May 3, 1938. R. H. LAWSON ET AL 2,115,929

KNITTING MACHINE AND METHOD OF KNITTING

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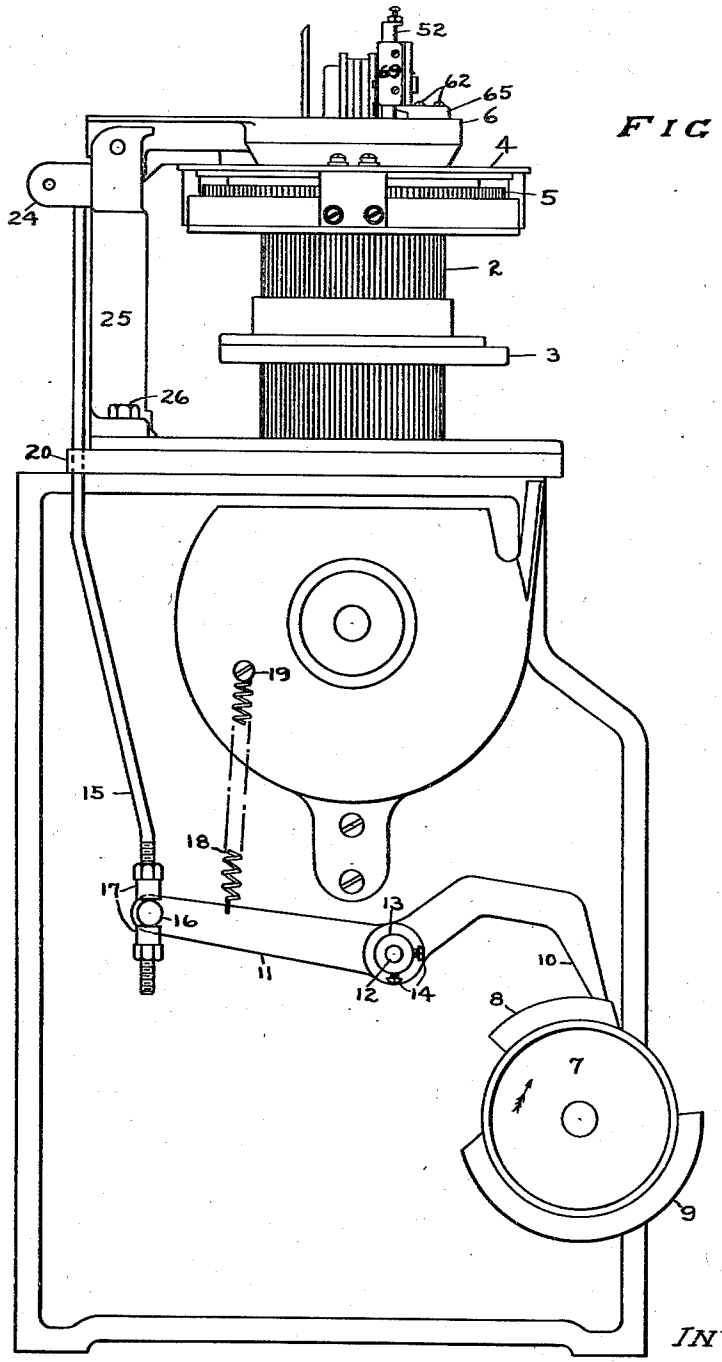


FIG. 1.

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KNITTING MACHINE AND METHOD OF KNITTING

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FIG. 2.

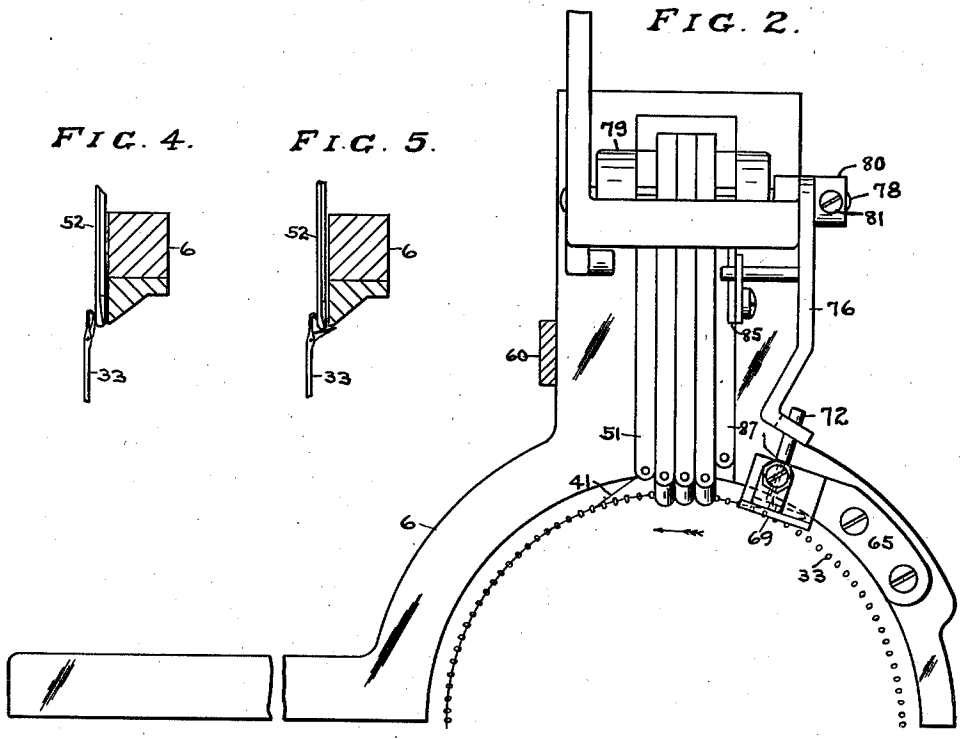


FIG. 4.

FIG. 5.

FIG. 6. FIG. 7.

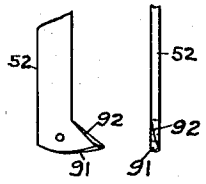


FIG. 3.

FIG. 3a.

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FIG. 8.

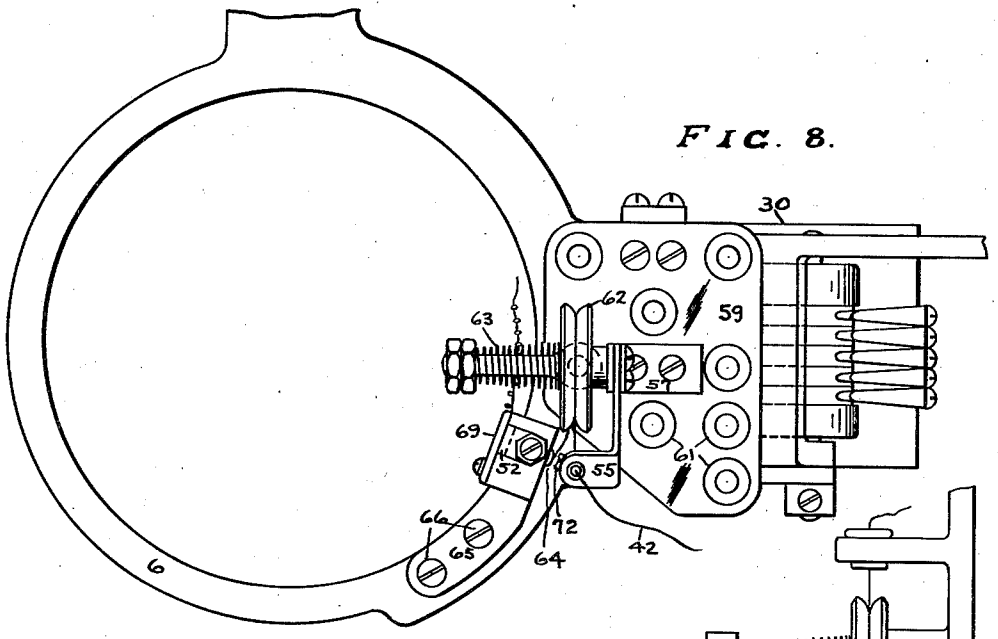


FIG. 9.

