W. A. SMITH.

MACHINE FOR LACING SHOE UPPERS.

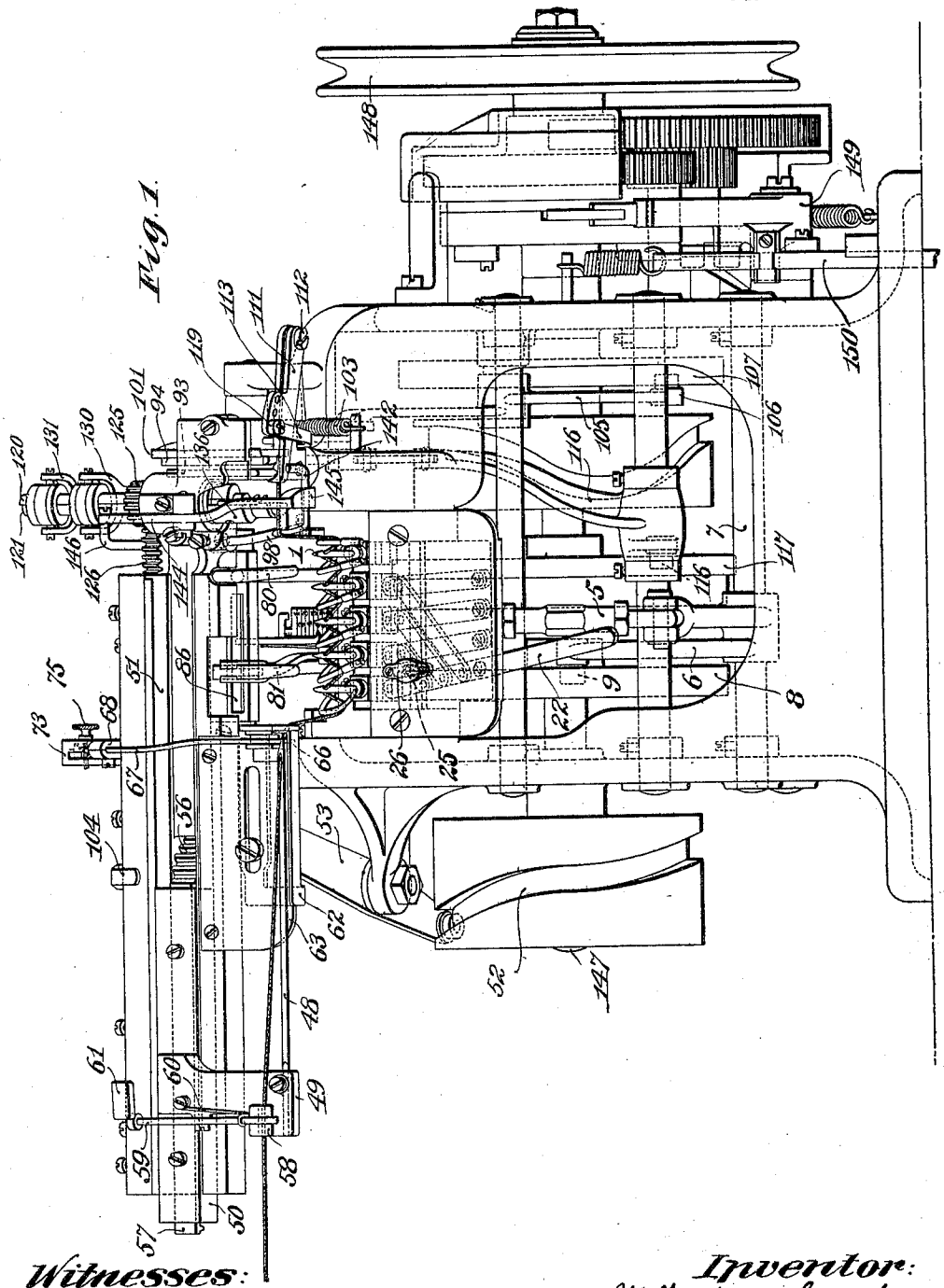
APPLICATION FILED MAR. 31, 1908.

1,030,547.

Patented June 25, 1912.

8 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

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N. D. McPhail

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by Phillips Van Everen & Fish

Attys

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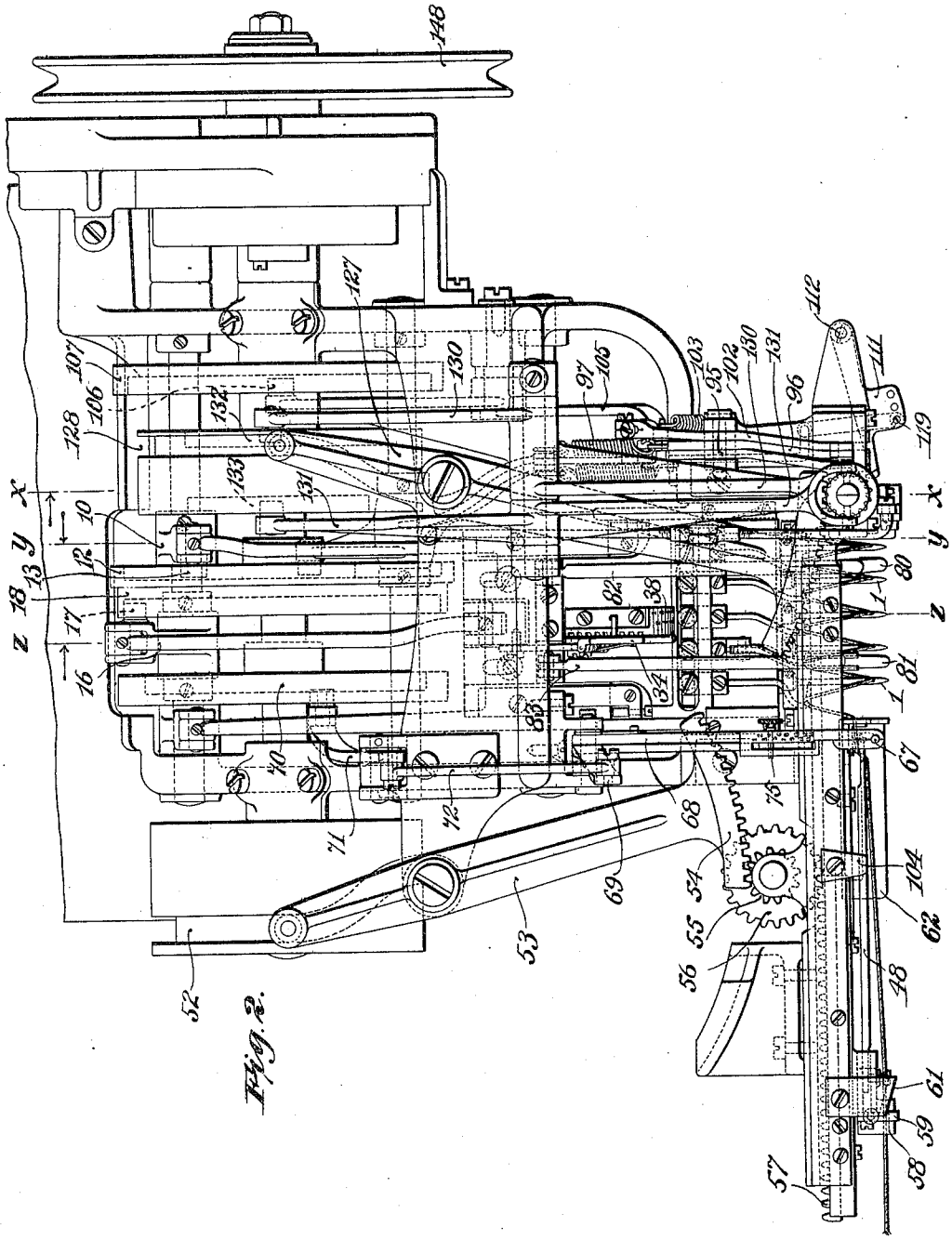

Fig. 2.

