Nov. 13, 1962 S. J. KETTERER ET AL 3,063,392

STITCH-FORMING MECHANISM FOR LOCK STITCH SEWING MACHINES

Filed March 18, 1960 6 Sheets-Sheet 1

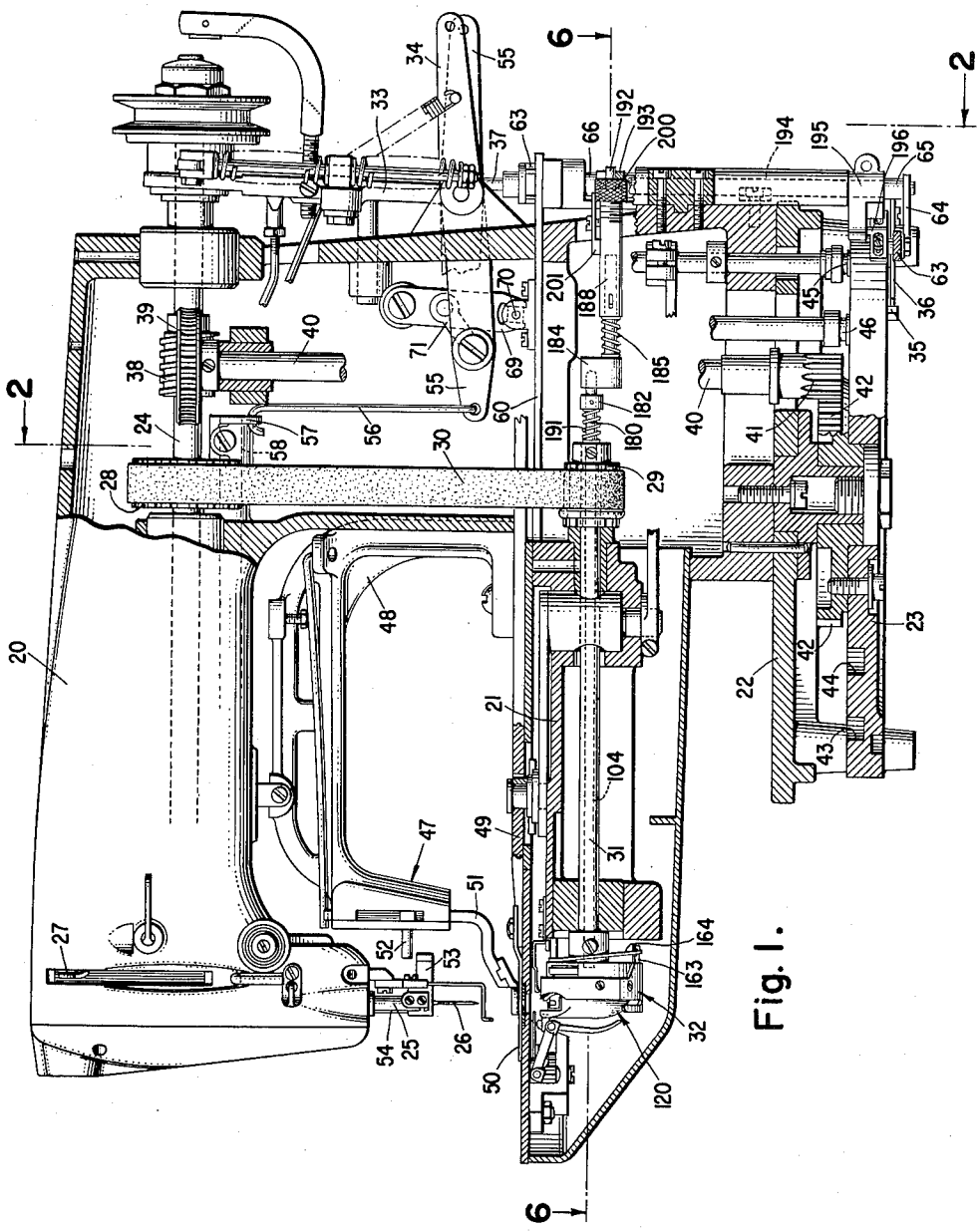


Fig. 1.