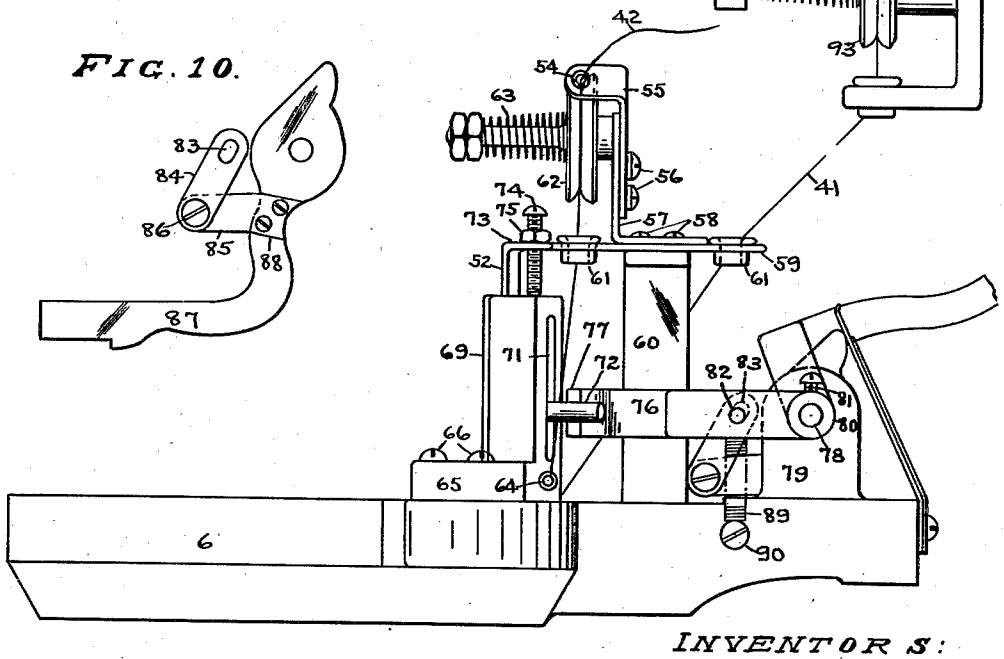


FIG. 10.

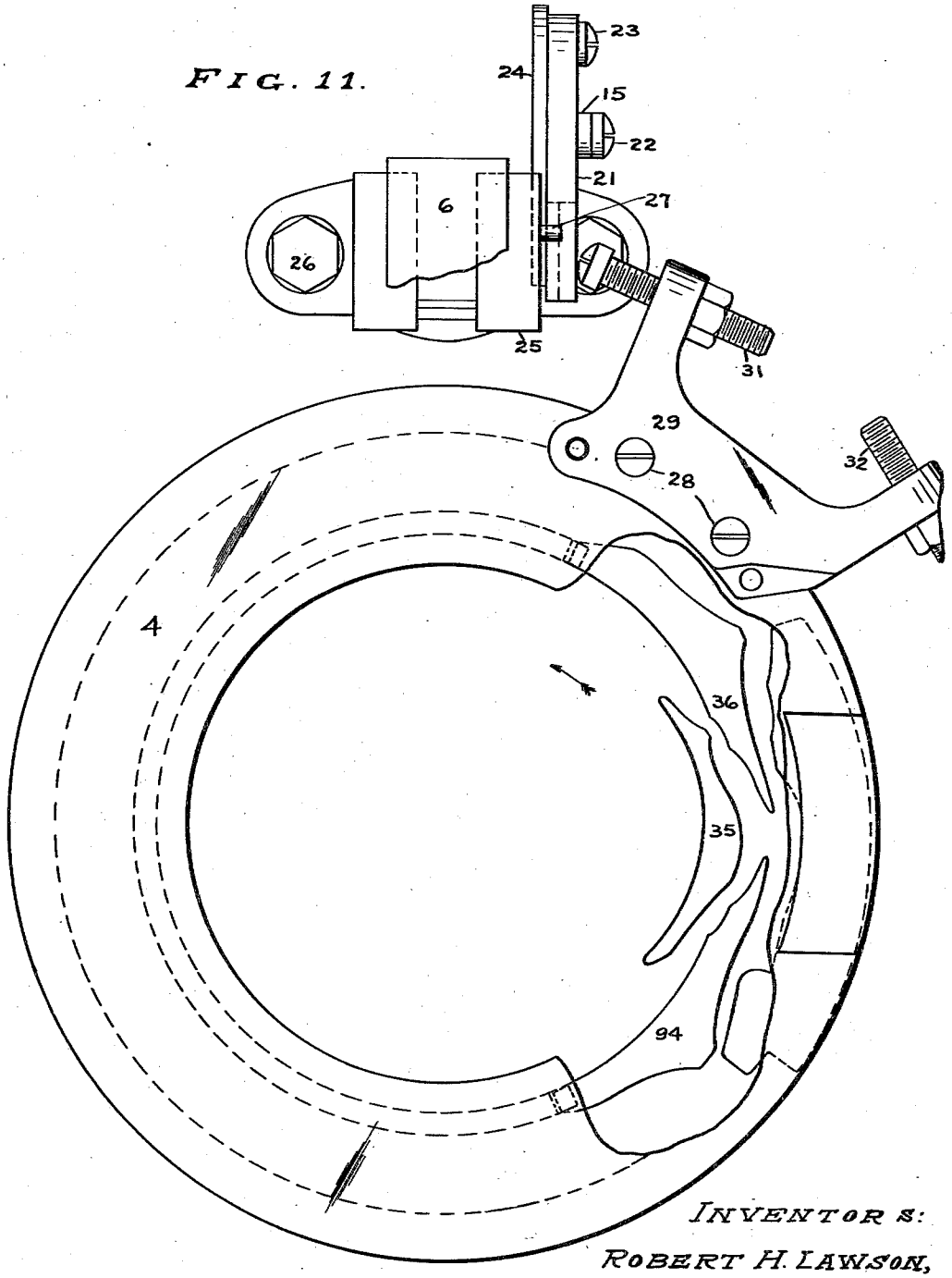
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FIG. 11.



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FIG. 12. FIG. 16. FIG. 24. FIG. 19.

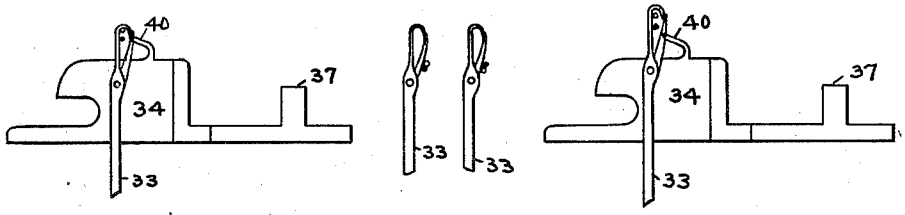


FIG. 13. FIG. 17. FIG. 25. FIG. 20. FIG. 21.

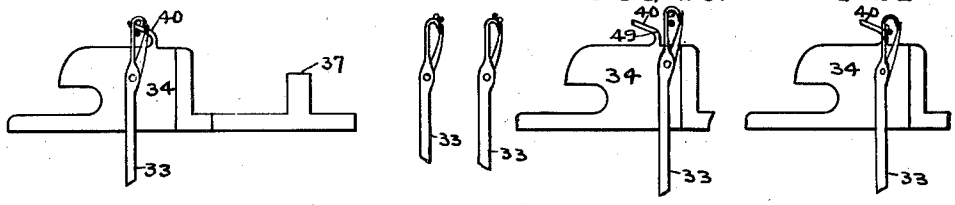


FIG. 14. FIG. 18. FIG. 26. FIG. 22.

