

The invention relates to a weft insertion machine for the production of a warp knit fabric, according to the preamble of claim 1.

A weft insertion machine of the kind mentioned above is known, for example from DE-PS 141 414. By means of the weft insertion machine, individual warp stitch columns are formed which are held together by weft threads. During the knitting process, the weft thread guides oscillate through the needle gaps of the warp needles. The fineness of the warp knit fabric to be produced is consequently limited by the breadth of the work needles and the breadth of the weft thread guides.

It is the aim of the invention to develop a weft insertion machine of the kind mentioned in the introduction so that it is possible to produce a finer warp knit fabric, that is to say, to provide a weft insertion machine that allows a closer spacing of the work needles.

According to the invention, this is achieved by the characterizing features of claim 1. The production of the warp knit goods is thus distributed over two identical rows of work needles off-set laterally by half a needle gauge, which operate out of phase. It is therefore possible to provide each work needle bar with a wider spacing while nevertheless obtaining a finer warp knit fabric. The stitches of each second column of warp stitches are thereby off-set by part of a stitch in relation to the stitches of each first column of warp stitches. The stitches of a row are not all produced simultaneously, but in two phases, corresponding to the two sets of work needles that come into operation out of phase, that is to say, in succession. The production of a row of stitches is thus divided into two phases, so that virtually twice

as many stitches per row of stitches can be accommodated as was the case with the previous finest warp knit fabrics.

Whereas previously the number of stitches was limited to 8 to 10 stitches per centimetre, up to 20 stitches can now be accommodated per centimetre breadth of the warp knit fabric. The warp knit fabric produced by means of the weft insertion machine is distinguished by an exceptional fineness which substantially improves the appearance and the feel of the warp knit fabric.

Advantageous constructions of the weft insertion machine are described in claims 2 to 16.

There are various possible constructions of the weft insertion machine for producing the warp knit fabric. Thus, according to claim 2 the work needle bars can be arranged one behind the other. A construction according to claim 3 is more advantageous, however, since then the work needles can be of substantially the same length. The work needles can then preferably be clamped according to claim 4. Clamping of the work needles according to claim 5 is also possible. In that case, a construction according to claim 6 is especially advantageous.

As a rule, the work needles of the two bars of work needles are of identical construction. A construction according to claim 7, however, is also advantageous, when yarns having different properties are to be worked together with the work needles of the individual work needle bars.

It is possible for the tips of the work needles of the two work needle bars to lie in different planes. Of greater advantage, however, is a construction according to claim 8. Here, it is expedient for the work needles to be guided according to claim 9. They can also be guided in the manner according to claim 10,

whereby the lateral spacing in particular of adjacent work needles can be kept especially small.

The work needle bars can be phase-displaced through an angle other than 180° . A construction according to claim 11 is advantageous, however, because at 180° the displacement of the stitches is just half a stitch length. The work needle bars are advantageously driven according to claim 12.

The arrangement of the warp thread guides according to claim 13 requires only minimum space, yet permits an individual drive of the sets of warp thread guides for the individual work needle bars.

Advantageously, the warp thread guides of each work needle bar are coupled with their drive as claimed in claim 14. Alternatively, it is possible for the warp thread guides for both work needle bars to be constructed as claimed in claim 15, but then a direct coupling of the drive of the warp thread laying apparatus with the work needle bars is not possible. The warp thread laying apparatus has to operate at twice the speed of a work needle bar, since the same warp thread laying apparatus has to serve two work needle bars.

In principle it is possible to control a full weft thread guide in such a manner that it comes into operation only when a row of first stitches is formed. A construction according to claim 16 is advantageous, however, since this results in two weft threads lying in each stitch. This produces an especially stable and dense warp knit fabric.

Examples of embodiments of the subject matter of the invention are described detail hereinafter with reference to the drawings, in which
Figure 1 is a fragmentary view of a first warp knit fabric which comprises only full weft threads;

- Figure 2 is a fragmentary view of a warp knit fabric as shown in Figure 1 in which additionally partial weft threads are arranged within the column of warp stitches;
- Figure 3 is a fragmentary view of a warp knit fabric as shown in Figure 2 in which a further partial weft thread is laid in a pattern;
- Figure 4 shows a fragmentary view of a weft insertion machine in section IV-IV of Figure 5;
- Figure 5 is a fragmentary view of the weft insertion machine of Figure 4 in the section V-V of Figure 4;
- Figures 6 and 7 show perspective views of the mode of operation of the work needles, warp thread guides and weft thread guides in different phases of production;
- Figure 8 shows the device of Figure 6, but with only one kind of warp thread guides; and
- Figure 9 shows the movement diagram of the elements of Figures 6 and 7.

