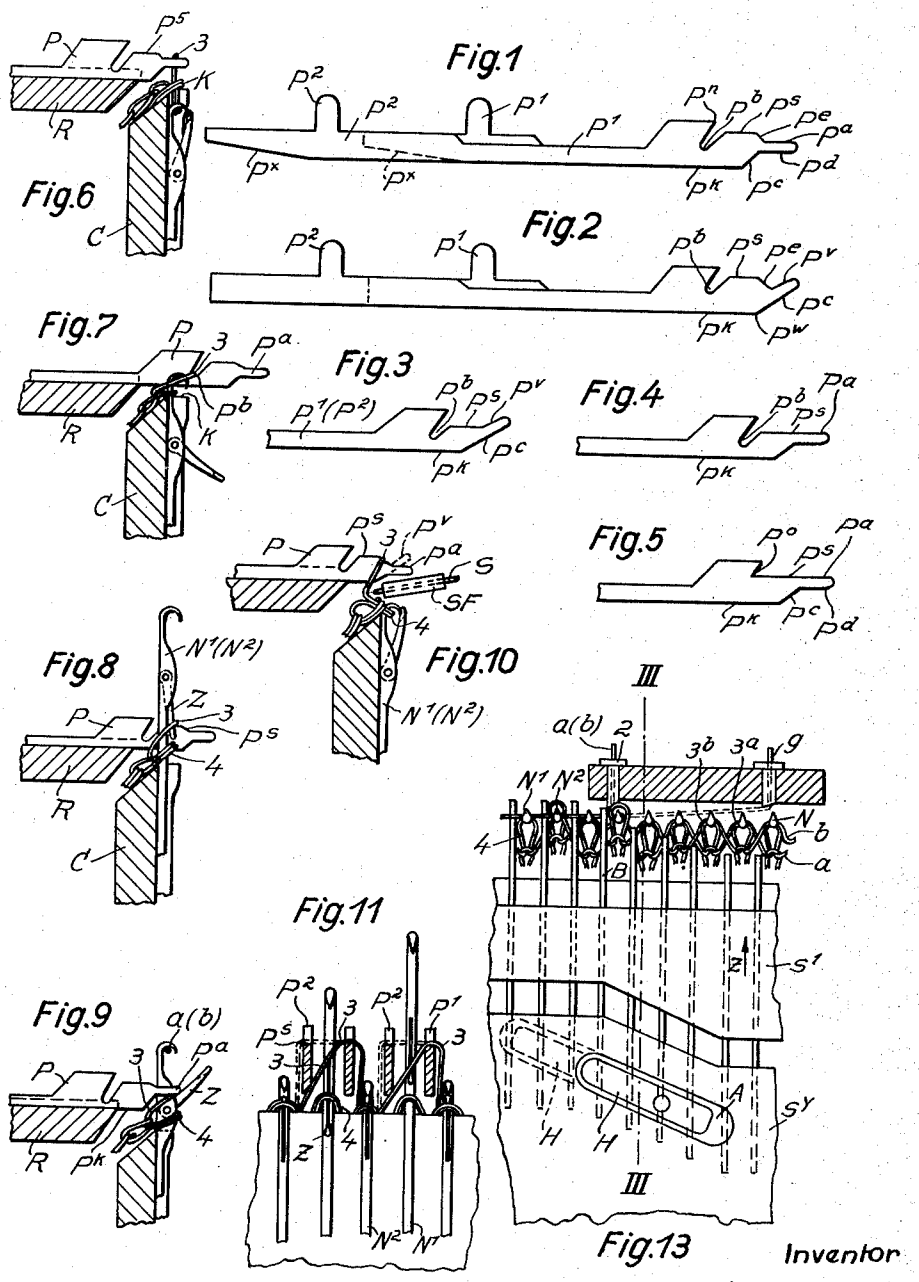
Sept. 4, 1956 M. NEBEL 2,761,302

CIRCULAR KNITTING MACHINE

Filed April 6, 1953

3 Sheets-Sheet 1



Inventor

Max Nebel

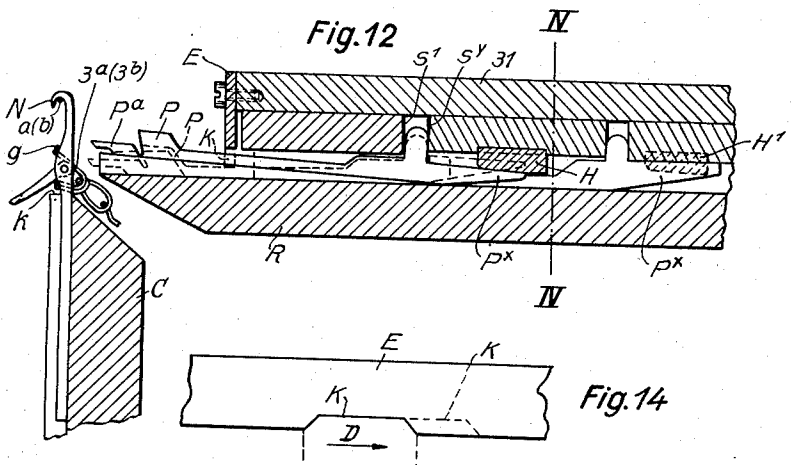
by Karlkirchner, Atty.

