Feb. 17, 1948. J. J. McDONOUGH 2,436,318

CIRCULAR KNITTING MACHINE

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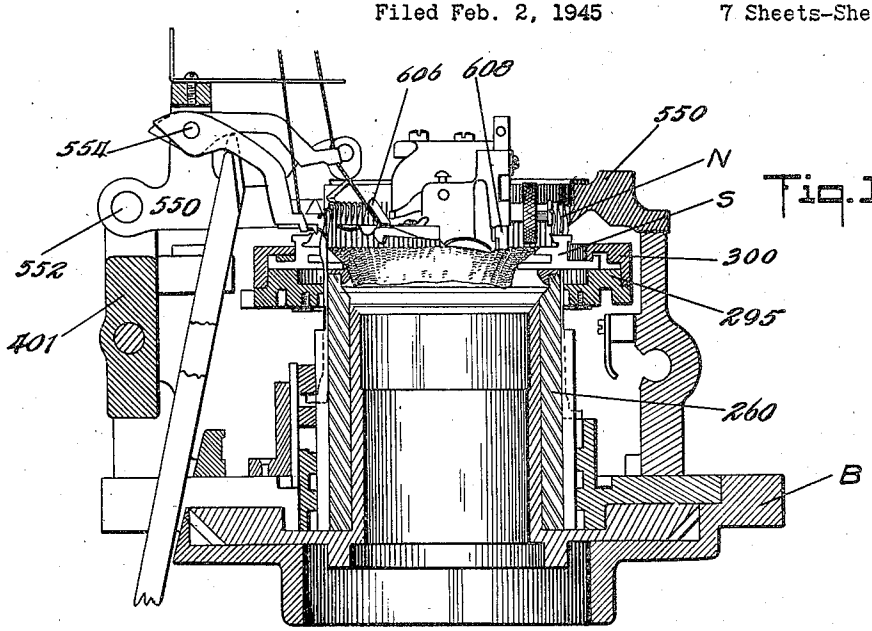


Fig. 1.

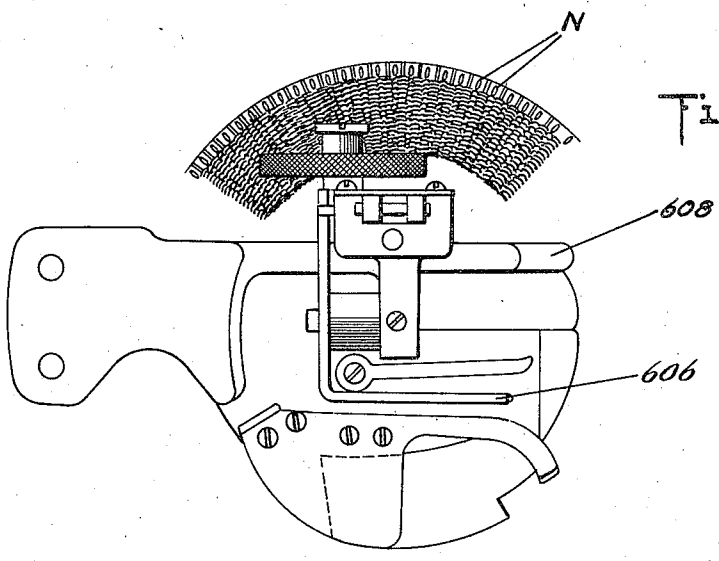


Fig. 2.

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CIRCULAR KNITTING MACHINE

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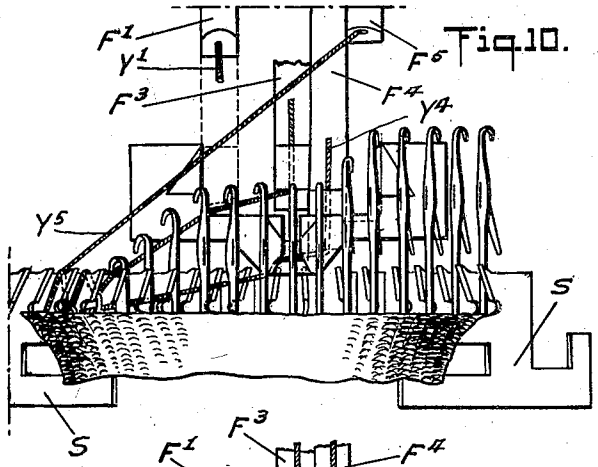


Fig. 10.

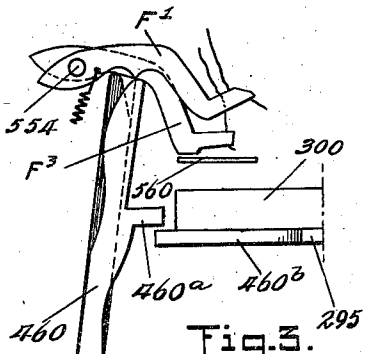


Fig. 3.

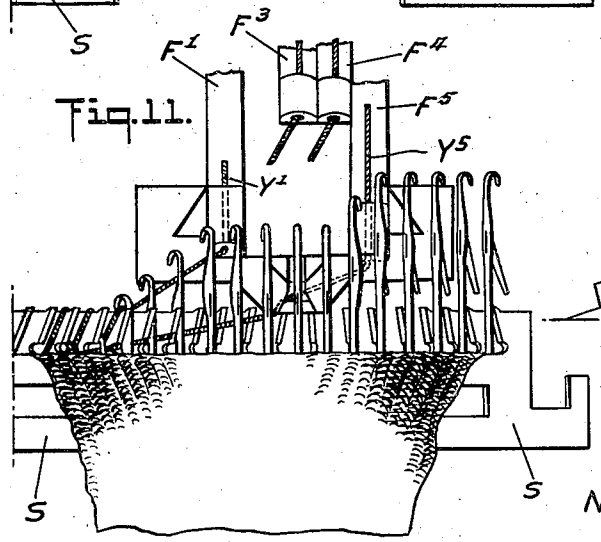


Fig. 11.

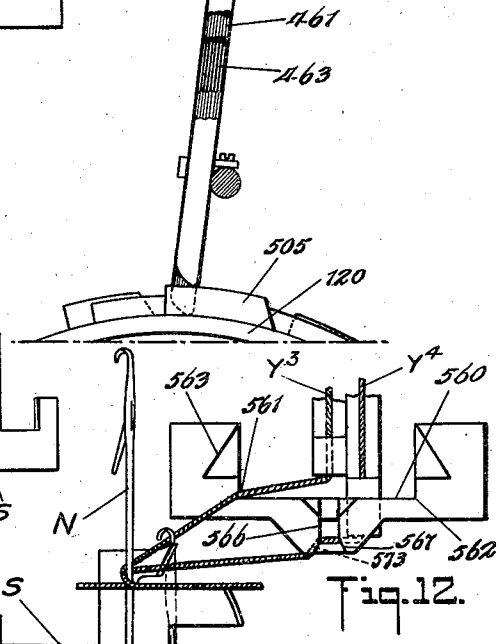


Fig. 12.

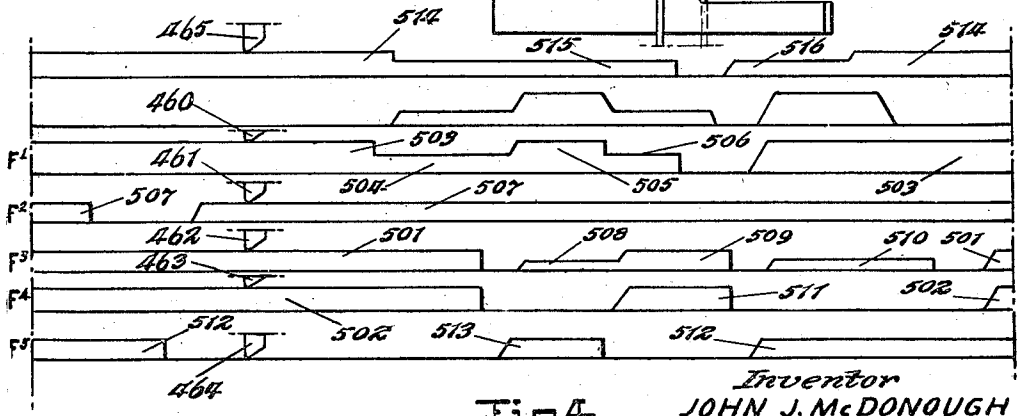


Fig. 4.

