Nov. 25, 1941. A. R. BELL 2,264,234

SEWING OR LOOPING MACHINE

Filed Jan. 12, 1939 8 Sheets-Sheet 1

Fig. 1.

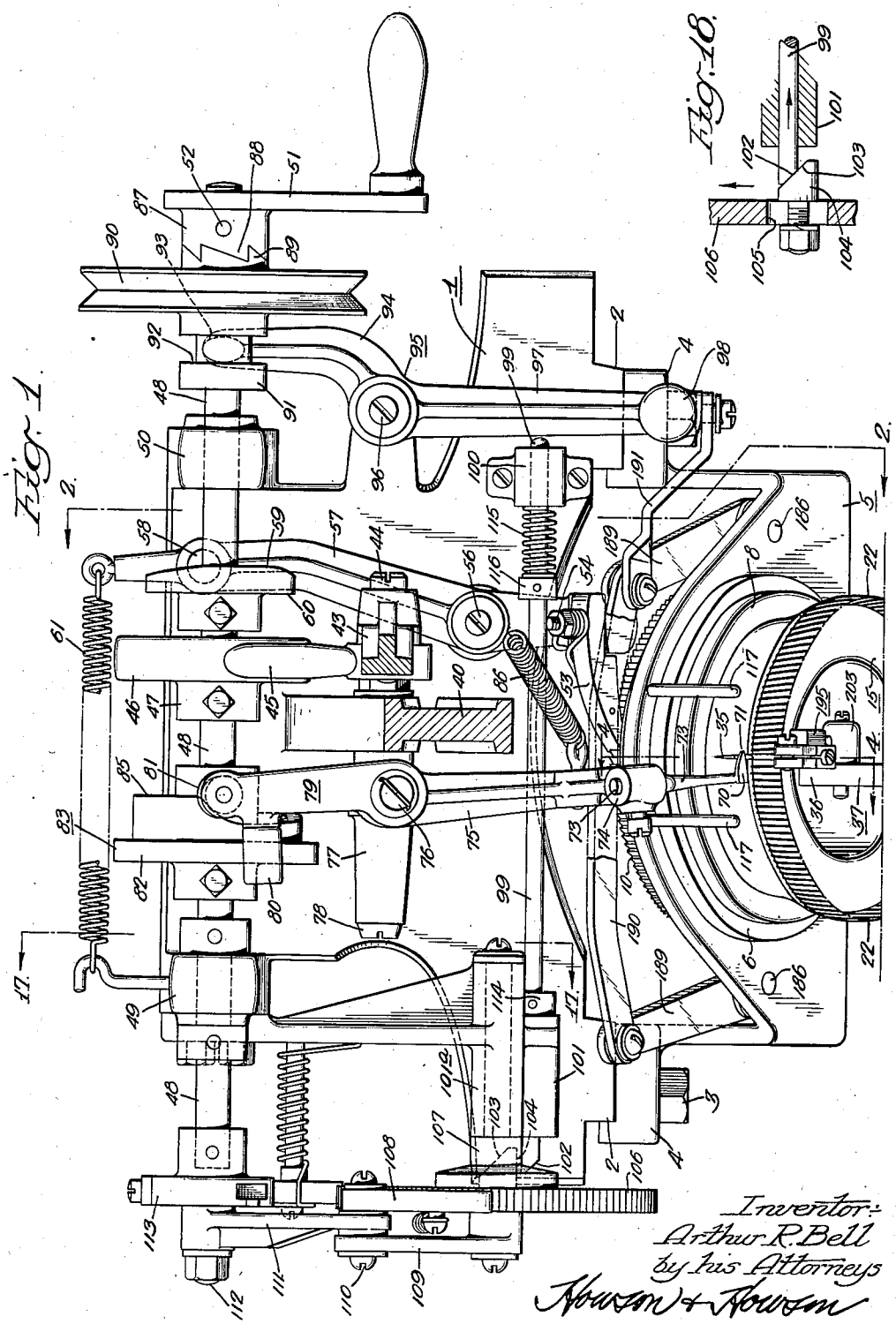


Fig. 1B.

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Nov. 25, 1941. A. R. BELL 2,264,234

SEWING OR LOOPING MACHINE

Filed Jan. 12, 1939 8 Sheets-Sheet 2

Fig. 9.

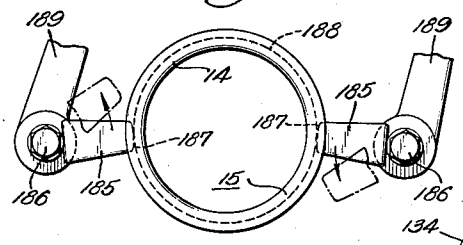


Fig. 2.

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Nov. 25, 1941. A. R. BELL 2,264,234

SEWING OR LOOPING MACHINE

Filed Jan. 12, 1939 8 Sheets-Sheet 3

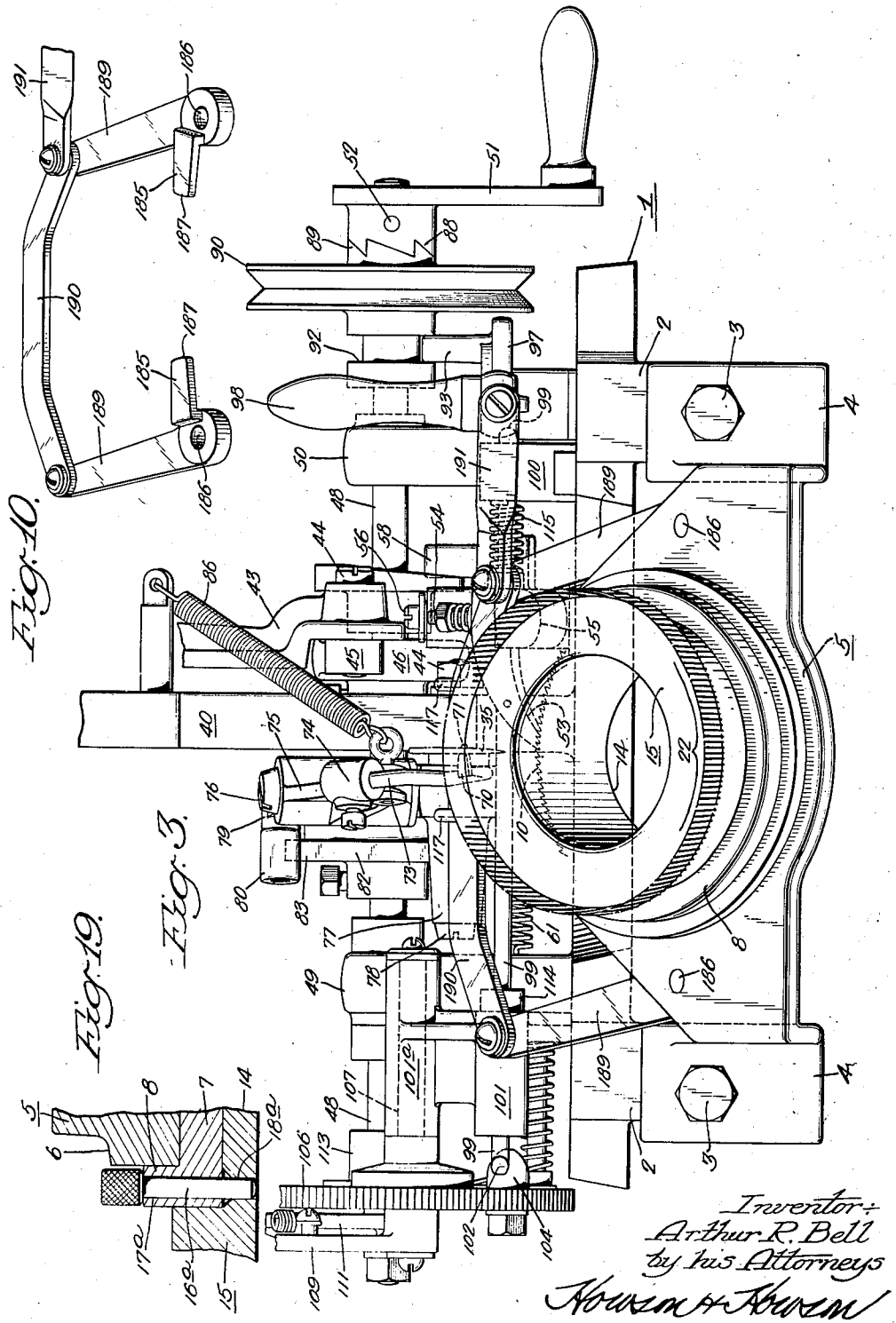


Fig. 10.

Fig. 3.

Fig. 19.

Inventor:
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Nov. 25, 1941. A. R. BELL 2,264,234

SEWING OR LOOPING MACHINE

Filed Jan. 12, 1939 8 Sheets-Sheet 4

Fig. 4.