Figure 1 shows the fragmentary view of a warp knit fabric which is formed from warp stitch columns 2_1 and 2_2 , which are worked from a warp thread 4 and are connected to one another by means of full weft threads 6_1 , 6_2 . The stitches 8_2 of each second warp stitch column 2_2 are off-set in relation to the stitches 8_1 , 8_2 of each first column of warp stitches 2_1 by half a stitch. In each stitch 8_1 , 8_2 of the warp stitch columns 2_1 , 2_2 there are arranged two full weft threads 6_1 , 6_2 . This produces an especially dense and fine structure of the warp knit fabric. It is also potentially possible for the warp knit fabric shown in Figure 1 to be produced with only one weft thread per stitch, by omitting every second full weft thread and introducing the full weft thread only when stitches of first warp stitch columns 2_1 or second warp stitch

columns 2, are formed.

Figure 2 shows a warp knit fabric as shown in Figure 1, so that identical parts have been given the same reference numbers. The warp knit fabric is additionally provided with partial weft threads 10 which run only within the warp stitch columns 2₁, 2₂. Such partial weft threads 10 can be differently coloured pattern threads or a rubber thread which imparts a special elastic property to the warp knit fabric.

Figure 3 again shows a warp knit fabric as shown in Figure 1, so that again identical parts have been given the same reference numbers. The warp knit fabric shown in Figure 3 is additionally provided with a further partial weft thread 12 which is guided between any of the warp stitch columns 2₁, 2₂ in a pattern. Accordingly, such a partial weft thread 12 can link with a full weft thread 6₁ in a stitch 8₃.

Figures 4 to 7 show the parts essential to the invention of a weft insertion machine which is otherwise known for the production of the warp knit fabric. This weft insertion machine contains two work needle bars 14, 16 arranged one above the other, each of which carries a set of work needles 18, 20. At the rearward ends of their shanks 22 the work needles 18, 20 have dovetailed extensions 24 with which they are fixed in a respective clamping device 26, 28. Clamping screws 30 serve to tighten the clamping devices 26, 28. These clamping screws 30 are accessible either from the rear or from the top or from the underside of the work needle bars 14, 16. The work needle bars 14, 16 are secured to sliders 32 which serve firstly to carry the work needle bars and secondly to drive the work needle bars 14, 16 to and fro. The sliders 32 are slideably guided in a housing 34 on two sliding bearings 36. Two driver rollers 38,

40 are arranged on the sliders. The driver roller 38 co-operates with an advance cam 42 and the driver roller 40 co-operates with a return cam 44; the cams are arranged on a drive shaft 46 in the housing 34. There is such a slider 32 present for each work needle bar 14, 16, the corresponding advance cam and return cam being arranged out of phase by 180° on the drive shaft 46, so that the corresponding sliders oscillate out of phase by 180° in relation to one another.

The work needles 18, 20 which are, for example, crochet needles, lie in one plane and are supported on a knockover plate 48 in which they are guided in guide slots 50, as especially apparent from Figures 5 and 6. Each set of work needles 18, 20 has associated with it a set of warp thread guides 52, 54 which likewise operate out of phase.

The warp thread guides 52, which are associated with the work needles 18 are secured to a shaft 56 on which is arranged an arm 58 that is connected by way of a link member 60 to an articulated lever 62. The articulated lever 62, which is mounted so as to oscillate on an axle 64, is connected by way of a further link rod 66 to an extension 68 of the work needle bar 14 so as to be driven from it. The warp thread guide 52 is thus moved vertically up and down synchronously with the work needle bar 14. The warp thread guides 54, which are associated with the work needles 20, are secured to a sleeve 70 partially surrounding the shaft 56. This shaft also has an arm 72 which is connected by way of a link member 74 to a further articulated lever 76 which is arranged to oscillate on the axle 64. This articulated lever 76 is connected by way of a link rod 78 to an extension 80 so as to be driven from it, the extension 80 being fixed to the work needle bar 16 so that the second warp thread guides 54 are swung synchronously with the

second work needles 20 in a vertical direction. A drive, not shown in detail, engages the shaft 56 in the axial direction and serves to off-set the warp thread guides 52, 54 by at least one work needle gauge so that the warp thread guides 52, 54 can be guided around a respective work needle 18, 20 in order to be able to introduce a warp thread 82, 84 into a work needle 18, 20, as especially clearly shown in Figures 6 and 7.

Above the knockover plate 48 and the pushed-forward work needles 18, 20 there are further arranged a full weft thread guide 86 and different partial weft thread guides 88, 90, both in the form of tubular thread guides and in the form of needle guides with holes. The guides are fixed to different laying bars 92, 94, 96 which are constructed, driven and controlled in the customary manner.

The warp knit fabric produced is drawn off downwards, in a slot formed between the knockover plate 48 and a guide strip 98, by a take-off device 100.

