Feb. 25, 1930. P. N. NEWMAN 1,748,495

WARP KNITTING APPARATUS

Filed June 16, 1928 4 Sheets-Sheet 1

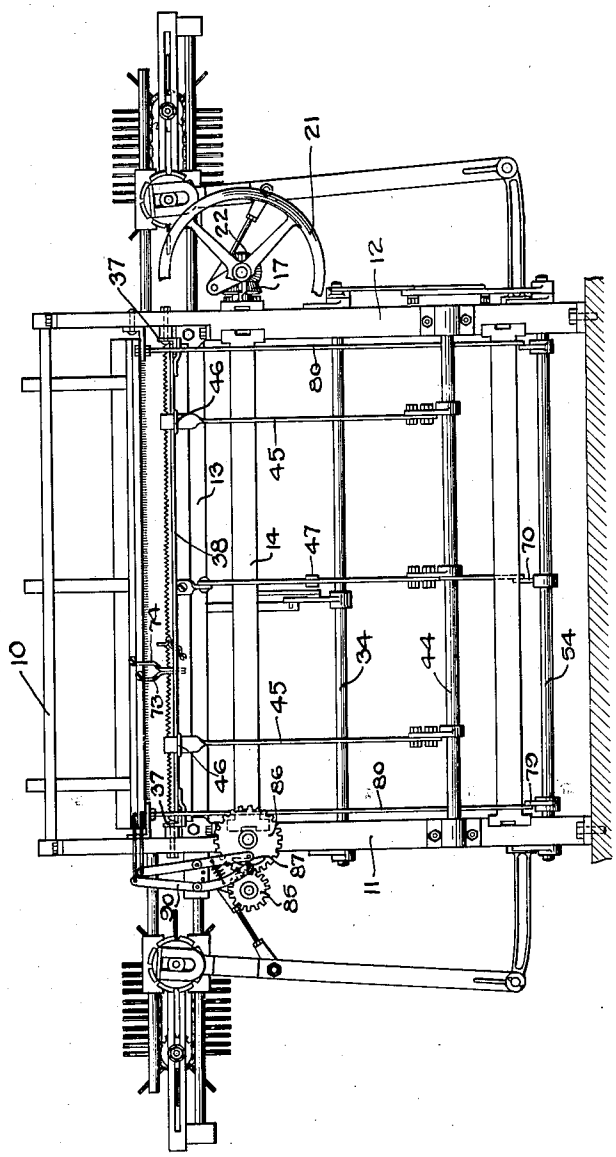


FIG. 1

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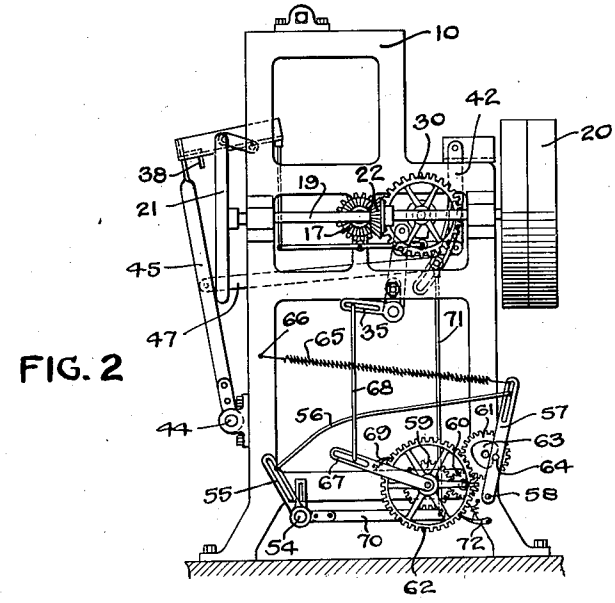
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WARP KNITTING APPARATUS

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FIG. 2



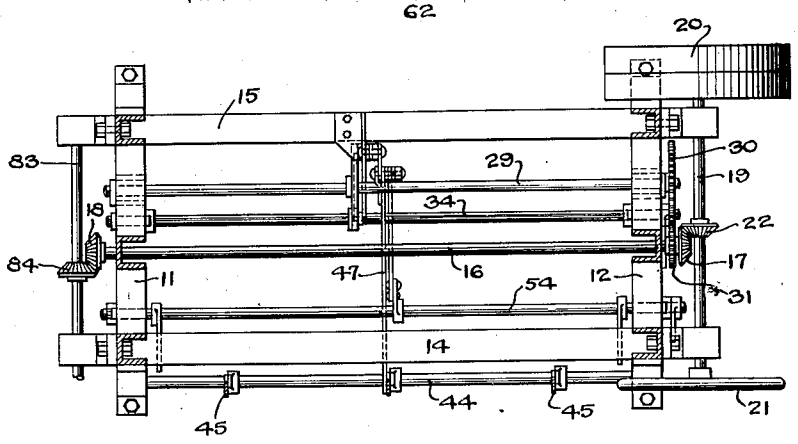


FIG. 3

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WARP KNITTING APPARATUS

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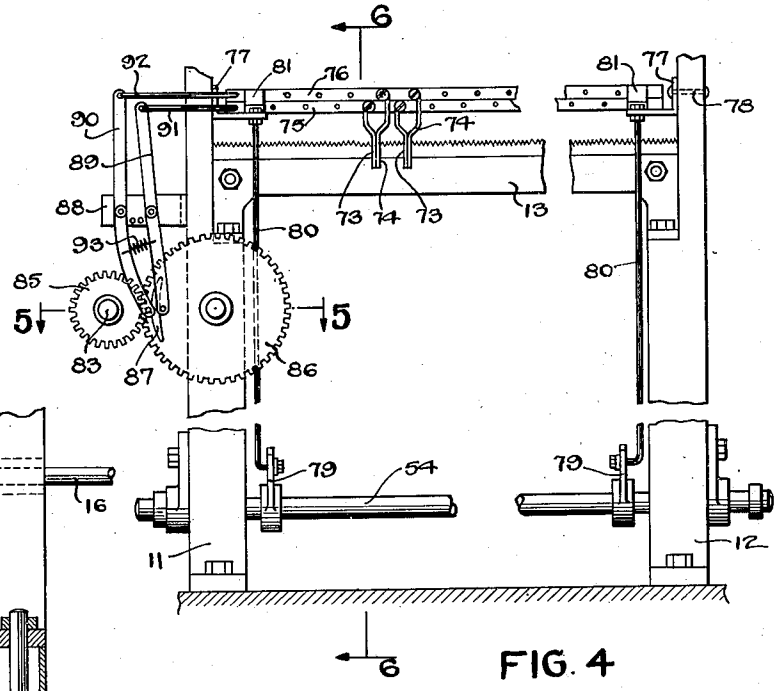


