March 7, 1967 F. SEILER 3,307,376

KNITTING MACHINE

Filed June 4, 1963 3 Sheets-Sheet 1

Fig. 1.

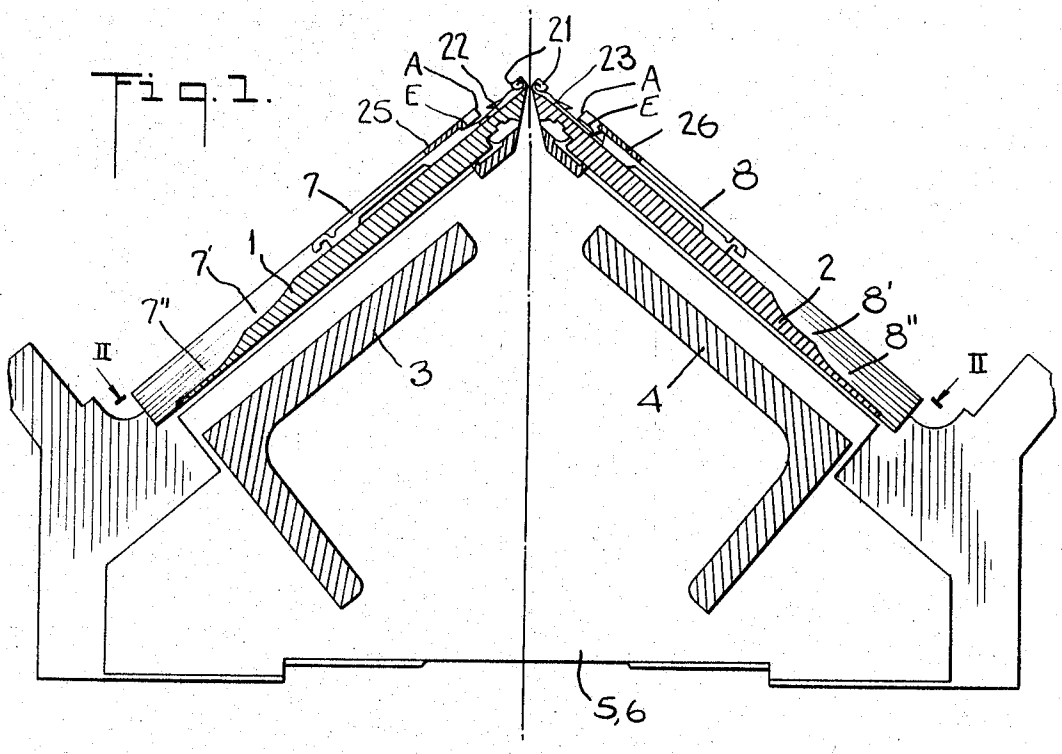


Fig. 5.

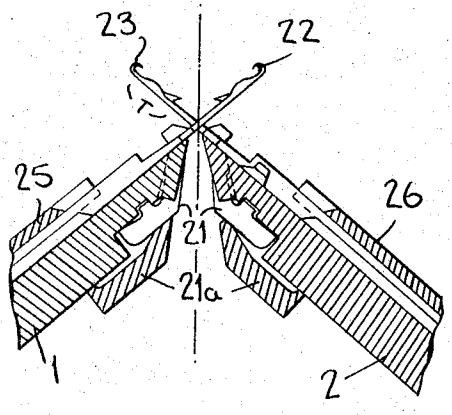
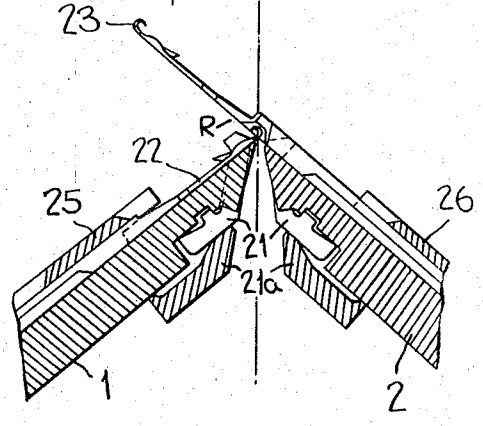


Fig. 6.