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STITCH-FORMING MECHANISM FOR LOCK STITCH SEWING MACHINES

Filed March 18, 1960 6 Sheets-Sheet 2

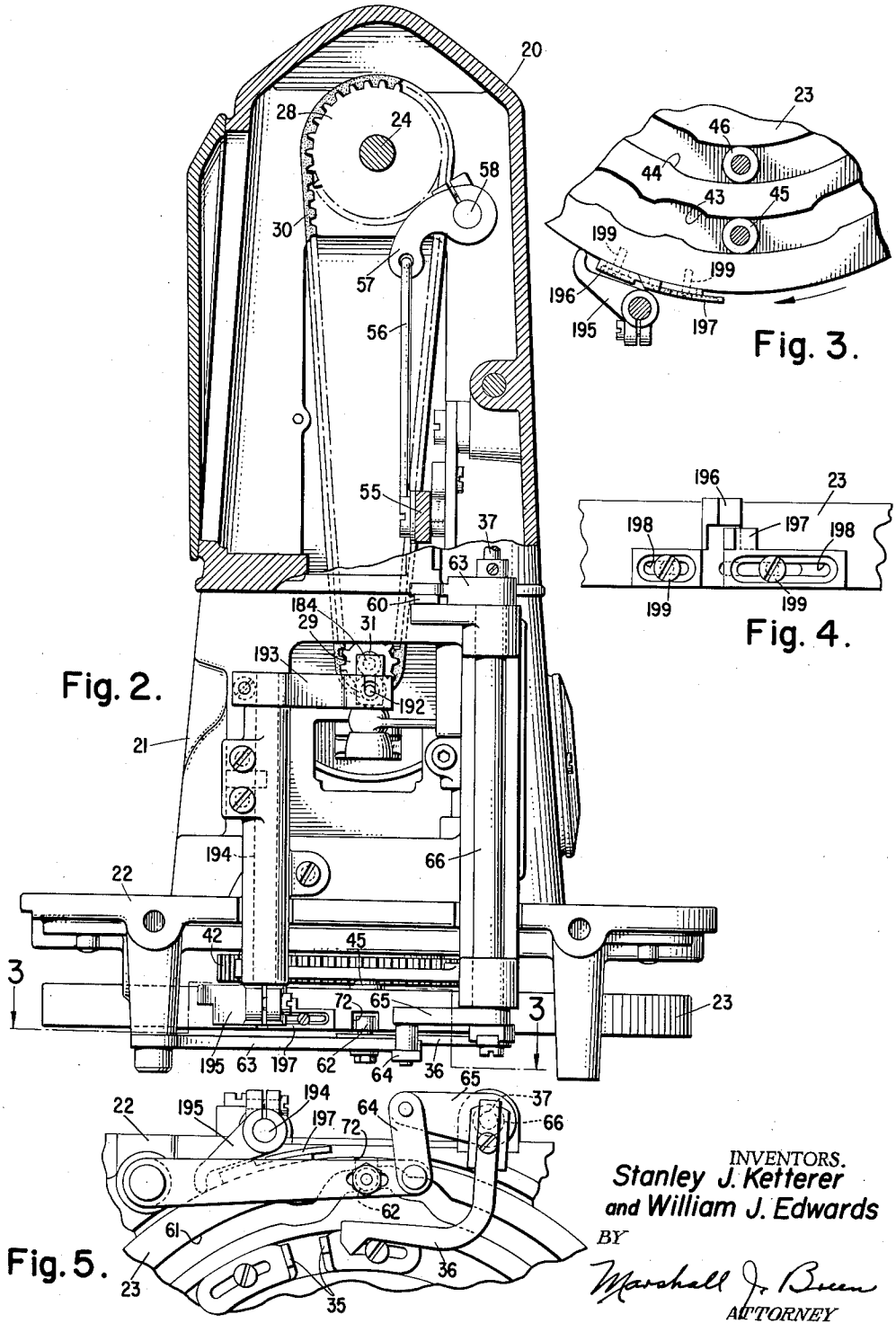


Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

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STITCH-FORMING MECHANISM FOR LOCK STITCH SEWING MACHINES

Filed March 18, 1960 6 Sheets-Sheet 3

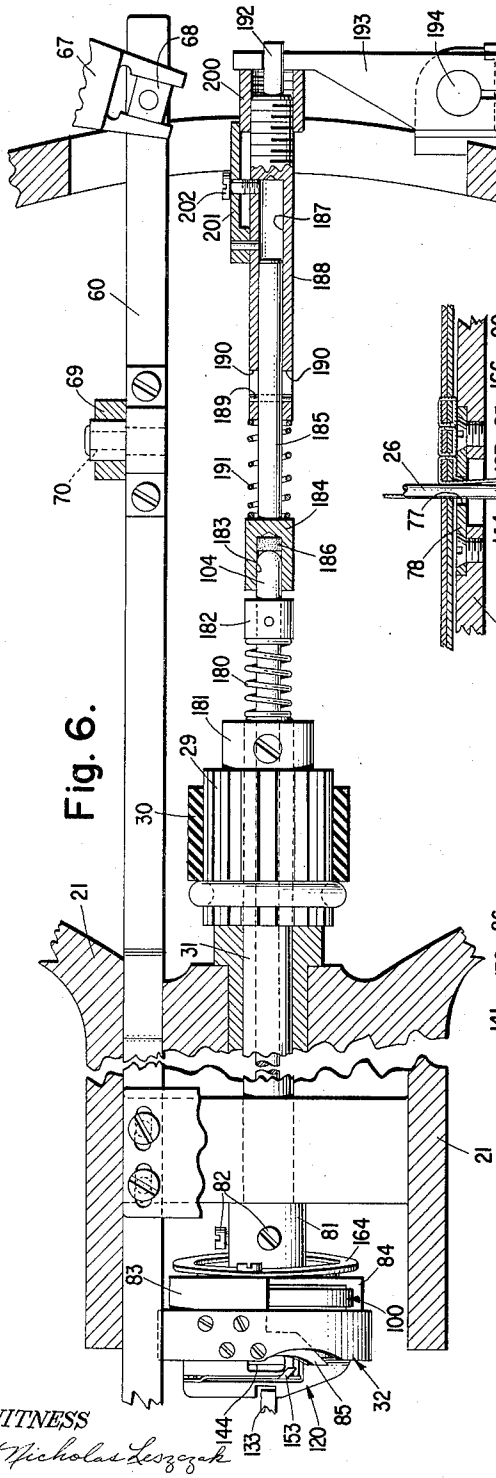


Fig. 6.

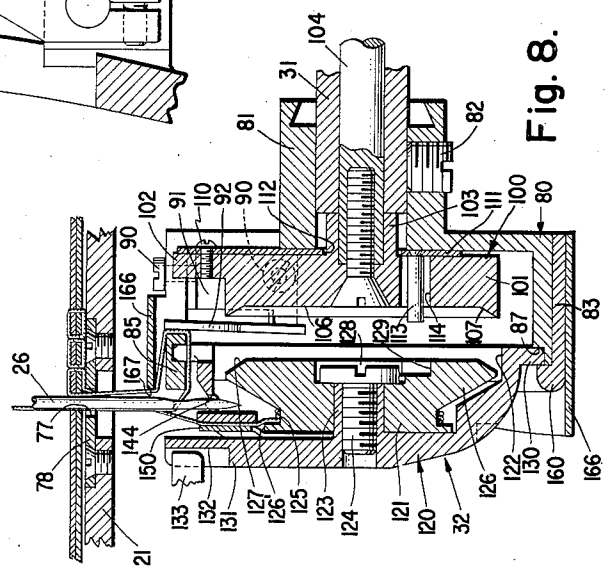


Fig. 8.

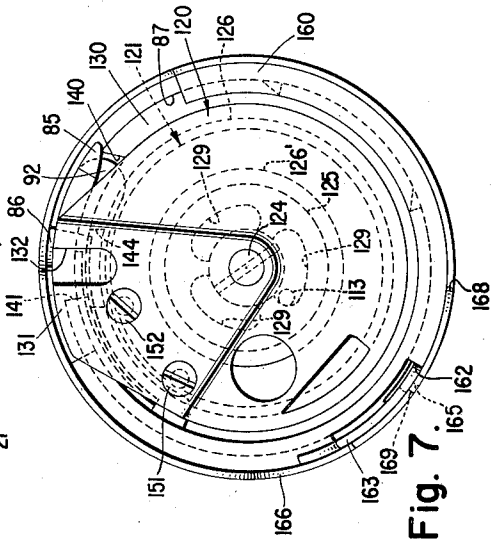


Fig. 7.

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STITCH-FORMING MECHANISM FOR LOCK STITCH SEWING MACHINES

Filed March 18, 1960 6 Sheets-Sheet 4

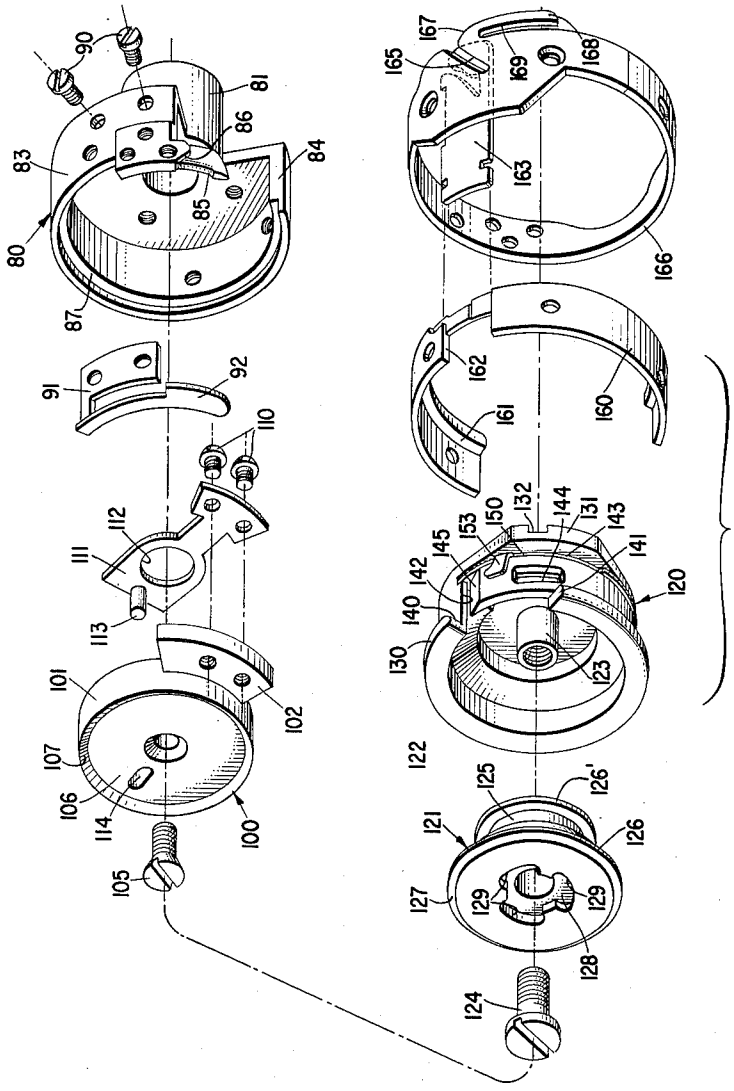


Fig. 9.

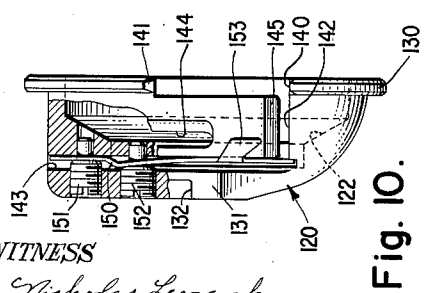


Fig. 10.

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STITCH-FORMING MECHANISM FOR LOCK STITCH SEWING MACHINES

Filed March 18, 1960 6 Sheets-Sheet 5

Fig. 11.

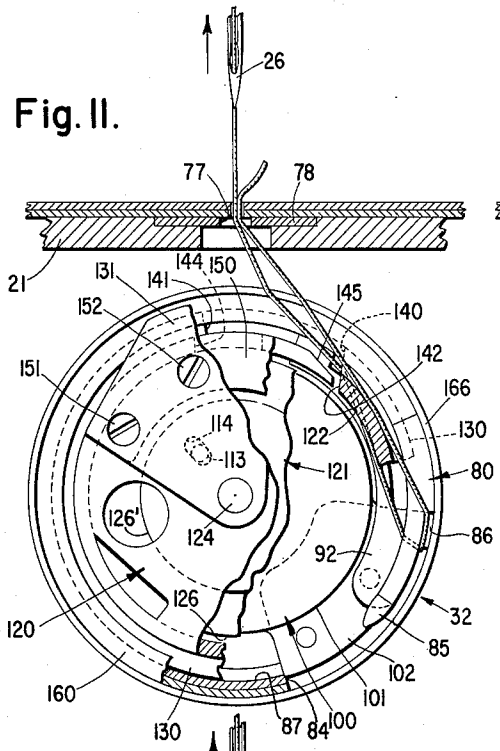


Fig. 11A.