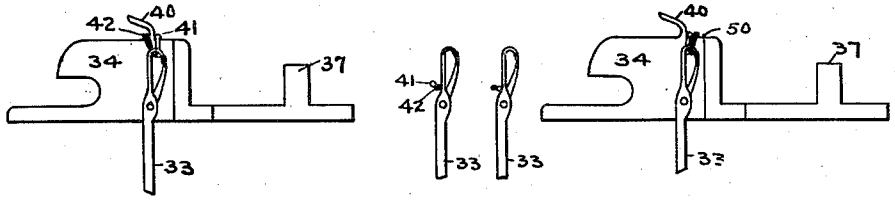
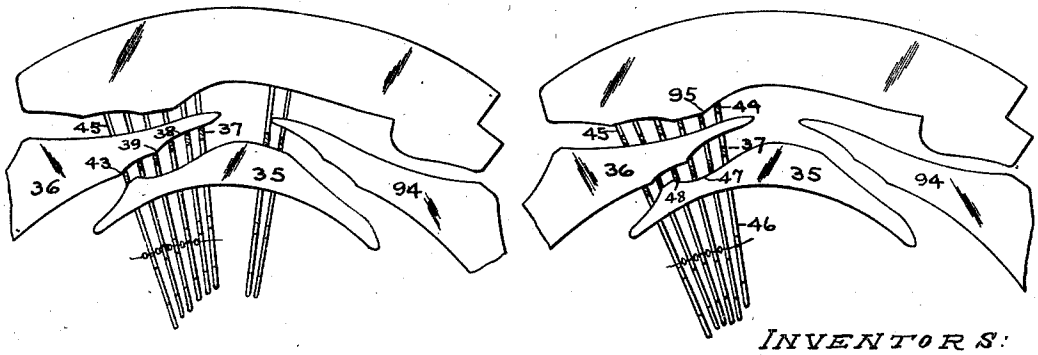


FIG. 15. FIG. 23.



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FIG. 27.

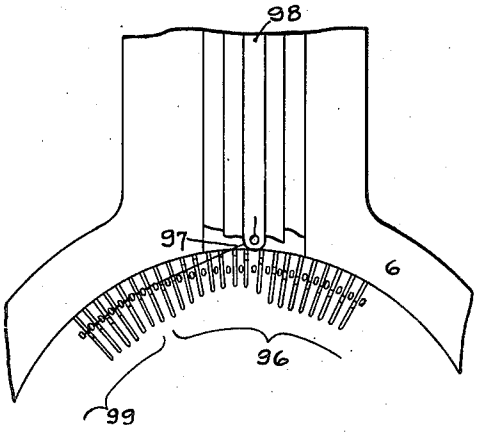


FIG. 28.

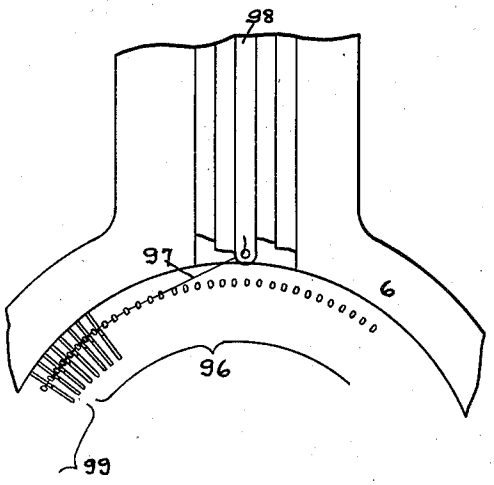


FIG. 29.

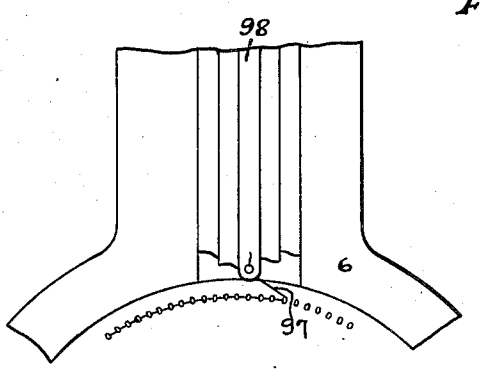


FIG. 32. FIG. 33. FIG. 34.

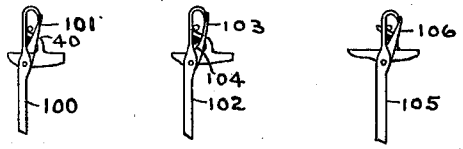


FIG. 30.

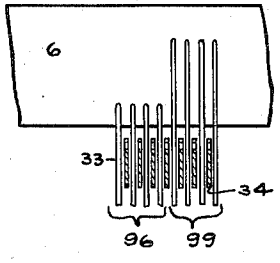
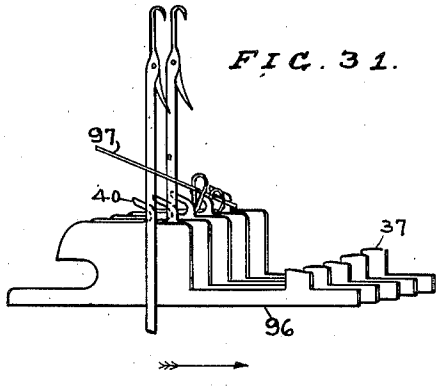


FIG. 31.



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KNITTING MACHINE AND METHOD OF KNITTING

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FIG. 36.

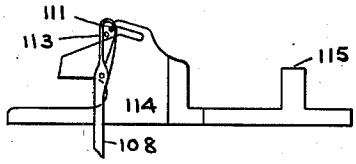


FIG. 35.

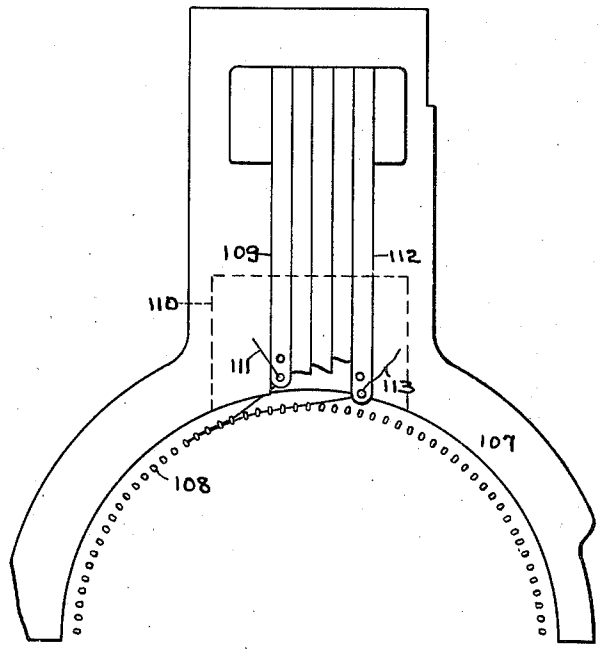


FIG. 37.

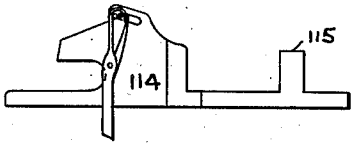


FIG. 38.

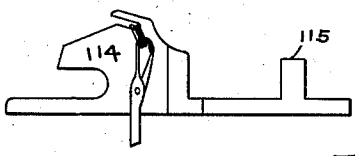


FIG. 39. FIG. 46.

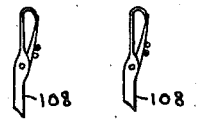


FIG. 44.

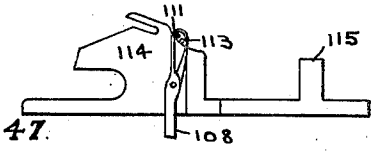


FIG. 42.

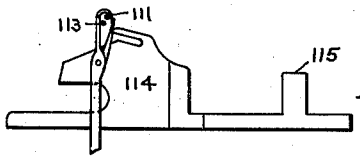


FIG. 40. FIG. 47.

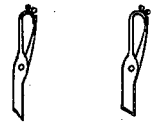


FIG. 45.

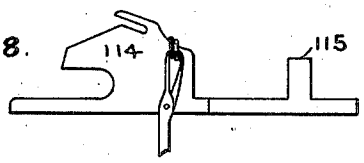


FIG. 43.

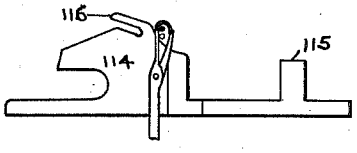
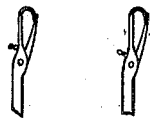


FIG. 41. FIG. 48.



