Dec. 12, 1961 S. J. KETTERER ET AL 3,012,530

LOCK STITCH SEWING MACHINES

Filed May 21, 1958 5 Sheets-Sheet 1

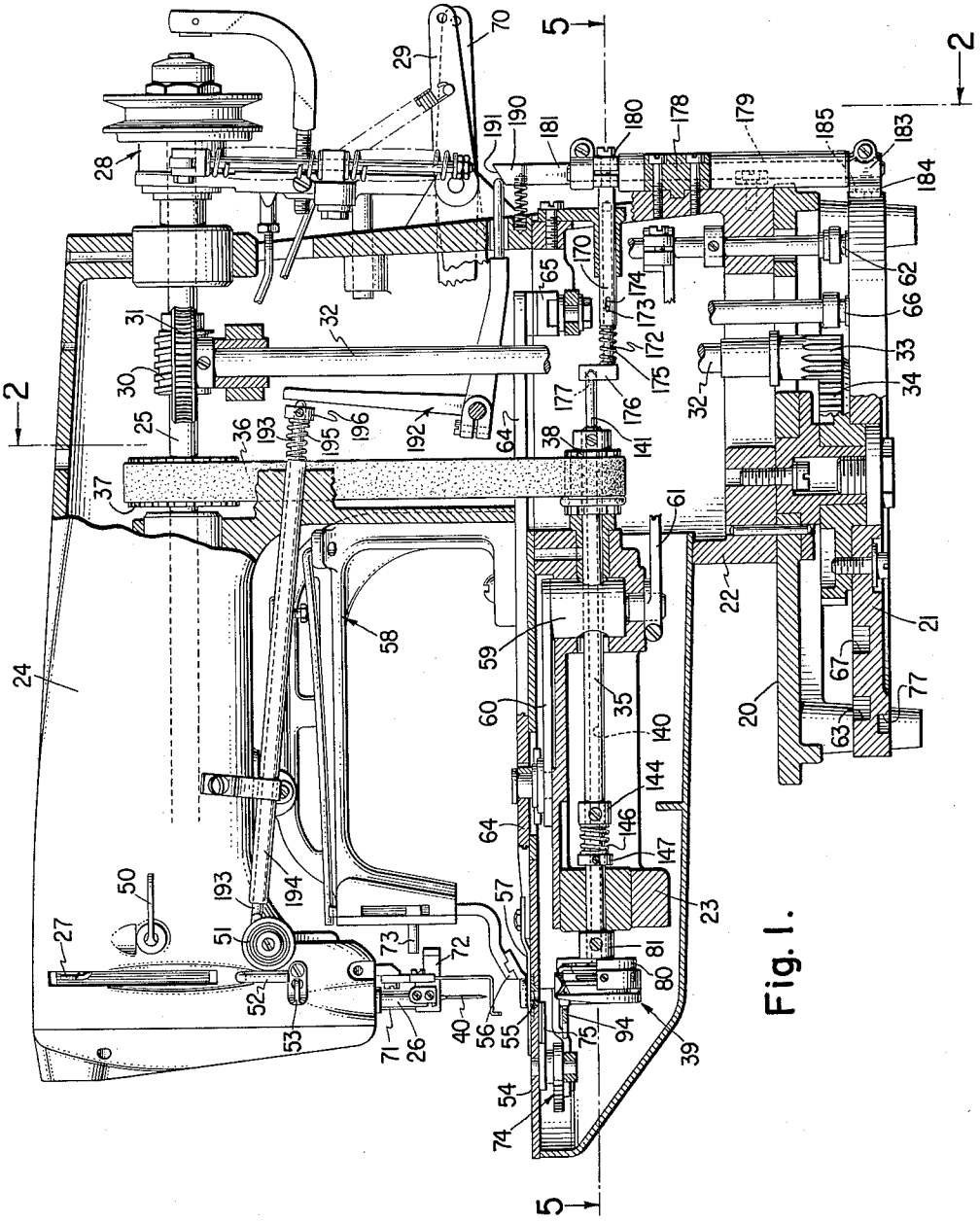

Fig. 1.

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Filed May 21, 1958 5 Sheets-Sheet 2

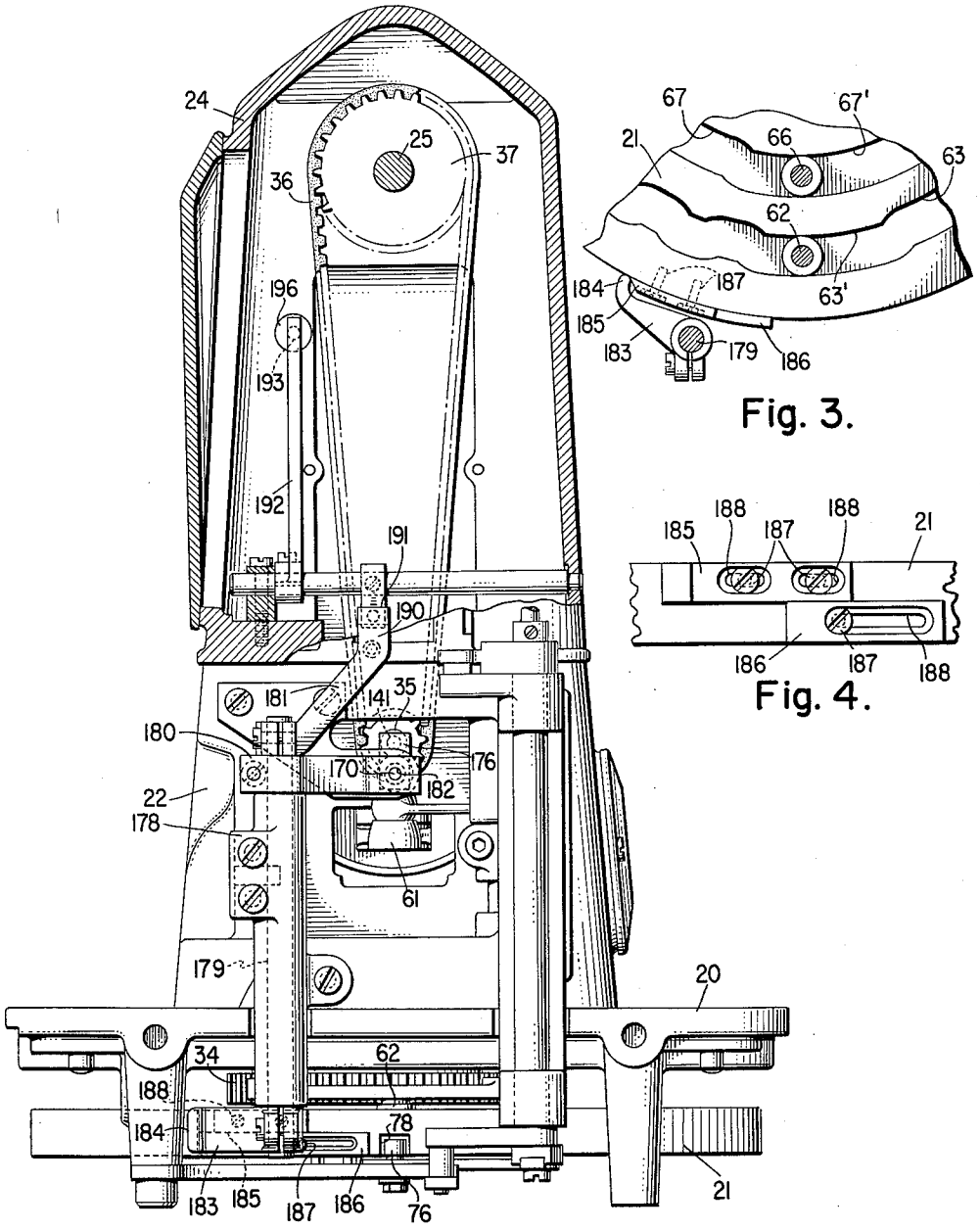

Fig. 2.

