

March 17, 1942.

W. L. SMITH, JR

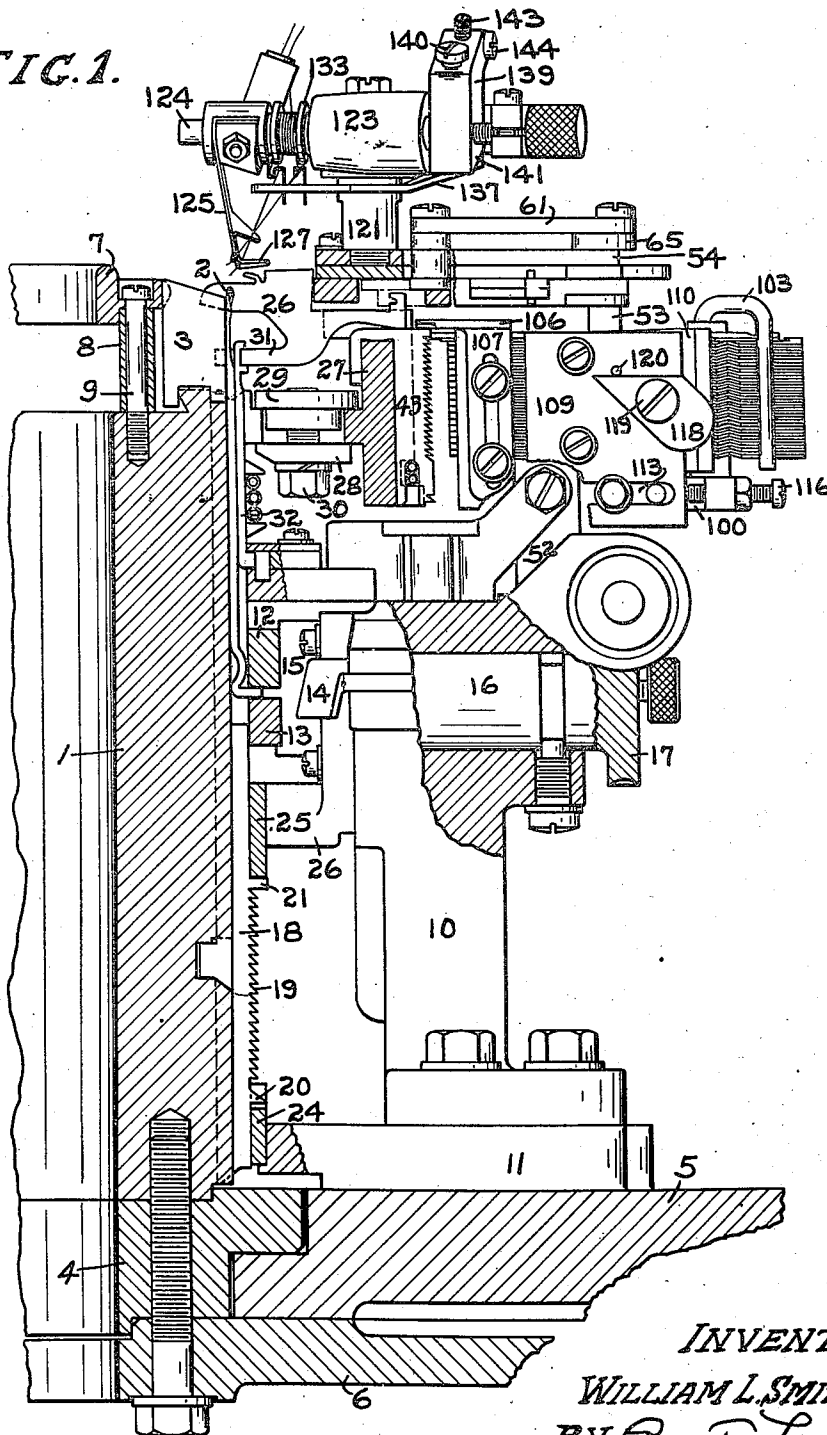
2,276,705

KNITTING MACHINE AND METHOD

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FIG. 1.



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FIG. 2.

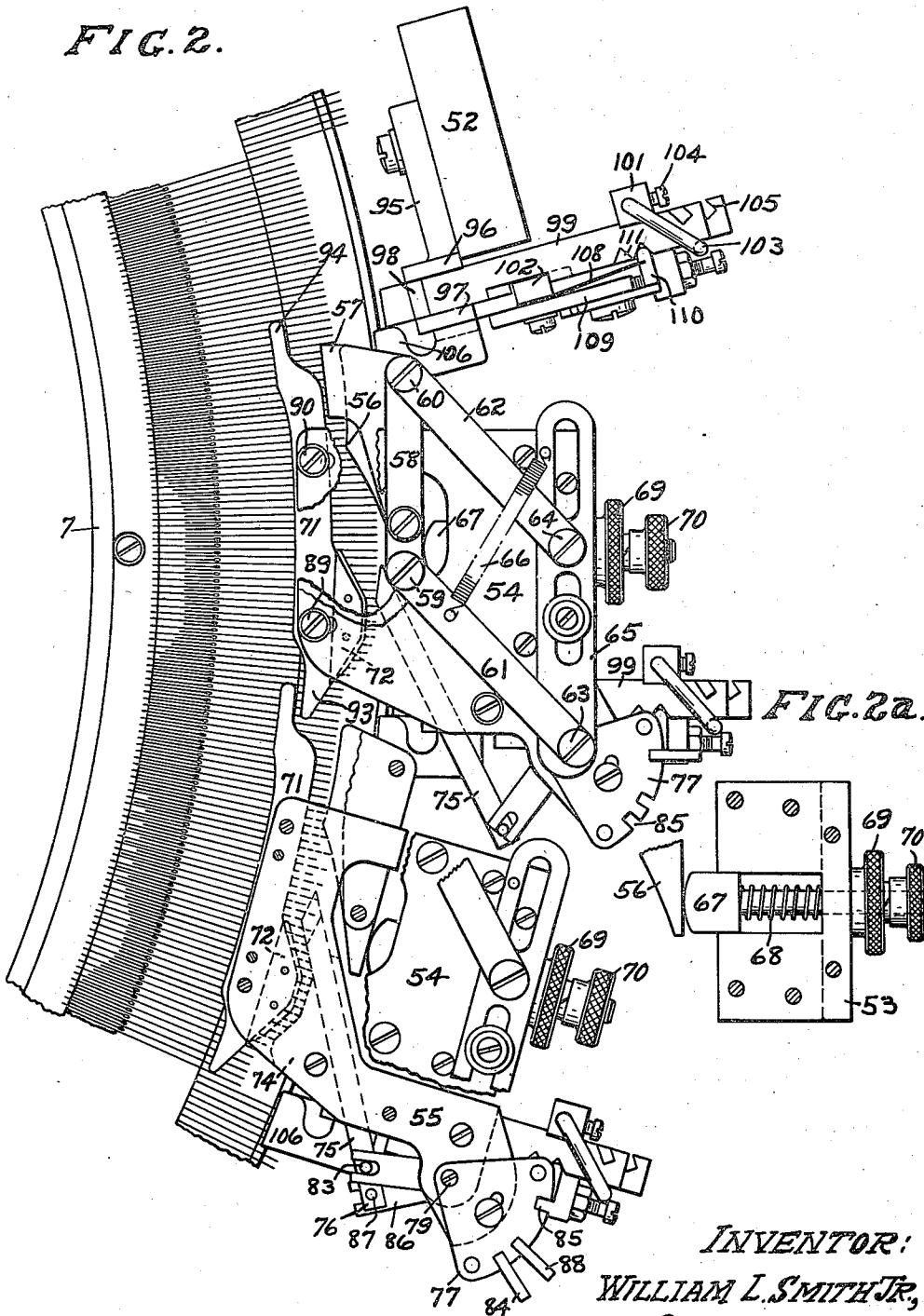


FIG. 2a.

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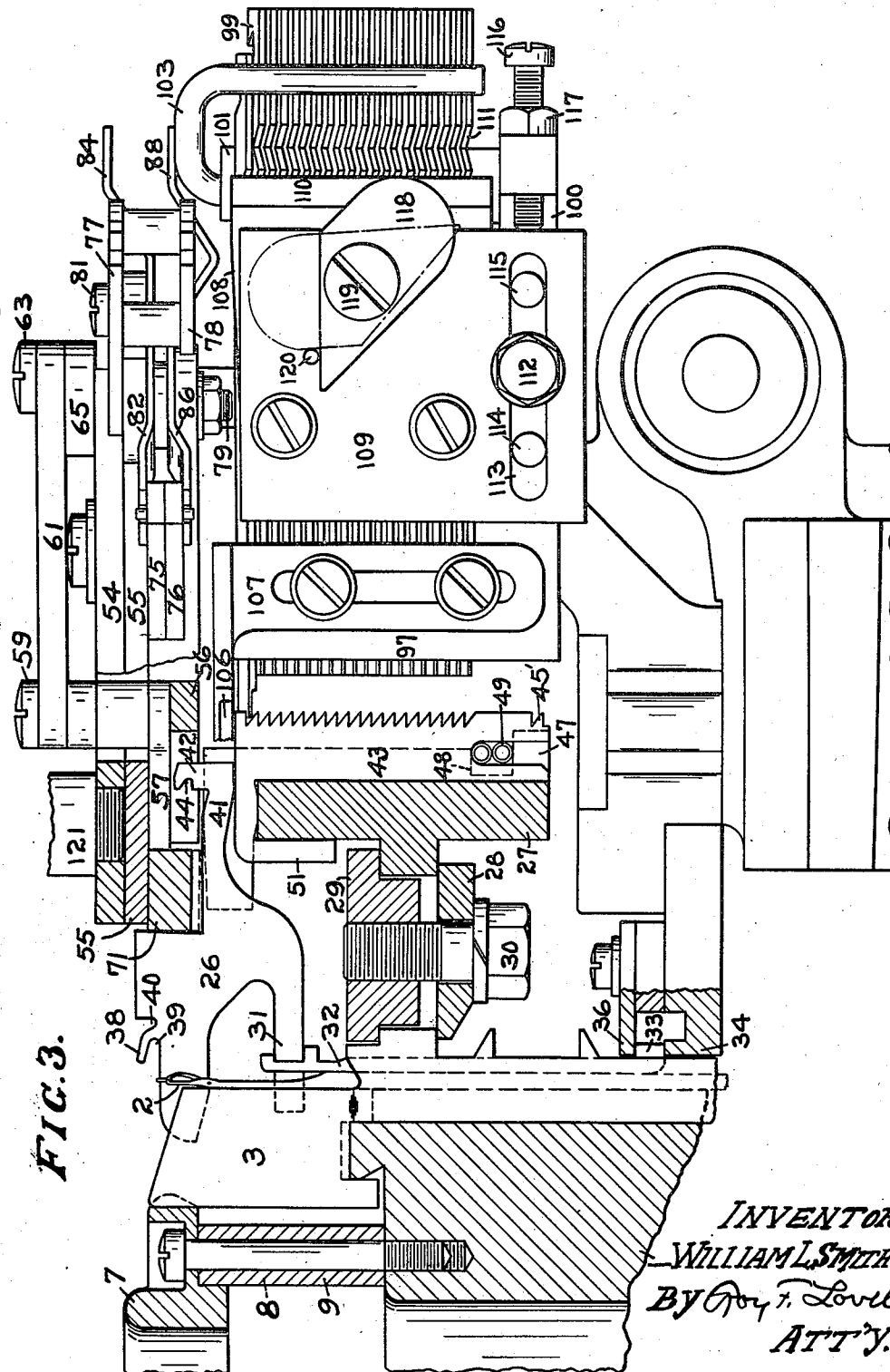
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FIG. 6.

