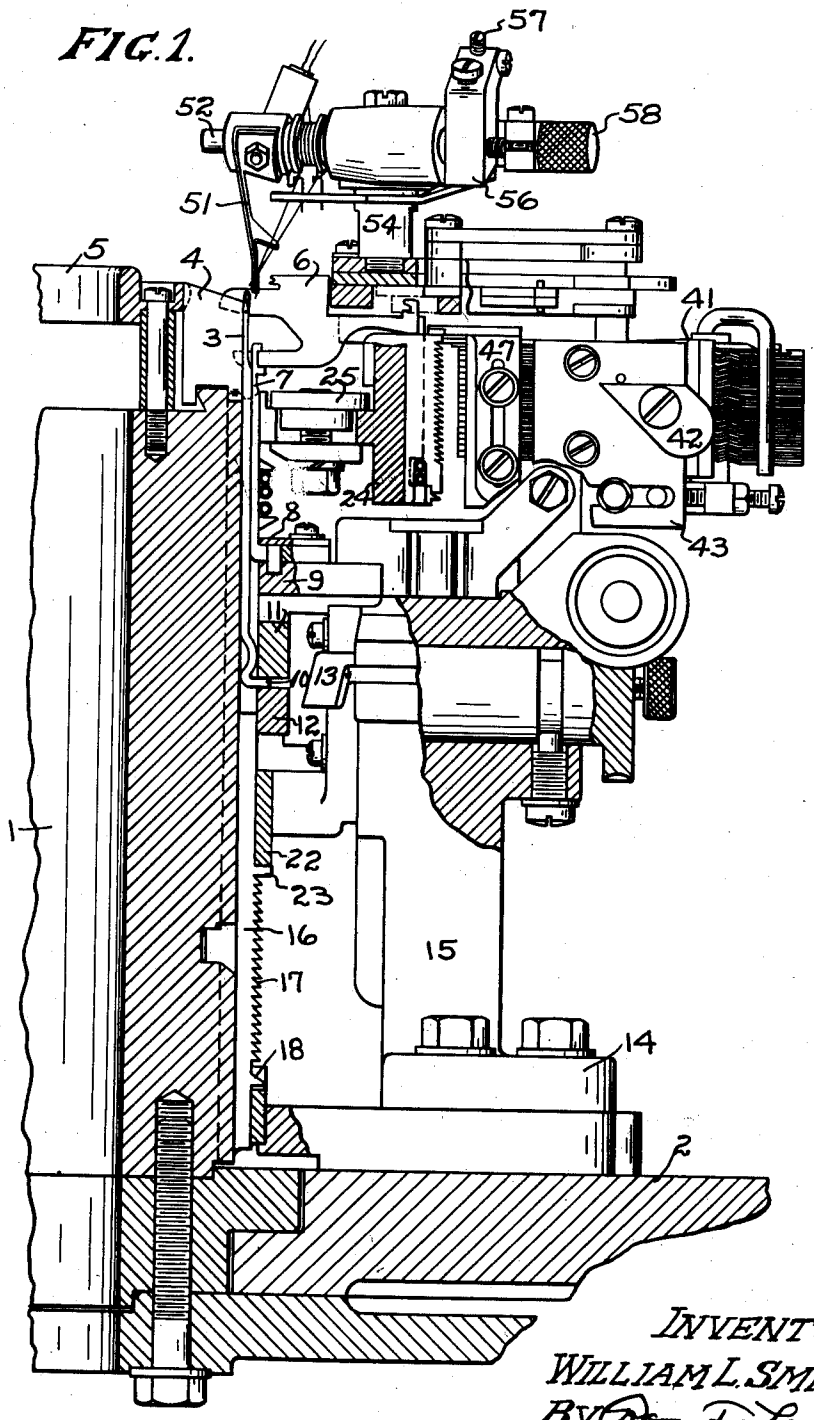
Jan. 20, 1942. W. L. SMITH, JR 2,270,719

KNITTING MACHINE FOR PRODUCING PILE FABRICS

Filed Oct. 7, 1938 11 Sheets-Sheet 1

FIG. 1.



INVENTOR:
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KNITTING MACHINE FOR PRODUCING PILE FABRICS

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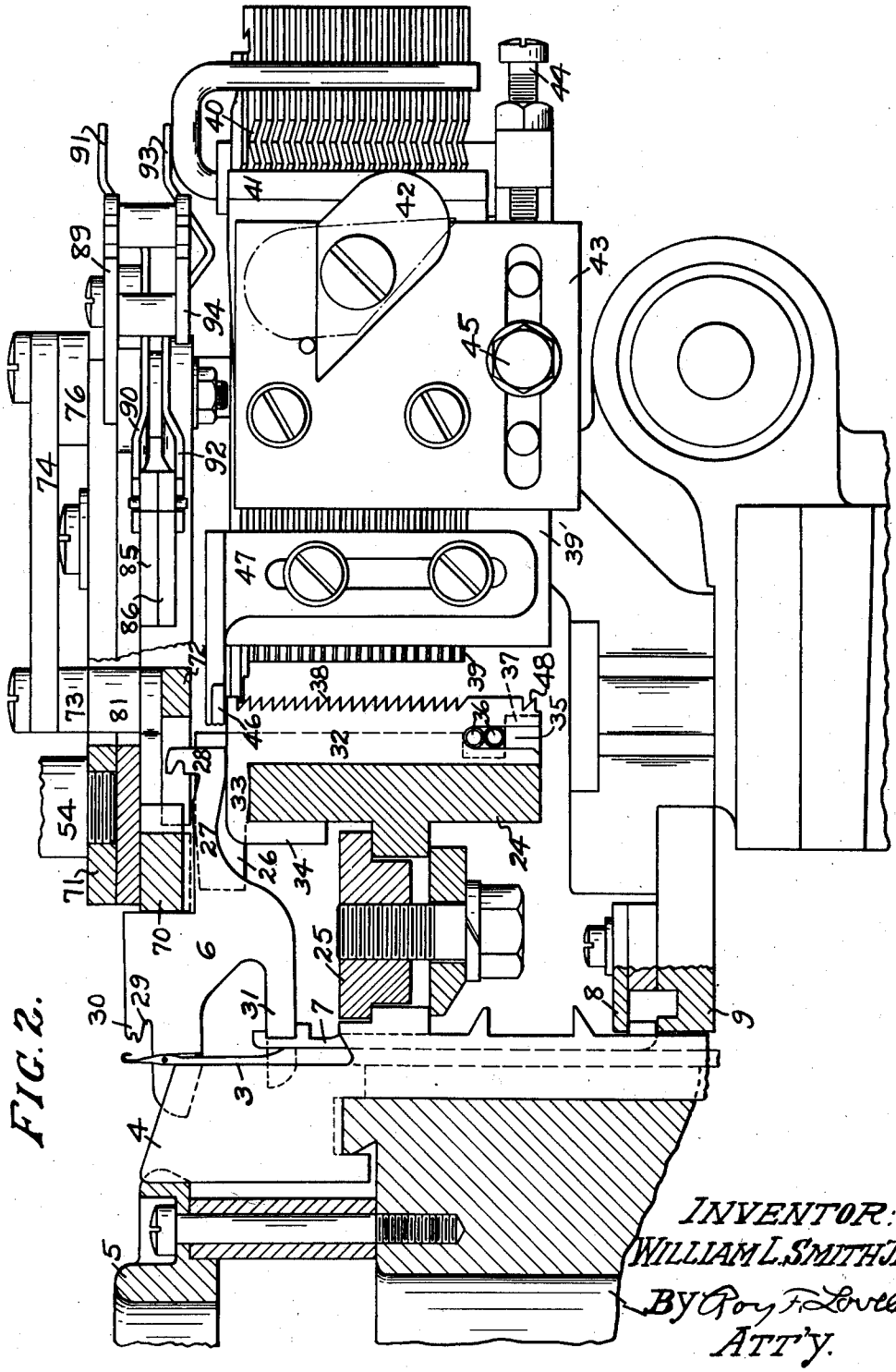


FIG. 2.