Fig. 3.

Fig. 4.

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LOCK STITCH SEWING MACHINES

Filed May 21, 1958 5 Sheets-Sheet 3

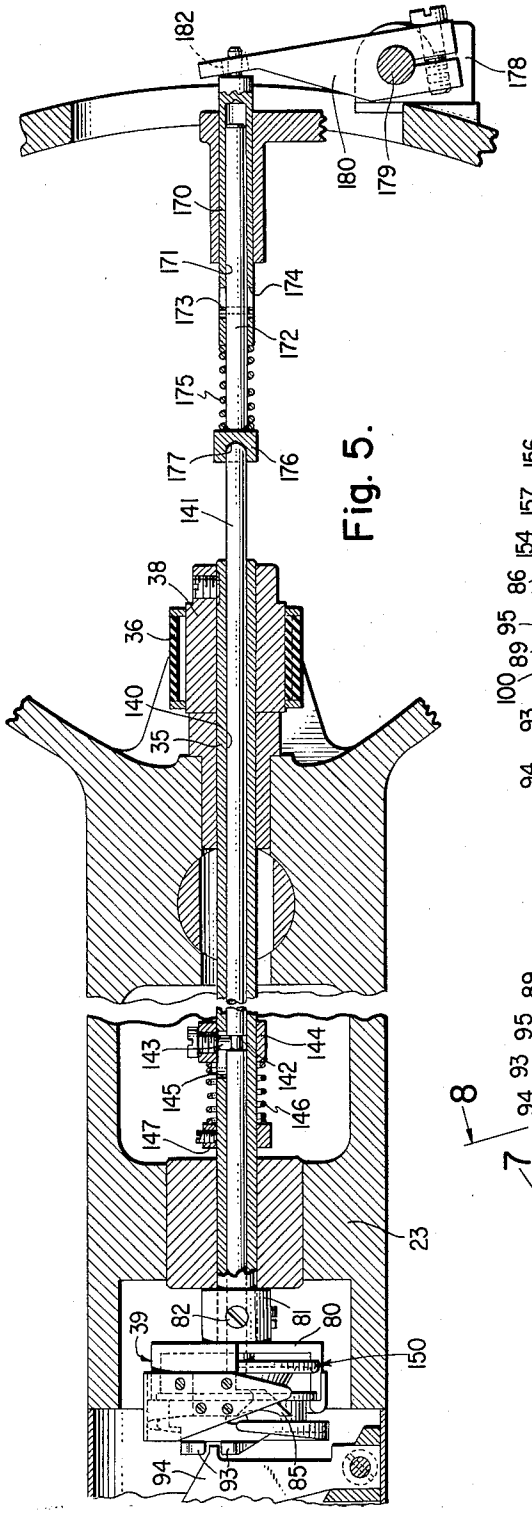

Fig. 5.

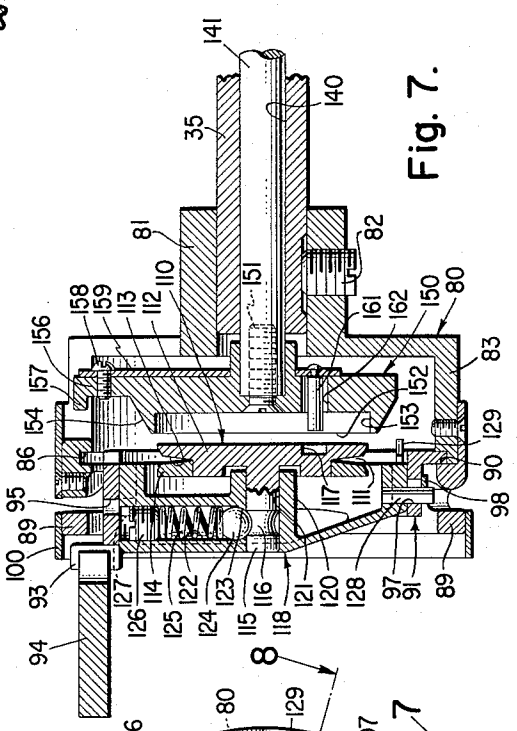

Fig. 7.

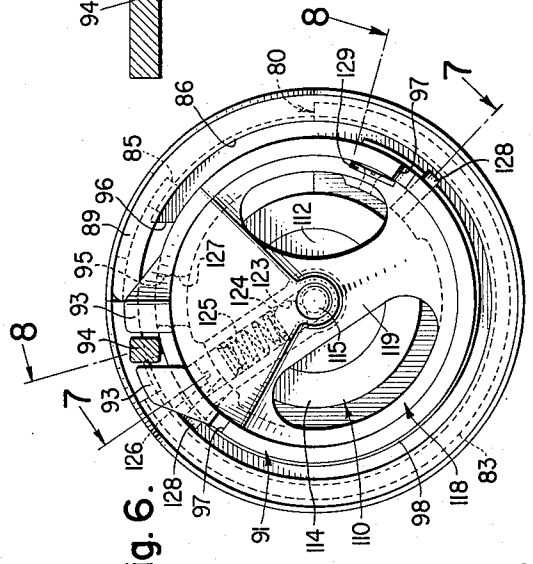

Fig. 6.

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LOCK STITCH SEWING MACHINES

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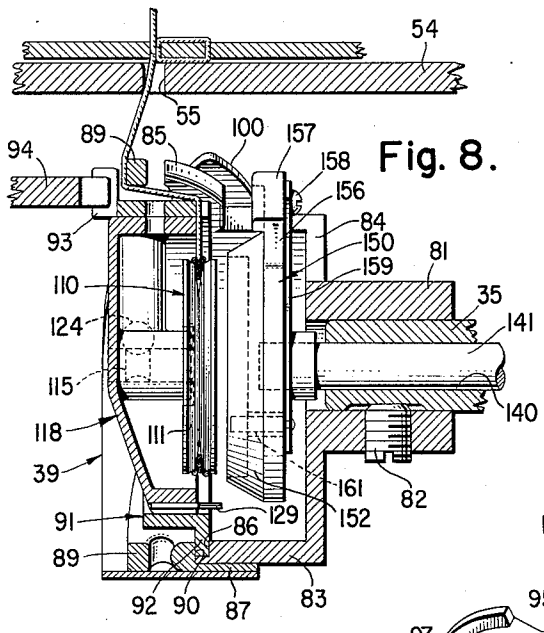

Fig. 8.

Fig. 9.

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LOCK STITCH SEWING MACHINES

Filed May 21, 1958 5 Sheets-Sheet 5

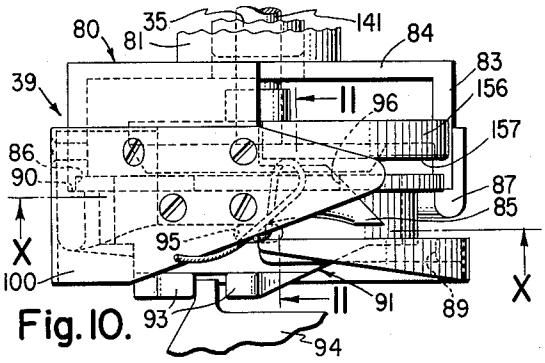

Fig. 10.

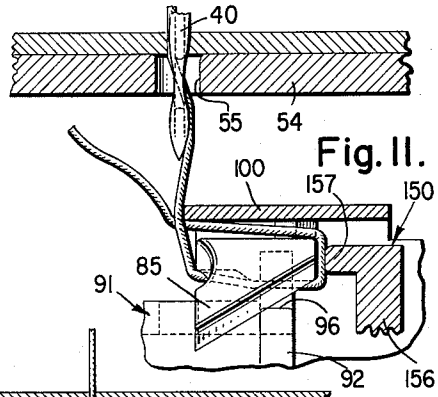

Fig. 11.