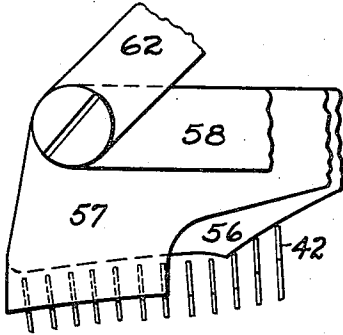


FIG. 5.

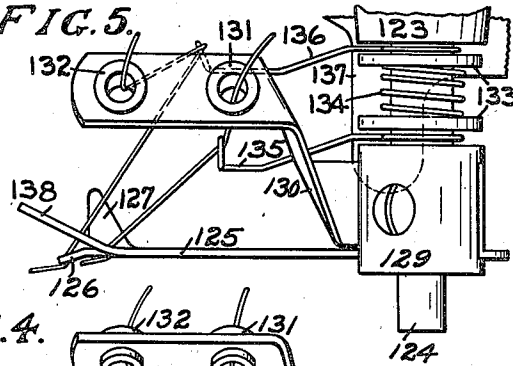


FIG. 4.

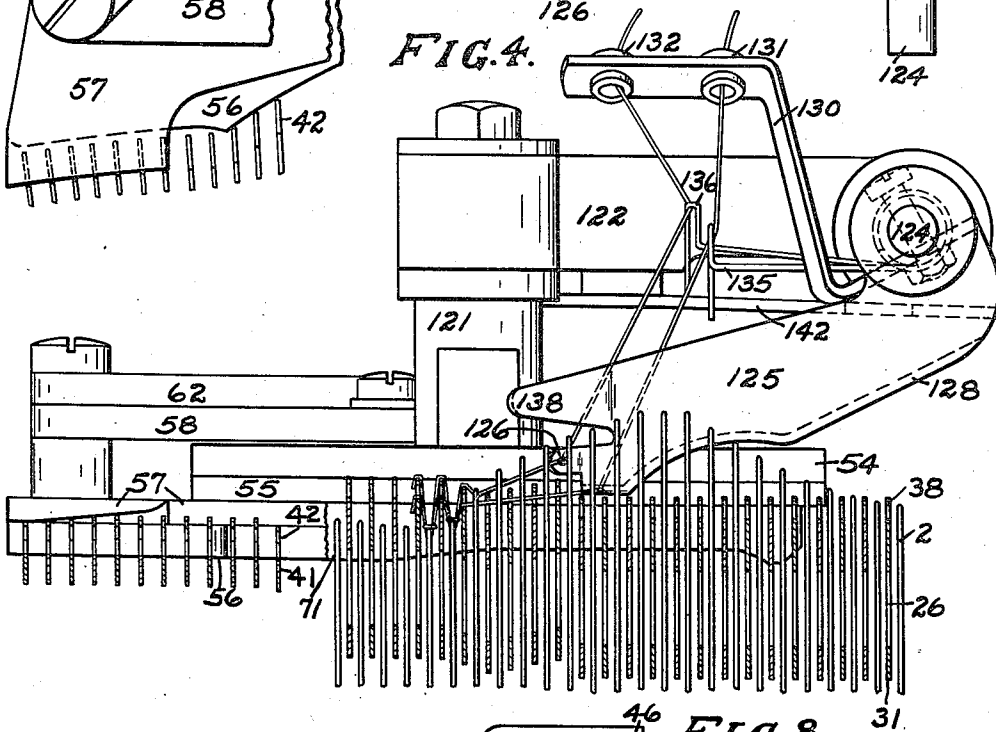


FIG. 7.

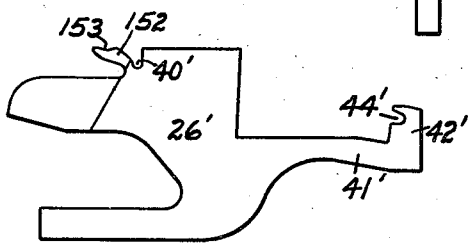
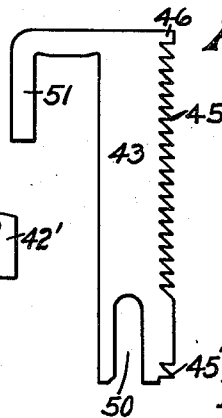


FIG. 8.



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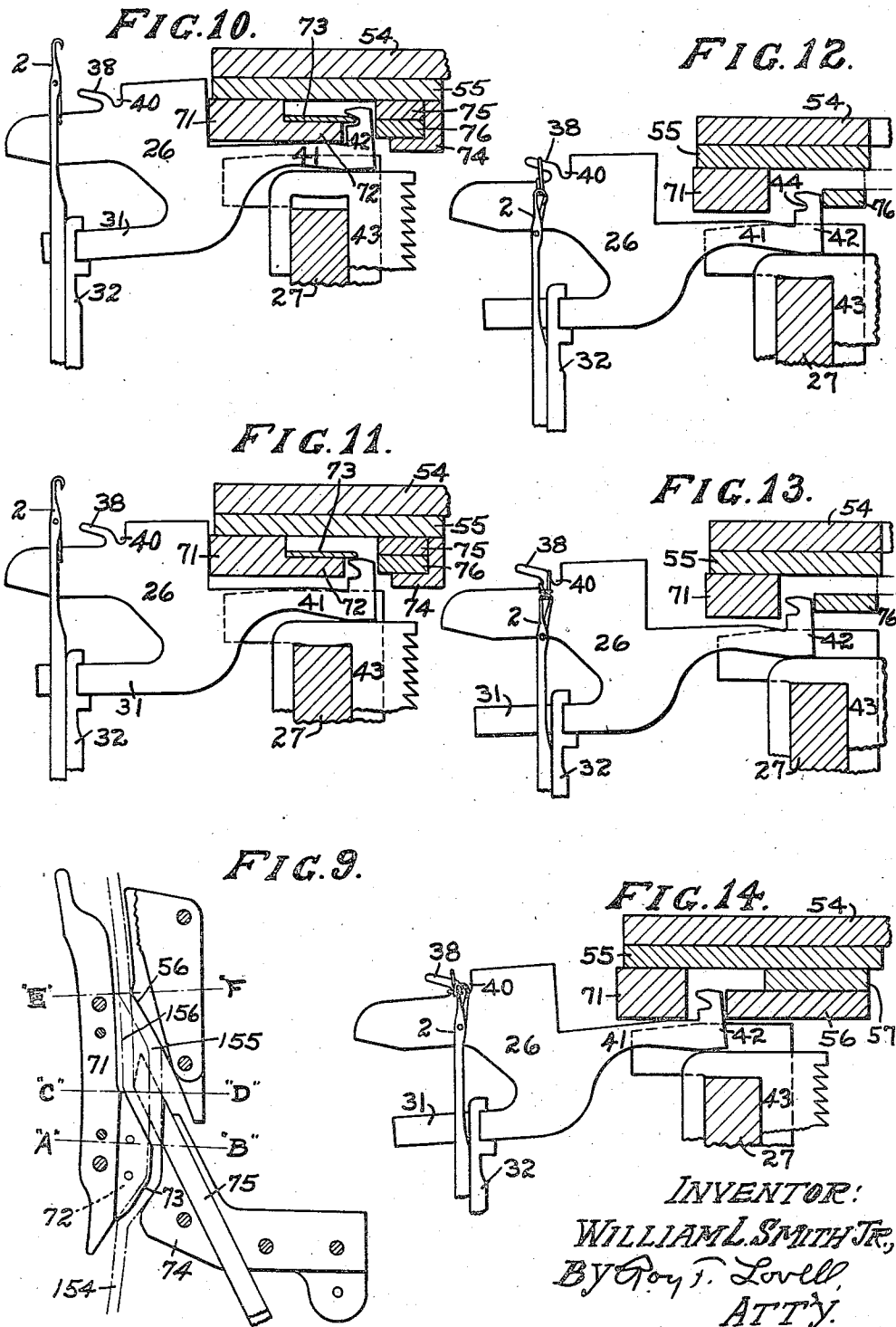
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FIG. 17.