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March 7, 1967 F. SEILER 3,307,376

KNITTING MACHINE

Filed June 4, 1963 3 Sheets-Sheet 2

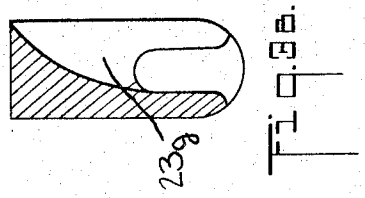

Fig. 3B.

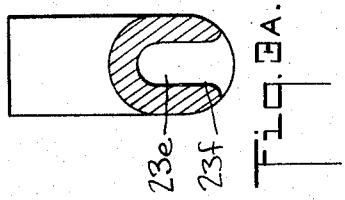

Fig. 3A.

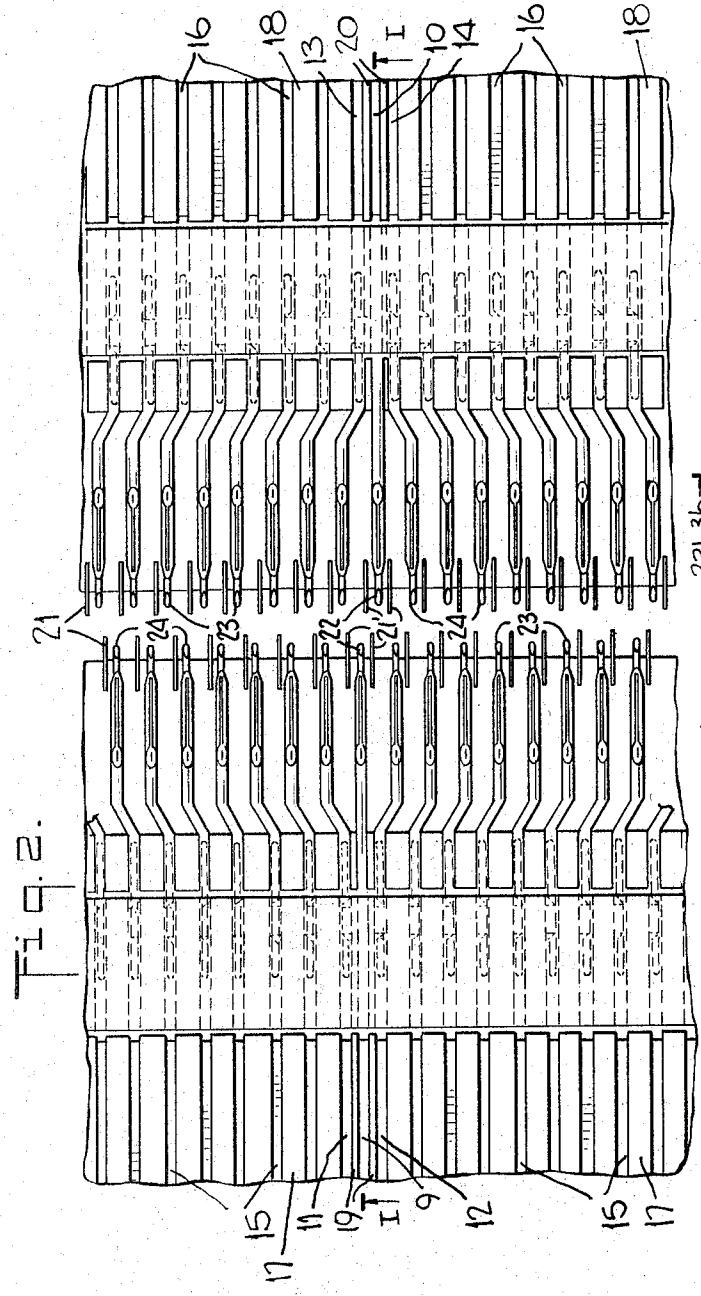

Fig. 2.