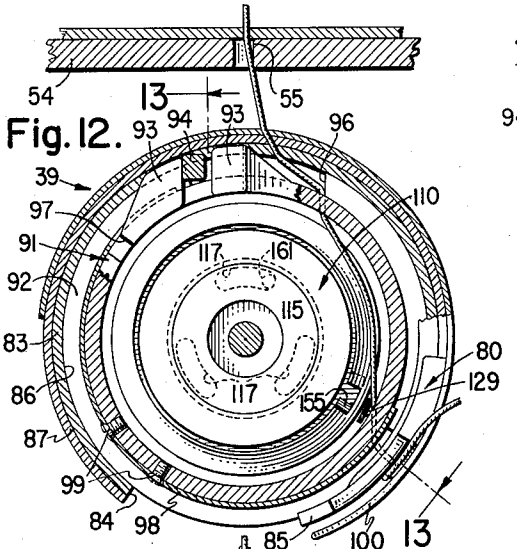

Fig. 12.

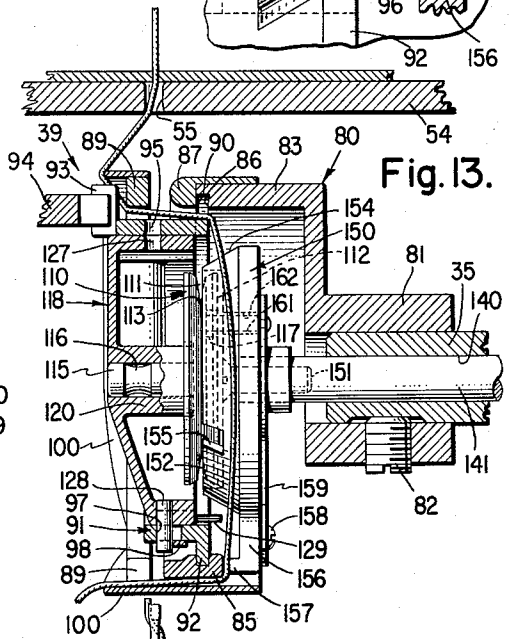

Fig. 13.

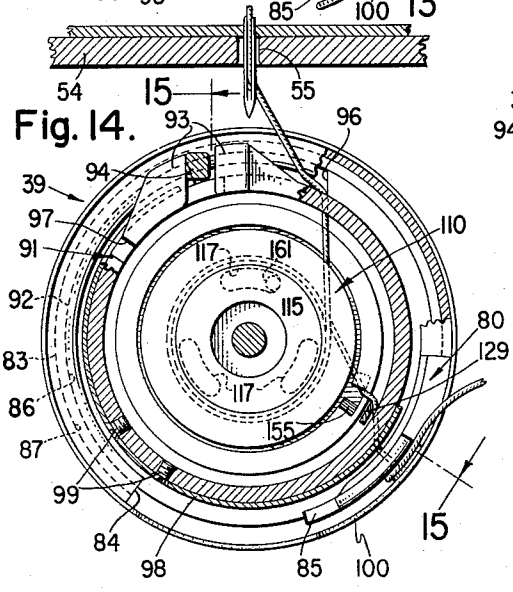

Fig. 14.

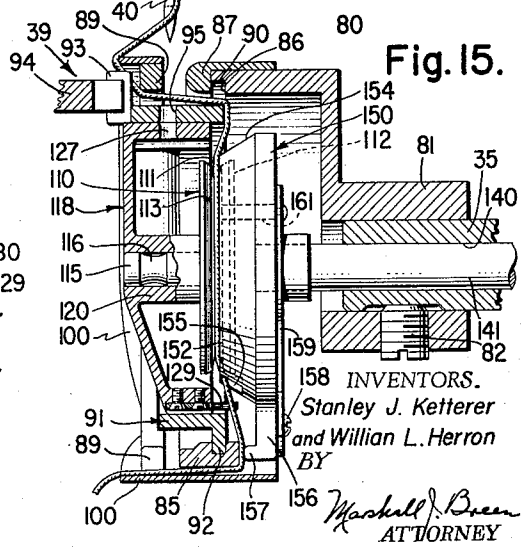

Fig. 15.

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United States Patent Office 3,012,530 Patented Dec. 12, 1961

3,012,530

LOCK STITCH SEWING MACHINES

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Filed May 21, 1958, Ser. No. 736,748
21 Claims. (Cl. 112—181)

This invention relates to lock stitch sewing machines, and more particularly, to bobbin thread replenishing mechanism for a lock stitch sewing machine.

It is an object of this invention to provide mechanism effective automatically during the normal operation of the sewing machine for winding needle thread on the bobbin to replenish the bobbin thread supply.

It is another object of this invention to provide an effective and dependable mechanism for introducing and securing a needle thread to the bobbin of a lock stitch sewing machine so that the needle thread may be wound thereon.

Another object of this invention is to provide a mechanism effective automatically during the normal operation of the sewing machine for winding a predetermined amount of thread on the sewing machine bobbin.

Still another object of this invention is to provide a mechanism for automatically winding needle thread on the bobbin during a plurality of work penetrating strokes of the needle and then automatically during subsequent work penetrating strokes of the needle concatenating the needle thread with the thread wound on the bobbin to form a lock stitch seam of a single length of needle thread.

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 of a sewing machine, partly in vertical cross section, having the features of this invention applied thereto,

FIG. 2 represents a standard end elevational view of the sewing machine of FIG. 1 with a portion of the bracket arm of the sewing machine illustrated in vertical cross section taken substantially along line 2—2 of FIG. 1,

FIG. 3 is an enlarged top plan view of a fragment of the pattern cam of the sewing machine including the cam follower which controls the bobbin winding mechanism,

FIG. 4 is an enlarged side-elevational view of a fragment of the pattern cam showing the bobbin winding cam lugs thereon,

FIG. 5 is a horizontal cross-sectional view taken substantially along the axis of the loop-taker drive shaft, i.e., substantially along line 5—5 of FIG. 1,

FIG. 6 represents an enlarged end elevational view of the loop-taker of the sewing machine of this invention,

FIG. 7 is a cross-sectional view of the loop-taker substantially along line 7—7 of FIG. 6 and illustrating the parts disposed in normal sewing position,

FIG. 8 represents a cross-sectional view of the loop-taker taken substantially along line 8—8 of FIG. 6 and illustrating the position of parts including a thread properly wound on the bobbin in normal sewing position,

FIG. 9 is an exploded perspective view of the loop-taker of the sewing machine of this invention,

FIG. 10 represents a top plan view of a loop-taker of this invention including a needle thread loop as it is seized by the loop-seizing beak to initiate winding of the bobbin,

FIG. 11 is an enlarged vertical cross-sectional view of the loop-seizing beak of FIG. 10 taken substantially

along line 11—11 of FIG. 10 and including a fragment of work fabrics and the needle,

FIG. 12 is a vertical cross-sectional view taken substantially along line X—X of FIG. 10, but illustrating the position of loop-taker parts, including the needle thread, after the loop-seizing beak has completed approximately half of a revolution after initial loop seizure,

FIG. 13 is a cross-sectional view of the loop-taker taken substantially along line 13—13 of FIG. 12 with the parts and the thread illustrated in the same positions occupied in FIG. 12,

FIG. 14 is a vertical cross-sectional view taken substantially along line X—X of FIG. 10, but illustrating the position of the loop-taker parts including the needle thread after the loop-seizing beak has completed approximately one and a half revolutions after initial loop seizure, and

FIG. 15 is a cross-sectional view of the loop-taker taken substantially along line 15—15 of FIG. 14, with the parts and the thread illustrated in the same position occupied in FIG. 14.

