

G. S. GATCHELL.
 THREAD CONTROLLING MECHANISM FOR SEWING MACHINES.
 APPLICATION FILED JULY 1, 1918.

1,361,247.

Patented Dec. 7, 1920.

6 SHEETS—SHEET 1.

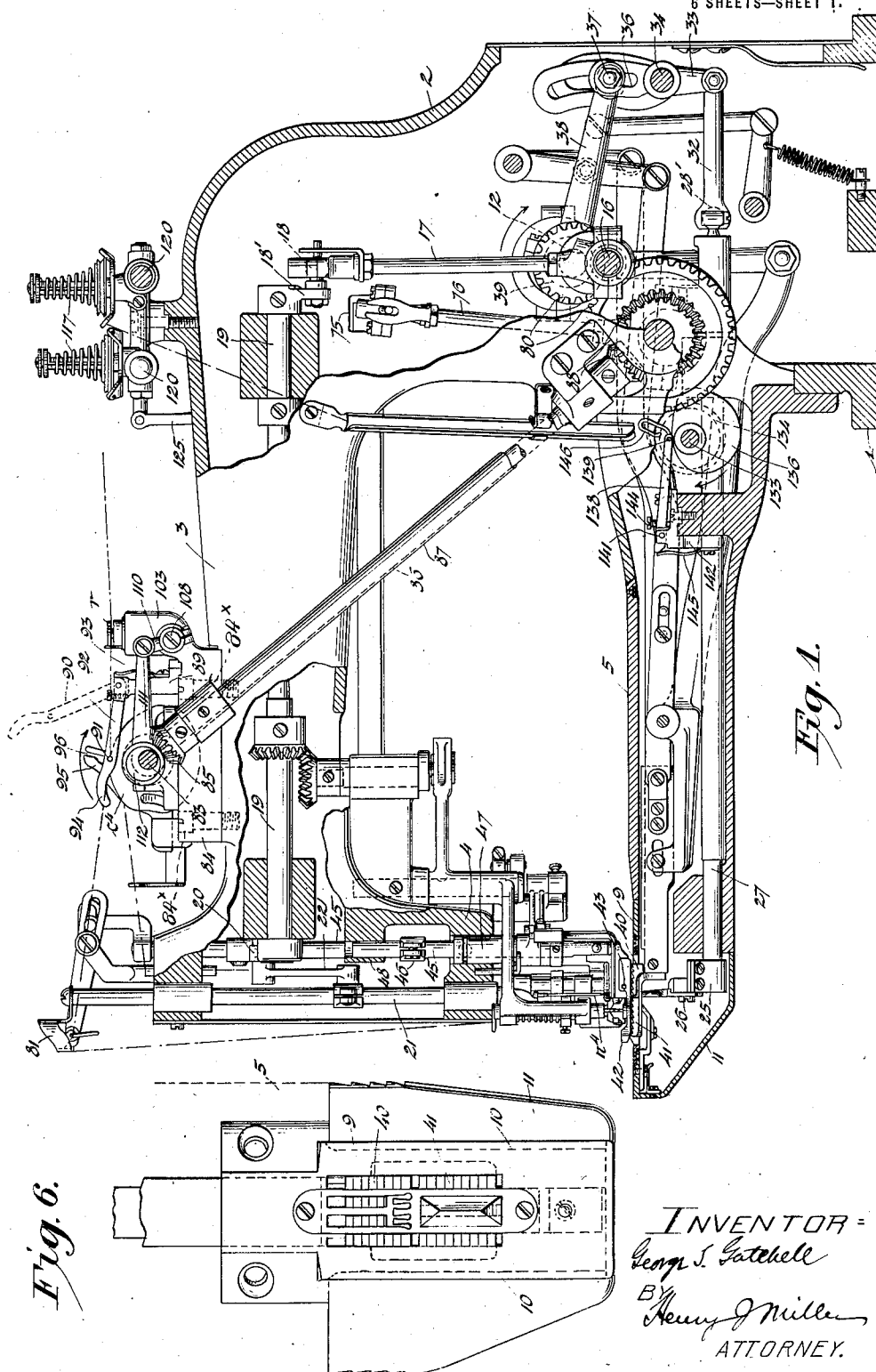


Fig. 1.

Fig. 6.

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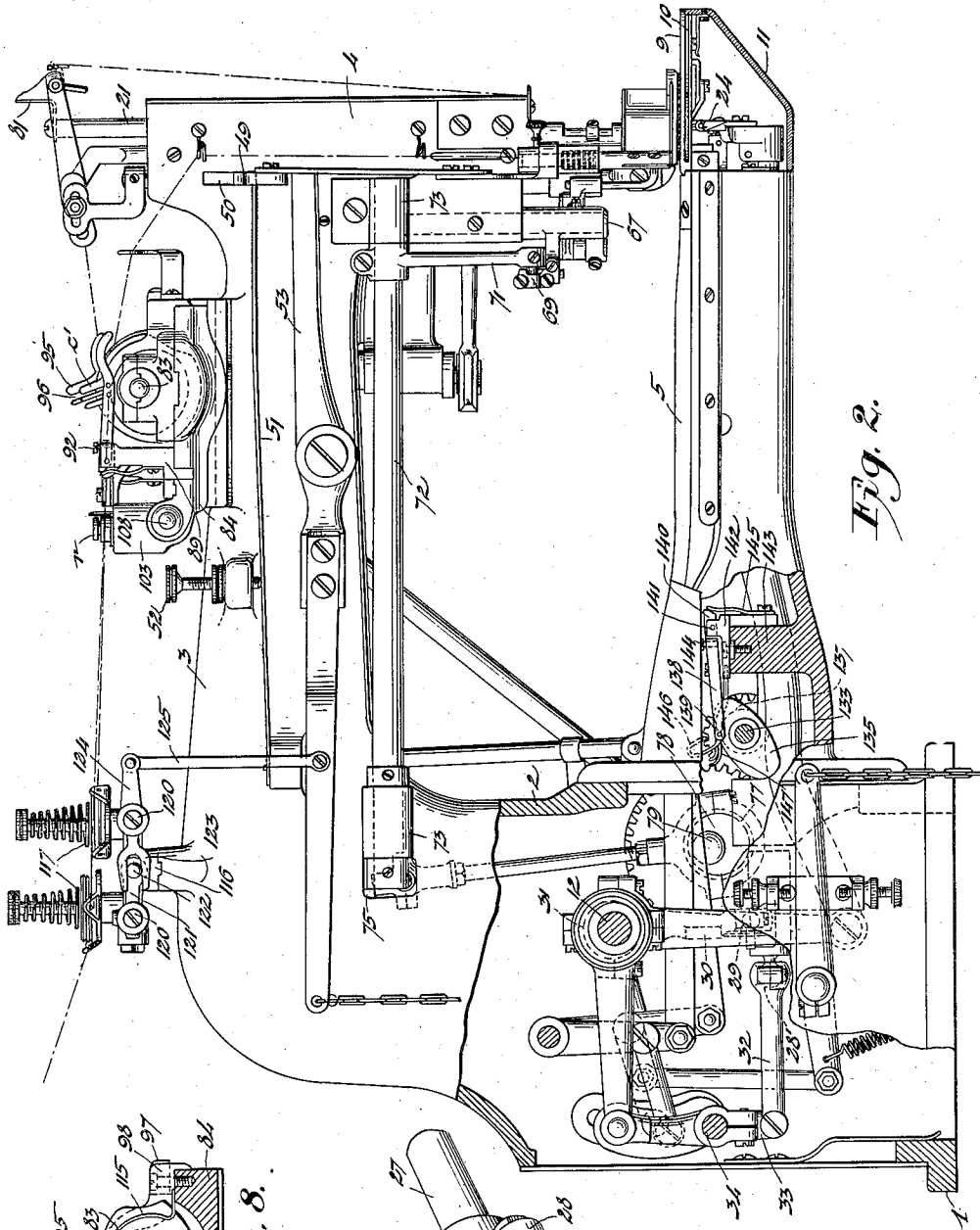