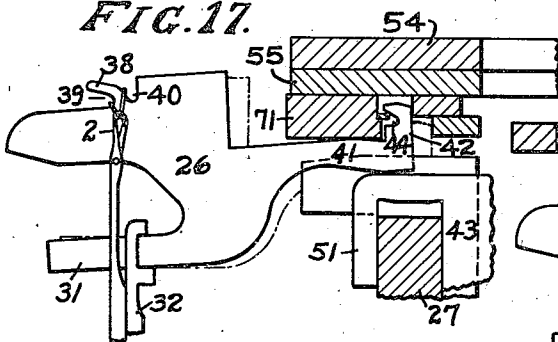


FIG. 18.

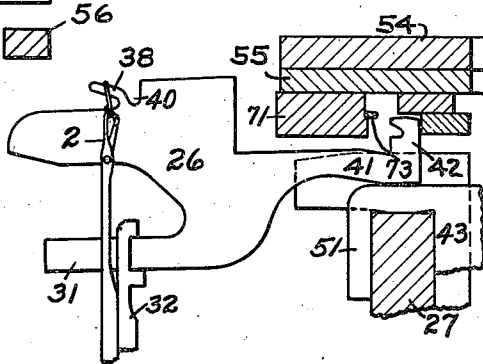


FIG. 15.

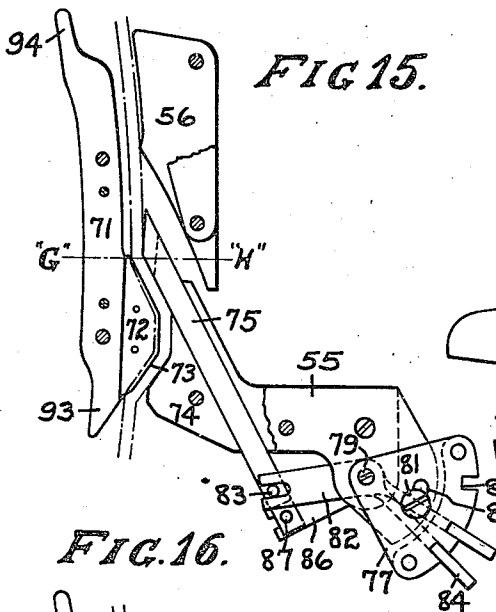


FIG. 19.

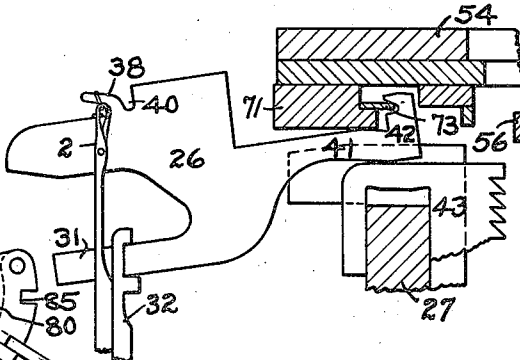


FIG. 16.

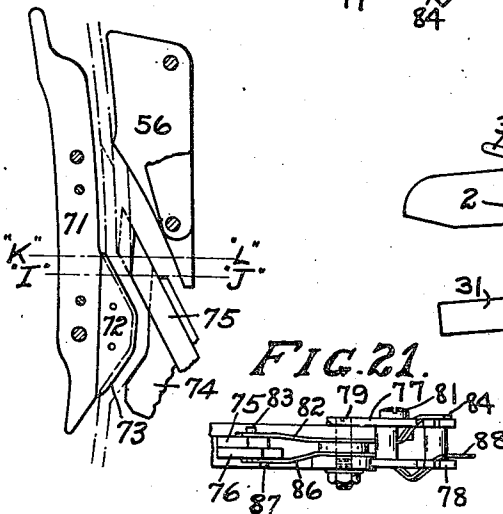


FIG. 20.

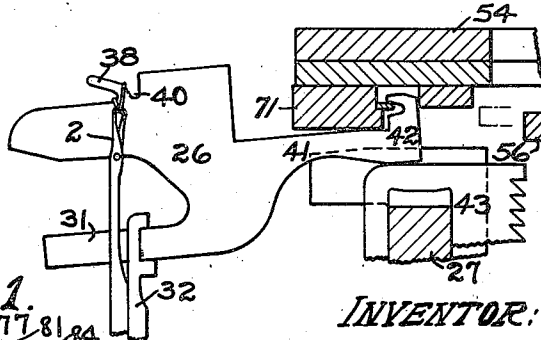
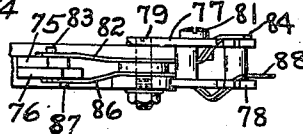


FIG. 21.



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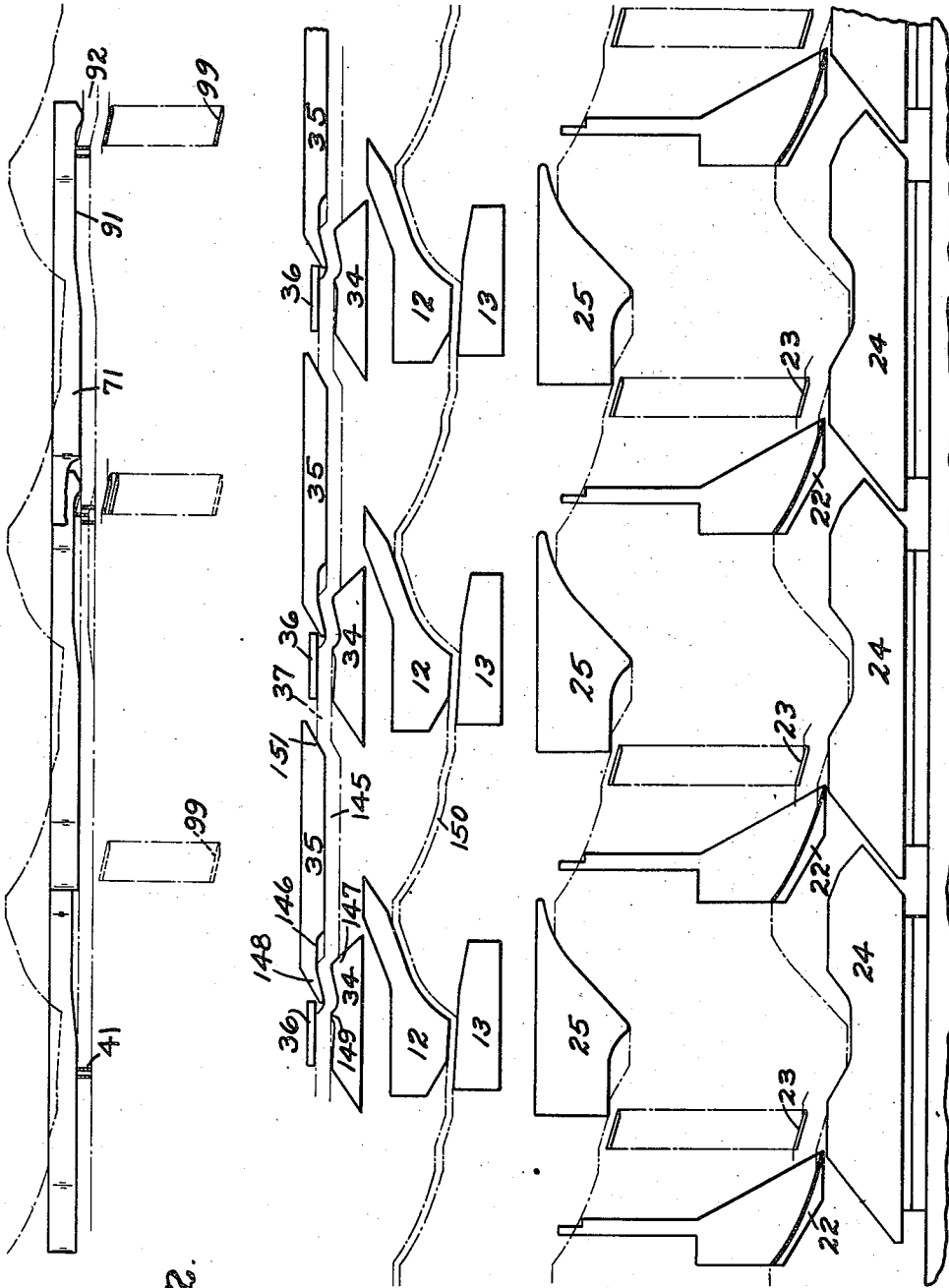


FIG. 22.

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FIG. 23.

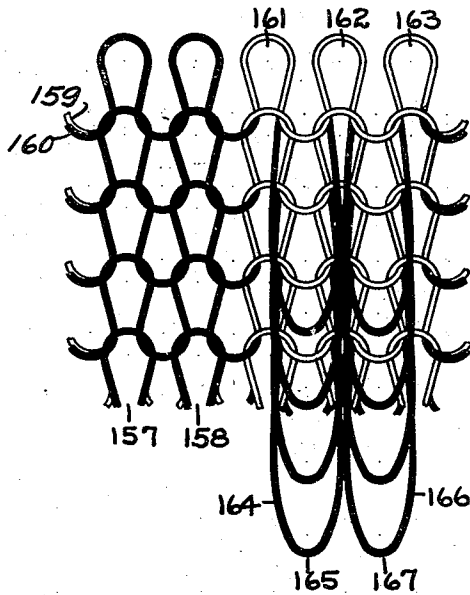


FIG. 24.