Referring to the drawings, FIGS. 1, 2 and 5 illustrate a sewing machine construction to which this invention has been applied in its preferred form. The sewing machine frame comprises a supporting base 20 beneath which is journaled a control member preferably in the form of a pattern cam 21 for controlling the operation of the machine. Rising from the supporting base 20 is a pedestal 22 carrying a work-supporting bed 23 and surmounted by a bracket arm 24, which overhangs the work-supporting bed. A main shaft 25 rotatably journaled in the bracket arm is operatively connected, as in any well known manner, to impart endwise reciprocatory motion to a needle bar 26 journaled in the bracket arm and to impart vibratory motion to a needle thread take-up member 27 also carried in the bracket arm. A mechanical stop motion mechanism, indicated generally at 28, is arranged at the outboard extremity of the main shaft and may be of any known construction in the art to establish driving relation between the main shaft 25 and a constantly running belt (not shown) upon operator-influenced depression of a start lever 29. The stop motion mechanism also serves to discontinue the driving relation and to provide a positive interlock between the main drive shaft and the machine frame to lock the main shaft in a definite predetermined stopped position upon an impulse from the pattern cam 21, as is known in the art. The pattern cam 21 is driven from the main shaft 25 by way of a worm 30 on the main shaft, a worm wheel 31 on a vertical cam drive shaft 32 and a pinion 33 on the shaft 32 meshing with a gear 34 fixed to the pattern cam. The sewing machine, therefore, will operate in cycles of predetermined numbers of stitch forming operations from an operator influenced start to a cam controlled stop. This type of sewing machine is referred to in the art as a group stitch sewing machine and is used universally for repetitive stitching operations such as sewing buttonholes, securing buttons, and producing tacks and designs of stitches.

A bed shaft 35 journaled lengthwise in the work-supporting bed 23 is driven in timed relation wtih the main shaft by means of a clip belt 36 and toothed sprockets 37 and 38 on the main shaft and the bed shaft respectively. Since the sprocket 38 is one half the size of the sprocket 37, the bed shaft will be driven at twice the speed of the main shaft.

Carried on the bed shaft is a loop-taker indicated generally as 39, which is preferably of the type referred to in the art as a rotary hook and is adapted to be rotated two revolutions for each reciprocation of a thread-carrying needle 40 carried in the needle bar 26 and adapted to cooperate with the rotary hook in the formation of lock

stitches. In the formation of a stitch, the loop-taker acts to sieze and carry a loop of needle thread about a thread mass usually referred to as the bobbin thread which is stored in the looptaker. With the loop-taker of this invention, the actual stitch forming process is much the same as with most prior art loop-takers; however, the loop-taker construction, particularly as to those features relative to the replenishment of the bobbin thread mass from the needle thread supply, is a radical departure from the prior art construction. The details of construction of the loop-taker, therefore, form an important part of the invention and will be described fully hereinbelow.

The needle thread, which may be supplied from any convenient spool (not shown), is directed through a thread guide **50**, to any known type of thread tension device such as that illustrated at **51** in FIG. 1 and comprising a pair of disks spring biased together and between which the thread is directed. From the tension device, the thread is passed under a thread guide **52**, to the take-up member **27**, then through a thread guide **53** and to the needle. The work-supporting bed may be fitted with a throat plate **54** apertured, as at **55**, for penetration by the needle in the stitch forming process.

In the preferred embodiment illustrated in the drawings, the work at the stitching point is gripped between the jaws **56** and **57** of a work clamp **58** which serves to hold and to feed the work fabric relatively to the path of action of the needle. It will be understood that with this invention, any known form of work controlling and feeding mechanism may be used, and if used with a work clamp mechanism as illustrated in the drawings, any known mechanism or linkage for shifting the work clamp may be used. As illustrated in the drawings, the work clamp may be shifted across the work-supporting bed by means of a lever **59** with offset arms **60** and **61** journaled in the bed. The lever arm **60** is operatively connected to the work clamp while the lever arm **61** is operatively connected to a pivoted cam follower **62** which tracks a cam groove **63** formed in the patern cam **21**. The work clamp may be shifted lengthwise of the work-supporting bed by means of an extension **64** of the work clamp operatively connected to a lever arm **65**. Movement of the work clamp is controlled by a pivoted cam follower **66** which tracks a cam groove **67** formed in the pattern cam **21**.

An operator-influenced lever **70** on the machine frame is operably connected by conventional mechanism (not shown) to raise and lower a slide bar **71** journaled in the bracket arm and carrying a bracket **72** underlying a set of pins **73** extending from the upper jaws **56** of the work clamp. By turning the lever **70**, the operator can thus separate the work clamp jaws for removal or insertion of a work fabric.

The sewing machine of the preferred embodiment of this invention is also provided with a thread cutting mechanism, a portion of which is indicated generally at **74** in FIG. 1. This thread cutting mechanism may be of the conventional variety in which a pair of thread cutting knives **75** are moved automatically during the last stitch of a cycle prior to operation of the stop motion device so that one knife will engage the bobbin thread and the other knife will engage the needle thread, and in which additional movement of the knives to sever the sewing threads is accomplished under the influence of the machine operator after the machine has stopped. The automatic thread engaging movement of the thread cutting knives is accomplished by a pivoted cam follower **76** which tracks a cam groove **77** formed in the underside of the pattern cam **21**, and by conventional mechanism (not shown) between the cam follower and the thread cutting fingers. As illustrated in FIG, 2, a slot **78** extends from the cam groove **77** to the periphery of the pattern cam **21** opposite which the cam follower **76** is disposed when the sewing machine is locked in stopped position. An operative connection (not shown) between the work clamp opening lever **70** and the thread cutting knives **75** is the conventional manner in which the knives **75** are turned by the operator to sever the sewing threads.

These mechanisms of the sewing machine hereinabove referred to as being of conventional construction may be of the type illustrated and described in greater detail in the copending United States patent application of Ivanko and Graham, 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 an understanding of the construction.

The loop-taker of this invention will now be described, having particular reference to the exploded perspective view illustrated in FIG. 9. A loop-taker body, indicated generally as **80**, is formed with a hub **81** adapted to receive the bed shaft **35**, the hub being drilled and tapped for a set screw **82** by which the loop-taker body is secured on the bed shaft for rotation therewith. A wide annular flange **83** formed on the loop-taker body provides an outwardly open cup-like enclosure open at the periphery by a gap **84** extending over approximately one quarter of the annular flange. Secured to the annular flange adjacent one side of the gap **84** is a loop-seizing beak **85** having a pointed free extremity extending into the gap. Formed at the inside of the flange is an annular groove **86** which defines the bottom and one side wall of a bearing raceway for the stationary portion of the loop-taker. An annular gib member **87** formed with a gap **88** to match the gap **84** in the loop-taker body is secured on the flange **83** of the loop-taker body. A thread confining tail **89** is formed on the gib member and arranged to span a portion of the gap **88**. Formed at the inside of the gib member **87** is an annular recess **90** which defines the other side wall of a bearing raceway in the loop-taker body. An annular thread case carrier **91** is formed with an annular radially extending bearing rib **92** which is disposed, as illustrated in FIG. 8, in the bearing raceway inside the loop-taker body. The thread case carrier **91** is formed with a pair of spaced lugs **93** which embrace a rotation restraining finger **94** fixed beneath the work-supporting bed to prevent the thread case carrier from rotating with loop-taker body. The thread case carrier is formed with a needle aperture **95** and the bearing rib **92** is formed with a gap **96** extending on both sides of the needle aperture **95** so that as the loop-taker body **80** rotates the gaps **84** and **87** in the bearing raceway will periodically coincide with the bearing rib gap **96** to provide an open passageway for entrance and exit of a limb of needle thread in stitch formation. The thread case carrier **91** is formed with a pair of outwardly open bayonet slots **97** and a two-armed spring **98** is secured to the thread case carrier as by screws **99** with one spring arm extending partially over each bayonet slot.