Sept. 4, 1956 M. NEBEL 2,761,302

CIRCULAR KNITTING MACHINE

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Fig.12



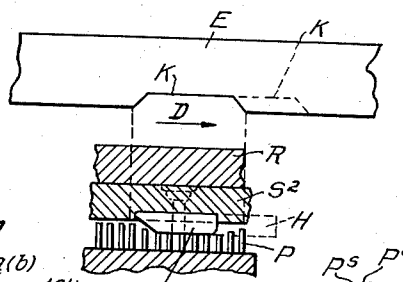
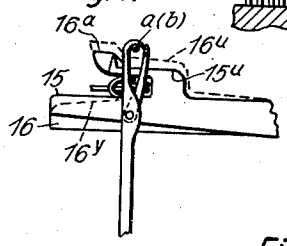


Fig.14

Fig.17



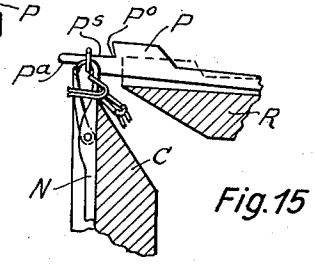
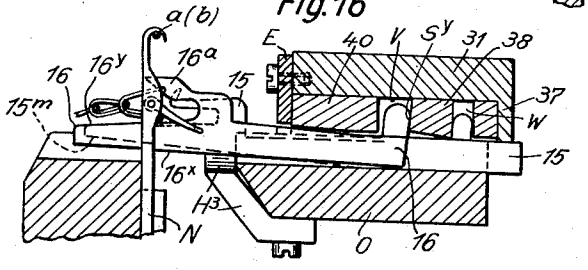


Fig.15

Fig.16



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Fig.18

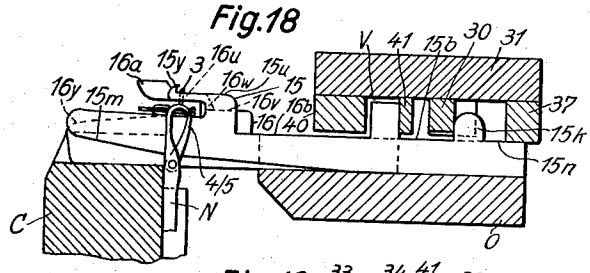


Fig.19

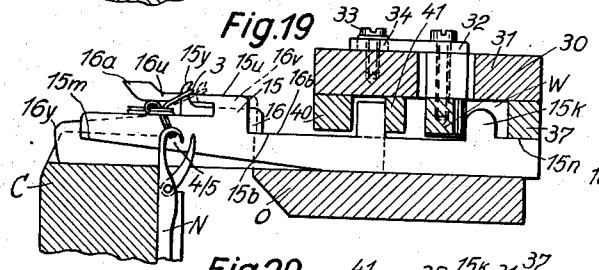


Fig.20

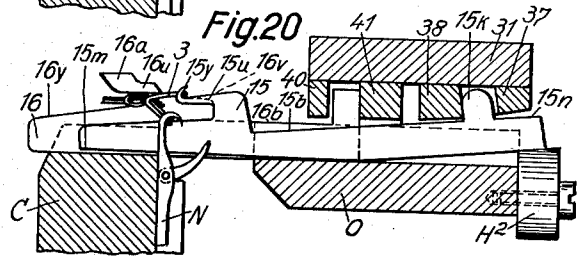


Fig.21

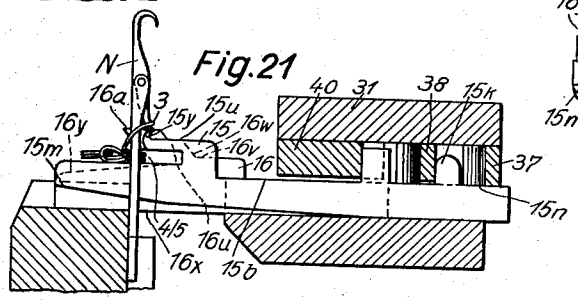


Fig.22

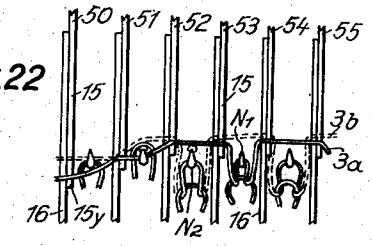


Fig.26



Fig.23

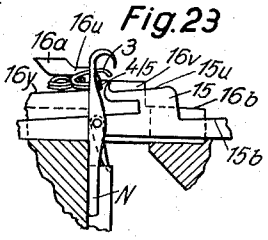


Fig.24

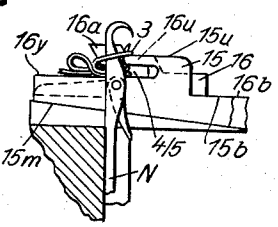
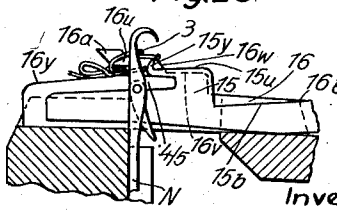


Fig.25



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United States Patent Office 2,761,302 Patented Sept. 4, 1956

2,761,302

CIRCULAR KNITTING MACHINE

Max Nebel, Wiesbaden, Germany

Application April 6, 1953, Serial No. 347,007

Claims priority, application Switzerland April 24, 1952

16 Claims. (Cl. 66—108)

This invention relates to the manufacture of hosiery and knitted fabrics without warp threads, similar to Milanese fabrics or other warp-knit fabrics according to British Patent No. 507,660. In the knitted goods to which that Patent relates, thread portions lying between non-adjacent needle loops in the same course are worked longer than usual and (after being pulled through a loop in that course) are knitted into a following course as elongated needle loops with the normal needle loops of that following course. In the following description and in the appended claims, these elongated needle loops are referred to as extended loops. There are thus formed mesh formations similar to warp knit fabrics, because of the mesh limb parts which bring about a cross connection of the needle meshes of one course with the needle meshes of a following course.

