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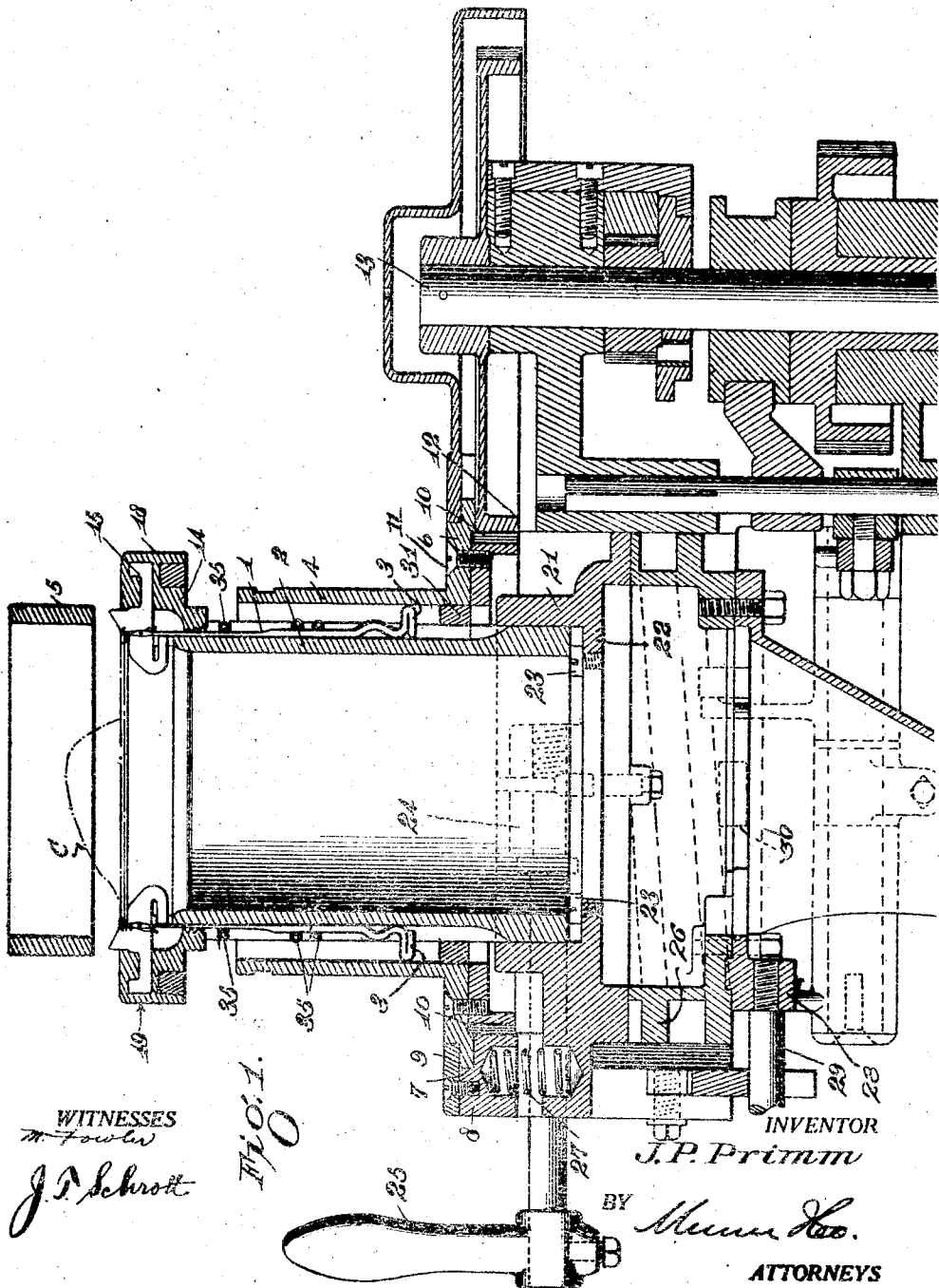
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J. P. PRIMM

CAM BOX FOR KNITTING MACHINES

Filed June 14, 1924

5 Sheets-Sheet 1



Dec. 1, 1925.

