Dec. 26, 1944. F. R. PAGE ET AL 2,366,124

KNITTING MACHINE AND METHOD OF OPERATING SAME

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Fig. 1.

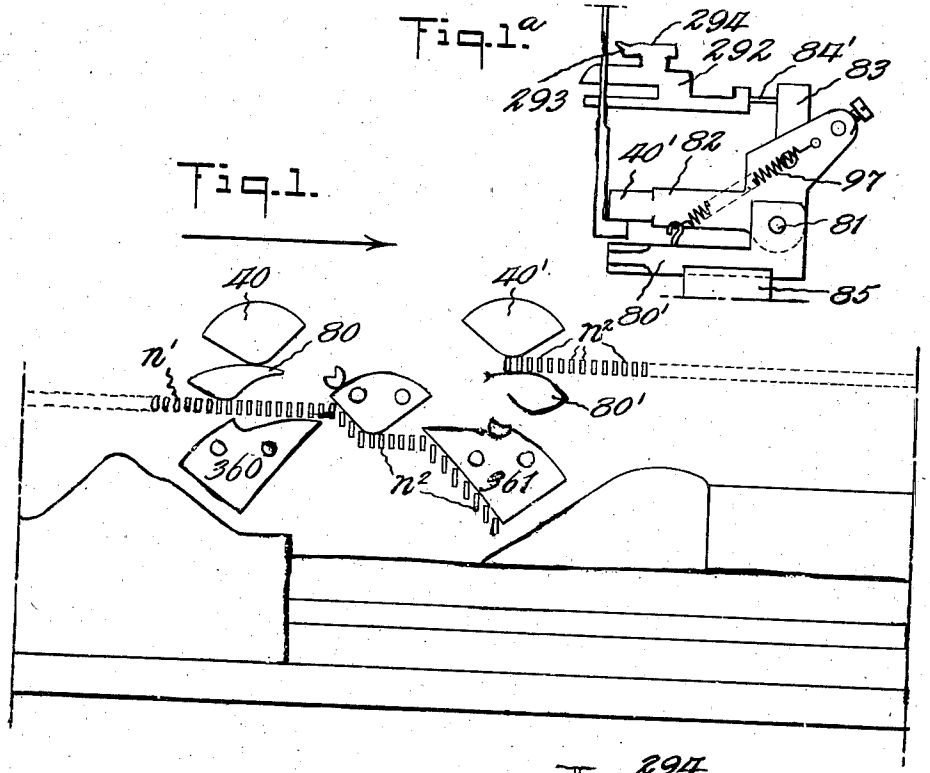


Fig. 1a.

Fig. 2.

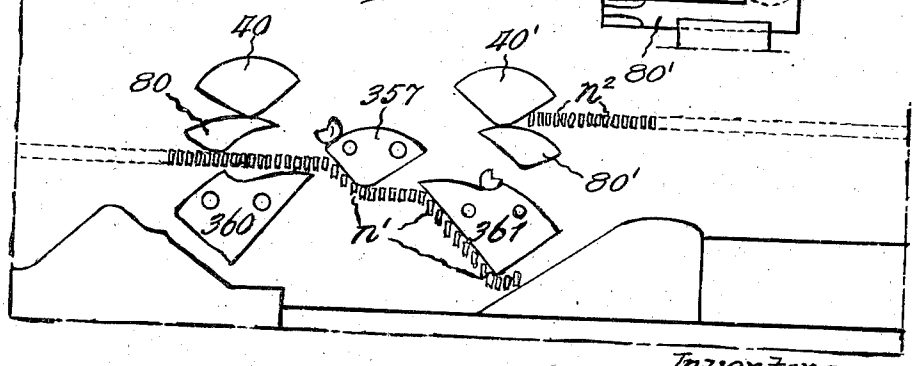
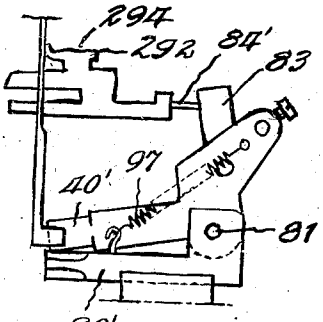


Fig. 2a.



Inventors
FRANK R. PAGE
JOHN J. McDONOUGH
by their attorneys
Howson and Howson

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KNITTING MACHINE AND METHOD OF OPERATING SAME

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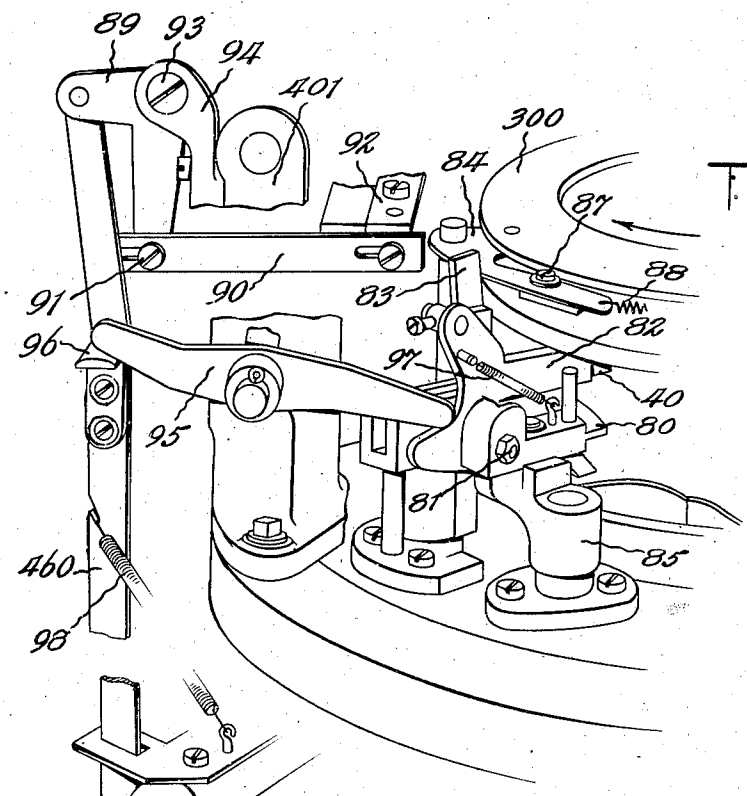


Fig. 3.

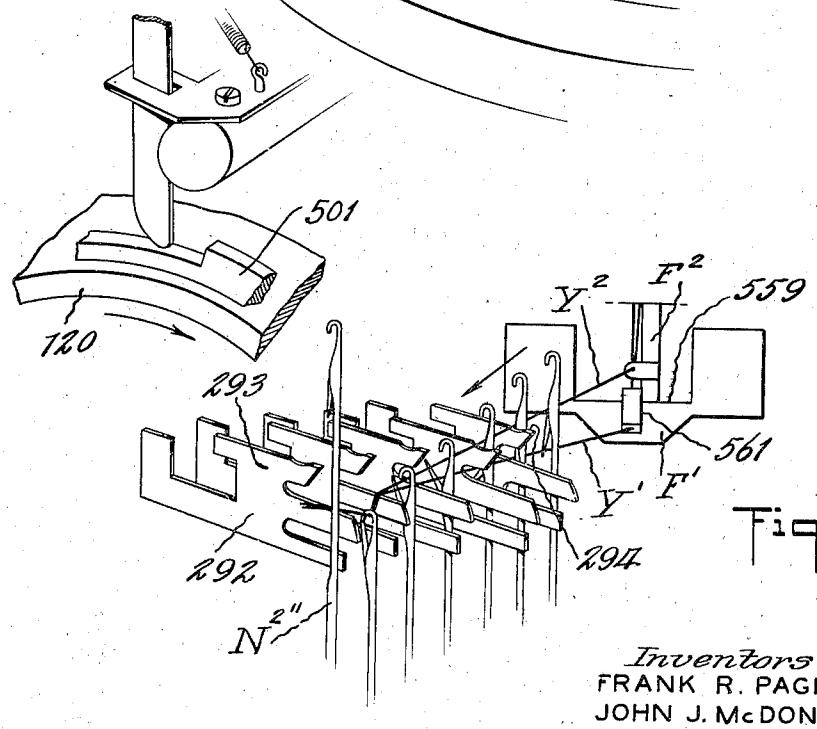


Fig. 4.

Inventors
FRANK R. PAGE
JOHN J. McDONOUGH
by their attorneys

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Fig. 5.

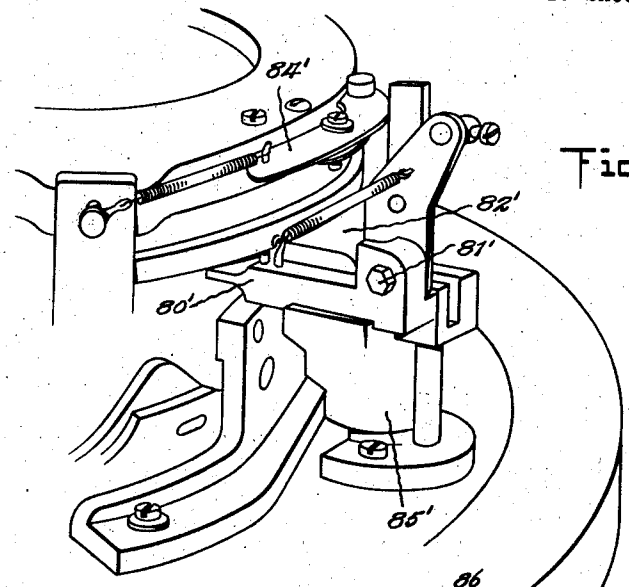


Fig. 6.