FIG. 4

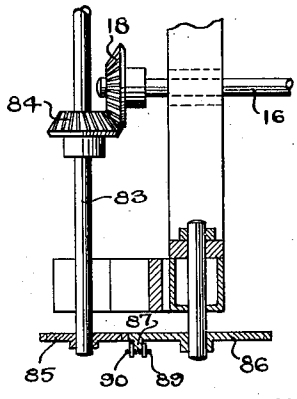


FIG. 5

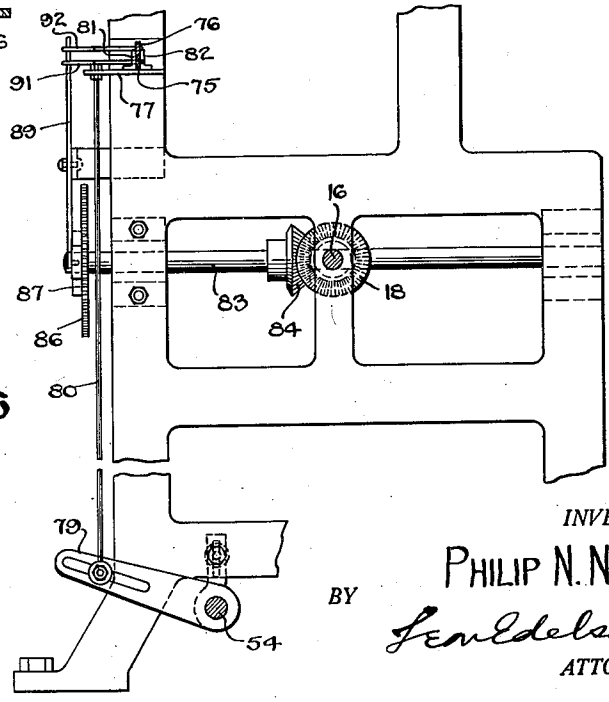


FIG. 6

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WARP KNITTING APPARATUS

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FIG. 7

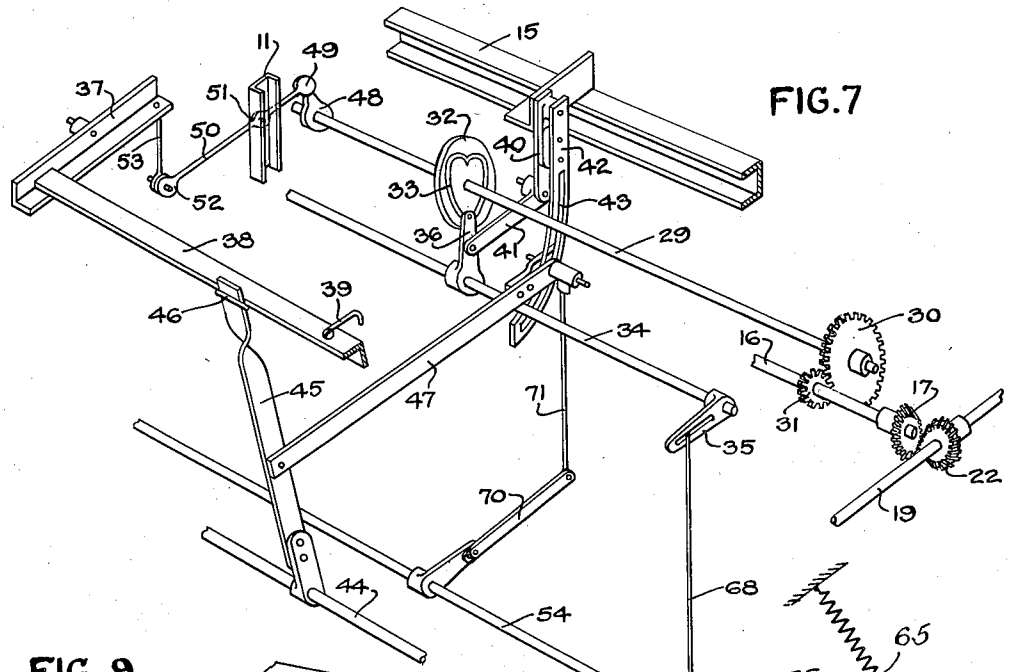


FIG. 9

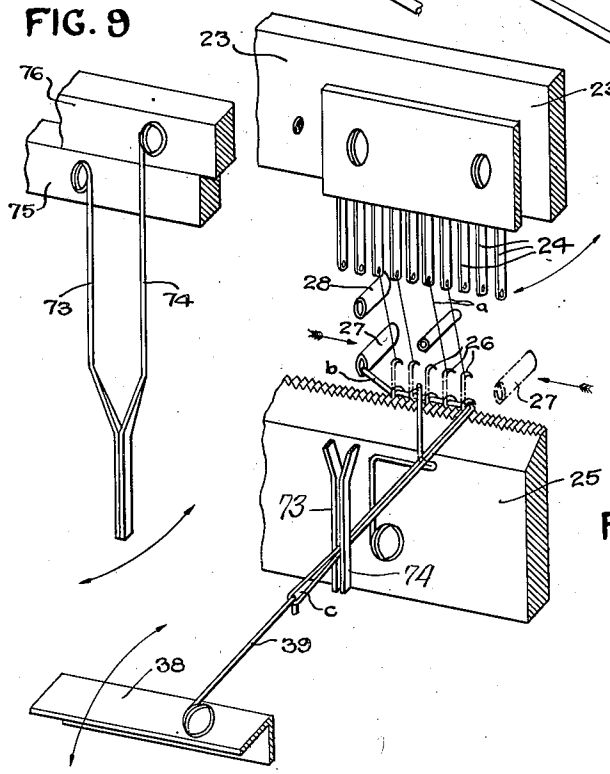


FIG. 8

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Patented Feb. 25, 1930 1,748,495

UNITED STATES PATENT OFFICE

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WARP-KNITTING APPARATUS

Application filed June 16, 1928. Serial No. 285,987.