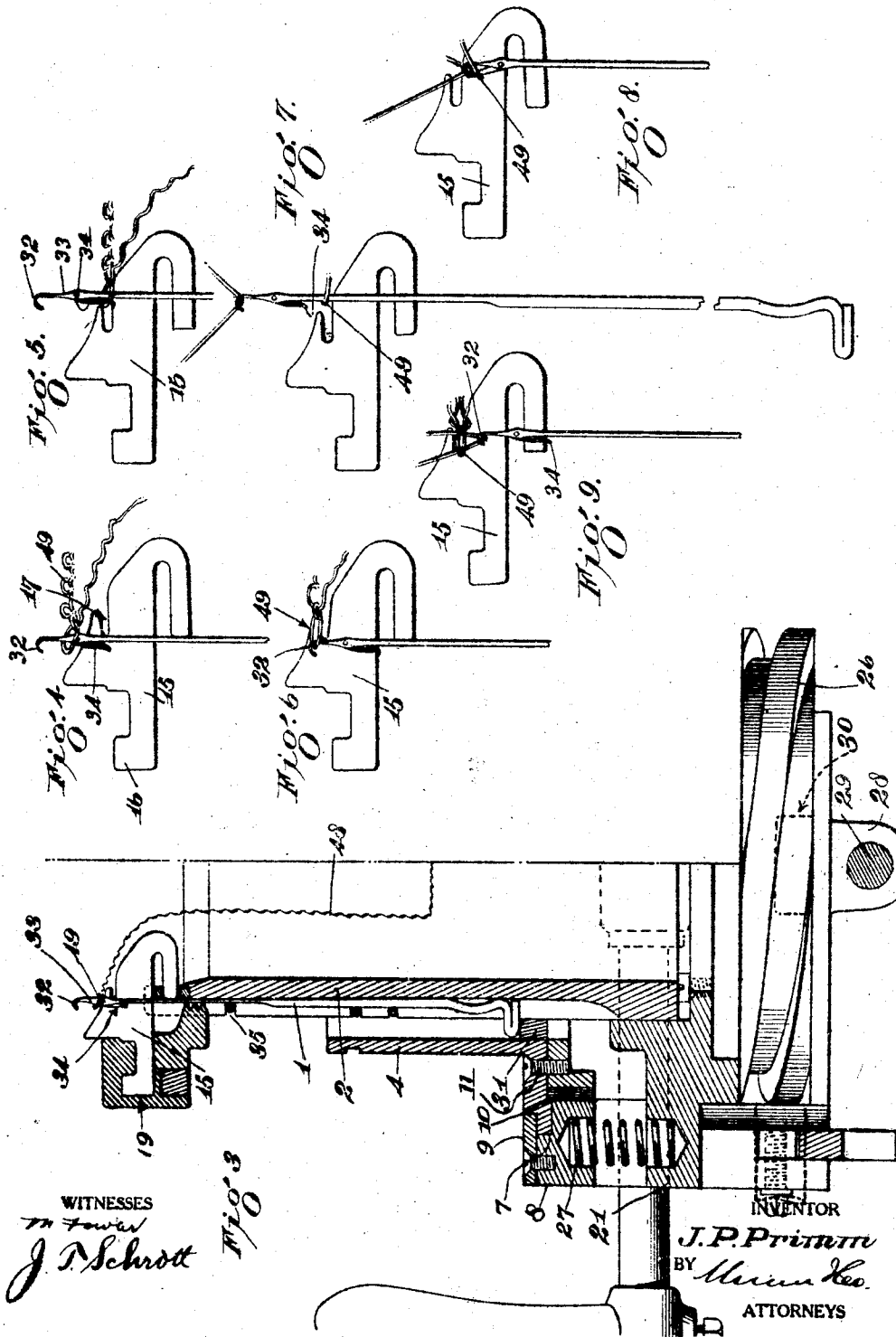
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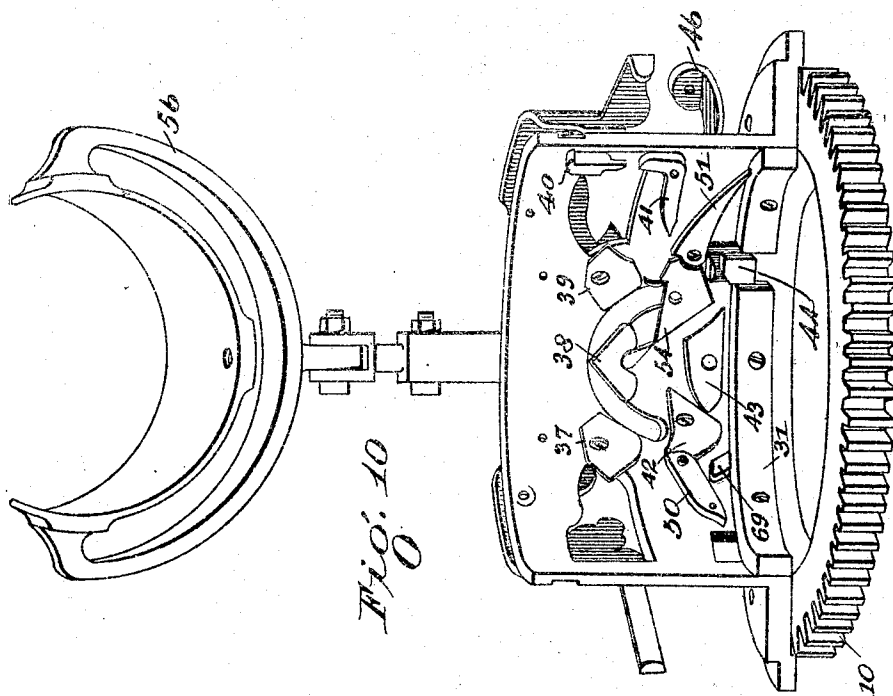