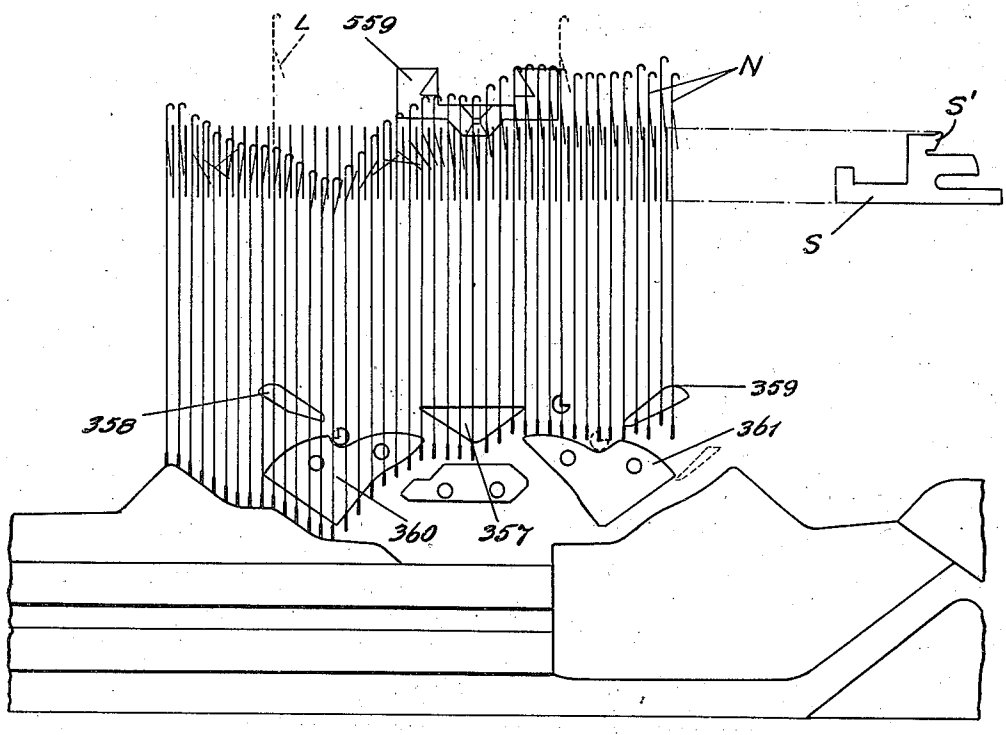
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CIRCULAR KNITTING MACHINE

Filed Feb. 2, 1945 7 Sheets-Sheet 3

Fig. 5.



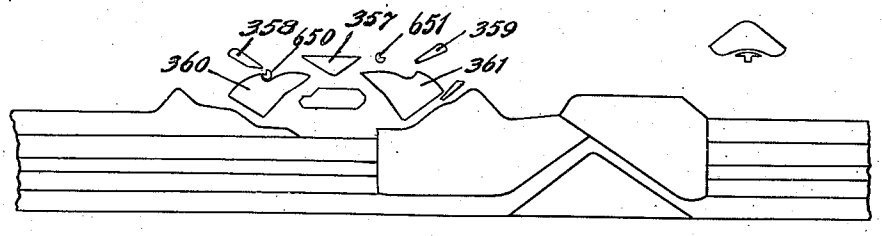


Fig. 6.

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CIRCULAR KNITTING MACHINE

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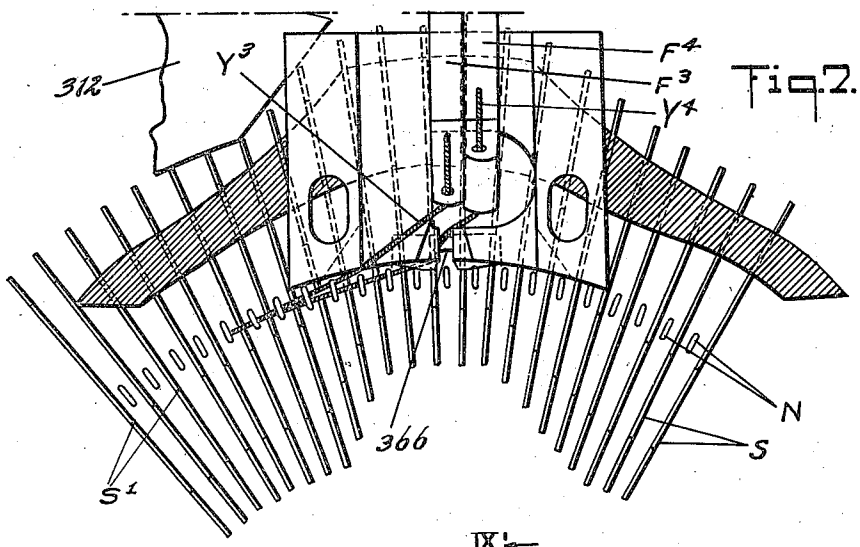


Fig. 2.

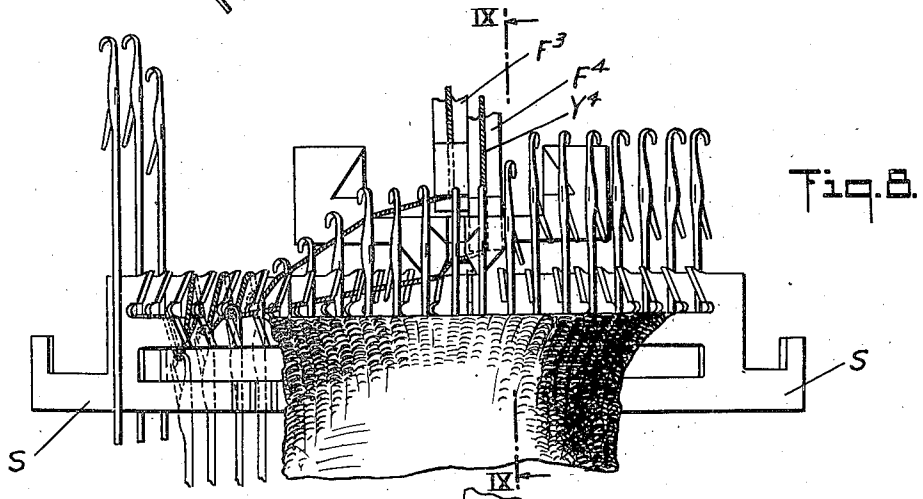


Fig. 8.

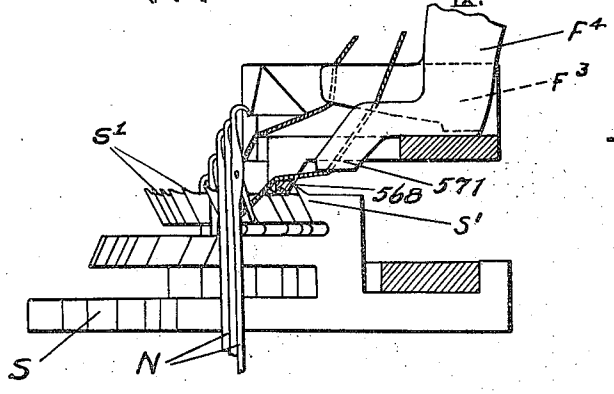


Fig. 9.

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CIRCULAR KNITTING MACHINE

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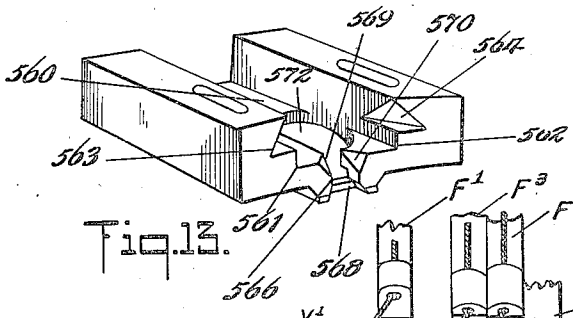


Fig. 13.

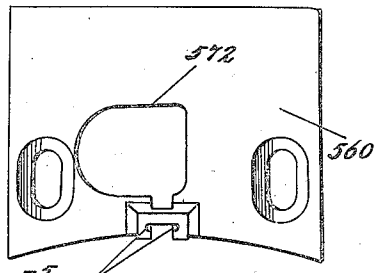


Fig. 14.