Witnesses:

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Fig. 3.

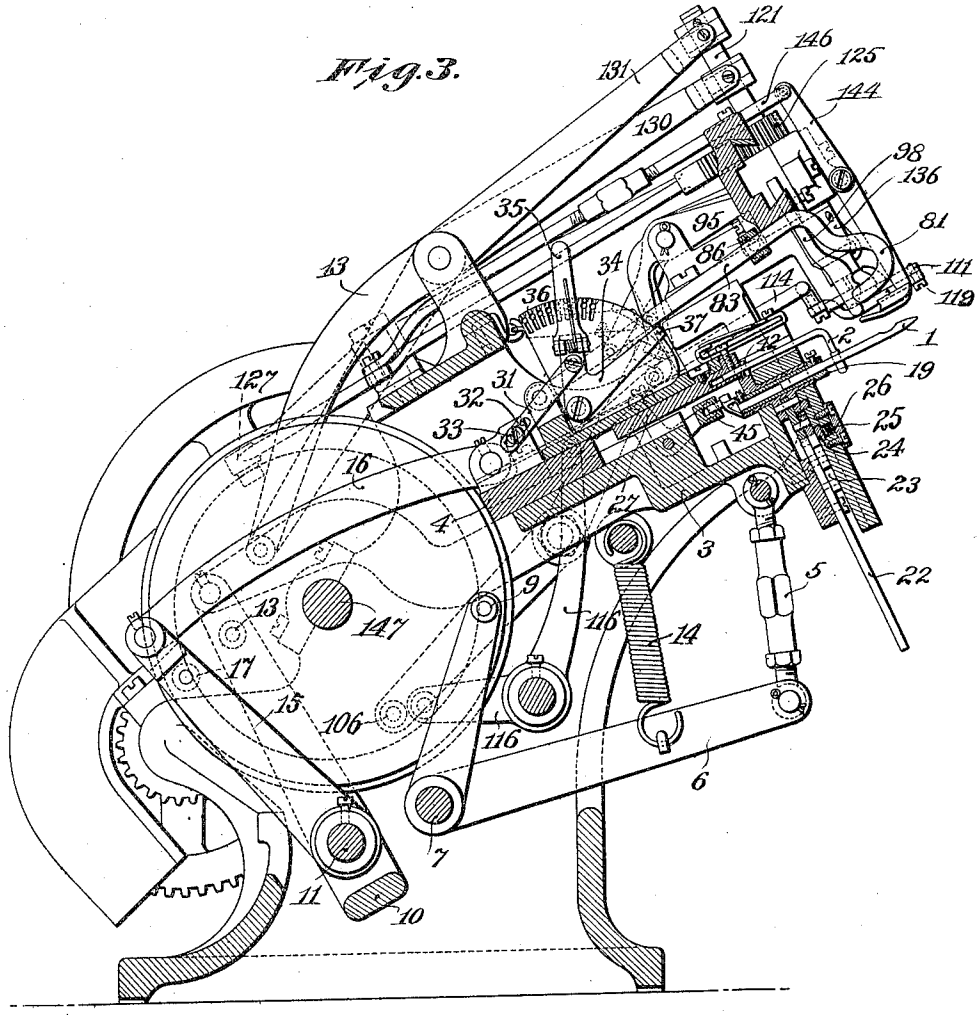

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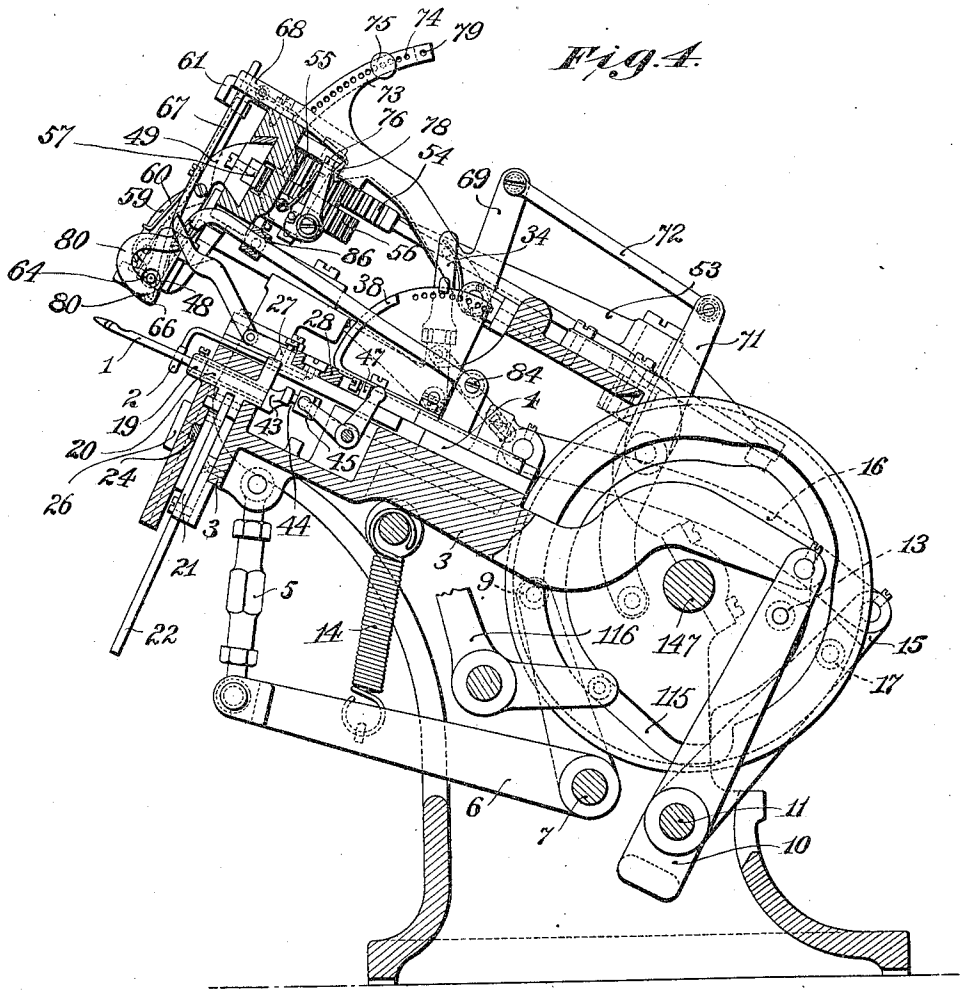
Fig. 4.



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8 SHEETS—SHEET 5.

Fig. 5.