Fig. 10

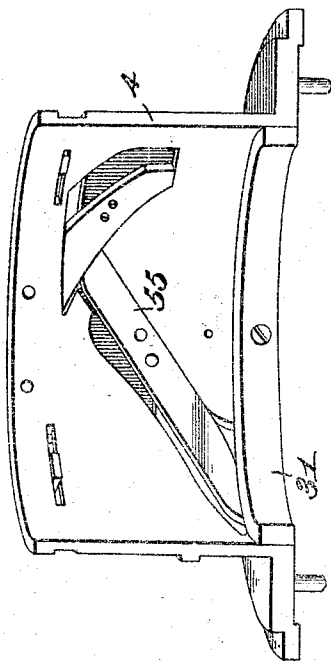


Fig. 11

WITNESSES

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CAM BOX FOR KNITTING MACHINES

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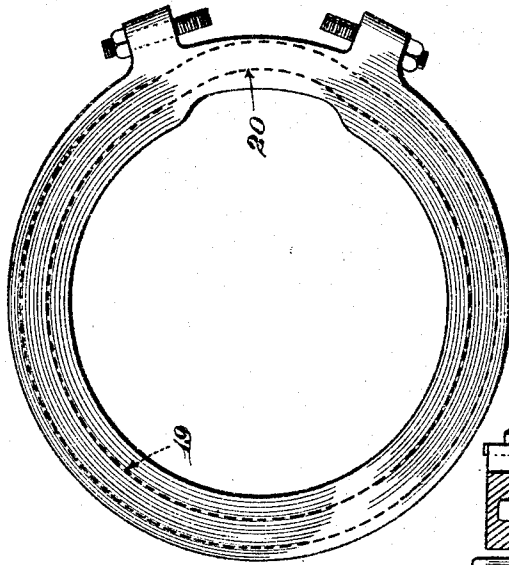


Fig. 13

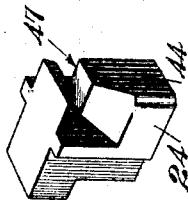


Fig. 12

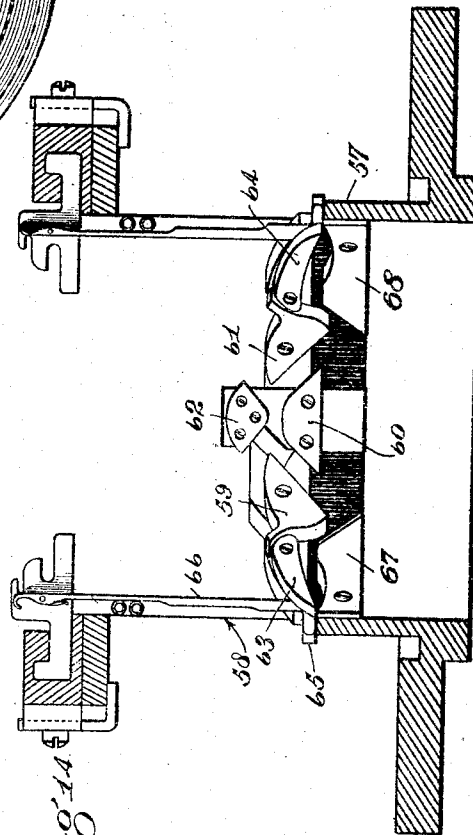


Fig. 14

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UNITED STATES PATENT OFFICE.

JOSEPH PARKS PRIMM, OF ROME, GEORGIA, ASSIGNOR OF ONE-FOURTH TO HENRY R. BERRY AND ONE-FOURTH TO JOHN M. BERRY, BOTH OF ROME, GEORGIA.

CAM BOX FOR KNITTING MACHINES.

Application filed June 14, 1924. Serial No. 720,030.

To all whom it may concern:

Be it known that I, JOSEPH PARKS PRIMM, a citizen of the United States, and resident of Rome, in the county of Floyd and State of Georgia, have invented certain new and useful Improvements in Cam Boxes for Knitting Machines, of which the following is a specification.

My invention relates to improvements in knitting machines, particularly of the circular knitting type, and it consists of the constructions, combinations and arrangements herein described and claimed.

An object of the invention is to provide a circular knitting machine having such an arrangement of cams, or the equivalent thereof as will largely confine the operation of the hooks, cheeks and latches of the needles within the sinkers, thereby establishing several outstanding advantages, principal of which is the relaxation of the tension on the stitches.

Another object of the invention, and one relating directly to the foregoing statement, is to permit the use of varying sizes of threads on the same machine without making any adjustments whatever and still produce an article which will prove to be of correct dimensions when placed upon what is known as a size board.

Another object of the invention is to provide a machine for knitting circular articles, such as full length and half hose, the particular improvement residing in the cam box in which the cams are so arranged that the needles will work lower in respect to the sinkers, thereby knitting in lumps and knots in the yarn as well as heavy places without damaging either the needles or the sinkers and producing fewer seconds.

Another object of the invention is to provide an improved cam box for knitting machines by the use of which there is considerably less tension on the stitches during the stitch-forming and stitch-casting operations with a resulting reduction in the wear on the needles and sinkers and also with the result that better and more uniformly dyed articles are produced by virtue of the relaxation of the tension on the thread.