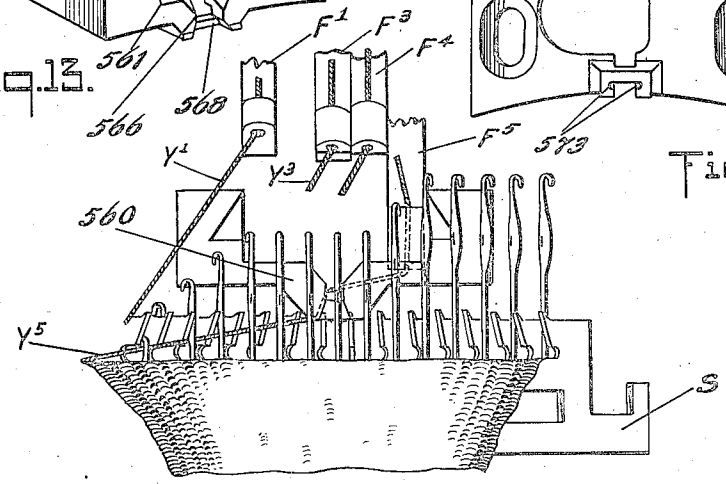


Fig. 19.

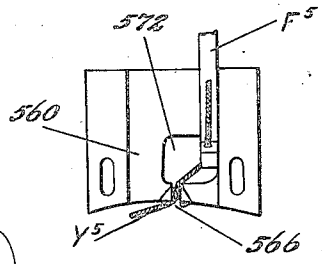


Fig. 20.

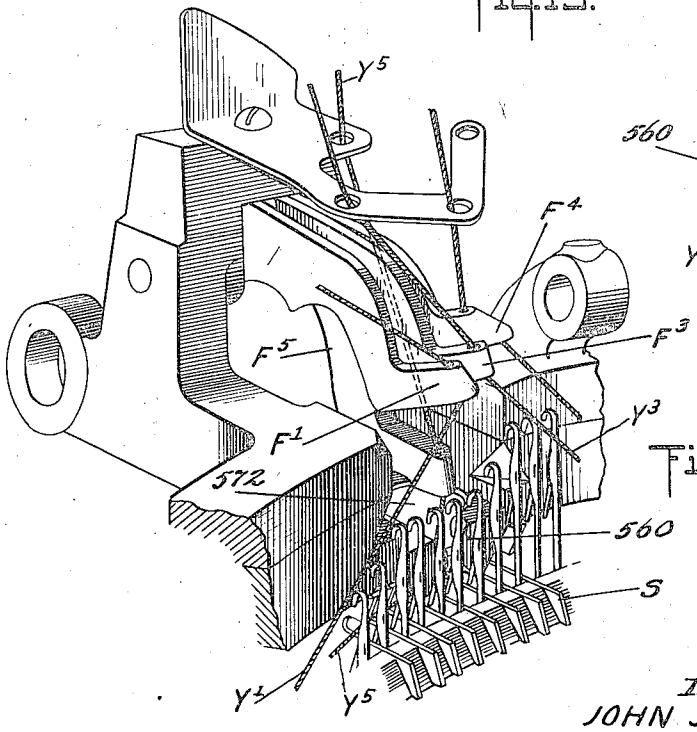


Fig. 21.

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CIRCULAR KNITTING MACHINE

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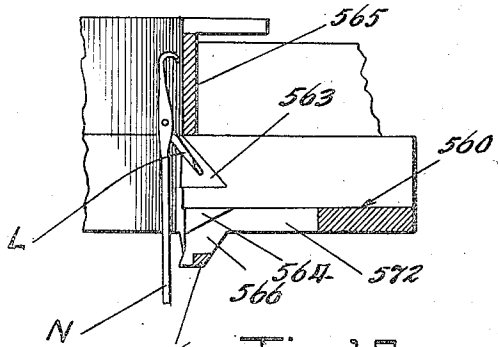
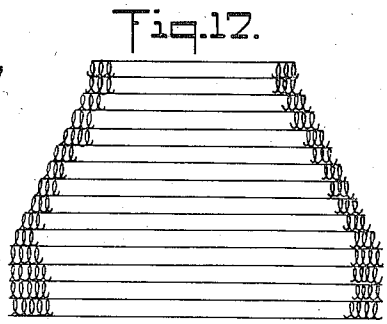


Fig. 15.

Fig. 17.



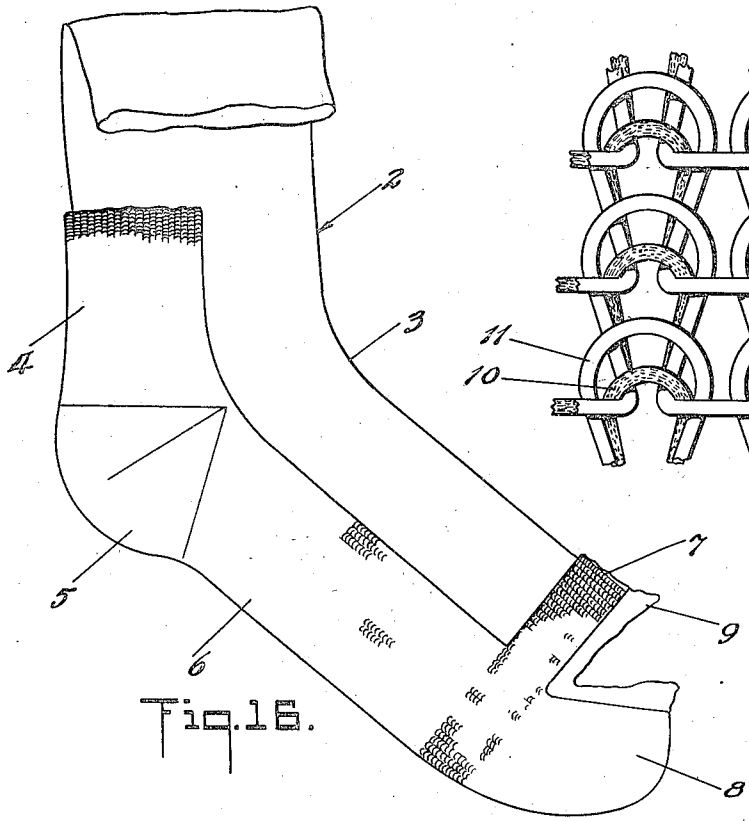


Fig. 16.

Fig. 18.

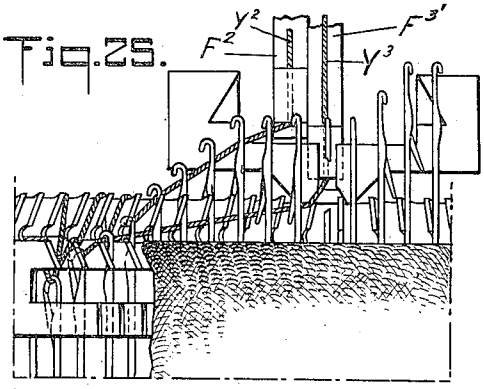
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CIRCULAR KNITTING MACHINE

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Fig. 25.



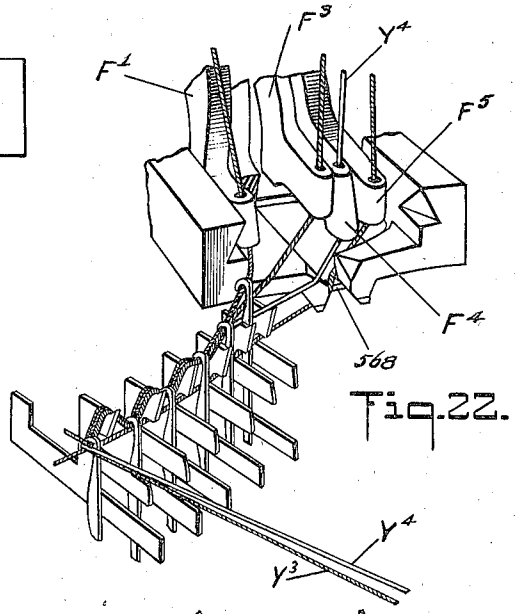
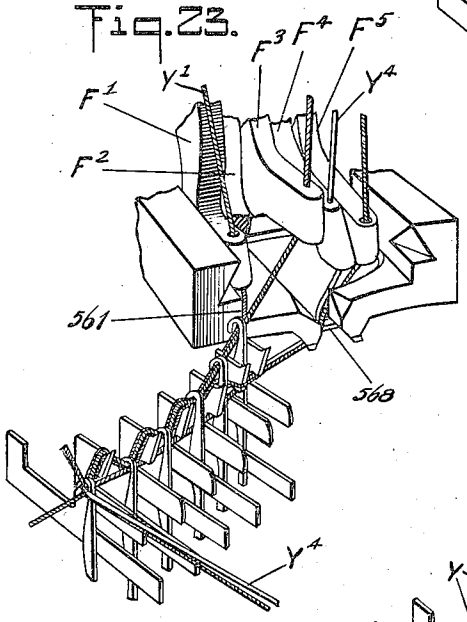


Fig. 22.