This invention relates to apparatus for manufacturing fringes and the like and more particularly to an apparatus for producing fringes having a knitted selvage or heading.

Heretofore and prior to this invention, it has been the general practice to fabricate scalloped bullion fringes by means of looms, the fringes so produced being formed with woven headings or sewing-selvages. To a less extent, knitting machines, as distinguished from weaving machines, have been employed for producing bullion fringes, but, to my knowledge, there has never been devised a machine capable of producing a fringe having a knitted heading and a scalloped lower edge. In the fabrication of bullion fringes and the like, the use of a knitting machine in place of a loom is advantageous in a number of respects, the chief advantages being that the knitting machines require considerably less floor space than do the looms, are less expensive, less complicated and easier to operate, and finally they are capable of fabricating fringes of superior quality and much more expeditiously than those produced by means of a loom. Considerable difficulty, however, has been encountered in constructing a knitting machine capable of producing a fringe having a scalloped lower edge and a knitted heading or selvage. In fact, until this invention it has been generally considered that a knitting machine was inherently incapable of producing a fringe of this character.

Not only is it an object of this invention to provide an apparatus or machine which is capable of producing a fringe having a scalloped lower edge and a knitted heading, but it is also one of the objects of this invention to so construct the apparatus that it is readily adapted for producing a fringe having a knitted heading and a straight lower edge. In other words, with the same apparatus it becomes possible to fabricate fringes the lower edge of which may be of any predetermined design. Yet, in every fringe produced by this apparatus the fringe thread or threads are continuous throughout the entire length of the fringe, the latter being thus characterized in that the depending strands thereof are looped, thereby avoiding any cut ends in the fringe. When a scalloped or similar effect is desired these depending strands are of varying lengths, while when a substantially straight lower edge is desired the several strands are of uniform length.

It is often desirable to vary the linear distance between similar points in the fringe edging without, however, varying the general contour of the edging design, or, in other words, to either "squeeze" or lengthen out the design, and it is among the objects of this invention to provide a mechanism which is operable to vary the edging design in this manner. A further object of the invention is to provide another mechanism which is operable, independently of that just mentioned, to vary the general contour or shape of the fringe edging without, however, affecting the length of the particular predetermined design. By means of these two mechanisms, it will be apparent that a practically limitless number of scalloped effects and designs may be obtained.

Probably one of the most important objects of the invention is the provision of means for permitting a greater number of fringes to be produced by one machine than has been possible heretofore, this means being operable with equal efficiency irrespective of whether the fringe is of the straight type or scalloped type and irrespective of the particular fringe width. The importance of this object cannot be over-estimated. In all fringe making apparatus now in more or less general use, the fringe threads are pulled in a direction at right angles to the warp thread. Inasmuch as in these machines the warp threads travel forwardly from the rear of the machine, it follows that the bullion or fringe threads were, of necessity, extended in directions paralleling the width of the machine. When it is considered that fringes are fabricated which vary in width (i. e., in length of fringe strand) up to ten inches and more, it will be seen that in order to produce a number of such fringes it becomes necessary to employ an apparatus of extraordinary overall width. In other words, the maximum number of fringes which it is possible to pro-

duce by machines as are now in general use cannot possibly exceed the number of fringes whose total width plus the total space between fringes approximates that of the machine. Thus, if each fringe be ten inches wide, it would require a machine at least fourteen feet in width to produce fifteen fringes, allowing one inch between adjacent fringes. When one considers the frame and possible attachments, the machine would exceed this width.

It is an object of this invention, as has already been stated, to increase the number of fringes for a given width of machine by providing means for drawing the bullion or fringe thread in a direction forwardly of the machine and paralleling the warp threads. It will be understood, of course, that the knitted heading of the fringe is of a relatively small width compared to the overall width of the fringe and that this width of heading is practically the same for all widths of fringe. By pulling the bullion forwardly of the machine in a direction paralleling the knitted heading, it will be seen that only a small proportion of the total fringe width extends in the direction of the machine width. Consequently, if the width of the heading be only one inch, it becomes possible to produce as many as eighty fringes on a machine fourteen feet wide. By reducing the width of the machine to about six feet, it is possible to produce at least thirty fringes regardless of their overall widths. While these figures are all approximate, it will be readily seen that by means of this invention, it is possible to produce upon a six foot machine twice as many fringes as can be produced upon a fourteen foot machine of the type now in use.

Inasmuch as the fringe bullion is given an initial twist, the tendency is for the bullion to run into a twist when portions thereof are permitted to come together in the form of a loop. These loops are formed by the pulling action of suitable movable hooks, it being a further object of this invention to provide a means for holding the looped bullion against any tendency for it to spring back toward the knitting needles after the looping hook has been released from the bullion. This bullion holding means is operable automatically to grasp and then release the bullion in a predetermined cycle.

A further and more general object of the invention is to provide a machine which is durable, simple of construction, readily changed or adjusted for making different designs and capable of producing in a most expeditious, economical and efficient manner fringes which vary greatly in width.

Other objects of the invention will be apparent more fully hereinafter.