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Patented May 3, 1938 2,115,929

UNITED STATES PATENT OFFICE

2,115,929

KNITTING MACHINE AND METHOD OF KNITTING

Robert H. Lawson, Pawtucket, and Arthur N. Cloutier, Lonsdale, R. I., assignors to Hemphill Company, Central Falls, R. I., a corporation of Massachusetts

Application August 13, 1930, Serial No. 474,964
In Great Britain July 16, 1930

26 Claims. (Cl. 66—107)

This invention relates to improvements in knitting machines and more specifically to improved methods and mechanisms for effecting perfect plating either throughout the wales and courses of a stocking or other fabric, or in combination with reverse plating in certain wales and courses.

In the drawings:

Fig. 1 is a view in side elevation of a knitting machine equipped with mechanism for carrying out the purposes of the present invention;

Fig. 2 is a plan view of a portion of the latch ring and showing how the body and plating threads are fed to the needles;

Fig. 3 is a vertical sectional view taken through the latch ring and also showing how the body and plating threads are fed to the needles;

Fig. 3a is an enlarged view corresponding to Fig. 3 but showing a few needles and sinkers only;

Figs. 4, 5, 6 and 7 are detail views showing the latch opening and closing functions of the plating guide;

Fig. 8 is a detail plan view of the latch ring and parts carried thereby;

Fig. 9 is a view corresponding to Fig. 8 but in elevation;

Fig. 10 is a detail view showing a connection between one of the regular yarn levers and the plating guide;

Fig. 11 is a detail plan view of the sinker cap with a portion of the upper plate thereof broken away to show certain of the cams carried thereby;

Fig. 12 shows a needle and a sinker the nib of which sinker is about to enter between the body and plating threads to insure plain plating;

Fig. 13 is a view corresponding to Fig. 12 but showing the needle and sinker at a later phase in the knitting cycle;

Fig. 14 is a view corresponding to Figs. 12 and 13 but at a still later phase in the knitting cycle;

Fig. 15 is a detail plan view showing a few adjacent sinkers and needles actuated by sinker cams to plain plate;

Figs. 16, 17 and 18 show the threads of two loops, which were drawn during the preceding course of knitting, as they ride up the closed latch, over the top of the needle hook and finally when they have been knocked over by the sinkers;

Figs. 19, 20, 21 and 22 correspond to Figs. 12, 13 and 14 but show the sinkers advanced earlier so as to reverse the normal plating relations of the two threads;

Fig. 23 corresponds to Fig. 15 but shows all of the sinkers controlled for reverse plating;

Figs. 24, 25 and 26 are views similar to Figs. 16, 17 and 18 respectively but showing two threads in reverse plating relation;

Fig. 27 is a fragmentary plan view showing the heel and toe thread passing back of the sinker nibs during a regular or anti-clockwise movement of the needles while knitting heels or toes;

Fig. 28 is a view similar to Fig. 27 but at the end of a regular or anti-clockwise movement of the needles;

Fig. 29 is a view similar to Figs. 27 and 28 but showing a reverse or clockwise movement of the needles;

Fig. 30 is a fragmentary view showing inactive instep needles and active heel and toe needles;

Fig. 31 is a view in perspective showing a few needles and sinkers and corresponding to Figs. 27 and 28;

Fig. 32 is a fragmentary view of one form of needle that may be used;

Fig. 33 is a similar view of a modified form of needle;

Fig. 34 is a view of a still further modified form of needle;

Fig. 35 is a plan view of a latch ring and corresponding to Fig. 2 but of a modification;

Figs. 36, 37 and 38 are views showing successive positions of the sinkers which correspond to the positions shown in Figs. 12, 13 and 14 but of a modified form of sinker;

Figs. 39, 40 and 41 are views showing successive positions of the needles and corresponding to Figs. 16, 17 and 18;

Figs. 42, 43, 44 and 45 are views corresponding to Figs. 19, 20, 21 and 22 but showing the modified form of sinker disclosed in Figs 36, 37 and 38; and

Figs. 46, 47 and 48 show successive positions of a needle and correspond to Figs. 24, 25 and 26.

The knitting machine which is designated in its entirety by the reference numeral 1 includes the needle cylinder 2, cam carrier 3, sinker cap 4, sinker head 5, and latch ring 6.

Carried by the frame of the knitting machine is the usual cam drum 7 which is advanced from time to time by means not shown and, of itself, not a necessary part of the present invention. Mounted upon the cam drum 7 are cams 8 and 9. When, due to rotation of the drum 7 in the direction of the arrow, Fig. 1, the cam 8 moves to a position opposite the toe 10 of a lever 11 the said lever is actuated which actuation of the lever advances the sinker cap 4 in a manner to be described. Likewise when, upon continued rotation of the drum 7, the cam 9 moves to a position opposite the toe 10 of the lever 11 the said lever

is again actuated and the sinker cap 4 advanced.

The lever 11 is pivoted intermediate its ends upon a shaft 12 and is held against movements lengthwise thereof by means of a collar 13 which is retained in position on the shaft by means such as set screws 14. The toe 10 constitutes the free end of one arm of the lever 11 while at or adjacent to the other arm of the said lever 11 is adjustably connected a link 15. The adjustable connection consists of a threaded end of the rod or link 15 passing through a hole provided in a laterally extending pin or collar 16 carried by the second mentioned arm of the lever 11. To retain the rod or link 15 in a desired adjusted position with respect to the arm of the lever 11 two nuts 17 are provided which nuts, after adjustments of the rod or link 15, are turned until they are in clamping engagement with the collar 16. Intermediate the ends of the last mentioned arm of the lever is attached at one end a coil spring 18, the other end of which is connected to the machine frame as by a screw 19. The rod 15 passes through a hole provided in the circular base 20 of the machine and extends thereabove where it is connected (Fig. 11) to and intermediate the ends of a lever 21 by means of a pin or screw 22. The lever 21 is pivotally mounted at one end by means of a pin or screw 23 to a plate 24 attached to the carrier ring post 25 which is fixedly mounted upon the circular base 20 as by means of screws or bolts 26. A pin 27 projects laterally from one face of the carrier ring post and acts as a stop to limit the upward movements of the free end of lever 21.

The sinker cap 4 (Fig. 11) has connected thereto by means of screws 28 the usual sinker cap bumper bracket 29 which bracket, during the oscillations of the sinker head while knitting heels and toes, oscillates back and forth between the carrier ring post 25 and the yarn lever box 30 (Fig. 8). The heads of the respective bolts 31 and 32, which are adjustably mounted in arms of the bracket 29, engage one face of the lever 21 and one side of the box 30 thereby to limit the oscillating movements of the said bracket and consequently advance the sinker cap.

During continuous circular knitting of the leg and foot portions of the stocking or during the knitting of any other fabric the bolt 31 of the sinker cap bumper bracket 29 is in engagement with the adjacent face of the carrier ring post 25 and the lever 21, at such times, is maintained in an elevated, inoperative position. While knitting circular portions of a stocking or other fabric the needles 33 and sinkers 34 travel in the direction of the arrow, Figs. 2 and 11.

For normal or plain plating the sinkers 34 are actuated by the sinker cams 35 and 36 which engage butts 37 on the sinkers 34 in the manner indicated in Fig. 15. The sinkers 34 are advanced in the normal manner and by the cam face 38 of the cam 36 engaging the butts 37 and as the said sinkers are advanced to the point 39 of the cam 36 they are in the relative positions with respect to their needles indicated in Fig. 13, i. e., with the upturned nibs 40 of the sinkers between and dividing the body and plating yarns 41 and 42 respectively. Continued movement of the sinkers in the direction of the arrow, Figs. 2 and 11, and the corresponding movements of the needles cause the needles and sinkers to assume the relative positions shown in Fig. 14 at which time the threads 41 and 42 have been looped and such loops drawn through the previously knit loops. Immediately thereafter the needles are raised a slight extent to relieve the stitches and the needles further advanced by the point 43 of the cam 36 which last mentioned movement of the sinkers cause the old loops to be knocked over the tops of the needles. Thereafter, preferably but not necessarily, the needles move around 270 degrees or more while the last drawn loops hang upon the latches after which the needles are raised to clear the latches of their stitches and to move the needles to a position to take thread for the next course of knitting.