Fig. 2.

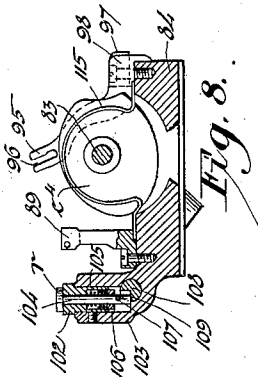


Fig. 8.

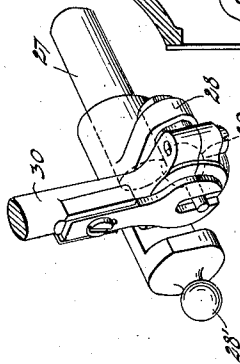


Fig. 7.

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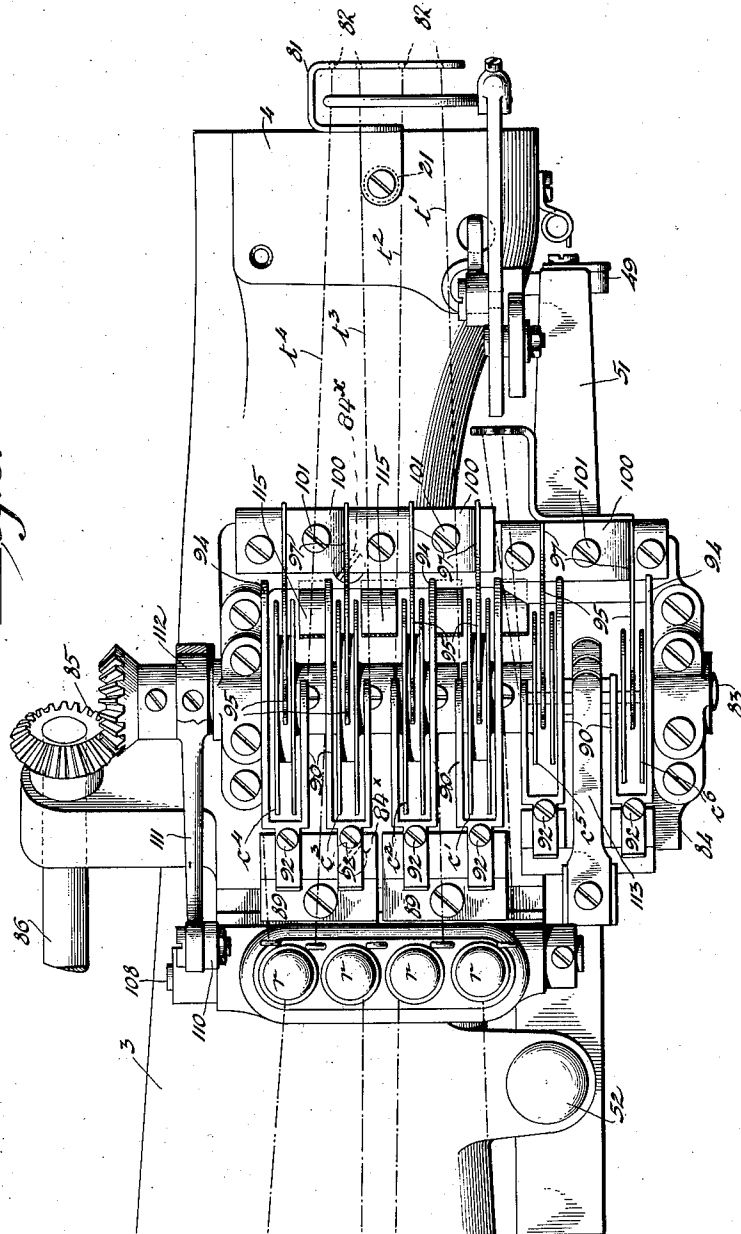
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6 SHEETS—SHEET 4.

Fig. 5.