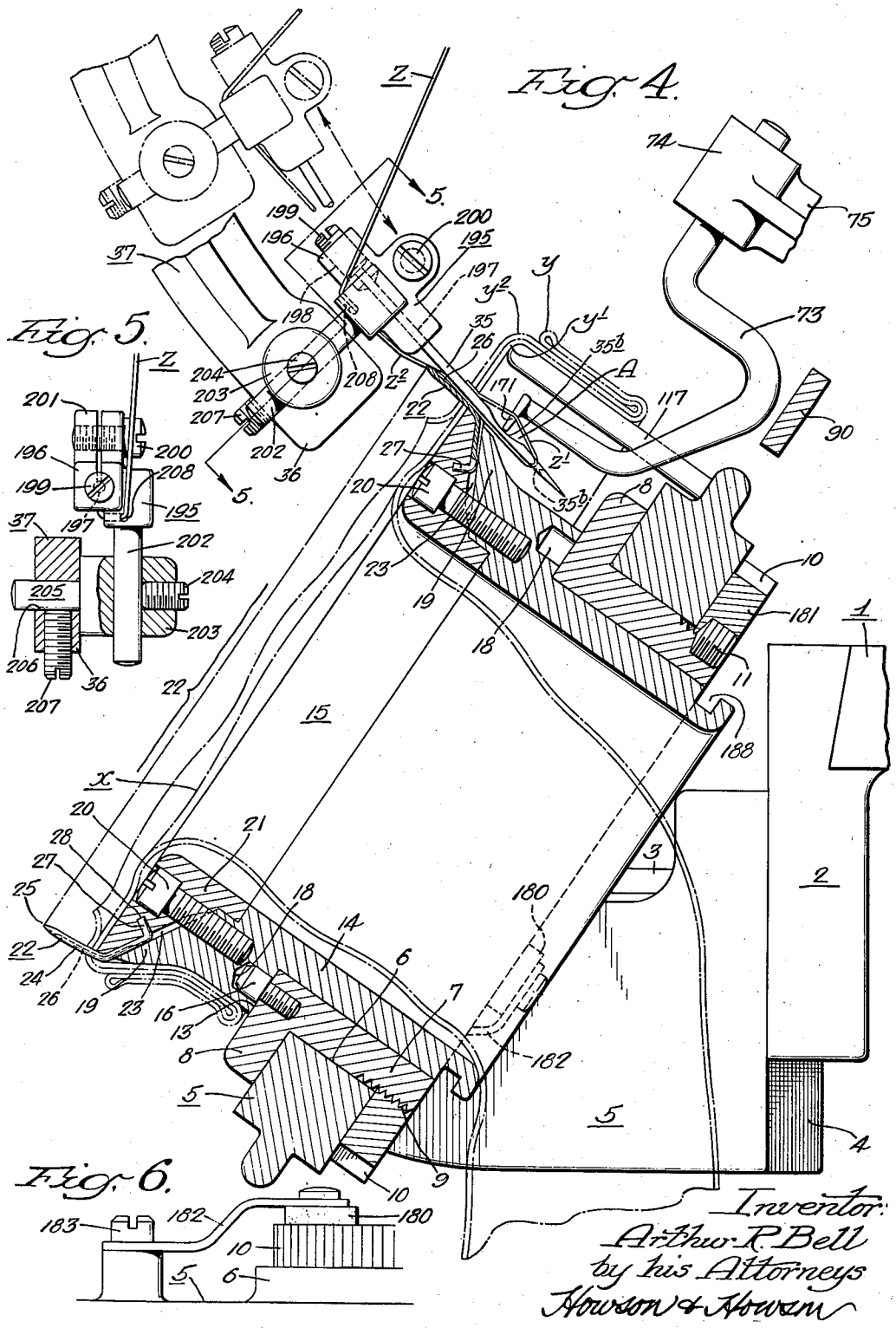


Fig. 5.

Fig. 6.

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Nov. 25, 1941. A. R. BELL 2,264,234

SEWING OR LOOPING MACHINE

Filed Jan. 12, 1939 8 Sheets-Sheet 5

Fig. 17.

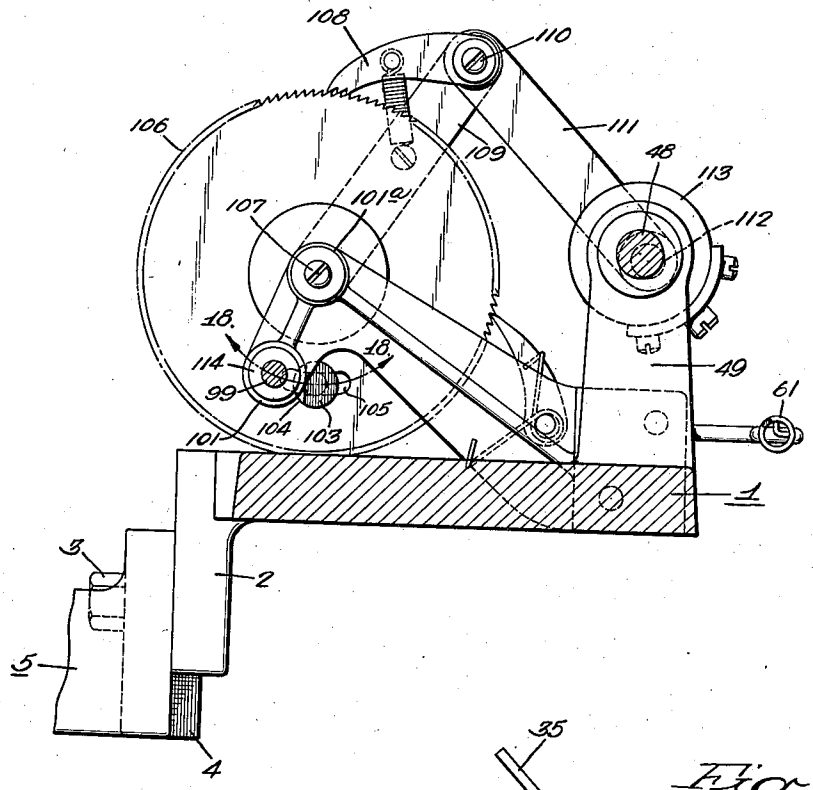


Fig. 8.

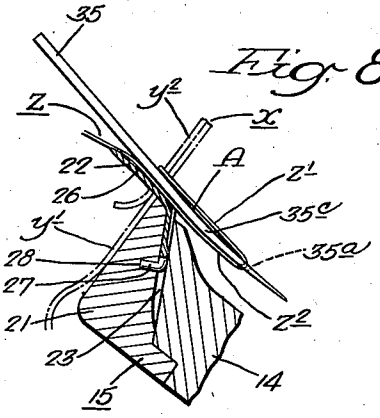
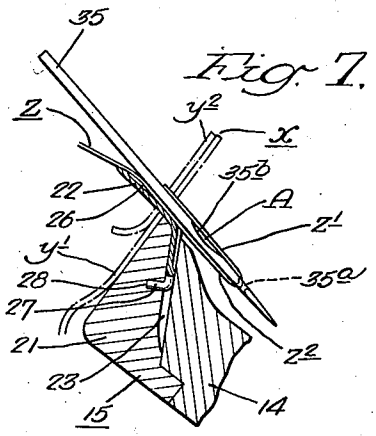


Fig. 7.



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Nov. 25, 1941. A. R. BELL 2,264,234

SEWING OR LOOPING MACHINE

Filed Jan. 12, 1939 8 Sheets-Sheet 6

Fig. 11.

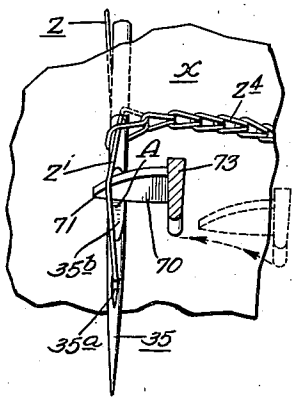


Fig. 12.

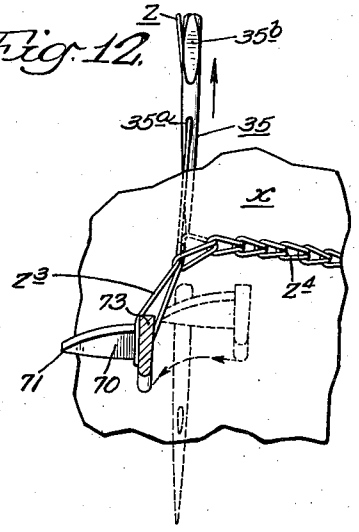


Fig. 13.

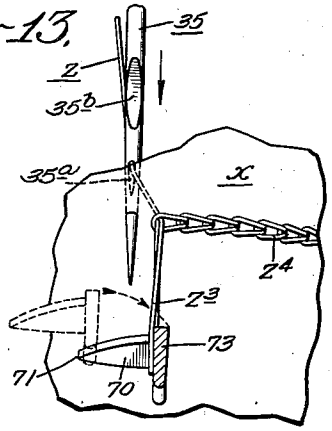


Fig. 14.

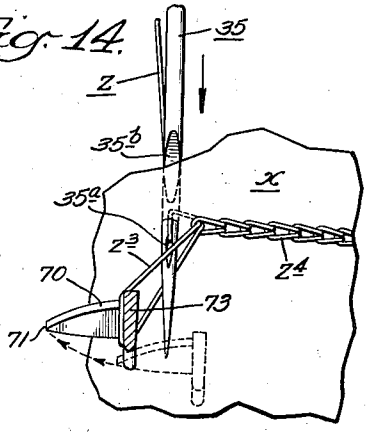


Fig. 15.