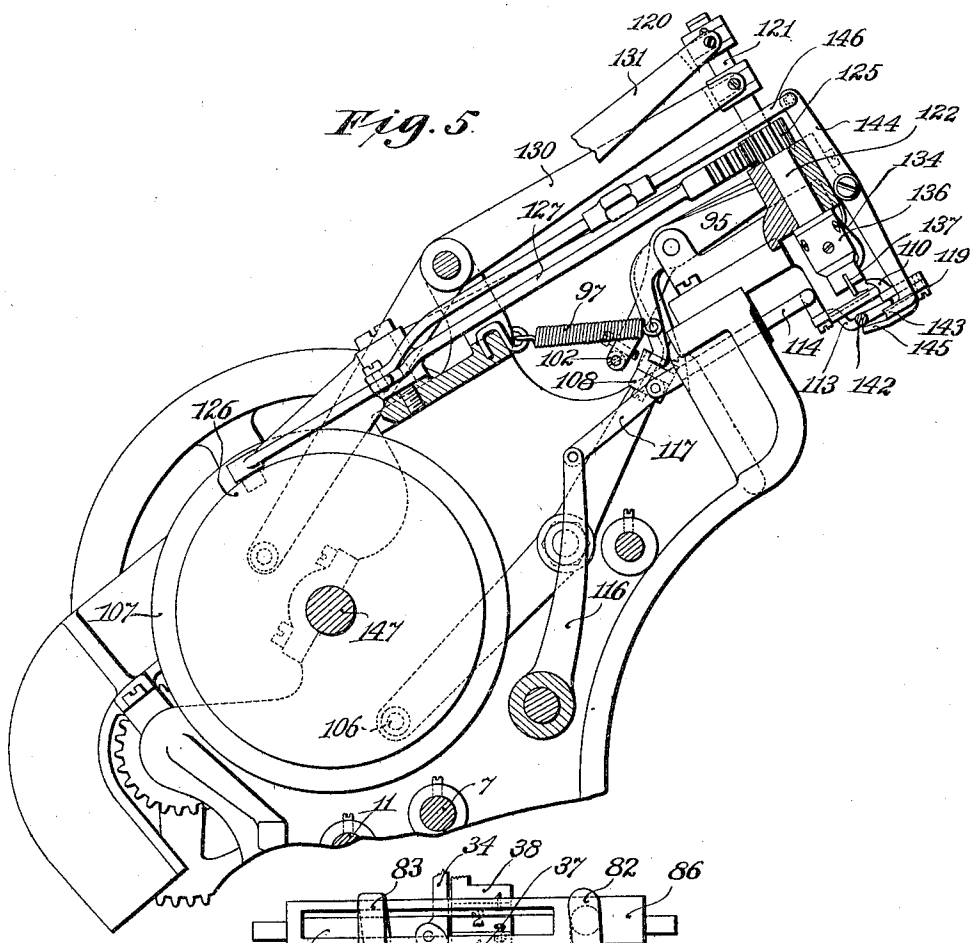
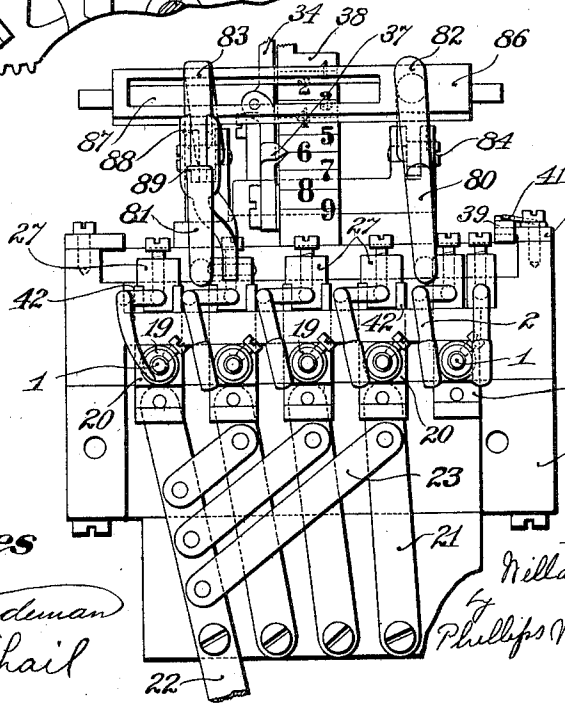


Fig. 6.



Witnesses

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8 SHEETS—SHEET 6.

Fig. 7.

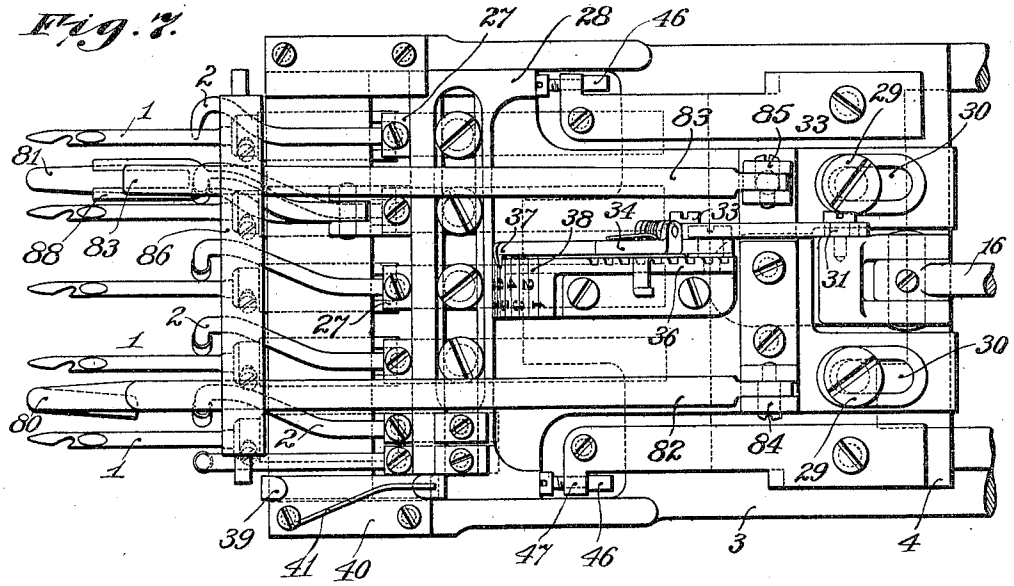


Fig. 8.

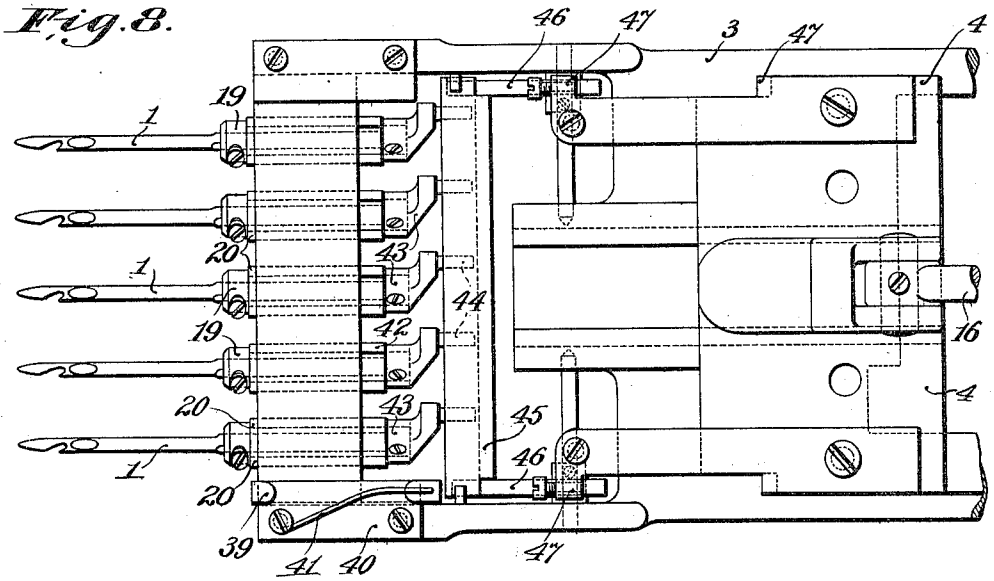
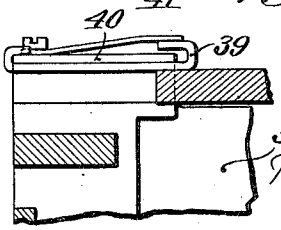


Fig. 9.