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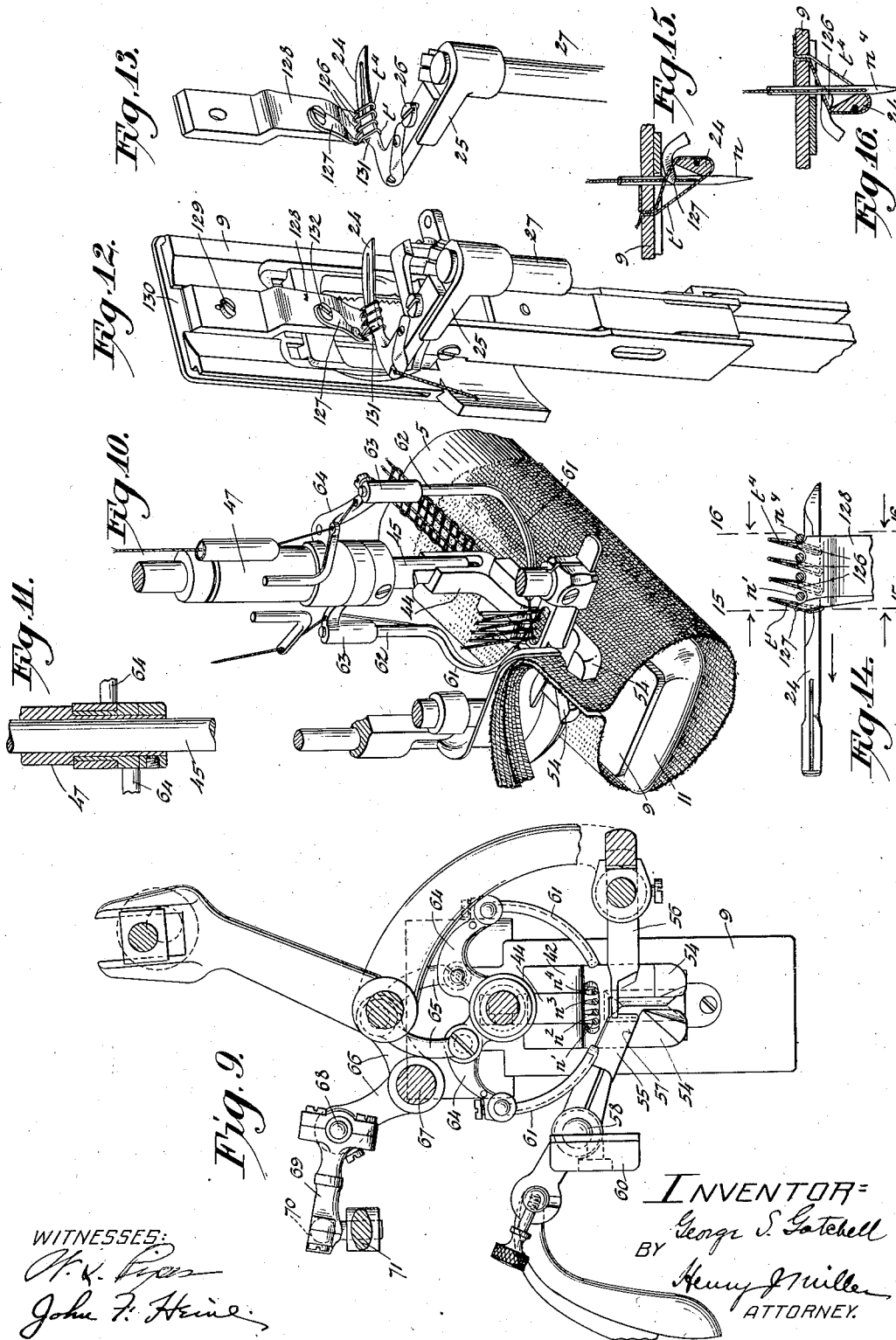
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6 SHEETS—SHEET 5.



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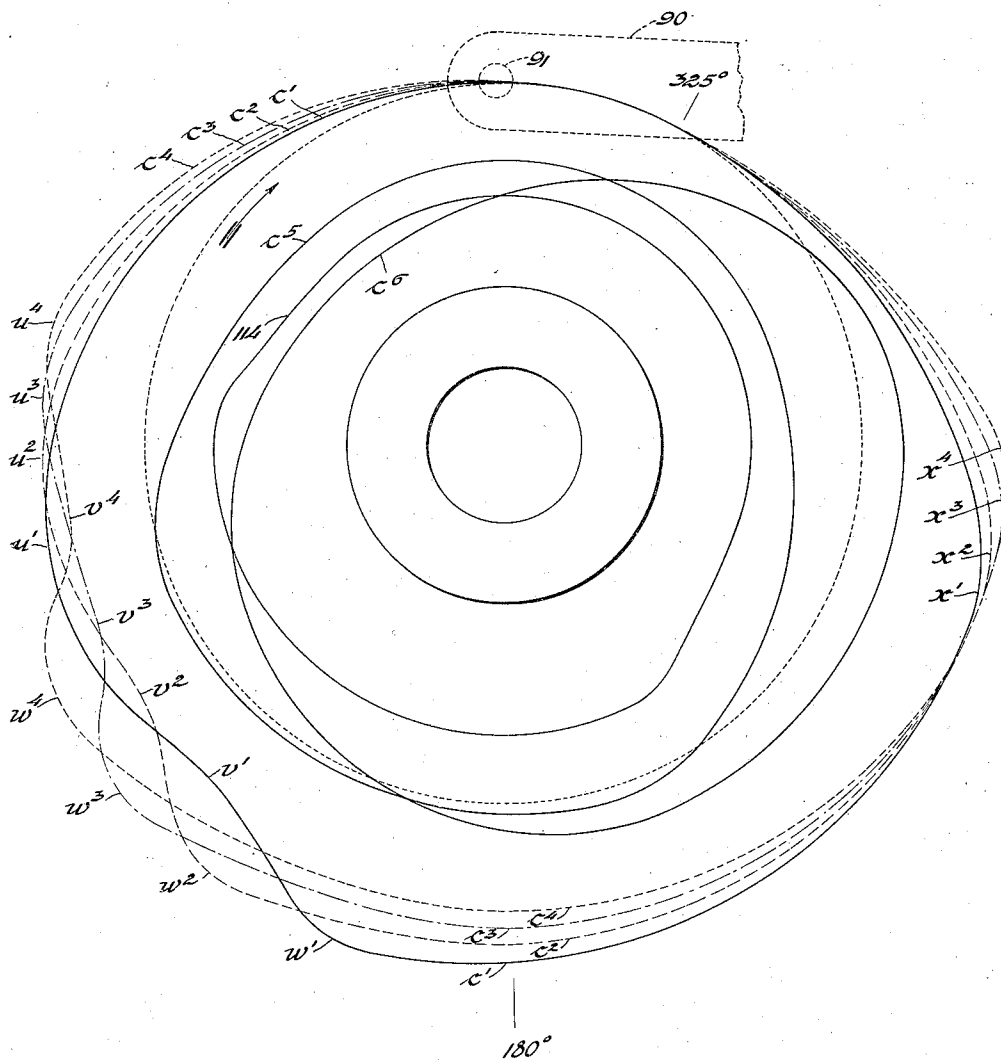


Fig. 18.

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UNITED STATES PATENT OFFICE.

GEORGE S. GATCHELL, OF ROSELLE PARK, NEW JERSEY, ASSIGNOR TO THE SINGER MANUFACTURING COMPANY, A CORPORATION OF NEW JERSEY.

THREAD-CONTROLLING MECHANISM FOR SEWING-MACHINES.

1,361,247.

Specification of Letters Patent.

Patented Dec. 7, 1920.

Original application filed August 10, 1917, Serial No. 185,446. Divided and this application filed July 1, 1918. Serial No. 242,702.