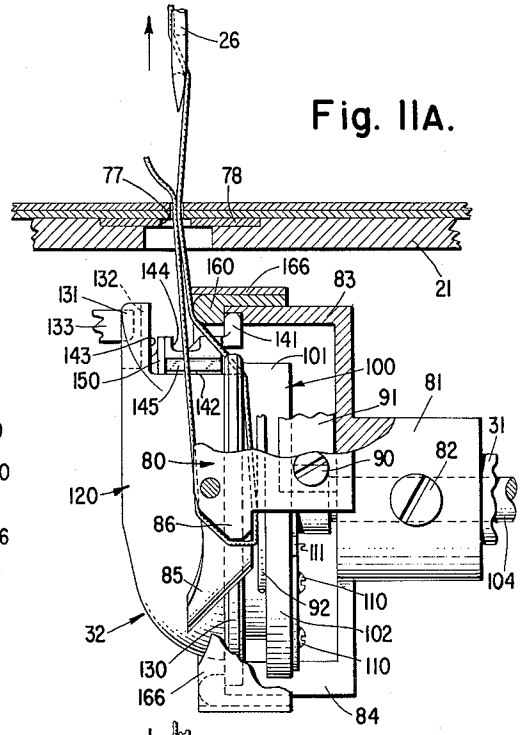


Fig. 12.

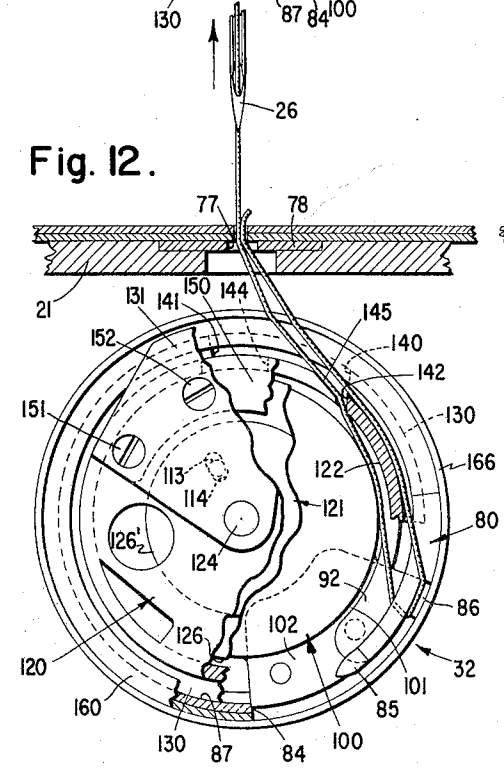
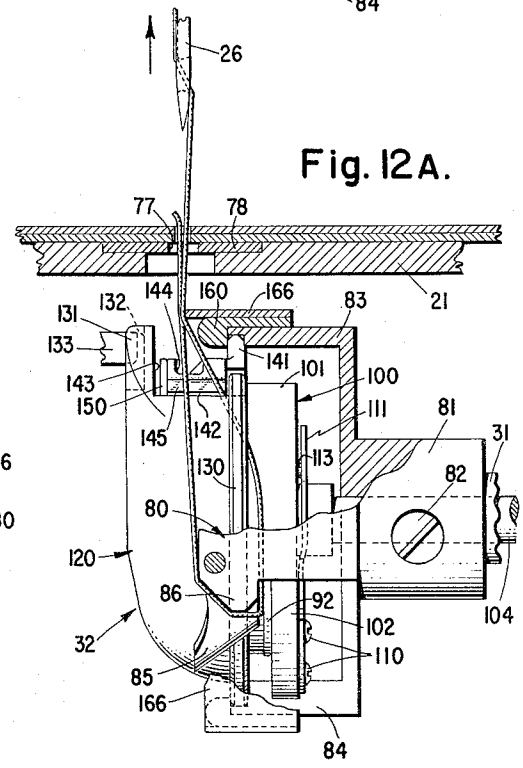


Fig. 12A.



Nov. 13, 1962 S. J. KETTERER ET AL 3,063,392

STITCH-FORMING MECHANISM FOR LOCK STITCH SEWING MACHINES

Filed March 18, 1960 6 Sheets-Sheet 6

Fig. 13.

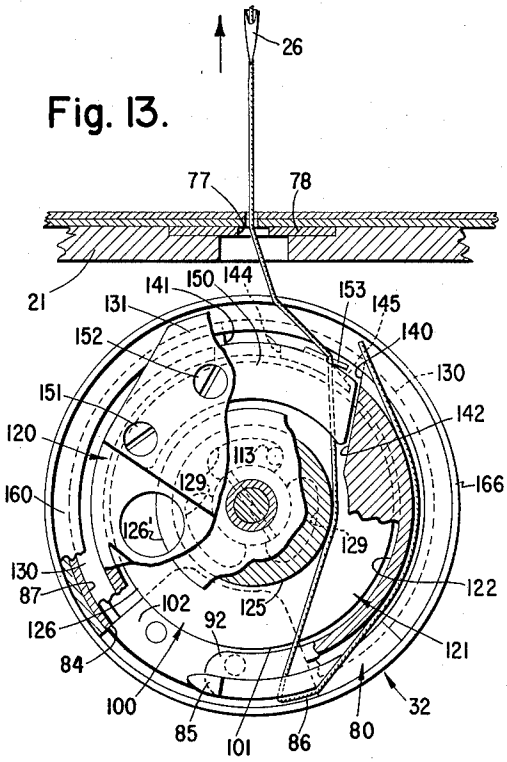


Fig. 13A.

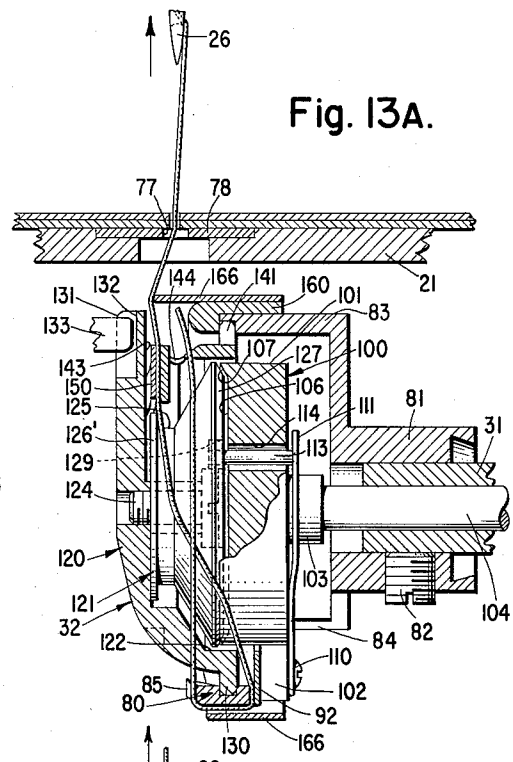
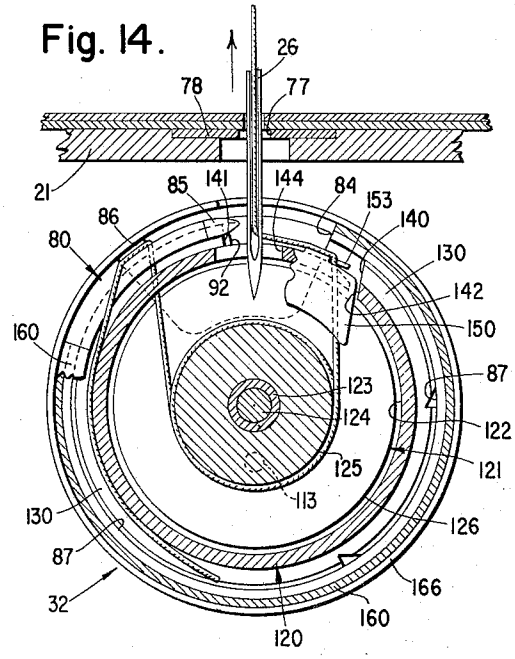


Fig. 14.