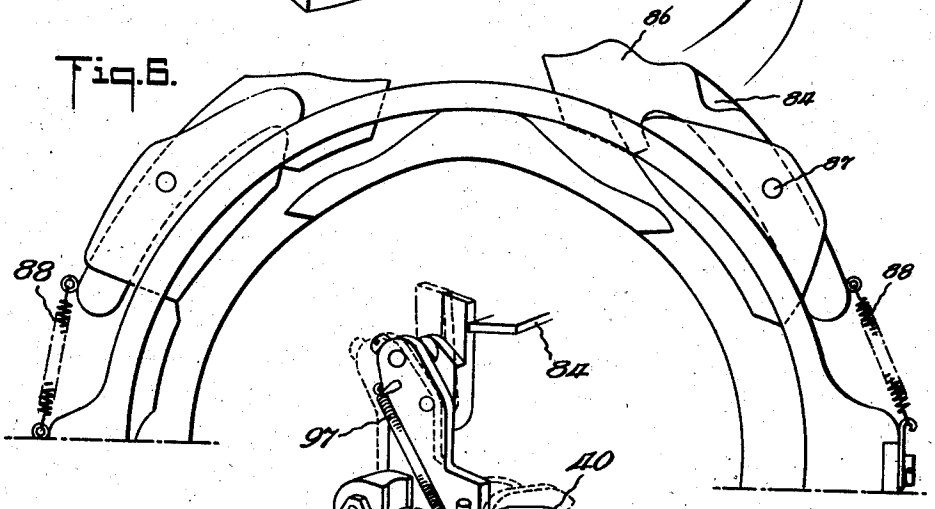
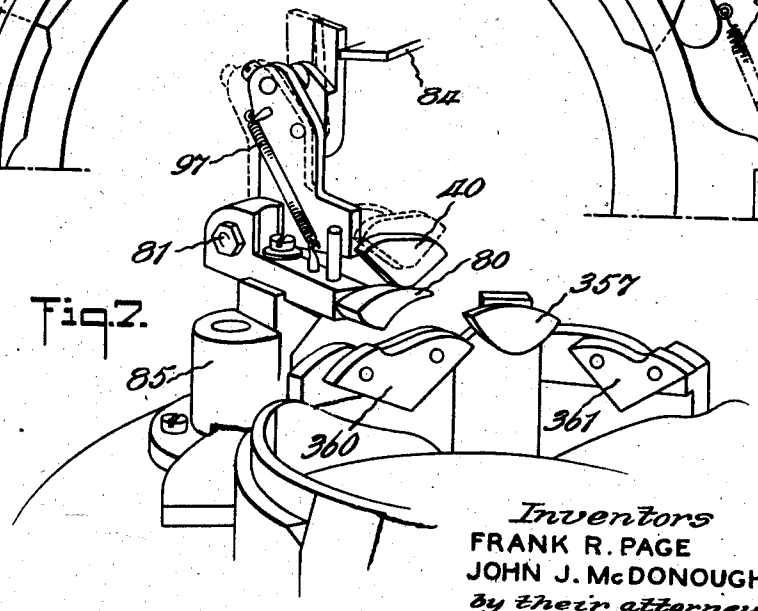


Fig. 7.



Inventors
FRANK R. PAGE
JOHN J. McDONOUGH
by their attorneys
Howson and Howson

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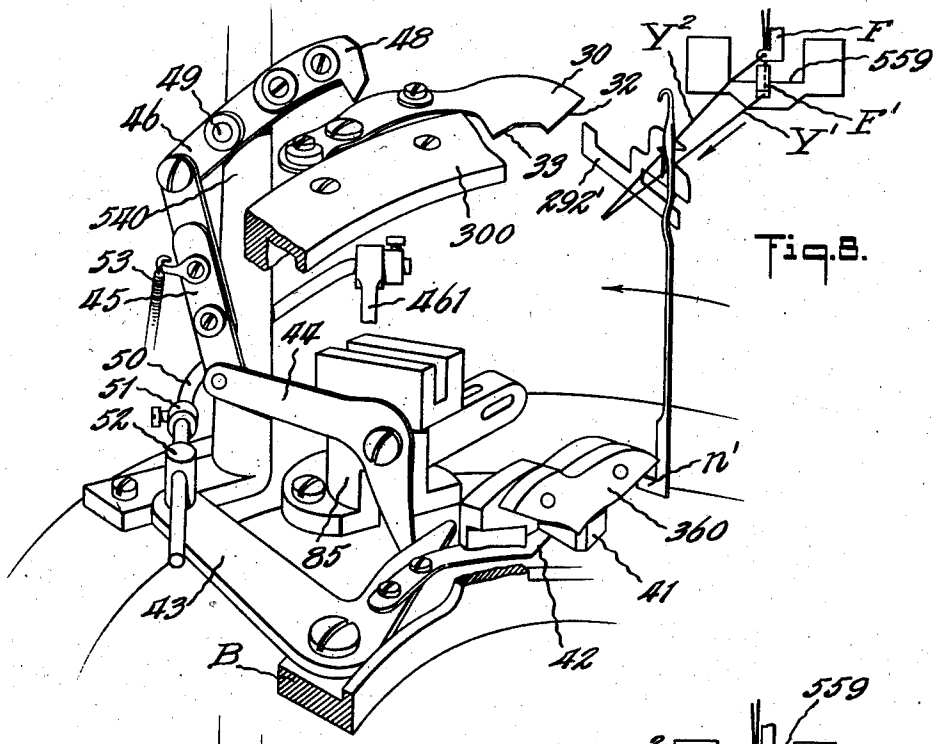


Fig. 8.

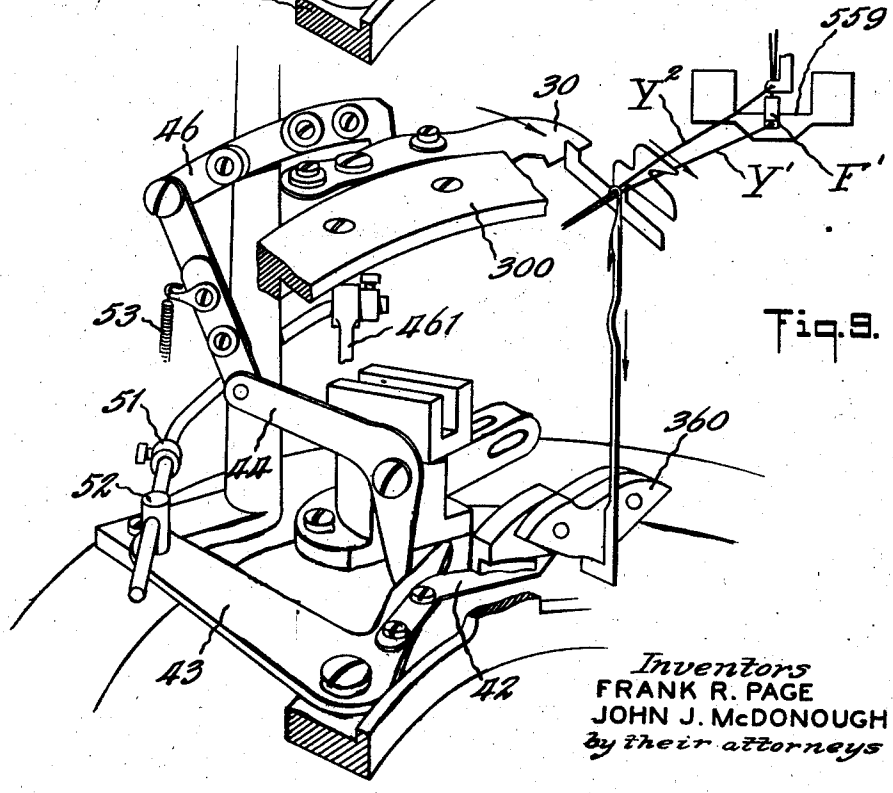


Fig. 9.

Inventors
FRANK R. PAGE
JOHN J. McDONOUGH
by their attorneys

Howson and Howson

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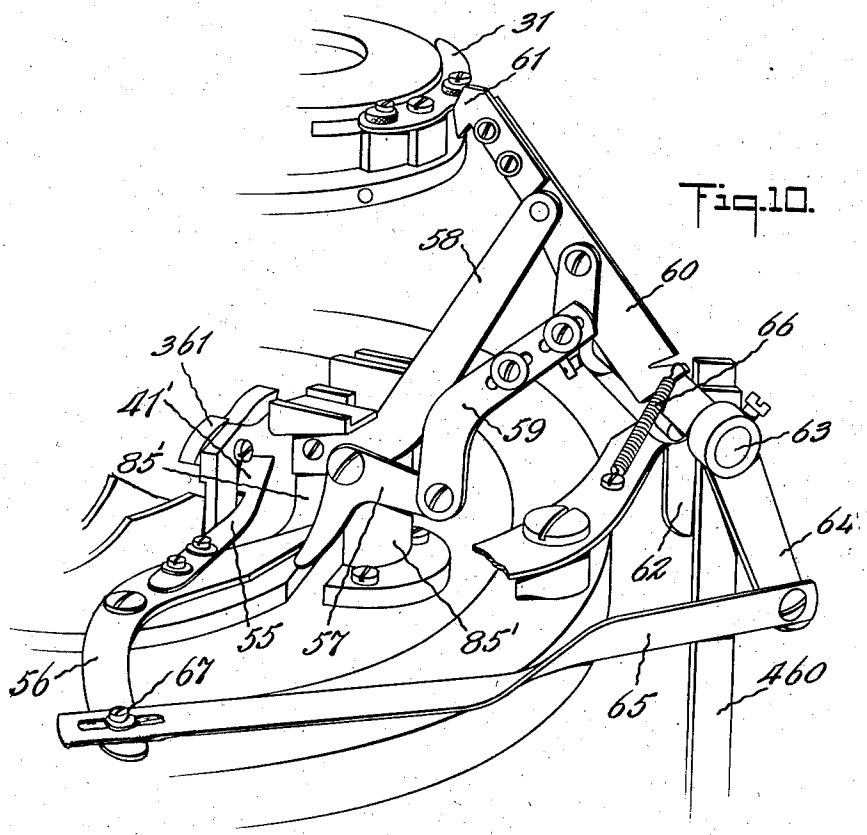


Fig.10.