To all whom it may concern:

Be it known that I, GEORGE S. GATCHELL, a citizen of the United States, residing at Roselle Park, in the county of Union and State of New Jersey, have invented certain new and useful Improvements in Thread-Controlling Mechanisms for Sewing-Machines, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to thread-controlling mechanism for sewing machines, more particularly of the multi-needle chain-stitch type disclosed in the patent to Molyneux *et al.*, No. 1,266,036 of May 14, 1918, and has for an object the improvement of the thread-controlling mechanism of the machine disclosed therein to overcome the noise and speed-limitation incident to the use of cam-actuated and spring-controlled thread-engaging levers, and to prevent skipping of stitches or thread-breakage due to abnormal displacement or bunching of the needle-loops on the looper, thereby rendering the machine quiet, smooth-running, and efficient under high-speed operating conditions.

A further object of the invention is to provide a machine with an improved and simplified covering-thread controlling mechanism.

Further objects of the invention will appear from the following description and claims.

The present improvements are preferably embodied in a four-needle single-looper machine of the cylinder-bed type adapted to produce a seam such as disclosed in the patent to Munsing No. 506,524, October 10, 1893; an additional needle being added in the present instance, to form an additional row of stitches. The needle-thread controlling mechanism includes a series of thread-cams adapted to act on the needle-threads directly, thereby securing a positive action upon the needle-threads and avoiding the noise and sluggishness of operation incident to the use of cam-operated thread-arms. In the present instance the thread-cams are specially shaped to closely and differentially control the needle-threads,

as will be hereinafter explained, to meet the exacting thread-control requirements of a multiple needle single-looper machine of the present character.

The covering-thread controlling mechanism comprises a thread-controlling cam, a pull-off cam and a nipper mechanism acting between the two, the timing being such that a measured quantity of slack covering thread is paid out to the covering-thread fingers at the proper times for incorporation in the stitching. The covering-thread cams are preferably mounted upon a shaft which carries the needle-thread controlling

In the accompanying drawings Figure 1 is a right-side elevation of the machine partly in section. Fig. 2 is a similar view from the left-side of the machine. Fig. 3 is a front elevation of the machine with the looper-inclosing end-cap in section. Fig. 3^a is a detail elevation showing how the stripper-plates of the take-up mechanism are mounted. Fig. 4 is a rear end elevation of the machine partly in section and with the rear cover-plate removed to expose the mechanism housed within the standard. Fig. 4^a is a detail sectional view of the tension releasing mechanism. Fig. 5 is an enlarged top plan view of the forward end of the bracket-arm showing the thread-controlling mechanism supported thereby. Fig. 6 is an enlarged plan view of the free end portion of the work-arm. Fig. 7 is a perspective view of a detail of the looper-actuating mechanism. Fig. 8 is a vertical longitudinal section through the take-up supporting frame. Fig. 9 is a plan view of the mechanism carried by the bracket-arm adjacent the stitching point. Fig. 10 is a perspective view of the same, with the work in position. Fig. 11 is a vertical section taken in a plane passing through the axis of the lower section of the presser-bar shown in Fig. 10. Figs. 12 and 13 are perspective views of the mechanism at the under side of the throat-plate showing the cooperation of the looper and needle-loop detainer. Fig. 14 is a top plan view illustrating the cooperative relation of the needles, looper, needle-loops and needle-loop

detainers. Fig. 15 is a vertical longitudinal section on the line 15—15, Fig. 14, with the throat-plate and material added. Fig. 16 is a similar view on the line 16—16, Fig. 14. Fig. 17 is a transverse vertical section through the throat-plate and presser-foot with the work in position therebetween and Fig. 18 is an enlarged elevation of the needle-thread controlling cams.

- 10 As disclosed in my copending application Serial No. 185,446, filed August 10, 1917, of which this application is a division, the machine is formed with a base 1 from which rises the standard 2 carrying the overhanging bracket-arm 3 terminating in the hollow head 4. Secured to the standard 2 is the flanged rearward extremity of the tubular work-supporting arm 5 which is formed with two angularly arranged flat sides 6, 7, 20 Fig. 3, and a curved upper side 8, whereby said work-arm is substantially sector-shaped in cross-section. Secured to the front or free end of the work-arm casting is the throat-plate 9 whose opposite lateral edges 25 are grooved at 10 to slidably receive and support the end cap 11 which is sector-shaped at its rearward end to conform to the cross-sectional shape of the work-arm. The under surface of the end cap tapers 30 upwardly and the sides thereof taper forwardly toward the free end of the throat-plate, as shown in Figs. 2 and 6, to facilitate the advance of tubular work about the work-arm and toward the stitch-forming mechanism. Journaled in and crosswise of 35 the standard 2, above the horizontal plane of the work-arm and crosswise of the vertical plane of the work-arm, is the main-shaft 12 carrying a pulley wheel 13 and hand-wheel 14 both cast integral with a common hub 15.

The main-shaft is formed with a ball-crank 16 which is embraced by the lower strapped end of a pitman 17 the upper 45 strapped end of which embraces a ball-ended crank-pin 18 carried by the crank-arm 18' at the rear end of the needle-actuating rock-shaft 19 which is journaled within the bracket-arm 3 and, at its forward end, carries a crank-arm 20 connected to the reciprocating needle-bar 21 by means of the link 22. Secured to the lower end of the needle-bar 21 is the needle-clamp-block 23 which, in the present instance, is socketed 55 to receive four needles n^1 , n^2 , n^3 and n^4 arranged in a vertical plane transversely of the work-arm 5.

Mounted within the end cap 11, in co-operative relation with the needles, is the 60 thread-carrying looper 24; the upper edge of the blade of which is curved concentrically with the curved upper side of the work-arm, Fig. 3, while the lower edge 24' of said blade is but slightly curved or may 65 even be substantially straight throughout a

portion of its length. The slotted shank of the looper is secured to the looper-support 25 by a screw 26 permitting adjustment of the looper-blade toward and from the stitching plane. The looper-support is clamped 70 to the front end of the oscillating and endwise movable looper-shaft 27 which is journaled within and lengthwise of the work-arm 5 as closely as practicable to the apex of the angle formed by the flat sides 6 and 7 thereof, Fig. 3, said angle being large 75 enough to accommodate the necessary loop-seizing and -shedding strokes of the looper.