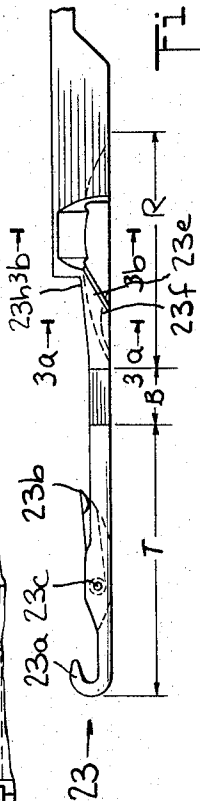

Fig. 3.

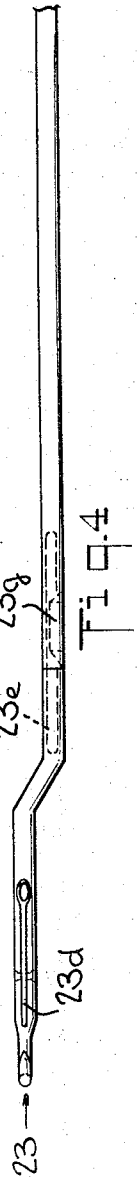

Fig. 4

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Fig. 7.

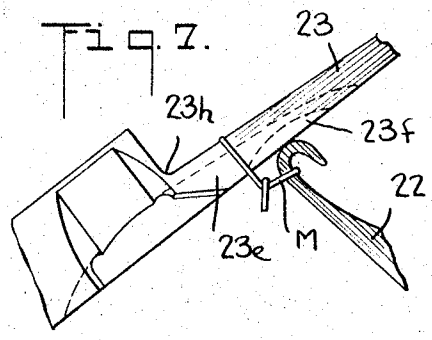


Fig. 8.

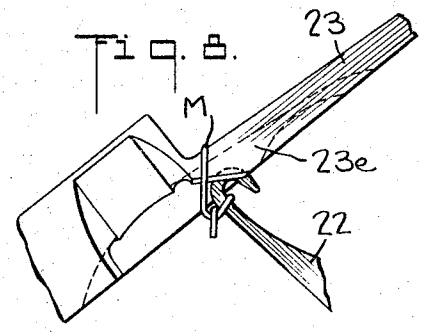


Fig. 9.

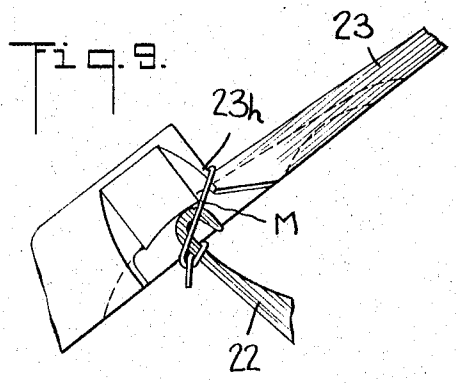


Fig. 10.

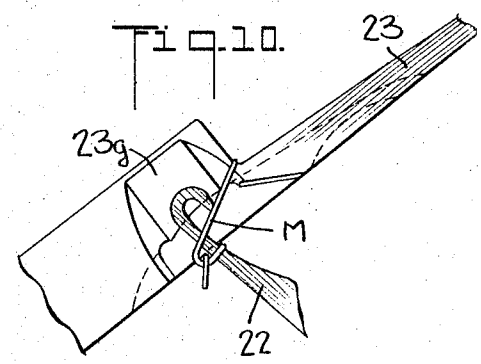


Fig. 11.