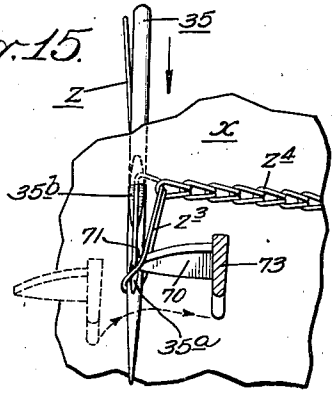
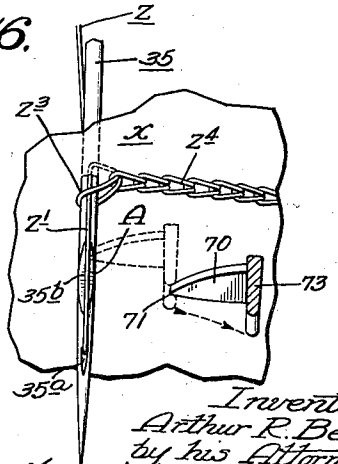


Fig. 16.



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Nov. 25, 1941. A. R. BELL 2,264,234

SEWING OR LOOPING MACHINE

Filed Jan. 12, 1939 8 Sheets-Sheet 7

Fig. 23.

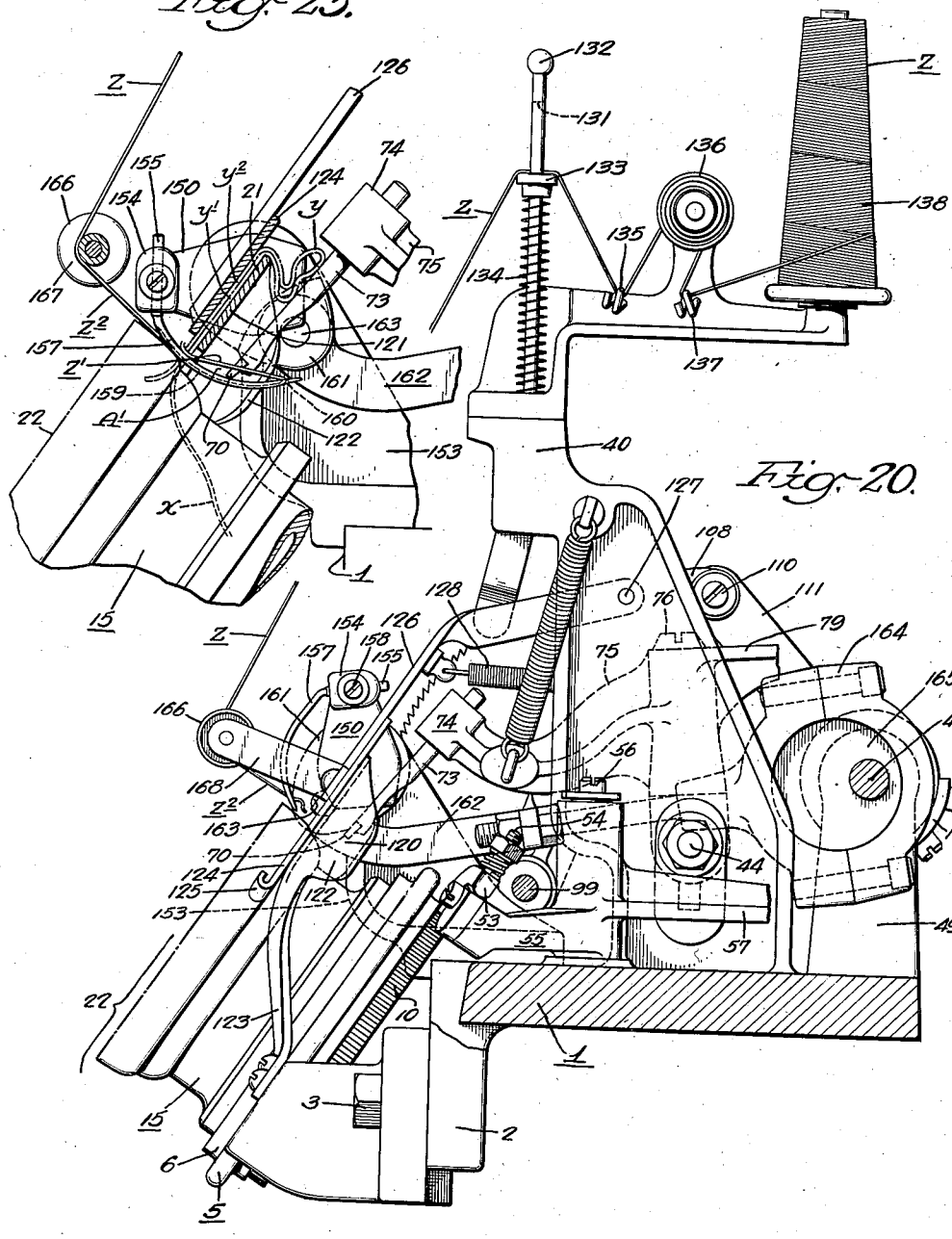


Fig. 20.

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Nov. 25, 1941. A. R. BELL 2,264,234

SEWING OR LOOPING MACHINE

Filed Jan. 12, 1939 8 Sheets-Sheet 8

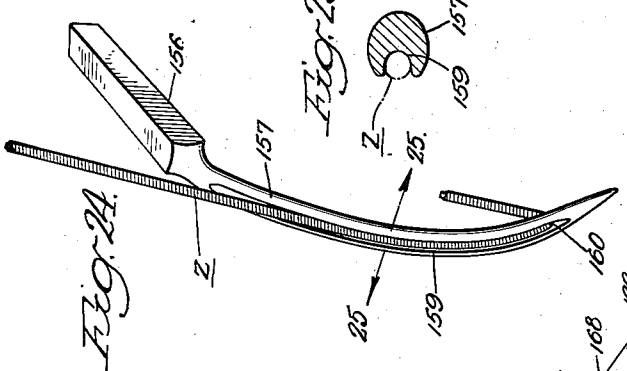


Fig. 24.

Fig. 25.

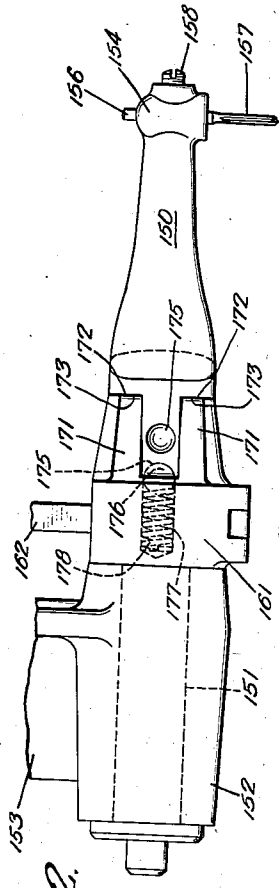


Fig. 22.

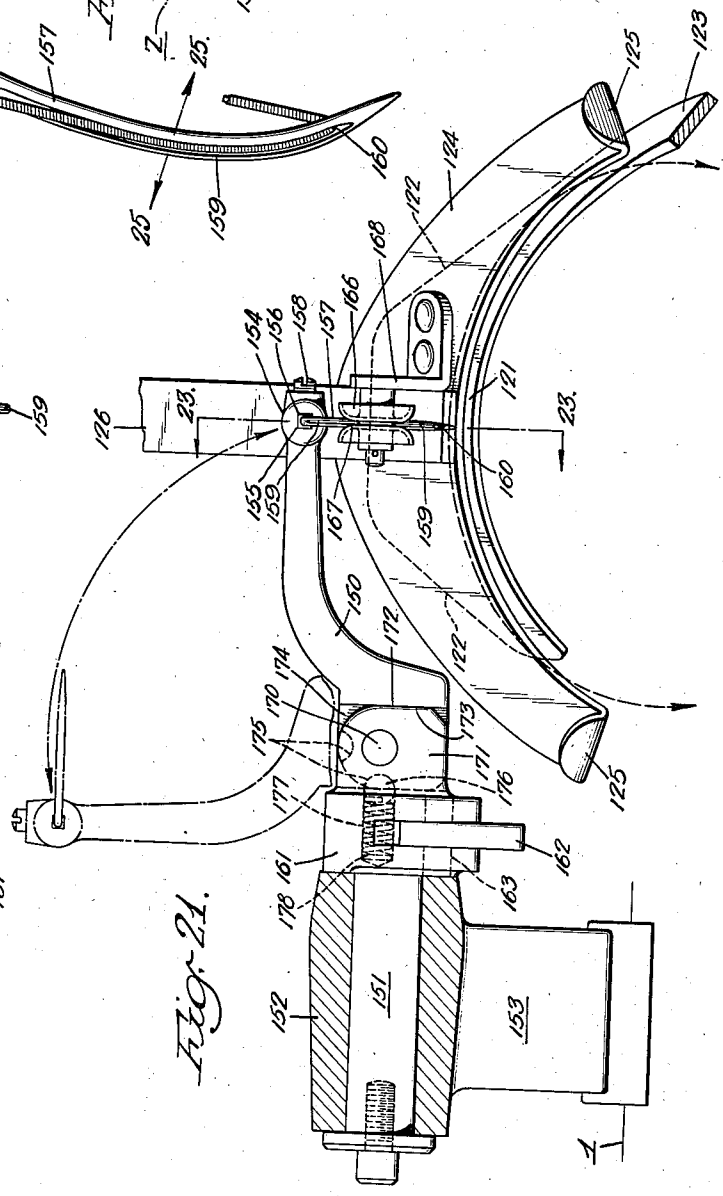


Fig. 21.

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Patented Nov. 25, 1941 2,264,234

UNITED STATES PATENT OFFICE

2,264,234

SEWING OR LOOPING MACHINE

Arthur R. Bell, Philadelphia, Pa., assignor of twenty-five per cent to Walter J. Horn and twenty-five per cent to Franklin S. Horn, both of Philadelphia, Pa., and twenty-five per cent to Albert J. Miller, Bala Cynwyd, Pa.