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8 SHEETS—SHEET 7.

Fig. 10.

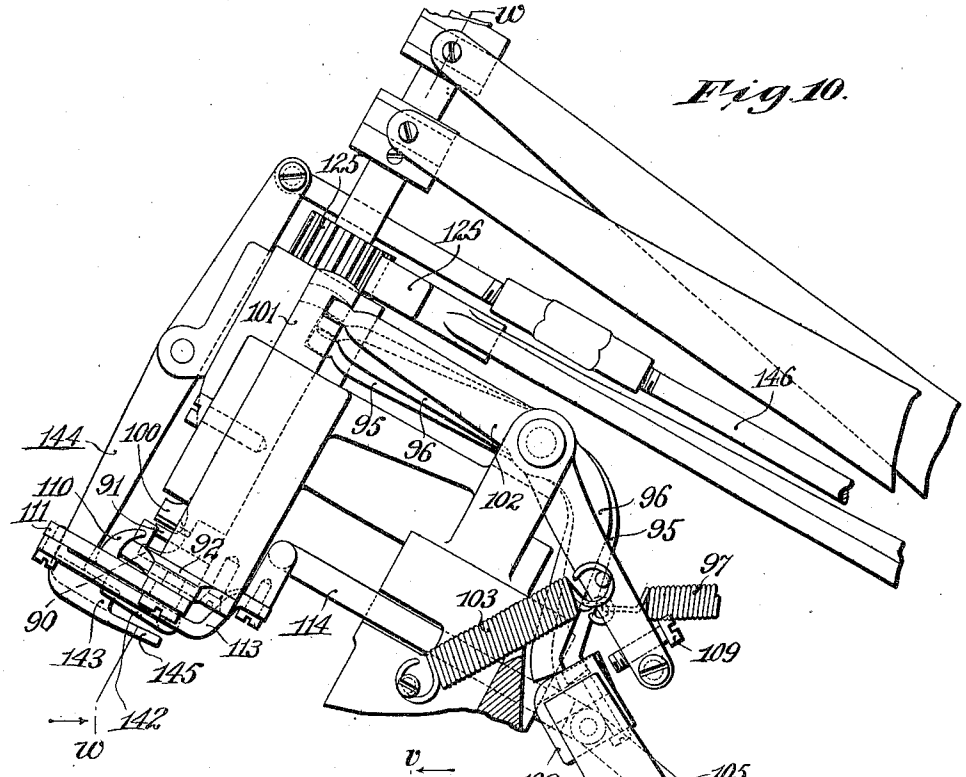
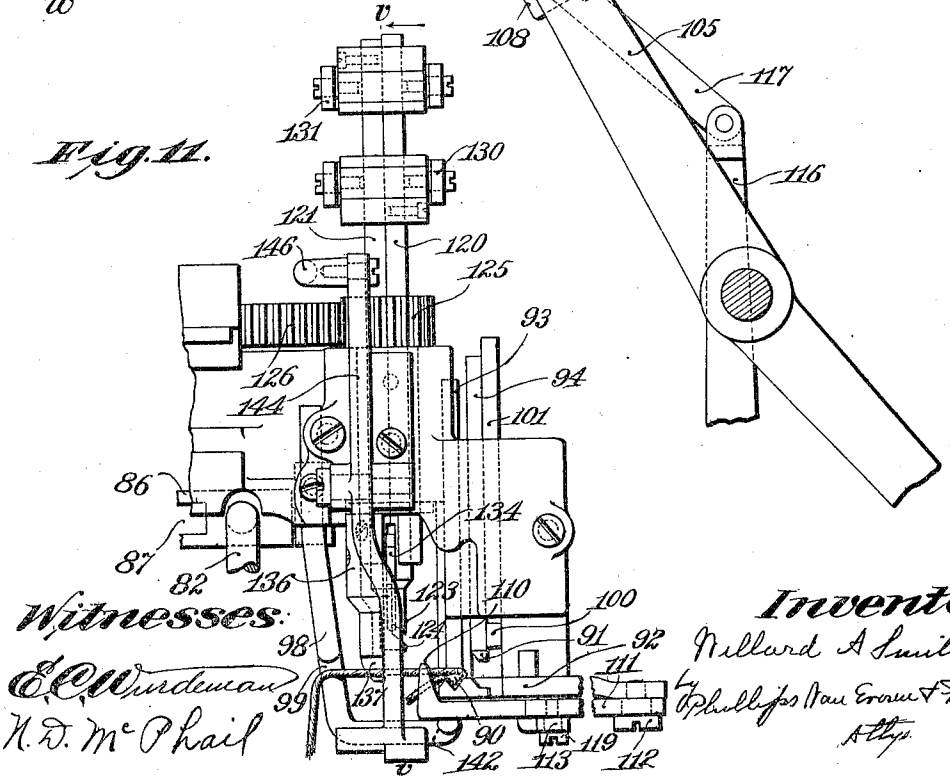


Fig. 11.



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8 SHEETS—SHEET 8.

Fig. 12.

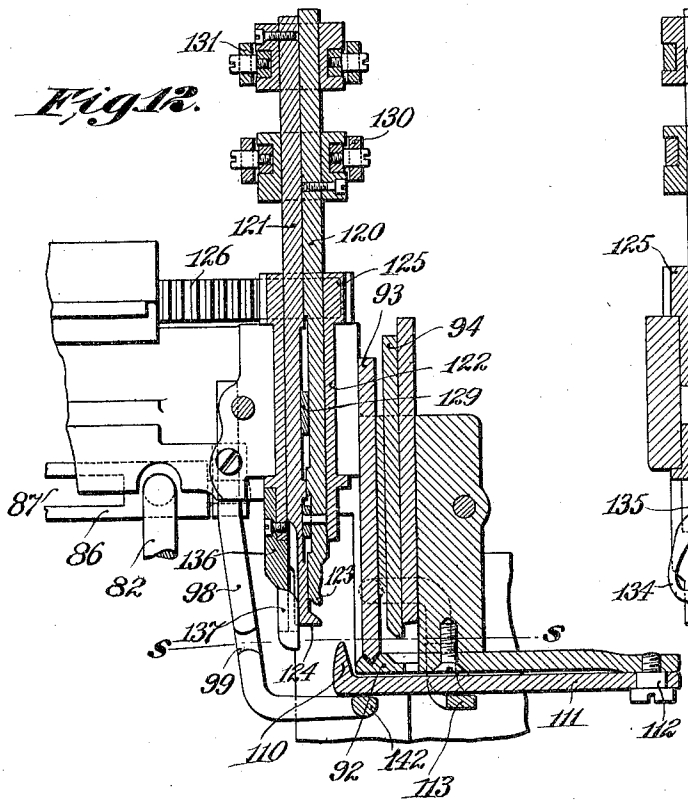


Fig. 13.