Other objects and advantages will appear in the following specification, reference being had to the accompanying drawings, in which—

Figure 1 is a longitudinal section of a por-

tion of a knitting machine embodying the improved cam box.

Figure 2 is a detail sectional view illustrating the various cams involved, and also showing the various positions assumed by the needles when operated by the cams.

Figure 3 is a diagrammatic section of enough of the knitting machine to illustrate the first step in a half-hose knitting operation when the cylinder cup worm is turned to lower the needle cylinder and in effect raise all of the needles in respect to the sinkers preparatory to transferring an elastic top.

Figure 4 is a detail sectional view again illustrating the position of one of the needles in the transferring operation.

Figure 5 is a diagram illustrating the second step in the knitting operation in which the sinkers are slid out in order to let the stitches down to the sinker throat.

Figure 6 is a diagram showing the position of the needle in respect to the sinker throat upon again raising the needle cylinder to the normal position as in the third step of the knitting operation.

Figure 7 is a diagram illustrating the first step of forming the stitch, the sinker having been worked out.

Figure 8 is a diagram showing the second step in forming a stitch, the sinker still being out.

Figure 9 is a diagram illustrating the third step in which the stitch is about completed, the sinker being on the way in.

Figure 10 is a detail perspective view of that half of the cam box containing the cams shown in Figure 2, the yarn guide being shown raised.

Figure 11 is a detail perspective view of the other half of the cam box.

Figure 12 is a detail plan view of the sinker cam ring shown in Figure 1, illustrating the cam which moves the sinkers in and out.

Figure 13 is a detail perspective view of the right transfer stitch cam mentioned below.

Figure 14 is a diagrammatic sectional view of a type of knitting machine other than that illustrated in the foregoing views, again showing such redesigning of the cams as will cause the needles to work within the sinkers.

Reference is made to the knitting machine disclosed in the patent granted to

J. E. Rowe, December 12, 1905. #806,921. This machine is known on the market as the Jenckes knitting machine and is herein so referred to. Reference is also made of a type of circular knitting machine known as the Scott and Williams machine which operates on a principle slightly different from that of the Jenckes machine. These are cited merely as examples of knitting machines which have been modified to embody the principles of the invention, because it is conceivable that knitting machines of types other than those disclosed may likewise be modified with the results fully set forth below.

Attention is directed to Figure 1. The needles 1 reciprocate in grooves in the needle cylinder 2 of the Jenckes machine here disclosed. The butts 3 of the needles are acted upon by cams mounted on the inside of the cam cylinder 4, (Figs. 2 and 10) in a manner somewhat different from the present custom.

The needle cylinder 2 remains stationary while the cam cylinder 4 rotates. To this end the cylinder 4 is provided with a flange 6 which is held in a recess 7 in the base 8 by a ring 9. The flange of the cam cylinder 4 carries a gear 10 which is affixed thereto by screws 11. The gear 10 meshes with and is continuously driven by a gear 12 on the clutch shaft 13, producing the rotation of the cam cylinder mentioned before. Inasmuch as the cam cylinder 4 rotates reciprocation of the needles 1 occurs by the action of the cams on the inside of said cylinder resulting in the production of stitches in a manner commonly known.

A ring 14 is secured to the upper end of the needle cylinder 2 and is suitably grooved to receive the sinkers 15 of which there are many. Figures 3 to 9 inclusive illustrate a typical sinker construction. Each sinker includes a heel 16 and a throat 17. There are as many needles as there are sinkers. The needles work in the spaces between the sinkers, and in doing so form the stitches. The sinkers are operated by a sinker cam ring 18 (Fig. 12). The groove 19 of the sinker cam ring receives the heels 16 of the sinkers. The major part of this groove is concentric, but at one side there is a cam 20 which causes the sinkers to slide in and out in respect to the needle cylinder 2.

A cup ring 21 provides the foundation upon which the needle cylinder 2 is removably supported. This ring has an inwardly projecting flange 22 carrying screws 23 upon the heads of which the needle cylinder rests. The cup ring has a clamping arrangement 24 at one side, and a handle 25 by which the same may be tightened.

Situated immediately below the cup ring 21 is what is known in the Jenckes ma-

chine as the cylinder cup worm 26. The ring 21 is kept in contact with the worm 26 by a spring 27. The worm has a lug 28 into which a handle 29 is screwed (Fig. 1) or otherwise fixed so that shifting of the handle turns the worm. To this end the handle extends out at the left side of the machine where it may be grasped by the operator for the purpose stated. In order that the worm shall move up and down as it is turned the worm rides upon lugs 30 which are fixed upon the frame. A shifting of the handle 29 thus causes turning of the worm 26, cup ring 21, needle cylinder 2, sinkers 15 and the sinker cam ring 18, these parts being carried by the worm, and inasmuch as the worm rides upon the fixed lugs these parts are either raised or lowered depending upon the direction of shifting the handle.

Situated inside of the cam box 4 at the bottom is a ring or cam 31, herein known as a rib. During the foregoing downward movement of the needle cylinder 2, etc., the butts 3 of the needles will soon reach the rib 31 in effect causing an elevation of the needles so that the hooks 32 and cheeks will be projected above the sinkers 15 (Figs. 3 and 4). Each needle includes a latch 34 which is pivoted in the cheek. Circumferential springs 35 in suitable grooves in the needle cylinder 2 hold the needles in place.