The procedures according to the invention are also suitable for the manufacture of knitted fabrics, in which such extended loops are not worked into meshes in a following course, but are only bound in as catch loops between the meshes.

These extended loops which for this purpose are formed between two non-adjacent needle meshes and pass across at least one needle mesh are sunk longer over transfer plates and transferred by means of said plates onto the needles for working in a following course. According to the process of the invention the extended loops are further to be carried not only by two transfer plates on both sides of the needle, but also, for certain modes of working by only one transfer plate between the needles, for which purpose they are given a special shape according to the requirement.

The process according to the invention relates to two types of circular knitting machines which operate for the purpose of the transferring of extended loops onto the needles with specially shaped transfer plates. One type of circular knitting machine is that which has a rib disc within the needle cylinder, in the slots of which sinkers are guided which are moved against the back of the needles. The other type of circular knitting machine is that which has a ring outside the needle cylinder in the slots of which knocking off or connecting plates are guided which are moved against the front of the needles.

According to the invention one of the two simultaneously sunk loops which is sunk longer than the other of usual length is held during the mesh formation on the plates and then, when the needle goes up again to its highest position, is so held over the needle hook of the needle that it goes through the loop.

By bringing the extended loop before the needle hook for the transferring onto the needles more thread is used than is needed for its sunk length. If this excess of thread were created by sinking more than is necessary then the meshes which formed from the long loops and the meshes of usual size, would be too large. Thus the fabric will be too loose and not knit close enough. If on the other hand this reserve of thread is not given then the long loop must bring the necessary excess of thread for the transferring from the adjacent small loop. That would be possible with a loose fabric but is impossible with the firm and closed fabric planned, as with such fabric the loops of usual size are already formed from the minimum of thread so that—even if only temporarily—they cannot deliver thread to the large loops without thread breakage.

It is intended to eliminate these disadvantages by the invention whereby it is first arranged that the extended loops are sunk by the transfer plates longer with more thread than the normal loops of usual length and that the transferring of these extended loops onto the needles by the transfer plates takes place at a point which lies nearer to the sinking point for the normal loops than the point for sinking of these extended loops and that the transfer plates after transferring are again moved above the extended loops on the needles between the row of needles.

With circular knitting machines the procedure according to a further feature of the invention is such that the extended loops are sunk at a point which lies higher than the sinking point for the loops of usual length and that the transferring of the extended loops on to the needles takes place so far below the sinking point that by bringing the loops into their transferring position before the needles or needle hooks no increase in the loops is effected. This is attained in that the edge of the plate on which the extended loop lies during the transference to the needle lies lower than the edge on which the loop is sunk.

This happens either by the fact that in the carrier of the sinker edge, which in this case is a transfer plate, there is provided a groove lying deeper than the sinker edge or that the carrier of the sinker edge, that is the transfer plate, on sinking for the long loops is tipped higher and after the sinking or transferring is again lowered.

If on changing the sinking depth for the usual loops the sinking point for the extended loops cannot at the same time be placed farther away from the usual sinking point then, according to a further feature of the invention, the extended loop must be sunk not only vertically, that is in the direction of the needle axis, but at the time in which the needles sink the loops, must also be sunk obliquely thereto so that the position of the sinking point of the extended loops can be altered according to the transfer point.

With this displacement of the position for the transfer of the extended loops after the sinking according to the invention, care must be taken however to see that after successful transmission of the extended loop there is again present sufficient vertical distance between the position of the extended loop and that of the lower meshes of loops of usual length. This distance is necessary in order to allow the long loop onto the needle latch with certainty at the time in which the formed mesh is brought from the latch onto the needle shaft, so that with the next mesh forming procedure the extended loop again comes into the needle hook. If the extended loops are carried by two transfer plates it is sufficient if the transferring point of the extended loops for this process lies at the same height as the sinking point.

In machines with spring (hook) needles this distance must be present so that the pressing of the needle hook between the extended loops and the meshes is possible.

The manufacture of such a hosiery fabric in warp knit fashion, as a close and needle proof mesh fabric presupposes that the transfer plates for transferring the extended loops to the needle for the co-forming of extended and normal meshes must have a shape which meets these re-

quirements and that these likewise are adapted to the needle movements.

This keeping apart of the extended loops which are located on the top edge of the transfer plates from those meshes which are held downwards on the lower edge thereof, demands, for the reliable execution of the operation, a movement going beyond the extent which is required for sinking the loops on the top edge of the plate, especially when the extended loops are only held by one transfer plate and in view of the fact that on the upward movement of the needles the meshes are still carried along upwards somewhat beyond the lower edge of the plate. According to the invention it is intended to eliminate this disadvantage by the fact that while the meshes are brought from the latches onto the shaft of the needle, the extended loops are located on a point on the top edge of the transfer plates which is higher than the point on which they are sunk.