Indicated at **100** is a sheet metal thread guard which is secured around the loop-taker body **90** and the gib member **87**. The guard **100** serves to protect the bobbin thread from the action of the loop-seizing beak, and also carries the bobbin and needle threads to one side of the path of the loop-seizing beak on the second or idle rotation of the hook during each stitch forming cycle.

The bobbin of the present invention comprises a cylindrical drum, indicated generally as **110**, formed with a V-shaped peripheral thread receiving groove **111**. As illustrated in FIG. 7, the drum is preferably formed in two parts, a main cylindrical part **112** to which the periphery is formed at one side with an annular recess **113** to define one-half of the groove **111**, and a ring **114** which may be brazed or welded onto the main cylindrical part **112** and which defines the other half of the groove **111**. A stud **115** extending axially from one face of the bobbin drum is formed near its free extremity with an annular groove **116**. The opposite face of the bobbin

drum is formed with a plurality of arcuate slots **117** of common radius about the axis of the drum.

The bobbin is journaled for rotation in a cylindrical thread case **118** formed with a diametrically arranged web **119** (FIGS. 6 and 7), which carries a boss **120** formed with a bore **121** in which the stud **115** of the bobbin is journaled. The web **119** is formed with a bore **122** perpendicular to the bore **121** and formed to provide a seat **123** opening onto the bore **120** for the reception of a ball **124** biased by means of a coil spring **125** into the annular groove **116** of the bobbin stud **115**. A set screw **126** threaded into the bore **121** serves to control the pressure of the spring **125**. The spring loaded ball **124** serves not only to constrain the bobbin in place in the thread case but also to provide an adjustable frictional resistance to turning of the bobbin so as to impart a drag or tension on any thread wound on the bobbin and used in stitch formation.

The thread case is formed with a needle accommodating aperture **127** and with a pair of radially extending pins **128** adapted to enter the bayonet slots **97** in the thread case carrier. When the pins **128** are inserted in the bayonet slots, the two-armed spring **98** serves to urge the pins into locked relation in the slots **97**, thus constraining the thread case in the thread case carrier. The thread case **118** and the thread case carrier **91** are thus locked together and serve during all operations of the machine as an integral unit which may be referred to as an under thread carrier member. The thread case and thread case carrier are preferably constructed as separable parts, however, for ease of assembly and convenience in providing access to the bobbin **110**.

Seated in the thread case and extending axially from a point adjacent the periphery thereof is a thread cutting knife blade **129**, the purpose of which will be described hereinafter.

The loop-taker parts thus far described provide a complete loop-taker, that is a construction capable of cooperating with a threaded needle to form lock stitches provided that a supply of thread is wound on the bobbin. FIG. 8 illustrates the assembled loop-taker parts with a thread wound on the bobbin and includes a fragment of the throat plate and a work fabric. The loop-seizing beak will carry a loop of needle thread about the bobbin with one limb of the loop entering into the gaps **84**, **87** and **96** in the raceway and bearing rib and passing between the bobbin and the hook body, and the other limb of the needle thread loop passing over the exposed face of the thread case and thread case carrier.

In order to replenish the bobbin thread from the needle thread supply, the bed shaft **35** is formed with an axial bore **140** in which bore is disposed a rod **141**. An annular groove **142** formed in the rod **141** is entered by a pin **143** threaded into a collar **144** slidable along the bed shaft, the pin **143**, extending through an elongated radial aperture **145** formed in the bed shaft. A coil spring **146** is constrained between the slidable collar **144** and a collar **147** fixed on the bed shaft so as to bias the rod **147** axially in a direction away from the loop-taker. The rod **141** protrudes past the end of the bed shaft and extends into the cup-shaped loop-taker body.

Secured to the rod **141** within the cup-shaped loop-taker body is a bobbin winding member indicated generally as **150**, which is provided with means for performing four distinct functions; first, it ensures that a needle thread will be drawn through the eye of the needle by the loop-taker; second, it guides the needle thread into the bobbin groove **111** rather than about the bobbin as occurs in normal sewing, third, it drives the bobbin so as to wind thread thereon; and fourth, it augments the cutting action of the knife blade **129** as will be hereinbelow explained. The bobbin winding member is secured to the rod **141** by a screw **151** and is formed with a circular flange **152** defining a recess **153** adapted to accommodate the cylindrical drum **110** of the bobbin. The outside surface **154** of the flange **152** is tapered inwardly toward the mouth of the recess **153** so as to define a conical thread guiding surface effective when the rod **141** is shifted toward the loop-taker, to direct a needle thread loop into the groove **111** of the bobbin. A slot **155** is cut into the flange **152** of the bobbin winding member for augmenting the cutting action of the knife blade **129** in cutting the tag end of thread on the loop-seizing beak, as illustrated in FIG. 15, and as will be further described in connection with the operation of this invention.

The bobbin winding member is formed with a quadrant-shaped radially projecting arm **156**, which is disposed snugly in the gap in the flange **83** of the loop-taker body. An arcuate finger **157** formed at one side of the arm **156** is disposed opposite the loop-seizing beak **85**. The arm **156** and the gap **84** thus provide an interlocking connection between the loop-taker body portion and the bobbin winding member, ensuring rotation of the bobbin winding member with the loop-taker body. The finger **157** serves when the rod **141** is shifted toward the loop-taker to clamp a needle thread loop securely on the hook beak **85**.

Secured on the back of the bobbin winding member by screws **158** is a leaf spring **159**, apertured as at **160**, to accommodate the rod **141** and fitted at its free extremity with a pin **161** which extends through an opening **162** in the control member into the recess **153** therein. The pin **161** is disposed in alignment with the arcuate slots **117** on the inside face of the bobbin drum and when the rod **141** is shifted toward the loop-taker, the pin **161** is adapted to enter one of the slots **117** to drive the bobbin. The spring **159** permits the pin **161** to yield should the initial contact of the pin with the bobbin occur on one of the spaces between the arcuate slots **117**. The bobbin winding member can, therefore, always be shifted fully into an operative position in which the finger **157** clamps a thread loop on the loop-seizing beak and the conical guide surface **154** leads into the bobbin groove **111** whether or not the pin **161** seats initially into one of the slots **117**.

Referring to FIGS. 2 and 5, the mechanism will now be described for shifting the rod **141** toward the loop-taker to carry the bobbin winding member **150** into operative position. Journaled in the pedestal **22** of the machine frame for endwise shifting movement substantially parallel to the axis of the bed shaft is a plunger **170**. The plunger is formed with an axial bore **171** in which a rod **172** is telescopically received. A radial pin **173** fast in the rod **172** extends outwardly through a slot **174** formed in the plunger **170** and a coil spring **175** is constrained on the rod **172** between the plunger **170** and a block **176** fast on the rod **172**. A socket **177** formed in the block **176** provides a seat into which the end of the rod **141** is received.

Carried on the pedestal **22** of the machine frame is a bushing **178** for a vertical rock shaft **179** having fast at its upper extremity a pair of rock arms **180** and **181**, the rock arm **180** being apertured, as at **182**, to embrace the free extremity of the plunger **170**. Fast on the lower extremity of the rock shaft **179** is a cam follower rock arm **183** terminating in a finger **184** adapted to bear against the periphery of the pattern cam **21** of the sewing machine. A pair of cam lugs **185**, **186**, are adjustably secured by screws **187** and slots **188** to the periphery of the pattern cam **21** in position to act upon the follower finger **184**. The cam lug **185** serves to initiate movement of the follower rock arm to cause movement of the bobbin winding member **150** into operative position while the cam lug **186** determines the point at which the follower rock arm can be returned and the bobbin winding member **150** shifted into inoperative position by the spring **146**.