Consider Figures 2 and 10. The cam cylinder contains cams 36, 37, 38, 39, 40 and 41 none of which are involved in the present consideration. The cams 42, 43 and 44 and 69 remain as in the present Jenckes machine. The cam 44, known as the transfer switch cam is capable of being moved up and down in a groove 45 in the rib 31 by means of a lever 46 (Fig. 10) provided for the purpose. This cam has a channel 47 (Fig. 13) through which the butts of the needles pass.

The invention begins with the omission of a rib situated inside of the cam cylinder 4 and a short distance above the rib 31 disclosed herein. The omission of this upper rib has an important result. It is to be borne in mind that moving the handle 29 from the operating or dotted line position to the full line position causes the lowering of the needle cylinder 2. This act causes the hooks 32 and cheeks 33 of the needles to project above the sinkers by virtue of the engagement of the butts 3 with the relatively stationary rib 31.

It is while the needles are thus projected above the sinkers that an elastic top 48 is put in place on the knitting machine. The elastic top is knit on a separate machine, and at one end it terminates in loops or stitches 49 which are preferably left large or loose. Prior to placing the elastic top 48 upon the knitting machine, it is fitted upon the points of a transfer device

or quill ring commonly used in the art. The stitches 49 are placed upon the points mentioned. The quill ring having an elastic top is now superimposed upon the upstanding needles, and upon reaching up inside of the knitting machine the operator may grasp the end of the elastic top 48 and pull it sufficiently so that the stitches 49 move down upon the needles.

In practice it is not always necessary that the operator reach up inside of the machine because with a little skill and experience the transfer device can be so manipulated as to leave the elastic top upon the upstanding needles. The stitches 49 are quite loose.

Having transferred the elastic top 48 to the needles of the knitting machine the operator gives the sinker cam ring 18 one or more turns. This causes each of the sinkers 15 to slide outward (Fig. 5) producing a channel through which the stitches 49 may drop into the throats 17. The stitches 49 being loose can readily pass over the cheeks 33. It is now that the operator may reach up inside of the machine to pull down on the top 48 so as to make sure that all of the stitches slide down into the sinker throats.

Having accomplished the foregoing step the operator moves the handle 29 (Fig. 3) back to the dotted line or original position. This causes the elevation of the needle cylinder 2, and consequently of the sinkers 15 as well. The needles 1, being frictionally held adjacent the needle cylinder by the circumferential springs 35, will not alter in relationship to the cylinder and consequently will be elevated therewith. This is true of all of the needles with the exception of those the butts 3 of which happen to be under the stationary cams 42 and 43 (Fig. 2). Such needles will be retarded and the hooks 32 thereof will disappear beneath the sinkers. However, so few needles are involved that the resulting pulling on the stitches 49 of the top 48 produces but a negligible strain which is therefore not taken into account.

By virtue of the fact that the majority of the needle hooks 32 move up with the cylinder 2 and sinkers 15 it is quite obvious that the needles preserve the same relationship to the stitches 49 in the elevated position of the cylinder as they did in the lowered position, with the result that no strain is imposed upon the stitches in moving the cylinder from one to the other position, the exception of the needles held down by the cams 42 and 43 being noted. Up to this time the stitches 49 are practically loose upon the needles. This preservation of the relationship of the needles 1 with the cylinder 2 during the movement of the cylinder from the lowered to the elevated position is the direct result of omitting the second rib of the Jenckes machine.

It is now necessary to describe the result of the corresponding action in the Jenckes machine. It is to be borne in mind that the Jenckes machine has two ribs, similar to the rib 31, spaced apart. According to this construction all of the needles are pulled down below the level of the sinkers when elevating the needle cylinder 2 after a top transferring operation the hooks 32 thereby pulling all of the stitches 49 of the top down between the sinkers and imposing such a strain and stretching upon the stitches that breaks frequently happen. There is no looseness of the stitches 49 whatever. The presence of the upper rib in the Jenckes machine is the reason for the foregoing pulling down of the stitches 49. The butts 3 of the needles being situated between the rib and the upper rib holds the needles down so that they cannot move up with the cylinder 2 and therefore that relationship between the needles and the cylinder is preserved which maintains the looseness of the stitches 49 attained in the improved machine.

The invention also includes a pair of cams herein known as the left initiator cam 50 (Fig. 2) and the right initiator cam 51. Each of these cams is pivoted at 52 and 53 respectively. These cams are made sufficiently long to reach from the fixed cams 42 and 54, with which they co-operate, to the single rib 31. The purpose of these cams in the Jenckes machine is to direct the needle butts upon the various cams 42 and 54 when the cam cylinder either rotates in one direction continuously or when it partakes of a reciprocatory motion. The Jenckes machine has cams for a similar purpose, but such cams are relatively short in that they have only to span the distance between the cams 42 and 54 and the uppermost rib mentioned before.