Fig. 23.



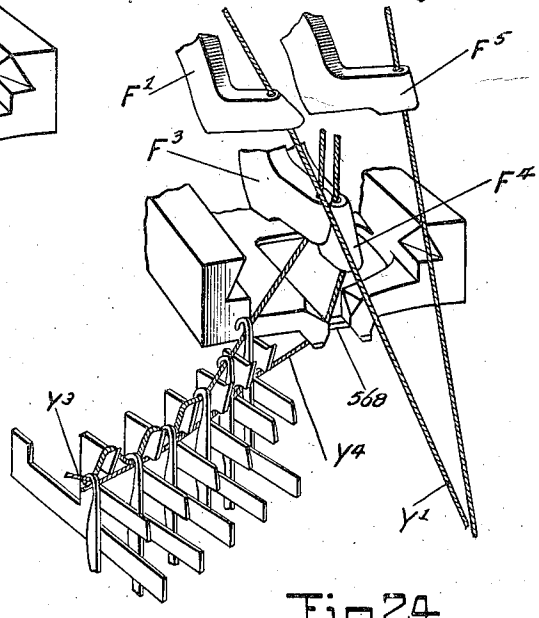


Fig. 24.

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Patented Feb. 17, 1948 2,436,318

UNITED STATES PATENT OFFICE

2,436,318

CIRCULAR KNITTING MACHINE

John J. McDonough, Belmont, N. H., assignor to Scott & Williams, Incorporated, Laconia, N. H., a corporation of Massachusetts

Application February 2, 1945, Serial No. 575,796

19 Claims. (Cl. 66—93)

1

This invention relates to independent needle circular knitting machines and more particularly to means for presenting yarns to the needles or sinkers at two levels. In independent needle circular knitting machines it is frequently desirable to feed yarns from two levels separated as far as possible, this being particularly so when making special stitches, such, for example, as plating or terry stitches. It is especially difficult to get this separation when the machine is knitting reciprocatorily, as in the case of the making of seamless heels and toes, berets, etc., and to do this without interfering with freedom of yarn change. When it is proposed to knit stitches requiring abnormally early insertion of sinkers, it is especially difficult to maintain this separation.

One object of the present invention is to produce an improved method of feeding the yarns when knitting reciprocatorily and making special stitches such as plating or terry stitches. Another object is to construct a machine in which it is possible to change yarns at any point in the stocking without stopping the making of the special stitches such as terry stitches, whether the machine is knitting in a rotary or a reciprocatory manner.

It is characteristic of the present invention that the machine has a throat plate with two feeding levels, each effective for both rotary and reciprocatory knitting, and that the machine is capable of making entire courses of terry loops during reciprocatory knitting. Another feature of the machine is that yarns from one or more fingers can be presented selectively at either level merely by varying the elevation at which the yarn finger presents the yarn to the throat plate. While the invention will be shown and described in a rotary needle cylinder machine intended to make seamless hosiery with terry cloth reinforcements, it should be understood that the invention is also useful in other types of circular machines for the making of other fabrics or articles.

In the drawings:

Figure 1 is a vertical view in section through the head of a rotary needle cylinder independent needle hosiery knitting machine made in accordance with my invention;

Figure 2 is a plan view of the yarn cutting and clamping means of Figure 1;

Figure 3 is a view in side elevation of some of the yarn fingers of Fig. 1, the thrust bars controlling them and the pattern drum cams for the bars;

Figure 4 is a developed view of the pattern drum cams of Figure 3;

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Figure 5 is a developed view of the needles and actuating cams near the throat plate while the machine is making rotary knitting, the needles moving from right to left in this figure;

Figure 6 is a similar developed view, on a smaller scale, of the cams and picks which actuate the needles;

Figure 7 is a plan view of the throat plate and some of the needles, sinkers and sinker operating cams of the machine of Figure 1, taken while the sinkers and needles are moving from right to left as viewed in the present figure;

Figure 8 is a view in elevation of part of the circle of needles and sinkers showing a portion of fabric and looking at the throat plate from the center of the machine;

Figure 9 is a view in vertical section through the throat plate, taken on the line IX—IX of Fig. 8;

Figure 10 is a view similar to Figure 8, with the third and fourth yarn fingers in action just after the fifth yarn finger has been raised out of action, this situation occurring as the knitting of the heel commences;

Figure 11 is a view similar to Figure 10, showing the first and fifth yarn fingers in action, this situation occurring during the knitting of the foot of the stocking after the heel has been knit;

Figure 12 is a diagrammatic view of a throat plate and a sinker, showing the neb of the sinker entering between the terry and backing yarns;

Figure 13 is a perspective view of a throat plate made in accordance with my invention and as shown in various figures of these drawings;

Figure 14 is a bottom plan view of the throat plate of Figure 13;

Figure 15 is a fragmentary view in vertical section through the throat plate and gap closing ring, showing the relation of the throat plate to the opened latch of an idle needle;

Figure 16 is a view of a stocking with terry cloth reinforcements knit on a machine constructed in accordance with my invention;

Figure 17 is a diagram illustrating the progressive increase in the number of wales in a terry cloth reinforced heel or toe segment made on a machine according to my invention;

Figure 18 is a diagram illustrating the loops in a fabric having plain loops of a body yarn and terry loops of a terry yarn;

Figure 19 is a view similar to Figure 8, showing the fifth yarn finger in action during the knitting of the leg or instep of the stocking of Figure 16;

Figure 20 is a plan view of the throat plate, active yarn and finger of Figure 19;

Figure 21 is a view in perspective of the throat plate, yarn fingers and some of the needles and sinkers of the machine of Figure 1, the parts being shown while knitting the sole and instep of the stocking, with the first yarn finger shown out of action on the instep side of the needle cylinder and therefore in correspondence with the positions of the parts in Figure 19;

Figures 22, 23 and 24 are fragmentary views of the throat plate, yarn fingers and some of the needles and sinkers of the machine of Figure 1, showing the knitting transition from high splice to heel; Figure 22 showing the third and fourth yarn fingers just after they have come down into action, the yarn from the fourth finger not having had time to get down to the lower feeding level; Figure 23 being similar to Figure 22 and showing the position of the finger and yarns after the backing yarn from the fourth finger has worked down to the lower level; and Figure 24 showing the first and fifth fingers out of action and the third and fourth fingers feeding the terry and backing yarns respectively for the knitting of the heel of the stocking; while

Figure 25 is a view similar to Figure 8, showing a modification in which the third yarn finger feeds to the lower level and the second yarn finger feeds to the upper level.

A typical fabric capable of being produced by the machine shown in the drawings is seen in Fig. 16, where a seamless stocking is shown diagrammatically, having the usual top and leg 2, instep 3; and also high splice 4, heel 5, sole 6, ring toe 7 and toe 8, all five containing terry loops and loopers rounds 9. While, of course, the machine can be adjusted to omit the terry loops from any one of these parts as desired, it should be understood—and I have attempted to illustrate in Fig. 17—that the machine is capable of knitting full courses of terry loops by reciprocatory knitting. The showing of the loops at the edges of the tapered segment in this figure is intended to show that the terry loops are found in the stitches at the end of the segment as well as in between. To further illustrate what is meant by terry loops, I have shown diagrammatically in Fig. 18 the interlacement of a body yarn 10 and terry yarn 11, the body yarn 10 forming the ordinary body fabric of tight stitches on which the long loops of terry yarn 11 are formed.