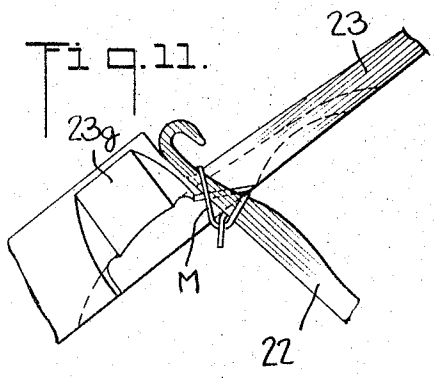
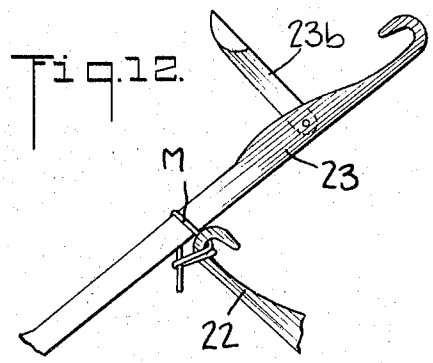


Fig. 12.



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United States Patent Office

3,307,376
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3,307,376

KNITTING MACHINE

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Filed June 4, 1963, Ser. No. 285,323
Claims priority, application Germany, June 8, 1962, D 39,114
4 Claims. (Cl. 66—70)

The invention relates to flat knitting machines having needle beds forming a V, in which in known manner a multiplicity of straight parallel transverse grooves for accommodating and guiding latch needles are milled, these needles being so shaped and disposed as to permit normal knitting as well as the transfer of loops immediately from one needle to the other in the same stroke of the carriage.

The transfer of stitches on a knitting machine, that is to say the taking up of stitch loops from the needles of one needle bed on to the opposite bed or the same bed, permits a very considerable expansion of the pattern range of the machines provided for this purpose. In this way it becomes possible on the one hand to knit interesting openwork patterns or to effect automatic transfer from 1/1 articles to 2/2 articles, while on the other hand reductions in width can be made for the purpose of producing shaped knitted parts.

Processes and devices for transferring stitches are already known in large number and in the most widely varying forms of performance and finish. One group of these makes use of special auxiliary members which cooperate with the ordinary knitting needles, while in another group the needles themselves are so constructed that they can operate the stitch transfer process by themselves alone. For comparison with the knitting machine in accordance with the invention, in what follows only the second group will be cited, as this machine works with specially shaped needles without the cooperation of additional transfer implements.

A further feature marking a difference between the known stitch transfer methods, is the additional fact that in one of them one of the two needle beds has to be displaced by half a needle gauge, while the other proceeds without this auxiliary measure. In this respect again in what follows only the second category will be taken into account, as no offsetting or displacement is necessary for the stitch transfer which will be described below.

The appropriate specially formed transfer needles can be divided again into two main groups; those with stitch spreading members (springs, wires, loops, etc.,) arranged laterally to the needle stem and those with recesses provided unilaterally in the stem. In the first group the stitch loop to be transferred is spread out by the spreading member so that the transfer needle can pass through it (between the stem of the needle and the spreading member), while in the second the head of the receiving needle is applied against the transfer needle and so is able to slide as the latter rises in its lateral recess and simultaneously thereby into the stitch loop stretched obliquely above. This second system is taken as a basis for the transfer process in the knitting machine in accordance with the invention.

All the above mentioned methods and devices from their first becoming known to the most recent times, have always been applied in knitting machines in such a way that in one and the same row of stitches it has only been possible to carry out the transfer but not at the same time the forming of the stitches. The result of this is that for producing a complete knitted row consisting of ordinary and suspended stitches at least two passes of the carriage are necessary only one of which can carry out the desired

operation. This of course means a noticeable reduction in the productivity of the machine.

Now, in evaluating a modern knitting machine, in addition to the pattern possibilities and the quality of the goods produced, the capacity of the machine is also critical and recently a number of proposals have been made for equipping the machines with devices which permit knitting and transferring in the same stroke of the carriage.