A third cam 55 (Fig. 11) is for the purpose of elevating those of the needles that have long butts so that they will be out of action when knitting heels and toes according to the established operation of the Jenckes machine. This cam is capable of being thrown into and out of action by certain ratchet mechanisms forming part of the Jenckes machine. Such mechanism is not disclosed herein. By virtue of the omission of the upper rib in the cam cylinder 4 it has become necessary to lengthen the cam 55 in order to reach the rib 31.

Another and extremely important function of the invention lies in confining the hooks 32, cheek 33 and latches 34 of the needles 1 within the sinkers 15 and below the upper surface thereof (Figs. 6, 8 and 9) during the greater part of the operation. It is only when the needle butts 3 ride upon the initiator cam 50 (Fig. 2) and over the cams 42 and 43 that the upper ends of the needles appear above the sinkers (Fig. 7).

The needle hooks 32 are brought to the level of the sinkers, by the switch cam 44. The channel 47 of this cam directs the needle butts into the plane α (Fig. 2) when in the active position, the occupation of the plane α by the butts 3 corresponding with the flush position of the hooks 32 (Fig. 6) with the upper surface of the sinkers. This is the normal working position of the needles according to the invention.

The switch cam 44 is in practice moved down in the groove 45 by appropriately operating the lever 46 (Fig. 10) when the needle cylinder 2 is lowered, and it is elevated to the position in Figure 2 when the cylinder 2 is elevated. This is accomplished by manual effort in the Jenckes machine, and the function of the cam 44 still obtains in the improved machine. The cam is also capable of automatic operation because it is thrown out when knitting half-hose by a stop link. In the Jenckes machine the switching cam 44 serves to direct the needle butts toward the upper rib, there being an additional cam in advance of the rib to provide a path up which the butts move. This cam is eliminated because neither the upper rib is used nor do the needle butts rise to the height of such second rib excepting when riding over the cams 50, 42 and 43.

Upon letting the latch ring or yarn carrier 56 (Fig. 10) down, the machine is ready to be started. It is this ring that supplies the thread to the needles in operation. The cheeks 33 are not forced up through the stitches 49 after having completed a stitch as in Figure 7. This is because the needle hooks remain even with the sinkers. In the Jenckes machine, the needles are constantly above the sinkers, and instead of normally standing as in Figure 6 they stand so high that the hooks, cheeks and latches are exposed. This circumstance makes it necessary to force the cheeks of the needles through a completed stitch to reach said normal position in the Jenckes machine, thereby stretching each individual stitch and imposing wear not only upon the stitch itself but upon the needle as well.

This forcing of the needle cheeks through the completed stitch in the Jenckes machine is made evident by an abnormal tension on the threads constituting the stitch.

The tension under which the thread is put is noticeable in watching the operation of the Jenckes machine because there is a marked tendency of the stitches to slightly follow the needles upward. The abnormal tension to which the stitches are subjected is also noticeable upon dyeing the hose, the evidence being a perceptible ripple in the color that detracts from the appearance of the article.

By keeping the needle hooks below the sinkers, and not forcing the needles and

cheeks through the stitches, the stitches are left loose upon the needles (Fig. 6) thereby resulting in another important advantage. Actual experimentation has proved that a wide variation of sizes of threads may be run through the knitting machine without in the least affecting either the character or size of the hose produced. This is due to the looseness of the stitch and to the lack of strain or tension thereon. In the Jenckes machine it is necessary to make an adjustment before changing thread sizes otherwise the hose will be longer or shorter than intended.

It sometimes happens that a needle butt will break off during the knitting operation. There being nothing to now actuate the needle it will remain in place, being held by the circumferential springs 35. When this happens in the present Jenckes machine in which the needles always stand above the sinkers, the breaking of a butt will leave that needle standing at an elevated position above the sinkers. The thread will begin to wrap around this needle causing it to bend, in turn causing an adjacent needle to bend, and finally clogging the action of the machine to such an extent that a breaking of needles will occur. Ten or more needles have been known to break in succession in this manner. With the needles protected as in Figure 9 no needle breakage can occur, and the worst that can happen is a run in the stocking.

Figure 14 illustrates enough of a Scott and Williams circular knitting machine to show the modification of the cams for the purposes of the invention. The cam cylinder 57 in this machine is stationary and the needle cylinder 58 revolves. The cams 59, 60, 61 and 62 correspond with the cams 42, 43, 54 and 38 (Fig. 2) of the Jenckes machine. The cams 63 and 64 correspond with the initiator cams 50 and 51. As in the Jenckes machine the cams 63 and 64 have been specially designed to span the space between the cams 59 and 61 and that portion of the cam cylinder 57 upon which the butts 65 of the needles 66 run. Cam 60, as well as cams 67 and 68, have been redesigned to conform to the new arrangement of the cam cylinder. It is regarded as unnecessary to either describe or illustrate much of the Scott and Williams machine because the principles of operation are substantially identical with those of the Jenckes machine already described. The purpose of Fig. 14 is merely to illustrate how a machine other than the Jenckes machine can be modified to embody the invention. The same advantages of housing the needle hooks within the sinkers obtain here.