Application January 12, 1939, Serial No. 250,619

17 Claims. (Cl. 112—25)

This invention relates to sewing or looping machines. The primary object of the invention is to provide a machine which will successfully form a highly elastic thread, i. e. a thread consisting of or including a strand of cut or extruded rubber, into a row or chain of stitches to form a seam, hem, or edge in or on a suitable fabric, especially knitted or other inherently elastic fabrics, for the purpose of providing a degree of elasticity in the seam, hem, or edge which will be consistent with or in excess of the inherent elasticity of the fabric.

Prior to the present invention considerable difficulty has been experienced in automatically forming a row of stitches in a fabric with a rubber thread, for the reason that, as the sewing needle pierced and passed through the fabric and carried the thread with it, the friction developed between the thread and the fabric stretched the thread and held it so tightly against the side of the needle, during both the forward and return strokes of the needle, that the shuttle or loop forming hook of the sewing or looping machine could not pass between the needle and the thread to form the thread into a loop on the one face of the fabric to function as a basis for a new stitch.

One object of the invention is to provide a special form of needle for projecting the elastic stitching thread through the fabric in a manner to cooperate with an auxiliary element arranged to lift or pick the elastic thread away from one side of the needle and to hold the thread in the form of an open loop to be subsequently entered by the needle.

The machine also includes mechanism for holding the fabric in a more or less expanded or stretched condition during the stitch forming operation and mechanism for advancing the fabric holding means step by step to regulate the distance between the needle piercings, for forming the elastic stitching thread into a chain of interconnected stitches, in coordination with the operations of the needle and the picking element.

The machine also includes tensioning means for the elastic stitching thread, to maintain the stitching thread under a tension corresponding to the tension under which the fabric is maintained during the stitching operation; and means which will take up surplus thread drawn from a cone or other elastic thread supply by the needle and the picker during the formation of the loops through which the needle is projected, in order that all of the loops will be substantially of the same size and under substantially the same tension as that to which the fabric is subjected for and during the stitching operation.

In the accompanying drawings:

Fig. 1 is a plan view of the machine, partly in section, as taken on the line 1—1, Fig. 2;

Fig. 2 is a transverse sectional elevation taken on the line 2—2, Fig. 1;

Fig. 3 is a longitudinal front elevation;

Fig. 4 is an enlarged transverse sectional elevation taken on the line 4—4, Fig. 1;

Fig. 5 is sectional elevation taken on the line 5—5, Fig. 4;

Fig. 6 is a side view of a detail of the invention;

Fig. 7 is an enlarged detail view, partly in section, showing the needle and a cooperating fabric holder;

Fig. 8 is a view similar to Fig. 7, showing a modified form of needle;

Fig. 9 is a rear elevation of a detail of the invention;

Fig. 10 is a perspective view of the mechanism shown in Fig. 9;

Figs. 11 to 16 inclusive are diagrams illustrating the various steps in one cycle of operations during the formation of one of the stitches of the series or chain;

Fig. 17 is a transverse sectional elevation taken on the line 17—17, Fig. 1;

Fig. 18 is a sectional view taken on the line 18—18, Fig. 17;

Fig. 19 is a sectional view of a modified form of quill ring locking mechanism;

Fig. 20 is a view similar to Fig. 2 and shows a modified form of needle and needle operating mechanism.

Fig. 21 is a front elevation, partly in section, of the mechanism shown in Fig. 20;

Fig. 22 is a plan view of the needle and needle operating means shown in Figs. 20 and 21;

Fig. 23 is a sectional elevation taken on the line 23—23 Fig. 21 and showing the needle being projected through the fabric;

Fig. 24 is an enlarged perspective view of the needle shown in Figs. 20 to 23 inclusive; and

Fig. 25 is a transverse sectional view of the needle as taken on the line 25—25, Fig. 24.

As clearly shown in Figs. 1, 2 and 3, the machine forming the subject matter of the present invention comprises a main base plate 1, which is adapted to be mounted in a horizontal plane. The base plate 1 is provided with a pair of laterally spaced lugs 2, 2 to which are secured, by bolts or screws 3, the opposite ends 4, 4 of a fabric holder supporting bracket 5.

As clearly shown in Fig. 4, the bracket 5 is provided with a central bearing 6. Rotatably mounted in the bearing 6 is a sleeve 7. One end of the sleeve 7 is provided with an annular flange 8, which bears against one end of the bearing 6. The opposite end of the sleeve 7 is threaded, as indicated at 9, for the reception of a ratchet wheel 10. The ratchet wheel 10 is adapted to bear against the opposite end of the bearing 6 and together with the flange 8 prevent axial movement of the sleeve 7 in and relative to the bearing 6, while permitting relative rotation between said sleeve and said bearing. The ratchet wheel 10 is secured to the sleeve 7 against relative rotation therebetween by a lock screw 11.

The sleeve 7 is adapted to receive a tubular element 14, which forms part of one of a number of interchangeable fabric holders 15. The tubular element 14 is arranged to be readily removed from and replaced in the sleeve 7, and is secured to said sleeve against relative rotation by a locking pin 16, which is mounted in and projects outwardly from the flange 8 of the sleeve 7 into an opening 18 formed in an annular shoulder 13 formed on the tubular element 14, which bears against the outer annular face of the flange 8.

The tubular element 14 is provided with an outwardly flaring flange 19 for the reception of a ring 21. Screws 20 pass through openings formed in the ring 21 and are tapped into the tubular element 14 to secure the ring 21 thereto.

Between the ring 21 and the flange 19, the fabric holder 15 is provided with a multiplicity of radially and axially extending longitudinally grooved quills or points 22, each of which is fitted into a radial slot or groove 23 formed in the under face of the ring 21 which lies opposite the outwardly turned face of the flange 19. Each of the quills 22, as clearly shown in Fig. 4, bends outwardly, as indicated at 24, i. e. in a direction away from the body of the machine, axially of the tubular member 14, within the radial plane occupied by the quill.

Each quill 22 is pointed at its outer end, as indicated at 25, and the outwardly projecting portion 24 of each quill is grooved longitudinally along its radially outward face or side, as indicated at 26.

The inner end of each quill 22 is bent at a right angle to the main body portion of the quill, as indicated at 27. The foot or bent portion 27 of each quill fits into an opening 28 formed in the ring 21 and is held in place therein and with the main portion of each quill in its seating groove 23 in the ring 21 by the flange 19. The plain face of the flange 19 presses each of the quills firmly into the base of its receiving groove 23, whereby the quills are held rigidly in the fabric holder 15.

As shown in Figs. 4, 7 and 8, a fabric such as the upper end of a circular knit tube, which may constitute the upper end of an elastic surgical stocking is stretched radially and placed on the quills 22, each quill entering a stitch of one of the stitch wales of which the tubular fabric x is emplosed, there being one quill 22 in the holder 15 for each wale in the circumference of the tube x.

If the tube x is to have a hem composed of two ply of the knitted fabric formed on its upper end, the quills 22 are first projected through the wales of the fabric at a predetermined distance inwardly from the extreme end of the tube. The extreme end of the tube is then folded inwardly, as illustrated in Fig. 4, and again placed on the quills of the holder 15, the two plies of the hem y being illustrated at $y1$ and $y2$ in said figure. In each instance the quills are preferably projected through the stitches of one and the same course thereof, around the full circumference of the tube x. After the hem has been completed, the fabric x lying outwardly beyond the course of stitches of the ply $y2$ through which the quills 22 have been projected is raveled out, down to the course occupied by the quills.

In instances where no double ply hem is to be provided, a single ply of the fabric of the tube x is placed on the quills 22 along a course spaced inwardly from the extreme end of the tube and the fabric from the extreme end down to the course of stitches occupied by the quills is raveled out in the same manner as noted above.

The stitches through which the quills 22 pass are held open by the quills for the entrance of the needle 35 of the machine which enters the opened stitches through the grooves 26 formed in the quills 22. In entering the stitches successively, the needle 35 carries with it the elastic stitching thread z, which, as hereinbefore noted, may consist of a strand of bare or covered, cut or extruded rubber.

The needle 35 is secured in one end 36 of a curved arm 37. The arm 37 is pivotally mounted on a pin 38 which is secured in a boss 39 formed on the upper end of a bracket 40. The bracket 40 may be formed integral with or be suitably secured to the base plate 1. The arm 37 is provided with a divided hub 41. That portion of the hub 41 to which the arm 37 is attached lies at one side of the bracket 40 while the second portion of the hub lies at the opposite side of the bracket 40 and is connected to the first portion by a yoke portion 42. At the second side of the bracket 40, the hub 41 is provided with an arm 43. The arm 43 is pivotally connected, at 44, to one end of a link 45, the opposite end of which is secured to or formed integral with an eccentric strap or ring 46. The strap 46 encircles an eccentric 47 which is secured to a shaft 48. The shaft 48 is rotatably mounted in a pair of bearings 49 and 50. The bearings 49 and 50 are respectively disposed at opposite ends of the base plate 1, with which said bearings may be integrally formed, or to which said bearings may be secured in any suitable manner. The shaft 48 is provided with a crank 51 secured thereto by any suitable means such as a dowel pin 52, and by which the shaft 48 may be rotated to rotate the eccentric 47, through which the arm 37 is rocked about its pivot 38 causing the needle 35 to be withdrawn from one quill 22 and the stitches mounted thereon, and by which the needle 35 is caused to enter the next adjacent quill 22 after the holder 15 has been rotated to the extent of the spacing between said quills circumferentially of the holder 15.