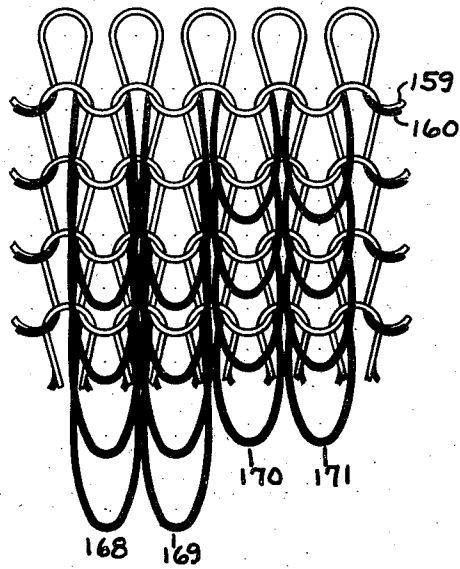


FIG. 26

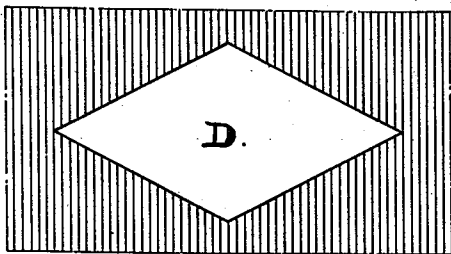


FIG. 25.

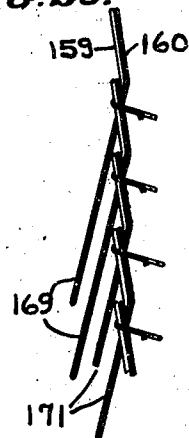
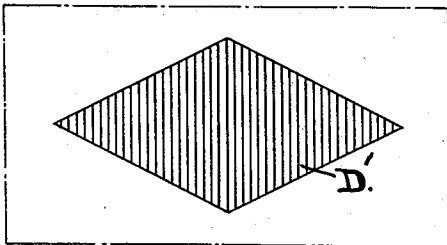


FIG. 27.



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UNITED STATES PATENT OFFICE

2,276,705

KNITTING MACHINE AND METHOD

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Application March 9, 1938, Serial No. 194,909

27 Claims. (Cl. 66—93)

This invention concerns a machine and method for knitting loop cloth or pile fabric according to desired patterns. The invention contemplates, among other things, certain improvements in selecting means for determining the pattern to be knitted in said pile fabric, and the knitting of pile fabric in patterns along with patterning of some types such as various forms of tuck stitches, open work, and the like, knitted under the control of certain pattern devices functioning upon needles. The invention further contemplates a novel and advantageous movement imparted to sinkers for the purpose of engaging between and maintaining proper relationship between the yarn which knits the pile and the main or backing yarn. Another object of the invention is that of knitting pile loops of various lengths and selectively controlling sinkers for making the pile in any piece of fabric of two different lengths, this adjustment and selection, accompanying the aforementioned functions whereby the machine is selectively controlled to knit plain fabric and other types of ornamentation as controlled by selection of the needles. Another object of the invention is that of providing sinker selecting mechanism very simple in its construction but effective to control a great variety of patterns, and furthermore, capable of being changed in a few minutes so that entirely different pattern effects may be knitted at any or all of the feeds. All this is accomplished without replacing any of the sinkers or other instrumentalities, or without replacing the pattern determining means themselves.

In the figures of drawings:

Fig. 1 is a section taken through a part of the needle cylinder adjacent one yarn feeding station and showing the various cams and selecting devices thereat;

Fig. 2 is a plan showing a fragment of the machine and illustrating certain of the sinker controlling cams and selecting devices which are subject matter of this invention;

Fig. 2a is a detail of adjusting means for the sinker casting-off cam;

Fig. 3 is a sectional view showing to an enlarged scale the sinker selecting and controlling mechanism at one feeding station;

Fig. 4 is an elevation showing some of the needles and sinkers, yarn feeding means and the feeding yarns as they are engaged by the needles and sinkers and are drawn into knitted loops;

Fig. 5 is a plan view showing the yarn feeding means illustrated in Fig. 4;

Fig. 6 is a detail of one of the sinker controlling cams necessary to the present system;

Fig. 7 is a detail of one form of sinker;

Fig. 8 is a detail of a sinker selecting jack;

Fig. 9 is a plan showing in detail sinker con-

trolling cams and different positions of the same for effecting the knitting of pile loops of different length;

Fig. 10 is a section taken at A—B, of Fig. 9, wherein the sinker and sinker jack are shown in a selected position;

Fig. 11 is a section taken at A—B, Fig. 9, but wherein the sinker and jack have not been selected;

Fig. 12 is a section taken at C—D, Fig. 9, parts being shown in non-selected position but wherein the sinker is drawing a long pile loop due to position of one of the sinker controlling cams;

Fig. 13 is a section taken at C—D and corresponding to Fig. 12 except that the sinker is being differently controlled by one of the sinker engaging cams to draw a short pile loop.

Fig. 14 is a section taken at E—F, Fig. 9, wherein the various parts are shown in casting-off position;

Fig. 15 is a similar view to Fig. 9, but showing still different positions of the movable sinker engaging cams and mechanism for determining and retaining them in those positions;

Fig. 16 is a plan showing sinker cams such as are illustrated in Figs. 9 and 15 but wherein the sinker controlling cams are shown in different positions;

Fig. 17 is a section taken at the line G—H, Fig. 15, and wherein the sinker and sinker jack are shown in selected position, the sinker drawing a short pile loop as determined by the selecting means and position of one of the movable sinker controlling cams;

Fig. 18 is a section taken at G—H, Fig. 15, where the sinker is not selected, but is drawing a long pile loop as controlled by one of the sinker cams;

Fig. 19 is a section taken on the line I—J, Fig. 16, the sinker being selected and drawing a long pile loop under control of the opposite movable cam from that shown as active in Fig. 18;

Fig. 20 is a section similar to Fig. 19 taken on line K—L, but showing the results of selection and a movable cam position for determining the drawing of a short pile loop;

Fig. 21 is an elevation showing a detail of the movable sinker controlling cam actuating means, the same mechanism being shown in plan at Fig. 15;

Fig. 22 is a diagrammatic view showing relative positions of needle and sinker cams, selecting plungers, and the pathways of needle butts, jack butts and of sinkers;

Fig. 23 is a view showing one form of fabric having some plain loops and long pile loops, this section of fabric being shown greatly enlarged;

Fig. 24 is a similar view showing a section of fabric having both long and short pile loops;

Fig. 25 is a sectional view taken through Fig.

24 and illustrating both long and short pile loops;

Figs. 26 and 27 are diagrammatic views showing how a typical pattern may be arranged upon a fabric.

The invention is shown and will be described relative to a multi-feed knitting machine of the type wherein needles and sinkers cooperate in the measuring and drawing of stitches. The sinkers are moved by jacks or other means, in a direction opposite to that in which the needles move to draw stitches, and are also controlled to move radially for the usual purpose of casting off. In the drawing of loops such as pile loops, it has been known to draw these loops over the ribs of sinkers, and further, to draw different lengths of pile loops by controlling sinkers so that the pile loops will be drawn over different elevations, this being selective to some extent. The selecting mechanism herein disclosed is a considerable improvement over anything heretofore known and comprises a selection of many more steps than have been possible previously. Along with this selection to make pile loops at selected areas within the fabric is a special control for determining different lengths of pile loops throughout these areas; the selection of the sinker, as controlled by one selecting means to be described, is combined with a separate cam control, the cumulative effect of both these devices eventually determining the result in the knitted fabric.

The machine, as disclosed in Patent No. 2,067,877 has a pattern control for needles which makes it possible to knit widely varying patterns of tuck stitches along with the patterns comprising pile loops. The combination of different forms of tuck and different lengths of loops makes it possible to produce very pleasing and varied effects in the knitted cloth. Another possibility is the knitting of open work between areas ornamented by pile loops, this open work takes many varied forms according to the control at the several feeds about the machine, the length of loops drawn, either below or over the nib and the different types of tuck work such as accumulated loops or float work.

Now referring to the figures of drawings, one form of the invention will be described relative to the machine illustrated, and several examples of the setting of the pattern means and different possibilities thereof will be given. It is to be understood that the invention is applicable to other machines than the one especially illustrated herein and that no attempt will be made herein to enumerate all the different pattern possibilities, different cam settings, or all the possibilities of fabric which may result. Referring to Figs. 1, 2 and 3, the knitting machine is of a multi-feed type, has a rotary needle cylinder, latch needles and radially movable sinkers, the latter being movable in a direction to cooperate in the drawing of stitches all as described more fully in patents numbered 2,104,231 and 2,090,500. The invention is also applicable to other types of machines such as stationary needle cylinder machines, and to those having spring beard or sliding latch needles. The cylinder is shown at 1, a latch needle at 2 which slides within the usual tricks or slots determined by strips 3 inserted to form the needle walls of said cylinder. The cylinder is attached to a bearing element 4 in turn engageable and rotatable within the circular base 5. A ring gear 6 is fixed to said cylinder and bearing element and performs the usual function of driving the cylinder from some

source of power not necessary of being shown in this case. At the upper end of the cylinder a stitch ring or fabric ring 7 is supported at intervals upon support 8 being attached to the top of the cylinder by the screw 9. The fabric ring serves to space and maintain rigid the upper ends of the needle and sinker guiding strips, all this being disclosed in co-pending application Serial No. 124,844. At each of the separate feeding stations is supported a post or bracket 10 attached to the circular base 5 by means of suitable bolts passing down through a plate 11. This post carries needle cams 12, 13 and 14. The cams 12 and 13 are mounted on a cross-head 15 which is vertically adjustable by means of an eccentric on the spindle 16 which is in turn subject to a micrometric adjustment by the worm wheel 17 and a worm (not shown). These elements are shown in detail and described in co-pending application Serial No. 34,579. The cam 14 may be moved inwardly to engage the needle butts or may be retained in the position shown in Fig. 1, this depending upon whether the needles are to be controlled for knitting tuck or float stitches. The construction and operation of this cam is also described in detail in the application last above mentioned.