One proposal envisages providing the known transfer needles with lateral spreading springs, by which the loops to be transferred are opened and simultaneously brought into a favourably inclined position for inserting the opposite transfer needle. In this connection the said transfer needles are arranged symmetrically to the axis of symmetry of the article to be knitted, and also to the transverse centre line of the needle bed, that is to say one half of the needle bed contains needles with right hand spreader springs and the other with left hand spreader springs. In this connection in order to obtain satisfactory 1/1 ribbed goods or fabrics the needles must be accurately placed in relation to the gaps in the opposed needles, and the needle grooves are therefore milled in, in the usual manner uniformly spaced over the whole bed length. The loops are suspended in this case without the usual 1/2 gauge racking on the one needle bed in relation to the other, which makes laterally widely projecting spreader springs necessary, which in turn leads to wide needle grooves and consequently to undesirably weak needle bed webs. The result of this is an excessive stretching of the open loops, which, depending on the yarn material used, can easily lead to the threads tearing. For the same reasons it is also impossible to knit narrow-mesh articles without difficulty. Furthermore, in the central zone of one of each of the two needle beds, because of the above mentioned symmetrical needle arrangement, there is in each case an unoccupied needle groove, the needle opposite which cannot therefore find any stitch to transfer. The result of this is a certain restriction of the freedom of patterning in this zone.

One solution has already been disclosed, which does indeed likewise provide a symmetrical distribution of the spreader spring needles, mirrorimaged in relation to the center of the needle bed, in correspondingly wide grooves, in which however a special narrow groove is milled accurately in the center of the needle bed, which accommodates an ordinary knitting needle. The opposing needle beds are accurately placed in this connection in relation to gaps, and their transfer process is facilitated by predominantly lateral bending of the transfer needles, thus making it possible to have comparatively narrow spreader springs.

In another known form of embodiment the normal needle beds are again fitted with spreader spring transfer needles, but in a completely uniform distribution over the whole bed length, that is to say without symmetry in relation to their center line. To avoid excessive widening of the suspension loops the lateral projection of the spreader spring is here restricted to the unavoidable minimum, so that while on the one hand admittedly narrow needle grooves and hence strong needle bed webs are obtained, on the other hand however, it becomes necessary to offset the bed of the transfer needles in known manner by about half the gauge of the needles, in order to ensure insertion in the only slightly opened loops. This racking results in a one-sided distrubance of the normal crossing so that it may happen that the ribbed article continuously knitted with the taken-up pattern will likewise be distorted one-sidedly.

As a third solution necessitates, in the narrowing process in addition to the ordinary knitting needles, special points for the stitch transfer process, that is to say is based on a quite different basic principle from that of the pres-

ent invention then there is no need here in describing generally the position of known art to give a more detailed comparison of the two solutions.

The object of the invention is to avoid the disadvantages of the hitherto known constructions. It relates to a knitting machine, in particular a flat knitting machine, with two opposed needle beds inclined in relation to one another in the shape of a V, in which in known manner a multiplicity of straight parallel transverse grooves for receiving and guiding latch needles are milled, in which connection however, differently from the usual uniform pitch over the whole bed length, one groove lies accurately in the centre of the needle bed and the two directly adjacent grooves to right and left are at a distance of only half the needle gauge, while all the other grooves on either side adjacent outwardly have the full normal gauge so that the grooves in one bed located opposite the spaces between the grooves of the other bed.

In a known manner (see U.S. Patent No. 3,102,404) the middle groove is fitted with an ordinary straight knitting needle while in all the other grooves special knitting-transfer needles bent laterally by half the needle gauge are inserted in such a way that the lateral bending of the front needle stem extends right and left of the straight central needle continuously from its path, thus producing a completely mirror-like arrangement of the needles in relation to the bed centre, with absolutely uniform spacing of the needle hooks with correct normal crossing. The lower straight front part before the bend, containing the hook and latch of the needle stem, serves in this connection for the usual loop-forming process, while the upper, also straight central path of the needle body has beyond the bend the known lateral recess for the insertion of the transfer needle during the loop take-up. The hooks on the front straight needle stems in one needle bed are located in this connection, because of the said lateral bending, accurately opposite the upper straight needle bodies in the other needle bed, so that for the stitch transfer process known per se no 1/2 racking is necessary. It is thus possible to produce in the same stroke of the carriage both completely uniform rib knitting and also transfer patter and/or narrowings or reductions in the width.