There is one tooth in the ratchet wheel 10 for each quill 22, in the holder 15. Consequently, movement of the ratchet wheel 10 to the extent of one tooth causes one quill 22 to be moved out of the path of reciprocatory movement of the needle 35 and the next quill to be moved into the path of movement of the needle 35. Obviously while the needle is entering and leaving each quill the holder 15 remains in a fixed position.

The intermittent rotary movements of the

ratchet wheel 10 are effected by a pawl 53, which is pivotably mounted at 54 on one end of a lever 55. The lever 55 is pivotably mounted on a vertically extending stud 56 which is rigidly mounted in the base plate 1. A second arm 57 of the lever 55 is provided with a cam follower 58 which bears against a cam surface 59 formed on one side of a cam disc 60, which is secured to the shaft 48, adjacent the eccentric 47. A spring 61 having one end attached to the arm 57 of the lever 55 and its opposite end anchored to the bearing 49, in the present instance, maintains the cam follower 58 constantly in operative engagement with the cam surface 59, whereby, for each revolution of the shaft 48, the needle 35 is caused to enter and to be retracted from the stitch or stitches of the fabric x, mounted on one of the quills 22; and the holder 15 is rotated to the extent of one tooth of the ratchet wheel 10, to bring the next quill into line with the needle for a repeat of the cycle.

As the needle 35 enters each quill 22 and the knitted stitch or stitches mounted thereon, it carries with it the elastic thread z, with one portion $z1$ of the thread, which lies between the fabric and the eye 35a of the needle, disposed in close contact with the one side of the needle, while the portion $z2$ of the thread which extends from the eye 35a of the needle 35 back through the stitches mounted on the quill, is disposed in closed contact with the opposite side of the needle, as clearly shown in Fig. 7.

While the needle 35 is in its fully projected position the portion $z1$ of the elastic thread z is picked off and out of contact with the needle by a picker 70, which, as clearly shown in Figs. 11 to 16, is of a plain wedge shape and includes a point 71 which passes between the portion $z1$ of the elastic thread z and the adjacent face of the needle 35, through a cavity A which may be formed by cutting away the needle as indicated at 35b in Fig. 7 or by bending the needle as indicated at 35c in Fig. 8.

The wedged shaped picker 70 is formed on the outer end of a shank 73, said shank being adjustably mounted in a boss 74 formed on one end of a picker lever 75. The picker lever 75 is pivotably mounted at 76 on a hub or sleeve 77 which in turn is pivotably mounted on a stud 78 carried by and extended laterally from the bracket 40 at right angles to the axis of the pivot 76.

A second arm 79 of the picker lever 75 is provided with a pair of cam followers 80 and 81 which are disposed at right angles to each other. The cam follower 80 is rotatably mounted about a substantially horizontal axis and arranged to engage a cam surface 82 formed on the peripheral edge of a cam disc 83 which is secured to a shaft 48, while the cam follower 81 is arranged to engage a cam surface 85 formed on and projecting laterally from one side of the cam disc 83.

A spring 86, having one end connected to the picker lever 75 and its opposite end anchored to the bracket 40, maintains the cam followers 80 and 81 constantly in contact with the cam surfaces 82 and 85, whereby, for each revolution of the cam shaft 48, the picker 70 is caused to receive a compound movement by which it passes through the cycle of operations illustrated in Figs. 11 to 16, wherein the first of which illustrates the point 71 of the picker 70 entering the space A between the needle 35 and the portion $z1$ of the elastic thread z, after the needle has been projected through the fabric of the tube x in the manner heretofore described. Fig. 12 illustrates the picker 70 as having passed to the left of the needle and holding the portion $z1$ of the thread z as the needle 35 is retracted, whereby the portion $z1$ of the thread z is formed into a loop $z3$. Fig. 13 illustrates the picker 70 as having been retracted to the right of the path of the needle, while the fabric has correspondingly moved to present the next quill 22 to a position in line with the path of movement of the needle 35, the picker 70 still retaining the previously formed loop $z3$ thereon. Fig. 14 shows the picker 70 as having moved again to the left of the path of movement of the needle with the needle having progressed in its passage through the fabric and into the loop $z3$ which, as the picker 70 moves from the position shown in Fig. 13 to the position shown in Fig. 14, spreads the loop $z3$ open for the needle 35 to pass therethrough. Fig. 15 shows the needle as having passed a sufficient distance through the loop $z3$ to receive and hold the loop as the picker 70 again recedes to a position to the right of the needle, wherein the picker is withdrawn from the previously formed loop $z3$. Fig. 16 illustrates the needle 35 as having attained its innermost projected position with the previously formed loop $z3$ slipped upwardly on the needle by reason of its inherent elasticity, to a position above the cavity A with another portion of the thread z lying parallel to the needle and in contact with the upper face of the needle and crossing the cavity A, with the picker 70 in its fully retracted position and about to move again to the left for the point 71 thereof to enter the cavity A between the newly presented portion $z1$ of the thread z and the needle, to begin the formation of another of the interconnected chain of extraneous stitches $z4$.

The peculiar serpentine path followed by the picker 70 is affected by the compound movements of the lever 75 as produced by the cams 82 and 85 working against the cam followers 80 and 81 which are held in constant contact therewith by the spring 86.

From the above it will be clear that for each revolution of the cam shaft 48 one of the quills 22 of the holder 15 is presented in a position to be entered by the needle 35. The needle 35 goes through a complete cycle of its operations and the picker 70 follows through a complete cycle of its operations, as above noted, to produce one of the stitches of the chain $z4$ whereupon the holder 15 is advancing one step to bring the next quill in line with the needle 35 for a repeat of the cycle of operations just described. This continues until the needle 35 has entered each and every one of the quills 22 around the periphery of the holder 15.

Due to the fact that the stitching thread z is inherently elastic it is necessary to lap the end of the chain of stitches $z4$ to prevent pulling out of the elastic thread z from the fabric in which the chain of stitches has been formed.

Care must be taken to avoid the chain of stitches being of a length less than the circumference of the tube x, or any considerable length greater than the circumference of said tube, in order to avoid raveling out in the first instance or undue restriction of the elasticity of the chain in the other instance. For these reasons the machine is provided with an automatic means for effecting the overlapping of the ends of the

chains of stitches to a predetermined number of stitches sufficient to avoid raveling but not great enough to produce restriction. For this purpose the hub 87 of the crank 51 is provided with clutch teeth 88. The clutch teeth 88 are arranged to intermesh with clutch teeth 89 formed on a pulley 90, through which the shaft 48 may be rotated from any suitable source of power.

The pulley 90 is loosely mounted on the shaft 48, for movement axially thereof and relative thereto. The hub 91 of the pulley 90 is provided with an annular groove 92 into which projects a stud 93 which is carried on one arm 94 of a control lever 95. The control lever 95 is pivotably mounted on a vertically extending stud 96 which projects upwardly from and is rigidly mounted in the base plate 1. The control lever 95 is provided with a handle 98 by which said lever may be operated in one direction to effect engagement between the clutch teeth 89 on the pulley 90 and the clutch teeth 88 on the hub 87 of the crank 51.

When the shaft 48 has completed a predetermined number of revolutions, sufficient to produce overlapping of the ends of the chain *z*4, the control lever 95 is automatically operated to disengage the clutch teeth 89 from the clutch teeth 88, by a knockoff rod 99. The rod 99 is slidably mounted in bearings 100 and 101 formed on or carried by the base plate 1. One end of the knockoff rod 99 is arranged to engage the arm 97 of the control lever 95 while the opposite end is beveled, as indicated at 102 in Figs. 1 and 18, for engagement with a cam surface 103. The cam surface 103 is formed on a cam piece 104 which is adjustably mounted in a segmental slot 105 formed in a ratchet wheel 106.

The ratchet wheel 106 is rotatably mounted on a stud 107 carried by a bearing 101*a* which is supported by the base plate 1. The ratchet wheel 106 is adapted to be moved step by step by a pawl 108 which is pivotably mounted on one end of a lever 109, said lever in turn being pivotably mounted on the stud 107 which rotatably supports the ratchet wheel 106. Pivotably connected to the lever 109 at 110 is a link 111, the second end of which is mounted on a crank pin 112, which is adjustably mounted in a disk 113 secured to the end of the shaft 48.

There is a greater number of teeth in the ratchet wheel 106 than there is in the ratchet wheel 10, and the cam piece 104, by reason of its adjustability in the slot 105 in the ratchet wheel 106, may be set to trip the control lever 95 when the ratchet wheel 106 has advanced the same number of teeth as there are in the full circumference in the ratchet wheel 10, or at any desired point after the ratchet wheel 10 has made one complete revolution, whereby the extent of the overlap of the opposite ends of the chain of stitches *z*4 may be minutely controlled.

The beveled end 102 of the trip rod 99 is held in position to be engaged by the trip cam 103 by a collar 114 which is secured to the trip rod 99 and which is normally held in engagement with one end of the bearing 101 by a spring 115. The spring 115 encircles the rod 99 between one end of the bearing 100 and a second collar 116, which is secured to the trip rod 99.