Each of the needles has a selecting jack 18 functioning beneath it and controlled by any suitable selecting means engageable with the removable pattern butts 19. Preferably the selecting device will take the form of manually set plungers such as illustrated in Patent No. 2,067,877. Each jack has a master butt 20 and a top butt 21. The master butt 20 will engage and ride up a cam 22, Fig. 22, in the event the jack is selected by any one of a series of plungers 23, same figure. The cam 24 is a raise and leveling cam and determines the proper height of the jack so that the butts 19 may approach the plungers 23 at the correct elevation. A cam 25 on a bracket 26 engages the butt 21 and returns each selected jack to its lowermost position prior to its passing through the next selecting and knitting station at which it may or may not be selected. Of course, each of these sets of cams and plungers is duplicated at the separate feeding stations, and plungers may be manually set to impart the proper pattern movements to the jacks and incidentally to their needles.

The sinker cam assemblies are supported at the upper ends of the brackets or posts 10 which have just been described. The sinkers indicated at 26 are retained within suitable slots in a sinker ring 27 which is clamped by clamping elements 28 and 29 and the screws 30, Figs. 1 and 3. The sinkers are free to move radially, their inner ends being guided within slots formed by the strips 3. The upper ends of these strips are offset so that the sinker slots provided thereby are equally spaced between the needle slots. Each of the sinkers has a lowermost projection 31 which slides between the nibs on a sinker actuating jack 32. Each of these jacks has a butt 33 at its lowermost end which is controlled by cams 34, 35 and plate 36 which are also attached at the upper ends of post 10. The contour of these cams and plate is clearly shown in Fig. 22 wherein the pathway of the butts 33 is indicated by a dot-and-dash line at 37.

Each of these sinkers 26 has a nib 38 which is inclined upwardly, a throat 39 and a notch 40, these determining different positions at which loops may be drawn. For example, ordinary loops may be drawn below the nib as in Fig. 3,

this being the usual practice and the nib merely functioning to cast off or shed the old loop. As will be more fully described later, one loop may be drawn in the throat and the other over the nib 38 in which case that loop drawn over the nib will be considerably longer than the one drawn in the throat. Such a loop drawn over the top of the nib will be referred to herein as a long pile loop. As the sinker is pushed in still farther, one loop may be drawn in the throat and the other in the notch 40. The loop drawn in the notch will be slightly longer than the one drawn in the throat but not so long as a loop drawn over the top of the nib; such a loop will hereinafter be designated as a short pile loop. By radial control of the sinker prior to taking yarn at the feeding point, both loops may be caused to be drawn in front of and beneath the nib as in the throat, one may be drawn in the throat and the other over the top of the nib, or one may be drawn in the throat and the other in the notch. These three positions are selectively determined by the movable sinker projecting cams and the selecting means hereinafter described. The notch is behind the nib and terminates at a depth approximating the level of the bottom of the throat. The short pile loops may be drawn very little longer than the plain loops drawn in the throat. Of course, this is varied by degree to which a sinker is pushed inwardly, or by varying sinker dimensions.

Each of the sinkers extends outwardly of the machine to terminate in a stem portion 41 and a butt 42. The stem is so constructed that the sinker will pivot about its outermost end and in this particular instance, will pivot on the upper edge of a jack 43, one of which is provided for each sinker. The butt 42 performs the normal function of pulling the sinkers outwardly by means of certain sinker cams to be described, and will push the sinker inwardly if the same contacts with one of the movable sinker projecting cams, two of which are provided at each sinker selecting station. Each sinker butt 42 has a notch 44 which engages a knife-edge cam so that once raised by jack 43, the said outer end of a sinker will not drop accidentally until it has engaged those cams essential to completing its movement after being selected.

One of the jacks 43 is shown in detail in Fig. 8. That jack has a plurality of saw-tooth butts 45 and one top butt 46, these butts all being engageable by selecting plungers or cams constructed in a manner to impart selective movements to the jack and incidentally to the sinker. These butts are removable such as by breaking. The upper end of the said jack is formed in such shape as to engage the rectangular section of the ring 27 each jack being held within a slot at the edge of the ring and within the same slot as the sinker at the top part of the ring, Fig. 3. The lower part of the ring 27 is flanged at 47 and is grooved at 48, the groove and flange accommodating a plurality of springs 49 which also engage within a slot 50 at the lower end of each jack. These springs serve to retain the lower ends of jacks inwardly against the bottoms of slots while the parts 51 at the upper ends of each jack hold the top of the jack inwardly. In assembling, the jack is inserted within a slot and is pushed downwardly within that slot until the top, hooked part has engaged the front side of the ring and the slot 50 likewise engages the springs 49. When pushed downwardly to fullest extent, Fig. 3, each jack will be securely held in position and

since the jack, and the stem of a sinker are approximately the same thickness and are a working fit in the grooves, the top of a jack will make a satisfactory pivot point for the outer end of the sinker. As the jack is raised upwardly, it will raise the outer end of the sinker so that a selection may thus be imparted. This will be described in greater detail in a later paragraph.

Now referring to Figs. 1, 2, 3, 9, 15 and 16, the cams for controlling sinkers will be described in detail. The post 10 has a projection 52 to which attaches an angular bracket or holder 53. This angular bracket 53 supports a plate 54 which extends inwardly and overhangs the sinker ring and the stems and butts on the outer ends of sinkers. In the original machine, sinker cams were carried by or attached to this plate in most instances. In the machine herein described this plate serves to support another detachable plate which is adjustable with respect to plate 54, but which actually carries most of the sinker cams. This second plate is illustrated at 55, Figs. 2 and 15. The only cams which are most definitely associated with the plate 54 are the casting-off cams 56 and the sinker butt leveling or lowering cam 57. These cams are both permanently attached to a link 58 which is pivotable at 59 and 60 on two swinging arms 61 and 62 which are also capable of pivoting freely at their other ends on the pivots 63 and 64. These pivots 63 and 64 are threaded into a bar 65 which is adjustably fixed adjacent the outermost edge of plate 54. This constitutes a parallelogram system whereby the cams 56 and 57 may swing outwardly.

The spring 66 normally tends to swing this parallelogram system and the cams 56 and 57 to outermost position. This outer position, that is, the position in which the cam 56 normally functions and which determines the projection of sinkers for casting off, is controlled by the abutment 67, spring 68, Fig. 2a, adjustable by means of the adjusting nut 69 and lock nut 70. The spring 68 allows the entire assembly including cams 56, 57, link 58, and arms 61, 62, to be moved outwardly in the event of some unusual circumstances whereby sinkers do not follow the intended pathway. The spring 68 is strong enough to maintain the cams in position for normal operation but will compress upon unusual resistance or abnormal conditions.

In Fig. 2 parts of three different sinker cam and selecting assemblies have been illustrated. An attempt has been made by breaking away portions of the mechanism, to illustrate all the essential features at one of the three stations at least. The plate 55 is illustrated at the lowermost station in Fig. 2 and part of the plate is shown in Fig. 15, the cams supported thereby being shown at Figs. 2, 9, 15 and 16. These cams include the elongated cam 71, sinker retracting cam 72, knife edge cam 73 and the cam 74 which serves as a guard cam behind cam 72. These cams are fixed to the plate 55, and, once the machine is assembled, are relatively stationary. Two other cams are associated with this plate 55, namely, the movable sinker projecting cams 75 and 76. These cams are slidable within the slot cut in the upper side of the cam 74 closed by plate 55. These cams are freely slidable within that slot. The purpose of these cams is that of moving sinkers inwardly to a position in which loops may be drawn forward of the nib, one loop in the throat and the other over the nib, or one in the throat and the other in the notch. The

lower cam 76 is at such an elevation that it engages the butts 42 on sinkers whether any selection is imparted to them or not. The upper cam 75 is at a height to miss these butts 42 unless a selecting movement is imparted to the sinkers.

As shown in Figs. 2, 15 and 21, two sectors 77 and 78 are attached to the outer edge of the plate 55, being centered at 79 and slightly adjustable about that center by means of slot 80 and clamping screw 81. The topmost sector 77 has associated therewith a lever 82 which is also free to pivot at 79 and which has a slot engaging with a pin 83 projecting upwardly from the outer end of the cam 75. At the opposite side of the pivot 79 this lever 82 projects radially of the sector 77 to form a sort of small hand lever 84 by means of which the cam 75 is shifted to any one of its three positions and whereby it may be locked in that position as the lever 84 springs upwardly within one of the slots 85 cut in the outer edge of the sector.

The lever 86, also pivoted at 79 has a similar slot engageable with pin 87 projecting downwardly from the cam 76. Likewise, this lever 86 has a projecting hand lever 88 which engages similar slots in the lower sector 78 for the same purpose. By shifting the levers 84 or 88 to the appropriate slots, the cams 75 and 76 may be set and retained in any one of their three operative positions.

These cams and attached plate 55 constitute a unit and while they serve some general knitting purpose, are more or less associated with the knitting of the patterned pile fabric. These cams are bodily adjustable as a unit since the plate 55 is adjustably attached to the plate 54. The screws 89 and 90, Fig. 2, passing through slots in plate 54 and threaded into the plate 55 provide this adjustment.

Now referring to Fig. 22, the elongated cam 71 generally serves to bear upon the topmost part of the sinker stems 41 and hold them downwardly. At certain points the underside of these cams are cut away as at 91 and allow the sinker stems to move upwardly as they are selected. The pathway of the stems is illustrated at 92 in this Fig. 22. Each cam 71 is recessed at 93 and has a projection at the opposite end at 94. This construction allows an overlap of the cams as illustrated in Fig. 2.

The cam 74, as illustrated in Figs. 2 and 16, is a sort of guard cam and prevents firing of sinkers as they are withdrawn by cam 72. This cam 74 is of such a depth as to engage all sinker butts, whether selected or not and further, keeps these butts in engagement with the knife edge cam 73 as will be described.

The cam 72 withdraws sinkers as illustrated in Figs. 2, 3, 15 and 16. The withdrawing of sinkers at this point brings them back to a position wherein, if not acted upon by either of cams 75 or 76, loops will be drawn forward of the nibs. That is, plain loops or plain knitting would result, except for ornamentation as controlled by the needle selection such as tuck work, float work, etc.