Figs. 12, 13 and 14 show three successive positions of the sinkers and needles whereby the nibs 40 of the sinkers pass between and divide the body and plating threads by which division of the threads they are maintained in normal plating relation and prevented from reversing wholly or partially in any given wale.

As the needles successively descend the old loops close the latches of the needles as shown in Fig. 16, then pass over the tops of the hooks of the needles, Fig. 17, and finally they are knocked over by the advancing sinkers to become part of the fabric, Fig. 18.

By means of the method and mechanism hereinbefore described perfect plating is assured and the body thread is prevented from showing through and mixing in with the plating thread, e. g., when knitting with a black plating thread and a white body thread the plating areas show solid black and are not tinged with gray.

In order to reverse plate in desired wales and courses the sinkers are selectively controlled in such a manner that certain ones of them are advanced at an earlier time in the knitting cycle and so that the nibs 40 of the sinkers pass beneath both the body and plating threads 41 and 42 which threads, as the sinkers and needles continue to move in the direction of the arrows, Figs. 2 and 11, are drawn down by the needles over the backs of the sinker nibs 40 and over the horizontal edges back of the said sinker nibs 40 in the manner indicated in Figs. 19, 20, 21 and 22. In order to impart an earlier advancing movement to the reverse plating sinkers jacks 44 are provided which jacks are slidable in the slots 45 within which slots the sinkers are also slidable. The jacks 44 are themselves selected to move forward in any desired manner and when so advanced the said jacks engage companion sinkers and move them to the position indicated by the numeral 46, Fig. 23, and to permit such early advance of selected sinkers the cam 35 is cut away at 47. When the earlier advancing movements are imparted to the sinkers by their jacks or other means the butts 37 of the sinkers are moved forward of the face 38 of the cam 36 and consequently the sinker movements are not controlled by the cam face 38 during the initial reverse plating movements of the needles and sinkers. Continued rotation of the sinkers and needles causes the sinkers to be retracted slightly by a portion of the cam 35 designated 48 and such movement of the sinkers moves them to and beyond the position with respect to the needles shown in Fig. 21. While the sinkers are being retracted the needles continue to descend and the portions 49 at the backs of the sinker nibs engage the plating thread 42 and cause the same to move to the forward portions of the needle hooks and thus prevent the same from turning back and displacing the body thread 41. The portions 49 of the sinker nibs provide, in effect, outwardly and downwardly inclined edges which edges assist in the reverse plating especially when the sinkers

are retracted by the cam 48. Thereafter as the needles and sinkers continue to move in the direction of the arrows, Figs. 2 and 11, the needles continue to descend until they reach their lowermost positions as indicated in Fig. 22 during which interval the sinkers again move forward a short distance with respect to the needles which draw their stitches over the backs of the sinker nibs and over horizontal edges 50 of the sinkers. Thereafter the needles are elevated a slight extent and the sinkers are further advanced by the face 38 of the cam 36 until the point 43 of cam 36 is reached when the old loops are knocked over the tops of the needle hooks.

In Figs. 24, 25 and 26 are shown positions of the needles which correspond to the positions shown, Figs. 16, 17 and 18 but with the threads reversed.

Thus the earlier advancing movements imparted to such of the sinkers as are to reverse plate causes the same to move forward at an earlier time in the knitting cycle and consequently pass beneath the plating as well as the body threads whereby both threads are drawn over the backs of the sinker nibs by the descending needles; whereas, when plain plating the sinkers move forward at the usual time in the knitting cycle and by such movement the upturned tips of the sinker nibs 40 pass between the body and plating threads and maintain the two threads in separated relation while the needles draw their stitches and as a result of the separation of such body and plating threads there is no possibility of misplating occurring in any plain plated wale.

It is desirable that the body and plating threads be fed to the needles at different angles so as to separate the two threads a substantial amount to permit the nibs of the sinkers to enter between the threads.

With the above stated object in view the body and plating threads 41 and 42 are fed to the needles by means of thread guides 51 and 52. The body thread 41 is, preferably, fed to the needles from the yarn lever 51 and adjacent to one corner of the mouthpiece 53 which is mounted in the latch ring 6 in the usual manner. Consequently the body thread 41 assumes a substantial angle with the horizontal, whereas on the other hand the plating thread 42, which is fed to the needles through the special yarn guide 52 located adjacent the other end of the mouthpiece and thus spaced laterally of the yarn lever 51, assumes a relatively small angle with the horizontal as compared with the angle assumed by the thread 41. The two threads 41 and 42 are thus substantially separated although they converge towards the needles where they are knit in. The separation of the threads permits the nibs 40 of the sinkers that are to plain plate to pass between and divide the body and plating threads while at the same time the feeding angle of the thread 42 permits the nibs 40 of the sinkers that are to reverse plate to pass beneath the thread 42 as well as the thread 41. In Figs. 3 and 3a is disclosed one sinker with its nib 40 dividing the two threads 41 and 42 while the nibs 40 of the adjacent sinkers are shown as passing beneath both threads 42. In the figures a few sinkers only are shown and in section more clearly to show the relations between the sinker nibs and threads.

As hereinbefore described the thread guides 51 and 52 are separated as much as possible and further to assist in the separation of the threads the guide 52 is specially constructed and controlled so as to feed its thread to the needles from a position as much lower as possible than that at which the body thread 41 is fed to the needles through the guide 51. Referring specifically to Figs. 1, 2, 3, 8 and 9 inclusive, the plating thread 42 which is led from a bobbin (not shown) suspended above the machine, passes through an eyelet 54 carried by an angle plate 55. The plate 55 is adjustably connected by screws 56 to another angle plate 57 which is attached by screws 58 to a plate 59. Plate 59 which is connected to an angle bar 60 carried by the latch ring, is provided with a plurality of porcelain or other eyelets 61 through which pass threads including the body and plating threads 41 and 42. After passing through the eyelet 54 the thread 42 is lightly tensioned between two discs 62 one of which is yieldingly urged towards the other by means of a coil spring 63. From between the two discs 62 the thread 42 passes through one of the eyelets 61 and from there through a porcelain tube 64 provided in a block 65 made fast to the latch ring 6 by means such as screws 66. From the other end 67 of the tube 64 the thread 42 passes to and through an eyelet 68 (Fig. 3) provided in the guide 52. The guide 52 consists of an elongated thin metal strip which is mounted for vertical sliding movements between an upright extension of the block 65 and a plate 69 fastened to the said extension as by means of screws 70. The extension of the block 65 is slotted as at 71 (Fig. 9) and passing through the said slot is a pin 72 the other end of which is connected to the guide 52. The upper end of the guide 52 is turned at a right angle as at 73 and through a hole in such turned end is threaded an adjustable stop screw 74 the lower end of which contacts with the upper face of the extension of the block 65 thereby to limit the downward movements of the guide 52. A nut 75 serves to lock the screw 74 in adjusted position.

Vertical movements are imparted to the pin 72 (Figs. 2, 3, 8, 9, 10) and consequently to the guide 52 by means of a lever 76 the end of which is turned at a right angle and bifurcated as at 77, the arms of which bifurcation straddle the pin 72. The other end of the lever 76 is pivotally mounted upon a shaft 78 upon which are also mounted other yarn levers including the yarn lever 51. The shaft 78 is supported by ears 79 rising from the latch ring. The lever 76 is prevented from endwise movement upon the shaft 78 by means of a collar 80 made fast to the said shaft 78 by means of a set screw 81. Intermediate the ends of the lever 76 is connected a pin 82 which projects laterally in the direction of the yarn levers and is received within an elongated slot 83 in one arm 84 of a lever the other arm 85 of which is pivotally connected at one end to the first named arm as at 86 and at the other end is rigidly connected to a yarn lever 87. To accommodate the lever arm 85 the yarn lever 87 is cut out or recessed intermediate its ends on one face thereof as at 88. The connection between the lever arm 85 and the yarn lever 87 is such that when the yarn lever is raised the lever 76 is raised with it and consequently the pin 72 and thread guide 52 are elevated. Conversely when the yarn lever 87 is lowered, the guide 52, through the connections described, is also lowered to a feeding position. A coil spring 89 attached at one end to a pin or screw 90 carried by the latch ring and at its other end to the pin 82 normally maintains the guide 52 in a lowered, feeding position.