INVENTOR:
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KNITTING MACHINE FOR PRODUCING PILE FABRICS

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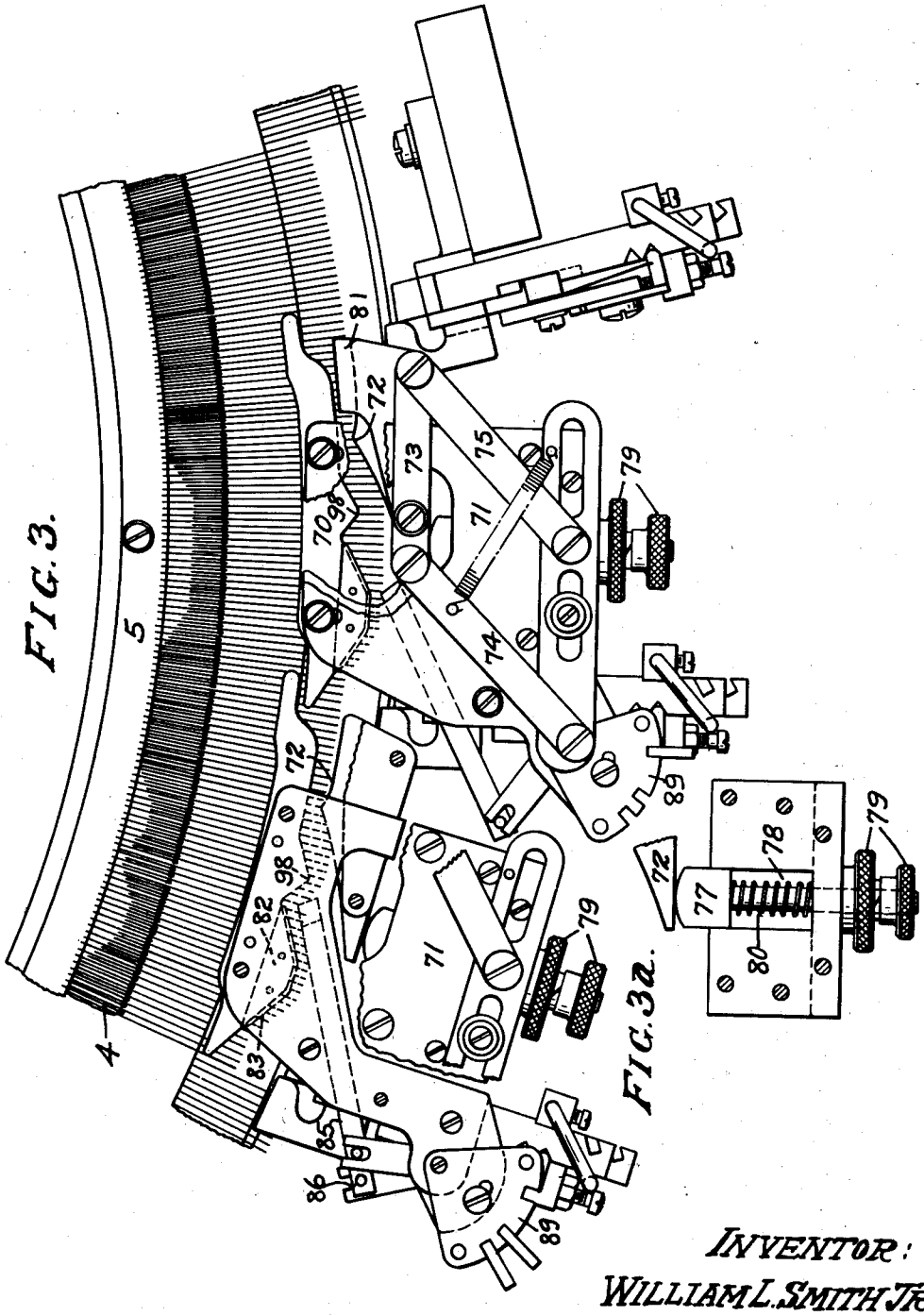


FIG. 3a.

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KNITTING MACHINE FOR PRODUCING PILE FABRICS

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FIG. 6.

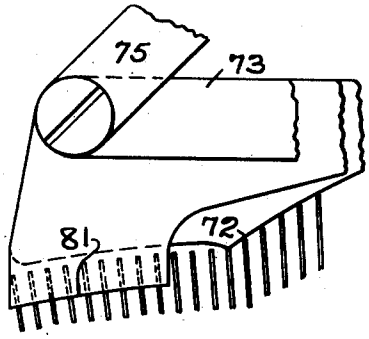


FIG. 5.

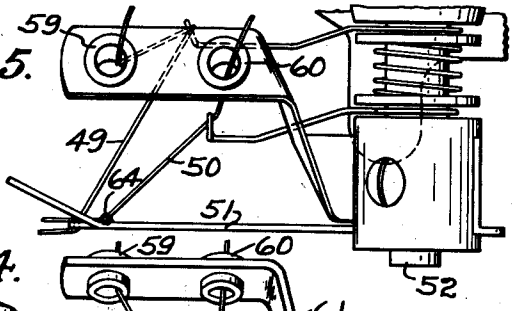


FIG. 4.

FIG. 7.

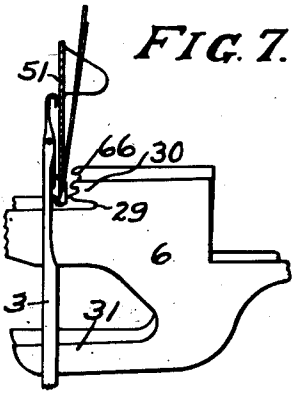


FIG. 8.

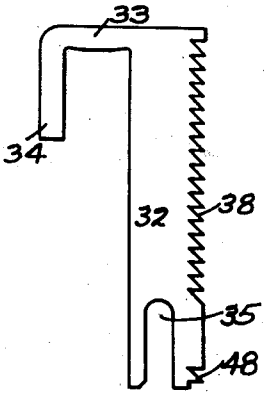
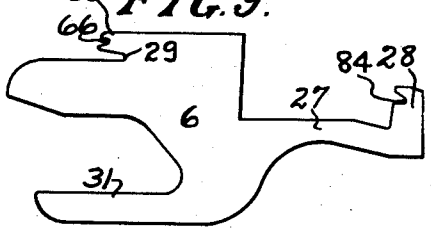


FIG. 9.



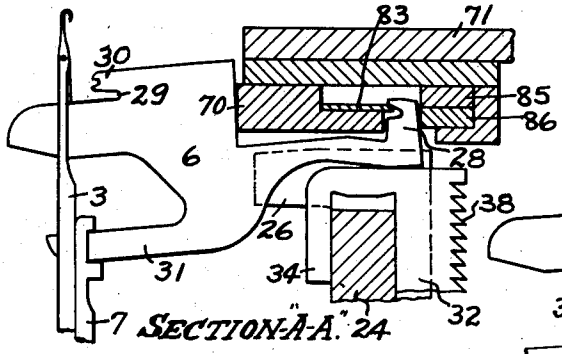
INVENTOR:
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Jan. 20, 1942. W. L. SMITH, JR 2,270,719

KNITTING MACHINE FOR PRODUCING PILE FABRICS

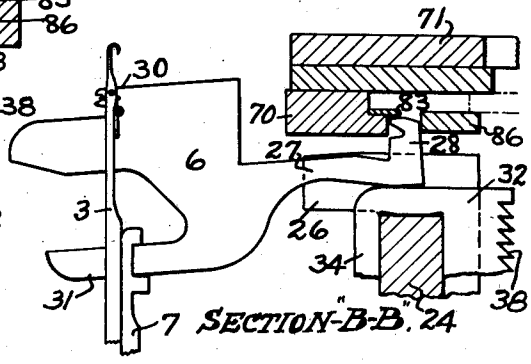
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FIG. 11.



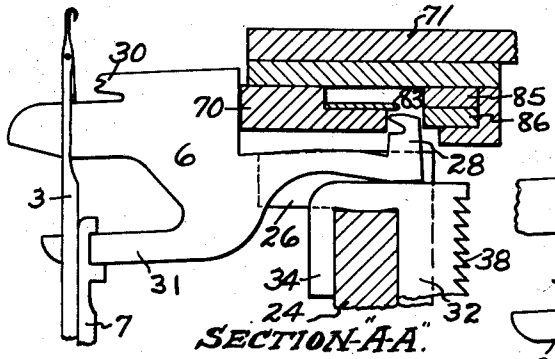
SECTION-A-A.

FIG. 13.



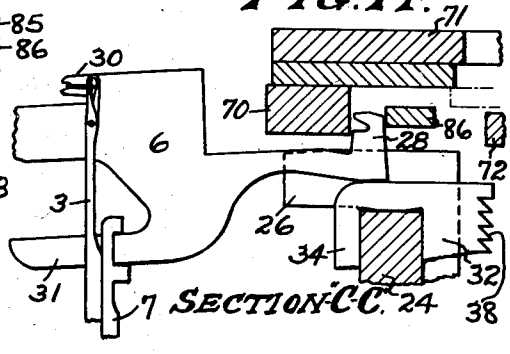
SECTION-B-B.

FIG. 12.



SECTION-A-A.

FIG. 14.



SECTION-C-C.

FIG. 10.

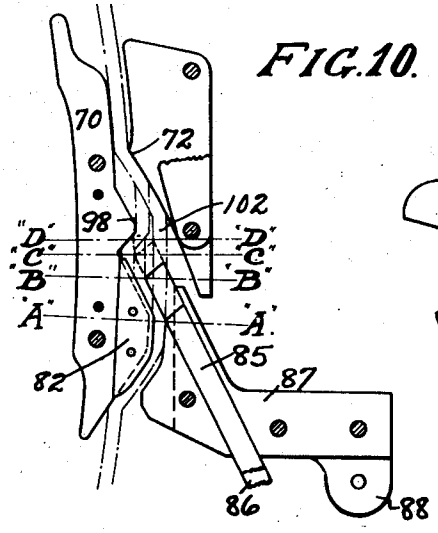
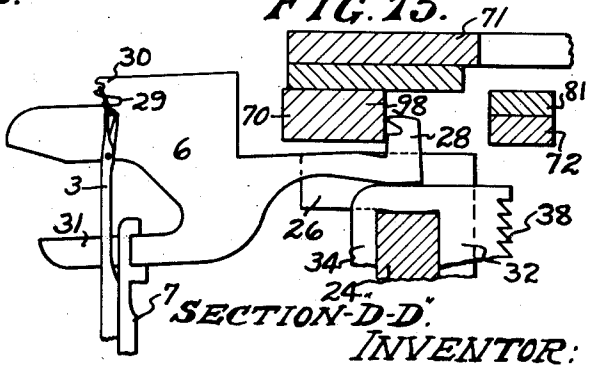


FIG. 15.



SECTION-D-D.

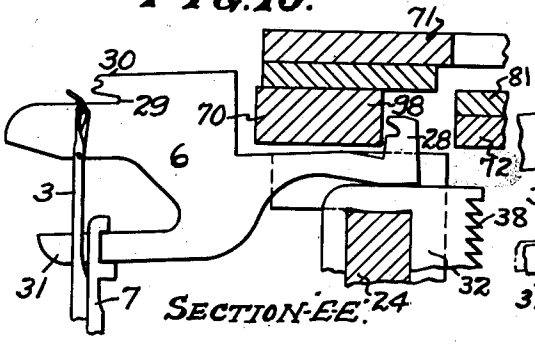
INVENTOR:
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ATT'Y.