The knitting machine needles with lateral bending of the needle stem are already known per se but this bending has the duty of bringing the loop to be transferred into such a lateral oblique position that the opposite take-off needle can easily pass through it. In other words the top-arm of the bend has here an essential function within the frame-work of the transfer process, while as will appear more clearly in the following description, it represents in the subject matter of the invention only the natural connecting member of the two straight needle stem parts displaced laterally in relation to one another.

A specific embodiment of the invention will now be described by way of example with reference to the accompanying drawings in which:

FIGURE 1 is a section through two needle beds mounted on the machine frame, along the line I—I of FIGURE 2.

FIGURE 2 is a plan view rotated into the plane of the drawing of the two needle beds along the lines II—II of FIGURE 1.

FIGURE 3 is a side elevation of the front half of a knitting transfer needle.

FIGURE 3A is a cross-section of FIGURE 3 taken along line *3a—3a* thereof.

FIGURE 3B is a cross-section of FIGURE 3 taken along line *3b—3b* thereof.

FIGURE 4 is a plan view of the same needle.

FIGURE 5 is a part cross-section through the two needle beds with two needles in the uppermost knitting position.

FIGURE 6 is a similar section with the right hand needle in the highest ejection position for casting off the stitch and the left hand needle in the insertion position for the stitch transfer.

FIGURE 7 shows the hook of a take-over needle approaching the groove in a delivery needle, at the beginning of the stitch transfer.

FIGURE 8 shows the hook partly located in the groove.

FIGURE 9 shows the hook partly inserted in the loop.

FIGURE 10 shows the hook nearly completely inserted in the loop.

FIGURE 11 shows the hook as it begins to descend, and

FIGURE 12 shows the loop in the hook.

In FIGURE 1 the two needle beds **1** and **2** of a V-bed flat knitting machine form an included angle between them of about 100°. This reciprocal position is maintained by a suitably constructed needle bed carrier, principally consisting of two angle cross-members **3**, and **4**, and end face walls **5** and **6** at the two machine ends. In the needle beds **1** and **2** are milled in known manner a multiplicity of straight, parallel needle grooves **7** and **8**, the depth of which in different cases can vary over their length as shown in **7'**, **7''**, **8'**, **8''**, according to the space requirements of the knitting and needle entrainment devices accommodated therein. In this connection in the upper needle bed half, which contains the actual needles, the groove base is completely rectilinear and parallel to the needle bed surface. By contrast with the ordinary groove arrangement with a uniform distribution over the whole bed width, here in both needle beds, right and left of a center groove **9**, **10** which is located exactly in the bed center there is milled in each case a groove **11**, **12** and **13**, **14** (FIGURE 2) at a distance of only ½ of the needle gauge or pitch, while the other grooves **15**, **16** adjacent on both sides to the bed ends, again have the normal regular 1/1 needle gauge or pitch between them. These grooves **15**, **16** are in this connection arranged in the two opposite needle beds in such a way that they are accurately related to gaps in respect of one another, as is also the case with ordinary knitting machines. Between all these grooves milled-in in this way parallel fillets or webs **17**, **18** are left which are very strong with the exception of the two webs **19**, **20** enclosing the central grooves **9**, **10**, the thickness of which is smaller because of the above mentioned 1/2 gauge in this bed central zone. Not all the webs extend over the whole needle bed width, but end at a certain distance below the knocking over comb at the edge A. Here furthermore they are undermilled, in such a way that a rectangular incision E is produced at their root, which permits the partial introduction of the oblique bent arm of the knitting transfer needle described further below. The comb webs **21** are separately inserted in known manner and are fixed by screwed-on clamping bars **21***a*, so that if required they can easily be changed. As in the case of the said milled-in grooves **15**, **16** these comb webs are located in the opposed needle beds exactly in relation to the gaps and in 1/1 gauge with the exception of the two webs **21'** to the right and left of the central straight knitting needles which have a narrower spacing.