In order to prevent breaking or bending of needle latches the leading edge or portion of the

guide 52 is bevelled as shown in Figs. 3–7 inclusive. The bevelling of the lower face 91 and adjacent edge of the guide 52 fully opens (Fig. 5) such of the latches as may be partially open when they reach the guide 52 during the revolutions of the needle cylinder and the bevelling of the face 92 and adjacent edge of the guide 52 likewise fully closes (Fig. 4) others of the needle latches which may be partially open when they reach the guide 52 during the revolutions of the needle cylinder.

The guide 52 remains in lowered, operative position throughout the knitting of the plain plated and reverse plated courses of the fabric, but, preferably, is elevated as the threads are changed for the ring toe courses and the said guide 52 remains in elevated, inoperative position throughout the knitting of the ring toe, toe and loopers rounds. The guide 52 is restored to operative position during the last course of the loopers rounds.

The plating thread 42 is under light tension while the body thread 41 may be and preferably is fed to the needles under considerable tension imposed thereupon by suitably positioned tension discs 93. However, if desired, the plating thread may be under tension while the body thread is substantially free from tension or both body and plating threads may be fed to the needles under substantially the same tensions, i. e., with substantial tension or with very little tension.

As hereinbefore stated during the knitting of the circular portions of the leg and foot or other fabric the screw 31 is in engagement with the adjacent face of the carrier ring post 25. However, during the knitting of heels and toes or other reciprocating knitting, and during the knitting of the ring toe and loopers rounds, it is desirable that the sinker cap be advanced. Therefore during the regular strokes while reciprocating the needle cylinder and sinker head, the sinker cap should be spaced, in a clockwise direction, Fig. 11, from the position it assumes during circular knitting and it is with that purpose in view that the automatically controlled lever 21 is provided.

During the last circular course preceding the knitting of the heel and while the short butt needles are moving past the mouthpiece the lever 21 is lowered to the position shown in Fig. 11 by the cam 8 on the drum 7 and the connections leading therefrom hereinbefore described. The movement of the lever 21 to the lowered position of Fig. 11 advances the sinker cap 4 or causes the same to move in a clockwise direction whereby the cams carried by the sinker cap are moved to such a position as to advance the sinkers sooner or earlier than they would otherwise be advanced. In other words the cam 36 is advanced and when in its advanced position it engages all of the sinkers and moves them forward before the corresponding needles have descended to the position shown in Fig. 12. Therefore the nibs 40 pass beneath the heel and toe thread or threads in the same manner as they pass beneath body and plating threads, Figs. 19–22, and the thread is drawn or the stitches measured over the backs of the sinker nibs and over horizontal edges 50 of the sinkers immediately back of the sinker nibs.

As the threads are changed for the first course of the ring toe the cam 9, Fig. 1, engages the toe 10 of the lever and by means of the connections hereinbefore described advances the sinker cap 4 to the position shown in Fig. 11 where it remains throughout the knitting of the said ring toe, toe and loopers rounds.

A cam 94 is provided, as usual, for advancing the sinkers during the reverse strokes of the needle cylinder and sinker head while knitting heels and toes or during other reciprocating knitting and such cam is positioned and proportioned so that the sinkers are advanced early enough to permit such sinkers to pass beneath the heel and toe thread or threads during such reverse strokes.

Although in Fig. 15 all of the sinkers shown are controlled or actuated in a normal manner by the cam 36 to plain plate and in Fig. 23 all of the sinkers shown are or have been controlled to reverse plate, nevertheless the sinkers may be selectively controlled in any desired order whereby single or other plain plated stitches may be interspersed among reverse plated stitches.

The sinkers may be selected for reverse plating in any desired manner and as herein shown jacks 44 themselves selected in any desired manner, are advanced by a cam 95. The advanced jacks by engaging their companion sinkers advance the latter to an early and reverse plating position with respect to the descending needles. However, the sinkers may be selected for reverse plating in any manner desired.

The needles 33 and sinkers 34 which function as web holders in the usual manner extend entirely around the needle cylinder 2 and sinker head 5 although a few only of the said needles and sinkers are shown.

Due to the forward movements of the sinkers the thread is engaged by the forward edges of the sinker nibs and as a result of the excess tension maintained on the body thread 41 the loops knitted with the said plated thread 42 are somewhat longer than are the loops knitted with the body thread 41 which latter is drawn over the sinkers back of or at the rear of the sinker nibs whereby the plating thread, in the plating areas, effectively covers or conceals the body thread.

When knitting heels and toes with the usual forms of sinkers the thread is drawn down by the active needles over the upper edges of companion sinkers and when the sinkers advance the nibs move over such thread; but on the other hand the inactive instep needles whether raised or not do not engage the thread and as a consequence thereof such thread passes above the sinker nibs.

When using sinkers such as herein disclosed, the nibs 40 of which are spaced more than the ordinary amount from the upper edges of their sinkers, the nibs of the sinkers 96 which are companion to the idle instep needles, (Figs. 27–31), when controlled in the normal manner, pass over the heel and toe thread 97 which is fed to the needles through an eye provided in a thread guiding lever 98. The forward movements of the sinkers which draw thread around the shanks of the needles cause a greater length of thread to be drawn through the take-up eye than usual which extra length of thread has to be taken up by the thread take-up during the next reverse stroke of the needle cylinder and furthermore such forward movements of the sinkers tend to cut the thread. Therefore, especially when using high sinker nibs 40 such as disclosed in the drawings, it is necessary that some provision be made for causing the heel and toe thread 97 to pass above the sinker nibs 40 of the sinkers companion to the idle needles and not be caught by them.

In order to overcome the excess drawing of the thread by the sinkers, hereinbefore referred to, all of the sinkers including the instep sinkers 96 and the active sinkers 99, i. e., the ones companion to and cooperating with the heel and toe needles, are advanced earlier in the knitting cycle and, preferably but not necessarily, by advancing the sinker cap as disclosed in Figs. 1 and 11. The earlier advancing movements imparted to the sinkers are especially important insofar as they affect the movements of the instep sinkers 96 whereby the nibs 40 of the said instep sinkers pass beneath the float of thread 97 and prevent the sinkers from engaging the said thread in their throats and thus drawing an undue length of float thread through the usual thread take-up eye (not shown). Fig. 27 shows in plan and Fig. 31 shows in perspective how the float of the thread 97 passes back of the sinker nibs 40.

To overcome the objection hereinbefore referred to it is not essential that the sinker cap be advanced nor is it essential that the sinkers themselves be advanced ahead of their usual time, but any suitable means may be provided which prevents the heel and toe thread from passing beneath the sinker nibs and within the throats of the sinkers.

Various types of latch or other needles may be employed and in Fig. 32 a forward hook needle 100 is shown which is provided with the usual latch 101. The adjacent faces of the said latch and needle shank near the latch pivot define an angle of approximately twenty-two degrees when the latch is in closed position.

Although the needle disclosed in Fig. 32 works in a satisfactory manner nevertheless its use results in a cutting of the plating thread 42 while knitting plain plated areas during the knitting of which the said plating thread is retained within the throats of the sinkers as the needle latches close and as a result thereof the thread is pinched by the closing of the latches and certain of the thread fibers are cut. However, by using the type of needle 102, Fig. 33, the cutting of fibers and the consequent formation of so-called hairs is avoided in a substantial measure at least. The latches 103 of the needles 102 are provided with more or less concaved inner faces 104 thereby providing more room adjacent the pivots of the latches for the plating thread 42 which is retained adjacent the pivots of the latches by the nibs 40 of the sinkers and in separated relation with respect to the body thread 41. The concavity provided by the inner face 104 of each latch 103 may be adjacent the pivots of the latches only or may extend more or less uniformly from the pivots or shortly thereabove to the spoons of the latches.