Jan. 20, 1942. W. L. SMITH, JR 2,270,719

KNITTING MACHINE FOR PRODUCING PILE FABRICS

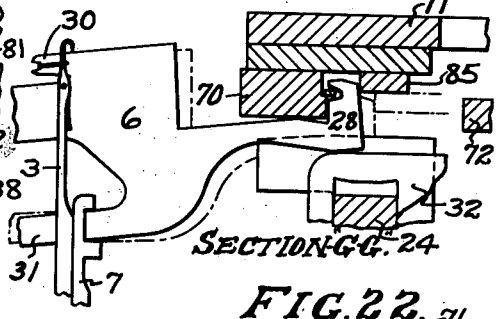
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FIG. 19.



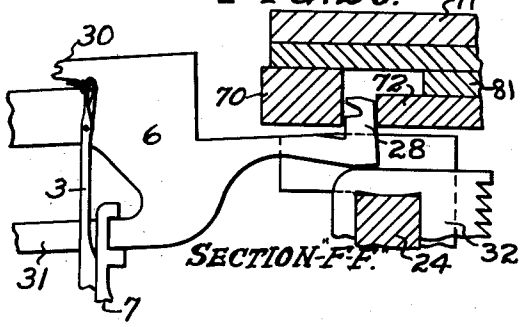
SECTION-E-E.

FIG. 21.



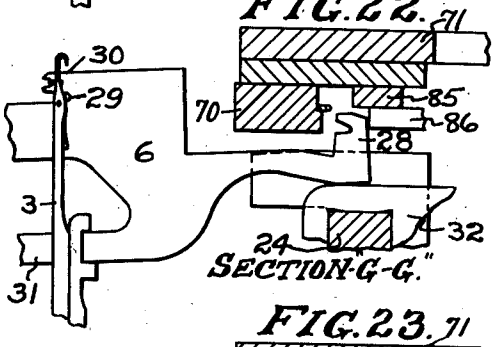
SECTION-G-G.

FIG. 20.



SECTION-F-F.

FIG. 22.



SECTION-G-G.

FIG. 18

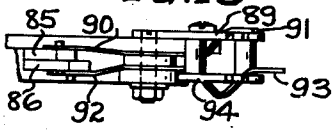
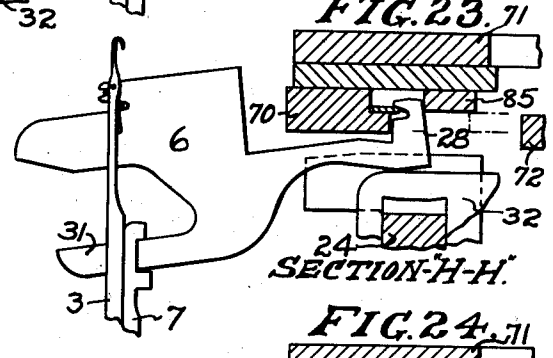


FIG. 23.



SECTION-H-H.

FIG. 16. FIG. 17.

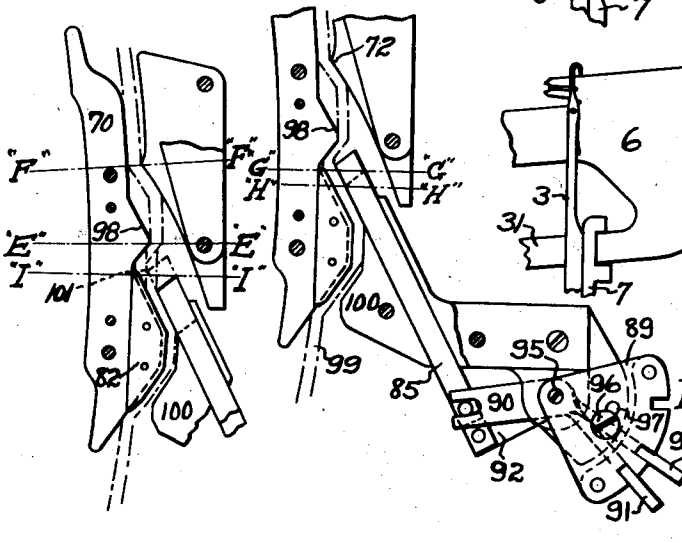
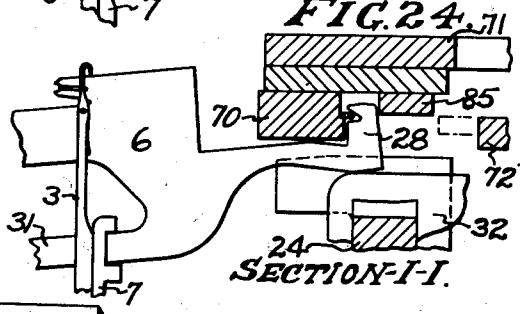


FIG. 24.



SECTION-I-I.

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Jan. 20, 1942. W. L. SMITH, JR 2,270,719

KNITTING MACHINE FOR PRODUCING PILE FABRICS

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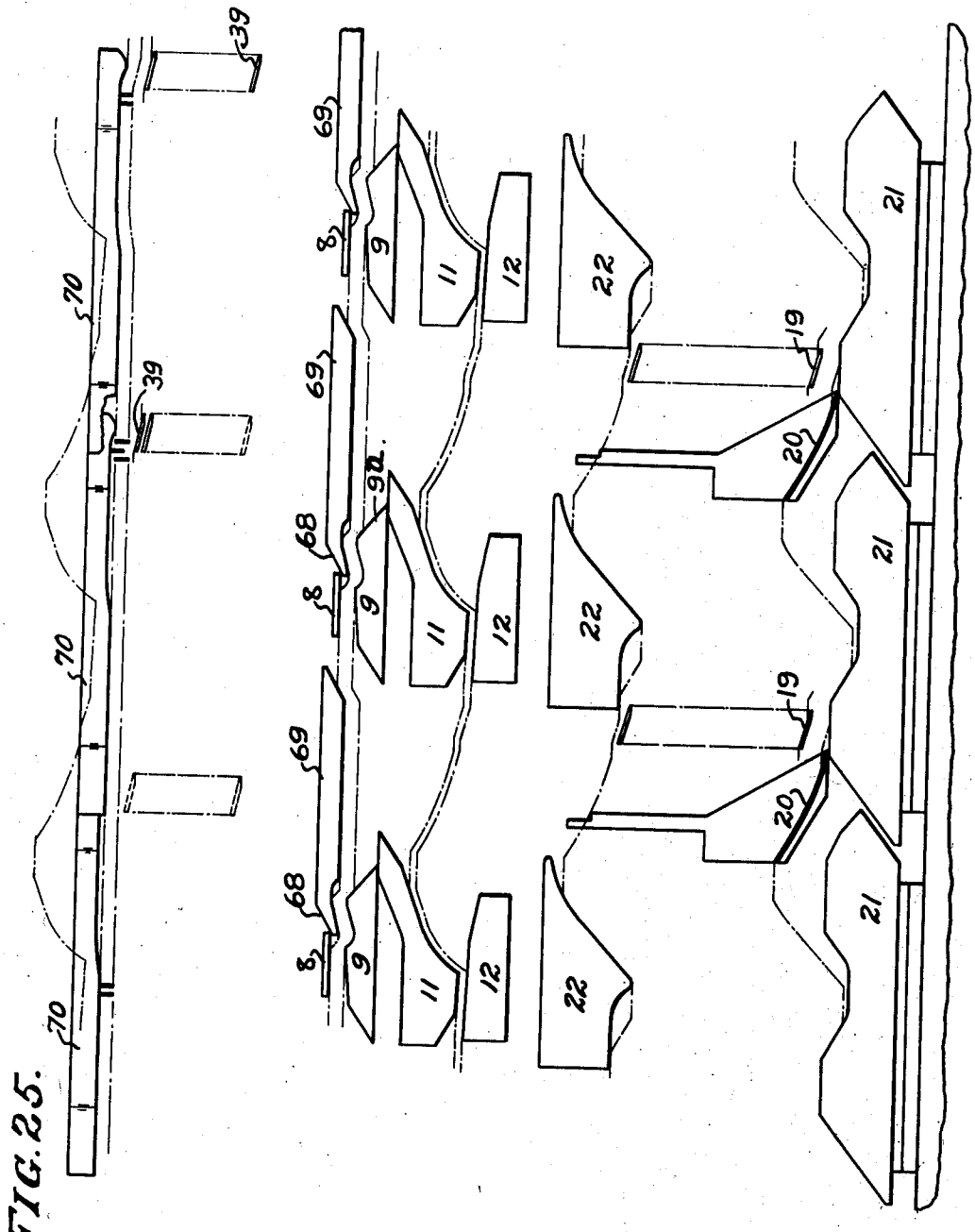


FIG. 25.

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KNITTING MACHINE FOR PRODUCING PILE FABRICS

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FIG. 26.