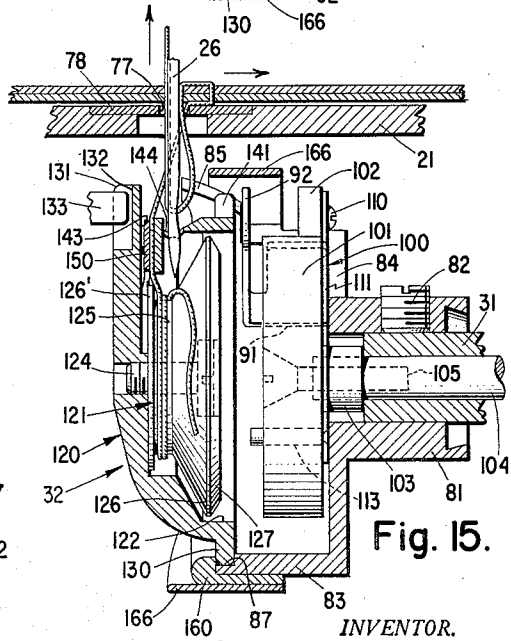


Fig. 15.

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United States Patent Office

3,063,392

Patented Nov. 13, 1962

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STITCH-FORMING MECHANISM FOR LOCK STITCH SEWING MACHINES

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Filed Mar. 18, 1960, Ser. No. 15,955
16 Claims. (Cl. 112—181)

This invention relates to lock stitch sewing machines in which the bobbin thread is replenished automatically during the normal operation of the sewing machine and, more particularly, to a new and improved loop-taker construction and means for operating the loop-taker for drawing in, winding, and tensioning a fresh supply of bobbin thread during the normal operative lock stitch forming movements of the needle and loop-taker of the sewing machine.

It is an object of this invention to provide novel and improved means associated with a loop-taker of a lock stitch sewing machine for automatically winding a fresh supply of thread on the bobbin during the normal operative stitch forming movements of the needle and loop-taker such that true lock stitches (Federal type stitch #301) may be formed without requiring the attention of an operator for rewinding or replacing the bobbin in the loop-taker.

Another object of this invention is to provide a novel and improved bobbin thread tensioning means advantageously arranged between the bobbin and the stitching point, and a novel means for unerringly introducing the fresh bobbin thread to the tensioning means automatically.

Still another object of this invention is to provide a means for insuring that the free end of each fresh supply of bobbin thread is wrapped on the bobbin within the loop-taker.

With the above and additional objects and advantages in view as will hereinafter appear, this invention comprises the devices, combinations, and arrangements of parts hereinafter described and illustrated in the accompanying drawings of a preferred embodiment in which:

FIG. 1 represents a side elevational view, partly in vertical cross-section, of a sewing machine having the present invention applied thereto,

FIG. 2 represents an enlarged rear elevational view of the sewing machine of FIG. 1, illustrated partly in cross-section taken substantially along line 2—2 of FIG. 1,

FIG. 3 is a cross-sectional view taken substantially along line 3—3 of FIG. 2 and illustrating, in plan view, a fragment of the sewing machine pattern cam,

FIG. 4 represents an enlarged elevational view of the edge of the sewing machine pattern cam illustrating the cam lugs carried thereon for controlling the periodic winding of a fresh supply of thread on the bobbin,

FIG. 5 represents a fragmentary bottom plan view of the pattern cam,

FIG. 6 is an enlarged cross-sectional view taken substantially along line 6—6 of FIG. 1 showing the loop-taker drive and control mechanism,

FIG. 7 represents a front elevational view of the loop-taker,

FIG. 8 represents a vertical cross sectional view of the loop-taker with fragments of the throat plate and needle illustrating the relationship of parts during normal sewing and including the sewing threads and a portion of the work fabrics being stitched,

FIG. 9 represents an exploded perspective view of the loop-taker,

FIG. 10 represents a top plan view of the bobbin case having a portion broken away to illustrate the thread tensioning spring,

FIGS. 11 to 15 illustrate the loop-taker of this invention together with fragments of the needle, throat plate, work fabrics, and sewing thread. Varying portions of the loop-taker are broken away in these views and illustrated in vertical cross-section best to illustrate the sequence of events in a typical operation of the loop-taker to replenish the bobbin thread supply,

FIGS. 11 and 11A represent a front elevational view and a side elevational view, respectively, of the loop-taker immediately after a needle thread loop has been seized preparatory to winding of the bobbin,

FIGS. 12 and 12A represent a front elevational view and a side elevational view, respectively, of the loop-taker after a few degrees of loop-taker rotation beyond that illustrated in FIGS. 11 and 11A illustrating the manner in which the thread is directed toward the tensioning device,

FIGS. 13 and 13A represent a front elevational view and a side elevational view, respectively, of the loop-taker after approximately 180° of loop-taker rotation beyond loop seizure, illustrating the position of the thread in the tensioning device and the manner in which the thread is directed to the bobbin,

FIG. 14 represents a front elevational view of the loop-taker after approximately two complete revolutions of the loop-taker beyond loop seizure, illustrating the absence of a needle thread loop to explain why winding may continue for a plurality of needle penetrations, and

FIG. 15 represents a vertical cross-sectional view of the loop-taker after winding of the bobbin has been completed and illustrating the formation of a needle thread loop immediately prior to loop seizure of the first stitch in a seam using the just wound bobbin thread.

Referring particularly to FIGS. 1 and 2 of the drawings this invention is illustrated as applied to a cylically operated group stitch sewing machine illustrated and described in detail in the co-pending United States patent application Serial No. 660,779, filed May 22, 1957, now Patent No. 2,938,477, granted May 31, 1960, to which reference may be had for a complete understanding of its operation.

The sewing machine comprises a frame including a bracket arm 20 and a work supporting bed 21. Secured beneath the bed is a subbase 22 in which is journaled a pattern cam 23 for controlling the operation of the sewing machine.

A main shaft 24 journaled in the bracket arm is operatively connected to reciprocate a needle bar 25 carrying a needle 26, the main shaft being also connected to oscillate a needle thread takeup member 27. Drivingly connected with the main shaft for rotation at twice the speed thereof, by means of sprocket wheels 28 and 29 and a clip belt 30, is a hollow bed shaft 31 to which a loop-taker, indicated generally as 32, is secured.

The main shaft 24 carries a start-and-stop motion mechanism controlled by a swinging frame 33. Depression of a starting lever 34 serves by way of the swinging frame to shift the start-and-stop motion mechanism into running position. The swinging frame is latched in the running position, and the machine is stopped after the latch for the swinging frame is released when cam lugs 35 secured beneath the pattern cam 23 engage and shift a follower arm 36 fast on a rod 37 carried vertically at the rear of the machine.

The pattern cam 23 is driven through a worm 38 on the main shaft, a worm wheel 39 on a vertical cam drive shaft 40, and a pinion 41 on the cam drive shaft meshing with a gear 42 fast on the pattern cam.

In addition to controlling the start-and-stop motion mechanism, the pattern cam 23 is formed in the upper face with a pair of cam grooves 43 and 44 tracked by followers 45, 46 operatively connected to control the lateral

and longitudinal movements, respectively, of a work clamp 47. The work clamp comprises a gooseneck 48 carried on a slidably pivoted plate 49 to which is fastened the lower jaw 50 of the work clamp. An upper jaw 51 of the work clamp is slidable vertically in the gooseneck 44. A lifting finger 52 on the upper jaw 51 is engageable by a lug 53 on a presser bar 54 in the bracket arm and operably connected to raise the upper jaw of the work clamp upon depression of a clamp opening lever 55 at the rear of the sewing machine. For this purpose, the clamp opening lever 55 is connected by means of a link 56 to a rock arm 57 of a clamp opening rock shaft 58 journaled lengthwise in the bracket arm.

A further function of the pattern cam 23 is to impart certain preliminary motions to the thread cutter actuating slide bar 60. For this purpose a cam groove 61 is formed in the underside of the pattern cam and tracked by a roller follower 62 carried on a lever 63 fulcrumed on the subbase 22. As best illustrated in FIG. 5, a pivoted link 64 connects the follower lever 63 to a rock arm 65 fast on a rock shaft 66 journaled vertically at the rear of the sewing machine. A rock arm 67 fast on the upper extremity of the rock shaft 66 is bifurcated and embraces a slide block 68 pivoted on the cutter actuating slide bar 60.