On the other hand however the lower edge of the carrier of the sinker edge for the extended loop must be as high as possible so that the extended loops lying on the opened latches, after the passing again of the plates for the sinking of new loops, are not pressed in the latch hinge of the needle and torn by the closing latch. For this purpose the front lower edge of the sinking edge carrier that is the transfer plate is made narrower towards its free end and inclined at the top. This inclining of the lower edge of the transfer plate has in addition the object according to the invention of providing sufficient space for the placing in of a weft thread by means of a weft thread-guide between the usual sinking point (cylinder upper edge) and the plate lower edge.

This inclining of the lower edge terminates after the free end, and does not extend to the transfer groove lying deeper than the sinking edge. The part which lies between the transfer groove and the termination of the lower edge slope is the part of the sinking edge carrier which creates the necessary distance between the sinker edge and lower edge for the keeping apart of the extended loops of the meshes.

In circular knitting machines with knocking off or connecting plates two plates are guided in a slot and in fact near the knocking off plate, which at the same time serves as cover plate, lies the hook transfer plate.

For the manufacture of these fabrics the extended loops must in most cases during a mesh forming process go over from the transfer plates to the needles and then be released from the transfer plates, whereupon the transfer plates go again above the extended loops and below the thread to be sunk, for the taking up of new extended loops. In order to avoid that these transfer plates (which may be moved against the back of the needle or against the needle breasts) drop or again take up the free loops, or in order to avoid that the loops or a thread to be worked into ordinary meshes become pressed down so deeply by the lower edges of the plate that on going to the latch (with latch needles) they are pressed into the latch joints and are torn or cut by the same, the plates are so formed according to a further characteristic of the invention and means is provided which act in such a manner that for the taking up of new extended loops the plates come higher up in the working position than their own height at which the extended loops are sunk and again released.

The application of the features according to the invention together or singly depends on the binding of such knitted fabrics similar to Milanese or warp knit fabrics to be manufactured.

In the accompanying drawing, various modes of carrying the invention into effect are illustrated.

Figs. 1–5 show various forms of transfer plates.

Figs. 6–10 and 15 show in side elevation the manner of operation of these transfer plates relatively to the needles; and

Fig. 11 is a front elevation for the same purpose.

Fig. 12 is a cross-section through a needle cylinder and transfer plate bed along the section line III—III in Fig. 13 with transfer plates raised to the high position according to the invention for entry into working position in full lines, and in the usual horizontal position for the sinking and release of the extended loops.

Fig. 13 is a section plan of the needles and the transfer plates;

Fig. 14 is a longitudinal section on line IV—IV in Fig. 3, through the transfer plate bed and a locking element, and showing auxiliary lock parts according to the invention which effect the lifting and sinking of the transfer plates;

Fig. 16 is a cross section through the transfer plate bed and needle bed with two plates on each plate guide which are guided in on two different cam tracks and act on the one hand as cover plate and knock off plate and on the other hand as transfer plate;

Fig. 17 is a side view showing the position of the cover plate and knock off plate and transfer plate according to Fig. 16, at the beginning of the sinking process;

Figs. 18–25 show the shape and mode of operation of the plates according to Fig. 16, Figs. 18–21 and 23–25 being side views, whereas Fig. 22 is a plan;

Fig. 26 illustrates a specially-shaped latch needle, particularly suitable for the mode of operation according to the invention.

The mode of operation of a circular knitting machine for the manufacture of fabrics of the kind to which the invention relates is for example such that two groups of needles (N^1 and N^2), in which the needles of one group alternate with those of the other group, respectively form the threads *a* and *b* into long loops 3*a*, 3*b*, and respectively form the threads *b* and *a* into shorter loops or meshes 4 and that transfer plates P^1 and P^2 operate between the needles, see for instance Figs. 11, 13 and 22.

The sequence of operation of the group of needles is, for the most part, in the order that one group of needles N^1 carries out two mesh-forming operations one after the other, and then the other group of needles N^2 carries out two mesh-forming operations one after the other, then again the needle group N^1 and so on.

The examples of the transfer plates illustrated in Figs. 1 to 5 are for circular knitting machines with rib disc R in which the plates are guided in their movement towards and from the needle.

These transfer plates are shaped according to the purpose for which they are used, and by reason thereof it is possible to have faultless manufacture of mesh fabrics such as those shown in the aforesaid British Patent 507,660.

The transfer plates P^1 and P^2 shaped as in Fig. 1 are particularly suitable for the case where the loop 3 is to be transferred to the needles by one transfer plate only. For this purpose transfer plates P^1 and P^2 of two different lengths are provided each of which may be actuated from a cam track (similar to the needles in interlock circular knitting machines) and these are so placed in the knitting machine that at least one short plate P^1 alternates with a long plate P^2.

For carrying out the required mode of operation the transfer plate (Fig. 1) is so shaped that its upper edge at the front is free and comprises the straight part to the sinking point P^a, upwardly inclined steep slope P^e, a higher straight edge P^s (which serves for the keeping of the extended loops apart from the meshes), then there is a steeply sloping downwardly inclined part and again an upwardly-sloping part, thereby providing a deep slot or throat P^b, the bottom of which is lower than the sinking point P^a. The edge P^s lies higher than the sinking point P^a so as to extend the loop 3 on transferring it into the slot P^b. The lower edge P^d at the free end of the transfer plate runs partly straight and parallel to the upper edge P^a and then has a downward slope P^c to the main lower

edge P^k. For the rest, the transfer plates may have the same shape as the stem portions of the needles.