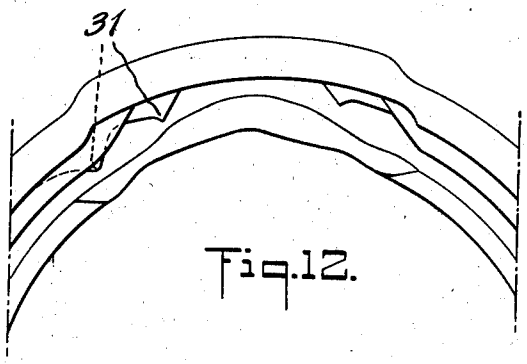


Fig.12.

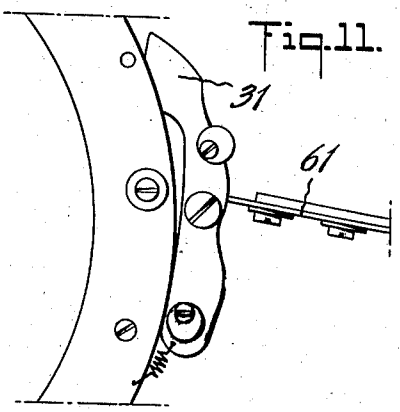


Fig.11.

Inventors
FRANK R. PAGE
JOHN J. McDONOUGH
by their attorneys
Howson and Howson

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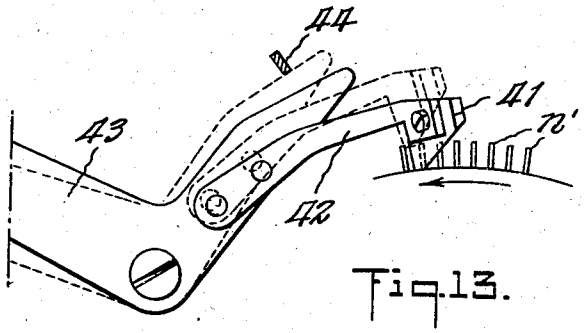


Fig. 13.

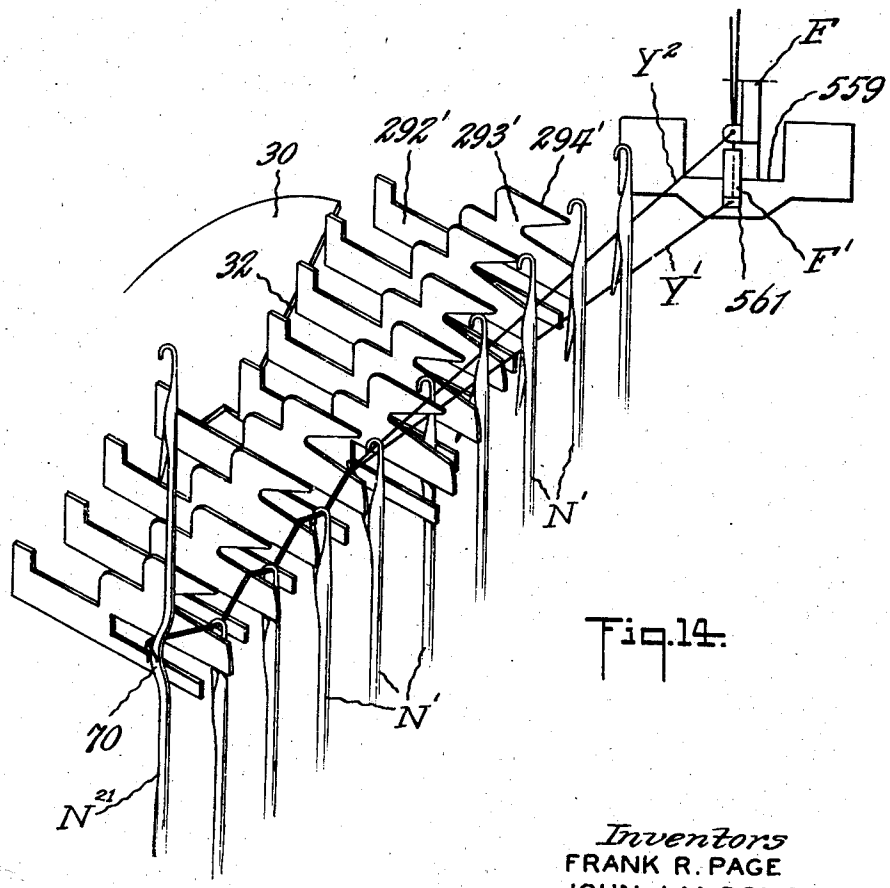


Fig. 14.

Inventors
FRANK R. PAGE
JOHN J. McDONOUGH
by their attorneys
Howson and Howson

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Fig. 15.