There is an operative connection between the clamp opening lever 55 and the thread cutter actuating slide bar 60 provided by a bifurcated lever 69 fulcrumed on the bracket arm 20 and embracing a pin 70 carried by the slide bar 60, and a link 71 pivoted to the clamp opening lever 55 and to the bifurcated lever 69. Motion of the slide bar 60 to perform the actual cutting of the sewing threads is derived from the manual depression of the clamp opening lever 55. The cam groove 61 and the associated follower mechanism serves to move the cutter actuating slide bar into a retracted position during sewing operations, to bring the thread severing and associated instrumentalities into a ready position at the completion of sewing, and to provide a radial clearance opening 72 in the cam groove 61 opposite which the follower 62 will repose in the stopped position of parts thus releasing the clamp opening mechanism for operation.

This invention relates primarily to the loop-taker construction whereby the bobbin thread is supplied automatically, in the preferred embodiment, from the needle thread supply. While the specific manner in which the sewing threads are cut after a sewing operation does not form a direct part of this invention, the thread cutting mechanism is associated indirectly with this invention in that it serves as a means for releasing the needle thread tension device 75 while the needle thread is being supplied to the bobbin in the loop-taker.

Reference is made to the United States patent of Ketterer, No. 2,902,960, September 8, 1959 which discloses a needle thread tension releasing mechanism for a sewing machine of the type illustrated in the present drawings. The tension releasing mechanism may be of the type disclosed in the above referenced Ketterer patent in which the cam groove 61, in returning the thread cutter actuating slide bar 60 to a retracted position at the start of each cycle of stitching, operates by way of the bifurcated lever 69, the link 71, and the work clamp opening lever 55 to effect release of the needle thread tension while the bobbin is being wound with needle thread.

The loop-taker of this invention is preferably of the type referred to in the art as a rotary hook, and more particularly of the type which performs two revolutions for each reciprocation of the needle. In forming lock stitches, the rotary hook serves to distend and manipulate successive loops of thread formed by the needle as it penetrates the work and a needle hole 77 formed in a throat plate 78 on the work supporting bed. The rotary hook carries the needle thread loop completely about an underthread mass called a bobbin thread, the needle thread loops thereafter being drawn from the rotary hook and set concatenated with the bobbin thread into the work fabrics.

With particular reference to FIGS. 7–10 of the drawings, the structure of the loop-taker of this invention will now be described.

A cup-shaped loop-taker body 80 is formed with a hub 81 bored to accommodate the hollow bed shaft 31 and to be secured for rotation therewith by a set screw 82. The loop-taker body is provided with a peripheral flange 83 formed with a gap 84 extending over approximately a fourth of the circumference of the flange. Carried by the flange 83 and extending into the gap 84 in the direction of rotation of the loop-taker is a hook beak 85 for engaging thread loops presented by the needle. A shoulder 86 is formed on the beak 85 adjacent to the flange 83, the free extremity of the hook beak from the shoulder 86 outwardly being correspondingly narrower. The flange 83 at the outer edge is formed with an annular internal groove 87 providing one half of a raceway for a non-rotating bobbin case.

Secured inside the cup-shaped loop-taker flange 83 by screws 90, is a thread loop restraining member 91 formed with a resilient finger 92 disposed, as illustrated in FIG. 8, in spaced relation alongside the hook beak 85. The finger 92, when not flexed by an outside influence, is preferably spaced from the hook beak sufficiently far so as to accommodate a needle thread snuggly therebetween but without pinching or nipping the thread.

Carried within the cup-shaped loop-taker body adjacent to the base thereof is a bobbin winding device 100. The bobbin winding device comprises a thread supporting disc with a straight cylindrical peripheral surface 101 radially outward from which extends a thread clamping element 102 subtending an arc of less than 90° on the disc. The thread clamping element 102 is accommodated in the gap 84 of the loop-taker body to lock the bobbin winding device for rotation with the loop-taker body. A hub 103 formed on one face of the bobbin winding device is bored to accommodate a rod 104 slidable in the hollow bed shaft 31 by which the bobbin winding device may be shifted axially with respect to the loop-taker body. The bobbin winding device is secured to the rod 104 by a fastening screw 105 threaded axially into the rod. The opposite face of the bobbin winding device is formed with a shallow recess 106 having an outwardly tapered periphery 107.

Secured on the back of the bobbin winding device 100 by screws 110 is a leaf spring 111 apertured as at 112 to accommodate the rod 104, and fitted at its free extremity with a bobbin rotating pin 113 which extends through an opening 114 in the bobbin winding device 100.

Indicated generally at 120 is a bobbin case so-called because its supports and encloses a bobbin 121 within the cup-shaped loop-taker body 80. The bobbin case is formed with a cavity 122 within which extends an axial stud 123 on which the bobbin 121 is freely journaled. The stud 123 is internally threaded to accommodate a fastening screw 124 which limits axial movement of the bobbin and constrains the bobbin completely within the bobbin case cavity 122. As best illustrated in FIG. 8, the bobbin includes a thread accommodating spindle 125 provided with an outer flange 126 and an inner flange 126' to confine thread on the spindle. The overall diameter of the outer flange 126 of the bobbin is substantially equal to that of the straight cylindrical outer surface 101 of the bobbin winding device, and the exposed outer face of the bobbin flange 126 may be chamfered as at 127 to match the shape of the shallow recess 106 of the bobbin winding device. The exposed flange 126 of the bobbin is also formed with a recess 128 including three equally spaced radially enlarged portions 129 any one of which may accommodate the bobbin rotating pin 113 when the bobbin winding device 100 is shifted axially toward the bobbin.

The bobbin case 120 is formed at the rim of the cavity

122 with a peripheral bearing rib 130 which is journaled in the raceway provided partly by the annular groove 87 formed in the loop-taker body. At the opposite side from the bearing rib 130, the bobbin case is provided with a radial projection 131 in which is formed a rotation restraining notch 132 which loosely accommodates a rotation restraining finger 133 secured to the work supporting bed 21.

The bobbin case bearing rib 130 is formed with a gap and the edges of the bearing rib bordering on the gap will be referred to as the ingoing thread detainer 140 and the outgoing thread detainer 141. Those familiar with the sewing machine art will recognize in the provision of gaps in both the loop-taker body raceway 87 and of the bobbin case bearing rib 130 a feature of the present loop-taker in common with all known rotary hooks. In order for loops of needle thread to be carried completely about the bobbin case in ordinary lock stitch formation, each needle thread loop must enter and exit from between the bearing rib 130 and the raceway 87. This is done, as is well known in the art, during periods while the gaps in the raceway and bearing rib open one to the other. Thus, when the needle thread loop is first seized by the hook beak 85, the gaps are open to each other and admit the thread loop, but the gaps then overlap closing toward the ingoing thread detainer 140. The loop of needle thread is lodged against the ingoing thread detainer 140 when the gaps first overlap, because the rotation restraining means positions the ingoing thread detainer at the point of tangency of the needle thread leading from the needle hole 77 to the annular bobbin case bearing rib 130.

As the needle thread loop is carried about the bobbin case with one limb passing behind the bobbin and the other limb passing over the bobbin case, the needle thread loop slides across the gap in the bobbin case bearing rib and lodges against the outgoing thread detainer 141 to await the earliest opportunity to be withdrawn by the take-up when the gaps in the raceway and bearing rib next open one to the other.

Referring particularly to FIGS. 9 and 10, the bobbin case 120 is formed with a substantially L-shaped thread slot having a short limb 142 leading from the ingoing thread detainer 140 on the bearing rib toward the front of the bobbin case substantially parallel to the axis of the bobbin, and a long limb 143 extending circumferentially of the bobbin case between the rotation restraining finger 131 and a needle clearance aperture 144 in the bobbin case. The bobbin case on that side of the short limb 142 of the slot nearest the needle clearance aperture 144 is beveled as at 145 in the direction of the normal thread lead from the ingoing thread detainer 140 toward the needle.

As best illustrated in FIG. 10, a bobbin thread tension leaf spring 150 is disposed in the long limb 143 of the L-shaped slot in the bobbin case. The bobbin tension spring is clamped in the slot by a clamp screw 151 and is urged toward the slot side wall nearest the bearing rib by an adjusting screw 152 by which the bobbin thread tension may be adjusted. The free end of the bobbin tension spring extends slightly beyond the juncture of the long limb 143 with the short limb 142 of the slot such that a thread being drawn along the slot from the ingoing thread detainer 140 will be drawn between the spring 150 and the slot side wall against which the spring is biased. An ear 153 formed on the spring provides a stop for accurately positioning a thread under the action of the spring.