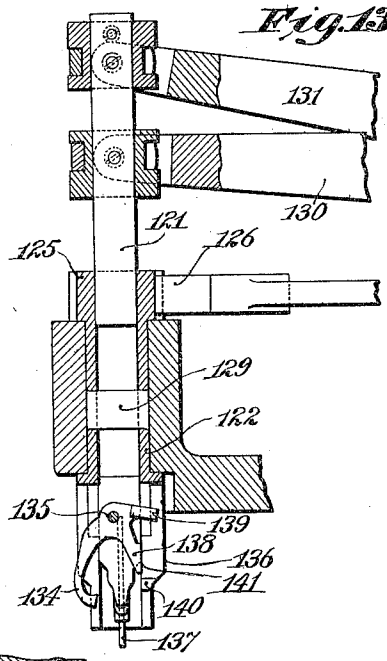


Fig. 14.

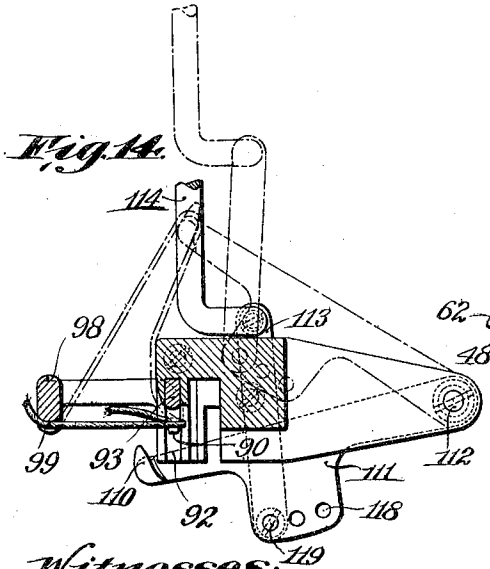
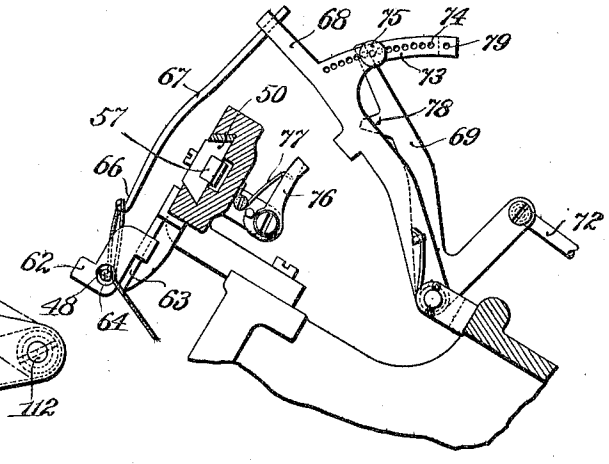


Fig. 15.



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UNITED STATES PATENT OFFICE.

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MACHINE FOR LACING SHOE-UPPERS.

1,030,547. Specification of Letters Patent. Patented June 25, 1912.

Application filed March 31, 1908. Serial No. 424,318.

To all whom it may concern:

Be it known that I, WILLARD A. SMITH, citizen of the United States, residing at Melrose, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Machines for Lacing Shoe-Uppers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The invention relates to machines for lacing together the eyeleted quarters of shoe uppers preparatory to placing them on the last for the lasting and other operations in order that the edges of the lacing slit shall be held at the proper distance apart, and the upper properly fitted to the last during the lasting operation.

The features of the invention may be embodied with special advantage in that class of machines in which the lace inserting mechanism comprises a plurality of spindles or needles arranged to pass a series of loops of lacing cord through the eyelet holes of an upper, an example of which is shown in Patent No. 779,008, dated January 3, 1905. The broader features of the invention are not limited, however, to this form of machine, but may be embodied with advantage in other forms of machines, and the specific construction and arrangement of the various parts may be varied as may be found desirable or best suited to the form of machine in which the invention is embodied, and to the construction and arrangement of lace inserting devices and the devices coöperating therewith.

The primary object of the invention is to provide a shoe upper lacing machine having its various parts so constructed and arranged that the operations incident to the lacing together of the quarters of the upper may be performed at a high rate of speed and in a uniformly reliable and satisfactory manner.

A further object is to so construct and arrange the parts of the machine that they may be readily and conveniently adjusted or their operation modified to secure such manipulation or control of the lacing cord and of the work as is best suited for inserting lacing in the particular style or size of shoe upper which is to be operated upon.

With these objects in view, one feature of the invention contemplates the provision in a machine in which a series of loops of lacing cord are formed and inserted in the eyelet holes of an upper, of means for varying the amount of slack in the lacing independent of the loop forming and inserting devices. This means in its preferred form consists of a slack thread device arranged to engage the lacing cord on the supply side of the loop forming devices, and so mounted and arranged that it may be rendered active or inactive at the will of the operator. The device is also preferably so mounted and operated that the amount of slack produced by its action may be varied to give the desired amount of slack in the completed lacing. The presence of this slack thread device in the machine enables the amount of slack formed in the lacing to be increased beyond the amount which is provided for by the adjustment of the loop forming devices in case an unusual amount of slack is required, as, for instance, in lacing certain styles and sizes of bluchers. The slack thread device may be rendered inactive when it is desired to remove substantially all the slack in the lacing, or to leave only such an amount of slack as may be provided for by the adjustment of the loop forming devices.

A further feature of the invention contemplates the provision in a machine in which the lace is inserted by passing a series of loops of lacing cord through the eyelet holes of an upper and then passing a locking cord through the loops, of a novel form and arrangement of work positioning device which acts to hold or to position and hold the upper out of the path of the needle or other means for passing the locking cord through the loops during the passage of such cord through the loops.

In accordance with one feature of the invention, the work is positioned and retained in position during the passage of the locking cord through the loops by an automatically operating work positioning device which is so constructed that the locking cord is passed through the loops between the work positioning device and the upper.

This enables the amount of slack in the lacing to be reduced to a minimum, since the locking cord may pass through the loops close to the upper. This construction also enables the work engaging end of the positioning device to be so curved or shaped that there is no danger of the positioning device passing between the two quarters of the upper, or of striking the edge of either quarter and damaging it as the upper is brought into position back of the positioning device.

Another feature of the invention consists in providing the work adjuster with a work engaging finger so constructed and mounted that it will not interfere with the proper adjustment of the guard which underlies the cord carrying needle in adjusting the machine to insert lacing in only two or three pairs of eyelets, as, for instance, in lacing baby work.

In accordance with another feature of the invention, the adjustable work engaging finger of the work positioning device is formed on the end of a rod which is mounted to swing laterally about a pivot on the plate which carries the looper fingers. This provides a simple construction which permits the free lateral movement of the finger into any desired position.

Another feature of the invention contemplates the provision of improved means for varying the length of cord taken up by the looper fingers and looper needles in forming the loops which are to be passed through the eyelet holes of the upper.