The machine shown has a revolving needle cylinder 260 mounted in bedplate B, the needle cylinder containing a circle of independent needles N. Mounted in the sinker ring 295 are sinkers S, the radial movements of the sinkers into and out of operative relation with the needles, yarns and fabric being occasioned by sinker cams in the sinker cap 300. The sinker cams are controlled from the main pattern drum 120 (Figs. 3 and 4) by a thrust bar 465, as usual. The yarns are fed from a series of yarn fingers F^1, F^2, F^3, etc., which are pivotally mounted at 554 on the latch ring 550, which in turn is pivoted at the point 552 on a latch ring post 401 on the bedplate B. The movements of the yarn fingers into and out of operative position are caused by thrust bars 460, 461, 462, etc., the vertical movements of these thrust bars being controlled from drum cams 501, 502, 503, etc. on the main pattern drum 120, all in the usual manner.

The yarns going from the yarn fingers are presented to the needles and sinkers by means of a throat plate 559, as is common in circular

knitting machines of the type above referred to, but one of the principal features of the present invention is the construction of this throat plate. The needles N move vertically to knit by means of cams around the needle cylinder 260 which act on the butts of the needles. These cams have a novel construction which forms another feature of the present invention.

It is, of course, very desirable to be able to change yarns at will for different parts of the stocking and to cut and clamp the withdrawn yarns inside the needle circle in the customary manner. Cutting and clamping of yarns in this position are shown, for example, in the Swinglehurst Patent No. 1,292,917, of January 28, 1919. The knitting machine shown in the drawings of the present application cuts and clamps yarns in the interior of the needle circle and is so arranged that the yarns may be withdrawn at the completion of one stocking, the fabric cast off and a new stocking commenced on the bare needles. The manner in which the loops are formed in the machine shown in the drawings can be seen, for example, in Figs. 10 to 12, where the body yarn Y^4 or Y^5 is fed to the needles at such an elevation as to come underneath the top of the neb of the sinker and be guided into the throat of the sinker, while the terry yarn Y^3 or Y^1 comes to the needle at such an elevation that this yarn is laid on top of the neb and when finally cast off it will therefore be much longer than the stitch knit of the body yarn. To obtain this separation of the yarns by means of the sinker, the sinker is inserted abnormally early, in the well-known manner.

In Figs. 5 and 6 I have shown the needles N passing through the usual knitting wave from right to left. The butts of the needles are shown going from right to left, riding over the top of the leading stitch cam 361, underneath the top center cam 357 and drawn down to the knocking-over point by passing under the following stitch cam 360. My novel throat plate 559 is shown in Figs. 13 and 14. It has a throat 560 which consists of the usual wide depression and, except when the yarns are otherwise controlled by the novel construction of my throat plate, the yarns tend to feed from the corners 561, 562 of this depression or floor, according to whether the knitting is proceeding toward the left or toward the right, as the parts are viewed in Fig. 12. The two elevated needles shown dotted in Fig. 5 are at the so-called "idle" level where they are not knitting, and are shown in this figure for comparison with the sinkers and throat plate. It will be noted from the latches L of the dotted needles in idle position in Fig. 5 and from the latch of the needle in Fig. 15, that if by any chance the latch of an idle needle should be swung outwardly by centrifugal force, it would be in line with the side of the depression in the throat plate and might be damaged by contact with the throat plate or the gap closer ring 565. For this reason I have provided bevels 563, 564 in the side walls of the depression just above the corners 561, 562 which will guide the latch back to vertical position clear of the throat plate.

Turning now to the novel parts of the throat plate which enable it to present yarns at two different levels, attention is called to the vertical notch 566 in the inner end of the throat. This notch extends from the top or upper side of the throat 560 to the bottom thereof and is adapted and shaped so as to receive and guide yarns to a lower feeding level than that of the

floor of the throat plate. This lower level is determined by the level of the bottom of the notch **566** so that it can be said yarns are fed both from the top and bottom sides of the throat of the plate. The lower feeding level represented by the bottom side of the throat should be compared in elevation with the level of the sinkers, and for this purpose attention is called to Figs. 5, 10, 11, 12 and 19. It will be noted that while yarns feeding from the top of the throat plate leave the throat plate at a level higher than the tops of the nebs of the sinkers, any yarns being fed from the bottom side of the throat plate (i. e., the lower feeding level) are being fed below the tops of the nebs S' of the sinkers. With the type of sinkers shown in the drawings, this lower feeding level can be at any elevation which will present the yarn at some point between the point of the neb of the sinker and the bottom of the throat (i. e., the knocking-over ledge). I find it preferable to have the yarns leave the throat plate at an elevation slightly above the knocking-over ledge. With other types of sinkers the elevation can be adjusted in accordance with the requirements of the machine, provided the lower feeding level is sufficiently low as to present the yarn below the top of the neb and so that, having reference to the shape of the neb, the yarn will be guided into the throat.

The exact shape of the surfaces of the upper and lower feeding levels and the opening between them are shown most clearly in Figs. 12, 13, 14, 19 and 20. The bottom of the notch **566** is flared outwardly, forming bevels **567**. The space between these two bevels **567** is so short that there is little likelihood of needle latches flying upwardly into the recess. However, if the latches do swing outwardly, the bevels and a small web **568** (described below) force the needles back out of the space. These bevels are also grooved vertically at **573** to insure proper feeding of the yarns going to the lower feeding level. The grooves serve to prevent the yarn from hopping out of the notch **566** when the direction of knitting is changed. The metal forming this lower feeding level is an extension of the main portion of the throat plate. There is only a small web **568** across the back of the notch, as can be seen for example in Figs. 7, 9 and 13. This web need not necessarily extend to the bottom face, but its upper surface should be below the bottom side of the main portion of the floor. This web guides the yarns.

There is one other kind of bevel found in the throat plate which cooperates to give the necessary results, this being the bevels designated in the drawings as **569**, **570** (Fig. 13). These two bevels are located on opposite sides of the upper end of the notch **566** and each extends laterally part way toward the adjacent corner of the floor. In the drawings each such bevel has been shown as extending a little less than half way from the notch to the adjacent corner. These bevels function to lead a yarn downwardly to the lower feeding level when the proper yarn finger is moved down to its operative position. These bevels also tend to completely close an almost closed latch of a passing needle, thereby preventing damage to said latch.

The variety of yarn feeding combinations which can be obtained from the construction so far described can be further increased by using a plurality of feeding levels for specific yarn fingers, but I shall first describe the basic combination of the throat plate with a plurality of yarn fingers, assuming that they each have a single active position. In the machine shown in the drawings there are five yarn fingers which, reading from left to right in the views taken from the center of the machine (such, for example, as Figs. 7, 8, 10, 11, 19, 21, 22, 23 and 24), are marked with the reference characters F^1, F^2, F^3, F^4 and F^5 and which respectively feed yarns Y^1, Y^2, Y^3, Y^4 and Y^5. In the machine shown, the yarn fingers all feed yarn to the throat plate, and the yarn fingers F^1 and F^2 are located to the left of the bevel **569** and feed from the upper side of the floor of the throat plate and, generally speaking, from the left-hand corner **561** of the throat plate. The two right-hand yarn fingers F^4 and F^5 are adapted to feed from the lower level, i. e., the bottom of the throat, through the notch **566**. It will be seen that the yarns Y^1 and Y^2 are terry yarns if the terry sinker cam is inserting the sinkers early enough to separate the yarn Y^1 or the yarn Y^2 from the other yarns, while Y^4 and Y^5 are body yarns. In Figs. 1 to 14 and 19 to 24, the yarn finger F^3 is shown feeding yarn from the left-hand corner **561** of the throat plate to act as a terry yarn, but in Fig. 25 a finger in this position is shown feeding yarn from the lower level to act as a body yarn.

To illustrate how a body yarn gets down to the lower feeding level automatically merely by insertion of a yarn finger, attention is called to Figs. 22 and 23. In Fig. 22 the yarn finger F^4 has been lowered to its normal operative position and the yarn coming from the clamp **606** (Fig. 2) has been grasped by the first five or six needles. As they pull on the yarn it bears against the left-hand bevel **569** at the upper end of the notch **566** and slides down that bevel into the vertical or central portion of the notch, and thence, by means of the lower flare or bevel at the left bottom of the notch, gets into the groove and feeds from the underside of the throat. However, if no body yarn is knitting at the time that this yarn Y^4 is first introduced by the yarn finger F^4, continued revolution of the needle cylinder and sinkers past the throat plate at first will draw both the yarn F^4 and whatever terry yarn is being used into long loops without forming any regular terry loops. (In order to have a terry loop there must be a body stitch present.) If a yarn is thus momentarily placed on top of the sinker, it will automatically be forced down to the lower or body yarn feeding level by the onformation of the throat plate within the first half dozen sinkers. The same is true of yarns coming from finger F^5 in the construction shown in the drawings, but it will be obvious that any yarn fingers which present yarns to the left of the bevel **569** will not be thus forced down to the lower or body yarn feeding level. It will be understood, of course, that yarns fed by fingers F^1 and F^2 will not make terry loops unless the terry sinker cam **312** is in action. The formation of terry loops can be stopped by withdrawing the terry sinker cam or by lowering the terry yarn to the lower feeding level as described hereinafter, for example, in connection with the modification of Fig. 25.