A gib 160 secured to the flange 86 of the loop-taker body is formed with an annular internal groove 161 which complements the groove 87 in the loop-taker body to complete the raceway for the bobbin case bearing rib. A shallow transverse slot 162 in the gib provides a guideway for an auxiliary hook member 163. As illustrated in FIG. 1, the auxiliary hook member 163 is connected to a flexible wobble plate 164 by which the auxiliary hook member may be shifted axially of the bobbin.

The auxiliary hook member 163 cooperates with an inclined slot 165 formed in a thread camming member 166 secured on the loop-taker body. The functioning of the auxiliary hook member to grasp a thread forms no direct part of this invention and the details of operation thereof will, therefore, not be described herein. During periods when the auxiliary hook is not active to grasp a thread, it is positioned so as to block the inclined slot 165 in the thread camming member to prevent threads from entering accidentally into the slot 165.

The inclined slot 165 extends from an inclined camming edge 167 of the thread camming member at a point along the camming edge adjacent to a camming finger 168 defined by a needle clearance slot 169 formed in the thread camming member.

The conversion of the loop-taker from a device for concatenating threads in the formation of lock stitches to a device for introducing and supplying thread from the needle to the bobbin within the loop-taker body is accomplished by effecting an axial shift of the bobbin winding member 100 by way of the rod 104. As illustrated in FIG. 6, the rod 104 is biased toward the right, i.e., in a direction to withdraw the bobbin winding member away from the bobbin, by a coil spring 180 acting between the hub 181 of the sprocket 29 on the bed shaft and a collar 182 fast on the rod 104. The free extremity of the rod 104 is accommodated snugly in a bore 183 formed in a block 184 carried by a plunger 185, and, preferably, a pad of cushioning material 186 may be interposed between the rod 104 and the bottom of the bore 183. The plunger 185 is slidably accommodated in the bore 187 of a connecting member 188. A transverse pin 189 in the plunger is confined in a slot 190 in the connecting member to limit axial movement of the plunger therein. A coil spring 191 interposed between the block 184 and the connecting member 188 biases the plunger toward an extreme extended position relatively to the connecting member.

A pin 192 protruding from the rear extremity of the connecting member is embraced by a rock arm 193 fast on the upper extremity of a rock shaft 194 journalled vertically on the rear of the sewing machine. At the lower extremity of the rock shaft 194 is secured a cam follower rock arm 195 which tracks the edge of the pattern cam 23 and is actuated by a pair of cam lugs 196 and 197 each slotted as at 198 to accommodate clamp screws 199 by which the cam lugs may be adjusted relatively to the pattern cam 23 and relatively to each other.

Apart from adjusting the rock arm 193 and cam follower rock arm 195 angularly relatively to the rock shaft 194, the motion imparted to the bobbin winding mechanism from the cam lugs 196 and 197 may be adjusted by turning a knurled nut 200 threaded on the extremity of the connecting member 188. Any selected position of the knurled nut 200 may be maintained by the clamp member 201 which is fixed on the connecting member and may be deflected into clamping relation with the knurled adjusting nut by a clamp screw 202.

Operation

In the stopped position of the sewing machine, i.e., between cycles of stitching operation, which is the position of parts illustrated in FIGS. 1, 2, 3 and 5, the pattern cam 23 will occupy a predetermined position since it is the shtop cam lugs 35 acting on the follower arm 36 which trip the start-and-stop motion mechanism into operation.

As illustrated in FIG. 5, the roller follower 62 of the thread cutter controlling mechanism at the stopped position is situated opposite the clearance opening 72 of the cam groove 61 to permit the work clamp to be opened for removal and replacement of work fabrics therein. The direction of rotation of the pattern cam is indicated by an arrow in FIG. 5. That portion of the cam groove 61 immediately beyond the stopped position, which will

be tracked by the roller follower **62** at the beginning of the succeeding cycle of stitches, does not immediately return the cutter parts to retracted position but continues for a distance at the same radius as in the stopped position in order to maintain the needle thread tension released during winding of the bobbin.

As illustrated in FIG. 3, the cam lugs **196** and **197** in the stopped position are disposed immediately in advance of the follower rock arm **195**, the direction of pattern cam motion being indicated by an arrow. At the beginning of the succeeding cycle of stitches and preferably timed to occur immediately after the initial needle thread loop seizure by the hook beak, the cam lug **196** becomes effective to turn the cam follower rock arm **195** to shift the rod **104** and the bobbin winding device **100** axially toward the bobbin and into operative winding position. The timing of the cam lug **196** may be adjusted so as to provide accurate control over the precise point that the bobbin winding device will be moved into operative position. Moreover, the relative positions of the cam lugs **196** and **197** may be adjusted nearer or farther apart to control the duration of time that the bobbin winding device is held in operative winding position thus providing a control of the amount of thread which will be supplied to the bobbin.

The sequence of operations of the loop-taker in automatically supplying the bobbin with a thread supply, properly tensioning the bobbin thread, and then concatenating the bobbin and needle threads to form lock stitches is best illustrated in FIGS. 11–15.

FIGS. 11 and 11A illustrate front and side elevational views of the loop-taker immediately after the initial seizure of a needle thread loop by the hook beak **85**. These figures include a representation of the work fabrics upon the work supporting bed but the work clamp has been omitted for clarity. The needle thread loop is engaged by the hook beak **85** with the thread loop disposed against the shoulder **86** on the hook beak and between the hook beak and the spring finger **92** of the loop restraining member. The bobbin winding device **100** has been moved axially toward the bobbin by the cam lug **196** on the pattern cam, thus carrying the clamping lug **102** against the spring finger **92** to clamp the needle thread loop securely on the hook beak **85**. When the bobbin winding device **100** moves axially toward the bobbin and, in effect closes the space between the back of the bobbin and the hook body, the bobbin driving pin **113** will be moved into one of the three radially enlarged portions **129** of the recess in the bobbin. Rotation of the bobbin will thus begin in the position of parts illustrated in FIGS. 11 and 11A, although the thread will not be positioned on the bobbin ready to be wound thereon until the parts advance to the position illustrated in FIGS. 13 and 13A. The position of the bobbin driving pin **113** and the associated recesses **129** in the bobbin are not emphasized in FIGS. 11 and 11A but may be viewed clearly in FIGS. 13 and 13A.

FIGS. 11 and 11A illustrate the needle thread loop lodged in the ingoing thread detainer **140**. The gaps in the loop-taker body and in the bobbin case bearing rib are already overlapped such that one limb of the needle thread loop (that extending from the needle) extends inside the bobbin case bearing rib while the other limb of needle thread (the free extremity) extends outside the bobbin case.

Referring now to FIGS. 12 and 12A, the loop-taker is illustrated in a position in which the hook beak has been rotated only a few degrees beyond that illustrated in FIGS. 11 and 11A. FIGS. 12 and 12A illustrate that the limb of needle thread loop leading to the needle will immediately begin to move out of the ingoing thread detainer and down the limb **142** of the L-shaped slot in the bobbin case toward the bobbin tensioning spring **150**. The reason for such movement of the needle thread loop into the slot **142** stems from the fact that the straight cylindrical portion **101** of the bobbin winding member is moved forward to span the planes containing the bearing rib **87**, and because the recess **106** therein rests closely adjacent to the chamfered flange of the bobbin, the passageway for the needle thread loop behind the bobbin is completely blocked and instead, that limb of the needle thread loop is supported on the straight cylindrical surface of the bobbin winding member and cannot move directly inwardly toward the center of rotation of the loop-taker as in normal stitching. The limb of needle thread leading to the needle will, in ordinary sewing, tend to form as straight a line as is possible from the shoulder **86** of the hook beak to the point of needle penetration in the work fabrics, and this limb of thread would therefore, in ordinary sewing, begin to move from the ingoing thread detainer **140** toward the outgoing thread detainer **141**. Since the cylindrical surface **101** supports this thread limb and prevents it from moving toward the outgoing thread detainer **141**, then the thread camming edge **167** of the thread camming member will immediately urge the thread limb into the slot **142**. FIG. 12 illustrates that the bevel **145** along the edge of the slot **142** matches very closely the lead of the thread toward the work as the thread is moved into the slot **142**, thus encouraging ready movement of the thread therein.