In order to prevent the hem *y* from curling inwardly around the holder 15, in a position to interfere with the operation of the needle 35 and the picker 70, means are provided for holding the hem *y* radially outward in a position to provide clearance for the needle and the picker. In some instances, as shown in Figs. 1, 2 and 4 this means may consist merely of a pair of posts 117, 117 secured to and projecting outwardly from the bracket 5 at each side of the space in which the needle and picker operate and which merely support the edge of the hem in a position outwardly from the holder as the holder revolves.

As shown in Figs. 1, 2, 3 and 4 the axis about which the holder 15 revolves is preferably disposed at an angle relative to the horizontal, for convenience of the operator.

The elastic stitching thread *z* after passing through the eye 35*a* of the needle 35 passes to any suitable guide formed in or carried by the free end 36 of the arm 37, as hereinafter more specifically described, from which the thread passes directly through a slot 131 formed in a post 132 which is carried by and projects vertically from the bracket 40. The thread passes over a collar 133 which is slidably mounted on the post 132 and is constantly urged upwardly by a spring 134 which encircles the post 132 and is confined between the lower end of the collar 133 and the upper surface of the bracket 40, from which the post 132 projects.

After passing over the collar 133 the thread *z* passes through an eye 135 to an adjustable tensioning disc 136 of conventional sewing machine type. From the tensioning device 136 the thread *z*, passes through a second eye 137 to the cone 138 from which the thread *z* is intermittently drawn.

The device 136 provides the necessary tension on the thread *z* and may be regulated to apply just the correct amount of tension to said thread during the stitching operation as will cause the finished chain of stitches to have an amount of elasticity corresponding to the inherent elasticity of the fabric, in the direction of the line of said chain of stitches. The spring 134, always tending to raise the collar 133, tends to take up the surplus thread carried through the fabric and drawn by the picker to form the loop *z*3 after the needle and picker retract, but the spring does not exert any undue tension on the thread which would disrupt the critical tension as applied by the tensioning device 136.

In the structure shown in Figs. 20 to 23 inclusive, the long needle arm shown in Figs. 1 and 2 etc., and which is designated thereon by the numeral 37, is replaced by a short needle arm 150. The short needle arm 150 is provided with a pivot-pin, stud or trunnion 151 which is rotatably mounted in a boss or bearing 152. The bearing 152 is secured to or formed integral with a bracket 153. The bracket 153 is secured to the base plate 1.

The short needle arm 150 is provided on its outer end with a needle holding head 154. The needle head 154 is provided with an opening 155 adapted to receive the butt 156 of the needle 157. The butt end 156 of the needle 157 in the present instance is of rectangular cross section and the needle opening 155 is correspondingly shaped to prevent turning of the needle from its definitely fixed position in the head 154. The needle is held in the opening 155 in the head 154 by a set screw 158.

The major portion of the needle 157 is curved on an arc substantially concentric to the axis of the pivot 151 of the needle carrying arm 150, as clearly shown in Figs. 20 and 23. The outer curved face of the needle 157 is provided with a groove 159 which extends longitudinally of the needle from the eye 160 thereof to a point ad-

jacent the butt 156 of the needle, for reception of the stitching thread z.

The pivot element 151 of the needle arm 157 is provided with an operating lever 161, for the needle arm 150. The needle arm 150 is rocked about the axis of the pivot element 151 by a connecting link 162, one end of which is pivotally connected at 163 to the lever 161 while the opposite end is connected to or provided with an eccentric strap 164. The eccentric strap 164 corresponds to the eccentric strap 46 in that form of the device which is shown in Figs. 1 and 2, etc. The eccentric strap 164 encircles an eccentric 165 which corresponds to the needle operating eccentric 47 of the device shown in Figs. 1 and 2, etc.

The eccentric 165, like the eccentric 47, is secured to the main shaft 48 of the machine, so that for each rotation of said shaft the needle 157 will be moved from its normal inoperative position shown in Fig. 20 to its thread projecting position shown in Fig. 23 and returned to its inoperative position shown in Fig. 20. During each oscillation of the needle 157 the operation of the picker 70 is the same as heretofore described during each reciprocation of the needle 35.

The needle 157, being bent on a relatively short radius, provides a relatively large gap A1 between the one side of the needle and the portion z1 of the stitching thread which projects from the eye 160 of the needle to the stitch or other opening in the fabric through which the needle 157 has been projected. The larger opening A1 provides greater space for the picker 70 to enter and permits the machine to be operated at relatively high speeds.

The operation of the machine at high speeds is facilitated further by the short length of the needle arm 150 and the short radius on which the needle 157 swings. The fore-shortening of the needle arm and the curvature of the needle on a correspondingly short radius eliminates lateral vibration which may occur in the long arm 37 previously described and which, if operated at high speed, may tend to effect mis-alignment of the needle with the grooves of the quills of the fabric holder, whereas, when using the short needle arm 150, the point of the needle, when withdrawn from the fabric, lies relatively close to the quills and insures alignment of the needle with each quill successively, when the machine is operated at high speed.

The groove 159 formed in the outer curved face of the needle 157 holds that portion of the stitching thread z which extends from the eye 160 of the needle to the thread supply, from slipping laterally off the needle to a position where it would be caught by the picker 70 at the time said picker operates through the space A1 to pick up the portion z1 of said stitching thread.

In order to insure the stitching thread z remaining in the groove of the needle, or being replaced in the groove of the needle should the thread for any reason, be displaced from the groove, said thread is controlled by a guide 166 having a deep groove 167 formed therein for reception of the stitching thread z and the plane of the groove 167 is maintained in a position coincident with the plane of the groove 159 in the needle 157.

The guide 166, during operation of the machine, remains in a fixed position and for that purpose is carried by a bracket 168 which is secured to a fabric presser plate 124.

In this instance the hem y is held in the position clear of the needle and the picker by means of a shoe 120 which is provided with a flat portion 121 arranged to extend circumferentially of the holder 15 throughout the area traversed by the picker 70, said shoe having ears 122, 122 at the opposite ends of the plate portion 121 which engage and curl the hem y outwardly as the holder 15 revolves. The shoe 120 is provided with an arm 123 which is secured to the bracket 5 to prevent movement of said shoe.

The fabric is held in flat contact with the portion 121 of the shoe 120 by a flat yoke shaped plate 124 having outwardly flaring ends 125 arranged to bear against one side of the hem, to prevent collapse of the fabric around the outer ends of the quills 22 into the path of the needle 35. The pressure plate 124 is carried on one end of an arm 126 which is pivotably connected at 127 to the bracket 40, said pressure plate being held in firm contact with the fabric, to more or less grip the fabric between the shoe 121 and the plate 124, by a spring 128 shown in Fig. 20.

When it becomes necessary to change fabric holders 15, after the completion of the stitching of the fabric carried by the holder 15 which is in the machine, the presser plate 124 is swung upwardly and carries the guide 166 with it, the stitching threads z at such time passing from the eye 160 of the needle to and around the guide 166, thence to the thread supply.

It is also necessary under the circumstances to swing the needle carrying arm 150 out of its normal operating position, to permit interchanging of the fabric holders 15, and for this purpose the needle arm 150 is pivoted at 170 to and between a pair of ears 171, 171 which are formed on the head 161 of the pivot stud 151. The lever 150 is provided with a pair of shoulders 172, 172 which normally bear against flat surfaces 173, 173 formed on the outer ends of the ears 171, 171 respectively. A lug 174 formed on the lever 150 and which extends between the ears 171, 171 and therewith forms the hinge for said lever, is provided with a pair of indentations 175, 175. The indentations 175, 175 are adapted to receive a spring pressed ball or plunger 176 which is mounted in a recess 177 formed in the head 161. In the recess 177 is also mounted a spring 178 which resiliently forces the retaining element 176 into one or the other of the indentations 175 formed in the lug 174 of the needle lever 150, whereby the needle arm 150 will be retained in either its full-line operating position, shown in Fig. 21, or in its broken-line inoperative position, shown in said figure.

The remainder of the elements making up the machine employing the short needle arm construction shown in Figs. 20 to 23 inclusive are substantially the same as the corresponding parts of the machine shown in Figs. 1, 2 etc. The adaptation of the short needle arm construction to the machine requires nothing more than a shifting of the needle operating eccentric to a position on the shaft 48 adjacent the bearing 49, it being understood that the bearing 152 for the pivot 151 of the short needle arm 150 and the operating lever 161 for said short needle lever occupy positions on the bed plate adjacent that end thereof at which the bearing 49 is located.

Prior to the present invention it has been mechanically impossible and commercially impractical to stitch a fabric with a highly elastic thread.

It has been impossible to stitch with rubber in a sewing or looping machine for the reason

that the rubber thread, when carried through the fabric by the eye of the needle, is frictionally retarded by the fabric at the point of penetration as the needle passes through the fabric. This causes the thread to stretch between the eye of the needle and the point of penetration of the fabric and the increased tension produced in the thread by this stretching causes the thread to hug closely to the opposite sides of the needle during both the forward and backward strokes of longitudinal reciprocation of the needle, therefore it has been impossible for the point of a shuttle or a loop former to enter between the needle and the elastic thread to pick the thread off the needle for effecting locking of the thread on the one face of the fabric to produce the required series of extraneous stitches by which the suture or edge is formed. In the present case the necessary space A or A1 is provided between the elastic thread *z* and one side of the needle as clearly shown in Figs. 7, 8 and 23 respectively.

It has been commercially impractical to stitch with rubber by hand sewing because of the time and labor required. Furthermore, hand sewn seams cannot be uniformly produced. In the case of rubber bearing fabrics, such as surgical stockings, bandages, etc. the pull of the rubber in the knitted fabric makes it extremely difficult to maintain the fabric manually in a spread condition, as required in hand sewing, and the production of a single operator for a working day is therefore extremely low.