In machines in which a series of loops are formed by a plurality of needles or spindles and coöperating looper fingers, the length of cord taken up by the looper fingers and needles in forming the loops has been varied by the adjustment of the looper fingers longitudinally of the needles, so that the length of the loops formed by the relative movement of the fingers and needles is varied. The mechanism for operating the looper fingers, and the means for making this adjustment, has been such that the distance to which the looper fingers are moved beyond the ends of the needles in discharging the upper from the needles has varied with the variation in the length of loops formed, the looper fingers being moved to a greater distance beyond the end of the needles when adjusted for short loops than when adjusted for long loops. It frequently happens, therefore, in doing some classes of work, that the upper is carried outward beyond the ends of the needles by the forward movement of the loopers to such a distance that the lacing is broken between the upper and the devices which grip the ends of the lacing, or the proper operation of the machine is otherwise interfered with.

The uniform and proper operation of the machine, whatever the length of loop being formed by the needles and looper fingers, is insured, in accordance with the present invention, by providing means for varying the length of the loops formed by the needles and looper fingers without varying the movement of the loopers beyond the ends of the needles in discharging the upper therefrom. The variation in the length of the loops is preferably secured without varying the outward movement of the loopers beyond the ends of the needles, by providing for a variable lost motion in the connections between the looper fingers and the cam which operates them. In embodying this feature of the invention in a machine such as is shown in the patent above referred to, it is preferred to so connect the looper carrying plate with the looper operating slide that there is lost motion between the plate and slide when short loops are to be formed, and providing means for varying the lost motion so that varying lengths of loops may be formed, there being substantially no lost motion when the longest loops are being formed.

A further feature of the invention contemplates the provision in a machine in which a plurality of loops of lacing cord are passed through the eyelet holes of an upper, of means for supplying cord from both sides of the loop forming devices in accordance with the number of loops being formed, so that the cord may be properly manipulated in forming the number of loops required for different classes of work. In embodying this feature in a machine similar to that shown in the patent above referred to, it is preferred to supply the thread from one side of the loop forming devices by a thread arm arranged to engage the cord between the devices which hold the free end of the thread and the loop forming devices, and operated to draw off slack thread from the thread supply prior to the formation of the loops, and to give up this slack thread to the loop forming devices during the formation of the loops, the operating mechanism being so constructed that the operation of the thread arm may be varied to draw off and give up varying amounts of thread, according to the number of loops being formed.

Further features of the invention contemplate the provision of novel and improved mechanism for operating the clamps which hold the ends of the lacing, and for operating the knife which severs the lacing from the thread supply; the provision of novel and improved means for tightening the knot formed by the knot tying mechanism; the provision of an improved form of knot tying mechanism; and the provision of improved means for adjusting the looper needles of a multiple needle machine to adapt the machine for operation upon uppers having differently spaced eyelets.

The various features above referred to, as well as the further features relating more or less to the preferred form and arrangement of devices employed in embodying the broader features of the invention in a machine of the class shown in the patent above referred to, will be understood from an inspection of the accompanying drawings, in which—

Figure 1 is a front elevation of a machine embodying the various features of the invention in their preferred form, the parts being shown in the position which they occupy when the loops have been formed and are being held by the needles and looper fingers in position to be passed through the eyelet holes of an upper; Fig. 2 is a plan view of the machine; Fig. 3 is a sectional view on line *z*—*z*, Fig. 2; Fig. 4 is a sectional view on line *y*—*y*, Fig. 2; Fig. 5 is a sectional view on line *x*—*x*, Fig. 2; Fig. 6 is a detail front view showing the front of the carrier for the looper needles and looper fingers and the work positioning device, the front plate of the needle carrier being removed to show the devices for adjusting the needles; Fig. 7 is a plan view of the carrier for the looper needles and looper fingers; Fig. 8 is a similar view with the slide on which the looper fingers are mounted removed; Fig. 9 is a detail sectional view showing the friction gib for holding the looper carrying plate in position on the looper slide; Fig. 10 is a detail elevation of the devices for acting on the ends of the lacing; Fig. 11 is a front view of the parts shown in Fig. 10; Fig. 12 is a vertical sectional view on line *w*—*w*, Fig. 10; Fig. 13 is a sectional view on line *v*—*v*, Fig. 11; Fig. 14 is a horizontal sectional view on line *s*—*s*, Fig. 12; and Fig. 15 is an elevation, partly in section, showing the slack thread device.

The machine illustrated in the drawings has the same general construction and mode of operation as the machine shown in the patent above referred to, and the construction and arrangement of the parts is substantially the same as the construction and arrangement of the parts in the machine shown and described in an application filed by W. A. Smith, January 16, 1906, Serial No. 296,388, except where the construction and arrangement of the parts is modified or changed in embodying the features of the present invention in the machine.

The machine comprises a plurality of needles equal in number to the number of pairs of eyelet holes which it is desired to lace, a plurality of looper fingers coöperating with the needles to form a series of loops in a lacing cord and retain the loops in position until the shoe upper is placed on the needles, a cord feeding needle acting to place the cord in position to be engaged by the needles and looper fingers, and to pass a portion of the cord through the loops after they have been inserted in the eyelet holes of the upper, cord clamping grippers to hold the ends of the lacing, a cutter to sever the lacing from the cord supply, and a knot-tying mechanism acting to tie the ends of the lacing together.

The looper needles or spindles 1, of which there are five in the machine shown, are mounted in a carrier 3, and the coöperating looper fingers 2 are mounted on a slide 4 supported on the carrier. The front end of the carrier 3 is supported by a link 5 from one arm of a bell crank lever 6 which is pivoted on a shaft 7 and is rocked to give vertical movements to the carrier by a cam 8 engaging a cam roll 9 on the other arm of the lever. The rear end of the carrier is pivotally supported upon the arms of a yoke 10, which is pivoted upon a rod 11, and is rocked to give the carrier its forward and return movements by a cam 12 acting upon a roll 13 which is mounted on one of the arms of the yoke. The weight of the carrier is supported or partially supported upon a spring 14. Movements are imparted to the slide 4 which carries the looper fingers to move the looper fingers longitudinally of the needles through a lever 15 which is connected with the slide by a link 16, and is provided with a roll 17 engaging a cam 18.

The looper needles 1 are secured in spindles 19 which are mounted in blocks 20, and the blocks are mounted in guideways formed in the front of the carrier 3, so that the blocks may be adjusted to vary the spacing of the needles. One of the blocks shown at the right in Fig. 6 is secured in fixed position, while the others are mounted to slide laterally in the carrier in changing the spacing of the needles. The needle blocks, which are moved with relation to the right-hand block in adjusting the needles for different spacings of eyelets, are pivotally connected with the upper ends of a series of levers 21. One of these levers, preferably the left-hand lever, is extended downward to form an operating handle 22 which may be grasped by the operator in adjusting the needle blocks. The movable blocks to the right of the operating lever are connected by means of links 23 with the operating lever, the links being connected to the operating lever at varying distances from the fulcrum of the lever, so that the needle blocks will be moved varying distances, and the equal spacing of the needles be maintained, whatever the adjustment of the blocks. The needle blocks are held in adjusted position by means of a clamping bar 24 which engages the front faces of the links 23, and is yieldingly forced against the links by a spring 25 interposed between a plate 26 and the bar (Figs. 3, 4 and 6). These needle adjusting devices are simple in construction and arrangement,

and enable the needle blocks to be readily and conveniently adjusted by the application of comparatively little force to the lever 22, since there is comparatively little tendency to cramp the blocks in their guiding bearings, and comparatively little friction between the moving parts.