In the above described grooves the various knitting implements are inserted in the usual manner, of which here only the actual needles will be considered, and not any possible associated push rods or platens. As already mentioned the central groove exactly in the center of the bed is occupied by an ordinary straight knitting needle **22** of the usual latch needle type which need not therefore be described here in more detail. All the other grooves contain special laterally bent knitting take-up needles, of which two kinds are present, one kind **23** with a left hand bending viewed from the hook and another kind **24** with a right hand bending of the front needle stem. FIGURES 3 and 4 show the needle type **23** on a larger scale, only the front half which affects the matter here being shown. These novel needles consisting of one piece contain essentially two basic elements,

namely an ordinary latch knitting needle portion T and a stitch transfer needle portion R known per se one of each of which works in a longitudinal plane of its own, offset laterally in relation to one another, in which connection these two elements are however connected by an oblique connecting member B to form a rigid whole. In this way there is obtained the bent shape of the complete member which has already been mentioned several times. Its front portion T has the usual hook **23***a* and the usual latch **23***b* which can swing round the pivot **23***c* and is guided in the slot **23***d* of the needle stem. In the central portion R are located two recesses one of which **23***e* (FIGURE 3*a*) takes the form of a groove open towards the underside of the needle and provided in the section plane, *a—a* with lateral facets **23***f* while the most important recess **23***g* (FIGURE 3*b*) is completely open both laterally and also underneath over a given length in relation to the needle stem, in this high zone. Fundamentally such a construction of the needle stem has already been disclosed by German Patent 692,981, the form of embodiment selected in connection with the subject matter of the invention represents however, a simplified variant of the original patent. Instead of the transition from the low front part of the needle to the high central part there is found the angular indent **23***h* likewise known in connection with transfer needles. All these needles **22, 23, 24** are guided and prevented from falling out by cover bars **25** and **26** in the two needle beds **1** and **2** respectively on the bottom of the grooves **7** and **8** respectively.

A knitting machine fitted with the above described needle beds and needles works as follows: different reciprocating movements in the longitudinal direction of the grooves are imparted in the conventional manner to the needles by the reciprocating motion of a carriage (not shown) over the needle beds by means of suitably arranged cams which act on the needle or push-rod feet. Each to or fro movement of the carriage constitutes a stroke. The normal original position (comb level) is shown in FIGURE 1, FIGURE 5 then shows the uppermost needle position during the normal knitting (loop-forming) process. It can be seen from this that here in the two needle beds only the straight front part T of the needle stem is involved, while the oblique bending and the high central part R remain inoperative inside the needle bed. In this connection the needle crossing is effected over the whole length of the bed in a completely regular reciprocal needle spacing producing equal-armed loop fillets.