In order to prevent overtravel of the holder **15** when moved intermittently by the pawl **53**, through the ratchet wheel **10**, a brake **180** is provided and bears resiliently against the rear face **181** of the ratchet wheel **10**, as shown in Figs. 4 and 6. The brake pad **180** is secured to one end of a resilient arm **182**, the opposite end of which is secured, by a screw **183**, to the bracket **5**.

Normally the holder **15** can be readily removed from the rotating sleeve **7**, for placing another holder **15** therein, it being understood that the tubes *x* may be placed on the quills of the holders **15** at places remote to the sewing or looping machine by one or more assistant operators to eliminate the necessity of the machine standing idle while a new tube *x* is being placed on the quills. The pin or key **16** carried by the sleeve **7** and entering any one of a number of indexing holes **18** in the holders **15** indexes the quills of the holder with the needle and causes the holder to rotate with the sleeve **7**.

In order to prevent accidental axial movement of the holder **15** relative to the sleeve **7** during the stitching operation, locking means such as shown in Figs. 9, and 10 or 19 may be used.

If the structure shown in Fig. 19 is used the rigid indexing pin **16** may be replaced by a movable indexing pin **16***a* which instead of extending axially of the sleeve **14** may extend radially and be slidably mounted in a bearing **17***a* formed in the flange **8** and sleeve **7** to enter any one of a number of index openings **18***a* drilled radially instead of axially in the tubular portion **14** of the holder **15**. In this case the pin **16***a* serves both as an indexing means and a means for locking the holder **15** to the rotary sleeve **7**.

If the structure shown in Figs. 9 and 10 is used, the index pin **16** and index openings **18** are employed to key the holder to the rotary sleeve for concurrent rotation therewith and relative axial movement is prevented by a pair of latches **185**, **185** pivotally mounted on the rear face of the bracket **5**, as at **186**, each latch having its tip **187** arranged to enter a circumferential groove **188** formed in the rear end of the tubular member **14** of the holder **15**.

Each latch **185** is provided with an operating lever **189**, said levers being connected together by a link **190**, so that rocking of one latch into or out of its locking or releasing positions shown in Fig. 9 will cause similar movement of the other of said latches.

The latches **185**, **185** are automatically moved into and out of locking position by a link **191** connecting the link **190** with the starting and stopping handle **98** of the machine so that when the clutch element **89** is released from the clutch element **88** the holder **15** is automatically released from the sleeve **7** and can be readily removed therefrom.

A new holder **15** with a new tube *x* thereon can then be placed in and indexed with the sleeve **7** and when the handle **98** is operated to start the machine the latches **185**, **185** will be automatically thrown into position to lock the holder **15** to the sleeve **7**.

The axis of the holder **15** is placed on an angle with respect to the horizontal for several reasons in addition to this position being more convenient for the operator, for example by so doing the quill portions **24** may be disposed substantially parallel to the axis of the holder **15** to avoid excessive stretching of the fabric of the tube *x* when being placed on and removed from the quills. Furthermore, the inclination of the axis of the holder throws the quill which is aligned with the needle into a position where the arc of sweep of the needle and the longitudinal axis of the groove in the projecting portion **24** of the quill are substantially coincident, whereby the needle will move into and out of the opened stitches of the fabric disposed on the quill without rubbing or straining the stitches.

In order to effect accurate alignment between the needle and the quills the needle **35** is adjustably mounted in a needle holder **195** as shown in Figs. 4 and 5. The needle holder **195** is adjustably mounted in the free end **36** of the sweep arm **37**.

The holder **195** comprises a longitudinally split head **196** having a small bore **197** for reception of the shank of the needle **35** and an axially aligned larger bore **198** threaded for the reception of a backing screw **199** against which the butt of the needle bears. A clamping screw **200** passing through one ear and threaded into another ear **201** which project from the head **196** is employed to effect clamping of the needle shank in the head of the needle holder.

The needle holder **195** is provided with a stud **202** which is adjustably mounted in a collar **203** and held thereon by a set screw **204**. The collar **203** is provided with a stud **205** which is mounted in an opening **206** formed in the free end **36** of the sweep arm **37**, a set screw **207** being provided to lock the stud **205** in its adjusted position.

With this means accurate alignment of the path of movement of the needle with the groove of each quill coming into stitching position may be attained.

As shown in Fig. 4, the tubular fabric *x* extends loosely through the open center of the tubular portion **14** of the fabric holder **15** with one end of the fabric tube hanging freely between the bracket **5** and the outer edge of the base plate **1**. A portion adjacent the opposite end of the fabric tube *x* is stretched radially and circumferentially

around the flange 19 and ring 21 of the holder 15 which are of larger diameter than the neck portion of the holder 15 lying directly behind the flange 19. The tube x then bends backwardly around the flange 19 and normally contracts into contact with the reduced neck portion of the holder 15 adjacent the flange 19. The fabric guide posts 117, 117 project outwardly from the bracket 5 over the reduced neck of the holder and the tube x is lifted from the upper part of the reduced neck and placed over the posts 117, 117 to provide working space for the fabric penetrating end of the needle 35 and the end of the picker 79 which cooperates therewith to form the chain stitches of the elastic stitching thread.

In order to hold the stitching thread z in alignment with the needle 35, as shown in Figs. 4 and 5, the needle holder is drilled, as indicated at 208, in a manner to produce a guide eye for the thread directly below and in the vertical plane of the needle.

I claim:

1. A machine for stitching a fabric with a highly elastic thread composed at least in part of a strand of rubber, said machine comprising means for holding said fabric in a stretched condition, a substantially axially reciprocable needle adapted to penetrate said fabric and having an eye adjacent its fabric penetrating end through which said elastic thread passes, said needle being formed with a concavity along one of its sides rearwardly of said eye to provide a space between said side of said needle and a portion of the elastic thread normally extending in a straight line and under tension from said eye to the point of penetration of the fabric, means operated in one direction in coordination with said needle to enter said space and flex said elastic thread from said straight line to form said thread into a stitch loop on one face of the fabric, means for intermittently advancing said fabric holding means transversely to the path of reciprocation of said needle during a predetermined portion of each cycle of reciprocation of said needle and while said elastic thread is held by said flexing means, and means for operating said flexing means in a reverse direction while holding said loop to carry said loop across the path of said needle into a position to be entered by the needle on a subsequent fabric penetrating stroke of reciprocation thereof.

2. A machine for stitching a fabric with a highly elastic thread composed at least in part of a strand of rubber, said machine comprising means for holding said fabric in a stretched condition, a substantially axially reciprocable needle adapted to penetrate said fabric and having an eye adjacent its fabric penetrating end through which said elastic thread passes, said needle being formed with a concavity along one of its sides rearwardly of said eye to provide a space between said side of said needle and a portion of the elastic thread normally extending in a straight line and under tension from said eye to the point of penetration of the fabric, means operated in one direction in coordination with said needle to enter said space and flex said elastic thread from said straight line to form said thread into a stitch loop on one face of the fabric, means for intermittently advancing said fabric holding means transversely to the path of reciprocation of said needle during a predetermined portion of each cycle of reciprocation of said needle and while said elastic thread is held by said flexing means, means for operating said flexing means in a reverse direction to carry the loop of the elastic thread held thereby across the path of said needle for entrance by the needle on the next fabric penetrating stroke of reciprocation thereof, and means for retracting said flexing means subsequent to the entrance of the needle into the held loop to transfer said loop from said flexing means to the projected end of the needle around the straight line portion of the elastic thread extending from the eye of the needle to the point of penetration of the fabric.

3. A machine for stitching an elastic tubular fabric with a highly elastic thread comprising a rotary element having a circumference in excess of the normal circumference of said fabric but of a size to permit the tube to completely encircle said element on the exterior thereof, a multiplicity of longitudinally grooved quills spaced apart at predetermined angles circumferentially of said element for passage through said fabric to hold said fabric in a radially and circumferentially stretched condition, a needle operable in the grooves of said quills and through the fabric impaled thereon from one side of the fabric, means arranged at the opposite side of the fabric and operated in coordination with said needle to form said thread into a chain of stitches passing through the fabric, means for intermittently rotating said element for successively advancing said quills relative to said needle and said coordinated means, and means adjacent the exterior of said rotary element to intercept the fabric adjacent said needle and said cooperating stitch forming means to move the fabric away from said rotary element and provide working clearance adjacent said quills for said needle and said cooperating stitch forming means.

4. A machine for stitching an elastic tubular fabric with a highly elastic thread comprising a rigid framework, a rotary element journaled in said framework and having a circumference in excess of the normal circumference of said fabric but of a size to permit the tube to completely encircle said element on the exterior thereof, a multiplicity of longitudinally grooved quills spaced apart at predetermined angles circumferentially of said element for passage through said fabric to hold said fabric in a radially and circumferentially stretched condition, a needle operable in the grooves of said quills and through the fabric impaled thereon from one side of the fabric, means arranged at the opposite side of the fabric and operated in coordination with said needle to form said thread into a chain of stitches passing through the fabric, means for intermittently rotating said element for successively advancing said quills relative to said needle and said coordinated means, and a post carried by and extending outwardly from said framework over said rotary element at each of the opposite sides of the path of movement of said needle and adapted to intercept and move the fabric away from said rotary element adjacent said needle and said cooperating stitch forming means and to support a portion of said fabric between said posts in spaced relation to said rotary element during the intermittent rotations thereof to provide working clearance adjacent said quills for said needle and said coordinated means.