The yarn Y^3 of the finger in the F^3 position is made to feed from the terry level merely by a change in elevation of the feeding end of the finger. However, when this is to be done a finger $F^{3'}$ (Fig. 25) shaped like F^4 is used in place of a finger shaped like F^3. Thus by using a low cam on the main pattern drum, the feeding end

of the yarn finger can be left slightly elevated above the floor of the throat and out of contact with the upper side of the floor (see Figs. 7 to 10 and 22 to 24). In this case, when the yarn is taken by the first few needles the needles pass the throat plate with their hooks above the upper face of the floor. The yarn will be swept to the left beyond the bevel 569 before it contacts the throat plate, and therefore the yarn will not be dragged down to the lower feeding level. If it is desired to feed body yarn from the finger in the F^3 position, then the finger is moved further down as shown in Fig. 25. It will be noted that the yarn from this finger is released at approximately the same low level as the yarn from the finger F^4 in Figs. 8 and 9. It will be obvious that the finger $F^{3'}$ in Fig. 25 could be left elevated so as to release its yarn at the same level as the finger F^3 in Fig. 8 if a terry yarn were desired. In this way, by using two heights of drum cams for finger F^3, the body yarn in that finger can be used at will for either a terry or body yarn, a finger $F^{3'}$ (Fig. 25) shaped like the finger F^4 having replaced finger F^3 of Figs. 8 and 9.

As shown in Fig. 9, I have found it useful to use for finger F^3 a common type of feeding end in which the hole from which the yarn comes out of the end of the finger to go to the throat plate is a very small fraction of an inch above the upper face of the floor. With regard to the finger F^4, however, I have found it useful to give the end of the finger a downward bend so that when the finger is resting on the floor, the nose 571 will be lower or, as shown in Fig. 9, below the lower face of the main part of the floor. However, this feeding end must be above the upper face of the web which lies across the back of the notch 566. To enable this finger and the fingers F^3 and F^5 to feed their yarns to the notch 566 from levels below the upper side of the throat, the floor of the throat plate is cut away to form an opening 572, as can be seen most clearly in Fig. 20. Since, as shown in Figs. 9 and 20, the noses of the fingers F^4 and F^5 do not extend radially inward toward the center of the machine as far as the inner end of the throat plate, this opening does not interfere with the forming of the bevel 570 which assists in guiding yarns from F^5, for example, into the notch. The conformation of throat plate described cooperates with the yarn fingers to permit ready removal of a yarn from either the upper or lower feeding level when a yarn is taken out of action. As can be seen from inspection of Figs. 1 and 3, the pivot point of the yarn fingers being considerably above the noses of the fingers when in their operative position, the raising of the yarn finger causes the nose of the yarn finger to move radially inward and thus carry the yarns out of the notch going from the lower feeding level and away from the throat. The bevels and web 568 prevent the yarn from catching.

I will next describe the means for raising and lowering the yarn fingers into and out of action to produce the stocking of Fig. 16. As usual in machines of this general type, each yarn finger is pivoted at the back end at a point 554 well above the throat plate (Fig. 3), and is swung up and down by a thrust bar whose upper end underlies the finger at a point radially inward of the pivot point of the finger. These thrust bars are raised as required by drum cams on the main pattern drum 120, the particular cams for operating the fingers to produce the stocking of Fig. 16 being shown in Fig. 4. It will be noted in Fig. 16 that for the high splice and sole it is necessary to have partial courses of terry loops during round-and-round knitting and to remove the yarn entirely while knitting the instep side of those courses or portions of the stocking. For this purpose the well-known device such as shown in the Robert W. Scott Patent 1,238,052, dated August 21, 1917, and illustrated in part in Fig. 3, can be used. This consists of means for raising or lowering the yarn finger F^1 every half revolution of the needle cylinder. This, in connection with a separation of the needles into two segments or groups by taking advantage of the differential in needle butt lengths, gives exact commencement and finish of the terry loops in each course. The thrust bar 460 for the yarn finger F^1 has a tension spring (not shown) connected with it which tends to keep it in its lowermost position and radially toward the center of the needle cylinder. There is a lug 460^a projecting laterally from the thrust bar at a point opposite the sinker dial, and there is a horizontal cam 460^b fastened to and revolving with the sinker dial. This cam 460^b pushing against the lug 460^a forces the upper end of the thrust bar 460 radially outward once every revolution of the needle cylinder. When thus forced outwardly, the tapered upper end of the thrust bar pushes against a downwardly-facing point on the underside of the yarn finger, thereby raising the yarn finger and holding it upwardly until the thrust bar is able to be pulled back radially inward by its spring as the cam 460^b passes beyond the lug 460^a.

It will be observed that by the construction of throat plate just described, the body yarn is fed low on the latches of the needles and a wide separation is provided between the body and terry yarns. As before mentioned, this wide separation of yarns can be taken advantage of when knitting fabrics other than terry loop fabrics.

This placing of the body yarn low on the needles must be maintained even on the first needle of the active group during reciprocatory knitting, and if the reciprocatory knitting involves a progressively widened or narrowed segment in which the leading needle is picked up to an inactive level, an additional difficulty is found. Referring to Figs. 5 and 6, attention is called to the usual lifting picks 650, 651 which serve to raise the leading active needle to inactive level during reciprocatory knitting, each pick operating on reciprocation in one direction only. The function of this pick is to catch the butt of the leading active needle just as the needle rises over the leading stitch cam, which at that moment is acting as a clearing cam, and raise it to a level where heretofore it could ride on, and be raised by, the customary rounded top of the top center cam 357. (See the Robert W. Scott Patent 1,148,055.) I have found that this last part of the raising of the leading active needle caused by the top center cam 357, i. e., the completion of the raising of the needle, causes the loop on the shank of the needle to be raised so high due to friction that on the first oscillation of the machine in the same direction after the needle was raised, the body yarn coming from the stitch on the needle will be so high that it will place the bight of yarn above the point of the neb S' of the sinker, and a slack stitch from the body yarn will result. I therefore construct my top center cam 357 with a flat top no higher than the level to which the butt of the needle is

raised by the pick (Fig. 5) and therefore this top center cam 357 does not raise the needle at all. I complete the raising of the needle to its final idle level by the use of an auxiliary top center cam, there being one provided for each direction of knitting. These auxiliary top center cams 358, 359 are located at such points on the circumference of the needle circle that the sinkers opposite them have been inserted subsequent to their withdrawal at the knitting point. As a result, when an auxiliary top center cam raises a needle, the stitch or stitches on that needle are held down in the throat of the sinker.

As already mentioned, in a machine made in accordance with this invention it is possible to knit stockings starting up from the bare needles and casting off the stocking after the end of the loopers rounds at the toe. This can be done in a manner similar to that shown in the Robert W. Scott Patent 1,148,055. In accordance with the machine shown in Figs. 1 to 4 and 19 to 24 of the present drawings and in the said Scott patent, the cycle of operations of the machine is complete in one revolution of the main pattern drum 120 and the cycle will now be described beginning at the completion of the so-called loopers rounds 9 of the stocking.

