft **27**, the endless chain **22**. Each of the two chains **22** and **23** has a respective finger **28** and **28'** secured to it and these engage in the slot of respective upright link rods **29** and **30**. At their lower ends the link rods **29** and **30** are provided with guide lugs and are fitted therewith on horizontal guide bars **31** and **32** which are directed parallel to the transport chains **1** and **2**. In this case the cross bar **14** is rigidly connected to the lower free end of the link rods **29** and **30**. When the two endless chains **22** and **23** are driven in the direction of the arrows of FIG. **2**, lower reversing wheels **33** and **33'** move slide **7** toward the stitch forming point, and the upper reversing wheels **34** and **34'** pull slide **7** back to its starting position.

In the embodiments of FIGS. **1** and **2**, the cross-bar **14** is movable back and forth parallel to itself. It is feasible also, however, to pivot the cross-bar **14**, for movement of the slide **7** crosswise to its fundamental movement, about an upright axis at the longitudinal center of the cross-bar **14**. According to FIG. **3**, this upright pivot axis is an imaginary one. Cross-bar **14** is guided for this purpose at its ends in two crossheads **57** and **57'**, for which guide bars **31** and **32** are provided. For the pivotal drive of the cross bar **14** there serves a double lever **58** which has a fixed bearing point **59** in the middle between the two transport chains **1** and **2**. Each of cables **17** is connected, at one end, to a respective end of the double lever **58**. The other end of each cable **17** is connected to fixed supporting structure with an extension spring **16** for each. The crossheads **57** are coupled to the cables **17** and execute by means of the double lever **58** opposite movements. The pivoting of the cross-bar **14** in one direction of rotation is effected by means of lever **18**, which cooperates with the cam plate **19**, and in the other direction by means of the extension spring **16**. There is rotatably fitted on the cross-bar **14** a sleeve **60** with a downwardly directed pin **61** which engages in a bearing **62**. The latter is located on the eyelet strip **12**. Elements **63** serve to guide the cross-bar **14** at its free ends.

In the case of FIG. **4**, the cross bar **14** is likewise pivotable about an upright axis or shaft **64**, but a physical one. A yoke **65** is connected to a holder **66** for the cross-bar **14** extending in the direction of the latter. At its lower end, shaft **64** is fitted in a fixed bearing **67**. Cross-bar **14** is guided at each end between a respective pair of bars **68** and **68'**, which are directed parallel to the endless transport chains **1** and **2**. Also in this case the cross-bar **14** passes through a sleeve **60**, which is rotatably arranged at the eyelet strip **12**. The pivotal drive of the cross-bar **14** about the axis or shaft **64** occurs at a point of yoke **65** eccentric thereto, the drive system being a hydraulic one, but which could alternatively be a pneumatic one. According to FIG. **5**, the drive system includes a double acting piston **69**, the rod **70** of which is articulated at one end to the yoke **65** (FIG. **4**). To the cylinder of piston **69** two lines **71** and **72** are connected which originate from a control valve **73**. The control piston thereof is displaceable by means of two electromagnets **74** and **75**. The latter are connected to the limit switches **76** and **77** which are actuated alternately, for example directly by the plate **5** of the weft yarn laying device **3**. The feed of this drive device is by means of a pump **78**, which takes the pressure fluid from a tank **79**. In the feed line **80**, a pressure limiting valve **81** is provided.