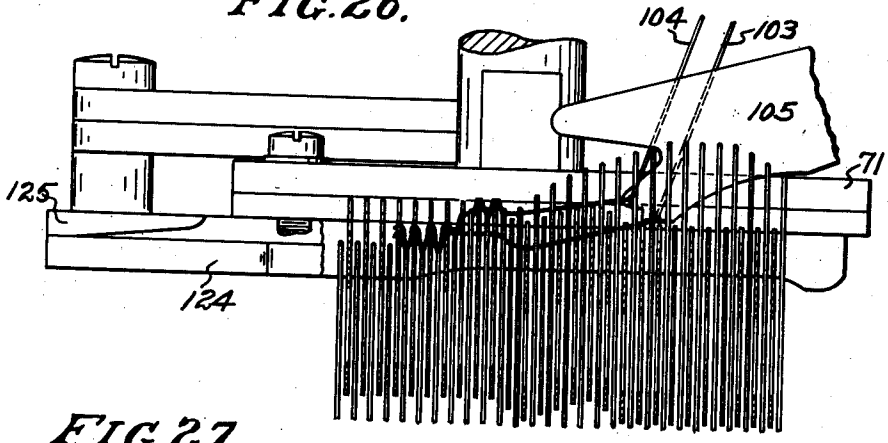
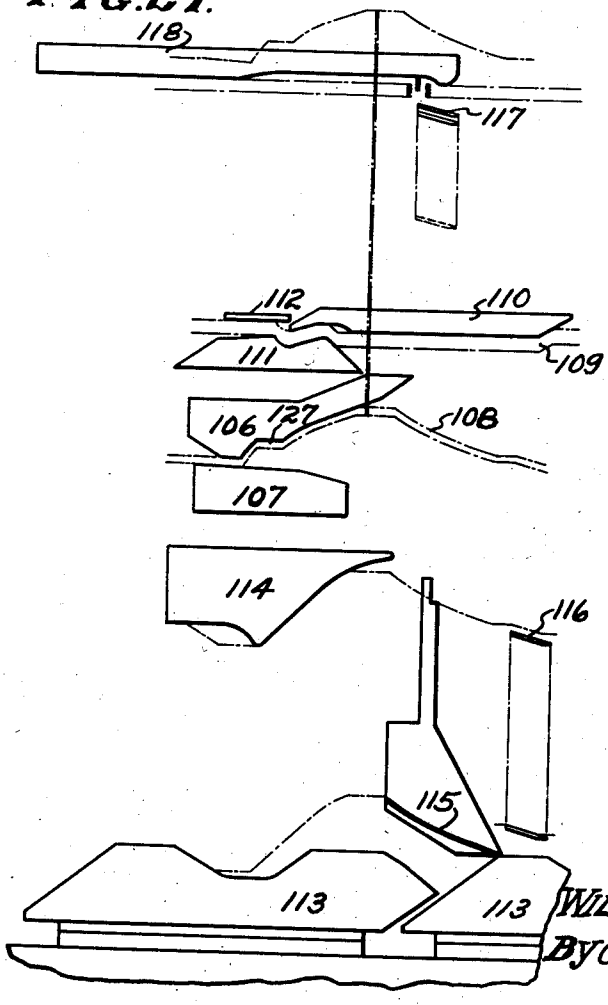


FIG. 27.



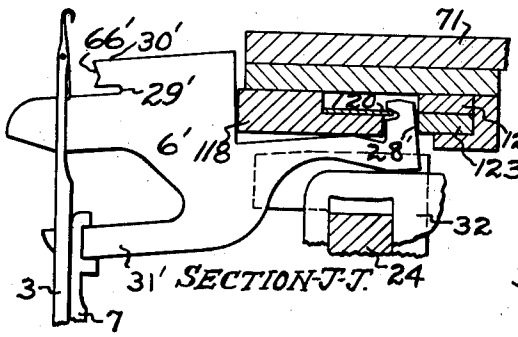
INVENTOR:
WILLIAM L. SMITH JR.
BY Roy F. Lovell,
ATT'Y.

Jan. 20, 1942. W. L. SMITH, JR 2,270,719

KNITTING MACHINE FOR PRODUCING PILE FABRICS

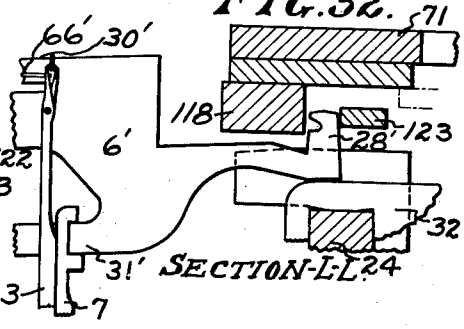
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FIG.29.



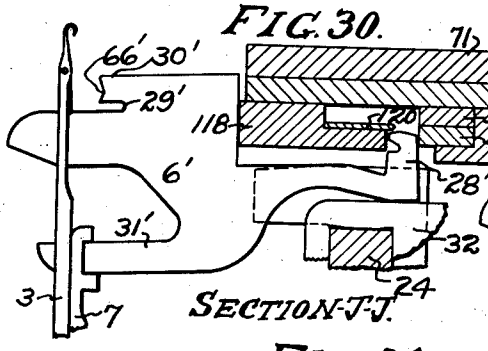
SECTION-J-J.

FIG.32.



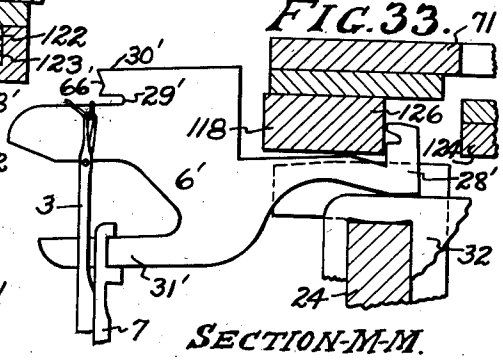
SECTION-L-L.

FIG.30.



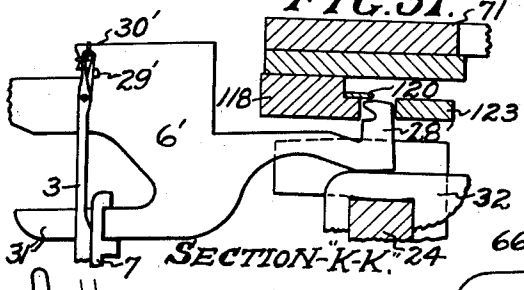
SECTION-J-J.

FIG.33.



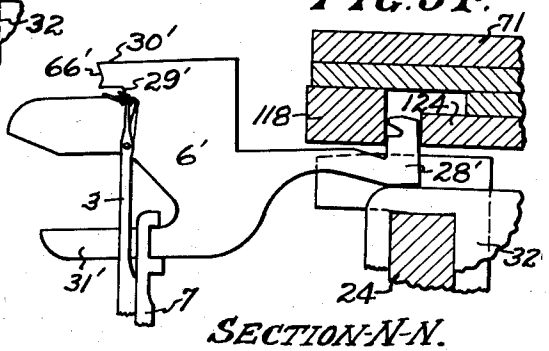
SECTION-M-M.

FIG.31.



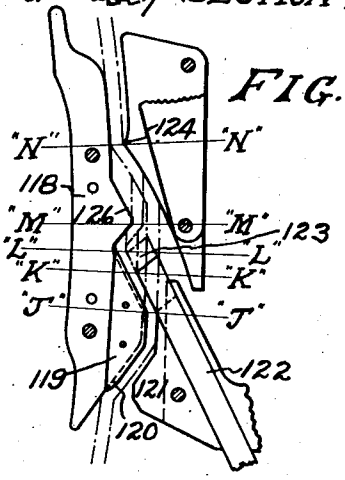
SECTION-K-K.

FIG.34.



SECTION-N-N.

FIG.28.



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Jan. 20, 1942. W. L. SMITH, JR 2,270,719

KNITTING MACHINE FOR PRODUCING PILE FABRICS

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FIG. 37.

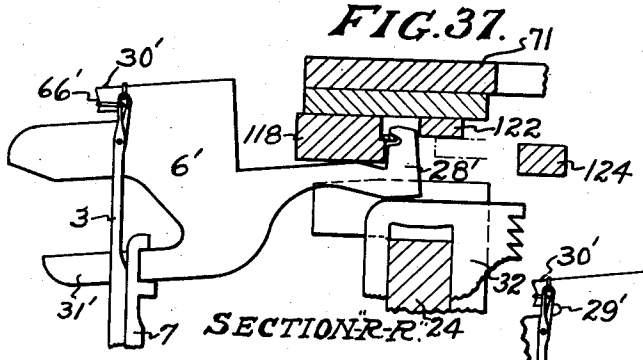


FIG. 39.

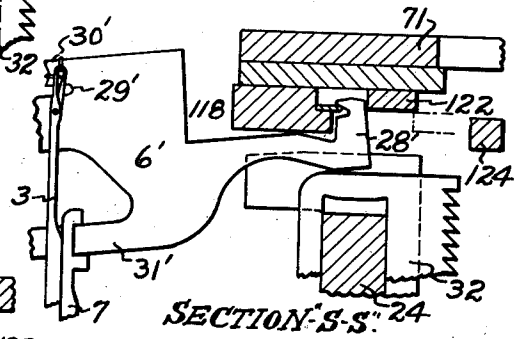


FIG. 38.

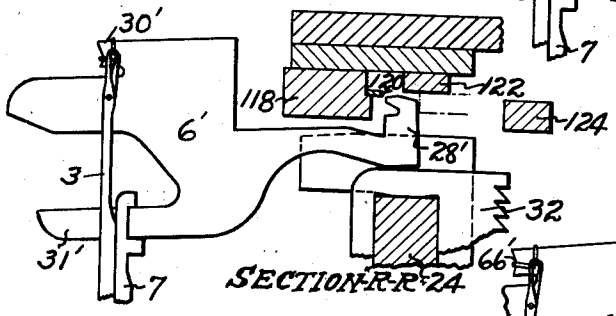


FIG. 40.

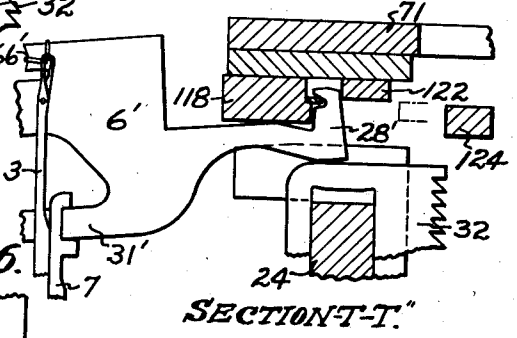
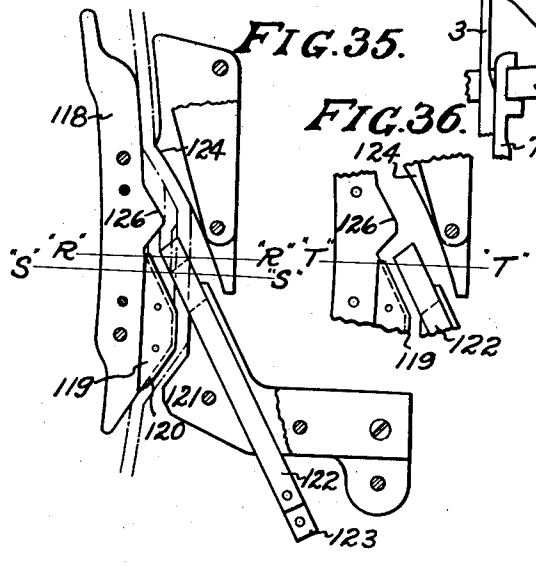


FIG. 35.