FIGS. 13 and 13A illustrate the position of parts after the loop-taker has been rotated approximately one quarter of a revolution beyond that illustrated in FIGS. 12 and 12A. The thread limb leading to the needle will have been moved by the cam edge **167** of the thread camming member **166** into the circumferential slot **143**. The thread will be only partially supported by the straight cylindrical portion **101** of the thread winding member and rather than sliding behind the bobbin as in ordinary sewing operations, the thread will fall, at this point, inside the flange **126** and onto the spindle **125** of the bobbin so that winding of the thread on the bobbin may begin. At this point, as illustrated in FIG. 13, the direction of lead of that limb of thread extending from the needle moves toward the vertical occasioned by the falling of this limb onto the thread accommodating spindle of the bobbin. This change in the lead of the thread will pull the thread along the slot **143** in the bobbin case and between the tensioning spring **150** and the edge of the bobbin case slot **143**. As illustrated in FIG. 13, the ear **153** of the bobbin tensioning spring will provide a stop for locating the thread properly relatively to the bobbin tension spring.

FIGS. 11–13 illustrate the sequence of events as the needle thread is directed to the thread accommodating spindle **125** of the bobbin and introduced to the bobbin tension spring **150**. Winding of thread on the bobbin from the needle thread supply through the eye of the needle will begin in the position of parts illustrated in FIGS. 13 and 13A and will continue as long as two conditions are maintained; first, the bobbin winding member **100** must remain urged against the bobbin with the thread clamping lug **102** tightly against the spring arm **92** clamping the needle thread loop between the spring arm **92** and the hook beak **85**, and second, feed of the work fabrics must be suspended, i.e., the needle must penetrate the same place in the work fabrics. In the sewing machine illustrated in the drawings, suspension of work feed is accomplished by the provision of straight circular segments of the work clamp shifting cam grooves **43** and **44** in the pattern cam **23** for that distance beyond the stopped position during which winding of needle thread on the bobbin will occur.

Winding of thread on the bobbin may thus continue for a plurality of needle penetrations, during which time the hook beak will seize a needle thread loop on only the initial needle penetration. FIG. 14 illustrates the position of loop-taker parts as the hook beak approaches the needle after a subsequent needle penetration. Since the needle will have penetrated the same point in the work fabrics as in the initial penetration, there will be no needle

thread loop for the hook beak to seize. The thread from the needle eye will lead directly to the tension spring **150** and thence to the thread accommodating spindle **125** of the bobbin.

When the bobbin winding device **100** is shifted axially away from the bobbin as the cam lug **197** releases the cam follower arm **195** and the coil spring **180** returns the rod **104** and the bobbin winding member **100** to retracted position, the clamping lug **102** on the bobbin winding device will release the thread loop previously clamped on the hook beak. Winding of thread on the bobbin from the eye of the needle and from the needle thread supply will cease when the thread clamp on the hook beak is released. The spring arm **92**, while not in itself clamping the thread on the hook beak, will confine the thread rather closely adjacent to the hook beak and impose a slight frictional resistance to the free running of a thread loop thereon. Referring to FIG. 14 it will be appreciated that in order to draw the thread limb from the hook beak to the bobbin spindle **125** along the bobbin slide wall flange **126** involves overcoming certain slight frictional resistance. The spring arm **92** provides this slight frictional resistance so that the loose end of thread from the hook beak will be wrapped on the bobbin rather than slipping freely off the hook and dangling just inside the path of the hook beak. The principal advantage of such wrapping in of the thread end are that an additional supply of usable bobbin thread is thus obtained, and the danger of this loose thread end being drawn prematurely into the seam being stitched and thus inevitably causing thread breakage is obviated.

FIG. 15 illustrates the position of loop-taker parts after winding has been terminated and the needle has penetrated the work fabrics in the formation of the first stitch.

The needle will have penetrated a different place on the work fabrics by virtue of a shift of the work fabrics in the direction of the horizontal arrow by the work clamp. A needle thread loop will thus be provided for seizure by the hook beak **85**. The thread previcusly wound on the bobbin **121** including the free extremity which is wrapped about the bobbin, extends between the tension spring **150** and the bobbin case **120** and to the work fabrics. From this point in each cycle of sewing machine operation, the needle thread wrapped on the bobbin provides the under or bobbin thread for the formation of the conventional lock stitches.

When the bobbin winding device **100** has been retracted into an inoperative position, as illustrated in FIG. 15, a passageway is provided between the bobbin **121** and the bobbin winding member **100** for the inside limb of needle thread to be carried about the bobbin. The needle thread loop will no longer be directed into the thread groove **142** from the ingoing thread detainer as with the initial thread loop, but instead the needle thread limb inside the bobbin case bearing rib will shift immediately toward the outgong thread detainer **141** and the loop-taker of this invention will thus form lock stitches in the same manner as that of the so-called rotary hooks well known in the prior art.

Having thus set forth the nature of this invention, what we claim herein is:

1. In a lock stitch sewing machine having a thread carrying needle, a loop-taker having a thread carrying bobbin journaled freely therein and a loop seizing beak for engaging and carrying loops of thread from said needle about said thread carrying bobbin in the formation of lock stitches, means associated with said loop-taker for imposing frictional resistance to passage of thread through said loop-taker and to said bobbin within said loop-taker, means for introducing one limb of a thread loop engaged by said loop seizing beak to the action of said thread frictioning means, means for drawing said limb of thread through the action of said thread frictioning means, and means for winding on said bobbin the thread drawn through the action of said thread frictioning means for subsequent use in the formation of lock stitches.

2. In a lock stitch sewing machine having a support for the work fabrics to be stitched, a thread carrying needle adapted to penetrate the work fabrics, a loop-taker having a thread carrying bobbin and a loop seizing beak normally operative for engaging and carrying about said bobbin loops of thread thrust through the work fabrics by said needle, a thread tensioning spring means associated with said loop-taker, a thread engaging portion of said thread tensioning spring means disposed between said sewing machine work support and said bobbin, means associated with said loop-taker and defining a thread guiding channel leading to said thread engaging portion of said thread tensioning spring means, and means effective on a predetermined one of a plurality of needle penetrations for deflecting one limb of the thread loop engaged by said loop seizing beak along said thread guiding channel into engagement with said thread engaging portion of said thread tensioning spring means, and means for winding said limb of the thread loop from said needle relatively to said thread tensioning spring means and onto said bobbin while said thread is in engagement with said thread engaging portion of said thread tensioning spring means.

3. A lock stitch sewing machine having a frame including a work support, an endwise reciprocating thread carrying needle carried by said frame at one side of said work support, a loop-taker carried by said frame at the opposite side of said work support, means operatively connecting said needle and said loop-taker for interrelated lock stitch forming motions, a bobbin journaled in said loop-taker, a thread tensioning means carried by said loop-taker, a thread engaging portion of said thread tensioning means disposed between said bobbin and said work support, means effective during said interelated lock stitch forming motions of said needle and loop-taker for introducing a thread carried by said needle into engagement with said thread engaging portion of said thread tensioning means, and means effective during continued interrelated lock stitch forming motions of said needle and loop-taker for winding on said bobbin said thread leading from said needle and passing in engagement with and relatively to said thread engaging portion of said thread tensioning device.

4. A lock stitch sewing machine having a frame including a work support, an endwise reciprocatory thread carrying needle carried by said frame at one side of said work support, a loop-taker journaled for turning movement in the frame at the opposite side of said work support, a bobbin journaled in said loop-taker, means operatively connecting said needle and said loop-taker for interrelated lock stitch forming motions in which said loop-taker engages and carries successive loops of a thread carried by said needle about the bobbin journaled in said loop-taker, a thread tensioning means carried by said loop-taker, a thread engaging portion of said thread tensioning means disposed between said bobbin and said work support, thread clamping means associated with said loop-taker for gripping thereon a thread carried by said needle, means effective during said interrelated lock stitch forming motions of said needle and loop-taker for introducing the thread gripped by said thread clamping means into engagement with said thread engaging portion of said thread tensioning means, and means effective during continued interrelated lock stitch forming motions of said needle and loop-taker for winding on said bobbin said thread leading from said needle, passing in engagement with and relatively to said thread engaging portion of said thread tensioning device and gripped by said thread clamping means.

5. A lock stitch sewing machine having a frame including a work support, an endwise reciprocatory thread carrying needle carried by said frame at one side of said

work support, a loop-taker journaled for turning movement in the frame at the opposite side of said work support, a bobbin case journaled in said loop-taker, means carried on said frame for constraining said bobbin case from turning movement with said loop-taker, a bobbin journaled in said bobbin case, a thread tensioning spring anchored on said bobbin case and having a free extremity biased yieldingly against said bobbin case, means effective during said interrelated lock stitch forming motions of said needle and loop-taker for introducing a thread carried by said needle between the free extremity of said thread tenisoning spring and said bobbin case, and means effective during continued interrelated lock stitch forming motions of said needle and loop-taker for winding on said bobbin said thread leading from said needle and between the free extremity of said thread tensioning spring and said bobbin case.