If it is intended to produce a weft-warp knit fabric which according to German Pat. No. 1,059,608 has a ground material consisting of weft yarns **36** directed obliquely to the longitudinal axis of the fabric, and which is moreover provided with pattern weft yarns **13** which at variance with the weft yarns **36** of the ground material extend parallel to the stitch rows and hence at right angles to the longitudinal axis of the fabric, then at least two weft yarn laying devices are provided, as is evident for example from FIG. **7**. In this case, the weft yarn laying device **3** is provided for the pattern-forming weft yarns **13**, while the weft yarn laying device **35** is provided for the weft yarns **36** forming the ground material (FIGS. **7**, **13** and **14**). The weft yarn laying device **35** is movable only crosswise to the transport chains **1** and **2**, driven by means of chain **37** and guided at the cross bars **38**. The weft yarn laying device **3** has again a slide **7** (FIGS. **8** and **9**) which is provided with an eyelet strip **12** (FIG. **7**). For the slide **7** the weft yarn laying device **35** has a guide **39** extending parallel to the transport chains **1** and **2** (FIGS. **8** and **9**). A spring **40** (FIG. **8**) holds slide **7** in the end position away from the stitch forming point of the machine. Slide **7** is provided with a roll **41**, which cooperates for example with two cam means that can be actuated alternately. According to FIG. **7**, these cam means consist of two guide rails **42** and **43** directed obliquely to the transport chains **1** and **2**. The rails **42** and **43** are each pivotable about its end nearer the edge of the fabric and held by a spring **44** or **44'** at a respective abutment **45** or **45'**, which limits the operative position of the guide rails **42** and **43**. Upon movement of the two weft yarn laying devices **3** and **35**, for example toward the transport chain **1**, roll **41** will in due time make contact with the side of the guide rail **42** toward the stitch-forming point of the machine, so that the rail **42** presses slide **7** of the weft yarn laying device **3** forward. A guide portion **46** or **47** directed at right angles to the transport chains **1** and **2** is contiguous with the guide rails **42** and **43**, respectively. When roll **41** has passed the guide portion **46** associated with guide rail **42**, slide **7** snaps back under the action of spring **40**, and with the reversal of movement of the weft yarn laying devices **3** and **35**, roll **41** of slide **7** pivots the guide rail **42** forward. The guide rails **42** and **43** therefore function as railroad type switches.

In the case of FIGS. **7** to **9**, the weft yarn laying device **3** for the pattern weft yarns **13** receives its fundamental movement directly from the weft yarn laying device **35**, which lays the ground weft yarns **36**. As opposed thereto, according to FIG. **10** only the weft yarn laying device **35** for the oblique ground weft yarns **36** is driven by means of chain **37**, while the weft yarn laying device **3** for the patterning weft yarns **13** is driven

by means of its own chain **46**. Although both chains **37** and **46** have a common main drive **47**, chain **46** is preceded by a transmission gear **48**. It is evident from FIG. **11** that in this case the weft yarn laying device **3** has a single end plate **51** guided by bars **49** and rolls **50**, the plate **51** having at the top a fixed eyelet strip **52** and at the bottom the eyelet strip **12**, the latter being located at the slide **7**. For the latter, cheek **51** is provided with two guide pins **53** and **53'** which extend in the direction of the transport chains **1** and **2**. On one of these is again fitted a spring **40**, which holds slide **7** in the rear end position. Also slide **7** is again provided with a roll **41**, which, however, alternately cooperates with two wedges **54** and **55** (FIGS. **10** and **11**). The wedges **54** and **55** are alternately lifted and lowered into the path of roll **41** and hence act in principle on slide **7** exactly like the guide rails **42** and **43** of FIG. **7**.

In the case of FIG. **7**, the pattern weft yarn laying device **3** is located in front of the ground weft yarn laying device **35**. The pattern weft yarns **13** then lie on the front (right side) of the textile fabric and are, as can be seen from FIG. **14**, bound in between the ground weft yarns **36** and the sinker stitches **81** of the warp knit fabric. Alternatively, however, the pattern weft yarn laying device may be arranged behind the ground weft yarn laying device **35**. In this case, the pattern weft yarns **13** will then be on the back of the textile fabric and are bound in between the needle stitches **56** of the warp knit fabric and the ground weft yarns **36**, as is evident from FIG. **13**.

As shown in FIG. **12**, the ground weft yarn laying device **35** may be provided with a pattern weft yarn laying device **3** before it as well as with a second pattern weft yarn laying device **82** behind it, which then guides the pattern weft yarns **83**. In this way a textile fabric can be produced which exhibits pattern weft yarns on both sides, which in the case of a warp knit fabric are bound in, in the sense of FIGS. **13** and **14**.