The operation of these transfer plates (Fig. 1) in the knitting process is as follows. The sinking of the longer-than-usual loops 3 (Fig. 6) takes place on the part P^a of the upper edge which is lower than the part P^s of the upper edge on which those loops are held whilst they and the meshes 4 must be kept separate from each other so that the meshes 4 can be brought below the opened needle latch onto the needle shaft and the loops 3 retained on the latch (Fig. 8). For the purpose of efficient separation of these loops, the edge P^s of the transfer plate must be higher from the lower edge P^k than is the sinking point P^a and the transfer throat P^b, in order to have a sufficient space for this process without the sinking of the loop 3 being dependent in its length on the height of the edge P^s.

Above all, if the loop 3 is sunk over only one transfer plate (P^1 or P^2) and consequently is transferred by only one transfer plate, the greater height of the edge P^s for the said separating process is particularly necessary, as in this case the loops 3 extend obliquely upwards in front of the needles to the upper edge part P^s (as shown in Fig. 11) so that only by the greater height of the edge P^s is a favorable loop formation obtained.

The slot P^b located behind the upper edge part P^s serves for transfer of the loops on to the needles and is cut so deep that its deepest point is deeper than the point P^a on which the loops are sunk. In this way one avoids the necessity of the loops having an excess of thread which is appreciably more than the length at which the loop is sunk (Fig. 7).

The sliding over of the loops 3 from the sinking point P^a onto the point P^s and into the transfer slot P^b is facilitated by the part P^e (of the upper edge) sloping backwards obliquely and furthermore in that at that time the needles have already moved upwards a little from their lowest position, whereby the loops 3 no longer lie tightly on the sinking point P^a. After transfer of the loops 3 that is, when the needle with its hook has entered the loop, the transfer plates move only so far back that the edge P^s holds the loop 3 at the required distance from the mesh 4 (Fig. 8). The slot P^b must be so obliquely cut that on the transfer plate moving backwards the loop 3 may slide easily out of the slot P^b onto the edge part P^s.

The notching of the lower edge P^d, P^c at the free end of the transfer plate P serves for the purpose that, on entry of the transfer plates below the thread *a* or *b*, to be sunk between the needles, the transferred loops 3 of the previous row are not pressed downwards and cut upon the closing of the latch (Fig. 9).

The transfer plate shown in Fig. 2 has the forward part or nose directed upwards, with an upper sinking edge P^v and a lower edge P^c, the remainder of the plate being of the same form as the transfer plate shown in Fig. 1. This modified feature, i. e. the upwardly-directed part, has for its object the sinking of the thread on an edge sloping gradually towards the point P^s which is lower than the highest part of the free end, whereby the loops 3 are formed on a point lying lower than the free end, and that free end, as it again enters over the loop transferred onto the needles and between the needles, is at a height greater than the length of the loops. The sinking of the loops may take place in the slot which is formed by the oblique sinking edge P^v and the slope P^e (as in Fig. 2) or on the straight edge P^s of the plate according to how far the transfer plate is moved forward between the needles. Furthermore, it is intended by means of the upwardly-directed part P^v to ensure that the loops, which during a mesh-forming process are held on the transfer plates, shall not inadvertently slip off the plate.

If the loops are sunk, held and transferred over two transfer plates, transfer plates are used without the raised point P^s opposite the sinking point P^a (as shown in Figs. 3 and 4). With the form of plate Fig. 4 the sinking point P^a and the point P^s for the loops after the transfer are the same height. The lowering of the point P^s and the decrease of the distance of the point P^s from the lower edge P^k is determined by the position of the loops 3 over two transfer plates P since, as illustrated the dotted position of the loop 3 in Fig. 11, in spite of the lower position of the loop on the edge P^s there is still sufficient space for keeping the mesh 4 apart from the loop 3. This lowering of the point P^s is necessary as the loops 3 lying over two transfer plates P require more thread than when they only lie over one plate of the same height.

In order also with these transfer plates to make use of the advantage of the part P^v, P^c directed upwards, the sinking point P^v slopes from the point P^s obliquely upwards to the free end (Fig. 3) whereby the free end lies higher than the point P^s whilst with the transfer plates P, Fig. 2, the free end of the part P^v, P^c directed upwards lies at about the same height as the edge P^s.

For the rest, the mode of operation of the transfer plates of Figs. 3 and 4 is the same as previously described for the transfer plate of Fig. 1.

The form of the lower edge of the transfer plates P at their free ends which slope forwards and upwards through the oblique slope P^c and then run parallel to the sinking point P^a to the end or run from the lower edge P^k in an oblique slope P^c to the free end, is also necessary for the purpose of the placing in of a weft thread S. This cutting P^c and P^d or only the oblique part P^c of the lower edge is so maintained that it is caused to lie inwardly under the sinking point P^a so that the height and length of the separating point P^s relative to the lower edge P^k is maintained (Figs. 1–5).

The space thus created makes it possible to place in a weft thread guide S^f so far between the needles N^1, N^2 at the height of the cylinder upper edge (comb height position) and the transfer plate P with its thread exit, that the weft thread S may be brought behind the needles (Fig. 10).

In applying the invention to circular knitting machines with transfer plates which are guided in a ring O outside the needle cylinder C, and moved against the needle breast, two plates are located in a slot, namely, a hook transfer plate 15 and a cover and knocking off plate 16 covering the hooks of the transfer plates 15 (Figs. 16–25).