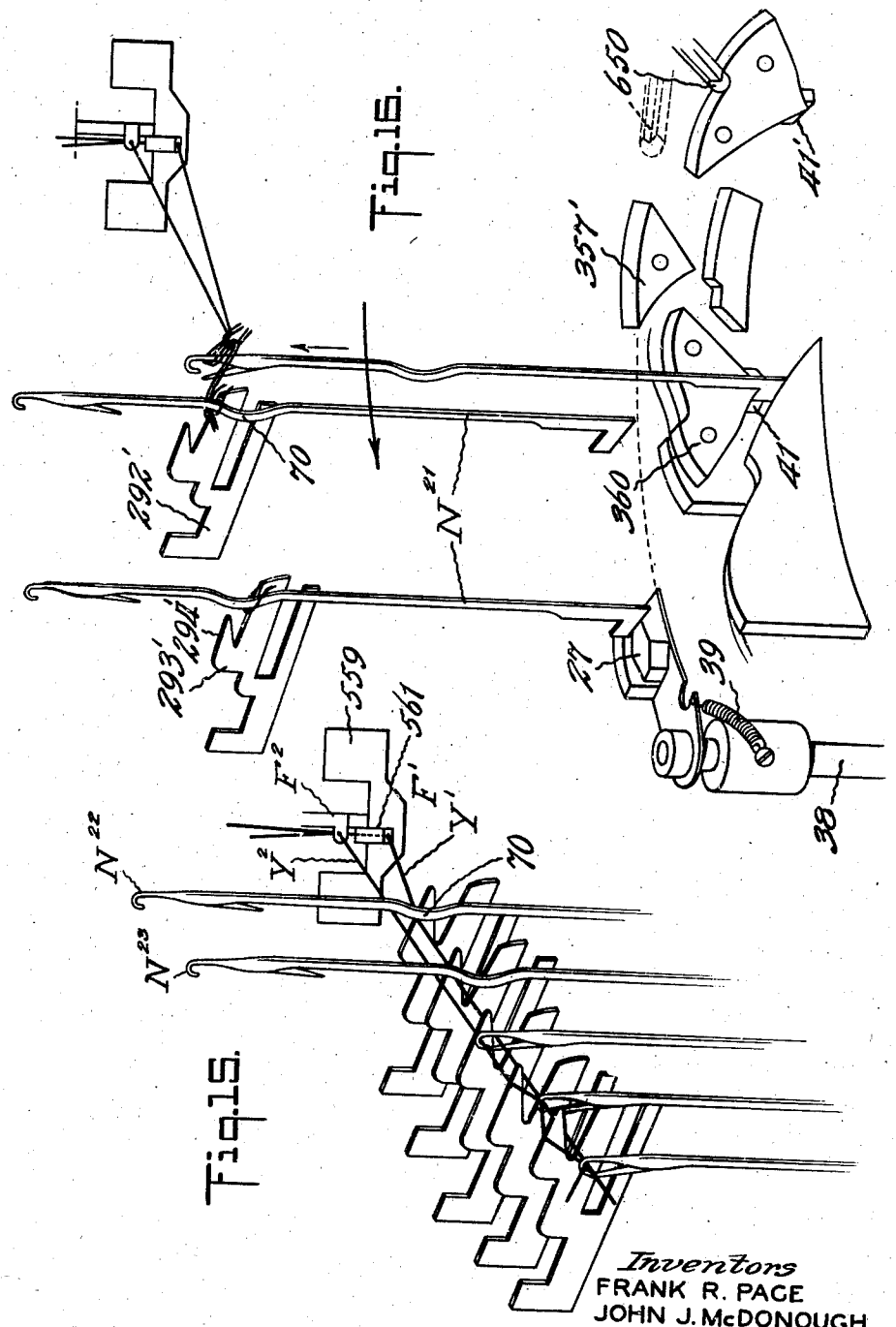


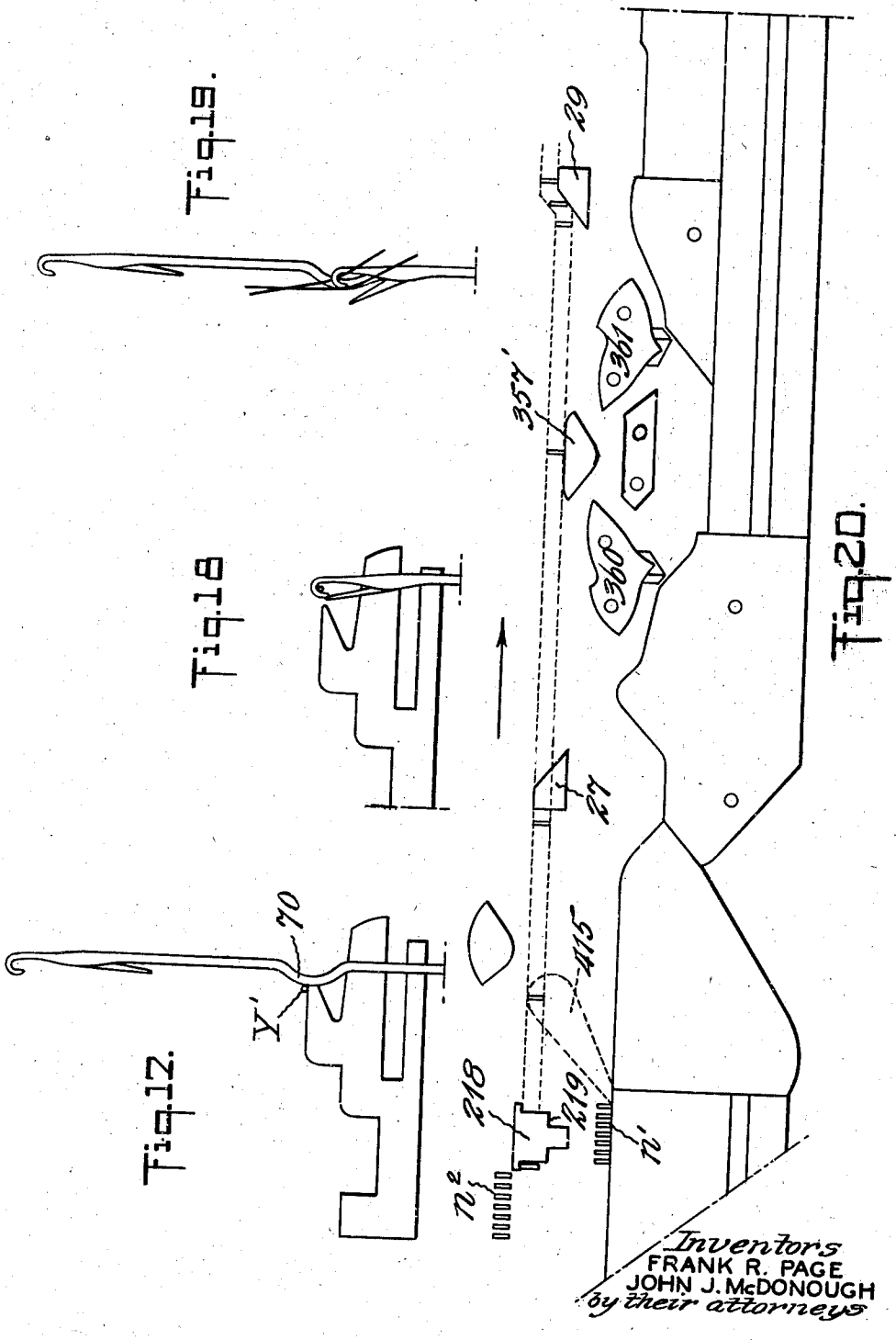
Fig. 15.

Inventors
FRANK R. PAGE
JOHN J. McDONOUGH
by their attorneys
Howson and Howson

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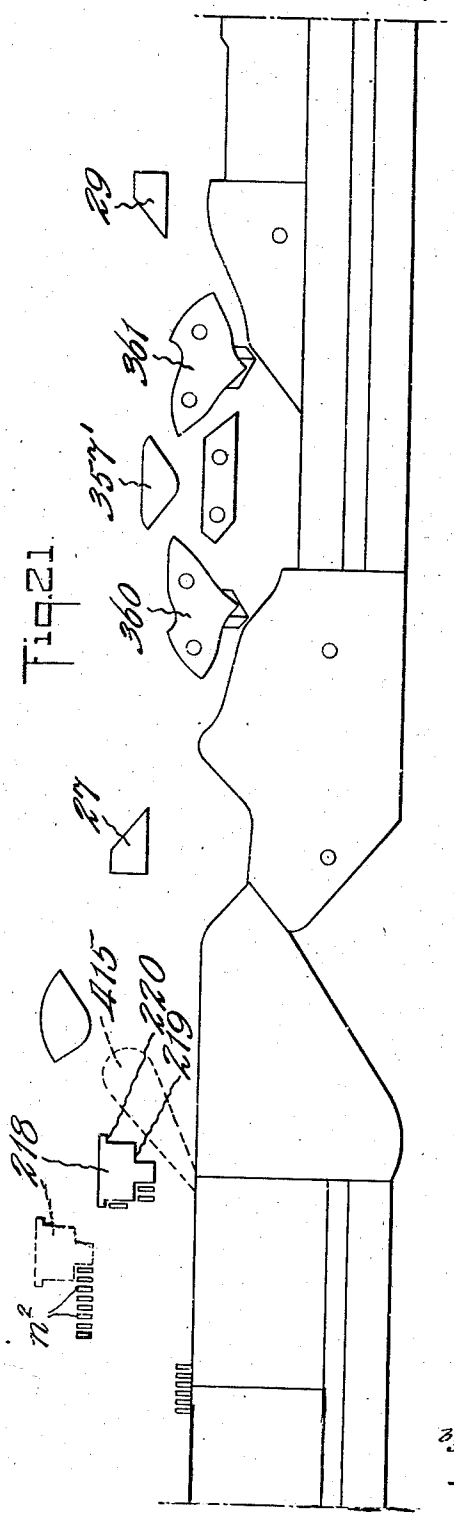


Fig. 21

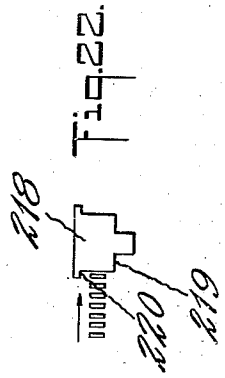


Fig. 22

Inventors
FRANK R. PAGE
JOHN J. McDONOUGH
by their attorneys
Howson and Howson

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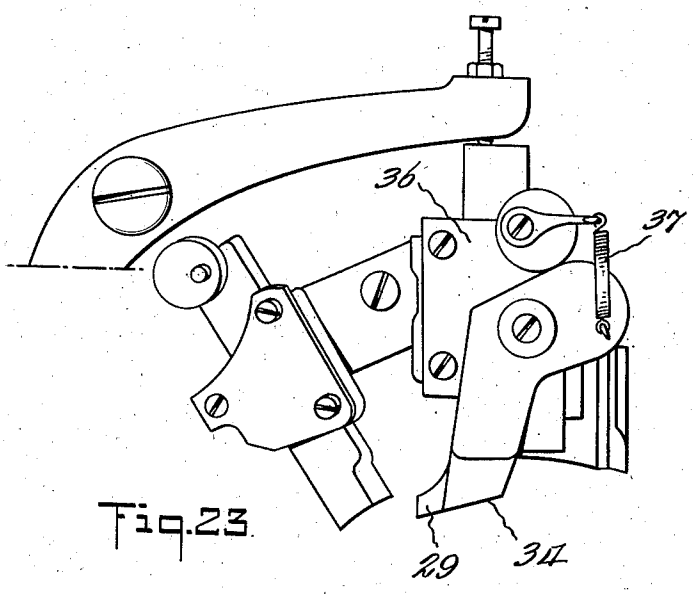


Fig. 23.

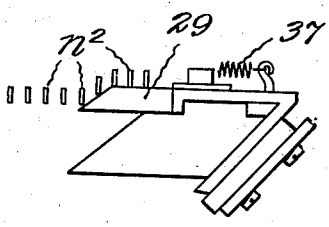


Fig. 24.

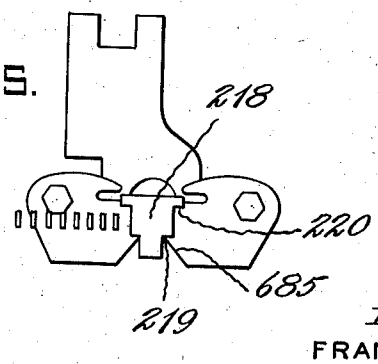


Fig. 25.

Inventors
FRANK R. PAGE
JOHN J. McDONOUGH
by their attorneys
Howson and Howson

Patented Dec. 26, 1944 2,366,124

UNITED STATES PATENT OFFICE

2,366,124

KNITTING MACHINE AND METHOD OF OPERATING SAME

Frank R. Page, Laconia, and John J. McDonough, Belmont, N. H., assignors to Scott & Williams, Incorporated, Laconia, N. H., a corporation of Massachusetts

Application December 30, 1942, Serial No. 470,672

24 Claims. (Cl. 66—93)

This invention relates to circular knitting machines and methods of operating same, more particularly to seamless hosiery machines adapted to make pile fabric known as "terry cloth." The invention relates to an improved machine for making terry cloth seamless heels and toes for hosiery, and the method of operating the machine to produce the fabric. In making terry fabric knit by reciprocatory knitting, such for example as seamless heels and toes, trouble has been encountered in keeping yarns feeding properly when the direction of knitting is changed. One object of the present invention is to devise a machine and method of operating same which will obviate all difficulty in handling the yarns when knitting terry cloth by reciprocatory knitting. It is characteristic of the invention that the terry cloth produced does not contain terry loops on the first few stitches knit in each course.

In forming the pile or terry loops on circular knitting machines having independent needles, it is customary to draw the terry loops over the tops of the nebs of the sinkers while the regular stitches are being drawn on the regular knocking-over ledge. It has been found that owing to the vertical separation and tensions of the yarns necessary to make these terry loops, the body yarn tends to get on top of the nebs of the first few sinkers when starting an oscillation of the machine, i. e., when the direction of knitting is changed. This results in cutting of the body yarn or the formation of large eyelets in the suture, or both. To prevent this difficulty a machine has been devised which keeps both yarns below the nebs of the first few sinkers when starting knitting in a new direction, terry loops being formed, however, on all the other stitches in the course. It has also been found that on certain gauges and sizes of machines, more particularly the finer gauges, the yarns sometimes get out of place at the end of the oscillation; and it is another object of this invention to provide a mechanism and method to avoid this trouble. Seamless hosiery made by using the mechanism of this invention and the method of same is claimed in the co-pending application of Frank R. Page, Ser. No. 472,503, filed January 15, 1943, for "Stocking and method of knitting the same."

Two embodiments of the invention will be shown and described. In both embodiments the omission of terry loops in the first few stitches of each course during reciprocatory knitting is obtained by controlling the sinkers from the needle butts. This is done in such a manner that not only is the number of needles which do not make terry loops kept uniform from course to course, but the needles on which this occurs are varied in accordance with variations in the length of course knit, as for example, during the narrowing and widening of the heel and toe of a seamless stocking.