The knife-edge cam 73 is normally positioned as illustrated in Fig. 11, for example, above the top of the butt 42 and will prevent the butt rising accidentally as might occur if it were not for this safety feature. As the outer ends of sinkers are raised by jacks upon selection, Fig. 10, the notch 44 will engage this knife edge cam so that

the outer ends of these sinkers will remain elevated until they have been pushed inwardly to whatever position they are to be projected, depending upon the setting of cams 75 and 76. Sinkers are frictioned within these slots and this knife-edge cam is merely an additional safety feature making the selection positive of determining length of pile loops or of plain knitting. The jacks raise the outer ends of sinkers, but do not tend to keep them raised after they have passed the selecting plungers which function upon the butts 45 on said jacks. The spacing between cams 74, 75 and 76 and cam 72 is such that the knife-edge is not disengageable from the notch 44 once they have become engaged and until the sinker butts have passed beyond the extent of that knife-edge at which time sinkers will have been projected inwardly to whatever position they are to occupy as the stitch is drawn.

Referring to Figs. 1, 2, 3 and 22, the selective mechanism functioning upon jacks 43 will be described. A bracket 95, Fig. 2, is attached to the upstanding projection 52. This bracket 95 has two upstanding parts 96 and 97 between which are inserted in slots the inclined spacers 98 between which the several selecting cams or plungers 99 may slide. Each of these plungers 99 is bevelled at its inner end to engage the saw-tooth butts 45. These plungers are movable to and from butt engaging positions as will be more fully described. At the lower side of bracket 95, a support 100 projects rearwardly and has attached thereto the upstanding posts 101 at one side of the set of plungers, and 102 at the other side. The post 101 is slotted to guide the outer ends of these plungers. The post 102 fits within recesses in that side of each plunger which limit the inward and outward movement of the plungers. A U-shaped retaining element 103 overhangs the plungers and projects downward at the opposite side from post 101 so that they are held within the shallow slots in that post. This retaining element 103 is adjustably maintained in position by the screw 104. Each plunger has a notch 105 in its outer end by means of which it may be engaged by a hook when it is desired to pull that plunger out when setting up a pattern.

The levelling cam 106, Figs. 1, 2 and 3, extends from an angular bracket 107 which is adjustably attached by means of suitable screws or other connections to the post 97. This bracket and the cam are adjustable vertically and the cam itself engages the top edge of the jacks 43 to level them prior to their contacting such of plungers 99 as may be in a position to engage butts 45 for purposes of selection.

A leaf spring 108 is fixed between a plate 109 and the post 102 and has a detent 110 soldered or otherwise fixed to its free end. This detent engages within one of two notches 111 cut in the side of each of the plungers 99. The spring is under sufficient tension to force the detent into these notches, and when in the outer notch, will retain a plunger in butt engaging position, but when in the other notch, will hold it in an inactive position. The tension in the spring is such that it will snap outwardly to allow movement of a plunger whenever that plunger is pushed in or pulled out. The spring itself might be shaped so as to present a ridge or other projection for engagement within the notches.

The plate 109 is adjustably attached to the lower outwardly projecting support 100 by means of a clamping screw 112 which passes through an

elongated slot 113, these elements being maintained in alignment by the dowel pins 114 and 115. The plate 109, spring and detent, as well as post 102 may be adjusted inwardly or outwardly as a unit upon loosening screw 112 and effecting an adjustment by means of the adjusting screw 116. Screw 116 is retained by means of a lock nut 117. After adjustment, the screw 112 is tightened to hold all elements in position. The method of adjustment is to start at a position too far out, and then to turn the screw 116 slowly inwardly until the plungers engage the saw-tooth butts 45 to a correct depth.

A latch 118 is pivoted at 119 and may be swung from the dot-and-dash line position, Fig. 3, to the full line position at which it is stopped by means of pin 120. In that position the detent 110 will be positively held in the notches 111 thus assuring that a plunger or plungers 99 which might be in outer or inactive position could not be accidentally pushed in thereby changing pattern unintentionally. Such might occur if some sort of safety mechanism were not provided. In this particular example twenty plungers and thus twenty different steps of selection have been provided. This is a satisfactory number for ordinary pattern work and in conjunction with the exceptional number of feeds which are characteristic of the Hemphill multi-feed machine, patterns of considerable scope are available. Of course, the invention may be applied with a great many more or with fewer steps of selection if so desired.

On each of the jacks 43 an extra butt 45' has been provided at the lowermost extent of that jack. This butt might be used under certain circumstances where a separate plunger was provided, possibly under automatic control, for controlling each of the jacks and necessarily their sinkers to change from pattern work to an all-over pattern with pile knitted at each loop.

Now referring to Figs. 1, 4 and 5, the yarn feeding finger or guide and adjacent parts are supported on a short stud 121 which is threaded into the plate 54. An arm 122 terminating in a boss 123 is adjustably fixed at the upper end of the stud. A spindle 124 extends through a hole in the boss 123 and carries at the inner end adjacent the needle circle a yarn guide or finger 125. This finger 125 terminates at its lower end in one yarn guiding eyelet 126 for the top or loop yarn and another eyelet at the lower horizontal part 127 for the body yarn. The lower edge of this finger or lever 125 is sharp as illustrated at 128 and serves to open needle latches, if necessary. This finger 125 is attached to a flattened portion on a hub 129 which is in turn fixed to the inner end of spindle 124. This same attaching means also secures a bent bracket 130 in which there are two eyelets 131 and 132 through which the yarns are threaded.

Between the hub 129 and the boss 123 are two spacing washers 133, a separating spring 134 and two detents or drop wires 135 and 136. Normally the yarns are threaded so that each yarn holds its drop wire in elevated position and away from a contact piece. When the yarn breaks or becomes too slack its drop wire falls and will contact the current carrying element 137, causing a stop motion to function in a well-known manner. The stop mechanism is not primarily a part of this case, thus further description is not necessary.

It is characteristic of this yarn feeding finger 125 that it feeds the lowest yarn just as close

to the top of the sinker throat, that is, as far below the nib, as possible. The eyelet 126 feeds the other yarn above the nibs and as high as is practicable so that both yarns have a maximum spacing. This gets the nibs in between the yarns without danger of misplacement. The finger also has an inwardly projecting tongue 138 which keeps the top yarn away from the hooks of the needles before it passes through the eyelet 126. The purpose of this is to prevent the hooks of needles catching in any frayed parts of the yarn such as sometimes happens. The yarn does not approach the hooks of the needles until it has passed through the eyelet at which time it is below the hooks and so close to the shanks that the entire yarn is taken within the hooks. It is the purpose of this finger to feed the two yarns spaced properly in a vertical direction but also as close to the needle circle as possible so that proper feeding and proper plating will result. It will be noted that the lower yarn feeds in advance of the upper one; the purpose of this will be explained, more fully in a following paragraph.

Referring to Fig. 1, the spindle 124 as it passes through boss 123 has attached thereto a stop arm 139. This arm is clamped to the spindle by means of the clamping screw 140. Said arm also has a lower flattened side 141 which bears against a leaf spring 142 (better shown in Fig. 4) which tends to maintain the spindle and attached parts including the finger 125 downwardly in feeding position, or, if swung up to withdraw the yarns from the needles, will retain the finger in that position. An adjustable stop screw 143 set in position by the locking screw 144 may be adjusted in such a manner as to limit the downward movement of the finger so that the lower yarn will feed properly as explained above.

In machines of the type described the sinkers are moved vertically at the stitch drawing point and cooperate, as explained in Patent No. 2,090,500 so that stitch measuring and drawing is divided between the two instrumentalities. In the instant machine sinkers are raised and lowered prior to the approach of the stitch point for the purpose of projecting sinker nibs between the two feeding yarns with greater accuracy. This is possible by employing the same jacks or raise sinkers at the stitch point and separately controlling them by additional camsto impart this preliminary wave. Referring to Fig. 22, the cam 35 maintains the jack butts and sinkers in a lower or normal position these jack butts passing along in pathway 145. The cam 35 is cut away as shown at 146 to allow these jack butts to be raised by the first part 147 of the cam 34. The downwardly inclined portion 148 of the cam 35 then moves these jacks back to substantially their lowermost elevation, which elevation corresponds to that normally existing just prior to approach of the stitch drawing ring. Referring to Fig. 4, the effect of these cam sections 147 and 148 and the movement of the sinker nibs may be seen. At this point it is also evident why the lower yarn is fed in advance of the upper yarn. The finger 125 is so cut away beneath the feeding eye 126 as to allow the sinker nibs to be projected upwardly and inwardly between the yarns without interference.

After nibs have been projected between the yarns, in the event a pile loop is to be drawn, or if not, in the event ordinary stitches are to be drawn forward of the nib, the second part 149 of cam 34 raises the jacks 32 and consequently the

sinkers to participate in the measuring and drawing of stitches. At this same time the needles are moving in pathway 150 down the stitch cam 12 and being guided between that cam and cam 13. Cam 36 serves to prevent firing of the sinkers upwardly and to cause them to move along at a common level after stitches have been drawn. The leading edge 151 returns these sinkers to their lower pathway prior to approach of the next feeding station. The stitch drawing is not particularly different in this case from that which has been described in previous cases with respect to this type of machine, but the preliminary raising to project sinker nibs between the yarns in the event pile loops are drawn is new in this particular case and is a desirable feature of the present invention. While the machine herein described is particularly adapted for this preliminary raising movement of sinkers incidental to drawing pile loops, the said movement has similar advantages in other types of machines such as those machines in which stitch drawing is done entirely by needle control. It is not intended to limit the invention to any particular knitting machine, but the same is advantageous and intended to be used in all machines wherein a sinker nib is to be projected in between two or more yarns and where the raising movement would facilitate the engagement thereof as described.