In accordance with the examples shown in Figs. 16–25 a cover plate 16 is provided next to each hook plate 15. The hook 15*y* itself is only slightly bent so that it can easily be brought out of the loop when the plate is tipped.

The extended loop 3 is sunk on the upper edge 16^u of the cover plate 16 which lies at the same height as the hook plate upper edge 15^u. Thus an increase in the sinking depth of the long loop 3 is obtained in that the hook plates 15 move back on sinking in the same step as the downwardly moving needles (Fig. 19). Thus the long loops are not only sunk vertically but also horizontally in the desired length.

The drawing back of the hook transfer plates 15 from the position according to Fig. 18 into the sinking position according to Fig. 19 and the consequent varying length of the loop 3 are particularly clearly seen by the different successive positions 50—55 of the plates 15 in Fig. 22. These positions may be changed by adjustment of the cam part 30. This cam part 30 is firmly screwed to an angle 32 by a screw 33 passing through a long slot 34 in the angle 32 on the plate ring 31. This to-and-from adjustable cam part 30 acts on the plate butt 15^k of the plate 15 within the limits of the slot 34.

In order that with the transferring of the loop 3 on to the needles no additional harmful supply of thread occurs the hook transfer plates 15 are tipped forwards and downwards with the aid of an auxiliary cam H^2 which acts upwards on the rear lower edge of the transfer plates. The cam parts 37, 38 for the hook transfer plates 15 are correspondingly shaped and sloped for this process

(Figs. 18 to 20). The cam H^2 is fixed at the outer periphery of the plate ring O, the place suitable for the tipping-up movement.

For carrying out this downwards-tipping movement of the transfer plates the plate **15** has a larger slope 15^m of the lower edge of the hook transfer plate **15** which is still guided in the needle cylinder C when the plate is in the normal (untipped) position. If the transfer plates **15** are to be moved to and fro horizontally whilst not tipped then they are held untipped by the rear lower edge of their cam part **37** which acts on the upper edge 15^n of the rear end of the plate, as well as by the lower edge of the cam part **38** acting against the upper edge 15^b (Figs. 19 and 21). If and when the hook transfer plates **15** are tipped up by the cam H^2 then the cam parts **37** and **38** are correspondingly cut away above the plate and the surface of the cam acting on the lug 15^k and also the upper edge 15^b are sloped (Fig. 20). The tipping up movement may also take place by the action of other means and on another part of the hook plate **15** than the rear end.

When, during the working operation the object of the tipping up is fulfilled, which consists in the fact that the loop is brought to its lowest possible position over the intermediate needle hooks and the transfer plate hooks 15^y tipped out of the loop **3**, then the plate is again brought horizontal by the under surface of the cam part **37** which again runs downwards in a slope, so that the plate may be brought from the cover position to the take up position in order to take up new thread. The tipping back into the horizontal position takes place as Fig. 21 shows, after the plate has run off the cam H^2, and where the lower edge of the cam part **37** acts on the upper edge 15^n of the transfer plate **15** to depress it.

The plates **16** have the function of covering the hooks and knocking off the meshes from the needles as usual and are operated by the cam parts **40** and **41**. (Figs. 18–21).

The covering of the hook 15^y of the hook plate **15** by the cover nose 16^a of the cover plate may take place by the placing of the cover nose 16^a horizontally next to the hook 15^y of the hook plate, and by a common movement of the parts **15—16** in this position relatively to the needles (Fig. 21). Preferably the loop **3** may also be brought out of the hook 15^y in that the hook plate **15** is, from its transfer position according to Fig. 20 (which also at the same time is the knocking off position of the cover plate and the knock off plate **16**) tipped so far downwards (Fig. 23) that the hook 15^a swings out of the loop **3** lying on the edge 16^v, or in that the hook 15^y is covered by the part of the cover plate which the sloping upper edge 16^w locates between the transfer plate 16^v and the sinking edge 16^u (Fig. 25). The slope 16^u may be so deep that the deep upper edge part 16^v of the cover plate **16** still lies below the usual sinking edge 16^v for the usual meshes.

In most cases it is not necessary to adapt the part 16^a covering the hook according to Fig. 21 to the height of the hook. The cover nose 16^a has however at the same time the function of a separating part between the meshes **4** and the loop **3** (Fig. 21) in the same manner as the part between the lower edge P^k and the point P^s of the transfer plates P. Consequently the height of the part 16^a must still correspond to the position of the loops whether they hang on one pair of plates **15** and **16** or on two pairs of plates **15** and **16**, in such a way that the certain keeping apart from the meshes 4/5 below the opened latch and the loop still on the latch is guaranteed. After this position the plates **15** and **16** go jointly out of the needleplate and loops and then into the position of Figs. 17, 18.

With this method of moving out the plates **15** and **16** a transferring of the loops onto a point which lies nearest the usual sinking point K is obtained.

Fig. 26 shows a latch needle with a latch bent out at the joint as known but particularly suitable for the mode of operation according to the invention as thereby the catching or tearing of the loops **3** transferred onto the needles is avoided upon subsequent closing of the latch.

In all cases before the transferring of the loops **3** a short up and down movement of the needles for the opening of the latches must be carried out.

According to a further feature of the invention the transfer plates for the re-entry between the needles are so moved or shaped that they enter with their free end higher above the loops **3** transferred onto the needles in the same mesh-forming process than the height at which the loops **3** have been formed on the transfer plates.