Referring to FIGS. 1 and 2, the rock arm **181** on the upper extremity of the rock shaft **179** terminates in a cam finger **190** having an inclined cam surface **191** disposed beneath one arm of a bell crank lever **192** pivoted in the bracket arm **24**. The other arm of the bell crank

192 abuts one end of a plunger 193 slidable in a bearing tube 194 secured on the bracket arm. The plunger is wedge-shaped at the opposite end and is disposed to enter between the pressure disks of the thread tension devices 51. A spring 195 on the plunger 193 and constrained between the bearing tube 194 and a collar 196 fast on the plunger serves to bias the tension releasing plunger out of engagement with the disks of the tension device.

Operation

FIGS. 1 through 7 illustrate the sewing machine in an at rest position between cycles of operation. In this position, the sewing machine drive will be interrupted and the main shaft 25 will be locked with respect to the machine frame by the stop motion mechanism with the pattern cam 21 in the position illustrated in FIGS. 1, 2 and 3. In this position of the pattern cam, the cam follower 76 of the thread cutting mechanism is disposed opposite the radial slot 78 of its cam groove 77 so that the work clamp 58 may be opened and the thread severing knives 75 may be actuated by the operator by depression of the lever 70. Thus, when the work clamp is opened, the needle thread will be severed beneath the work and the bobbin thread will be severed at the work and a small amount of thread withdrawn from the bobbin by the action of the knives 75. It will be apparent, therefore, that the amount of thread wound on the bobbin is carefully controlled so that just enough is wound to provide for the tack of stitches to be sewn, then the action of the knives 75 will completely withdraw the tag end of thread from the bobbin and there will be no build up of these tag ends in the bobbin to clog the mechanism. The manner in which the careful control of the winding is accomplished will be described hereinbelow.

With reference to FIG. 3, it will be understood that at the completion of each cycle of stitching, the sewing machine will be stopped with the follower finger 184 of the bobbin winding cam follower poised adjacent the leading edge of the cam lug 185 and that the work shifting cam followers 62 and 66 will have entered circular segments 63′ and 67′ of their respective cam grooves 63 and 67. At the beginning of each cycle of machine operation, therefore, the winding cam follower 183 will be actuated immediately and the work shifting or work feeding mechanism, which is the shiftable work clamp 58 in the drawings, will be immobilized so that during winding of the bobbin the needle will penetrate, successively, the same hole in the work fabrics held in the work clamp 58.

When the sewing machine is started by actuation of the start lever 29, the initial movement of the pattern cam 21 will cause the cam lug 185 to actuate the follower lever 183 to oscillate the shaft 179 on the initial down stroke of the needle 40. Consequent turning movement of the rock arm 181 will cause the cam surface 191 to underride the bell crank 192 and thus to shift the plunger 193 to the left, as viewed in FIG. 1, to cam apart the disks of the thread tension device 51 and to release the usual needle thread tension.

Counterclockwise movement of the rock arm 180, as best illustrated in FIG. 5, will shift the plunger 170 and the rods 172 and 141 to the left, thus shifting the bobbin winding member 150 from the position illustrated in FIG. 7 to that illustrated in FIGS. 11, 13 and 15. The spring 175 and the pin and slot connection 173, 174, between the plunger 170 and the rod 172 provides for an excess of movement of the rock arm 180 without a binding of the parts.

By means of the screws 187 and the slots 188, the position of the cam lug 185 on the pattern cam 21 may be adjusted so as to effect the shift of the bobbin winding member 150 in timed relation with the movement of the hook beak 85 and the needle 40 so that the finger 157 on the bobbin winding member will be moved against the hook beak 85, after the beak has seized a loop of needle thread. Since the segmental arm 156 of the bobbin winding member 150 is fitted into the gap 84 of the hook body, the bobbin winding member 150 will be driven with the hook and a needle thread loop so clamped against the beak 85 will remain so clamped throughout the winding operation.

As the bobbin winding member 150 is shifted toward the left as viewed in FIGS. 5, 13 and 15, the tapered flange 154 of the bobbin winding member will be shifted over a portion of the bobbin 110 and the bobbin will occupy a position partly within the recess 153 of the bobbin winding member. As the needle thread is drawn down by the beak 85 and the clamping finger 157, the tapered thread camming surface 154 will thus guide the thread into the bobbin groove 111, as illustrated in FIG. 13.

The pin 161 mounted on the spring 159 at the back of the bobbin winding member serves as a driving connection to turn the bobbin 110 to wind thread thereon. The pin seats in any one of the arcuate slots 117 in the bobbin but should the pin 161 first engage a space between the slots 117, the spring 159 will yield, permitting the thread clamping finger 157 and the thread guiding surface 154 to continue to move into operative position in the interim while the pin 161 slips into one of the slots 117.

The groove 111 of the bobbin 110 is preferably made with a sharp V shape in cross section, as best illustrated in FIG. 7, so that when a needle thread is wrapped once around itself in the bobbin groove the thread will bind in the groove and thereafter turning of the bobbin by way of the control member 150 and the pin 161 thereon will continue to wind needle thread on the bobbin.

The knife 129 carried on the thread case is arranged as illustrated in FIG. 13, out of the normal path of travel of the needle thread loop on the loop-seizing beak so that in normal sewing when the needle thread loop passes behind the bobbin, and during the first needle penetration when winding has not yet commenced, as illustrated in FIG. 13, the needle thread extending from the beak 85 to the needle will pass alongside the knife 129 and not be severed. When, however, the needle thread has been guided into the bottom groove and the lead of the thread exists from the bobbin groove 111 to the beak 85, as illustrated in FIGS. 14 and 15, the needle thread will be carried against the knife and will be severed between the bobbin and the beak. The slot 155 in the flange 153 of the control member is positioned so as to accommodate the thread leading from the bobbin to the hook beak and, as illustrated in FIGS. 14 and 15, the slot 155 serves to catch and hold the thread closely adjacent the knife 129 so as to augment the cutting action and to insure that the thread will be severed at a uniform distance from the bobbin on each successive cycle of machine operation.

After the first complete rotation of the hook beak has occurred and the thread between the beak and the bobbin has been severed by the knife 129, winding of thread on the bobbin will continue as long as the bobbin continues to be driven by the pin 161 on the bobbin winding member. The beak 85 will not seize a second loop from the needle as long as winding continues since the feed of the work is immobilized and one of the limbs of the needle thread leads directly to the bobbin. In order to form a loop for seizure by the hook beak, it is necessary that two limbs of the needle thread extend from the needle eye upwardly to the work.

The duration or extent of winding is thus determined by the position of the cam lug 186 on the pattern cam 21. When the finger 184 of the cam follower arm 183 passes the trailing end of the cam lug 186, the spring 146 will return the rod 141 and retract the bobbin winding member to the position illustrated in FIG. 8. Simultaneously, the spring 195 will retract the tension release rod 93 and the needle thread tension will be re-established. The

severed end of thread clamped between the hook beak and the finger 157 will be released and will fall out of the loop-taker.

The cessation of winding may be timed to occur at any point during the needle reciprocation and thus a very accurate control may be had of the amount of thread that is wound on the bobbin.

Stitching will not occur until the work feeding mechanism becomes operative. As illustrated in FIG. 3, the cam groove begins to deviate from a circular path 63' to shift the follower arm 62 shortly after the cam lug 186 terminates the winding of thread on the bobbin.

On the succeeding down stroke of the needle, in penetrating a different position on the work fabric, the needle will form a loop for seizure by the hook beak 85. Since the bobbin winding member 150 is retracted into the position illustrated in FIG. 8, the beak will carry the seized needle thread loop around the bobbin 110 and a normal lock stitch will result.