The invention consists substantially in the combination, construction, location and relative arrangement of parts, all as will be described more fully hereinafter, as shown in the accompanying drawings and as finally pointed out in the appended claims. For purposes of illustration I have shown a preferred form of the invention in the accompanying drawings. In the particular instance, the invention has been applied to a machine for knitting fringes, but it will, of course, be understood that certain of the mechanisms to be described in greater detail hereinafter may be used with equal effect and efficiency in connection with machines other than those especially adapted for knitting fringes. It is accordingly desired that a broad interpretation of the following specifications be had, as well as of the appended claims.

In the accompanying drawings:—

Figure 1 shows a front elevation of the machine constructed in accordance with the principles of this invention;

Figure 2 is a side elevation of the machine;

Figure 3 is a partial plan view of the machine;

Figure 4 is an enlarged front elevation of the bullion gripping mechanism;

Figure 5 is a sectional view taken on the line 5—5 of Figure 4;

Figure 6 is a sectional view taken on the line 6—6 of Figure 4;

Figure 7 is a skeleton perspective view showing the coordination of the several operating mechanisms;

Figure 8 is a fragmentary perspective view showing in enlarged detail the looper and needle bars and associated parts; and

Figure 9 is a perspective view of one set of gripping fingers.

Referring now to the drawings and more particularly to Figures 1, 2 and 3, it will be observed that the apparatus comprises generally the frame 10 including the side or end frames 11—12, the latter being at the motor or drive end of the machine. Extending longitudinally between the end frames 11 and 12 and secured to the front edges thereof are the members 13 and 14, while secured to the rear edges of the end frames is the longitudinally extending member 15. Suitably journalled between the end frames intermediate the front and rear edges thereof is the longitudinally extending shaft 16 (Figure 3) opposite ends of which project exteriorly of the end frames of the machines and are provided with bevel gears 17 and 18. Arranged exteriorly of and paralleling the end frame 12 is the horizontally extending main driving shaft 19, to the rear end of which is secured the driving pulley 20, while to the front end is secured a hand wheel 21. Secured to the driving shaft 19 intermediate the ends thereof for meshing engagement with the bevel gear 17 is a bevel gear 22 whereby rotation of the driving shaft 19 is imparted to the longitudinally extending shaft 16.

Extending longitudinally across the front of the machine is a looper bar 23 upon which are mounted a series of loopers 24 having eyes through which the warp threads *a* pass. Arranged below the looper bar 23 is a needle bar 25 which carries a series of latch needles 26 in the usual manner. There are, of course, as many loopers as there are needles, the action of the loopers being to carry the warp threads through the spaces between the needles and, as the needles are shogged, they cross the threads to form loops, whereupon the loopers are withdrawn through the spaces on the opposite sides of the needles from which they entered. Inasmuch as the loopers and latch needles are actuated in the manner common to knitting machines, no further description thereof need be given here. Suffice it to point out, however, that in the drawings I have shown five needles, the function of which is to provide a firm knitted heading having five warp threads passing therethrough. It might also be observed at this point that the knitted heading or selvage of the fringe is of a width approximately equal to the space occupied by the set of needles employed in connection with the particular fringe.

It will be further observed (see Figure 8) that the bullion *b* forming the weft of the fringe passes through the tubular guide 27 which operates, through suitable mechanism not shown, to carry the bullion back and forth across the needles 26. The right hand limit of this movement of the tubular guide 27 is shown by the dotted position thereof, while the left hand limit is indicated in full lines. If desired, a second tubular guide 28 may be employed for an additional bullion thread of different color, the thread of one color alternating with that of the other color in any predetermined manner. Instead of forming the fringe loops, designated *c*, by pulling the bullion in a direction paralleling the needle bar 25, it will be noticed that the bullion is pulled in a direction making a right angle with the needle bar and paralleling the warp threads *a* of the fringe heading. As was pointed out above this makes it possible to produce upon a given machine a far greater number of fringes than was heretofore possible, the width of the machine occupied by any one fringe being governed solely by the throw of the tubular guide member 27. By dividing the machine into a number of spaces each of which is equal to the throw of the tubular guide 27, the machine is capable of producing at the same time a number of fringes corresponding to the number of spaces. For a machine of given width, the number of such spaces depends, of course, upon the lengths of throw of the several guides 27.

The various operating mechanisms will now be described. Referring again to Figures 1, 2, 3 and 7, it will be observed that extending longitudinally across the rear of the machine is a cam shaft 29 the opposite ends of which are suitably journalled in the end frames 11 and 12. Secured to that end of the shaft 29 which projects exteriorly of the end frame 12 is a gear 30 arranged for meshing engagement with a gear 31 carried upon the shaft 16. Rotation is thus imparted to the cam shaft 29 and to a cam member 32 rigidly secured thereto intermediate the ends thereof. As appears most clearly in Figure 7, the cam member 32 is formed with a closed substantially heart-shaped groove 33 in one surface thereof.

Paralleling the cam shaft 29 and also journalled in the end frames 11 and 12 is a shaft 34, one end of which also projects exteriorly of the end frame 12. Secured to this projecting end of the shaft 34 is a rigidly secured lever or arm 35, while similarly secured to the shaft intermediate the ends thereof is a second lever or arm 36. As will be seen most clearly in Figure 7, this latter arm 36 is provided at its free end with a suitable cam roller arranged to travel in the heart-shaped cam groove 33. Rotation of the shaft 29, and accordingly the cam member 32, will cause the lever or arm 36 to rock in a plane extending normally to the shaft 34 with the result that said shaft 34 will be caused to oscillate. Oscillation of the shaft 34 will in turn impart a rocking movement to the lever 35 secured to the end of said oscillating shaft.

Pivotally journalled in each of the end frames 11 and 12, toward the front edges thereof, is a cradle member 37 of angle section, these cradle members being operative to support, between the forward ends thereof, a longitudinally extending bar 38 for carrying a series of rearwardly projecting hooks 39. While in the drawings only one such hook 39 is shown, it will be understood that one of these hooks is provided for each length of fringe being made. It will be further understood that these hooks are respectively arranged to hook into the bullion *b* of each fringe at a point located immediately to the right of its corresponding bank of warp thread needles 26 while the tubular guide 27 is in the dotted position shown in Figure 8. It will also be noted that the hook 39 travels in a plane making a right angle with the plane of the warp thread needles, that is, the hook travels toward and away from the needle bar 25.