The first embodiment shown in Figs. 1 to 7 operates the terry sinker cams from the butts of the needles of the inactive group during reciprocatory knitting, while the embodiment of Figs. 8 to 25 actuates the terry sinker cams through the butts of the needles of the active group. In this second embodiment will be found the means for further controlling the yarns in fine-gauge machines.

In the drawings:

Figure 1 is a development of part of the needle cylinder and needle butts of a circular knitting machine according to our invention, in which the butts of the inactive needles control the graduating terry sinker cam, showing the parts just before the terry sinker cam is inserted; the arrow indicating the direction of movement of the needles;

Figure 1*a* is a view in side elevation of one of the terry sinker cams and needle butt reader cams of Figure 1;

Figure 2 is a development similar to Figure 1, showing the parts just after the sinker cam has been inserted; the arrow indicating the direction of movement of the needles;

Figure 2*a* is a view in side elevation similar to Figure 1*a*, showing the parts in the position of Figure 2;

Figure 3 is a view in perspective of the mechanism connecting the left-hand terry sinker inserting cam and needle butt reader cam of the preceding figures;

Figure 4 is a view in perspective of the terry sinkers and the yarns at the commencement of the making of terry loops;

Figure 5 is a view in perspective of the parts of Figures 1*a* and 2*a*;

Figure 6 is a plan view of part of the cams in the sinker cam cap of the machine of Figures 1 to 5;

Figure 7 is a view in perspective of some of the parts of Figures 1 and 2, the dotted lines showing the position of the parts corresponding to Figure 1;

Figure 8 is a partial view in perspective of the mechanism controlling the left-hand sinker inserting cams of an embodiment of the invention in which the cam is controlled by the butts of the active needles, the needle shown being the

first active needle and ready to go under the knitting cam;

Figure 9 is a view similar to Figure 8, showing the parts as the first sinker to make a terry loop is inserted:

Figure 10 is a view in perspective of the right-hand reader and sinker inserting cams of the embodiment of Figures 8 and 9;

Figure 11 is a plan view of the graduating terry sinker inserting cam and operating lever of Figure 10;

Figure 12 is an inverted plan view of part of the sinker cam cap of the embodiment of Figures 8 to 11;

Figure 13 is a plan view of the needle butt reader cam of Figures 8 and 9; the dotted lines showing the position of the cam when the sinker cam is inserted;

Figure 14 is a diagrammatic view in perspective of the needles and sinkers of this embodiment, showing the first needles not making terry loops but the fifth needle preparing to do so;

Figure 15 is a view similar to Figure 14, showing the last needles to knit and needles elevated to control the yarns;

Figure 16 is a view similar to Figure 14, with the necessary needle cams added;

Figure 17 is a view in side elevation of the right-hand sinker and inactive needles of the embodiment of Figure 15, showing how the bump on the needle shank holds the body yarn above the neb of the sinker;

Figure 18 is a view of a sinker and needle, showing the position of the parts when the needle is about to pull the terry yarn below the neb to make an ordinary stitch;

Figure 19 is a diagram showing how the bump on one needle at full inactive height keeps the body yarn out of the hook of another needle when there is no intermediate needle at low inactive level;

Figure 20 is a development of the needle cylinder of the embodiment of Figures 8 to 19, showing the path of needles at the low inactive level while moving in the counterclockwise or rotary direction during a narrowing operation;

Figure 21 is a view similar to Figure 20, taken during a widening operation; the dotted position of the dropper pick being its position before it is acted on by the needle butts;

Figure 22 is a view of the relation of the dropper pick and needle butts during widening before the pick is moved to the position it occupies in Figure 20;

Figure 23 is a plan view of the right-hand needle levelling cam and the parts on which it is mounted;

Figure 24 is a view in front elevation of the levelling cam of Figure 23; while

Figure 25 is a view in elevation looking at the end of the dropper pick in its normal high relation to its cams.

When a terry cloth stitch is desired on machines of the type above referred to, the sinker is inserted at a time which will cause the neb to penetrate between the two yarns. If it is desired to knit regular loops with both yarns, the sinker is inserted at a later point where both yarns are so low that they pass under the neb. According to the present invention, the time of insertion of the sinkers is varied so as to produce plain stitches or terry stitches, by means of novel mechanism controlling the sinkers and yarns on a new principle.

As already mentioned, the invention is peculiarly useful during reciprocatory knitting, and especially when making narrowed and widened fabric having sutures, such, for instance, as heels and toes. If it were attempted to make terry loops in every stitch in the heel and toe of a seamless stocking, the yarns would tend to get out of place and be cut. This is due in part to the necessary tension on the lower yarn tending to pull the loop on the last inactive needle upwardly, thus causing the lower yarn to lead from a higher point and allowing the sinker neb to get under it instead of over it. This results in both yarns being drawn over the top of the neb, making excessively long stitches and cutting the threads. It has been discovered that a terry cloth heel or toe of wholly satisfactory quality can be produced by omitting the terry loops from the first few stitches knit in each course. Thus there are no terry loops immediately adjacent the suture in every other course. By pursuing the method set forth herein, it is possible to produce a heel or toe of terry cloth with the terry loops omitted from say three or four needles on each side of the suture, maintaining that uniform spacing in spite of the narrowing and widening of the fabric which is going on at the same time.

The time element in changing from a plain to a terry stitch is the time of insertion of the sinker, as can be seen from Fig. 14 of the drawings, where the fourth sinker from the left was inserted at the normal time, so that a normal loop is drawn from the terry yarn as well as the body yarn. The fifth sinker is inserted abnormally early so that the terry neb goes between the two yarns, separating them and leaving the body yarn on the regular knocking-over ledge and the terry yarn on the higher terry neb.

We have discovered that a satisfactory method of selecting accurately the first sinker to make a terry loop on each reciprocation, regardless of whether the segment of active needles is being narrowed or widened, is to allow the operating butts of the needles themselves to initiate the selection and to do it at a point circumferentially separated from the point at which the sinker inserting cam is located. We find that if the cam reading the butts of the needles is located at or near the knocking-over point, the spacing from the sinker inserting cam will be satisfactory.

The embodiment of the invention shown in Figs. 1 to 7 is the simpler of the two constructions and is well suited for many types and sizes of machines. In this embodiment the terry sinker cams are operated during the making of tapered segments by reciprocatory knitting from the butts of the inactive needles. The body yarn is fed very low and the terry yarn high, so that there is considerable separation between the yarns. This requires a somewhat heavier tension on the body yarn than would normally be used, and when a needle is raised to the inactive level during the making of either narrowed or widened segments of heels or toes, for example, the stitches on the shank of that needle are pulled upward slightly. At the beginning of an oscillation the yarns therefore are higher than they should be, so the sinker neb moves in under both of the yarns. Cutting of the yarns or the formation of eyelets in the suture frequently result. To prevent this condition, the first few needles to knit at the beginning of each stroke are allowed to draw both of the yarns beneath the sinker nebs before the terry sinkers are inserted. To keep uniform the number of needles which draw both yarns beneath the sinker nebs

so that the making of terry stitches will begin a constant distance from the edge in spite of the narrowing or widening of the segment, the time of movement of the terry sinker cams is gradually changed as the knitting of the segment proceeds. As already stated, this adjustment is automatically obtained from the inactive needle butts.

As can be seen in Figs. 1, 1*a*, 2 and 2*a*, the timed operation is obtained from the butts n^2 of the inactive needles by putting a movably mounted reader cam **40** or **40'** in the path of the butts of the inactive group, so that when those butts push the cam **40** or **40'**, the sinker cam **84** is retracted, and when the inactive butts have passed beyond the reader cam **40** or **40'**, that cam will drop down and the sinker cam will be inserted. Below each of these pivoted reader cams is a support cam **80** or **80'** which serves at once to hold the needle butts at their level so that their oscillatory movement circumferentially of the machine can effectively lift these cams without moving the needle vertically, and also to limit the dropping movement of the cams when the needle butts have passed. In Figs. 1 and 1*a* the needle butts are shown passing under the cam **40'** so that the cam is raised and the terry sinker cam **84'** retracted; while in Figs. 2 and 2*a* the inactive needle butts have just passed the cam **40** and that cam therefore is dropped to its lower position where the terry sinker cam is inserted. In Fig. 2 the direction of movement of the needles is from left to right, and it will be observed that about three active needles have passed beyond the stitch-drawing point although the cam **40** has only just dropped off the inactive needle butts n^2. It therefore follows that about five or six needles of the active group will not have their sinkers inserted in time to make terry loops.

The mechanism connecting the left-hand needle-operated cam **40** to the left-hand terry sinker cam **84** is as follows (see Figs. 3 and 7). The stationary support cam **80** extends radially outward a short distance from the needle cylinder, and at its outer end **81** is pivoted the cam **40**. The reader cam actually is mounted on the lower end of a lever **82** which serves as a terry sinker cam-operating lever, and that lever is the element which is pivoted at the point **81**, the cam **80** being mounted on a bracket **85**. To the upper end of the lever **82** is fastened a toe **83** which is the portion of the terry sinker cam-operating lever that actually engages the sinker cam **84**. It is held in engagement by a tension spring **97**. This cam **84** is adapted to push inwardly only the sinkers having long butts, and the device is so manipulated that it functions only during the heel, toe and high splice, while other mechanism (not shown in these particular figures) operates on all the sinkers at certain other points in the making of a stocking. This other cam is indicated by the reference character **86** in Fig. 6. The two cams **84** and **86** are fastened by a shouldered collar **87** to a platform on the side of the regular sinker cap **300** (see Fig. 6). Each cam is held out of action when not making terry loops by a coiled spring **88** (see Figs. 5 and 6). It will be understood, of course, that the mechanism which has been described is actually on the machine in duplicate, one set working when the machine is turning in one direction, and the other working when the machine is turning in the other direction.