It will be seen by referring to Fig. 3 that the needle-eyes are arranged on an incline; 80 being placed at progressively lower elevations beginning with the needle n^1 to compensate for the upward movement of the needles as the looper-beak advances across the space between said needles; the purpose 85 being to insure the passage of the looper-beak at the correct distance above each needle-eye to insure seizure of the respective needle-loop. It will be further seen that the needle points are arranged substantially in 90 a common plane parallel to the plane of the throat-plate; the purpose being to insure that the previously formed needle-loops on the looper will be passed simultaneously by their respective needles at the time the lower edge 24' of the looper-blade occupies a sub- 95 stantially horizontal or otherwise favorable angular position relatively to the throat-plate.

The looper-shaft 27 carries at its rearward 100 end a crank-arm 28 having a ballcrank-pin 29 which is embraced by the lower strapped end of a link 30 the upper strapped end of which embraces a ball-eccentric 31 on the main-shaft 12 which imparts loop-seizing 105 and -shedding movements to the looper. The hub of the crank-arm 28 is formed with a rearward extension carrying a ball-ended pin 28' disposed concentrically with the axis of the looper-shaft and embraced by the 110 socketed end of a link 32 whose opposite end is connected to the depending arm 33 of a rock-lever fulcrumed to oscillate upon and independently of the cross-shaft 34 journaled in the standard 2. The upwardly ex- 115 tending arm 35 of said rock-lever is slotted at 36 to receive an adjustable pin 37 which, through the pitman 38, connects said lever with the eccentric 39 carried by the main-shaft; said eccentric serving to impart side- 120 wise or "needle-avoiding" movements to the looper.

The machine is equipped with differential feeding mechanism comprising main and 125 auxiliary feed-dogs 40 and 41, respectively, actuated through suitable connections with the main-shaft, such as shown in my said copending application.

The feed-dogs cooperate with a presser-foot comprising, in the present instance, a 130

sole-piece 42, Fig. 1, pivoted at 43 to the shank 44, Fig. 10, secured to the lower end of the presser-bar 45 which is formed in two parallel sections offset from one another and connected to move as one bar by means of the lateral arm 46. The lower section of the presser-bar is journaled in the bushing 47 and bearing lug 48, Fig. 1, and the upper section is journaled in aligned bearings formed in the bearing lug 48, Fig. 3, and in the top of the head 4. The presser-bar carries a bracket 49 extending laterally through a slot 50 in the head 4 and acted upon by a leaf spring 51 the pressure of which may be adjusted by means of the screw 52. The presser-foot may be lifted by means of the usual treadle-controlled lever 53 the forward extremity of which extends under the bracket 49. The sole-piece of the presser-foot is formed with forwardly extending spaced toes 54, Figs. 9 and 10, defining a slot within which the upturned portions of material to be trimmed pass toward the stitching point.

The machine is provided with trimming mechanism comprising, in the present instance, ledger and cutter blades 55 and 56, respectively, which operate in advance of the stitch-forming mechanism to shear off the upturned portions of material. The ledger-blade rests in a groove 57 in the upper side of the left-hand presser-foot toe 54 and is rigidly clamped to the lower end of a vertically slidable rod 58 journaled in spaced lugs 59 formed on the bracket 60 secured to and depending from the side of the head 4. The trimmer-actuating mechanism is more fully described in my said copending application.

The covering threads to be incorporated in the upper side of the seam are presented by a pair of eyed thread-fingers having curved horizontally disposed blades 61, Figs. 9 and 10, and vertically arranged shanks 62; the latter being secured in socketed bosses 63 at the free ends of the thread-finger carrying levers 64 the opposite apertured ends of which are fulcrumed upon the lower reduced end of the bushing or sleeve 47 surrounding the presser-bar, as shown in Fig. 11. The thread-finger blades are preferably curved to the same radius concentrically with the presser-bar and operate in planes one slightly above the other. Simultaneous oscillatory movements in opposite directions are imparted to the levers 64 by means of the links 65 which connect the latter with one arm of the bellcrank-lever 66 fulcrumed on the headed pin 67 carried by the head 4. The other arm of the bellcrank lever carries a ball-ended pin 68, which is connected by a link 69 to a ball-ended pin 70 carried by the lower end of the depending arm 71 clamped to the front end of the rock-shaft

72 journaled at the side of the bracket-arm in the bearing lugs 73. The rear end of the shaft 72 carries a crank-arm 74 which projects into the standard 2 through an opening 75 in the side of the latter and is connected by a ball-and-socket joint to the upper end of the pitman 76 actuated by a ball-eccentric 77 on the hollow counter-shaft 78 journaled on the fixed pin 79 in parallelism with the main-shaft and driven by the latter through two-to-one speed-reducing gear 80. The thread-fingers are thus actuated back-and-forth across the line of seam in front of the needles at one-half the frequency of reciprocation of the needles, so that each threaded-finger presents its thread to the needles alternately at opposite sides of the line of seam.

The take-up for the needle-threads consists of a thread-guiding bracket 81 secured to the top of the needle-bar 21 and formed with a horizontal bar having individual needle-thread eyes 82. Coöperating with the take-up bracket 81 to differentially control the needle threads t^1 , t^2 , t^3 and t^4 are the respective thread-engaging cams c^1 , c^2 , c^3 and c^4 , each of which comprises, in the present instance, two similar spaced disks formed integral with a common hub. Said cams are mounted on a cam-shaft 83 which is journaled in a thread-controller frame 84 detachably secured to the top of the bracket-arm by screws 84^x and is driven by a one-to-one bevel-gear connection 85 with the upper end of an inclined shaft 86 inclosed within the shaft casing 87. The lower end of the shaft 86 is connected to the counter-shaft 78 by a one-to-two speed multiplying bevel-gear connection 88, whereby the shaft 83 is driven at the same speed as the main-shaft 12. Rising from the frame 84 are two standards 89, Figs. 1, 2 and 5, to each of which are pivoted the shanks of two similar fork-shaped thread-guides 90, the tines of each fork being disposed at opposite sides of a corresponding one of said thread-cams and apertured at 91 to guide the thread across the active peripheral portion of said cam. Threaded into the shank of each thread-guiding fork 90 is an adjusting screw 92 which determines the position or height of the thread-eyes 91. A spring 93 presses against the inclined rear end of the shank of each fork and yieldingly maintains the screw 92 in contact with the top-surface of the standard 89. One of the tines of each fork 90 is extended forwardly to form a finger-piece 94 which may be readily lifted by the operator to shift the fork to threading position, shown in dotted lines, Fig. 1. Disposed in a plane between the spaced members of each thread-cam is a corresponding stripper-plate 95 the upper extremity of which is slotted at 96 to guide the thread and to cause said cam to deflect the thread radially,

thereby overcoming the tendency of the cam to carry the thread around with it. The shanks 97 of the stripper-plates 95 are fitted in corresponding slots cut in the supporting block or frame 98 and defining spaced and opposed abutments 99 against which the shanks 97 are clamped by means of the arched springs 100 through the centers of which pass the screws 101; said screws serving to slightly flatten the springs 100 and thereby clamp the shanks of the stripper-plates 95 tightly against the abutments 99, as will be readily understood.