This back and forth movement of the hooks 39 is obtained as follows, it being remembered that said hooks are mounted upon the hook bar 38 which in turn is carried by the longitudinally spaced cradle members 37. Pivotally suspended from the rear frame member 15 (see Figure 7) is a depending arm or link 40, the lower free end of which is secured to the cam roller arm 36 by the

link 41. It will be apparent that by this arrangement a rocking movement will be imparted to the depending arm or link 40. Rigidly secured to and carried by the depending arm 40 is a relatively long arm or link 42 which is curved from top to bottom with the free lower end thereof projecting toward the front of the machine. This curved link 42 is provided with an elongated slot or opening 43 which is curved to correspond generally to the curvature of the link 42. Preferably, this curved slot 43 extends substantially throughout the length of the link in which it is formed. Depending upon the particular shape of the cam groove 33, it will be apparent that a swinging movement similar to that of a pendulum will be imparted to the slotted link 42 upon rotation of the cam shaft 29 and that the length of the arc of movement will be constant for any given shape of cam groove. It will also be noted that the upper end of the slot 43 will traverse a smaller arc than the lower end thereof while intermediate points in the slot will traverse arcs of corresponding intermediate lengths.

Extending across the front of the machine and journalled upon the end frames 11 and 12 thereof is a shaft 44 upon which are rigidly mounted a plurality of longitudinally spaced substantially vertically extending arms 45. The upper ends of these arms 45 are operatively connected to the hook bar 38. The connections between these arms 45 and the bar 38 are of such character that the arms are movable with respect to the bar 38 along their longitudinal axes. This relative movement is effected by means of yokes 46 secured to the bar 38 and freely embracing the upper portions of the arms 45. Interconnecting the centrally arranged arm 45 and the slotted link 42 is a link or arm 47 through the intervention of which the hook bar 38 is caused to move toward and away from the needle bar 25. This movement of the hook bar 38 causes the hooks 39 to pass beyond the knitting line for respective engagement with the bullion *b* of each fringe being fabricated.

In order to insure each of the hooks 39 properly engaging the bullion prior to pulling the same into the loop *c* (see Figure 7) and then, when a loop of proper length has been formed, to effect disengagement of these hooks from the bullion, a suitable mechanism must be provided which operates to depress and raise the hooks in a predetermined manner. This mechanism will now be described. Secured to the left hand end of the cam shaft 29 is a cam 48 (Figure 7) which is operatively associated with the rear end 49 of a lever 50 suitably pivoted, as at 51, upon the end frame 11. The forward end 52 of this lever 50 is pivotally connected to the lower end of a link 53, the upper end of which is in turn connected to the rear end of the left hand cradle member 37. The cams 32 and 48 are so designed and arranged relatively to each other that when the hook bar 38 is in its extreme rearmost position the rear end of the cradle 37 will be raised and so cause the hooks 39 to assume a depressed position. This depressed position of the hooks 39 is maintained throughout the entire extent of forward movement of the bar 38 and through a portion of the return movement thereof. Soon after this return movement begins the hooks 39 begin to raise until they reach a position where they become disengaged from the bullion, this raised position being maintained until after the hooks pass behind the line of knitting. In Figure 7, the cam 48 is shown in operative position for maintaining the hooks in raised position. By reason of the relatively free connection between the arms 45 and the hook bar 38, the latter is permitted to move toward and away from the needle bar and at the same time be raised or lowered to effect disengagement or engagement with the bullion *b* in the manner heretofore described.

The various mechanisms described to this point are capable of producing straight fringes varying in width from two inches to ten or more inches, it being possible to produce upon the one machine the same number of fringes irrespective of their widths, this for the reason that the fringe strands are pulled forwardly of the machine rather than in a direction paralleling the needle bar. (See Figure 8.) To obtain straight fringes of varying widths, it is merely necessary to change the point of connection of the link 47 with the curved, slotted arm 42. When the rear end of the link 47 is permanently connected to the extreme upper end of the slot 43, a fringe of minimum width will be obtained due to the fact that the stroke of the link 47 will then be least. As the rear end of the link 47 is lowered in the slot 43, the stroke of the link 47 is gradually increased. It, therefore, follows that the maximum width of fringe is obtained when the link 47 is permanently connected to the lowermost end of the slotted arm 42.

But not all fringes are straight. In a majority of instances, the fringe is provided with a scalloped design, which design varies within wide limits. I have provided suitable mechanisms for obtaining these various scalloped effects without necessitating any changes in the mechanisms hereinbefore described. Extending longitudinally across the bottom of the machine and journalled in the end frames 11 and 12 is a pattern changing shaft 54, one end of which projects exteriorly of the end frame 12. Secured to this projecting end of the shaft 54 is a slotted lever or arm 55. The free end of this arm 55 is connected, by means of a rod 56, to the upper end of a substantially vertically extending arm 57, the

lower end of which is pivotally mounted, as at 58, upon the end frame 12.

Journalled upon the side of the end frame 12 immediately in front of the pivoted upstanding arm 57 are a series of entrained gears 59, 60 and 61. Rigidly secured to the gear 59 for imparting rotation thereto is a ratchet wheel 62, while secured to the gear 61 for rotation therewith is a cam member 63, the latter being, in this instance, of heart-shape. The pivoted upstanding arm 57 is provided, intermediate its upper and lower ends, with a suitable cam roller 64 engageable with the cam surface of the cam member 63. A spring 65 (see Figure 2), connected at one end to a fixed point 66 and at its opposite end to the upper free end of the pivoted arm 57, tends to maintain the cam roller 64 in constant engagement with the cam member 63.