The control mechanism idling the round-and-round terry sinker cam **86** and the graduated sinker cam **84** is shown in Fig. 3, being operated from the thrust rod **460**, which in turn is controlled by a series of cams on the main pattern drum **120**. The insertion of the round-and-round terry sinker cam **86** is obtained from the thrust rod **460** by bell crank lever **89** fastened to the upper end of the thrust rod and connected to a slide link **90** by a shouldered screw **91**. This bell crank lever **89** is pivoted by a shoulder screw **93** in a bracket **94** mounted on the latch ring bracket **401**. Said connecting link is fastened to a bracket **92** which is carried near the sinker cam **84**. The round-and-round terry sinker cam **86** can be used, for example, to make terry loops all around during the ring toe, if desired.

To hold both terry cams out of action during the knitting of the leg, a lever **95** on the gap-closer shaft is operated by adjusting plate **96** projecting laterally from the thrust rod **460**. Thus when the thrust rod is raised, the forward end of the lever **95** moves downward against the tail of the sinker operating lever **82**, thus pulling the toe **83** away from the graduated terry cam **84**. In addition the thrust rod **460** also holds the slide link **90** (Fig. 3) away from the terry sinker cam **86** (Fig. 6) at all times except during the ring toe.

The shape of the sinkers **292** can be seen in Fig. 4. The nebs **293** are adapted to receive the terry yarn Y^2 on their upper edges in the notches **294**. The body yarn Y^1 is fed from a yarn finger F^1 resting in a notch **561** cut in the throat plate **559**. The terry yarn Y^2 is fed from a yarn finger F^2 fed at an elevation above the normal surface of the throat plate. In Fig. 4 the fourth sinker from the left is the first one which is inserted early enough to make a terry loop.

The right-hand reader cam **40'** and support cam **80'** are similarly mounted (Figs. 1 to 2*a* and 5). The pivot point **81'** supports the reader cam, the whole being carried on the bracket **85'**. The right-hand sinker cam is shown at **84'**.

The operation of the device is as follows. When knitting the leg the terry cam operating lever **82** is held out of action by the high pattern drum cam **501** until the high splice is reached, keeping the thrust rod **460** raised. At the beginning of the high splice the thrust bar drops onto a low step on the pattern drum cam, allowing the control lever **95** to push the toe **83** against the terry sinker cam **84**, thus pushing the terry sinkers in. At the beginning of the heel the instep needles are raised out of action by the usual switch raising cam (not shown), and as they pass between the support cam **80** and the needle-operated cam **40**, they raise this latter cam. This carries the toe **83** away from the terry sinker cam **84**. At the beginning of the counter-clockwise stroke, after the first few needles have drawn both terry and body yarns beneath the sinker needles (as shown, for example, in Fig. 4), the last inactive needle N^{211} passes from under the toe of the cam **40** and a tension spring **97** draws the toe **83** of the sinker-operating lever **82** against the graduated terry sinker cam **84**. This pushes the sinker nebs between the terry and body yarns. There is a tension spring **98** pulling the thrust rod down when it rides off the cam on the main pattern drum.

In the ring toe when the thrust bar **460** drops off the low step on the drum cam onto the surface of the pattern drum, the thrust bar allows the sliding link **90** to be pushed against the lower terry sinker cam **86** in order to push all the sink-

ers into action to begin the making of terry cloth.

The second embodiment of our invention is shown in Figs. 8 to 25, inclusive. This is the form which uses the butts n^1 of the active needles. As in the previous embodiment, it is necessary to feed the two yarns from distinctly different elevations at the throat plate **559**. Thus in Fig. 14 the body yarn Y^1 is fed from the same finger F^1 in the same notch **561** in the throat plate, as in the first embodiment, and the terry yarn Y^2 from the finger F^2

The sinkers **292'** in the machine have nebs **293'** which are modified in shape to permit the making of terry cloth. The upper surface **294'** of the neb is flat. The lower surface of the neb is a substantially straight line tapering down to the throat of the sinker. The end of the nose or neb is somewhat pointed so that it can easily enter between and separate the yarns Y^2 and Y^1, as shown for instance by the fifth sinker **292'** from the left. The active needles are designated by the reference numeral N^1, and the last inactive needle by the character N^{21}. As can be seen in this figure or Fig. 18, once the needles have pulled the yarns down over the knocking-over ledge, then insertion of the sinker will cause the formation of an ordinary stitch.

In Figs. 8 and 14 is shown the left-hand terry sinker cam **30**, i. e., the one which is in use when the cylinder is turning in a counter-clockwise direction. The first angle or edge **32** of the cam to contact the sinkers pushes the sinker nebs between the terry and body yarns. The second angle or edge **33** pushes the terry sinkers in deeper and ahead of the time when they would be inserted by the regular sinker side cam. The purpose of this second or deeper insertion is to slacken the body yarn loops when making a terry seam, in order to prevent loose loops of yarn showing on the face of the fabric.

It will be observed from Fig. 14 that the machine with the novel camming arrangement is so adjusted in this instance that the first terry loop to be formed occurs between the fourth and fifth needles away from the last inactive needle N^{21}, i. e., the point at which the seam or splice will be formed. In other words, the time of insertion of the left-hand sinker cam **30** is such that it is the fifth sinker from the last inactive needle N^{21} which is the first one to be pushed in early enough to separate the terry yarn from the body yarn, so that the terry yarn loop is drawn over the top **294'** of the sinker neb **293'**. In Fig. 9 the first active needle is just being knocked over and the cam **30** is pushing in the first sinker to make a terry loop. However, there are in Fig. 9 three additional sinkers (not shown) between the needle and sinker shown in that figure. The cam **30** itself is pivotally mounted at the outer edge of the sinker cap **300**, as already described, and operates radially inward through a slot in that cap. The right-hand terry sinker cam **31** is similarly mounted, facing in the opposite direction, of course (Fig. 11).

The mechanism transmitting motion from the butts n^1 of the active needles to this terry sinker cam **31** will be traced next. We locate the left-hand needle butt reader cam **41** underneath the stitch cam **360**, the contacting portions of the reader cam beginning at the knocking-over point and extending a short distance beyond same (see Figs. 8, 16, 20 and 21). The exact shape of the reader cam can be seen in Fig. 13, from which it appears that the cam **41** itself is mounted on an adjusting plate **42** fastened to a bell crank lever **43** pivoted on the bedplate B of the machine. The contact from this bell crank lever **43** to the terry sinker inserting cam **30** is through a bell crank lever **44** pivotally mounted on a horizontal axis on the left up-pick bracket **85**. The lower arm of the lever **44** lies in back of the arm of the lever **43** and is so mounted that when the reader cam **41** is pushed radially outward, the upper arm of the bell crank lever **44** rises. The end of this upper arm is connected by a link **45** to a terry sinker operating lever **46**. This lever **46** is pivoted on the latch opener bracket **540** which is radially behind the left up-pick bracket **85**. This lever **46** has an adjusting toe **48** on its end which is located above the pivot point **49** of the lever just mentioned, with the result that when the needle butt reader cam **41** is pushed radially outward, the upper arm of the bell crank lever **44** moves upward and the adjustable toe **48** of the terry sinker operating lever **46** pushes the cam **30** into action.

The control means just described are needed of course only during reciprocatory knitting so the control of the terry sinker cam **30** by the needle butts is held out of action at all times except during the making of heels and toes. The control is from the main pattern drum and is connected to the needle butt reader cam **41** through the rear arm of the bell crank lever **43** carrying the reader cam **41** (Figs. 8 and 9). Coming upwardly from the main pattern drum (not shown) is a pivoted bell crank lever **461** operated by cams on this main pattern drum. When the lower end of the bell crank lever **461** rides onto a cam on the main pattern drum, the upper end of the lever draws back. This withdraws a collar **51** on a wire **50** attached to the lever, from contact with a stud **52** on the rear arm of the bell crank lever **43**. As a result the reader cam **41** is pushed into the path of the butts of the needles by a tension spring **53** fastened to the lever **45**. This also positions for action the toe **48** on the terry sinker cam operating lever.

When the foot of the bell crank lever drops off the drum cam, a heavy spring (not shown) connected between the lever and the bedplate B of the machine pulls the upper end of the lever forward so that collar **51** on wire **50** operates against the stud **52** moving the lever **43** and retracting the reader cam clear of the butts of the needles. In addition the movement of lever **43**, acting through the lever **44** on the lifter up-pick bracket, carries the toe **48** of the sinker operating lever **46** below the terry sinker cam **30** and out of operative position. It might be further pointed out with regard to the manner of operation of this control that the manner of adjustment shown in the drawings is based on the fact that the active needles during the making of heels and toes on this machine have relatively short butts and the idle or inactive needles have long butts. The adjustment therefore is such that the toe of the operating lever **46** will cause the terry sinker cam **30** to insert sinkers early when the reader cam **41** is engaged by a short needle butt n^2. If a long needle butt were to engage the reader cam, it would cause the toe **48** of the operating lever **46** to be carried beneath the terry sinker cam **30**.

The operating means above described for the terry sinker cam can be identified as the graduating attachment. If it is desired to splice sectionally without varying the number of needles spliced, it is possible to hold the terry sinker cam in action by a regular double-sole slackener cam operating arm which is fastened to the usual gap-

closer thrust bar (well known). Such a construction, for example, can be used in the high splice and double sole of a stocking where it is not desired to make terry loops.

We have so far described the mechanism controlling the terry sinker cam 30 on the left side of the machine. The mechanism controlling the right-hand terry sinker cam 31 is very similar, and is shown in Figs. 10, 11 and 12. The terry sinker cam 30 above described operates when the cylinder is turning in a counter-clockwise or rotary direction. The sinker cam 31 to be described operates on what is known as the "reverse" side, which is when the machine is turning in a clockwise direction during reciprocatory knitting.