Coöperating with the thread-cams are a series of thread-nippers r , one for each thread. As these nippers are all alike a description of one will suffice. Referring to Fig. 8 it will be seen that each thread-nipper comprises a sleeve 102 which is fixed in a socket in an upward extension 103 on the thread-controller frame 84. Fixed within the sleeve 102 is the shank of a headed pin 104 which nips and locks the thread against the top of said sleeve 102 under the influence of the relatively strong coiled spring 105. The spring 105 surrounds the pin 104 and reacts against a shoulder within the sleeve 102 and an opposed shoulder within a smaller sleeve 106 telescoping within the sleeve 102 and sustained by a cross-pin 107 extending through the pin 104. Journalled in the frame 84 at the lower ends of the pins 104 is a rock-shaft 108 which is cut away under each of said pins to afford a lifting shoulder 109. The rock-shaft 108 carries a crank-arm 110, Fig. 1, which is pivotally connected to a pitman 111 actuated by the eccentric 112 on the shaft 83. The thread-nippers r act to lock and release the needle-threads during each cycle of operations, as will be more fully explained.

In addition to the needle-thread cams, the shaft 83 carries a covering thread-controller cam c^5 and a covering thread pull-off cam c^6 . These cams and their coöperative thread-guides and stripper-plates are substantially of the same construction as the needle-thread cams and need no further description. A plurality of superposed thread-nipper springs 113 are disposed between the thread-cams c^5 and c^6 and are actuated in the usual manner by the cam 114 on the shaft 83 to nip the covering threads during the action of the pull-off cams c^6 .

A series of arched guard-members or springs 115 are provided to prevent winding of the needle-thread about the take-up shaft 83 in case of thread-breakage. Each of the guard-springs is wide enough to extend across the space between the cams for adjacent needle-threads and the ends of said springs may be sprung into suitable recesses provided therefor in the frame 84, as shown in Fig. 8.

Mounted on top of the bracket-arm at the rear of the machine is a tension-supporting frame 116 carrying a series of tensions 117 for the needle, looper and covering threads. Each of these tensions includes a tension-releasing pin 118 being of the well known construction disclosed, for example, in the patent to De Voe, No. 1,146,405. In the present instance, however, the pins 118 are lifted to release the tensions by shoulders 119 afforded by notches in the tension-releasing rock-shafts 120 journalled in the frame 116. One of the rock-shafts 120 carries an arm 121 having a lateral pin 122 embraced by the forked extremity 123 of a lever 124 secured to the other rock-shaft 120 and actuated by means of a link connection 125 with the presser-foot lifting lever 53. When the presser-foot is lifted all the tensions 117 will, accordingly, be released.

The thread-engaging cams carried by the shaft 83 are shaped substantially as illustrated in Fig. 18. Starting at the position shown, the needle-bar is at its highest point and the thread-nippers r are opened; the threads being restrained or steadied, however, by the tensions 117. As the needles descend, the outwardly inclined portions of the cams to the left of the thread-eyes 91 positively take up or absorb the slack given up by the descending take-up guide-bar 81, thereby preventing the formation of slack thread below the needle-eyes and maintaining the previous needle-loops snugly about the looper-blade.

The eye of the needle n^4 enters the work as the thread-nippers r act to lock the needle-threads and as the peak u^4 of cam c^4 passes the line of stationary thread-guides 91. The inward inclination of cam c^4 following the peak u^4 gives up the thread required by the eye of needle n^4 as it doubles its thread below the material. Similarly, at successively later stages, the peaks u^3 , u^2 and u^1 of the cams c^3 , c^2 and c^1 , respectively, pass the guides 91 as the eyes of needles n^3 , n^2 and n^1 , respectively, descend below the work, and the inward inclines following said peaks give up the thread required by the respective needle-eyes as they double their thread below the work.

At the point v^4 the previously formed loop of the needle n^4 is shed from the looper and the outward incline following the point v^4 and leading to the peak w^4 acts positively to quickly take up or tighten said loop. Similarly at the points v^3 , v^2 and v^1 , the respective loops of needles n^3 , n^2 and n^1 are successively shed by the looper and are successively and positively tightened by the outward inclines following the points v^3 , v^2 and v^1 and leading to the respective peaks w^3 , w^2 and w^1 . The inward inclines following said last-mentioned peaks give up the thread required by the needles to complete

their down-strokes, while maintaining the previous needle-threads somewhat taut and closely under control.

When the needles reach the end of their down-stroke the cams have rotated 180° and the slight inward inclination of the cam c' following this point slightly slackens the thread t' so that the loop thrown out by the needle n' will not be robbed of any of its thread or reduced in size by the contracting tendency of the thread when relieved of strain. The progressively steeper outward inclines of the cams c^2 , c^3 and c^4 , following the 180° point, act to reduce the sizes of the respective loops presented by the needles n^2 , n^3 and n^4 , by drawing thread back through the eyes of said needles, to reduce said loops to the proper size prior to their seizure by the looper-beak. It will be understood that since the eye of the needle n^4 descends below the work a greater distance than the needle n^3 &c., more thread will have to be drawn back through the eye of the needle n^4 than through the eye of the needle n^3 , etc., prior to seizure of the needle-loops on the looper, in order that said loops may be reduced to substantially the same size. The nippers r are opened as the needles start to rise.

When the peak x' reaches the line of thread-guides 91, the looper-beak will just have entered the loop of the needle n' and the inward inclination of the cam c' , following the peak x' , will give up just enough thread to compensate for the take-up action of the needle-bar and maintain the loop of needle n' snugly about the looper-blade. Similarly, as the peaks x^2 , x^3 and x^4 pass the guides 91 at successively later stages, the looper will have successively seized the loops of the respective needles n^2 , n^3 and n^4 , and the inward inclines following said peaks will give up just enough thread to compensate for the take-up action of the rising needle-bar and maintain the loops of said needles snugly about the looper-blade.

After the cams have rotated about 325° the last mentioned giving up action of the cams ceases and the continued upward movement of the needle-bar guides 82 acts to draw or measure from the supply the amount of thread required for the next stitch; the nippers r being still open.