Pivotally mounted upon the shaft of the ratchet wheel 62 is a slotted lever 67, the free end of which is connected to the free end of the slotted lever 35 (secured to the end of the shaft 34) by means of a rod 68. The lever 67 is provided with a suitable pawl 69 arranged to operatively engage the teeth of the ratchet wheel 62. Oscillation of the shaft 34 in the manner hereinbefore described transmits a rocking motion to the lever 35 which in turn effects a corresponding movement of the pawl lever 67. For each upward stroke of this pawl lever, the ratchet wheel 62 is ratcheted through a certain predetermined arc thereby causing the cam member 63, through the intervention of the entrained gears 59, 60 and 61, to rotate and in so doing cause the pivoted arm 57 to move rearwardly and then forwardly. This forward and rearward movement of the arm 57 is a gradual one, the stroke thereof being governed by the particular shape of the cam member 63.

By reason of the fact that the lever 57 is connected to the lever 55 through the rod 56, the movement of the former lever is transmitted to the latter which in turn causes the shaft 54 to rotate. Thus, as the lever 57 moves backwardly against the tension of the spring 65, the shaft 54 is caused to rotate in a clockwise direction, while when the lever 57 is moved forwardly (by action of spring 65 pulling the lever against the cam surface) the shaft 54 is rotated in a counter clock-wise direction. Although the ratcheting of the wheel 62 is continuous in one direction, it will be seen that, by the action of the cam 63, the shaft 54 will first rotate in one direction and then in the opposite direction.

Rigidly secured to the shaft 54 intermediate the ends thereof is a rearwardly extending lever or arm 70. A rod 71 interconnects the rear end of the lever 70 with the rear end of the link 47. Upon rotation of the shaft 54 in the counter clock-wise direction as explained above the lever 70 is raised and through the rod 71 causes the rear end of the link 47 to ride upwardly in the curved slot 43 of the pendulum member 42. Naturally, this produces a gradual shortening of the stroke of the link 47 with the result that the fringe strands are gradually decreased in length. Conversely, when the shaft 54 rotates in clockwise direction, the rear end of the link 47 is caused to ride downwardly in the curved slot 43, thereby causing the stroke of the link 47 to be gradually increased. This results in the production of fringe strands of gradually increasing length. This gradual increase to a maximum and decrease to a minimum of the several fringe strands continues throughout the length of the fringe to produce a scalloped fringe the design of which is dependent upon the shape of the particular cam member 63 employed. In the drawings, this cam member is shown as of heart-shape, but it will be understood that it may be of any other suitable shape capable of producing various scalloped effects.

Should it be desired to obtain a straight fringe of any given width without locking the link 47 to the pendulum member 42, it is merely necessary to substitute a circular member (not shown) for the heart-shaped cam 63. By using such a circular member, the pivoted arm 57 will be maintained in constant position with the result that no movement of any sort will be transmitted to the shaft 54. The rear end of the link 47 will thus bear a fixed relation with the pendulum member 42. By increasing or decreasing the diameter of this circular member, the stroke of the link 47 may be correspondingly increased or decreased to produce fringes of increased or decreased width.

Still further variations in the scalloped design may be had by changing the diameter of the ratchet wheel 62, this being in addition to the possible variations produced by changing the pattern changing cam member 63. For instance, if the diameter of the ratchet wheel 62 be increased there will be obtained for each upward stroke of the pawl lever 67 a smaller angular movement of the ratchet wheel. This in turn causes the shaft 54 to be rotated at a slower speed with the result that the rear end of the link 47 travels at decreased speed in the slot 43 of the pendulum member 42. The final result is a spreading out of the particular design produced by the pattern changing cam member 63. Conversely, if a ratchet wheel of smaller diameter be substituted for that shown in the drawings, the rear end of the link 47 will travel at increased speed in the curved slot 43, the result being that the particular design of fringe will be "squeezed" together. It will be understood that the particular design is obtained by the pattern changing cam member, while the shortening or lengthening out of this particular design is obtained through the use of

ratchet wheels of decreased or increased diameter. In order to prevent any "backlash" in the ratchet wheel a suitable spring-pressed detent 72 is employed.

The same result may be obtained by employing ratchet wheels of the same diameter but differing in the number of teeth. Thus, if a ratchet wheel be used wherein the teeth are greater in number than that of the wheel shown in the drawings (the result being that the teeth are formed closer together) it then becomes possible, by properly adjusting the stroke of the pawl lever 67, to obtain a smaller angular movement of the wheel for each stroke of the lever. This will in turn produce a slower movement of the lever 57 and thereby cause a correspondingly slow speed of rotation of the shaft 54. In consequence of this, the elapsed time for the link 47 to travel from end to end of the curved slot 43 is prolonged, thereby causing the particular design produced by the cam 63 to be spread out. Conversely, if the teeth on the ratchet wheel 62 be reduced in number, that is spaced farther apart, a greater angular movement is obtained for each upward stroke of the pawl lever 67. This results in a faster movement of the lever 57, a correspondingly fast speed of rotation of the shaft 54 and a shorter time for the link 47 to traverse the curved slot 43, the final result being the production of a scalloped fringe in which the design is contracted or "squeezed" together.

This squeezing together of the design may also be obtained with a ratchet wheel of given diameter and given number of teeth by merely altering the stroke of the lever 67 so that upon the upward stroke thereof the pawl 69 will engage alternate teeth instead of every tooth. This stroke adjustment is obtained by suitably locking the ends of the rod 68 in adjusted position within the slotted levers 35 and 67. The same result may also be obtained by suitably changing the speed gear ratio between the gears 59, 60 and 61, it being apparent that in order to spread out or contract a given design the idea is to decrease or increase the time which it takes for the pivoted lever 57 to pass from one extremity of its arc of travel to the other.

Figures 4, 5 and 6 illustrate most clearly the mechanism employed for preventing the looped bullion to spring back into the path of movement of the warp thread needles. For this purpose, it is preferable to employ a pair of gripping fingers 73 and 74, one pair of such fingers being used for each hook 39. These fingers 73 and 74 are respectively mounted upon a pair of longitudinally extending bars 75 and 76, said bars being arranged in superimposed relation. It will be noted that the fingers 73 and 74 project downwardly beyond the path of travel of the hook 39.