FIG. 36.



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KNITTING MACHINE FOR PRODUCING PILE FABRICS

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FIG. 41.

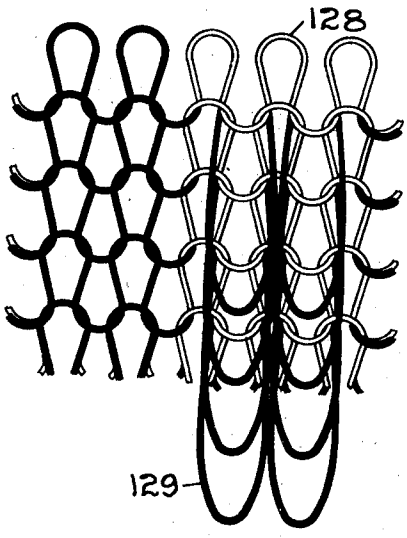


FIG. 42

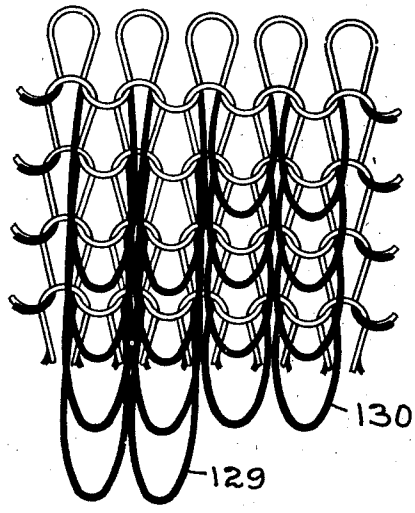


FIG. 44

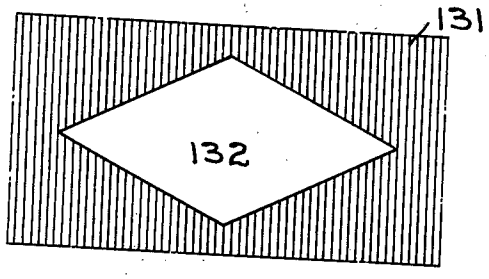


FIG. 43.

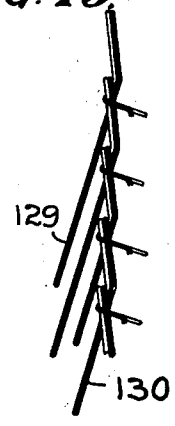
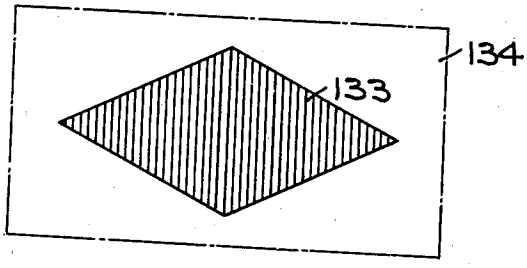


FIG. 45.



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ATT'Y.

Patented Jan. 20, 1942 2,270,719

UNITED STATES PATENT OFFICE

2,270,719

KNITTING MACHINE FOR PRODUCING PILE FABRICS

William L. Smith, Jr., Pawtucket, R. I., assignor to Hemphill Company, Central Falls, R. I., a corporation of Massachusetts

Application October 7, 1938, Serial No. 233,771

14 Claims. (Cl. 66—93)

This case concerns a method and machine for knitting pile fabrics. The machine has capabilities of knitting pile fabrics wherein the pile may be knitted according to varied patterns and again, wherein different lengths of pile may be knitted in the same fabric, the pattern being based upon a difference in length of pile and the placement of certain figures of the longer pile loops. By the method of stitch drawing and by simple adjustment of certain machine parts it is possible to knit pile of any length from a minimum to a maximum dependent upon limits determined by design of the machine.

In the figures of drawings:

Fig. 1 is a section taken through the needle cylinder and one cam block of a multi-feed machine embodying the principles of the invention;

Fig. 2 is a section showing to an enlarged scale the selecting means and other operating means functioning upon sinkers;

Fig. 3 is a plan showing a fragment of the machine and the design of sinker cams which function to impart stitch measuring and other movements to sinkers incidental to their function in the knitting of plain and pile loops;

Fig. 3*a* is a detail showing part of the adjusting means for stitch casting off cams;

Fig. 4 is an elevation showing the means for feeding yarns at one of the feeding stations, the sinker wave and needle wave as stitches are being measured and drawn;

Fig. 5 is a plan showing in detail the yarn feeding fingers and other yarn guiding elements;

Fig. 6 is a plan view of the casting off cam and a guard cam, parts being shown enlarged for purposes of clearness;

Fig. 7 is a section taken at *x—y*, Fig. 4;

Fig. 8 is a detail of one of the sinker selecting jacks;

Fig. 9 is a detail of a sinker employed in one form of the invention;

Fig. 10 is a detail view of certain of the sinker cams showing different pathways of sinker butts passing through, these pathways depending upon selection or lack of selection to determine the type of stitch knitted;

Figs. 11–15 are sections showing in detail the position and manner of operation of sinkers, needles and attendant parts for drawing plain loops, short pile loops and long pile loops, each of these sections being taken at a particular point at Fig. 10 as identified by letters applied to the figures and corresponding lines on which sections are taken;

Fig. 16 is a view similar to Fig. 10 but showing different pathways for the needle butts;

Fig. 17 is another view according to Figs. 10 and 16 and showing in some detail the controlling means for the sinker selecting cams;

Fig. 18 is an elevation showing the sinker selecting cam control;

Figs. 19—24 are sectional views showing in detail the positions of sinkers and other parts as controlled by certain selecting means and cams in the knitting of plain loops. The figures are sections taken on lines indicated by corresponding numerals in Figs. 16 and 17;

Fig. 25 is a diagrammatic view showing all cams functioning on needles, jacks, sinker jacks and sinker selecting jacks;

Fig. 26 is an elevation similar to Fig. 4 showing yarns being fed and stitches being measured and drawn by needles and sinkers in accordance with a modified form of the invention;

Fig. 27 is a diagrammatic view similar to Fig. 25 illustrating like pathways of elements while practicing the modified method of stitch and pile loop drawing;

Fig. 28 is a plan of sinker controlling cams for this modified form of sinker control;

Figs. 29–34 are sections showing in detail the method of drawing stitches to effect drawing of plain loops, short pile loops and long pile loops in accordance with the second method. The said figures are taken on section lines indicated by corresponding numerals in Fig. 28;

Figs. 35 and 36 are views similar to Fig. 28 showing pathways of sinker butts through the cams;

Figs. 37–40 are sections showing in detail the drawing of long and short pile loops according to different positions of sinker cams and different phases of selection for the sinkers. These sections are taken on lines indicated by letters corresponding to lines evident on Figs. 35 and 36;

Fig. 41 is a view showing to a greatly increased size a fabric knitted partially plain and partially with pile loops;

Fig. 42 shows in a similar view another fabric having pile loops of two different lengths;

Fig. 43 is an end view of a fabric such as illustrated in Fig. 42;

Figs. 44 and 45 show diagrammatically a fabric with patterned areas effected by the knitting of pile at one position and plain fabric at others, or of pile of one length in contrast to pile of a different length.

One system and a corresponding mechanism for knitting pile fabric has been illustrated

and claimed in co-pending application Serial #194,909 filed March 9, 1938. In that case patterned areas were to be knitted according to various designs effected by selecting means operable on jacks individual to each sinker. Two lengths of pile were possible according to the method of that case, one length being drawn over the top of a sinker nib and the other lengths being drawn in a throat or recess behind the nib. While some slight variation in length of pile loops in contrast to the length of the plain loops might be effected by sinker cam adjustment in the mechanism of that case, no appreciable variation was possible. Obviously it would be desirable to have a machine more or less universal in its possibilities wherein all lengths of pile might be knitted from that only slightly longer than the plain loops of the base fabric up to a limit determined by practical limitations in length of pile which it might be desired to knit. This in conjunction with selective drawing of relatively short and long pile loops to effect patterns in the same piece of fabric is accomplished by the method and mechanism herein to be described.

According to the first form of the invention to be described, sinkers are employed for measuring pile loops about the shanks of needles as in stitch measuring by a modification of the so-called Wildman method. While the pile loop is thus being measured by a sinker pushed inwardly to kink the yarn about the shanks of needles, the pile loop is to be drawn over the usual edge determined by the normal throat in the sinker. After the pile loop has been measured by this first inward movement of a sinker, the sinker is withdrawn dropping the pile loop down to the throat and thereafter, both loops are cast off in the throat of the sinker as is the usual practice.

According to the second form of the invention, sinkers are moved inwardly similar to the system just described briefly in the last paragraph, this movement measuring pile loops while plain loops are drawn by an initial downward movement of needles drawing yarn for the base fabric loops over the tops of sinkers. Thereafter both yarns are dropped down to a throat as the sinker is withdrawn and the old loop is then cast off in the throat of the sinker in more or less the usual practice.