After the loopers rounds the yarn fingers F^3, F^4 are elevated by the main pattern drum cams 501 and 502 which raise the corresponding thrust bars 462, 463. As these thrust bars raise their yarn fingers, the continued rotation of the needle cylinder 260 causes the yarns Y^3, Y^4 to be engaged in the main yarn clamp 606 and severed by the main yarn cutter 608, shown in Fig. 2. The withdrawal of the yarns and the continued rotation of the cylinder causes the last drawn loops of the loopers rounds 9 to be cast off the needles, whereupon the completed stocking falls into a suitable container beneath the machine. When the main pattern drum 120 is again advanced, the knitting of the next stocking commences, it being possible, if desired, to knit a few rounds at the top of the stocking with the yarn Y^2 in the second yarn finger F^2. This occurs when the thrust bar 461 drops off the drum cam 507. At all other times the finger is held out of action by this drum cam. When the main portion of the leg is reached, the yarn Y^5 from the finger F^5 at the right of the throat plate can be used. As explained above, the yarn Y^5 goes down through the novel opening in the floor of the throat plate to the lower feeding level and consequently gets into the throats of all the sinkers and is knit as a body yarn in all the needles. The position of the yarn finger at this time is shown in Figs. 19 and 20. As the high splice 4 is reached the terry yarn Y^1 is brought to the needles by the yarn finger F^1 moving to its lower or feeding position. The downward movement of this finger is caused by its thrust bar 460 dropping off the drum cam 503 on which it has rested since the beginning of the toe, the thrust bar 460 dropping down onto a lower drum cam surface 504 which brings the lug 460^a on the thrust bar 460 opposite the cam 460^b on the sinker dial. This causes the raising and lowering of the yarn finger out of and into action to give partial courses of terry loops for the high splice, as previously described (see Fig. 21). At the end of the high splice a high drum cam 505 comes under the thrust bar 460 and the finger F^1 is held out of action during the heel (Fig. 3).

Another low cam 506 is used during the making of the foot to give terry loops on the sole. During the ring toe when the terry stitches are desired all the way around the stocking, the thrust bar 460, for the only time in its cycle of operations, drops down onto the surface of the main pattern drum 120, there being no cam under this thrust bar at this point. Drum cam 503 raises the yarn finger out of action as the toe is commenced.

The yarn finger F^3 which contains the terry yarn for the heel and toe is held out of action by a high drum cam 501 during the making of the stocking until the heel is reached. When the heel is commenced the thrust bar 462 for this yarn finger drops off the drum cam 501 momentarily onto the surface of the pattern drum in order to insure the yarn change, then rides up onto a low cam 508 which leaves the yarn feeding in terry position over the corner of the throat plate during the heel. At the completion of the heel, the thrust bar 462 rides up onto a high cam 509 which holds the yarn finger F^3 out of action during the making of the foot. When the toe is reached the thrust bar momentarily drops off the cam 509 down onto the main pattern drum, for the same purpose as at the beginning of the heel, and then is raised immediately to a low cam 510 which holds the finger slightly raised in terry position until the completion of the toe. The thrust bar 462 drops off the cam 510, after which the terry sinker cam may be withdrawn, but this is unnecessary if a finger $F^{3'}$ (Fig. 25) is substituted for finger F^3 of Figs. 8 and 9 and if the finger $F^{3'}$ is lowered in the loopers rounds. The thrust bar rises up onto the high cam 501 and remains out of action through the commencement of the stocking and leg, as already described.

The yarn finger F^4 which carries the body yarn for the heel and toe is held out of action during the commencement of the stocking and the leg by a high cam 502 underlying the thrust bar 463. Similarly to the case of the yarn finger F^3, when the high splice has been completed and the heel is reached, the thrust bar for the yarn finger F^4 drops off its high drum cam down onto the surface of the main pattern drum 120 and the body yarn is fed in this manner for the entire heel. During the making of the foot the yarn finger F^4 is held out of action by a high drum cam 511 acting in the same manner as the cam 509 for the finger F^3, after which the thrust bar for the yarn finger F^4 rests on the surface of the main pattern drum and remains there during the making of the entire toe and the loopers rounds. After the loopers rounds are made the thrust bar rides up onto the high drum cam 502 which holds the finger out of action during the commencement of the next stocking and during the making of the leg, as in the case of the cam 501 and the yarn finger F^3. The yarn finger F^5 which carries the body yarn for the leg and foot is held up out of action by a high drum cam 512 until the body yarn for the ring top coming from yarn finger F^2 has made the ring top, when the thrust bar 464 drops off the drum cam 512 and the yarn finger F^5 comes into action in time to overlap with the yarn from finger F^2. This finger F^5 remains in action throughout the making of the leg and the high splice, being taken out of action by a drum cam 513, when the yarn finger F^4 is dropped into action at the beginning of the heel. At the end of the heel the thrust bar 464 for the yarn finger F^5 drops off the drum cam 513 in overlapping action with the yarn finger F^4 which is going out of action at the beginning of the foot, and the yarn finger F^5 stays

in action during the making of the foot and the ring toe in timed overlapping relation with the yarn finger F^4. The yarn finger F^5 is raised out of action at the commencement of the toe by a drum cam 512 just as the yarn finger F^4 is dropped into action and this drum cam keeps the yarn finger F^5 out of action during the making of the toe and the loopers rounds. This cam holds the finger out of action until after the completion of the ring top of the next stocking, as just described.

Turning now to the drum cams which control the terry sinker can 312 (Fig. 7), there is a high drum cam 514 which holds the thrust bar 465 up out of action so that the terry sinker cam is not inserted (Fig. 4). This high cam extends around the portion of the main pattern drum corresponding to the press-off at the completion of the stocking and the beginning of the stocking down as far as the high splice. During the high splice, heel and sole, a low cam 515 determines the position of the cam controlling the sinkers at terrying position, and for making terry loops all around the stocking during the ring toe the thrust bar 465 for the terry sinker cam drops off this low cam 515 down onto the surface of the main pattern drum. After the ring toe and during the making of the toe, the thrust bar rests on a low cam 516, riding back up onto the high cam 514 prior to the making of the loopers rounds.

As already mentioned, one of the advantages of the novel machine which I have invented is its ability to change yarns during reciprocatory knitting when terry loops are being made, without interrupting the making of such terry loops. This feature is of value, for example, when making a stocking having "tip" heels and toes. In this case the cams on the main pattern drum which control the thrust bars for the yarn fingers are changed so that the yarn fingers are manipulated as follows.

The yarn finger F^5 containing the body yarn for the leg and foot, instead of being taken out of action at the beginning of the heel, will remain out of action until that portion of the heel is reached where it is desired to insert the special colored tipping yarn. At this point the yarn finger F^5 is replaced by the heel and toe body yarn finger F^4 and the change back is made when the tipping yarn in finger F^4 is to be taken out of action. As far as concerns the terry yarns, the main terry yarn finger F^1 is replaced at the beginning of the heel by the yarn finger F^2 which was used during the ring top at the beginning of the stocking, and this yarn finger F^2 in turn is replaced by the yarn finger F^3 when the tipping begins. The yarn in finger F^3 therefore will be a tipping yarn. It will be observed that no adjustments of the machine are necessary to make these changes, other than selecting a proper yarn finger.

In the construction shown in Fig. 25 the finger F^2 is used for a terry yarn and the finger $F^{3'}$ is serving as a body yarn finger. It will be seen that the finger $F^{3'}$ can serve as a body yarn finger at one point in the stocking and as a terry yarn finger at another. It will be understood, of course, that when it is desired to accomplish this result, a finger $F^{3'}$ shaped like F^4 is substituted for the finger F^3. In this case there will be three heights of drum cams. The surface of the pattern drum would be used for the body yarn feeding position. This arrangement can be availed of to stop the formation of terry loops without withdrawing the terry sinker cam.

It will be obvious that it is also proper to call the notch 566 a second throat which makes it possible to feed a yarn underneath the neb of the sinker from the bottom of the notch, i. e., the guiding edge, and that the sinkers do not have to be withdrawn in order to do this. It will be further noted that the yarns going to the lower level are kept at the center of the main throat plate.

The advantages of my novel machine in any situation where wide separation of knitting levels of yarns is desired, are believed to be obvious. From the description given above, many uses other than the specific illustrations described, which do not depart from the scope of my invention, will be obvious to those skilled in the art.

What I claim is:

1. A circular knitting machine having independent needles and sinkers and pivoted yarn fingers, in combination with a throat plate under the yarn fingers, said throat plate having a throat with an open notch in the end face thereof whereby feeding of yarns to the needles and sinkers occurs when yarn fingers are moved into operative position both under the end face of the throat by passing through the notch and across the inner edge of the throat, according to whether or not the yarns catch in the notch.

2. A circular knitting machine having independent needles and sinkers and pivoted yarn fingers, in combination with a throat plate under the fingers, said throat plate having a throat with an open notch in the end face thereof and being adapted to receive and feed yarns to the needles and sinkers both across the top of the throat and underneath the end face of the throat through the notch during both directions of knitting.