The finger bars 75 and 76 are supported at their ends upon suitable cradles 77 which are in turn pivotally mounted, as at 78, upon the end frames 11 and 12. The forward ends of these cradles 77 are respectively connected to levers 79 rigidly secured to the shaft 54 through the rods 80. It will thus be seen that rotation of the shaft 54 in one direction or another will cause the cradles 77 to rock about their pivots 78. The finger bars 75 and 76 are maintained in superimposed relation by means of opposed clip members 81 and 82 arranged adjacent opposite ends of the bars. In order to obtain the necessary holding and releasing action of the fingers 73 and 74, the bars upon which said fingers are respectively mounted are longitudinally slidable with respect to each other. In the arrangement shown, it will be noted that when the upper bar 76 is moved to the right and the lower bar 75 to the left, the fingers 73 and 74 will be caused to separate. When the bars are moved in the opposite direction, the fingers are brought into engagement with each other.

The operation of these fingers is effected automatically and in predetermined timed sequence with the mechanisms hereinbefore described. Suitably journalled upon the end frame 11 is a horizontally arranged shaft 83 upon which is secured a bevel gear 84. This bevel gear 84 meshes with the gear 18, which latter, it will be remembered, is secured upon the left hand end of the shaft 16. Rotation of the latter thus imparts rotation to the shaft 83 and to the gear 85 which is secured to the forward end of the latter shaft. The gear 85 is in turn meshed with a gear 86 suitably journalled upon the forward edge of the end frame 11. Provided on the forward face of the gear 86 is a cam member 87 of generally meniscoidal shape. This cam 87 is arranged adjacent the peripheral edge of the gear 86.

Pivotally mounted upon a bracket 88 are a pair of substantially vertically extending levers 89 and 90, the lower ends of which are provided with suitable cam rollers. The upper ends of these levers 89 and 90 are respectively connected to the finger bars 75 and 76 through the rods 91 and 92. A spring 93 interconnects the lower portions of the pivoted levers 89 and 90 and tends constantly to urge the lower ends thereof toward one another. The lower ends of the levers 89 and 90 are so arranged that as the gear 87 rotates the meniscoidal cam member 87 passes therebetween. It will thus be seen that when the cam 87 passes between the cam rollers, the latter will be first separated against the action of the spring 93 and then pulled together by said spring. The greatest separation is had when the widest or thickest portion of the cam 87 lies between the cam rollers. The action of the meniscoid cam upon the cam rollers thus causes the finger bars

75 and 76 to be shifted relatively to each other with the result that the fingers 73 and 74 are first separated and then moved together.

The several cams 37, 48 and 87 are so arranged that the separating movement of the fingers takes place simultaneously as the hook 39 starts on its outward or forward movement. Simultaneously as the hook reaches its outermost position, the fingers move into the closed bullion engaging position shown in Figure 8. The fingers continue to hold the bullion until after the hook 39 has passed out of the loop *c* and has begun its return movement toward the needle bar. Immediately thereafter, the fingers 73 and 74 move apart and out of the path of travel of the hook 39. Due to the fact that the finger bar cradles 77 are connected to the oscillating shaft 54, it will be quite evident that the lower or bullion engaging ends of the fingers 73 and 74 will closely follow the variations in stroke of the bullion pulling hook 39, it being remembered that the stroke of the latter is governed by the shaft 54 through the pendulum arm 42, the link 47 and their associated parts. The result is that the distance between the fingers and the free end of the hook 39, as measured along the line of the looped bullion, is always the same when the hook has reached the outermost limit of its stroke.

It will be understood that various changes in the several mechanisms hereinbefore described may be made from time to time without departing from the general spirit or principles of this invention. It will also be understood that these mechanisms may be incorporated in machines other than that in connection with which the invention has been illustrated and it is accordingly intended to claim the invention broadly, as well as specifically, as indicated in the appended claims.

What is claimed as new and useful is:

1. In an apparatus for fabricating fringe, in combination, a needle bar, a continuous bank of needles operable thereon, means for laying successive portions of a fringe thread across said bank of needles, and means operable to draw looped portions of said thread forwardly from one extremity of said bank of needles and in a direction extending substantially at right angles to the common plane of said bank of needles.

2. In an apparatus for fabricating fringe, in combination, a needle bar, reciprocating means for successively drawing predetermined fixed lengths of a fringe thread to lie in the vertical plane of said needle bar, means engaging said predetermined lengths of thread immediately prior to the return stroke of said reciprocating means for drawing intermediate portions of said thread in a direction extending forwardly of and at an angle to said bar, and means for securing said fixed lengths of the thread together to constitute a heading for a fringe.

3. In an apparatus for fabricating fringe, in combination, means for laying spaced portions of a continuous length of fringe thread closely together across a continuous bank of needles to form a single heading of uniform width, and means for drawing the intermediate portions of the thread in a direction extending transversely with respect to the heading portions of the fringe thread.

4. In an apparatus for fabricating fringe, in combination, means for laying spaced portions of a continuous length of fringe thread closely together across a continuous bank of needles to form a single heading of uniform width, means for passing one or more warp threads transversely across said portions of the fringe thread to secure the same together, and means for drawing intermediate portions of the thread in a direction substantially paralleling said warp threads.

5. In a machine for fabricating fringe, in combination, means for laying alternate portions of a continuous fringe thread widthwise of the machine and across a continuous bank of needles to form a single fringe heading of uniform width, and means for drawing intermediate portions of said thread from one edge of said heading and in a direction extending transversely of the width of the machine to form the strands of the fringe.

6. In a machine for fabricating fringe, in combination, a needle bar having a bank of needles operable thereon, a bullion guide movable along a path arranged to one side of said bank of needles, means for limiting the stroke of said bullion guide such that it moves from a point located immediately beyond one end of said bank of needles to a point located immediately beyond the opposite end thereof whereby to lay certain portions of the bullion across the needles, and means for drawing intermediate portions of the bullion from one end of said bank of needles in a direction extending substantially at right angles to that portion thereof which lies across said needles.