As especially apparent from Figures 6 and 7, and from the movement diagram of Figure 9, the first work needles 18 and the second work needles 20 are in use alternately, that is, in phases displaced through 180° (curves a and b). In Figure 6, the first work needles 18 are pushed forward (curve a) and the first warp thread guides 52 insert warp threads 82 into the work needles 18 (curve c). In this phase of operation the second warp thread guides 54 (curve d), which are associated with the second work needles 20 (curve b), are in their retracted position, that is to say in the lower position. The first work needles 18 are then retracted into the position shown in Figure 7, in order to knock over a stitch. At the same time, the full weft thread guide 86 (curve e) moves across the breadth of the fabric to the right-hand side of Figure 6 (not illustrated). The second work needles 20 are

thereupon pushed forward (curve b) and the warp laying operation is carried out by means of the warp thread guides 54 for the warp threads 84 on the second work needles 20 (curve d), as illustrated in Figure 7. During the retraction and knocking over of the stitches of the second work needles 20, the full weft thread guide 86 is moved again to the left-hand side, before the first work needles 18 are pushed forward. In this manner two weft threads are introduced into each stitch, as shown in Figure 1.

Figure 8 shows a further variation of the first warp thread guides 52₁ and the second warp thread guides 54₁, which are arranged on a common laying rod, not illustrated in detail, and are moved jointly. All warp thread guides 52₁, 54₁ perform the same movement, but it is only either the first warp guides 52₁ or the second warp thread guides 54₁ that are in use and the remaining warp thread guides perform an idling movement. Unlike the warp thread guides 52 and 54 of Figures 6 and 7, the warp thread guides 52₁ and 54₁ have to operate at twice the speed.



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Patent Claims

1. Weft insertion machine for the production of a warp knit fabric, having work needles (18, 20) guided to and fro transversely to a knockover plate and, associated with these work needles, warp thread guides (52, 54, 52₁, 54₁) which, when the work needles (18, 20) are pushed forward, are movable for the insertion of the warp threads between and through the work needles (18, 20), and having at least one weft thread guide (86) moving to and fro transversely to the work needles (18, 20), characterized in that the work needles (18, 20) are distributed evenly on two work needle bars (14, 16) lying on the same side of the fabric and are arranged alternately, and are arranged to be driven out of phase, each work needle bar (14, 16) having associated with it a set of warp thread guides (52, 54, 52₁, 54₁).
2. Weft insertion machine according to claim 1, characterized in that the work needle bars (14, 16) are arranged one behind the other.
3. Weft insertion machine according to claim 1, characterized in that the work needle bars (14, 16) are arranged one above the other.
4. Weft insertion machine according to claim 3, characterized in that the work needles (18) of the upper work needle bar (14) are arranged to be clamped from above and the work needles (20) of the lower work needle bar (16) are arranged to be clamped from below.
5. Weft insertion machine according to claim 1, characterized in that the work needles (18, 20) of the



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two work needle bars (14, 16) are arranged to be clamped from behind.

6. Weft insertion machine according to claim 1, characterized in that the work needles (18, 20) have dovetailed extensions (24) which are held in corresponding clamping devices (26, 28) of the work needle bars (14, 16).

7. Weft insertion machine according to claim 1, characterized in that the work needles (18, 20) of the one work needle bar (14, 16) are of narrower construction than the work needles (20, 28) of the other work needle bar (16, 14).

8. Weft insertion machine according to claim 1, characterized in that at least the tips of the work needles (18, 20) of both work needle bars (14, 16) lie in a common plane.

9. Weft insertion machine according to claim 1, characterized in that the work needles (18, 20) of both work needle bars (14, 16) are arranged on a common knockover plate (48) with comb-like guide slots (50).

10. Weft insertion machine according to claim 1, characterized in that the work needles (18, 20) of both work needle bars (14, 16) are arranged on a common level knockover plate without lateral guidance.

11. Weft insertion machine according to claim 1, characterized in that the work needle bars (14, 16) are arranged to be driven out of phase by 180° in relation to one another.

12. Weft insertion machine according to claim 1,



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characterized in that the work needle bars (14, 46) are arranged to be driven by means of cranks or cam gears (38, 40, 42, 44).

13. Weft insertion machine according to claim 1, characterized in that the warp thread guides (52, 54) of the two work needle bars (14, 16) are arranged on a common axle and are arranged to be driven out of phase.

14. Weft insertion machine according to claim 12 and 13, characterized in that the warp thread guides (52, 54) are coupled by way of lever mechanisms with a respective swivel-mounted articulated lever (62, 76) so as to be driven from the associated work needle bar (14, 16) to perform a corresponding vertical oscillating movement, the common shaft (56) being displaceable to and fro by at least one needle gauge by means of a transverse drive.

15. Weft insertion machine according to claim 1, characterized in that the warp thread guides (52, 54) for both work needle bars are arranged on a common warp thread laying device, the drive speed of which is twice that of the work needle bars.

16. Weft insertion machine according to claim 1, characterized in that it comprises a full weft thread guide (86) which, on the formation both of a row of first stitches (8₁) and a row of second stitches (8₂), is movable across the breadth of the web of fabric.