In this manner and with transfer plates which are moved against the backs of the needles or against the breast of the needle into the row of needles in the working position, one avoids that these plates stick or take up again the free loops **3** or that the loops **3** or a thread *g* (Fig. 12) to be worked into usual meshes placed below the transfer plate are pressed so deeply by the under edges of the plate that these on going to the latches (with latch needles) are pressed into the latch joints and are torn or cut by them.

According to the invention the transfer plates and their movement are such that, means is provided which obviate this disadvantage in that the plates enter by upward tipping of the part acting forwards, higher into the working position for the taking up of a new loop **3** between the needles than their height at which the loops **3** are sunk on same and again released by same.

The tipping or swinging of the plates P according to the invention and also of the knocking off plates or cover plates **16** must occur at the time at which the plates are moved from their out-of-action position (drawn back position) at A, Fig. 13 plan view and Figs. 12, 16 side view, to their foremost position for the loops sinking Figs. 9 and 17, between the needles N below the thread or threads *a* and *b* as well as above the loop **3***a* and **3***b*, which makes the tipping of the transfer plates upwards necessary as shown in Fig. 12, as also does the position of a thread *g* to be worked into needle meshes and plate meshes of usual length which obviate the sticking or taking up again of the loop shown dotted. The cam parts S^1 and S^2 affect the forward and backward movement of the plates. The tipping of the plates *p* at the places A—B is obtained by means of a special curved part H. With machines with plate movement against the back of the needle this curved part H is fixed at the rear cam part S^2 and such that its curve projects on the lower edge of the cam part (Fig. 12) and presses on the upper edge of the plate ends behind the butts and raises the transfer plates at the front (Fig. 12) from the dotted to the drawn out position and in fact until the plates have reached the position B.

If the groups of transfer plates P^1 and P^2 are necessary then a further curved part H^1 is located for the long transfer plates P^2 at the lower edge of their rear cam part (Fig. 12 curved part H^1 shown dotted).

The extent of the rise is determined by the height of the curve H, H^1 outside the cam part S^2. The transfer plates P^1 and P^2 have, in order to facilitate the tipping up, behind the plate butt beginning at the lower edge of the plate, a lower edge P^x running obliquely upwards.

This working process may be effected also without tipping movement of the transfer plates P, by the shape of the transfer plate (Fig. 2) by the fact that the part P^v, P^c the free end of which is higher than the sinking point for the length of the loop **3** (Figs. 2 and 3).

In machines with plate movement against the needle breast (Fig. 16) a curved part H^3 for the tipping of the cover plate **16** is fixed at the plate ring O and in fact at its forward edge adjacent the cylinder C. As with this embodiment two plates, a cover plate and knock-off plate **16** as well as a transfer plate **15** are available, only the knock off plate **16** is tipped which is shorter than the

other and is guided in the front plate cam path V. The curved part H^3 acts on the front lower edge 16^x which runs straight and consequently lies lower than the lower edge 15^m of the transfer plate **15** which for the purpose of downward tipping is sloped upwards. Therefore the cover plate **16** can be lifted sufficiently upward without the curve H^3 acting on the lower edge 15^m (Fig. 16). The striking irons E (Figs. 12, 14, 16) serve in known manner for keeping downwards the plates P and **16** on their whole path in the direction D at the front, that is before the plate butt. During the tipping movement the striking iron has a concave curve K which is so dimensioned relatively to the curve of the tipping cam H or H^3 that the plates are not hindered in their tipping movements and, after termination of the tipping movement are returned to their low position (Fig. 14). In order that no jamming of the plates occurs the curve K is somewhat longer than the tipping curve, as shown in Fig. 14 by the two dotted connecting lines for the curve beginnings and endings.

The surface S^y may advantageously be correspondingly sloped and likewise the lower surfaces of the cam part where the tipping movement takes place and the plate butt is thus made sloping.

The lower edge 16^y of the knocking off throat of the plate **16** (Figs. 16 and 17) which tips up alone and also goes a little earlier than the transfer plate **15** with its part *16a* between the needles into the position B, is sloped downwards to the front so that on tipping the fabrics located on the needles and at the same time also the loops **3** are not raised (Fig. 16) since by such a raising of the fabric and loop the plates **16** as well as the plates **15** could enter the loop **3**.

For carrying out the process whereby the loops **3** are transferred onto the needles at lower point than the point at which the same are sunk on the transfer plates it is intended according to the invention that the tipping or swinging movement of the transfer plates be used during the sinking of the thread. With this manner of operation transfer plates P according to Fig. 5 may be used without a deeper lying transfer throat P^b for the sinking point P^a. These transfer plates have a transfer throat P^o which lies at the same height therefore on a straight line with the sinking point P^a and the point P^s. In addition the transfer plates P have the shape of the transfer plates according to Figs. 1, 2, 3, 4. With both kinds of knitting machine according to Figs. 12, 14 and 16, 17 the higher placing of the sinking point relative to the transfer point is brought about in that the tipping movement of the transfer plates P and knocking off plates **16** is carried beyond the termination of the sinking process of the needles N. For this it is only necessary to lengthen correspondingly the tipping cam curves H, H^1 and H^3 similarly as shown in Figs. 13 and 14 by broken lines. Fig. 12 and also Fig. 16 show how the needles N go in the sinking direction upwards with the thread *a*, *b* to be sunk in the hook and the beginning of the tipping movement of the plates P and **16**. Figs. 15 and 17 show further the placing of the thread *a*, *b* on the sinking point P^s of the plates P and the point 16^u of the plates **16** (shown in broken lines) these plates having been displaced upwards by tipping.