Referring to Fig. 7, a modified form of sinker is illustrated. This sinker is designated generally by numeral 26' and has a stem 41', butt 42' and notch 44' all as in the form of sinker first referred to. The nib of this sinker 152 is different in that the top of the nib is notched at 153 so that long pile loops may be drawn in this notch rather than on the slanting upper surface as in the case of the nibs 38. A notch 40' is similar to the notch 40 and is employed when it is desired to draw short pile loops.

Operation

Now referring to Figs. 9-22, I will describe briefly the manner in which the machine functions to knit the several types of stitches, and briefly, how patterns are to be determined. In Fig. 9 the pathway of sinker butts 42 is shown at 154 in which all sinkers approach the cams 71, 72 and 74. The sinkers then are withdrawn by cam 72, the knife edge cam 73 either maintaining them in non-selected position or if they are selected, maintaining them elevated. The cams 75 and 76, depending upon their position, will determine how far in a selected or a non-selected sinker is to be projected. In this Fig. 9 some of the sinkers are shown as passing along in a pathway 155, or are not being affected by either of the cams 75 or 76. The cam 56 will push all these sinkers in for purposes of casting off. The other pathway shown at 156 is the result of sinker butts contacting either one or the other of cams 75 or 76 which is moved inwardly to its extreme position. In that position sinkers are pushed in so that the pile loops are drawn in the notch behind the nib. The sinkers which are pushed in to this extent are practically in the casting off position when they strike cam 56, however, that cam may impart a slight additional casting off movement if the cams 75 or 76 were not set as deeply as the cam 56. It must be understood that the adjustment of cams 75 and 76 is capable of being varied by setting the sector 77, Fig. 15, whereupon longer or shorter loops may be drawn. The basic loop will be reg-

ulated by setting the stitch cams so as to regulate the amount of draw imparted to the needles. The comparative size of the pile loop with respect to the basic loop drawn in the throat of the sinker may be varied by setting these cams 75 and 76. The long loop will be varied by drawing over higher or lower parts of the inclined nib 38, while the depth to which the sinker is pushed in will control the relative length of the short loop with respect to the basic loop. The construction and adjustment provided is such that short loops may be drawn which are slightly longer than the basic loops, and the longest of the long loops is determined by the height of the nib 38 above the throat of the sinker.

Referring to Fig. 15, all sinkers are shown as being guided through a pathway to draw short pile loops. In Fig. 16 some of the sinkers are moved in a pathway to draw short pile loops, while others are moving in such a pathway as would cause them to draw long pile loops.

Now referring to Fig. 10 which is a section taken on line A-B, Fig. 9, the sinker is shown having its butt or outer end selected and raised by one of the jacks 43 so that the notch has engaged the knife-edge cam. The sinker butt is about to engage one or both of the cams 75 or 76, but since those cams are, in this view, shown completely retracted, the sinker butt will move in a pathway corresponding to 155, Fig. 9. In other words, the selection does not make any difference unless one of the cams 75 or 76 is in intermediate or fully projected position. Such a sinker as illustrated in Fig. 10 would merely cooperate in the drawing of an ordinary stitch, both yarns being fed to be drawn forward of the nib and in the throat.

In Fig. 11, the section is also taken at line A-B, Fig. 9, but merely shows the difference if the sinker is not selected. The entire butt 42 passes below the knife-edge cam and will be held downwardly against accidental raising. Here it would not make any difference if the cam 75 were in a different position; the butt would not contact that cam. The position of the lower cam 76 would make a difference; if in intermediate position, the sinker would have a long pile loop drawn over the nib, but if in fully projected position, would have a short pile loop drawn in the notch.

In Figs. 12 and 13 the section is taken at line C-D, Fig. 9, and cam 76 is shown in that intermediate position, Fig. 12, but in fully projected position, Fig. 13.

In Fig. 14, the section is taken at line E-F at which point the casting off cam 56 is effecting its intended function. If the butts 42 are not at their lowest position at this time, they would be moved downwardly by cam 57, Fig. 4, shortly after passing the point of cam 56.

Fig. 17 is taken at line G-H, Fig. 15, and shows a sinker having been selected by its jack and being pushed inwardly to draw a short pile loop under the influence of cam 75. If the sinker had not been selected, it would have been governed by cam 76 and would have drawn a long pile loop, this condition being illustrated at Fig. 18.

In Fig. 19 the section is taken at I-J and shows parts in that position where a sinker is selected, but is to be controlled to draw a long loop by the upper cam 75 which is in intermediate position. Here if the sinker had not been selected it would have drawn a plain loop in front of the nib since cam 76 is fully retracted.

In Fig. 20 the cam 75 is in position for controlling sinkers which have been selected to draw short pile loops, while cam 76 indicated by dot and dash lines, would have allowed that sinker to pass along in pathway 155 thereby drawing a plain loop. The examples illustrated and just described are merely some of the combinations which may be derived from the manipulation of these cams 75 and 76 along with selection by the plungers 99 functioning upon jacks 43. No attempt is made to enumerate all the possibilities, but merely to show representative examples from which the principle of operation and the invention may be learned.

At some feeds the upper yarn feeding through eyelet 126 may be fed omitting the lower or body yarn. Then according to selection, long or short single loops may be drawn at this feed to produce open work. According to the selection of sinkers long open stitches may be interspersed as desired with stitches of normal length. This would give simple pattern effects of open or eyelet work in plain cloth.

Another variation made is that of drawing alternate courses of long loops entirely and the intermediate courses of short loops. It would give a sort of open fabric effect which would be to some extent run resistant due to the tightness of the courses knitted of extremely small loops. The pile fabric is run proof to a considerable extent anyway.

Tuck or float stitches may be knitted at any of these feeds by proper selection of needles; the tuck or float work would normally be employed to set off certain figured areas to contrast with plain work, open work, or loop or pile fabric. About the only limitation on combinations of these stitches is that at any feed where a single yarn is fed for the producing of open work, pile fabric will be available at that feed since there will be no backing yarn or base yarn upon which to superimpose the pile loop.

Still another effect which may be produced is that of knitting double pile loops. Certain of the needles may be caused to knit tuck stitches taking a plurality of pile loops as well as a plurality of base or body loops. When casting off, each loop cast off will constitute a tuck stitch with two pile loops projecting therefrom. This means that when the tuck is knitted quite close, the fabric will have more dense pile than otherwise. Still another possibility is that of knitting both a base and pile yarn at alternate feeds and a pile yarn only at intermediate feeds. The intermediate feeds would be set so that the needle would take yarn but would not cast off thereafter. This would result in a single base yarn being knitted at each complete stitch, but that single base yarn would be characterized by two pile loops. These last examples are disclosures of fabric and methods of knitting it whereby fabric corresponding to heavy velvet is to be made.

Now referring to Figs. 23, 24 and 25, I will describe rather briefly the fabric which is to be knitted. The wales 157 and 158 are needle wales which have been knitted of two yarns, one being shown shaded and the other unshaded for purposes of identification. These yarns may be of any suitable material, for instance, the yarn 159 which I will term the base yarn may, for example, be cotton or mercerized, while the other yarn 160 may be silk, artificial filaments, or any other satisfactory material; this yarn 160 is the yarn from which pile loops are drawn. The pile loops are formed at the back of the fabric, that is,

what is commonly considered the back of a plain knitted fabric, and in this instance, the yarn 160 from which the pile loops are drawn is at that side of the fabric and is plating over the yarn 159 when considered from the point of view illustrated in these Figs. 23 and 24. Incidentally when sinkers are so constructed as to have pile loops drawn over them from the yarn 160, they reverse plate the two yarns so that throughout the areas where pile loops are drawn, the two yarns will be reversed as to their position. The wales 161, 162 and 163 are thus shown reverse plated, these wales being drawn by needles which have drawn pile loops 164 in sinker wales 165 and pile loops 166 in wale 167. More specifically, the sinkers forming these sinker wales 165 and 167 have been controlled to have long pile loops drawn over their nibs. These long pile loops come out from under the sinker loops of the yarn 159 drawn between wales 161, 162 and 163.

In Fig. 24 long pile loops are drawn in wales 168 and 169 while short pile loops are shown in sinker wales 170 and 171. The sinker wales 170 and 171 are formed while the sinkers corresponding thereto are pushed in to fullest extent so as to have the yarn 160 drawn in the notches behind the nibs. Since the entire area of fabric shown in Fig. 24 has pile loops associated therewith, that area is reverse plated. Of course, some control might be used to avoid this reverse plating, but the same comes about as a result of sinker movement and is desirable since the same yarn 160 will appear at the same side of the fabric as the pile loops. This means that if the yarn 160 is of silk or any other particular material as contrasted with the yarn 159 the face of the fabric which is to be used, that is, the side upon which the pile loops appear, will present a uniform appearance so far as the character of yarn is concerned. When viewed from the opposite side to that illustrated in Figs. 23 and 24, the areas in which pile loops are drawn will appear as reverse plated. For example, those areas, if made of silk which has a greater luster than the other yarn, will present an appearance wherein the figures will show in that side of the fabric as a watered or moiré effect.

The pile loops may be brushed up by any satisfactory means, or may be used in exactly the form in which they are knitted. Again they may be cut as in velvet and may be brushed to stand out from the fabric.

In Fig. 25 a section is taken through the fabric of Fig. 24 wherein the yarns 159 and 160 are shown in their reverse plated relationship, long pile loops 169 contrasting in length with the shorter pile loops 171.

Now referring to Figs. 26 and 27, two forms of ornamentation are shown. In certain instances the figure may be characterized by the lack of pile loops while in another form the pile loops may constitute the figure itself. In Fig. 26 the diamond D is the result of there being pile loops throughout the remaining portion of the fabric except where the diamond or diamonds would appear. In Fig. 27 the opposite is true, the diamond D' is formed from the pile loops themselves and stands out from the fabric. Other forms of ornamentation and other schemes will suggest themselves and it is not the purpose of this case to disclose all manners or all uses to which this fabric may be put. Neither is it my purpose to disclose the various treatments to which the pile loops may be subjected.