If a weft-warp knit fabric is to be produced in which the ground material consists of weft yarns which extend parallel to the stitch rows, then the weft yarns **13** are the ground weft yarns and hence replace the obliquely directed weft yarns **36** of FIG. **3**, **13** and **14**. The weft yarn laying device **3** would thus guide the ground weft yarns and would then of course have to be of the size of the weft yarn laying device **35**.

What is claimed is:

1. A flat warp knitting machine comprising two continuously driven endless transport chains provided with hooks, carrier means, weft yarn laying means carried by the carrier means, means for moving the carrier means and therewith the weft yarn laying means back and forth transversely to the transport chains for inserting weft yarns alternately into the hooks of the two transport chains and means for reciprocating the weft yarn laying means relative to the carrier means in the direction of motion of the transport chains for the insertion of the weft yarns into at least approximately opposite pairs of hooks so that the weft yarns extend at least approximately at right angles to the transport chains.

2. Flat warp knitting machine according to claim **1**, further comprising guide rails each directed obliquely to the transport chains and pivotably mounted at its outer end, means defining an abutment adjacent each of the rails and means resiliently urging each of the rails against the abutment means adjacent thereto.

3. Flat warp knitting machine according to claim **1**, further comprising two wedge pieces and means for alternately lifting the wedge pieces into the path of the weft yarn laying device.

4. Flat warp knitting machine according to claim **1**, in which the weft yarn laying means comprises a cross slide and weft yarn guide means carried by the cross slide and the cross slide is carried by the carrier means for said reciprocating by said reciprocating means.

5. Flat warp knitting machine according to claim **4**, in which the reciprocating means comprises a cross-bar by means of which the cross slide is movable in said reciprocation.

6. Flat warp knitting machine according to claim **5**, in which the reciprocating means further comprises means for driving the cross-bar back and forth parallel to itself.

7. Flat warp knitting machine according to claim **6**, further comprising two co-directional drive means operatively connected to the respective ends of the cross-bar.

8. Flat warp knitting machine according to claim **5**, further comprising means pivoting the cross-bar at the longitudinal center of the cross-bar.

9. Flat warp knitting machine according to claim **8**, further comprising a sleeve pivotably mounted on the cross-slide, the cross-bar being carried by the sleeve.

10. Flat warp knitting machine according to claim **9**, further comprising two cross-heads, the cross-bar being mounted near its respective ends in the respective cross-heads, a pair of guide bars parallel to the transport chains, the guide bars carrying the respective cross-heads for movement along the guide bars, and means for driving the cross-heads in opposite directions.

11. Flat warp knitting machine according to claim **10**, in which said driving means comprises means defining a double lever mounted for pivotal movement about a point intermediate its ends, means for pivotally moving said lever means in alternatingly opposite senses and means for transmitting movement from the respective ends of the lever means to the respective cross-heads.

12. Flat warp knitting machine according to claim **9**, further comprising means connected to the cross-bar at opposite sides of the cross-slide, pivot means supporting said connecting means for pivoting about an axis parallel to the axis of pivoting of the sleeve, and means for oscillatingly driving the pivot means.

13. Flat warp knitting machine according to claim **1**, in which the reciprocating means includes a cam and means operatively connecting the cam to the weft yarn laying means, the connecting means including spring means for effecting a return movement of the weft yarn laying means.

14. Flat warp knitting machine according to claim **1**, in which the reciprocating means includes a pair of endless chains.

15. Flat warp knitting machine according to claim **1**, in which the reciprocating means includes drive means comprising a double acting hydraulic or pneumatic piston.

16. Flat warp knitting machine according to claim **15**, further comprising a second weft yarn laying means and means for moving the second weft yarn laying means back and forth transversely to the transport chains but not in the direction of movement of the transport chains.

17. Flat warp knitting machine according to claim **5**, further comprising means for guiding the cross slide along the length of the cross-bar while the weft yarn laying means moves back and forth transversely to the transport chains.

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