Referring to figures such as Figs. 1, 2 and others the invention is illustrated in connection with a multi-feed type machine having a rotatable needle cylinder, latch needles independently actuated, although it is to be understood that the principles are equally applicable to stationary needle cylinder machines and to machines wherein spring beard or other types of needles are employed. It is further applicable in single feed machines such as hosiery machines and in flat type knitting machines such as the V-bed or full fashioned types of machines. A needle cylinder is shown at 1 rotatable within a base 2 and having needles 3 slidable in individual slots either cut in the cylinder or, as illustrated herein, formed by inserted walls set within milled slots in the cylinder itself. These inserted walls are described and claimed in co-pending application Serial #124,844, filed February 9, 1937, now Patent No. 2,135,187 and will not be described in detail here. The upper ends of these wall strips are offset and constitute a widened sinker guiding portion 4 which is also maintained in alignment by a ring 5 further serving the purpose of a fabric ring. Sinkers are generally indicated at 6 and may be movable radially of the machine only as is a well-known practice, but preferably, are capable of being moved vertically or in a direction substantially with movement of the needles by means of jacks 7 operated by cams 8 and 9, Figs. 1, 2 and 25. These jacks may move sinkers in opposition to movement of needles thereby cooperating in the measuring and drawing of knitted stitches in addition to an earlier movement vertically for the purpose of feeding the two yarns with less chance of misplacement with respect to sinker nibs and throats, as will be more fully explained with respect to the two specific forms of the invention herein illustrated. This first movement for raising sinker nibs is also described and claimed in co-pending application Serial #194,909 and serves substantially the same purpose therein as here, although the method of drawing stitches, measuring pile loops, and the form of sinkers is quite different. It is to be understood that the invention may be practiced without resorting to either the cooperating stitch drawing movement of sinkers or to the initial movement for separating the two feeding yarns.

Needles have butts 10 which are engaged by stitch cams 11 and cooperating cams 12, Figs. 1 and 25. Other cams 13 known as tuck cams are movable to engage needle butts as described, and that purpose and function will not be described herein since they are clearly indicated in Patent #2,067,877. All these cams for needles, jacks and other instrumentalities to be described are supported by a cam block having a base 14, post 15 and other parts including a stitch cam adjusting means described and claimed in United States Patent #2,123,534. Selecting jacks 16 have a plurality of removable butts 17 and a master butt 18. These jacks may be arranged to function upon each needle for selecting the same for pattern purposes such as for knitting tuck and float work. The selecting butts 17 are engaged by plungers or other selecting instrumentalities 19 and upon selection of any jack, the master butt 18 will engage one of the cams 20 thereby being raised and incidentally raising its needles to effect the desired pattern result. Cams 21 serve to level these jacks prior to their butts 17 being engaged by plungers 19. Other cams 22 engage a butt 23 common to each of the said jacks and return those jacks to a lowermost position. It is to be understood that the stitch drawing as practiced to effect the knitting of pile fabric is not necessarily to be practiced along with the knitting of other patterns effected by such jack control of needles, although both may be knitted together to obtain various combinations of pattern work comprising both pile stitches and tuck or float work. Other effects such as open work and lace effects may be obtained.

Now referring to Figs. 1 and 2, more especially the enlarged Fig. 2, a sinker ring 24 is fixed for operative engagement with the cylinder by clamps generally indicated at 25, this being more or less the common construction. This ring 24 has slots cut horizontally at its upper portion leaving the walls 26 and it is within these slots that the outer ends of sinkers function. Of course, the said sinkers slide radially for the usual casting off of stitches and for other purposes which are new in this case. In addition to these radial movements the rocking effected by jacks 7 moves said sinkers about a fulcrum adjacent the tails or actuating butts at the outer ends of sinkers. These sinkers generally indicated by numeral 6

have stems 27, butts 28, throats 29 and nibs 30. A projection 31 engages said nibs at the upper end of jacks 7 as described in United States Patent #2,073,595, whereby the vertical movements are imparted.

The ring 24 is also slotted in a vertical direction at its outer portion, these slots being in alignment with said horizontal slots and sinker selecting jacks 32 fit within these vertical slots and also in the horizontal slots engaging beneath the outer ends of sinker stems so that the actual pivoting of sinkers is upon the uppermost surface presented by these sinker selecting jacks. Each jack is hooked to engage by the angular projections 33 and 34 about the ring itself so as to retain jacks in perfect working relation beneath sinker stems. The lower end of each jack is slotted as at 35 and a spring or springs 36 engage in this slot and above a shoulder 37 or other retaining element at the lower end of the ring. These springs hold the lower ends of the sinker selecting jacks from flying outwardly under the influence of centrifugal force. Each jack has a plurality of removable selecting butts 38 by means of which jacks and incidentally sinkers are to be selected for effecting the knitting of various types of stitches as will be more thoroughly explained in the following paragraphs.

Referring to Figs. 1, 2 and 25, the selecting means for these jacks includes a series of plungers 39 or other suitable selecting elements which are shaped for engagement with butts 38 and are slightly inclined so as to raise those jacks which are engaged. These plungers 39 are mounted within a support generally indicated at 39' which has slots within which the plungers may be moved from one position to another depending upon whether any particular plunger is to engage butts or is to remain inactive. These plungers have notches 40, two in each plunger, for engagement by a detent 41 which is spring pressed to enter the said notches and to retain plungers in set position. The plungers may be snapped from one position to another and when all have been set as desired, a latch 42 is moved to the full line position of Fig. 2 whereupon the detent 41 and other parts are temporarily locked in position. The position of the detent and thus the maximum inward projection of plungers is governed by plate 43 to which the detent spring is attached. This plate is slidable radially of the machine by the adjusting screw 44 and may be locked in position by the locking screw 45. These parts are described and claimed in co-pending application Serial #194,909 and will not be described in greater detail in this case.

A cam 46 extends angularly from bracket 47 which is vertically adjustable on the support 39'. This cam engages the tops of jacks 32 and returns them to a lowermost position, or levels them, prior to their engagement with plungers 39. A separate butt 48 at the bottom of each of the jacks 32 may be used to control all of these jacks, or any predetermined part of them, in unison by a single plunger or cam (not shown).

Now referring to Figs. 1, 4, 5 and 7, the yarns 49 and 50 are to be fed by a yarn feeding finger or yarn guide 51. This guide is capable of being swung vertically about a pivot 52 which extends from the projection 53 attached at the upper end of a short post 54. The said yarn feeding guide or finger is held in either of its positions by a leaf spring 55 which engages a flattened side of a block 56, Fig. 1, which has a stop screw 57 engageable with a fixed part of the projection 53 to limit the lowermost or feeding position of the finger. The knurled head 58 merely serves as a convenient means by which the machine operator moves these yarn feeding fingers or levers to and from feeding position. Such movement is only necessary when threading up or if it is desired to withdraw one feed of a group temporarily.

The said yarns 49 and 50 pass through guiding eyelets 59 and 60 in an angular bracket 61 and also engage beneath the hooked ends of stop motion detents 62 and 63 before being threaded through the guiding eyelets in the end of the finger. The yarn 50 is threaded through an eyelet 64 which is vertically arranged at the lowermost part of the yarn feeding finger. This yarn feeds at a low position and is the yarn from which the base fabric loops are to be knitted. The other yarn 49, the pile loop yarn, feeds through an eyelet 65 which is located somewhat above the feeding end of eyelet 64 and also circumferentially in advance of that eyelet. This yarn will feed so as to be engaged within a notch 66 in the nib of each sinker.

The said yarn 49 which is fed into these notches 66 is first kinked about needle shanks above the latches of those needles, and it is by this system that the pile loops are measured. The flexibility of the machine will be evident at this point since pile loops of any desired length may be measured depending upon the extent to which sinkers are projected inwardly at this point. The other yarn 50 is merely being fed to lie in front of the throats of sinkers and will pass into the throat as the said sinkers are pushed inwardly for the measuring operation.

Referring to Figs. 4 and 7, the needle wave and sinker waves are illustrated, it being seen that sinkers are elevated just as they pass the eyelet 65 or at about the position indicated by numeral 67. This assures that the yarn 50 will feed at a very low position thus making it practically impossible for it accidentally to feed into the notch 66, and giving more freedom in feeding the pile yarn into the notches in the nibs of sinkers without interference. As the said sinkers are raised initially by jacks 7 at the leading part 9a of cams 9, the notches will be at just the proper height to engage yarn 49. Just as these sinkers are raised to this height they will be projected inwardly by mechanism presently to be described. The inward projection depends upon whether long or short pile loops are to be drawn according to pattern requirements and further, upon the general setting of parts which determine the relative length of long and short pile loops with respect to the base loops or plain loops in the fabric. After being raised on the part 9a of the cam 9, the said jacks lower forward ends of sinkers as dictated by a downwardly inclined end 68 of a jack leveling cam 69, Fig. 25. Thereafter the central part of cam 9 serves to raise jacks and the forward ends of sinkers so that base fabric stitches may be measured and drawn. Cam 8 limits this upward movement. At the same time stitch cam 11 is drawing the needles downwardly completing the stitch drawing wave of those instrumentalities. At the completion of pile loop measuring about the shanks, the sinkers are withdrawn so that the pile loops drop from the notches 66 and before completion of the stitch drawing wave with respect to needles as controlled by stitch cams 11. Cams for effecting these various functions will be more thoroughly described.

Now referring to Figs. 2, 3, 3*a*, 6 and 10–24, the various sinker cams and other mechanism functioning therewith to control sinkers will be described. At each cam block adjacent each feeding station is located a sinker cam assembly including a sinker cam generally indicated at **70** which is adjustably attached to a plate **71** fixed to the cam block assembly by suitable connections more thoroughly illustrated and described in United States Patent #2,123,534. A casting off cam **72** is also attached to a bar **73** capable of being swung inwardly and outwardly radially of the machine by a system of levers **74** and **75** pivoted on an adjustable element **76** which is secured to the top of plate **71**. Referring to Fig. 3*a*, this cam **72** may be adjusted inwardly or outwardly of the machine to regulate the degree of projection of the sinkers for casting off old loops by a spring pressed plunger **77** working in a slot **78** and adjusted by thumb nut **79**. This plunger will allow the said casting off cam **72** to move outwardly as the spring **80** is compressed in the event of any unusual occurrence which might cause breakage of sinker butts or other parts. A guard cam **81**, Figs. 3, 4 and 6, serves to move sinkers downwardly to level them after they have cast off the old stitches.