Stitching in the normal manner of lock stitch sewing machines will then continue until the stop motion mechanism of the sewing machine again becomes effective to stop the machine. When the work clamp is then opened to release the work, the thread cutter 74 will sever the needle and bobbin threads and will draw out the tag end of thread on the bobbin provided only that the cam lugs 185 and 186 have been properly adjusted to wind no more thread than is necessary for the tack of stitches being made. It will be apparent that this invention provides a completely automatic mechanism of sewing lock stitch seams using a single supply of thread for both the needle and the bobbin. Moreover, this invention provides for accuracy in the replenishing of the bobbin thread that a minimum of thread is lost during each cycle and the bobbin kept free of the tag ends of thread prevalent during each cycle of stitching.

Having thus described the nature of the invention, what I claim herein is:

1. A lock stitch sewing machine having a frame, a thread carrying needle carried in said frame, a loop-taker journaled in said frame, an under thread carrier member journaled with respect to said loop taker, a bobbin freely journaled in said under thread carrier member, drive elements operatively connecting said needle and said loop-taker for interrelated lock stitch forming motions, actuating means for said drive elements for causing said needle and said loop-taker to partake of interrelated lock stitch forming motions, means operated by said actuating means for winding a thread on said bobbin while said needle and loop taker are operatively connected by said drive elements and said drive elements are operatively connected to said actuating means, means associated with said needle and loop taker for sewing lock stitches using a thread wound on said bobbin by said last mentioned means, and interengaging rotation restraining means on said sewing machine frame and on said under thread carrier member effective to restrain said under thread carrier member from rotation during operation of both said winding means and said sewing means.

2. A lock stitch sewing machine having a thread carrying needle, a cup-shaped rotary loop-taker, actuating means connecting said needle and said loop-taker for causing them to operate in timed relation in the formation of lock stitches, bobbin carrying means journaled in said cup-shaped loop-taker, means for constraining said bobbin carrying means against rotation with said loop-taker, a bobbin journaled in said bobbin carrying means and disposed within said cup-shaped loop-taker, a bobbin winding member slidably supported within said cup-shaped loop-taker for bodily movement into and out of engagement with said bobbin, operatively interengaging means on said bobbin winding member and on said loop-taker constraining said bobbin winding member for rotary movement with said loop-taker, and means driven by said sewing machine for shifting said bobbin winding member into engagement with said bobbin during operation of said actuating means.

3. A lock stitch sewing machine having a thread carrying needle, a cup-shaped rotary loop-taker, actuating means connecting said needle and said loop-taker for causing them to operate in timed relation in the formation of lock stitches, bobbin carrying means journaled in said cup-shaped loop-taker, means for constraining said bobbin carrying means against rotation with said loop-taker, a bobbin journaled in said bobbin carrying means and disposed within said cup-shaped loop-taker and coaxially therewith, a bobbin winding member slidably supported within said cup-shaped loop-taker for bodily movement axially thereof, said bobbin winding member being formed with a bobbin accommodating recess, a radial arm formed on said bobbin winding member, said loop-taker being formed with an axially extending gap into which said radial arm projects to constrain said bobbin winding member for rotary movement with said loop-taker, a pin extending into said bobbin accommodating recess substantially parallel with the axis of turning movement of said bobbin, spring means sustaining said pin on said bobbin winding member for limited movement of said pin axially of said bobbin, said bobbin being formed with an arcuate slot disposed to accommodate said pin, and means driven by said sewing machine during operation of said actuating means for shifting said bobbin winding member to carry said pin into the arcuate slot in said bobbin.

4. In a lock stitch sewing machine having a thread carrying eye pointed needle, a loop-taker, a bobbin freely journaled in said loop-taker, a loop-seizing beak carried on said loop-taker and adapted to engage and carry about said bobbin a loop of thread extending from said needle eye, and actuating means connecting said needle and said loop-taker for causing them to operate in timed relation in the formation of lock stitches, means for winding thread from the needle eye on said bobbin during operation of said actuating means comprising shiftable thread guiding means associated with said loop-taker and having an operative position in which said thread loop under the influence of said loop-seizing beak is guided into said bobbin, shiftable bobbin rotating means driven by said actuating means and having an operative position in driving engagement with said bobbin, and a control member driven by said actuating means and effective periodically to shift both said thread guiding means and said bobbin rotating means into operative position.

5. In a device as set forth in claim 4, a thread gripper, means shiftably supporting said thread gripper on said loop-taker for movement into and out of operative position clamping said thread loop on said loop-taker beak, and means operatively connecting said thread gripper with said control member for movement of said thread gripper, said thread guiding means, and said bobbin rotating means simultaneously into operative position.

6. In a device as set forth in claim 5, a thread cutting knife means associated with said loop-taker and disposed in the path of travel of a limb of thread extending from said bobbin to said thread gripper, and means for restraining said knife from rotation with said loop-taker.

7. In a lock stitch sewing machine having an endwise reciprocatory thread carrying needle, a loop-taker adapted to engage and carry about itself loops of needle thread from said thread carrying needle, a thread carrying bobbin freely journaled within said loop-taker, actuating means operatively connecting said needle and said loop-taker for causing them to operate in timed relation in the formation of lock stitches, and a means for feeding a work fabric with respect to said needle, a mechanism for replenishing the bobbin thread during operation of said actuating means comprising, shiftable needle thread guiding means associated with said loop-taker and having an operative position in which a needle thread loop under the influence of said loop-taker will be guided into said bobbin, shiftable bobbin rotating means driven by said

actuating means and having an operative position in driving engagement with said bobbin, a control member driven by said actuating means and effective periodically to shift both said needle thread guiding means and said bobbin rotating means into operative position, and means driven by said actuating means for immobilizing said work feeding means when said needle thread guiding means and said bobbin rotating means are in operative position.

8. In a device as set forth in claim 7, means driven by said actuating means for shifting both said needle thread guiding means and said bobbin rotating means out of operative position, and means driven by said actuating means for initiating the operation of said work feeding means prior to the needle reciprocation next succeeding the movement of said needle thread guiding means and the bobbin rotating means out of operative position.

9. In a rotary loop-taker for a lock stitch sewing machine of the type having a cup-shaped rotating loop-taker body, a loop-seizing beak carried on said loop-taker body, a stationary thread case, and means journaling said thread case within said rotating loop-taker body, a thread carrying bobbin disposed within said loop-taker body, means journaling said bobbin in said thread case for turning movement substantially coaxial with said rotary loop-taker body, a bobbin winding member disposed within said loop-taker body, means supporting said bobbin winding member in engagement with said loop-taker body for rotation therewith and for sliding movement axially thereof, thread clamping means carried on said bobbin winding member for gripping a thread loop on said loop-seizing beak, thread guiding means carried on said bobbin winding member for directing a thread loop clamped on said loop-seizing beak onto said bobbin, bobbin rotating means carried on said bobbin winding member and means for shifting said bobbin winding member axially within said loop-taker body to effect movement of said thread clamping means, said thread guiding means, and said bobbin rotating means simultaneously into operative positions.

10. A device as set forth in claim 9 in which said loop-taker body is formed with a peripheral opening and in which said thread clamping means comprises a radial arm carried on said bobbin winding member, said arm extending through said peripheral opening to interlock said bobbin winding member for rotation with said loop-taker body, and a finger carried on said radial arm and disposed for engagement with said loop-seizing beak to clamp a thread loop thereon.

11. A device as set forth in claim 9 in which said thread guiding means comprises a circular-shaped flange formed on said bobbin winding member to define a socket adapted on axial movement of said bobbin winding member to accommodate and enclose a portion of said bobbin, said flange being formed with a substantially conical outer surface which is inclined inwardly toward the mouth of said socket.