The operation of the Jenckes machine is reviewed in order to emphasize the advantages arising from the improvements. In

order to avoid repeating the description of manipulating the handle 29 (Fig. 3) it may be assumed that a ribbed or elastic top 48 is hung upon the needles 1 by the loose stitches 49 at one end of the top. The needles now stand above the sinkers 15 as shown in Figs. 3 and 4. One or more rotations of the sinker cam rings 18 will successively slide the sinkers 15 outward and back (Fig. 5) so that the loose stitches 49 may drop down upon the needles into the throats 17. The stitches 49 are purposely made large so that they may readily slide over the cheeks 33 of the needles.

Upon properly shifting the lever 46 (Fig. 10) the switching cam 44 (Fig. 2) is moved upward out of the groove 45 in the rib 31 into which it was formerly moved by the reverse operation of the lever. The cam 44 then assumes the operative position above the rib 31. Upon giving the cam cylinder 4 several turns before starting the machine (this being done by a handle provided for the purpose), the channel 47 will cause the needle butts 3 to be elevated into the plane *a* (Fig. 2) in position to be picked up by the point of the initiator cam 50. This cam carries the butts upward so that they assume the position indicated at *b*, and it is only when the butts are thus elevated that the needle hooks appear above the sinkers 15 as indicated by the broken line *c* in Figure 1.

Figure 6 illustrates the relationship of a needle 1 and the hooks 32 to the sinker 15 at the position A in Figure 2. The butt 3 of this needle has been elevated into the plane *a* by the cam 44. All of the needles from the right of the switch cam 44 around the cam cylinder 4 to the left of the initiator cam 50 assume the same position during the operation of the knitting machine, and it is in this position that the looped stitches rest immediately below the needle hooks where they are held by the sinkers with the desired looseness which renders subsequent forcing through of the needle cheeks and latches easy.

Figure 7 illustrates the position of the needle at the position B in Figure 2. The needle hook 32 and a cheek 33 have been thrust through the previously looped stitch to clear the latch 34 and have reached the thread provided by the yarn carrier 56 preparatory to forming a stitch. The sinker 15 has been slid or worked out by the sinker cam 20 (Fig. 12). The latch 34 is down.

Figure 8 illustrates the needle at the position C in Figure 2. The latch 34 has moved up and the needle is shown about ready to cast the stitch 49 which is yet in place thereon. The sinker 15 is now on the way in.

Figure 9 shows the needle at the position D in Figure 2. The sinker 15 is about all the way in, and the stitch 49 has been cast. The looseness of the stitch 49 is noticeable.

It is this looseness of the stitch, or the lack of excessive tension on the thread, that permits the use of a wide variation in the size of thread without making any compensating adjustment.

The invention also involves several steps of an improved method of knitting. Of necessity the new steps of the process are associated with and supported by steps in the knitting operation already old in the Jenckes machine.

Step 1 consists of elevating the needles 1 with the needle cylinder 2 and the sinkers 15 so as to preserve the relationship of the needle hooks with the sinkers and prevent pulling the stitches of an elastic top previously fitted upon the needles down between the sinkers as is the case when the needles are held rigid and relative movement of the sinkers occurs when the needle cylinder is elevated as in the Jenckes machine. The relationship of all hooks with the sinkers 15 is preserved in the case of all of the needles excepting those few the butts of which happen to be under the fixed cam 42 and 43 (Fig. 2).

Step 2 consists of confining the hook 32, cheek 33 and latch 34 of each needle within the sinkers 15 after the casting of a stitch so as to hold the completed stitch upon the needle between the hook and cheek in a loose condition (Fig. 6), thereby keeping the stitch off of the cheek and latch and preventing tension on the stitch as in the Jenckes machine where the needle cheeks are forced through the completed stitch to reach the normal and resting position above the sinkers.

Numerous advantages arise from incorporating the foregoing method steps in the operation of knitting. The looseness of the stitch in both steps cannot be emphasized too strongly. The looseness of the stitch upon the shank of the needle after casting, according to step 2, has an advantage of its own. Experiments have been made to prove that the machine will knit in heavy places, lumps and knots in the thread without even so much as straining the stitch much less breaking the thread.

It is the function of the sinkers to roll the fabric inwardly as the knitting operation proceeds. All lumps, knots and heavy places are in turn rolled inwardly, the needles readily holding the stitches containing such lumps, etc., without any strain on the fabric, because the stitches are primarily loose and are not under tension.

It is for the same reason that a wide variation in the size of threads may be run through the knitting machine and still arrive at the same result so far as the character, length, etc., of the finished article is concerned. By virtue of the fact that the completed or cast stitch rests upon the shank of

the needle, and the needle cheeks and latches are not forced through the completed stitch as in the Jenckes machine, there is considerably less wear on the butts 3 of the needles as well as on the needles themselves. This advantage in turn is reflected in the reduction of wear on the machine in general, ultimately requiring even less oil to maintain the machine in running order.

It has been found by actual experimentation that a plaiting operation can be carried out more successfully in a knitting machine embodying the principles of the invention than with the Jenckes machine of present construction. The combination of #150 Denier artificial silk and #30 single cotton was used. It was found that by introducing the silk and cotton at proper angles the stitch forming operations were carried through successfully, keeping the cotton on the inside and the silk on the outside.