The greater amount of room adjacent the latch pivots provided for in the form of needle disclosed in Fig. 33 is due, in part, to the greater angle between the adjacent faces of latch 103 and of the shank of the needle 102 as compared with the corresponding angle of approximately twenty-two degrees between the latch 101 and the shank of the needle 100, Fig. 32. The same result, i. e., the increase in the angle between the latch and shank of the needle is provided for in the form of needle 105, Fig. 34, by shortening the latch 106 which necessarily increases the angle between the inner face of the latch 106 and the adjacent face of the needle 105.

Furthermore by using a relatively short latch such as latch 106, Fig. 34, the latches are closed somewhat later in the knitting cycle by the old loops or stitches and as a consequence thereof the plating thread 42, when plating normally, is not so liable to be pinched and cut by the closing needle latches.

When using any of the needles, Figs. 32, 33 and 34, the adjacent sinker nibs 40 enter between and separate the body and plating threads and thereby positively prevent a turning over or reversal of the two threads in the plain plated wales and/or courses.

In Figs. 36–45 inclusive is disclosed a modified form of sinker and method of plating and reverse plating. Pivotally carried by a latch ring 107 and in the usual manner are a series of thread or yarn levers which are adapted to feed yarns or threads to needles 108. A lever 109 which is located adjacent one end of the mouthpiece 110 is provided with an eye by means of which a body thread 111 is fed to needles 108. A second yarn lever 112 is provided with a thread guiding eye spaced radially inward or toward the needles with respect to the thread feeding eye in the lever 109 and through the eye of lever 112 a plating thread 113 is fed to the needles. The radial separation of the thread guide eyes in the respective levers 109 and 112 maintains the two threads in a substantially separated and plating relation such as indicated in Fig. 36 wherein the body thread 111 is shown as adjacent the forward or hook portion of the needle while the plating thread 113 is against or adjacent the shank of the needle opposite the bill of the hook. In order to maintain the body thread 111 adjacent the bills of the hooks and separated from the plating thread 113, the said body thread 111 is maintained under substantial tension while the plating thread 113 is fed to the needles substantially free from tension or with as light tension as possible consistent with proper feeding of the thread to the needles. Furthermore by maintaining the body thread under substantial tension and at the same time feeding the plating thread 113 to the needle substantially free from tension the loops knit in by the needles with the tensioned thread 111 are somewhat smaller than are the loops knit in by the needles with the relatively untensioned plating thread 113 with the result that the plating thread loops, being larger, substantially cover the loops formed with the body thread 111 thereby preventing the latter from showing through a plain plated area.

The sinkers 114 are provided with actuating butts 115 which butts are engageable in raceways defined by cams which cams cause the sinkers to move in a direction radially or otherwise of the needle cylinder or other needle bed within slots of which the needles 108 are adapted to slide to and from thread taking positions as is usual in independent needle machines of the circular or other types. By maintaining the tensioned thread 111 adjacent the bill portions of the hooks of the needles until the needles reach the approximate position with respect to companion sinkers disclosed in Fig. 36, at which time the needles and sinkers are about to draw or measure the loops or stitches, the threads are prevented from reversing. When the threads are within the bills of the hooks, Fig. 36, and thereafter, Figs. 37 and 38, there is no possibility of the loops turning over or reversing, or in other words during the initial stages of the loop drawing movements only is it necessary to maintain the threads in separated relation.

In Figs. 42, 43, 44 and 45 are disclosed successive relative positions of the needles and sinkers during different phases of their relative stitch

drawing movements. Fig. 42 shows the tensioned body thread 111 held against the inner face of the bill of a hook while the relatively untensioned plating thread 113 is somewhat below the thread 111 and against the shank of the needle hook. Fig. 43, which shows a sinker advanced to such a position that its nib 116 has passed beneath both threads 111 and 113, also shows the needle in a position below that shown in Fig. 42. Fig. 44 which shows a sinker retracted slightly from the position shown in Fig. 43 thereby to turn the thread or, in other words, to move the plating thread 113 to a position against or adjacent the inner face of the bill of the hook of a needle 108; also shows the needle in a somewhat lower position than that shown in Fig. 43. Fig. 45, which shows the sinker advanced slightly with respect to the relative positions shown in Fig. 44, also shows a needle 108 in its lowermost stitch drawing position.

Although the means and method of plating and reverse plating disclosed specifically in Figs. 12–26 differs somewhat from the means and method of plating and reverse plating disclosed in Figs. 36–45, nevertheless they have in common the idea of maintaining a considerable tension upon the upper or body thread or the first thread received within the needle hooks while at the same time permitting the lower or plating thread to be fed to the needles substantially free from tension or under less tension than that under which the body thread is fed to the needles.

The tensions on the body and plating threads are as usual adjustable and although the body thread has hereinbefore been referred to as under substantial or considerable tension, nevertheless such tension while greater than the tension on the plating thread is, preferably, less than the usual plating tensions.

Although as hereinbefore disclosed latch needles are preferably employed the invention is not limited to the use of latch needles but is equally applicable to other types of needles as well.

For purposes of illustration and description the present invention has been disclosed as being used in connection with a knitting machine of the revolving cylinder type such as disclosed in the patent to Hemphill 933,443, September 7, 1909. Nevertheless, the invention is nowise limited in its application to circular knitting machines whether of the revolving needle cylinder or revolving cam types, nor to independent needle knitting machines; but is applicable to knitting machines of any type whether for the purpose of knitting hosiery or any other fabric.

Throughout the foregoing description various parts and combinations of parts have been described in detail but the present invention is not limited other than by the limitations recited in the several claims appended hereto.

We claim:

1. A knitting machine, needles and sinkers mounted therein adapted to cooperate in the formation of complete and partial courses, a sinker cap and means for maintaining the same in one position during the knitting of complete courses and in a relatively advanced position during the knitting of partial courses to avoid engagement of the thread by the nibs of idle sinkers during reciprocatory knitting.

2. A circular knitting machine of the independent needle type having needles and sinkers mounted therein, a sinker cap having cams for controlling the movements of the sinkers, means for feeding at least two threads to the needles while knitting certain courses and at least one thread while knitting other courses, means for selectively controlling the knitting of plated areas during the knitting of the courses first mentioned, means for maintaining the sinker cap in a relatively advanced position during the knitting of the courses second mentioned and whereby the sinkers are advanced earlier throughout the knitting of all the wales of the courses second mentioned than during the knitting of the courses first mentioned to avoid engagement of the thread by the nibs of idle sinkers during reciprocatory knitting.

3. A method of plain and reverse plating consisting in variably controlling sinkers in such a manner that two threads are divided by the nibs of the sinkers when plain plating but pass back of the said sinker nibs when reverse plating.

4. A knitting machine of the circular independent needle type having mounted therein needles and sinkers for independent movements, nibs carried by the sinkers, means for feeding at least two threads to the needles and in separated relation, means for advancing selected ones of the sinkers so that the sinker nibs pass between the separated threads, and for advancing others of the sinkers as selected so that the nibs of the sinkers last named pass beneath both threads.

5. A knitting machine of the independent needle type having mounted therein needles and sinkers for independent movements, nibs carried by the sinkers, means for feeding at least two threads to the needles and in separated relation, means for advancing selected ones of the sinkers so that the sinker nibs pass between the separated threads, and for advancing others of the sinkers as selected so that the nibs of the sinkers last named pass beneath both threads.

6. A circular knitting machine of the independent needle type adapted to knit continuous circular or reciprocating work, needles and sinkers mounted in the machine and adapted to cooperate in the knitting of stitches, nibs for holding down the stitches, said nibs being carried by the sinkers, means for imparting cooperative stitch forming movements to the needles and sinkers so that one or more threads may be drawn by needles over the sinkers forwardly of the nibs thereof during circular knitting and over the sinkers to the rear of the sinker nibs thereof during reciprocatory knitting.