12. A device as set forth in claim 9 in which said bobbin rotating means comprises an interlocking plunger and socket arranged between said bobbin and said bobbin winding member which are to be drivingly connected, said plunger being slidably supported substantially parallel to the axis of turning movement of said bobbin in one of said parts to be drivingly connected, and said socket being formed in the other of said parts to be drivingly connected, and spring means operatively connected between said plunger and the element in which said plunger is supported.

13. A device as set forth in claim 9 in which said means journaling said bobbin in said thread case comprises an axial stud secured on said bobbin, said thread case being formed with an axial bore to receive said stud, a spring detent carried by said thread case and disposed projecting into said bore against said stud, and means for adjusting the pressure of said spring detent to vary the frictional resistance to turning of said bobbin.

14. In a cyclically operated lock stitch sewing machine having a cup-shaped rotary loop-taker, a bobbin journaled coaxially within said rotary loop-taker, an endwise reciprocatory thread carrying needle cooperating with said loop-taker in the formation of lock stitches, a stop motion mechanism, and a stop motion controlling cam means driven by said sewing machine, means for automatically winding needle thread on said bobbin comprising, a bobbin thread winding member slidably supported with said rotary loop-taker for bodily movement axially thereof, operatively interengaging means on said bobbin winding member and on said rotary loop-taker constraining said bobbin winding member for rotary movement with said loop-taker, a bobbin winding cam means driven by said sewing machine in timed relation with said stop motion controlling cam means and effective to shift said bobbin winding member axially of said loop-taker into operative engagement with said bobbin during a predetermined period at the start of each cycle of sewing machine operation.

15. In a cyclically operated lock stitch sewing machine having a cup-shaped rotary loop-taker, a bobbin journaled coaxially within said rotary loop-taker, an endwise reciprocatory thread carrying needle cooperating with said loop-taker in the formation of lock stitches, a stop motion mechanism, and a stop motion controlling cam means driven by said sewing machine, means for automatically winding needle thread on said bobbin comprising, a loop-taker driving shaft journaled in said sewing machine, and formed with an axial bore, a rod endwise slidable in said axial bore, a bobbin thread winding member disposed within said cup-shaped loop-taker and secured to said endwise slidable rod, operatively interengaging means on said bobbin winding member and on said rotary loop-taker constraining said bobbin winding member for rotary movement with said loop-taker, a bobbin winding cam means driven by said sewing machine in timed relation with said stop motion controlling cam means, cam follower means carried by said sewing machine and disposed for actuation by said bobbin winding cam means for shifting said rod endwise to move said bobbin winding member axially of said loop-taker into operative engagement with said bobbin during a predetermined period at the start of each cycle of sewing machine operation.

16. In a lock stitch sewing machine having a reciprocatory thread carrying needle, a loop taker, a bobbin freely journaled in said loop taker, and actuating means connecting said needle and said loop taker for causing them to operate in timed relation in the formation of lock stitches, the combination comprising, a thread cutting means for severing the needle thread extending between the lock stitches and the needle, means for operating said thread cutting means, and means effective during the needle reciprocation next succeeding the operation of said thread cutting means for winding on the bobbin the free extremity of thread extending from said needle.

17. In a lock stitch sewing machine having a thread carrying eye-pointed needle, a work fabric supporting throat plate having an aperture therein, mechanism for reciprocating said needle endwise to cause its eye-pointed portion to penetrate a work fabric on said throat plate and descent through said aperture, a needle-loop seizing member operating in timed relation with said needle and located in a position adjacent to the throat plate to seize a thread loop from said needle when its eye-pointed end passes through the aperture in the throat plate, the combination comprising a thread cutting means for severing the needle thread extending between the needle and the work fabric, means for operating said thread cutting means when said needle is raised out of the work fabric, thread clamping means associated with said loop seizing member for seizing and securing the needle thread on said loop taker, a bobbin journaled in said loop seizing member, thread guiding means for directing to the bobbin a thread seized by said thread clamping means, thread winding means for winding said thread on said bobbin, and means automatically effective during the needle pene-

tration next succeeding the operation of said thread cutting means for rendering said thread clamping means, said thread guiding means, and said thread winding means effective.

18. In a lock stitch sewing machine having an endwise reciprocatory thread carrying needle, means supporting a work fabric for penetration by said needle, a loop taker, actuating means for operating said loop taker in timed relation with said needle in the formation of lock stitches in said work fabric, and a bobbin freely journaled in said loop taker, the combination comprising thread cutting means for severing the needle thread extending between the work fabric and the needle to provide a free extremity of needle thread extending from said needle means for operating said thread cutting means when said needle is raised out of the work fabric, means operating together with said loop taker and automatically effective during the needle penetration next succeeding the operation of said thread cutting means for securing the free extremity of said needle thread to said bobbin, means for rotating said bobbin during operation of said needle and loop taker actuating means to wind needle thread thereon, means for constraining the path of needle reciprocation with respect to said work fabric to cause successive needle penetrations at the same point in the work fabric during the operation of said bobbin rotating means, and means for discontinuing the operation of said bobbin rotating means and simultaneously effecting a relative motion of said work fabric with respect to said path of needle reciprocation.

19. In a lock stitch sewing machine having a casing, a thread carrying needle supported in said casing for endwise reciprocatory movement, a loop-taker journaled in said casing for turning movement, a bobbin means, means for journaling said bobbin means with respect to said loop taker, drive elements operatively connecting said needle and said loop-taker in timed relation for causing said loop-taker to seize and carry loops of a thread carried by said needle about said bobbin means in the formation of lock stitches, actuating means for said drive elements, means for winding a thread carried by said needle on said bobbin means comprising thread guiding means, means operated by the actuating means for said drive elements for shifting said thread guiding means relatively to said loop-taker and said bobbin means into an effective position for urging at least one limb of said thread loops seized by said loop-taker into an abnormal path into said bobbin means, rotating means for said bobbin means, means for rendering said bobbin rotating means effective automatically upon operation of said means for shifting said thread guiding means into said effective position, and means operated by said actuating means for operating said bobbin rotating means to wind said limb of thread on said bobbin means while said needle and loop taker are operatively connected to said actuating means.

20. In a lock stitch sewing machine having a casing, a thread carrying needle supported in said casing for endwise reciprocatory movement, a loop-taker journaled in said casing for turning movement, a bobbin means, means for journaling said bobbin means with respect to said loop taker, drive elements operatively connecting said needle and said loop-taker in timed relation for causing said loop-taker to seize and carry loops of thread carried by said needle about said bobbin means in the formation of lock stitches, actuating means for said drive elements, means for winding a thread carried by said needle on said bobbin means comprising thread guiding means shiftable relatively to said bobbin means into an effective position for guiding a thread loop seized by said loop-taker into an abnormal path into said bobbin means, means operated by the actuating means for said drive elements for shifting said thread guiding means into said effective position, a retractable rotating member for said bobbin means driven by said actuating means in timed relation with said needle and loop taker, and means for automatically shifting said bobbin rotating member into driving relation with said bobbin means simultaneously with a shift of said thread guiding means into said effective position.

21. In a lock stitch sewing machine having a casing, a rotary loop-taker journaled in said casing and formed with a cavity, a bobbin means, means for journaling said bobbin means within said loop taker cavity so that a thread may be passed between said loop taker and said bobbin means, means for constraining said bobbin means relatively to said loop-taker cavity to provide for passage therebetween of thread loops seized and being manipulated by said loop-taker during conventional lock stitch formation, and a means for winding a thread on said bobbin means comprising thread guiding means, means for shifting said thread guiding means relatively to said loop-taker and said bobbin means into an effective position within said loop taker cavity and between said bobbin means and said loop-taker for urging a thread loop seized and being manipulated by said loop-taker onto said bobbin means.

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