6. A loop-taker for a lock stitch sewing machine having a needle reciprocated endwise in a predetermined path, said loop-taker comprising a rotatable cup-shaped loop-taker body having a sidewall formed with a gap, a loop seizing beak carried by said loop-taker body and projecting into said gap in the desired direction of rotation of said loop-taker body, said loop-taker body being formed with an annular internal groove defining a raceway, a non-rotating bobbin case formed with a cavity, rotation restraining means on said bobbin case adapted to cooperate with complemental means on said sewing machine, a bobbin journaled in said bobbin case cavity, a bearing rib formed on said bobbin case and journaled in the raceway in said loop-taker body, said bearing rib being formed with a gap, said bearing rib being positionable by said rotation restraining means with said gap disposed adjacent to the path of reciprocation of said needle, one edge of said gap in said bobbin case bearing rib toward which said loop-taker body is rotatable defining an ingoing thread detainer, thread tensioning spring means yieldingly bearing against at least a portion of a surface on said bobbin case, and a thread guiding slot formed in said bobbin case open to said bobbin case cavity and leading from said ingoing thread detainer to the portion of the surface yieldingly engaged by said thread tensioning spring means.

7. A loop-taker for a lock stitch sewing machine comprising a rotatable loop-taker body having a base adapted to be secured on a loop-taker drive shaft and a cup-shaped flange defining a cavity opening away from said base, said flange formed with a gap and with an annular internal groove defining a raceway broken by said gap, a loop seizing beak carried by said loop-taker body and projecting into said gap in the direction of rotation of said loop-taker body, a non-rotating bobbin case formed with a cavity, a bobbin journaled in said bobbin case cavity, a bearing rib formed on said bobbin case and journaled in the raceway in said loop-taker body with the bobbin case cavity opening toward said loop-taker base, said bearing rib being formed with a gap, one edge of said gap toward which said loop-taker body rotates defining an ingoing thread pocket, an L-shaped slot formed in said bobbin case and opening onto said bobbin case cavity, said L-shaped slot having a first leg leading from said ingoing pocket away from said loop-taker base, and a second leg extending circumferentially of the bobbin case, a thread tensioning leaf spring carried in the second leg of said slot and bearing yieldingly against a side wall of said leg of the slot, and an annular thread camming member carried on said loop-taker flange for urging a thread loop seized by said loop seizing beak in a direction along said first leg of the L-shaped slot toward said second leg thereof.

8. A loop-taker for a lock stitch sewing machine comprising a rotatable loop-taker body having a base adapted to be secured on a loop-taker drive shaft and a cup-shaped flange defining a cavity opening away from said base, said flange formed with an annular internal groove defining a raceway and with a gap, a loop seizing beak carried by said loop-taker body and projecting into said gap in the direction of rotation of said loop-taker body, a non-rotating bobbin case formed with a cavity, a bobbin journaled in said bobbin case cavity, a bearing rib formed on said bobbin case and journaled in the raceway in said loop-taker body with the bobbin case cavity opening toward said loop-taker base, said bearing rib being formed with a gap, one edge of said gap toward which said loop-taker body rotates defining an ingoing pocket, a thread slot formed in said bobbin case opening onto said bobbin case cavity and extending from said ingoing pocket in a direction away from said loop-taker base, a thread tensioning leaf spring carried in the thread slot and bearing yieldingly against a side wall thereof, and an annular thread camming member carried on said loop-taker flange for urging a thread loop seized by said loop seizing beak along said thread slot toward said thread tensioning spring.

9. A lock stitch sewing machine having a frame including a work support, an endwise reciprocatory thread carrying needle carried by said frame at one side of said work support for reciprocation through a needle hole in said work support, a cup-shaped loop-taker journaled for turning movement in the frame at the opposite side of the work support, said cup-shaped loop-taker having a side wall flange formed with a gap, said flange provided with an internal annular raceway broken by said gap, and a loop-seizing beak extending into said gap and in the direction of rotation of said loop-taker, a bobbin case having a cavity, a bobbin journaled within said cavity, an annular bearing rib on said bobbin case journaled in said loop-taker raceway, said bearing rib formed with a gap, one edge of said gap toward which said loop taker rotates defining an ingoing pocket, means carried on said frame for constraining said bobbin case from turning movement with said loop-taker and for positioning said ingoing pocket substantially on a tangent from said needle hole to that side of said annular bearing rib toward which said loop-taker rotates, a thread slot formed in said bobbin case and opening onto said bobbin case cavity, said slot extending from said ingoing pocket in a direction axially away from said loop-taker, a thread tensioning leaf spring carried in the thread slot and bearing yieldingly against a side wall thereof, a thread camming member carried by said loop-taker including a thread engaging lobe protruding axially away from said loop-taker and disposed substantially diametrically opposite said loop seizing beak on said loop-taker, a thread supporting member having a retracted position within said loop-taker cavity, and means for shifting said thread supporting member into a position partially within said bobbin case cavity for supporting one limb of a thread loop seized by said loop seizing beak in a position at the mouth of said thread slot in said ingoing pocket.

10. A lock stitch sewing machine as set forth in claim 9 in which said thread supporting member comprises a disc having a straight cylindrical peripheral surface substantially equal in diameter to the maximum diameter of said bobbin.

11. A lock stitch sewing machine as set forth in claim 9, in which a thread clamping element is associated with said thread supporting member and is shiftable relatively to said loop seizing beak to grip therebetween a thread loop seized by said loop seizing beak when said thread shifting member is shifted into a position partially within said bobbin case cavity.

12. A lock stitch sewing machine as set forth in claim 11 in which said thread clamping element extends radially outwardly of said thread supporting member and said thread clamping element is disposed in the gap formed in said loop-taker side wall flange so as to interlock said thread supporting element for rotation with said loop-taker, and interengageable driving means on said

thread supporting member and said bobbin shiftable into driving relation when said thread supporting member is shifted partially within said bobbin case cavity.

13. A lock stitch sewing machine having a frame including a work support, an endwise reciprocatory thread carrying needle carried by said frame at one side of said work support for reciprocation through a needle hole in said work support, a cup-shaped loop-taker journaled for turning movement in the frame at the opposite side of the work support, said cup-shaped loop-taker having a cavity defined by a side wall flange formed with a gap, said flange having a rim formed with an internal groove defining an annular raceway broken by said gap, and a loop seizing beak carried on said flange and extending into said gap and in the direction of rotation of said loop-taker, a cup-shaped bobbin case having a cavity, an annular bearing rib formed at the rim of said cup-shaped bobbin case cavity, said bearing rib formed with a gap one edge of said gap toward which said loop-taker rotates defining an ingoing pocket, means for constraining said bobbin case bearing rib in said loop-taker raceway with said bobbin case and loop-taker cavities opening toward each other, means carried on said frame for constraining said bobbin case from turning with said loop-taker and for positioning said ingoing pocket substantially at the point of tangency from said needle hole to that side of said bearing rib toward which said loop-taker rotates, a bobbin journaled completely within said bobbin case cavity, and means for winding on said bobbin a thread from said thread carrying needle comprising a thread supporting member disposed within said loop-taker cavity a thread clamping element carried on said member and protruding through said gap in the loop-taker side wall flange, means for shifting said thread supporting member into a retracted position completely within said loop-taker cavity and to an operative position in which said thread supporting member spans the planes containing said bobbin case bearing rib and the thread clamping element abuts said loop seizing beak, said bobbin case formed with a thread accommodating slot leading from said ingoing pocket toward said bobbin, and thread camming means carried on said loop-taker side wall flange for urging a thread loop seized by said loop seizing beak axially of said loop-taker and in a direction toward said bobbin case.

14. A lock stitch sewing machine as set forth in claim 13 in which said bobbin is formed with a spindle and cylindrical flanges at each end of said spindle for constraining thread thereon, said thread supporting member being formed with a straight cylindrical peripheral surface substantially equal in diameter to that of the cylindrical bobbin flange nearest the mouth of said bobbin case cavity.

15. A lock stitch sewing machine as set forth in claim 13 in which cooperating rotationally interlocking means are provided on said bobbin and on said thread supporting member for engagement in the operative position of said thread supporting member and disengagement in the retracted position of said thread supporting member.

16. A lock stitch sewing machine as set forth in claim 13 in which a thread tensioning spring is carried on said bobbin case in said thread accommodating slot.

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