7. In an apparatus for fabricating fringe, in combination, a thread carrier movable to successively lay certain portions of the thread along a predetermined line, a pivotally suspended pendulum arm, means for causing said pendulum arm to oscillate between fixed limits, means operatively associated with said pendulum arm and engaging said thread for forming looped fringe strands, and means for automatically varying the operative connection between said pendulum arm and said thread engaging means.

8. In an apparatus for fabricating fringe, in combination, means for feeding a continuous length of fringe thread thereto, means operable to draw successive portions of said fringe into the form of a looped strand, and

means for governing the stroke of said fringe drawing means whereby to form a fringe the several strands of which are of predetermined lengths.

9. In combination, a thread carrier movable to successively lay certain portions of the thread along a predetermined line, a hook operable to engage the same end of each of said portions of the thread, means for moving the hook away from said predetermined line while holding the thread whereby to draw intermediate portions of the thread into the form of loops, and means for effecting disengagement of the hook from said loops immediately after said hook reaches the limit of its outward movement.

10. In combination, a weft thread carrier arranged for reciprocating movement across the path of a plurality of warp threads, a hook operable to engage the weft thread immediately prior to the return stroke of said carrier whereby to draw alternate portions of the weft thread in a direction extending substantially at right angles to the path of movement of said carrier, means for limiting the outward movement of said hook, and means for effectually precluding the disengagement of said hook from said weft thread until after said hook has reached the limit of its outward movement.

11. In an apparatus for fabricating fringe, in combination, a weft thread carrier movable across a series of warp threads, a hook operable to draw alternate portions of the weft thread in a direction paralleling the warp threads whereby to form looped fringe strands, means for maintaining the hook in depressed position throughout its thread-drawing movement, and means for raising said hook out of thread-engaging position during its return movement.

12. In combination, a thread carrier movable to successively lay certain portions of the thread along a predetermined line, a hook, means for moving said hook inwardly across said line and thence downwardly to engage the thread, means for drawing said hook outwardly and in a direction substantially normal to said predetermined line, and means for limiting the outward movement of said hook.

13. In combination, a thread carrier movable to successively lay certain portions of the thread along a predetermined line, a hook, means for moving said hook inwardly across said line and thence downwardly to engage the thread, means for drawing said hook outwardly, and means for predeterminingly and gradually varying the limit of the outward movement of said hook.

14. In combination, a thread carrier movable to successively lay certain portions of the thread along a predetermined line, a pivotally suspended member, means for causing said member to oscillate within predeterminedly fixed limits, a hook bar interconnected with said oscillating member, whereby movement of the latter is transmitted to said bar, a hook carried by said bar for drawing the thread outwardly to form a fringe strand, and means operable independently of said oscillating member for moving said bar in a plane intersecting its plane of movement obtained through said oscillating member, both of said aforesaid means being so timed that the bar is depressed during its entire outward travel and raised during a portion of its inward travel.

15. In combination, a thread carrier movable to successively lay certain portions of the thread along a predetermined line, a pivotally suspended member, means for causing said member to oscillate within predeterminedly fixed limits, a pivotally supported hook bar, a hook carried by said bar for drawing the thread outwardly to form a fringe strand, means interconnecting said hook bar and said oscillating member whereby to permit the latter to impart a reciprocable movement to said bar, and means for gradually varying the effective stroke of said oscillating member as respects said hook bar whereby to correspondingly change the stroke of the latter.

16. In combination, a thread carrier movable to successively lay certain portions of the thread along a predetermined line, a pivotally suspended member, means for causing said member to oscillate within predeterminedly fixed limits, a pivotally supported hook bar, a hook carried by said bar for drawing the thread outwardly to form a fringe strand, a link interconnecting said hook bar and said oscillating member, means for varying the effective stroke of said oscillating member as respects said hook bar, and means for changing the rate of variation in said effective stroke of the oscillating member.

17. In combination, a thread carrier movable to successively lay certain portions of the thread along a predetermined line, a hook operable to draw intermediate portions of the thread outwardly along a line intersecting said predetermined line, and means for engaging each of said intermediate portions of the thread at a point spaced inwardly of the free outer end thereof simultaneously as said hook reaches its outer limit of movement.

18. In combination, a weft thread carrier movable across a series of warp threads, means for interlooping said warp threads with the weft thread, a reciprocating hook operable to successively engage alternate portions of said weft thread whereby to draw the same outwardly and in parallelism with said warp threads to form fringe strands of predetermined lengths, a pair of relatively movable fingers operable to grasp said fringe

strands therebetween simultaneously as said hook reaches its outermost limit of travel, and means for moving said fingers together, said latter means being also operable to effect the separation of said fingers immediately after said hook has begun its inward movement.

19. In combination, a movable hook, a thread carrier movable across the path of movement of said hook whereby to permit the hook to engage and draw the thread outwardly to form a fringe strand, means for varying the distance of outward movement of the hook, means operable to engage said fringe strand simultaneously as the hook reaches its outermost limit of travel, and means for maintaining a fixed distance between the point of engagement of the fringe strand and said outermost limit of travel of the hook.

20. In an apparatus for fabricating fringe, in combination, a bank of needles, means for successively laying alternate portions of the fringe thread across said bank of needles, means for drawing intermediate portions of said thread in a direction extending transversely to said bank of needles, means for predeterminingly varying the distance through which each of said intermediate portions of the thread is drawn whereby to obtain a particular design in the fringe edging, and means for varying the linear distance between similar points in said edging without departing from the said particular design.

21. In an apparatus for fabricating fringe, in combination, a bank of needles, means for laying doubled portions of a bullion thread successively across said bank of needles, means engageable with the looped ends of said doubled portions of said thread for drawing the same into fringe strands, and means for governing each stroke of said thread engaging means.

In testimony whereof, I have hereunto affixed my signature.

PHILIP N. NEWMAN.