FIGURE 6 which relates to the stitch transfer from the needle bed **2** to the needle bed **1** is generally directed to explaining the basically known stitch transfer process. The delivery needle **23** is accordingly shown in its extreme ejection position in which the central part R of the needle stem has been brought into the working zone of the opposite take-over needle **22**, in such a way that it projects by about ⅔ of its length beyond the knocking over comb. Because of the lateral displacement of this central part R in relation to the front part T the hook of the needle **22** is located accurately in relation to the centre of the stem part R of the needle **23**, so that the said hook can travel safely into the lower and laterally open recess **23***g* without a preparatory needle bed racking being necessary. The most important phases of the stitch transfer process are then illustrated on a larger scale by FIGURES 7 to 12. This process corresponds in principle to that already described in German Patent 692,981, but with some simplifications. FIGURE 7 shows the instant in which the hook of the take-over needle enters the widening **23***f* of the groove **23***e* on the underside of the delivery needle **23** in order to act as an additional stripper member of the loop M hanging on these two needles, that is to say to move the latter during the further rise of the needle **23** in support of the tensile stress produced by the drawing-off of the article towards the angular indent **23***h*. In FIGURE 8 can be seen the definite end position of this displacement process, in which the hook of the needle **22** has already penetrated to a certain extent in the groove **23***e* and the loop M begins to assume an oblique position in relation to the stem of the needle **23**. With a further rise of the needle **23** the loop M then lies as can be seen in FIGURE 9, completely in the indent **23***h*, so that the former because of the draw-off tension moves more and more into an expressly oblique position, in which connection it is simultaneously somewhat extended. Meanwhile the needle **22** likewise continues its rise so that its hook begins to be inserted in the obliquely lying extended loop M. The closing stage of this actual insertion process can then be seen from FIGURE 10, in which the delivery needle **23** has reached the highest point of its rise while the hook of the take-over needle **22** is closely applied, with a slight lateral deviation, against the perpendicular base surface of the lateral recess **23***g*. While the delivery needle **23** now stays for a while in its highest ejection position, the hook of the needle **22** completes the insertion in the loop M, projecting with safety a little beyond this. Next the needle **23** begins its return descent, during which as shown in FIGURE 11 the hook of the needle **22** which has completely penetrated into the lateral aperture **22***g* is forced out of this aperture with a predominantly somewhat stronger bending over, so that it is applied against the corresponding outer side of the stem of the needle **23**. In this connection the loop M is now held back by the needle **22**, by which it is again straightened out and released from stress. With a further descent, correctly synchronised in relation to one another in time, of the two needles **22** and **23**, the taken-over loop M finally slides in turn, as is shown in FIGURE 12 in a desired intermediate stage, into the hook of the needle **22** and on the other hand over the whole length of the finely polished front stem of the needle **23**, in which connection this loop because of the bent shape of the said stem is deflected laterally, and in sliding forward and over the latch **23***b* closes the latter and then leaves the needle in the usual manner. Thus the complete stitch process is ended.

It can clearly be seen from the preceding description that on a flat knitting machine equipped with needle beds in accordance with the invention and bent-over knitting transfer needles, both correctly ribbed articles and also transferred patterns and/or narrowings can be made symmetrically in one and the same carriage stroke without any needle bed racking being necessary. A satisfactory quality of the articles produced is obtained together with a higher rate of production.

I claim:

1. In a stitch-transfer V-bed flat knitting machine having two opposed inclined needle beds: a straight transverse central groove in the center of each needle bed, the central groove of one bed being laterally offset from that of the other; a first transverse groove on each side of the central groove of each bed, parallel thereto and spaced therefrom by one-half the needle gauge; and a like number of a plurality of transverse grooves lying on either side of each central groove and beginning at one full needle gauge from a said first groove, said plurality of grooves extending parallel to the corresponding central groove and adjacent grooves of said plurality being separated by one full needle gauge, said central grooves, first grooves, and plurality of grooves all having a common width for receiving each a single knitting needle.

2. A knitting machine according to claim **1**, including a straight knitting needle located in each central groove of each bed; and located in each of said first grooves of each bed and each of said plurality of grooves of each bed a knitting-transfer needle having first and second straight and parallel portions laterally offset by one-half of a needle gauge and a bent portion intermediate the

ends of the needle for connecting together said first and second portions.

3. A knitting machine according to claim 2, wherein said bent portions of the knitting-transfer needles located on one side of a central groove are all bent in the same direction in the plane of the bed and those bent portions of the knitting-transfer needles located on the other side of the same central groove are all bent in the opposite direction in the plane of the bed.

4. A knitting machine according to claim 2, wherein said first portion of a knitting-transfer needle contains a latch and terminates in a hook and serves in the loop forming process; and said second portion contains a lateral recess for insertion therein of a receiving needle during a loop transfer.

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