The right-hand needle butt reader cam 41' is located under the leading stitch cam 361 in a position corresponding to the location of the reader cam 41 under the left-hand stitch cam 360. The right-hand reader cam 41' is mounted on an adjusting plate 55 which is fastened to a lever 56, one spur of which is engaged by the lower arm of a bell crank lever 57 pivoted on a horizontal axis on an arm 58 carried by the right-hand up-pick bracket 85'. The arm 58 is stationary and not only acts as a support for the bell crank lever 57 but also as a pivot point for the terry sinker cam operating lever 60. The connection between the bell crank lever 57 and the sinker cam operating lever 60 is a linkage 59 adapted to cause insertion of the sinker cam when the needle butt reader cam 41' is engaged by a needle butt. The operating lever has an adjusting toe 61 similar to the operating lever 46 for the left-hand terry stitch cam.

As in the case of the left-hand sinker cam, it is necessary to provide mechanism to hold the graduating attachment out of action, and again this is controlled from the main pattern drum. A thrust rod 460 acting through a cam 62 on its upper end causes rotation of a short horizontal shaft 63, which moves forward a short arm 64 carried on the shaft, pushing a control link 65 which is connected by a shouldered screw 67 to the rear end of lever 56. This link 65 holds the reader cam out of action with the toe 61 on the operating lever below the terry sinker cam 31. There is a tension spring 66 on the back end of the operating lever 60 to raise it to operative position when released by the mechanism just described. The cams on the main pattern drum are so adjusted that the graduated attachment on the right side of the machine just described is moved out of action during the make-up of the stocking to allow a dividing cam (not shown) to be inserted to carry the divided needles beneath the so-called reverse stitch cam 361 on the right side of the machine.

It will be seen that the circumferential separation of the needle butt reading cam and the sinker cam determines the width of the narrow band adjacent the suture in which terry cloth loops are not formed. The manner in which the sinkers are selected by the needles and the band where terry loops are not formed is kept of uniform width in narrowed or widened segments of the heel or toe, will be described next. This is accomplished by taking advantage of the fact that during reciprocatory knitting the butts of the active needles form a group at one level and the butts of the inactive needles form a group at a different level. This differentiation between the groups makes it possible for the needle butts to control the insertion and removal of the terry sinker cam. Thus it has been found possible to use the beginning of a group of the needle butts, or in cases where there are both active and inactive groups, a dividing line between an active and inactive group, or vice versa, to control the moment of insertion or removal of the sinker inserting cam for making terry loops. (It will be understood of course that there is a regular sinker cam in the machine which inserts at the regular time any sinkers which were not inserted early.) It will be observed that operating on this principle, the selection or moving of a needle into or out of the active segment of needles automatically readjusts the point at which the terry cloth loops will begin to be formed, thus maintaining the proper width of non-terry cloth band adjacent the suture. Thus it will be seen that the sinker to be selected is the one passing the terry sinker inserting cam at the moment that the dividing line between the active and inactive segments of needle butts are passing the needle butt reader cam or the knocking-over point. It might be noted at this point that the omission of terry loops in a course in a heel or toe occurs at only one end of the course. Thus when knitting away from the suture, the loops are omitted at the first few needles at the leading end of the segment of active needles, and the effect of the circumferential separation of the reader cam and the sinker inserting cam is to cause a few sinkers beyond the last inactive needles to be inserted early without affecting the knitting.

It will be noted that there is a unique combination of controls in that the variable terry cam is operated by the needle butts as described, but idled by the main pattern drum which directly controls the formation of terry cloth in other parts of the stocking.

To avoid clipping the yarns, it has been found advisable in fine-gauge machines to raise both body and terry yarns above the nebs of the sinkers at the end of each stroke. This is accomplished through manipulation of the yarns by a crook 70 formed part way down the shank of each needle. This crook 70 is a bulge towards the sinkers, which is opposite (i. e., overlaps) the nebs of the sinkers when the needles are at the full inactive level. (See the needle N^{22}, Fig. 15, and the needle in Fig. 17.) In Fig. 15 the right-hand needle N^{22} is at the inactive level, and it will be observed that the lower yarn is held radially outward by the hump 70 (see Fig. 17). The hump also serves to raise the lower or body yarn sufficiently so that it is above the sinker nebs at the time they are inserted by the terry sinker cams. In other words, the hump on the needle raises and pushes the body yarn out and above the sinkers, thus preventing the body yarn from being crinkled while the needles are inactive, and being subsequently clipped.

It is found that this pushing of the yarns radially outward causes the terry yarn to be pushed clear of the hook of the last active needle, if done too close to the last active needle. (The body yarn is kept from being thrown out of the hook because the last terry sinker which took the body yarn pushes the body yarn downward and inward.) It is also found that at the beginning of the stroke in the next direction the crook or hump in the needles will throw both yarns out of the first needle which is supposed to knit them. This can occur because the terry sinkers are not inserted immediately and the body yarn is not guided downwardly and inwardly. Both these difficulties can be overcome by temporarily plac-

ing the inactive needle adjacent the active needle at a slightly lower level.

Prevention of throwing off of the yarns from the first needle to knit in spite of the hump on the needle is obtained by special vertical manipulation of the needle with the resulting movement of the hump, and this manipulation is obtained automatically by modification of the cams in the cam cylinder and the picking mechanism. The method and mechanism are shown in Figs. 14 to 25, inclusive. The central feature of the method is the raising of the first inactive needle a slightly lesser distance than normal. By placing this first inactive needle at a level not quite so high, the hump in the shank of that needle is low enough so that it does not push the yarn out of the path of the active needles following it (see Fig. 16).

The other condition in which the hump might throw yarn out of a needle which is to knit occurs where the last active needle is followed by inactive needles whose humps are being used to keep the two yarns above the nebs of the sinkers. This is shown in Fig. 15. Similarly to the means and method of preventing the hump from throwing the terry yarn out of the hook of the last needle to knit, the first needle to knit is taken care of by having the first following inactive needle drawn down a little from the inactive level.

The construction which modifies the elevation of the last inactive needle preceding a group of active needles at a lower level than usual is as follows. Normally in most machines of this type the up-picks **650** which raise needles to the inactive level one at a time during the narrowing operation, do no raise the butts of their needles to the full inactive level. They merely raise the butts until they are above the point of the top center cam, and the curved top of the center cam raises the needles the rest of the way to what is known as the inactive level. In the modified construction which we have devised, the top center cam **357'** is cut down in height so that a needle brought up to it by a raising pick **650** will be raised by the top center cam only to a point where the hump on the needle will not keep the incoming yarns from the first needle to knit. After the needle raised by the pick **650** has passed the top center cam **357'** it is raised by a pivoted auxiliary side cam **27** or **29** to the regular inactive height where the stitch around the needle shank will rest below the hump (see Fig. 16). In this figure the last inactive needle N^{21} is shown in two positions, namely, the low inactive level corresponding to the reduced height of the top center cam, and the full or normal inactive level which is shown in the needle at the left of the figure. The progress of the needles in this figure is from right to left. The complete layout of the modified cam and picker mechanism for controlling this low-level action is shown in this figure where the needles are turning in the counter-clockwise or rotary direction, and in Figs. 20 and 21, where the machine is turning in a clockwise direction. We have already mentioned that the raising of a needle to the low inactive level by an up-pick is employed. This takes care of the matter of both yarns being thrown out of the first active needle at the beginning of the stroke during the narrowing operation.

In the machine as constructed, this lifter pick operation continues through the widening segment of the heel or toe, as well as through the narrowing, the narrowing thus caused being more than offset by the action of the dropper pick, which will be described.

The lowering of the first inactive needle N^{23} to the low inactive level is caused by the dropper pick **218** which is shown in Figs. 20, 22 and 25. We will first describe the manipulation of this dropper pick during the knitting of the narrowing segment of the heel, this being shown in Fig. 20. The dropper pick is of the two-level type and is operated at all times during the making of the heel and toe. During narrowing of the heel, it is held down to the low level shown in Figs. 20, 22 and 25 by cams on the main pattern drum acting through the usual dropper control finger (not shown). When thus held down, the regular or lower lip **219** will be below the normal inactive needle level, as shown in Fig. 22. The contact of the leading inactive needle N^{23} with the upper lip **220** causes the dropper to move sideways in accordance with the cam surfaces **685** shown in Fig. 25, and to be lowered thereby to the level of the pick shown in Fig. 20, after which the dropper pick swings sideways and away from the needles due to separation of the needle circle and the arc of movement of the pick. This leaves the first inactive needle at the low inactive level shown in Fig. 15, where its hump is low enough so that it will not throw the terry yarn outward away from the hook of the last active needle. Continued rotation of the machine in the direction of movement shown in Fig. 20 causes this partially lowered inactive needle to pass inside the switch cam **415**, after which it strikes the levelling cam **27** adapted to act on needles of this level when the machine is turning in the forward direction. This levelling cam **27** then swings aside and allows the needle to pass by virtue of the mounting shown in Fig. 16. The needle then passes over the cut-down top center cam **357'** and is raised again to its full inactive height by the companion levelling cam **29**. On the stroke or oscillation in the other or forward direction, the upper lip **220** on the other side of the dropper pick **218** engages the leading inactive needle in that direction, partially lowers it, and that needle knocks aside the levelling cam **29**, passes over the top center cam **357'** and is raised to its full inactive height by the levelling cam **27**.

During the making of a widened segment of the heel or toe, the dropper pick performs its usual widening function without ceasing to provide an inactive needle at the low inactive level, as just described. This is accomplished by causing the dropper control finger (not shown) to allow the dropper pick **218** to rise to its full height and to operate from that level during the making of the widened segment. As shown by the dotted line position of this dropper pick in Fig. 21, a lower or regular lip **219** engages two butts n^1, and the extent of movement of the dropper is such that those two needles are lowered to join the active segment by passing under the top center cam **357'**. As the dropper is pulled down under the combined action of the butts of the first inactive needles and the cam surfaces **685** in Fig. 25, the third needle in that inactive segment becomes the leading needle and is pulled down part way to the so-called inactive level, as set forth in the above description in connection with Fig. 20.