The cam **70**, as illustrated in Fig. 25, bears upon the upper edges of sinker stems and retains sinkers downwardly within their slots tending to level them at the proper positions, the cam **81** merely acting as a sort of safety cam to assure that just prior to selection by the jacks **32**, each sinker butt will be in proper position. These cams **70** also serve to impart radial movements to sinkers so that the pile loops may be properly drawn. The part **82** constitutes a sinker withdrawing cam which is also characterized by a knife edge **83** more clearly shown in Figs. 11–24. This knife edge engages within a notch **84** in the forward edge of the sinker butts **28**. The purpose of said knife edge is that of maintaining these sinker butts downwardly at a proper level in the event there is no selection through the jacks **32**, but to maintain the outer ends of the sinkers in selected position in the event they are raised by the said jacks and other selecting mechanism which has been described.

Each of these sinker cam assemblies has two other cams which are herein referred to as sinker projecting cams. The upper cam is designated at **85** and the lower at **86**. These cams **85** and **86** slide within a slot in an extension **87** which is attached to the under side of plate **71**. This extension has a boss **88**, Fig. 10, to which is adjustably connected a sector **89**, Figs. 17, 18 and others, having three notches therein. The upper projecting cam **85** is controlled by a lever **90** which terminates in an angularly disposed finger lever **91** engaged within one of the slots in the sector **89**. The lower projecting cam **86** is controlled by a similar lever **92** and finger lever **93** which engages within corresponding slots in a lower, partial sector **94**. Thus either of these levers and necessarily the cams **85** and **86** may be set to any one of three positions. The inner ends of these projecting cams are arranged and shaped to engage the sinker butts **28** and to move sinkers inwardly after they have been moved outwardly by the cam **82**. The lower cam **86** engages sinker butts in the event a sinker is not selected or raised by its jack **32**, but the upper cam **85** is located above the topmost portion of said sinker butts which pass in this non-selected position. In the event a sinker is selected and raised, the upper cam **85** will then control said sinker in the event it is at a position at least as far inward as the other cam **86**. It is by means of these cams **85** and **86** and the selecting means that plain loops, short pile loops and long pile loops are to be drawn. If it is desired to vary the length of either the short or the long pile loops, the sectors **89** and **94** which are assembled as a unit are to be adjusted about a center **95**. A screw **96** engageable within a slot **97** allows this adjustment to be made and thereafter serves to lock the parts in adjusted position. By the mechanism herein shown the difference in length between the short and the long pile loops will be maintained the same, that is, adjustments effected would either shorten or lengthen each of the loops a given amount. However, it is contemplated to have the sectors individually adjustable so that one length of loop may be adjusted independently of the other.

After sinkers have been projected inwardly by cams **85** or **86** to determine the drawing of various types of loops, another cam lobe **98**, a part of the entire cam **70**, immediately moves all sinkers outwardly so as to allow the pile loops held in the notches **66** to drop from these notches in preparation for drawing loops of the base fabric over an edge at the throat of the sinker. If these pile loops were not dropped from the notches at this time, further movement of needles downwardly would either elongate the pile loops or break them in the event those loops were not so long as to allow the base fabric loops to be drawn without tending to extend the pile loops which might still be held within notches. By dropping the pile loops from the notches after they are measured, it is possible to draw pile of any minimum length above the actual length of loops which constitute the base fabric.

Having described the various parts and the general operation thereof with respect to the first form of the invention described, the operation in drawing different types of loops will be described with respect to Figs. 11–24. Referring to Fig. 17, one pathway **99** for sinker butts **28** is shown. These butts strike the cam **82** being withdrawn to an extent limited by the cam **100**, thereafter the movable sinker projecting cam **85** causes the butts and necessarily the sinkers to be projected inwardly to a maximum extent dependent upon the setting of that cam **85**. Of course, the other cam **86** or both cams might effect such a movement. This maximum inward projection of sinkers would serve to measure long pile loops. After measuring said loops, the cam lobe **98** withdraws sinkers just far enough for the measured pile loops to fall from notches **66** whereupon needles then draw the stitches which go to make up the base fabric over the usual stitch drawing surfaces at the throats of the sinkers. The sinker butts **28** are thereafter affected by the casting off cam **72** at the point of which both the base yarn and the pile loops previously drawn are cast from the needles.

In Fig. 16 a pathway similar to **99**, Fig. 17, is shown being controlled by one of the cams **85**, **86** which is shown in dot-and-dash lines. The other of said cams is in a position in which it projects sinkers inwardly but not to so great an extent. This results in a second pathway **101**; some of the sinker butts, that is, those engaged by the cam set inwardly to the greatest extent, travel in pathway **99** while those which are contacted only by the cam set to mid-position assume the

pathway 101. The only difference in these two pathways is that right at or adjacent the inner ends of cams 85 and 86 the point at which pile loops are measured, the pathway 101 deviates to that in which sinkers control the measuring of short pile loops. Referring to Fig. 10, the pathways just mentioned with respect to Figs. 16 and 17 plus a third pathway are illustrated. This third pathway designated by numeral 102 is that which prevails with respect to sinker butts of those sinkers which merely function to control the knitting of plain loops. These butts are not engaged by either of the cams 85, 86, merely being moved outwardly by the cam 82 and retaining that position until engaged by the casting off cam 72.

In Fig. 11 the sinker is shown being selected by the sinker selecting jack so that the knife edge cam 83 engages within the notch 84 at the front of the sinker butt 28. Here neither of the cams 85, 86 is projected inwardly to control drawing of pile loops and the sinker would merely have both yarns drawn over the lower edge of the sinker throat. These sinker butts 28 would pass in pathway 102. Fig. 12 illustrates a set up which produces the exact result of Fig. 11 except by a different combination. The said sinker shown in this Fig. 12 has not been selected and is merely contacted by the lower cam 86. The same sort of stitch will be drawn since cam 86 is set to its outermost position. Here the same result would prevail even though cam 85 were set to either of its innermost positions.

Fig. 13 shows non-selection of a sinker by a combination wherein cam 86 is set to bring about a projection of that sinker inwardly to intermediate position, one in which a short pile loop is being measured. This result would be forthcoming irrespective of the position of the upper cam 85.

Fig. 14 shows a situation similar to that of Fig. 13 except that the lower projecting cam 86 is set to its innermost position for the particular length of long pile loop being drawn so that in this situation, all the sinker butts 28 would be forced to pass in a pathway similar to that at 99.

In Fig. 15 the section is taken at line D—D, Fig. 10, and the cam 98 is shown withdrawing or retracting a sinker which has previously been pushed inwardly to measure a pile loop. The said pile loop is about to drop from the notch 66 and a loop of the base fabric, from the yarn 50, is in process of being drawn in the throat of the sinkers. In Fig. 19 taken at line E—E, Fig. 16, the sinker has been completely retracted by the cam 98 and the pile loop is shown after being disengaged from the notch 66.

In Fig. 20, section F—F, casting off cam 72 has pushed a sinker inwardly so that the old loops have been cast off by the throat of the sinker.

The remaining Figs. 21–24 are taken at lines G—G, H—H and I—I, Figs. 16 and 17, and show different possibilities of selection due to various combinations in the setting of cams 85, 86 and by selection with respect to the sinker selected jacks. In Fig. 21 selecting sinkers will measure long pile loops while non-selected sinkers, dot-and-dash lines, will measure short pile loops. The actual measuring of said short pile loops is shown in the next Fig. 22.

Figs. 23 and 24 show selection of the sinker in each instance, but by different setting of cam 85, short pile loops result in the first instance and long pile loops in the second.

Referring to Figs. 26–40, another form of the invention will be described wherein similar results are obtained by mechanism and a method very much like that of the first form except for certain details which will be more fully described hereinafter. The same general system of sinker control and sinker selection by cams and jacks is employed. Pile loops of different selective lengths and of varying lengths are to be drawn by measuring about the shank of the needle as in the first form, but the loops of the base fabric are drawn over the nibs of sinkers rather than at a level with the throats of sinkers.

In Fig. 26 a pile loop yarn 103 and a base fabric yarn 104 are shown feeding through a yarn guide 105, this guide being practically identical with the yarn guide 51, Fig. 4. The sinkers are to be selected by a plurality of manually set selecting plungers or other selecting instrumentalities such as are well known for selecting knitting machine elements of this type. Two cams such as the cams 85 and 86 are employed for moving selected or non-selected sinkers to position for drawing long or short pile loops. Of course, the invention may be practiced independently of selection or independently of such cams as those indicated by numerals 85 and 86, but fullest advantages are not apparent except in this particular or an equivalent combination. The sinkers 6' are controlled by jacks at their forward ends as before stated, and are raised to engage the pile loop yarn 103 more effectively. Thereafter these sinkers drop to a lowermost position and again are raised at or adjacent the stitch drawing point so that they present surfaces at a predetermined elevation over which base fabric loops are to be drawn. The various cams affecting knitting instrumentalities such as needles, needle selecting jacks, sinker raising jacks and sinker jack selecting plungers are illustrated in Fig. 27. Needle cams are designated by numerals 106 and 107, the needle cam path being shown at 108. The sinker raising jacks are guided in a pathway 109 by cams 110, 111 and 112. The needle selecting jacks, if such are to be employed, are controlled by cams 113, 114 and 115 the said jacks being selected by a series of plungers 116. Another series of plungers 117 serve to select sinker selecting jacks as in the first form of the invention. A sinker cam generally indicated at 118 will be more thoroughly described with respect to Figs. 28, 35 and 36.