7. A circular knitting machine of the independent needle type, needles and sinkers mounted therein for independent stitch forming movements, nibs carried by the sinkers, actuating butts carried by the sinkers, means for feeding a body and a plating thread to the needles, a sinker cap and cams mounted thereon for controlling the movements of the sinkers, two of the said cams spaced apart to permit the passage of the butts on the sinkers and one of the said two cams provided with a recess whereby desired ones of the sinkers may be abnormally moved for the purpose of effecting reverse plating in desired wales, a cam face on the other mentioned cam adapted to engage the sinker butts and impart normal movements to the sinkers and for normal plating, the abnormal movements imparted to certain of the sinkers adapted to cause their nibs to pass beneath the body and plating threads and the normal movements imparted to certain ones of the sinkers by the said other cam adapted to cause the sinker nibs to pass between and divide the body and plating threads.

8. A knitting machine of the independent

needle type having mounted therein for independent stitch forming movements needles and sinkers, the sinkers having upper edges over which threads are drawn by the descending needles, a sinker nib projecting upwardly from the said upper edge of each sinker, means for timing and controlling the advancing movements of the sinkers in such a manner as to cause certain ones of the sinker nibs to enter between the body and plating threads and others of the sinkers to be positioned to permit the descending needles to move the body and plating threads past downwardly and outwardly inclined edges for the purpose of reverse plating.

9. A knitting machine of the independent needle type having mounted therein for independent stitch forming movements needles and sinkers, the sinkers having upper edges over which threads are drawn by the descending needles, a sinker nib projecting upwardly from the said upper edge of each sinker, means for timing and controlling the advancing movements of the sinkers in such a manner as to cause certain ones of the sinker nibs to enter between the body and plating threads and others of the sinkers to be positioned to permit the descending needles to move the body and plating threads past a downwardly and outwardly inclined edge, which constitutes the rear edge of the sinker nib, for the purpose of reverse plating.

10. A method of plating and reverse plating consisting in selectively controlling the movements of sinkers so that some at least of the same will advance in a normal manner while others of the same will advance earlier in the knitting cycle and whereby the nibs of the sinkers first mentioned pass between the body and plating threads while the nibs of the sinkers second mentioned pass beneath both the body and plating threads.

11. A method of knitting consisting in selectively controlling the movements of sinkers so that some at least of the same will advance in a normal manner while others of the same will advance in an abnormal manner and whereby the nibs of the sinkers first mentioned pass between the body and plating threads while the nibs of the sinkers second mentioned pass beneath both the body and plating threads.

12. A knitting machine having needles and web holders independently mounted therein, said web holders having edges over which a thread is adapted to be drawn and having web engaging nibs, means for feeding at least two threads to the needles while knitting certain of the courses and in plating relation, one of such threads being fed to the needles at a substantial angle to the horizontal and one other such thread being fed to the needles at a lesser angle but at a sufficient angle to permit the nibs of the web holders either to pass beneath or between the same, in combination with means for so acting upon the web holders as to cause some of them to be moved to cause their nibs to pass between the two threads and, during the same course of knitting to cause others of the nibs to pass beneath the two threads.

13. A knitting machine of the independent needle type having needles and sinkers mounted therein, a sinker cap having cams for controlling the movements of the sinkers, means for feeding at least two threads to the needles while knitting certain courses and at least one thread while knitting other courses, means for selectively controlling the knitting of reverse plated and plain plated areas during the knitting of the courses first mentioned, means for maintaining the sinker cap in a relatively advanced position during the knitting of the courses second mentioned and whereby the sinkers are advanced earlier throughout the knitting of all the wales of the courses second mentioned than during the knitting of the courses first mentioned to avoid engagement of the thread by the nibs of idle sinkers during reciprocatory knitting.

14. A method of knitting plain plated and reverse plated areas consisting in variably controlling sinkers in such a manner that two threads are divided by the nibs of the sinkers when knitting one of such areas but pass back of the said sinker nibs when knitting the other of such areas.

15. A knitting machine having one means consisting of needles and sinkers having nibs and another means consisting of cams for actuating the needles and sinkers, one of such means adapted to move continuously in one direction, and back and forth with respect to the other, means for feeding a thread over the backs of the sinker nibs during relative back and forth movements of the said two means, and for feeding one thread under some of the nibs and another thread over the nibs last mentioned during the aforesaid continuous movements.

16. A knitting machine of the independent needle type having needles and sinkers mounted therein, a sinker cap having cams for controlling the movements of the sinkers, means for feeding at least two threads to the needles while knitting certain courses and at least one thread while knitting other courses, means for controlling the knitting of plated fabric while knitting the courses first mentioned, and means for maintaining the sinker cap in an advanced position during the knitting of the courses second mentioned whereby the sinkers are advanced earlier throughout the knitting of all the wales of the courses second mentioned than during the knitting of the courses first mentioned to avoid engagement of the thread by the nibs of idle sinkers during reciprocatory knitting.

17. A knitting machine having mounted therein for independent stitch drawing movements companion needles and sinkers, means for feeding at least two threads to the needles and sinkers and in plating relation, nibs on the sinkers adapted to enter between and separate the two threads in desired wales and courses, latches pivoted upon the needles for closing the hooks thereof which latches have concaved inner faces.

18. A knitting machine having mounted therein needles and sinkers for independent stitch forming movements, means for feeding the last two threads to the needles and in plating relation, sinkers provided with nibs which are adapted to enter between and separate the two threads, latches pivoted upon the shanks of the needles, the adjacent inner faces of the latches and shanks of the needles when the said latches are in closed positions, defining an angle not less than twenty-two degrees.

19. A method of plating and reverse plating consisting in feeding at least two threads to the needles substantially separated one from the other in the direction of the needle movements and at the same time maintaining a substantial tension upon the first one of the two threads to be engaged by the needles when moving to thread taking and stitch drawing positions while feeding the other thread to the needles substantially free from tension, reverse plating by drawing the

threads over the backs of the sinker nibs and effecting plain plating by causing the thread that is under less tension to appear on the outer face of the fabric.

20. A knitting machine of the independent needle type, needles and sinkers mounted therein for independent movements to and from stitch forming positions, means for feeding at least two threads to the needles and substantially separated the one from the other, means for maintaining a substantial tension upon the first of the two threads to be engaged within the needle hooks while feeding the other thread to the needles substantially free from tension, reverse plating by drawing the threads over the backs of the sinker nibs and effecting plain plating by causing the thread that is under less tension to appear on the outer face of the fabric.

21. A method of knitting plated areas consisting in maintaining a substantial tension on the body thread but not maintaining a substantial tension on the plating thread thus causing the loops of the plating thread to be longer than loops of the body thread, and maintaining the body and plating threads in such separated relation adjacent to the knitting point as to ensure the plating thread appearing on the outer face of the knitted fabric, the longer loops of the plating thread effectively covering the loops of the body thread in said plated areas.

22. A knitting machine having needles and means for feeding two threads thereto and in plating relation, means for relatively tensioning the body thread while permitting the plating thread to be fed to the needles substantially free from tension, in combination with means for maintaining the body and plating threads in such relative plating position during the knitting of plain plated areas that the body thread cannot displace the plating thread at the plain plated stitches.

23. A method of knitting plain plated and reversely plated areas consisting in drawing relatively longer loops with the plating thread than with the body thread and while knitting plain plated areas maintaining the body and plating threads in separated relation so as to ensure the plating thread appearing on the outer face of the knitted fabric in the plain plated areas.

24. A method of knitting plain plated and reversely plated areas with a body thread and a plating thread consisting in maintaining more tension upon the body thread than upon the plating thread and drawing relatively longer loops with the plating thread than with the body thread and while knitting plain plated areas maintaining the body and plating threads in separated relation so as to ensure the plating thread appearing on the outer face of the knitted fabric in the plain plated areas.

25. In a knitting machine in which, at times, there are reciprocatory movements between the needles and actuating cams, sinkers having nibs, needles and cams for actuating the sinkers and needles, means for advancing the sinkers at an earlier time in the knitting cycle to cause the nibs of inactive sinkers to avoid engaging over the thread.

26. In a knitting machine in which, at times, there are reciprocatory movements between the needles and actuating cams, sinkers having nibs, needles and cams for actuating the sinkers and needles, means for so feeding a thread and manipulating the sinkers as to cause the nibs of inactive sinkers to avoid engaging over the thread.

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