Certain variations in colored yarns is contemplated.

plated so that with all the types of stitches possible to be knitted, widely varying colored effects are possible. No attempt is herein made to enumerate or describe all the stitches or combinations of stitches that are possible. The invention is capable of such variations and modifications as will readily suggest themselves to those skilled in the art and is not limited otherwise than by the limitations expressed in the appended claims.

I claim:

1. In a multi-feed knitting machine the combination of knitting instrumentalities including needles and sinkers said sinkers being so constructed as to have plain knitted stitches or pile loops of either of two different lengths drawn thereover, selecting means operable upon said sinkers for projecting them to different positions at any desired course of knitting, the construction and operation being such that either plain stitches, short pile loops or long pile loops may be drawn selectively at any feed and at any course.

2. In a multi-feed knitting machine, needles and sinkers, said sinkers being adapted to have one yarn of each stitch drawn below a nib and the other drawn over a nib, selecting means operable on said sinkers at each feed of said machine to project them inwardly to positions so that the yarn drawn over the nib will be drawn at different positions thereover.

3. In a multi-feed knitting machine the combination of knitting instrumentalities including needles and sinkers, said sinkers being constructed so that two knitting yarns simultaneously fed may be drawn forward of a nib, one yarn beneath the nib and the other above it, or one yarn beneath the nib and the other behind it and at a lower elevation than that drawn over the nib, and selecting means for determining to which of these three positions any sinker shall be projected prior to the drawing of stitches at any feeding station about said machine.

4. In a multi-feed knitting machine the combination of knitting instrumentalities including needles and sinkers, said sinkers being constructed to have both of two feeding yarns drawn forwardly of a nib, one yarn below a nib and the other above said nib, or one yarn below said nib and the other behind said nib and at a lower elevation than that drawn above the nib, sinker projecting cams movable to different positions for projecting sinkers to any one of said three positions, and selecting means for moving sinkers to contact predetermined ones of said projecting cams.

5. In a knitting machine, knitting instrumentalities including vertically movable needles and transversely movable sinkers having nibs, means for feeding yarns, one above and one below nibs on said sinkers, and means for raising sinkers prior to engagement of the yarn so that sinker nibs will more effectively engage between the said yarns.

6. In a knitting machine, knitting instrumentalities including sinkers having nibs, means for feeding two yarns, one vertically spaced with respect to the other, means for projecting sinkers inwardly so that their nibs will separate the spaced yarns and in combination means for moving sinkers upwardly so that the nibs may more effectively engage between the two yarns.

7. In a knitting machine, knitting instrumentalities including sinkers having nibs, yarn feeding means for feeding a plurality of yarns, one

spaced vertically with respect to the other, means for projecting sinkers in so that their nibs will engage between and separate the yarns, selecting means for determining this inward projection of sinkers and other means for raising sinkers whereby nibs of those sinkers selected and pushed inwardly may more effectively engage between the said yarn.

8. In a knitting machine, knitting instrumentalities including vertically movable needles and horizontally movable sinkers, yarn feeding means for feeding a plurality of yarns, one of which is vertically spaced with respect to the others, means for projecting sinkers inwardly so that nibs on said sinkers may engage between the two yarns to draw one yarn beneath the nib and the other over said nib, jack means for raising said sinkers prior to their being moved inwardly so as to engage the yarns more effectively.

9. In a knitting machine, knitting instrumentalities including needles and sinkers, said sinkers being radially movable, a plurality of sinker projecting cams for imparting said radial movements, said cams being adapted to be manually set in different positions to determine different degrees of movement for sinkers, and selecting means in combination therewith for moving sinkers to different positions to engage predetermined ones of said projecting cams.

10. In a knitting machine the combination of knitting instrumentalities including needles and sinkers, said sinkers having butts thereon by means of which they are to be projected inwardly, a plurality of sinker projecting cams movable to different positions and means for maintaining them in said positions, said projecting cams being engageable with said butts, and selecting means for moving said sinkers so that their butts will engage different ones of said sinker projecting cams thereby to determine different degrees of movement for any sinker.

11. In a knitting machine, needles and sinkers, cams for imparting radial movement to said sinkers, a butt on each sinker and a jack individual to each sinker functioning at a position adjacent said butt for raising the butt to different selective positions, a sinker projecting cam engageable with a butt when it has been selectively raised, and pattern means functioning upon said jacks selectively to raise them and the butts on sinkers adjacent thereto whereby said projecting cam may be caused to engage the butt and project said sinker inwardly.

12. In a knitting machine the combination of knitting instrumentalities including needles and sinkers having nibs, said sinkers being radially projectable whereby stitches may be drawn forward of or over said nibs, a butt on each sinker and a sinker raising jack adjacent the butt on the sinker for moving it to a position to engage a sinker projecting cam, said butt having a notch therein, a knife edge cam for engaging said notch when said sinker is moved as aforesaid to maintain the butt in a position to which it has been moved until the sinker has been projected radially to a desired position.

13. In a knitting machine the combination of knitting instrumentalities including needles and sinkers having nibs, said sinkers being radially projectable whereby stitches may be drawn forward of or over said nibs, a butt on each sinker for moving it to and from positions in which the yarn may be drawn either forward of or over the nib, a notch in said butt, cams for engaging said butt and another cam for engaging said

notch whereby the sinker butt may be maintained at different elevations.

14. In a knitting machine the combination of knitting instrumentalities including sinkers having nibs, said sinkers each having a butt, a notch in said butt, cams for moving said sinker radially of the machine by engagement with said butt, means for lifting the butt and adjacent portions of the sinker, a knife-edge cam engageable above the butt or within the notch whereby the sinker will be retained in either one of two selected positions.

15. Selecting means for sinkers in knitting machines including jacks having a plurality of removable butts, selecting means including a plurality of manually set butt engaging instruments, movable sinker projecting cams at different elevations and engageable with parts of said sinkers, the construction being such that different cams are engaged depending upon selections imparted by said first mentioned selecting instrumentalities.

16. Sinker selecting means for knitting machines including a plurality of movable sinker projecting cams, levers for moving said cams to different positions with respect to said sinkers to be controlled, a sector having notches within which said levers may engage for retaining said projecting cams in any one of a plurality of positions.

17. Selecting means for knitting instrumentalities of knitting machines having in combination a support, a plurality of selecting plungers slidable within said support, each of said plungers having two notches, these notches aligning vertically throughout the group of instruments, a spring pressed detent engageable with said notches, the construction being such that a plunger may be moved to and from active position as the detent is snapped from one notch to another.

18. A sinker for independent needle knitting machines having in combination a throat, a nib and a vertically disposed butt, said butt having a horizontally disposed notch facing toward the nib and adapted to engage a cam for maintaining the butt at a desired elevation.

19. In a knitting machine, instrumentalities including needles and sinkers, said sinkers being adapted to have stitches drawn over their nibs or in a notch behind their nibs, the construction being such that relatively long stitches may be drawn over the nibs but that relatively short stitches compared to ordinary knitted loops drawn forwardly of the nibs, may be drawn in said notches behind said nibs.

20. In a knitting machine the combination of knitting instrumentalities including needles and sinkers, said sinkers having nibs and being so constructed as to have loops drawn forwardly of the nibs, over the nibs, or in a notch behind the nibs, the construction being such that relatively long loops may be drawn over the nibs, but so that stitches drawn in the notches behind the nibs may be of a length much shorter than those drawn over the nibs and slightly longer than stitches drawn forwardly of the nibs.

21. A knitting machine having in combination means for knitting fabrics having plain and pile loop areas, including sinkers constructed to have plain loops and pile loops of different length drawn thereover, selecting means for selectively positioning said sinkers to draw plain loops or

pile loops of different lengths including cam means selectively engageable with parts of sinkers for imparting to them movements of different extent, and pattern means operable upon sinkers to determine their selective engagement with said cam means.

22. A method of knitting in knitting machines having needles adapted to draw stitches over horizontally movable sinkers, the construction being such that yarns are fed, one below and one above nibs on sinkers, said method including the step of preliminarily raising the sinkers as they are moved inwardly in a horizontal direction so that sinker nibs may more effectively engage between the feeding yarns.

23. A method of knitting in independent needle knitting machines including the vertical reciprocation of needles and horizontal movement of sinkers, feeding a plurality of yarns, one above nibs on sinkers and the other below those nibs, and in addition to the transverse movement, preliminarily moving said sinkers vertically or along the direction of movement of needles so that nibs more effectively engage between yarns fed above and other yarns fed below sinker nibs.

24. In a knitting machine the combination of instrumentalities having a plurality of removable selecting butts, manually controlled selecting instruments supported for engagement with said butts movable to and from positions for selectively engaging predetermined ones of the butts, each instrument having a plurality of notches, a spring pressed detent for engagement with said notches, corresponding notches being in alignment and so placed that in one position of each instrument a notch will be engaged by said detent for holding that instrument in butt engaging position, the other notch being so positioned that said detent will engage therein and hold the instrument in an inactive position.

25. A sinker for independent needle knitting machines of the type described constructed and arranged to operate transversely of a series of needles, normal movement of said sinker being substantially in a horizontal direction, a horizontally disposed throat, a nib above said throat and a vertically disposed butt horizontally spaced from the nib and throat and having a notch therein at the side of said butt which is towards the nib, said notch being adapted to engage a cam and to retain the butt and sinker at a desired elevation.

26. A method of knitting pile fabric including imparting cooperating movements to needles and sinkers, said sinker movements being in a direction transverse to the direction of needle movements, and including the steps of feeding two yarns, one above and one below nibs on sinkers, and further, preliminarily moving sinkers in a direction parallel to the direction of needle movement so that sinker nibs may more effectively be positioned between feeding yarns.

27. A sinker for circular, independent needle knitting machines having in combination a horizontally disposed throat, a nib above said throat and a relatively narrow notch defined by the back edge of the sinker nib and a closely adjacent shoulder between which the yarn is rather closely confined as it is drawn, said notch being of a depth substantially level with the lower edge of the sinker throat.

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