5. A machine for stitching an elastic tubular fabric with a highly elastic thread comprising a rotary element having a circumference in excess of the normal circumference of said fabric tube but of a size to permit the tube to complete en-

circle said element on the exterior thereof, a multiplicity of longitudinally grooved quills spaced apart at predetermined angles circumferentially of said element for passage through said fabric to hold said fabric in a radially and circumferentially stretched condition, a needle operable in the grooves of said quills, means operated in coordiation with said needle to form said thread into a chain of stitches passing through the fabric, means for intermittently rotating said element for successively advancing said quills relative to said needle and said coordinated means, and a plate disposed in a plane substantially at right angles to the axis of said holder adjacent the path of movement of said quills and against which said fabric bears adjacent said needle and said coordinated means to provide working clearance for said needle and said cooperating stitch forming means adjacent said quills.

6. A machine for stitching an elastic tubular fabric with a highly elastic thread comprising a rotary element having a circumference in excess of the normal circumference of said fabric tube, a multiplicity of longitudinally grooved quills spaced apart at predetermined angles circumferentially of said element for passage through said fabric to hold said fabric in a radially and circumferentially stretched condition, a needle operable in the grooves of said quills, means operated in coordination with said needle to form said thread into a chain of stitches passing through the fabric, means for intermittently rotating said element for successively advancing said fabric holding quills relative to said needle and said coordinated means, and guiding means comprising a plate having a main portion disposed in a plane substantially at right angles to the axis of said holder and against which said fabric bears adjacent said needle and said coordinated means, the ends of said plate curving away from said plane of said main portion of said plate to guide said fabric onto the main right angle portion thereof for guiding a portion of the fabric past the point of cooperation between the needle and said coordinated stitch forming means to provide working clearance for said needle and said cooperating stitch forming means.

7. A machine for stitching an elastic tubular fabric with a highly elastic thread comprising a rotary element having a circumference in excess of the normal circumference of said fabric tube, a multiplicity of longitudinally grooved quills spaced apart at predetermined angles circumferentially of said element for passage through said fabric to hold said fabric in a radially and circumferentially stretched condition, a needle operable in the grooves of said quills, means operated in coordination with said needle to form said thread into a chain of stitches passing through the fabric, means for intermittently rotating said element for successively advancing said quills relative to said needle and said coordinated means, means for guiding a portion of the fabric past the point of cooperation between the needle and said coordinated stitch forming means to provide working clearance for said needle and said cooperating stitch forming means comprising a plate disposed in a plane substantially at right angles to the axis of said holder and against which said fabric portion bears, and a second plate disposed substantially parallel to the first said plate and adapted to hold the fabric in flat contact with said first plate.

8. A machine for circumferentially stitching a tubular fabric, comprising a normally horizontally disposed bed plate, a tubular holder through which said fabric may extend, a diametrically enlarged end on said holder around which said fabric is diametrically and circumferentially stretched, longitudinally grooved quills projecting outwardly from said enlarged end of said holder through said fabric, a needle operable in the grooves of said quills, means cooperating with said needle for forming a chain of stitches circumferentially of said fabric, means projecting outwardly from one edge of said bed plate for rotatably supporting said holder with the axis of the holder disposed at an incline with respect to the plane of said base plate, and means for intermittently rotating said holder to bring said quills successively into alignment with said needle.

9. A machine for circumferentially stitching a tubular fabric, comprising a normally horizontally disposed bed plate, a tubular holder through which said fabric may extend, a diametrically enlarged end on said holder around which said fabric is diametrically and circumferentially stretched, longitudinally grooved quills projecting outwardly from said enlarged end of said holder through said fabric, a needle operable in the grooves of said quills, means cooperating with said needle for forming a chain of stitches circumferentially of said fabric, means projecting outwardly from one edge of said bed plate for rotatably supporting said holder with the axis of the holder disposed at an incline with respect to the plane of said base plate, a needle supporting arm pivotally mounted on said base plate inwardly from said edge thereof and causing the needle to swing through an arc substantially coinciding with the groove in one of said quills, and means for intermittently rotating said holder to bring said quills successively into alignment with said needle.

10. In a machine for circumferentially stitching a tubular fabric, a bearing, a rotary element in said bearing, means for preventing relative axial movement between said rotary element and said bearing, a readily removable fabric holder carried by said rotary element, means for preventing relative rotary movement between said holder and said rotary element, readily releasable means for preventing relative axial movement between said rotary element and said holder, means for intermittently rotating said rotary element and said holder, means for driving said intermittent rotating means, means for controlling said driving means, and means operable by said controlling means for releasing said holder from said rotary element to permit removal thereof.

11. In a machine for circumferentially stitching a tubular fabric, a tubular holder through the interior of which said fabric extends, an annular diametrical enlargement on one end of said holder around which said fabric is radially and circumferentially stretched, said holder having an outer diametrically reduced neck adjacent said annular enlargement adapted to be engaged by a relatively contracted portion of the tubular fabric, longitudinally grooved quills projecting from said annular enlargement through the fabric stretched thereby, a needle operable in the grooves of said quills, means for intermittently rotating said holder to bring said quills successively into alignment with said needle, and stationary posts at opposite sides respectively of said needle and projecting over said neck and lifting said fabric from said neck to provide work-

ing clearance for said needle adjacent said quills.

12. A machine for stitching a fabric with a highly elastic thread composed at least in part of a strand of rubber, comprising a longitudinally curved needle providing an inner longitudinally concaved side and an outer longitudinally convexed side thereon and having a pointed fabric penetrating end and an eye adjacent said pointed end through which said elastic thread passes, a relatively short rocker arm supporting said needle adjacent the opposite end thereof, the curvature of said needle being substantially concentric to the pivotal axis of said rocker arm to provide a space between said concaved side of said needle and a portion of the elastic thread normally extending in a straight line under tension from said eye to the point of penetration of the fabric by said needle and said elastic thread and having the convexed side provided with a thread receiving groove extending substantially from said eye along said needle to a point beyond the point of greatest penetration of the fabric, means located outside the path of movement of said arm in alignment with said groove for guiding said thread into said needle groove beyond said fabric, means for rocking said arm to effect penetration of the fabric by said needle, and means arranged and operated in coordination with said needle to enter said space and form said thread into a stitch loop on one face of the fabric.

13. A machine for stitching a fabric with a highly elastic thread composed at least in part of a strand of rubber, comprising a longitudinally curved needle having a pointed fabric penetrating end and an eye adjacent said pointed end through which said elastic thread passes, a relatively short rocker arm supporting said needle adjacent the opposite end thereof, the curvature of said needle being substantially concentric to the pivotal axis of said rocker arm to provide a space between said needle and a portion of the elastic thread normally extending in a straight line under tension from said eye to the point of penetration of the fabric by said needle and said elastic thread, means for rocking said arm to effect penetration of the fabric by said needle, means arranged and operated in coordination with said needle to enter said space and form said thread into a stitch loop on one face of the fabric, said rocker arm including a pivotal section and a needle carrying section pivotally connected together on an axis extending transversely to the pivotal axis of said rocker arm as a whole.

14. A machine for stitching a fabric with a highly elastic thread composed at least in part of a strand of rubber, comprising a longitudinally curved needle having a pointed fabric penetrating end and an eye adjacent said pointed end through which said elastic thread passes, a relatively short rocker arm supporting said needle adjacent the opposite end thereof, the curvature of said needle being substantially concentric to the pivotal axis of said rocker arm to provide a space between said needle and a portion of the elastic thread normally extending in a straight line under tension from said eye to the point of penetration of the fabric by said needle and said elastic thread, means for rocking said arm to effect penetration of the fabric by said needle, means arranged and operated in coordination with said needle to enter said space and form said thread into a stitch loop on one face of the fabric, said rocker arm including a pivotal section and a needle carrying section pivotally connected together on an axis extending transversely to the pivotal axis of said rocker arm as a whole, and means for retaining said needle carrying section in either of two positions relative to said pivotal section.

15. A machine for stitching a fabric with a highly elastic thread composed at least in part of a strand of rubber, comprising a longitudinally curved needle providing an inner longitudinally concaved side and an outer longitudinally convexed side thereon and having a pointed fabric penetrating end and an eye adjacent said pointed end through which said elastic thread passes, a relatively short rocker arm supporting said needle, the curvature of said needle being substantially concentric to the pivotal axis of said rocker arm to provide a space between said concaved side of said needle and a portion of the elastic thread normally extending in a straight line under tension from said eye to the point of penetration of the fabric by said needle and said elastic thread, said needle having the convexed side provided with a thread receiving groove extending substantially from said eye along said needle to a point beyond the point of greatest penetration of the fabric, means for guiding said thread into said needle groove beyond said fabric, and means for supporting said guide in either an operative position or in an inoperative position in a plane coincident with the plane of said needle groove.

16. In a sewing or looping machine, the combination of a needle, an oscillating arm carrying the needle in the free end thereof, a needle holder slidably and rotatably adjustably mounted in said free end of said arm, and means for adjustably securing one end of said needle in said needle holder including an abutment screw axially aligned with the needle.

17. In a sewing or looping machine, the combination of a needle, an oscillating arm carrying the needle in the free end thereof, a needle holder slidably and rotatably adjustably mounted in said free end of said arm, means for adjustably securing one end of said needle in said needle holder including an abutment screw axially aligned with the needle, and thread guiding means in said needle holder adjacent the secured end of the needle.

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