3. A circular knitting machine having independent needles and sinkers and pivoted yarn fingers, in combination with a throat plate under said fingers for the feeding of yarns to the needles and sinkers, said throat plate having a throat with an open notch in the end thereof, yarns presented over the end face of the throat being fed to the sinkers over the nebs of the sinkers, and yarn laid in the notch by a yarn finger being led to a lower level and fed underneath the end face of the throat and below the tops of the nebs of the sinkers regardless of knitting direction.

4. In a circular knitting machine, a throat plate for the feeding of yarns to the sinkers and needles of the machine, said plate having a throat with an open notch in the end face thereof, yarns fed over the end face of said throat being presented to the sinkers over the tops of the nebs thereof and yarns fed under the end face of the throat through the notch being presented below the tops of the nebs of the sinkers, said latter yarns being capable of being fed during knitting in either direction of movement of the sinkers and needles.

5. A circular knitting machine having independent needles and sinkers and pivoted yarn fingers, in combination with a plate under said fingers provided with a throat having an end face, yarns fed above said end face being presented to the sinkers above the tops of the nebs of the sinkers, and said end face having a notch, whereby yarns laid in the notch by a yarn finger will be led underneath the throat and fed to the needles and sinkers at a level below the tops of the nebs of the sinkers regardless of knitting direction.

6. A circular knitting machine having independent needles and sinkers and pivoted yarn fingers, in combination with a throat plate for the feeding of yarns to the needles and sinkers at different levels, said throat plate having a notch in the end face thereof with the sides thereof bevelled at the top, whereby when the yarn from a yarn finger moved into operative position engages the bevel, the yarn will be guided into the notch and will be fed under the end face at the lower feeding level.

7. A throat plate for a circular knitting machine adapted for the feeding of yarns to the needles and sinkers of the machine, said plate having a throat with a notch in the end face thereof, said notch being adapted for the feeding of yarns to the needles and sinkers at a level underneath the end face, and the sides of said notch being recessed at the bottom to retain the yarn during reciprocatory knitting.

8. A throat plate for a circular knitting machine adapted for the feeding of yarns to the needles and sinkers of the machine, said plate having a throat with a notch in the end face thereof adapted for the feeding of yarns to the needles and sinkers under the throat, the lower edges of said notch being flared outwardly on both sides so as to prevent damage to the latches of any active needles which fly out.

9. A circular knitting machine having pivoted yarn fingers, independent needles and sinkers, in combination with a throat plate adapted for the feeding of yarns from the fingers to the needles and sinkers at either of two levels, said plate having a throat for the feeding of yarns at the upper level and a notch in the throat extending through the bottom thereof, the lower end of said notch acting as the lower feeding level and the notch being undercut vertically to keep the yarns in proper feeding position.

10. A circular knitting machine having independent needles and sinkers and pivoted yarn fingers, in combination with a throat plate for the feeding of yarns to the needles and sinkers, said plate having a throat provided with a corner at each side of the end face and adapted to feed yarn to the sinkers and needles, said plate having a notch intermediate the corners in the end face thereof, said notch extending through to the bottom side of the throat and being adapted for the feeding of yarns to the needles and sinkers at a lower feeding level than the corners, and an opening in the throat below one or more yarn fingers connecting with the notch and adapted to permit such yarn fingers to present yarn to the notch below the level of the throat.

11. A circular knitting machine having independent needles and sinkers and pivoted yarn fingers, in combination with a throat plate for the feeding of yarns to the needles and sinkers, said plate having a throat provided at each side with a corner and having a notch intermediate said corners in the end face of the throat and extending through to the bottom thereof to form a lower feeding level for yarns, one of said yarn fingers being located above said notch, said yarn finger being adapted to present yarns to the needles and sinkers over a corner when feeding from a position elevated above the end face, said finger being adapted to position the yarn to be drawn through into the notch and to the lower feeding level when the finger is in its lowermost feeding position.

12. A circular knitting machine having independent needles and sinkers and pivoted yarn fingers, in combination with a throat plate for the feeding of yarns to the needles and sinkers, said plate having a throat provided at each side with a corner adapted to guide yarn to the sinkers and needles, said plate having a notch intermediate to corners in the end face thereof, said notch extending through to the underside of the end face for the feeding of yarns to the needles and sinkers at a lower feeding level than the corners, an opening in the throat below one or more yarn fingers and connecting with the notch, said opening being adapted to permit such yarn fingers to present yarn to the notch below the level of the throat, and a web across the back of the notch helping to keep a yarn in the notch while the yarn finger is down.

13. A circular knitting machine having independent needles and sinkers, in combination with a throat plate adapted for the feeding of yarns to the needles and sinkers at either of two levels, said plate having a throat adapted for the feeding of yarns for the making of terry cloth stitches at a level above the nebs of the sinkers and having a notch in the throat of the plate, said notch extending through the bottom of said plate and adapted for the feeding of a body yarn below the tops of the nebs of the sinkers.

14. A circular knitting machine having independent needles and sinkers and pivoted yarn fingers, in combination with a throat plate adapted for the feeding of yarns to the needles and sinkers at either of two levels when the yarn fingers are lowered into action or for the withdrawal of said yarns when the yarn fingers are raised, said plate having a throat provided at each side with a corner, said corners forming the upper feeding level, there being a notch intermediate said corners in the end face of the throat and extending through to the bottom of said end face, the bottom of said notch comprising the lower feeding level, said notch being bevelled at its upper end in such a manner that when a yarn finger is lowered and its yarn is fed in contact with a bevel it will be drawn down into the notch and fed from underneath the throat.

15. A circular knitting machine having a throat plate adapted for the feeding of yarns to the needles and sinkers at either of two levels when yarn fingers are lowered into action or the withdrawal of said yarns when the yarn fingers are raised, in combination with independent needles and sinkers and yarn fingers pivoted at a point higher than the plate, said plate having a throat provided at each side with a corner, said throat comprising the upper feeding level, and having a notch intermediate said corners in the end face of the throat, said notch extending through the bottom of said end face and the bottom of the notch comprising the lower feeding level, said notch being so shaped that when a finger whose yarn is feeding in the notch is elevated, the continued rotation of the needle cylinder will guide the yarn out of the notch.

16. A circular knitting machine adapted to make terry cloth, having pivoted yarn fingers and independent needles and sinkers, in combination with a throat plate having a throat adapted to feed yarns from the corners thereof at levels above the nebs of the sinkers for the making of terry yarn stitches during reciprocatory knitting, said throat having means adapted for the feeding to the sinkers below the tops of the nebs of the sinkers any yarn laid therein by a yarn finger regardless of the knitting direction, and to per-

mit the removal of the yarn by raising the finger, whereby the terry and body yarns can be changed for other yarns after a reciprocatory heel or toe pocket is partially knit.

17. A circular knitting machine having independent needles and sinkers and pivoted yarn fingers, in combination with a throat plate having a throat under the yarn fingers, and a second throat in the end face of the first throat and having a guiding edge well below the first throat adapted to feed a yarn regardless of knitting direction, whereby yarns may be fed with wide vertical separation with the lower yarn fed under the neb of the sinker.

18. A circular knitting machine having independent needles and sinkers and pivoted yarn fingers, in combination with a throat plate for the feeding of yarns to the needles and sinkers at different levels, said throat plate having a notch in the end face thereof, the lower end of the notch being adapted to feed under the end face of the throat plate at a level below the tops of the nebs of the sinkers a yarn from a finger moved into operative position regardless of knitting direction, whereby the necessity of withdrawing sinkers in order to place a yarn under their nebs is avoided.

19. A circular knitting machine having independent needles and sinkers, a throat plate for the feeding of yarn to the needles and sinkers, said plate having a throat with a notch in the end face thereof, yarns fed over the end face of said throat being presented to the needles at a lower level, in combination with a yarn finger adapted to present yarn for feeding at either level, substantially as described.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,143,630	Nebel	Jan. 10, 1939
2,173,783	Holmes	Sept. 19, 1939
2,361,280	Fregeolle	Oct. 24, 1944
2,366,124	Page	Dec. 26, 1944
2,375,683	Page	May 8, 1945
2,376,050	Green	May 15, 1945
2,426,357	Killian	Aug. 26, 1947

FOREIGN PATENTS

Number	Country	Date
672,875	Germany	Mar. 13, 1939