By these means the needle-threads are controlled in a positive and efficient manner and a high-speed quiet running and quick acting system of differential thread-controllers is provided, thus insuring a full realization of the important advantages inherent in the idea of controlling the needle-threads differentially as disclosed in said Molyneux *et al.* patent.

By the use of a long radius looper in conjunction with the present thread-controlling mechanism, the needle-loops on the

looper will ordinarily be maintained evenly spaced apart so that each needle in its descent will pass down beside its respective previously formed loop. However, to further insure against abnormal displacement of the needle-loops on the looper, the machine may, if desired, be equipped with the loop-detainers comprising, in the present instance, three hooked fingers 126 for cooperation with the loops of the needles n^2 , n^3 and n^4 and an additional oppositely hooked finger 127 for cooperation with the loop of the needle n' . The detainers 126 are formed at the end of a plate 128, the slotted shank of which is entered by a screw 129 securing the shank of said plate within a groove 130 at the under side of the throat-plate, thereby permitting adjustment of said fingers lengthwise of the throat-plate and facilitating accurate positioning of said fingers relatively to the needles and looper.

The tip ends of the detainers 126 are curved or inclined opposite to the direction of retraction of the looper and are positioned between the needle-paths and above the looper-path to engage the upper limbs of the respective previously formed needle-loops extending between the last stitch and the curved upper edge of the looper-blade, as shown in Figs. 15 and 16 and prevent the retracting looper from dragging said loops back into the paths of their respective next adjacent needles. In practice, it is found that there is a tendency for the previously formed loop of the needle n' to slip toward the point of the looper and into the path of said needle. To avoid this difficulty, the looper-blade may be notched to provide a shoulder 131 adapted to engage the loop of said needle n' during the first part of the retracting stroke of the looper, as shown in Fig. 12, and drag said loop backwardly a slight distance past said finger 127, the looper at the same time also moving sideways under said finger, whereupon the loop slips over the shoulder 131 and is detained at one side of the path of the needle n' by said finger, as shown in Figs. 14 and 15. The tip end of the finger 127 is preferably curved or directed slightly toward the direction of retraction of the looper-blade and is made separately from the detainers 126 being, in the present instance, secured to the plate 128 by a screw 132 which permits adjustment of the finger 127 about said screw as a pivot.

The looper-thread is controlled by the following mechanism. Journaled within and crosswise of the rearward end of the work-arm 5 is a shaft 133 which is connected to the gear 80 on the hollow counter-shaft 78 by a gear 134 of one-half the size of the gear 80 in order that the shaft 133 will be driven at the same speed as the main-shaft 12. Mounted upon the shaft 133 and within the work-arm is a looper-

thread controller-cam 135, a looper-thread pull-off cam 136 and a thread-nipper actuating cam 137.

The construction of the cams 135 and 136 is similar to that of the cams carried by the shaft 83; the cam 135 being shaped to control the slack in the looper-thread as the looper advances and retreats while the cam 136 is shaped to measure off a supply of looper-thread required for the formation of a stitch. Coöperating with the cams 135 and 136 are thread-engaging forks 138 whose tines are apertured at 139 and whose shanks 140 are pivoted at 141 to brackets 142 mounted on frame-lugs 143 within the work-arm. The thread-guiding apertures 139 may be raised or lowered by means of adjusting screws 144 and the rearward inclined ends of the shanks 140 are acted upon by springs 145 to yieldingly maintain the screws 144 in contact with the brackets 142 while permitting the forks to be swung upwardly to threading position. Stripper wires 146, corresponding in function to the stripper-plates 95 previously described, are situated between the disks of each cam. The nipper-cam 137 acts upon a pair of superposed nipper-springs 147 to nip the looper-thread; the timing in the present instance being such that the nippers are closed upon the thread as the looper begins its retracting stroke, and are opened as soon as the advancing looper has entered all of the needle-loops. The pull-off cam 136 begins to pull looper-thread from the supply as soon as the nippers 147 are closed and gives up the thread to the advancing looper as soon as the nippers are opened.

It will be apparent to those skilled in the art that the construction shown and described as a specific embodiment of the invention is susceptible of material modification both in the form and arrangement of the various parts within the scope of the invention.

Having thus set forth the nature of the invention, what I claim herein is—

1. A sewing machine having a plurality of needles set in a plane crossing the line of feed, a single looper coöperating therewith to form stitches, and thread-controlling mechanism including a plurality of rotary needle-thread controlling cams acting directly upon their respective needle-threads, and being relatively timed to positively tighten the needle-loops successively as they are shed from the looper.

2. A sewing machine having a plurality of needles set in a plane crossing the line of feed, a single looper coöperating therewith to form stitches, and thread-controlling mechanism including a plurality of rotary needle-thread controlling cams each formed with an outward incline leading to a peak, said cams being so timed relatively to one

another and to the looper that said outward inclines act successively and directly upon the respective needle-threads to tighten the needle-loops successively as they are shed from the looper.

3. A sewing machine having a plurality of needles set in a plane crossing the line of feed, a single looper coöperating therewith to form stitches, and thread-controlling mechanism including a plurality of rotary needle-thread controlling cams acting directly upon their respective needle-thread and being relatively timed to positively tighten the needle-loops successively as they are shed from the looper, and a plurality of thread-nippers adapted to lock their respective needle-threads during the positive loop-tightening action of said cams.

4. A sewing machine having a plurality of needles set in a plane crossing the line of feed, a single looper coöperating therewith to form stitches, and thread-controlling mechanism including a plurality of rotary needle-thread controlling cams each formed with an outward incline leading to a peak, said cams being so timed relatively to one another and to the looper that said inclines act successively and directly upon the respective needle-threads to tighten the needle-loops successively as they are shed from the looper, and a plurality of thread-nippers adapted to lock their respective needle-threads during the positive loop-tightening action of said cams.

5. A sewing machine having a plurality of needles set in a plane crossing the line of feed, a single looper coöperating therewith to form stitches and thread-controlling mechanism including a plurality of rotary needle-thread controlling cams acting directly upon their respective needle-threads and timed relatively to one another to positively take up the slack thread below the needle-eyes during the first part of the downstroke of the needles, to give up thread to the needles as their eyes descend below the work, and to positively tighten the needle-loops successively as they are shed from the looper.

6. A sewing machine having a plurality of needles set in a plane crossing the line of feed, a single looper coöperating therewith to form stitches, and thread-engaging cams for the needle-threads, each constructed to act independently of the other cam or cams to give up thread to its respective needle as the eye thereof descends below the work and to positively tighten its respective needle-thread loop as soon as it is shed from the retracting looper, said cams being further shaped to give up the thread required by the needles to complete their down strokes.