It has been observed that a knitting machine, particularly a "Standard" knitting machine, when operated with the improved cam box embodied therein produces an attractive form of stitch at the gore of the heel and toe. This stitch is of a regular open character having an appearance very much like that of a hem-stitch. Hose made in this manner are quite attractive in appearance, and make a more readily salable article.

The success in this particular use of the knitting machine is attributed to the fact that all undue tension on the thread is prevented by keeping the needles housed below the sinkers, thereby preventing interference with the stitch after it has been cast by the stitch cam. By virtue of the fact that the stitch is left perfectly loose after it has been cast and avoiding all undue friction between the stitch and needle parts plaiting is made successfully possible whereas in other machines it has been unsatisfactory.

I claim:—

1. The hereindescribed process consisting of drawing needles in a cylinder machine below the sinkers to loop stitches thereupon, causing a relative motion of the co-acting sinkers preparatory to holding the looped stitches upon the needles, raising the needles until the looped stitches rest immediately below the hooks where they are held by the sinkers, maintaining said hooks in the aforesaid position thereby preserving an initial looseness in the looped stitches until a subsequent thrust of the needles wherein the latches clear the stitches and thrusting the needles through said stitches that the latches may clear the stitches preparatory to forming new stitches, said initial looseness permitting said thrusting through of the needles without distorting the stitches.

2. The steps of the herein described process consisting of drawing needles in a cyl-

inder machine below the sinkers to loop stitches upon the needles with pre-determined looseness, and thereafter raising the needles only sufficiently to dispose the stitches between the needle hooks and latches thereby maintaining said stitch looseness until a subsequent action of the needles, wherein the needle cheeks and latches are thrust through said stitches.

3. The steps of the herein described process consisting of drawing needles in a cylinder machine below the sinkers to loop stitches upon the needles, and thereafter raising the needles in reference to co-acting sinkers only to such extent that the stitches lie immediately below the needle hooks and that the needle hooks remain confined within the boundaries of said sinkers until a subsequent action of the needles wherein the needle cheeks and latches are thrust through said stitches, thereby avoiding any distortion of the stitches.

4. A knitting machine having a cylinder, needles carried thereby, sinkers mounted upon the needle cylinder; in combination a cam cylinder, a system of cams carried thereby for actuating the needles including a stitch cam over which the needle butts pass to depress the needle hooks below the sinker throats to loop stitches upon said needles, and a cam then engageable by the needle butts to elevate the needles until the needle hooks come substantially level with the sinker throats and the needles pass through said stitches sufficiently that the stitches rest upon the needles immediately below the hooks thereby leaving the stitches loose, said cylinder wall being uninterrupted in the circumferential plane of said last cam up to a position in which the needles are subsequently acted upon to cause the latches to clear the stitches, thereby avoiding disturbance of the needle butts and keeping the needle hooks in the aforesaid relationship with the stitches for a corresponding determined time.

5. A knitting machine having a cylinder, needles carried thereby, sinkers mounted upon the needle cylinder; in combination a cam cylinder, a system of cams carried thereby for actuating the needles including a stitch cam over which the needle butts pass to depress the needle hooks below the sinker throats to loop stitches upon said needles, a cam then engageable by the needle butts to elevate the needles until the needle hooks come substantially level with the sinker throats and the needles pass through said stitches sufficiently that the stitches rest upon the needles immediately below the hooks thereby leaving the stitches loose, said cylinder wall being uninterrupted in the circumferential plane of said last cam up to a position in which the needles are subsequently raised to cause the latches to clear

the stitches, thereby avoiding disturbance of the needle butts and keeping the needle hooks in the aforesaid relationship with the stitches for a corresponding determined time, and a cam in said position to deflect the needle butts upward from said circumferential plane thereby to raise the needle hooks out of said relationship with the sinker throats and sufficiently high above the sinkers that the latches may clear the stitches looped upon the needles.

6. A knitting machine having a circumferential series of sinkers, needles operable between the sinkers, a reciprocable cam cylinder having an uninterrupted zone extending nearly the circumferential distance, the needle hooks and latches being confined within the sinkers while said needle butts occupy said zone, a pair of stitch cams alternately becoming operative to cause the needles to loop stitches when knitting heels and toes, and an initiator cam at the approach of each stitch cam causing the eleva-

tion of the needle butts from said zone and the raising of the hooks and latches above the sinkers preparatory to the looping of said stitches.

7. A knitting machine having a circumferential series of sinkers, sets of long and short-butt needles operable between the sinkers, a cam cylinder which is reciprocable while knitting heels and toes, a system of cams including stitch cams at one side of the cam cylinder, there being an uninterrupted zone extending from and ending at said cam system, said zone being occupied by the needle butts without bottom support at which time the needle hooks and latches are housed in the sinkers, and a cam projectable into said zone at the other side of the cam cylinder intercepting and raising the long butts to a level above said cam system and elevating the corresponding needle hooks and latches to an inactive position above the sinkers.

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