The looper fingers 2 are secured in blocks 27 carried by a plate 28 which is mounted upon the upper side of the looper carrying slide 4. The plate 28 is retained upon the upper surface of the slide by means of screws 29 which pass through slots 30 in the plate and are provided with heads overlying the plate. The plate 28 (Fig. 4) is also connected with the slide 4 by means of a link 31, the rear end of which is provided with a slot 32 engaging a screw 33 on the head (Fig. 3). The front end of the link 31 is pivoted to a lever 34 which is mounted upon the slide 28. The lever 34 is provided with an operating handle 35 which is pivoted to the lever, and is forced yieldingly toward the face of the segmental plate 36 to which the lever is pivoted. The segmental plate is provided with a series of notches arranged to be engaged by a lug on the face of the handle 35, and to coöperate with the lug in locking the lever 34 in any desired adjusted position. The lever is also provided with a finger 37 arranged to coöperate with a scale 38 formed on the segmental plate in indicating the adjustment of the lever 34 and link 31.

By means of the slotted link 31 and the slots 30 through which the screws 29 pass, the looper carrying plate is so connected with the operating slide that a variable amount of lost motion between the plate and slide may be secured, and thus the length of loop drawn by the looper fingers and needles be varied, without varying the outer position of the loopers with relation to the ends of the needles. When the slide 4 is advanced, the screws 29 will engage the front ends of the slots 30 and move the looper fingers forward to a definite position with relation to the ends of the needles. When the slide 4 is retracted, the screws 29 will ride idly in the slots 30, and the slide 4 will move rearward without effecting any movement in the plate 28 until the screw 33 engages the rear end of the slot 32 in the link 31. The plate 28 will then be moved rearwardly with the slide 4 until the slide has reached its rearward position. If the lever 34 is adjusted so that the rear end of the slot 32 is in engagement with the screw 33 when the screws 29 are in engagement with the front ends of the slots 30, then there will be no lost motion between the slide 4 and the plate 28, and the movements of the plate 28 will correspond to the movements of the slide 4. With this adjustment the longest loops will be formed. By varying the position of the lever 34 and link 31, the amount of lost motion between the slide 4 and plate 28 may be varied, and thus the extent to which the plate 28 is retracted by the rearward movement of the slide 4 may be varied to vary the length of loops drawn by the looper fingers. Whatever the adjustment of the link 31, and whatever the length of loops being drawn, the looper fingers will be advanced to the same point with relation to the needles by the engagement of the screws 29 with the front ends of the slots 30, the length of the loops being varied by the variation in the position to which the loopers are moved during the backward stroke of the slide 4. The discharge of the upper from the looping needles will thus be effected uniformly and properly and without danger of breaking the lacing or interfering with the operation of the knotting devices, whatever the length of loop being formed. The plate 28 is retained in position against accidental displacement by means of a friction gib 39 arranged between one of the bearing plates 40 and the upper surface of the plate 28, and forced against the surface of the plate 28 by the spring 41 (Fig. 9).

The blocks 27 which carry the looper fingers 2 are mounted for lateral adjustment in the front end of the plate 28, and are connected with the needle carrying blocks 20 by lugs 42 formed on the rear ends of the needle blocks, and arranged to embrace the front ends of the looper carrying blocks. By these connections the looper fingers are adjusted simultaneously with the looper needles when the needles are adjusted for different spacings of eyelets, so that the proper relation between the needles and looper fingers is automatically maintained.

The spindles 19 in which the needles 1 are secured are rocked at proper intervals to bring the hooks in the needles into position to receive the lacing cord, and to thereafter turn the needles into position to hold the loops so that the cord carrying needle will pass through the loops, by means of crank arms 43 secured to the rear ends of the spindles, and provided with pins 44 engaging a slot in a transverse bar 45. The bar is carried on the forward ends of two bell crank levers 46, the upper ends of which extend into the path of shoulders 47 which are formed on the slide 4. When the slide is advanced to bring the looper fingers in front of the hooks in the looper needles, the rear shoulders 47 act on the levers 46, moving the bar 45 downward and thus turning the needles into position to bring the hooks upward where they may receive the lacing cord. When the slide 4 is retracted, and the looper fingers have engaged the cord, and coöperating with the needles, have formed the loops in the cord, the front shoulders 47 act upon

the levers 46, raising the bar 45 and turning the needles through an angle of 90°, so that the loops are held by the needles in position for the passage of the cord carrying needle through the loops.

The cord feeding or shuttle needle 48 is secured in an arm 49 of a needle carrying slide 50 which is mounted to slide in ways 51. The needle carrying slide is reciprocated by means of a cam 52 which engages a roll on the rear end of a lever 53, the front end of which is provided with a gear segment 54. The segment 54 engages a pinion 55 which is connected with a gear 56 engaging a rack 57 on the needle carrying slide. The lacing cord leads from the eye of the needle 48 through two guides 58 arranged on opposite sides of a lever 59, the lower end of which is arranged to engage and frictionally clamp the cord between the guides. The lever 59 is forced yieldingly in clamping position by a spring 60, and is operated to relieve the tension on the cord when the needle is in its retracted position, by a cam 61 arranged to engage a roll on the upper end of the lever.

The machine is provided with a guard plate 62 arranged to underlie the shuttle needle, and adjustably secured to a vertical guard plate 63. The guard plate 62 is provided at its front end with an eye 64 (Fig. 15), through which the lacing cord passes from the left-hand looper finger to the eye of the shuttle needle when the needle is in its retracted position. In order that the amount of slack thread in the lacing may be increased, if desired, beyond the amount produced by the adjustment of the looper fingers to draw the longest loops, a slack thread device in the form of a hook 66 is arranged to engage the cord between the loop forming devices and the thread supply. As shown, the hook 66 is formed on the lower end of a rod 67 which is adjustably secured in the outer end of a lever 68. The devices for operating and controlling the arm 68, and the slack thread hook 66 carried thereby, are so constructed that the hook may be thrown into or out of action as desired, and so that it may be operated to give more or less slack as desired. The means for operating the slack thread hook 66 consists of a lever 69 which is operated from a cam 70 through a lever 71, one end of which carries the roll engaged by the cam, and the other end of which is connected with one end of the lever 69 by a link 72. The forward end of the lever 69 is arranged to play in a slot formed in an arm 73 which extends upward from the lever 68. The arm 73 is provided with a series of holes 74 adapted to receive a pin 75 which, when in position in any of the holes 74, extends across the path of the lever 69. When the slack thread drawing hook is in action, the pin 75 is inserted in one of the holes 74, determined by the amount of slack which it is desired to provide in the lacing. When the parts are in position for receiving the upper, as indicated in Fig. 1, the hook 66 stands in its lowest position below the cord leading from the left-hand looper finger through the eye 54 to the shuttle needle. When the machine is started, and the looper fingers and needles move upward to bring the loops into position for the passage of the shuttle needle, the front end of the lever 69 is swung upward, and in its upward movement engages the pin 75 and lifts the lever 68 and hook 66 through a distance depending upon the adjustment of the pin 75. In this upward movement the hook 66 draws a loop of thread from the thread supply. The hook reaches its upper position just before the shuttle needle starts forward, and remains in this position until the shuttle needle has carried the cord through the loops held by the looper needles and fingers, and has nearly reached its retracted position. The hook therefore acts to retain a loop of slack thread in the lacing on the supply side of the looping devices, and thus provide slack thread in the lacing independent of the loop forming devices. The hook 66 moves downward to give up the loop of thread held thereby as the looper needles and fingers move downward and the looper fingers move forward to discharge the upper from the needles. As the upper is discharged, the hook comes into position with its lower end just above the eye 64, through which the lacing cord passes to the upper, and is retained in this position by a supporting latch 76 which is pivoted to the frame, and is yieldingly retained in supporting position by a spring 77. When in this position, the hook is properly located to readily shed the loop as the upper is discharged from the looper needles. After the downward movement of the hook 66 is arrested by the engagement of the lever 68 with the latch 76, the operating lever 69 continues its downward movement, and as this movement is completed, a cam 78 on the lever strikes the latch and disengages it from the hook carrying lever, thus allowing the hook 66 to drop down into its lower position with its lower end underlying the path of the shuttle needle. The hook 66 moves down into this lower position below the path of the shuttle needle just before the shuttle needle starts forward, so that in presenting the thread in position to be engaged by the looper needles, the lacing cord is carried over the hook and brought into the position indicated in Fig. 1. In case the hook 66 is to remain out of action, the pin 75 is removed from the holes 74, and may be conveniently located in a hole 79 in the upper end of the arm 73. In such case