7. A sewing machine having a plurality of needles set in a plane crossing the line of feed with the eyes of the needles at different elevations, a single looper coöperat-

ing therewith to form stitches, and a plurality of needle-thread engaging cams having inclines adapted to positively steal thread from certain of the nascent needle-loops and other inclines timed relatively to one another to positively and successively tighten the respective needle-loops as they are shed from the looper.

8. In a sewing machine, in combination, a frame including a bracket-arm, multi-needle single-looper stitch-forming mechanism incorporated in said frame, and needle-thread controlling mechanism including a plurality of differentially acting thread-cams, each for a corresponding one of said needle-threads, said thread-cams being mounted on said bracket-arm to turn about a common axis and thread-guiding means disposed at opposite sides of a the planes of said cams and adapted to guide the needle-threads across the paths of the active peripheral portions of their respective cams.

9. A sewing machine having a plurality of needles, a single looper cooperating therewith to form stitches, means for tightening the needle loops successively as they are shed from the looper, and a plurality of needle thread nipping devices on the supply side of the loop tightening means for locking the needle-threads while the needle-loops are being successively tightened.

10. In a sewing machine, in combination, a frame including a bracket-arm, multi-needle single-looper stitch-forming mechanism incorporated in said frame, and needle-thread controlling mechanism including a plurality of thread-cams, each for a corresponding one of said needle-threads, a cam-shaft common to said thread-cams, a plurality of thread-nippers and actuating connections between said cam-shaft and said thread nippers for actuating the latter to nip and release the needle-threads at predetermined times during the stitching cycle.

11. In a sewing machine, in combination, a frame including a bracket-arm, multi-needle single-looper stitch-forming mechanism incorporated in said frame, and needle-thread controlling mechanism including a supplemental frame detachably mounted on top of said bracket-arm, a plurality of thread-cams, each for a corresponding one of said needle-threads, a cam-shaft common to said thread-cams, a plurality of thread-nippers mounted on said supplemental frame and actuating connections between said cam-shaft and said thread-nippers for actuating the latter to nip and release the needle threads at predetermined times during the stitching cycle.

12. In a sewing machine, in combination, a frame including a bracket-arm, multi-needle single-looper stitch-forming mechanism incorporated in said frame, and needle-thread controlling mechanism including a

rotary cam-shaft and an oscillatory thread-nipper actuating shaft both journaled on top of the bracket-arm, a plurality of thread-cams carried by said cam-shaft, and means connected to said cam-shaft for actuating said oscillatory shaft.

13. A sewing machine comprising, in combination, multi-needle stitch-forming mechanism, covering thread laying means, and thread-controlling mechanism for the needle and covering threads comprising a rotary shaft, and needle and covering thread controlling cams mounted on said shaft.

14. A sewing machine comprising, in combination, multi-needle stitch-forming mechanism, covering thread laying means, and thread-controlling mechanism for the needle and covering threads comprising a plurality of needle-thread controlling cams, a covering thread controlling cam, a covering thread pull-off cam, a shaft carrying all of said cams and means connected with the stitch-forming mechanism for rotating said shaft.

15. A sewing machine comprising, in combination, multi-needle stitch-forming mechanism, covering thread laying means, and thread-controlling mechanism for the needle and covering threads including a covering thread pull-off cam, a covering thread controlling cam, a thread-nipper adapted to nip the thread between said cams, a plurality of needle-thread controlling cams, a shaft carrying all of said cams, means carried by said shaft for actuating said thread-nipper and means connected with the stitch-forming mechanism for rotating said shaft.

16. A thread-controlling device for sewing machines comprising a frame formed with a slot having a side wall defining an abutment, a thread-engaging cam, a stripper-plate cooperating with said cam and having a shank received in said slot, and means for clamping the shank of said plate sidewise against said abutment.

17. A thread-controlling device for sewing machines comprising a frame formed with a slot defining an abutment, a thread-engaging cam, a stripper-plate cooperating with said cam and having a shank received in said slot, and an arched spring for clamping the shank of said plate against said abutment.

18. A thread-controlling device for sewing machines comprising, a frame formed with spaced slots defining opposed abutments, a pair of thread-engaging cams, a pair of stripper-plates cooperating with said cams and having shank-portions received in said slots, an arched spring disposed between said shanks, and means for flattening said spring to clamp the shank-portions of said plates against said abutments.

19. In a multiple needle sewing machine,

in combination, a shaft, a plurality of thread-controlling cams carried by said shaft, one for each needle-thread and one or more stationary arched guards disposed
5 between the cams for adjacent needle-threads and partially surrounding said shaft, whereby accidental winding of a broken needle-thread about said shaft is prevented.

10 20. In a sewing machine, in combination, a frame, a shaft journaled therein, a plurality of thread-controlling cams carried by said shaft, and one or more resilient bowed guard-strips disposed between said cams
15 and partially surrounding said shaft, said frame being formed with portions into engagement with which the terminal portions of said resilient bowed guard-strips are yieldingly held to retain the latter in po-
20 sition.

21. In a sewing machine, in combination, stitch-forming mechanism including a plu-
rality of needles, a main-shaft, a counter-
25 shaft, a needle-thread controller shaft, covering thread mechanism including an eyed thread-finger adapted to move back-and-forth in advance of the needles and con-
nected to said counter-shaft, a two-to-one
30 speed-reducing driving connection between said main- and counter-shafts and a one-to-two speed-multiplying driving connec-

tion between said counter and needle-thread-controlling shafts.

22. In a sewing machine, in combination, stitch-forming mechanism including a plu- 35
rality of needles, a main-shaft, a counter-shaft, a looper-thread-controller shaft, covering thread mechanism including an eyed thread-finger adapted to move back-and-
40 forth in advance of the needles and connected to said counter-shaft, a two-to-one speed-reducing driving connection between said main- and counter-shafts, and a one-
to-two speed-multiplying driving connec- 45
tion between said counter and looper-thread-controlling shafts.

23. In a sewing machine, in combination, stitch-forming mechanism including a plu-
rality of needles, a main-shaft, a counter-
50 shaft, needle and looper-thread-controller shafts, covering thread mechanism including an eyed thread-finger adapted to move
back-and-forth in advance of the needles, a two-to-one speed-reducing driving con-
55 nection between said main- and counter-shafts, and a one-to-two speed-multiplying driving connection between said counter-shaft and said needle- and looper-thread-controlling-shafts.

In testimony whereof I have signed my
60 name to this specification.

GEORGE S. GATCHELL.