Now referring to those figures, this cam 118 has a sinker withdrawing cam 119 and a knife edge cam 120. These cams 119 and 120 perform the same function as cams 82 and 93, Fig. 10, etc. Another cam 121 corresponding to the cam 100 limits the outward movement of sinkers and makes certain that the notches at the forward edges of sinker butts 28', when engaged with the knife edge cam, can not become disengaged therefrom until the desired time for such disengagement occurs. A pair of sinker projecting cams 122 and 123 correspond to the cams 85 and 86. No further description will be given of these parts since they are practically identical and function in precisely the same manner as the corresponding parts described with respect to the first form of the invention. A sinker casting off cam 124 and a guard cam 125 as well as a second sinker retracting cam 126 complete this sinker cam assembly. Three pathways for the sinker butts are thus provided, these pathways being similar to the pathways described with respect

to the first form of the invention and being capable of variation in the same manner. That is, the length of pile loops, either short or long may be varied within reasonable limits.

According to this modified method, after the pile loops are measured by projection inwardly of the sinkers, needles draw the loops of the other or base fabric yarn over the tops of sinker nibs, or the tops of sinkers, rather than at the level of the throat. These loops are really drawn more or less simultaneously with the measuring of the pile loops, although the exact timing at this point is not so very important. The sinkers are maintained at an elevation to which they have been raised by the second point of cam 111 and thus present edges over which stitches are drawn in the usual way. That is, the needles perform the stitch drawing function rather than having the same accomplished by a combined action of needles and sinkers. At this time needles are drawn down only part way to the point of the stitch cam 106. They are held at a sort of dwell 127 on this cam, this marking the maximum extent of stitch drawing.

After the base yarn stitch has been drawn and the pile loop is measured, the sinkers are retracted by the cam 126 so that both loops drop from the nib 30' and the notch 66' and thereafter the needles are pulled down by the second part of the active cam surface on the stitch cam 106 so that the stitches are held in the throat 29' of the sinker in more or less the usual way. Casting off is then effected by cam 124 very much as in the previously described form of the invention.

In Figs. 29–34 and 37–40, various different possibilities in drawing long and short pile loops and in varying the length of pile loop to be drawn from either of these types will be evident. The result to be expected is dependent upon the position of cams 122 and 123 in combination with the possibilities of selection at that particular feeding station for which the setting of said cams 122 and 123 is being considered. The main distinction between this form of stitch drawing and that previously described is that the yarns feed in the reverse order, that is, the pile yarn feeds at a lower position while the base fabric yarn feeds at a higher elevation and over the tops of sinker nibs. This results in the opposite type of plating from that of the first form. Both yarns are measured and drawn very nearly at the same time and when the sinker is retracted they both drop to the throat after which the old loops are cast from the needle. In this instance there is more flexibility as to length of pile loop which may be drawn. If it were so desired, the reverse effect might be obtained wherein the measured yarn would be shorter than the base fabric yarn whereupon the base fabric yarn would project as pile at certain feeds or at certain areas while at others, the feeding might be such that the opposite would prevail. It is easy to measure any length of pile loop from an absolute minimum up to lengths as extreme as could possibly be desired in practical work.

Now referring to Figs. 41, 42 and 43, fabric is shown knitted in accordance with the first form of the invention. In Fig. 41 loops 128 are drawn from the base fabric yarn and pile loops which are characterized as long pile loops 129 are drawn from the other yarn. Two of the sinker wales have these pile loops projecting therefrom while two adjacent wales are plated upon said pile loop yarn. Obviously the pile projects at the back of the fabric and since wherever pile loops are knitted reverse plating takes place, the pile loop yarn projects to the front of the fabric as plated loops while at the other areas, it lies at the back of the fabric. In Fig. 42 two areas are shown, one having long pile loops 129 while the other area is characterized by short pile loops 130. In Fig. 43 these pile loops are shown at about the angle they project from the fabric. It is to be understood that the tighter the fabric is knitted the more dense will be the pile thereon and the straighter it will project from the surface of the fabric. It is contemplated to cut the pile by shearing or other suitable means and to brush or nap the same by any satisfactory method. In Figs. 44 and 45 certain possibilities in pattern are illustrated, the area 131 will be one type of pile loop while the diamond shaped area 132 would be of a pile of different length or characteristics. In Fig. 45 the diamond shaped area 133 is from pile of one type while the background 134 of fabric is from plain loops, that is, loops of one of the yarns knitted in conjunction with the other yarn and plating thereover.

In the second form, the pile will project to the back of the fabric but plating will be reversed.

The invention has been described in general terms with respect to specific forms of the same, but the principles are applicable to many types of machines having different types of needles, sinkers and other knitting instrumentalities. Application of the invention is contemplated in all of the common types of knitting machines and is considered to be covered by the scope of the claims appended hereto.

I claim:

1. A method of knitting pile fabric including the steps of moving knitting instrumentalities progressively to measure pile loops about shanks of needles and thereafter measuring loops of base fabric and drawing both loops over cooperating stitch drawing edges on said instrumentalities.

2. A method of knitting pile fabric by needles and sinkers including the steps of projecting sinkers transversely of needles to measure pile loops about the shanks of needles, thereafter withdrawing said sinkers and then measuring and drawing loops of a base fabric by cooperative action of needles and sinkers engaging and drawing yarn over an edge substantially at the throat of the sinker.

3. A method of knitting pile fabric by cooperative movements of needles and sinkers including the steps of feeding a pile thread to be engaged within notches in sinkers and thereupon projecting sinkers transversely of needles to measure pile loops about their shanks, retracting sinkers to drop said pile loops from said notches, thereafter drawing needles downwardly to measure and draw stitches over stitch drawing edges defined by the lower edges of the throats of sinkers and then casting off previously drawn loops in the throats of sinkers.

4. In a knitting machine, needles and sinkers, said sinkers having nibs characterized by notches in the forward parts of said nibs, throats beneath the nibs of said sinkers, means for feeding a yarn to be engaged within said notches and cam means for moving said sinkers transversely of the needles to measure said yarn about the shanks thereof but above needle latches, means for drawing needles downwardly and other feeding means for feeding another yarn to the hooks

of needles whereby the same may be measured and both yarns drawn over cooperating stitch drawing edges of sinkers.

5. A knitting machine having in combination needles and cooperating sinkers, said sinkers being characterized by throats and nibs, said nibs having a notch at the forward edge thereof, yarn feeding means for feeding one yarn to be engaged within the notches of said sinkers and another yarn to be fed below nibs of sinkers and to hooks of needles, means for first moving said sinkers transversely of needles after the yarn has been fed within the notches thereof to measure it about shanks of needles, means for withdrawing said sinkers and other means acting subsequently to impart a stitch drawing wave to needles for drawing the second mentioned yarn over stitch drawing edges at the throats of said sinkers.

6. In a knitting machine the combination of needles and cooperating sinkers, said sinkers having throats and nibs, said nibs being notched for engagement of a feeding yarn, means for feeding one yarn to the notches of said sinkers and another yarn below the nibs of sinkers but to be engaged within the hooks of needles, cam means movable to varying positions for projecting said sinkers transversely of needles to measure the yarn which is fed within the notches about the shanks of needles, means for retaining said cam means in any of its different positions thereby to determine the length of loops which are to be measured about the shanks of needles, means for withdrawing said sinkers and other means for thereafter imparting a stitch drawing wave to needles for measuring and drawing loops of the yarn which is fed to hooks of needles whereby pile loops are first measured about the shanks of needles and thereafter loops of a base fabric are drawn in a conventional manner.

7. In a knitting machine the combination of independently movable needles and sinkers, said sinkers having nibs and throats and yarn receiving notches in said nibs, means for feeding yarn to be received within the notches of said nibs, cam means engageable with said sinkers for moving them transversely of needles, said cam means being manually movable to different selective positions and separately adjustable to vary the transverse movement imparted to sinkers.

8. In a knitting machine the combination of independently movable needles and sinkers, said sinkers having nibs and throats and yarn receiving notches in said nibs, means for feeding yarn to be received within the notches of said nibs, cam means engageable with said sinkers for moving them transversely of needles, said cam means being movable to different selective positions and adjustable to vary the transverse movement imparted to sinkers, and means for selecting sinkers so that predetermined ones thereof may be differently affected by said cam means.

9. A method of knitting pile fabric including the steps of measuring pile loops about shanks of needles and substantially simultaneously drawing base fabric loops within hooks of those needles and over cooperating stitch drawing instrumentalities.

10. A method of knitting pile fabric by cooperating needles and web holders including the steps of moving web holders transversely of needles to measure pile loops about needle shanks, simultaneously imparting a stitch drawing wave to needles and drawing loops of a base fabric over stitch drawing surfaces on said sinkers which are positioned above that part of sinkers by means of which the said pile loops are measured.

11. A method of knitting pile fabric by cooperating needles and sinkers including the steps of moving sinkers transversely of needles to measure pile loops about the shanks thereof, drawing said needles downwardly to engage a base fabric yarn and draw stitches thereof over stitch drawing edges of said sinkers, retracting sinkers to drop said measured and drawn loops to a sinker throat and thereafter casting loops from needles.

12. A method of knitting pile fabric by cooperative action of needles and sinkers having throats, nibs and notches in the forward edges of said nibs, including the steps of projecting sinkers transversely of needles to measure pile loops about shanks of needles, drawing needles downwardly to engage a base fabric yarn within the hooks thereof and drawing loops of said yarn over nibs of sinkers, retracting sinkers to drop said loops down to the sinker throats and thereafter projecting sinkers inwardly to cast loops from needles.

13. A method of knitting pile fabric on independent needle knitting machines wherein sinkers are provided with throats, nibs, and notches at the forward edges of said nibs, including the steps of feeding a pile yarn to be engaged within notches of said sinker nibs, projecting said sinkers transversely of needles to measure pile loops about shanks of needles and simultaneously drawing said needles downwardly thereby engaging a base fabric yarn within needle hooks and drawing stitches thereof over sinker nibs, then withdrawing said sinkers to drop said loops to the sinker throats and thereafter casting previously drawn loops from the needles.

14. A method of knitting pile fabric including the steps of measuring pile loops only about the shanks of needles and then measuring loops of a base fabric only over cooperating instrumentalities and drawing loops of both pile and a base fabric yarn by independent action of needles drawing stitches over stitch drawing edges on cooperating instrumentalities.

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