This plate position is maintained to the end of the sinking process according to Fig. 6 whereupon the plates are again moved into their horizontal position according to Figs. 7 and 20 by means of the striking iron E so that the transferring position of the loops **3** is at a point lower than and nearer to the normal sinking point K.

As the curve H^3 for the knocking off plates **16** may be arranged so as to be adjustable for the desired loop length it is indispensible that a longer sinking of loops **3** takes place with the transfer plates **15** with the needles N oblique to the sinking direction according to Fig. 19.

The characteristics according to the invention may be used singly as well as jointly in circular knitting machines.

I claim:

1. A circular knitting machine having needles and sinkers, cam means for operating the needles, and further cam means for operating the sinkers both for sinking and for transferring operations, each sinker having a loop drawing edge at a lower level and a holding out edge at a higher level and means whereby loops held out on said holding out edge are transferred from a point which is nearer to said drawing level than to said holding out level.

2. A circular knitting machine according to claim 1 wherein each sinker comprises a transfer plate having a loop drawing edge at one level, having a loop holding edge at a higher level, and having a transferring groove or throat lower than both said levels.

3. A circular knitting machine according to claim 1 having means for tilting the sinkers of selected loops during drawing and lowering them before transferring, so that the loop drawing edge is at a higher level during the drawing than during the transferring operations, said cam means controlling the transfer plates so as to hold out those selected loops during knitting of the course in which they were drawn.

4. A circular knitting machine comprising a needle cylinder, latch needles therein and cam means for reciprocating the needles, a sinker guide plate, sinkers in such guide plates and cam means for reciprocating the sinkers, each sinker having a lower edge for loop drawing purposes, a higher edge for holding selected loops on the needle latches during transfer and a transfer throat which is lower than both said edges, said cam means for the sinkers being shaped so as to advance the sinkers to a first position for drawing and then to a second position for transferring.

5. The machine of claim 1, wherein each sinker comprises a transfer plate and having cam means whereby the plates enter their free end between the needles in a position for the taking up of new loops which is higher than the usual position of the plates in which those loops are transferred.

6. The machine of claim 1, wherein each sinker comprises a transfer plate and having cam means whereby selected transfer plates are tipped upwards during the downward movement of the corresponding needles during drawing of the loops which are to be held and, after the drawing, are again lowered for the transfer of the drawn loops.

7. The machine of claim 1, wherein each sinker comprises a transfer plate which is provided behind the loop drawing edge with a transfer throat lying deeper than said loop drawing edge.

8. The machine of claim 1, wherein each sinker comprises a transfer plate the front lower edge of which is sloped upwards so that the free end of such transfer plate is narrower than the portion immediately behind it.

9. The machine of claim 1, wherein each sinker comprises a transfer plate the front lower edge of which is sloped upwards so that the free end of the transfer plate is narrower than immediately behind it, and in which behind the said slope of the transfer plate at the front lower edge is a transfer throat lying deeper than the loop drawing edge.

10. The machine of claim 1, wherein each sinker comprises a transfer plate the front lower edge of which is sloped upwards in which behind the said slope of the transfer plate at the front lower edge is a transfer throat lying deeper than the loop drawing edge, and in which the part of the transfer plate which lies between the said transfer throat and the beginning of the said lower edge slope, has a height sufficient to keep any loops thereon, on the needle latches, away from the normal loops passing below the latches.

11. The machine of claim 1, wherein each sinker comprises a transfer plate the front lower edge of which is sloped upwards, and in which the loop drawing edge also runs obliquely upwards towards the free end.

12. A circular knitting machine having a needle cylinder and needles therein, a sinker guide plate with guide slots, a hook transfer plate and a knock-off and cover plate in each said guide slot, sinkers in said guide slots of the sinker plate, means for tilting the sinkers of selected loops during drawing and lowering them before transferring, and having cam means for tilting selected transfer plates during the transferring operation so that the loops are transfered at a lower level than that over which they are drawn.

13. A circular knitting machine having a needle cylinder and needles therein, a sinker guide plate with guide slots therein, a hook transfer plate and a knock-off and cover plate in each said guide slot and having cam means for tilting the transfer plates during the transferring operation so that the loops are transferred at a lower level than that over which they are drawn, and in which the knock-off and cover plate has a loop drawing edge at a higher level and a transferring edge at a lower level and cam means whereby the hook transfer plate is tipped farther downwards beyond the transfer position until the hook thereof is covered by the part of the adjacent cover plate between the said two edges.

14. The machine of claim 1, wherein each sinker comprises a transfer plate and in which the transfer plates have butts, cam means engaging those butts to move the plates to and fro horizontally and further cam means

which behind the butts presses downwards on to the plates and swings the front ends of the plates upwards, further cams being provided for the plates, which return the plates into their lower position for loop drawing and transferring of the loops.

15. The machine of claim 12, in which cam means is provided to tilt the cover plate and knock-off plate upwardly and further cams are provided which bring those plates again into their lower position for the transfer of the loops.

16. The machine of claim 12, in which the cover plate and knock-off plate inclines downwardly and rearwardly at the lower front edge.

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