In this way the terry yarn is not pushed out of the hook of the last inactive needle on an oscillation in either direction during either the narrowed or widened segments of the stocking.

The mounting and manner of construction of the levelling cams **27** and **29** above referred to are

shown in more detail in Figs. 16, 23 and 24. The forward levelling cam 29 is pivoted on the dividing cam slide cover plate 36, which is fixedly mounted on the bedplate B of the machine, the levelling cam being pivotally mounted thereon, and the rear end of the cam being held by the tension of a spring 37 so that it tends to stay in its operative position, as shown in elevation in Fig. 24. It will be noted, however, that coming from the side the needles approach it when the machine is rotating or turning in a counter-clockwise direction, the face of this cam 29 is tapered away from the needle cylinder at 34, so that the needle butts will cause the levelling cam to be brushed aside against the tension of the spring 37, thus allowing the needles to pass. The companion auxiliary raising cam 27 which completes the raising of the inactive needles to their usual level when the machine is turning in the counter-clockwise direction is shown with its mounting at the left side of Fig. 16. This levelling cam 27 is pivotally mounted on a stud 38 in the cam ring, and there is associated with this pivotal mounting a tension spring 39 tending to pull the cam into its operative position.

What we claim is:

1. In a circular knitting machine, independent needles, butts on said needles and means causing differentiation of said butts into groups, in combination with sinkers adapted to form terry loops when inserted earlier than usual, a cam adapted to push sinkers in early and means actuated by the butts of at least one of said groups to cause insertion of said sinker cam during part of a revolution of the machine.

2. In a circular knitting machine, independent needles, butts on said needles, means separating said butts vertically into groups and sinkers adapted to form terry loops when inserted earlier than usual, in combination with a cam adapted to insert sinkers early and means adapted to cause insertion of said sinker cam at varied times, said means being actuated by the needle butts at one level.

3. In a circular knitting machine adapted to knit in reciprocation, a circular series of independent needles having operating butts thereon and means adapted to separate said needles vertically into active and inactive groups for reciprocatory knitting, in combination with sinkers adapted to cause the formation of terry loops when inserted earlier than usual, a cam adapted to insert sinkers early and means operated by the butts of one of the groups of needles adapted to cause insertion of said sinker cam at varied times.

4. In a circular knitting machine, independent needles, butts on said needles, means separating said needles vertically into active and inactive groups and sinkers adapted to form terry loops when inserted earlier than usual, in combination with a cam adapted to insert sinkers early and means actuated by the butts of one of the aforesaid needle groups to cause insertion of said sinker cam, said sinker cam being located at a different effective point on the needle circle than the means actuated by the needle butts, whereby the point on the fabric where terry loops begin is separated from the point on the fabric which corresponds to an end of one of the needle groups.

5. In a circular knitting machine, a circular series of independent needles having operating butts thereon, means adapted to cause vertical separation of said needle butts into groups corresponding to the groups of active and inactive needles for reciprocatory knitting, means causing the progressive narrowing and widening of the active group, in combination with sinkers adapted to cause the knitting of terry loops when inserted earlier than usual, a cam adapted to insert the sinkers early and means operating said sinker cam controlled by the butts of one of said needle groups.

6. In a circular knitting machine adapted to knit heels and toes by reciprocation with narrowing and widening of an active needle group, sinkers adapted to make terry loops when inserted earlier than usual, a sinker cam adapted to cause early insertion of the sinkers, and needles and operating butts on the needles, in combination with a cam reading the butts of the active needles actuating said sinker cam, whereby said singer cam is inserted in fixed time relation to the passage of the leading active needle.

7. In a circular knitting machine adapted to knit heels and toes by reciprocation with narrowing and widening of the inactive needle group, sinkers adapted to make terry loops when inserted earlier than usual, a sinker cam adapted to cause such early insertion of the sinkers, needles and operating butts thereon, in combination with a cam reading the butts of the active needles actuating said sinker cam, whereby said sinker cam is inserted in fixed time relation to the passage of the leading needle of the active group.

8. In a circular knitting machine adapted to knit heels and toes by reciprocation with narrowing and widening of an active needle group, sinkers adapted to make terry loops when inserted earlier than usual, a sinker cam for each direction of knitting adapted to cause such earlier insertion, independent needles and operating butts thereon, in combination with a needle butt reader cam for each direction of knitting adapted to cause insertion of the corresponding sinker cam when needle operating butts are passing under the knitting cam.

9. In a circular knitting machine according to claim 8, the locating of the needle butt reader cams at points circumferentially later than the corresponding terry sinker cam, whereby the terry loops are omitted on the first few stitches of the course.

10. In a circular knitting machine adapted to knit heels and toes by reciprocation with narrowing and widening of an active needle group, two yarn fingers feeding yarns at different elevations, sinkers and independent needles having humps on the hook side of their shanks, in combination with needle-manipulating means adapted to place a selected needle at a low inactive level in order that the hump may guide the upper yarn with relation to the sinker, and other cam means adapted to raise said needle higher after passing the point where the yarn reaches the sinkers.

11. A circular knitting machine according to claim 10, in which the needle manipulating means comprise in part a top center cam which leaves needles passing over it at the low inactive level and an auxiliary cam on each side of the top center cam adapted to raise to the normal inactive level needles approaching it from the top center cam side.

12. A circular knitting machine according to claim 10 in which the needle manipulating means comprise in part a top center cam which leaves needles passing over it at the low inactive level and an auxiliary cam on each side of the top center cam adapted to raise to the normal inactive level needles approaching it from the

top center cam side, said auxiliary cams being adapted to be pushed aside by needle butts moving past in the opposite direction.

13. A circular knitting machine according to claim 10 in which the needle manipulating means comprise in part a dropper pick adapted to move at least one needle butt from inactive to low inactive level, a top center cam which leaves needles passing over it at the low inactive level and an auxiliary cam on each side of the top center cam adapted to raise to the normal inactive level needles approaching it from the top center cam side.

14. A circular knitting machine according to claim 10 in which the needle manipulating means comprise in part a top center cam which leaves needles passing over it at the low inactive level, two raising picks each adapted to raise the leading needle of the active group on its oscillation so that it passes over the top center cam at low inactive level, and a dropper pick adapted to move at least the leading inactive needle at each oscillation to the low inactive level and an auxiliary cam on each side of the top center cam adapted to raise to normal inactive level needles approaching it from the top center cam side.

15. In a circular knitting machine, a control drum, independent needles and sinkers adapted to cause formation of terry loops when inserted earlier than usual, in combination with butts on said needles and means causing differentiation of said butts into groups at different levels, cam means adapted to cause early insertion of sinkers, means controlled by the butts of the needles at one level adapted to actuate the cam means for partial courses at one point in the knitting, and means controlled by the drum adapted to actuate the cam means at another point in the knitting.

16. In a circular knitting machine, a control drum, independent needles and sinkers adapted to cause formation of terry loops when inserted earlier than usual, butts on said needles and means causing progressive differentiation of said butts into groups at different levels on different courses, means controlled at each course by the butts of the needles at one level adapted to actuate the cam means for partial courses of varying length at one point in the knitting, and means controlled by the drum adapted to actuate the cam means at another point in the knitting.

17. In a circular knitting machine, independent needles and sinkers adapted to cause formation of terry loops when inserted earlier than usual, butts on said needles and means causing differentiation of said butts into groups at different levels, cam means adapted to cause early insertion of sinkers, means controlled by the butts of the needles at one level adapted to actuate the cam means for partial courses at one point in the knitting, a drum, and means controlled by the drum adapted to actuate the cam means at a point in the knitting different from that where the needle butt controlled means operate and to control the idling of the means controlled by the needle butts.

18. In a method of making terry cloth by reciprocatory knitting on a circular knitting machine, the steps of separating the needles vertically into active and inactive groups and selectively inserting sinkers early to separate the terry yarn and draw terry loops thereof, said selectivity being controlled by the passage by the knitting cams of a dividing line between the active and inactive groups.

19. In a method of making terry cloth by reciprocatory knitting on a circular knitting machine, the steps of separating the needles vertically into active and inactive groups, reading the butts of the active group by means of a cam and causing insertion of a sinker cam when the reader cam rides onto the needle butts, but applying the sinker cam at a point in advance of the reader cam, whereby the sinkers adjacent the first few needles in the group do not form terry loops, and drawing terry loops on the sinkers inserted by the cam.

20. In a method of making terry cloth by reciprocatory knitting on a circular knitting machine, the steps of separating the needles vertically into active and inactive groups and causing the passage of a reader cam onto or off of the butts of one of said needle groups to cause insertion of a sinker cam at such a position as to cause the drawing of terry loops on sinkers passing the cam while the latter is inserted.

21. In a method of making terry cloth by reciprocatory knitting on a circular knitting machine, the steps of separating the needles vertically into active and inactive groups, reading the butts of the active group of needles by means of a cam and causing the insertion of a sinker cam at a point circumferentially in advance of the reader cam at a time when the latter is on a needle butt, whereby terry loops are formed on all the needles in the active group except the first few at the leading end.

22. In a method of knitting terry cloth by reciprocatory knitting on a circular knitting machine, the steps of separating the needles vertically into active and inactive groups, and then causing a cam to read the butts of the active group, thereby inserting a sinker cam at a point circumferentially in advance of the reader cam when the reader cam rides onto the butts of the active needles, whereby terry loops are formed on all needles in the active group except the first few at the leading end.

23. In the method of knitting of claim 22, the added step of varying the number of needles in the active group while continuing to control the insertion of sinkers for terry loops from the circumferentially earlier point on the needle circle, whereby the needles on which terry loops are formed are varied but the terry loops are kept a uniform number of stitches away from the edge of the segment of fabric being knit.

24. In the method of knitting of claim 22, the added step of placing an inactive needle following the active group at such a level that as the yarns reach the sinkers a hump on the needle shank guides both yarns over the nebs of the sinkers, whereby subsequent cutting of the yarns is avoided.

FRANK R. PAGE.
JOHN J. McDONOUGH.