the operating lever 69 moves idly up and down in the slot in the arm 73 without imparting any movement to the hook carrying lever 68, and consequently the hook 66 remains in its lower position and does not engage and act upon the lacing cord.

After the upper has been placed on the needles, and the loops carried by the needles thus passed through the eyelet holes of the upper, the carrier for the looper needles and looper fingers is moved upward to bring the loops carried by the needles into line with the shuttle needle 48, so that the shuttle needle on its forward stroke carries the cord through the loops on the needles. In order that the upper may be held in such position upon the needles that it will be out of the path of the shuttle needle during its advance stroke, a work positioning and holding device comprising two work engaging fingers 80 and 81 is provided. These work engaging fingers are formed on the forward ends of two rods 82 and 83, the rear ends of which are pivotally connected at 84 and 85 respectively to supports on the upper face of the looper carrying plate 28. The rods 82 and 83 are supported near their forward ends by a bar 86 through which they pass, and which is pivotally supported upon the frame of the machine. The forward ends of the rods are bent or extended downward to form the work engaging fingers 80 and 81. Above their work engaging ends the fingers 80 and 81 are curved or bent outward so that the shuttle needle may pass between the fingers and the upper in passing the lacing cord through the loops carried by the looper needles. The outwardly curved lower ends of the work engaging fingers also insure the proper positioning of the work back of the fingers as the upper is carried up back of the fingers by the upward movement of the looper needles. Thus all danger of improper positioning of the upper, or of injury to the upper by the work positioning device, or by the shuttle needle, is avoided.

The work engaging finger 80 is arranged to engage the upper near the upper eyelet through which the lacing cord is passed, and the work engaging finger 81 is arranged to engage the upper near the lower eyelet. In order that the position of the work engaging finger 81 may be varied to correspond with the variations in the positions of the needles when adjusted for different spaced eyelets, the support to which the rod 83 is pivoted is itself pivotally mounted upon the looper carrying plate 28, so that the rod and finger may be swung laterally. The bar 86 is also provided with a longitudinal slot 87 through which the rod 83 passes. In order that the lateral adjustment of the finger 81 and rod 83 may be automatically effected in adjusting the needles, the finger 81 is connected with one of the looper carrying blocks by means of an arm 88, the rear end of which is pivoted to the block, and the front end of which is forked, and is arranged to embrace the upper part of the finger 81. The front end of the forked arm 88 is supported by engagement with shoulders 89 formed on the finger 81. By thus forming the finger 81 upon the outer end of a laterally movable rod, the finger and its supporting rod may be readily and easily adjusted. This construction also enables the finger and its support to be moved laterally into proper position to coöperate with the looper needles when it is desired to insert the lacing through only two or three pairs of eyelet holes. When thus adjusted, the work engaging finger and its support do not interfere with the proper adjustment of the guard plate 62 which underlies the shuttle needle 48. When loops are to be inserted through only two or three pairs of eyelet holes, as in doing baby work, for instance, the looper needles at the right and adjacent to the knot-tying mechanism are utilized for forming and inserting the loops. In order that the upper may be properly retained in position upon the needles, without danger of projecting up into the path of the shuttle needle, the plate 62 in such case should be adjusted to overlie the space to the left of the looper needles being used, and thus prevent the swinging of the upper up into the path of the shuttle needle. The lateral movement of the rod 83 in adjusting the work engaging finger 81 into proper relation to the looper needles being used, carries it into position where it does not interfere with the proper adjustment of the needle guard plate 62.

When the looper needles are moved upward to bring the loops into position for the passage of the shuttle needle, the upper carried on the needles passes up back of the work engaging fingers 80 and 81, the fingers acting to press the work back upon the needles, and to restrain it from springing forward into the path of the shuttle needle. When the looper fingers move forward longitudinally of the needles to remove the laced upper from the needles, the rods 82 and 83 and the work engaging fingers carried thereby move forward with the loopers, so that the fingers do not interfere with the removal of the upper.

The grippers 90 and 91 for grasping the ends of the lacing are arranged at the right of the loop forming devices, and coöperate with a plate 92 in gripping the cord. The grippers are in the form of fingers which project forward from the lower ends of two sliding bars 93 and 94, and these bars are moved at proper intervals through levers 95 and 96. The front ends of the levers en-

gage recesses in the rear sides of the gripper bars, and are yieldingly forced in a direction to operate the grippers to clamp the lacing cord by springs 97. The gripper 90 is arranged and operated to grip the free end of the cord when the shuttle needle advances, so that on the return stroke of the needle the cord is fed into position to be engaged by the hooks of the looper needles. The cord at this time lies in front of the guide bar 98, and when the loops are formed by the needles and looper fingers the cord draws across this bar, being retained in position on the bar by engagement with a notch 99 (Figs. 11 and 12). The gripper 91 is arranged and operated to grip the lacing cord carried by the shuttle needle after the needle has passed through the loops carried by the looper needles. After the cord has been gripped, and the shuttle needle has started on its return stroke, the cord leading from the gripper to the eye of the needle draws over the gripper finger 91, and after the needle has returned a sufficient distance to provide a free end of thread projecting through the eye of the needle, the cord is severed at the gripper 91 by the action of a knife 100 which is formed on the lower end of a knife bar 101. The bar 101 is operated through a lever 102, the front end of which engages a recess in the rear side of the knife bar. The lever is forced yieldingly in a direction to raise the knife bar by a spring 103.

In order to insure that the cord shall be drawn taut at the moment when the cutter acts, and to insure the complete separation of the ends of the thread, a cam 104 (Fig. 1) is provided for engaging the roll on the upper end of the tension lever 59, and forcing the lower end of the lever firmly against the cord, so that a pull is put upon the cord at the time the cutter acts.

The operating levers 95 and 96 for the cord grippers are operated at proper intervals to raise and lower the grippers, and the operating lever 102 for the knife bar is rocked at proper intervals to reciprocate the knife bar, through a single lever 105 the rear end of which is provided with a roll 106 engaging a groove in the cam 107. When the parts are in the position indicated in the main views of the drawings, the lever 105 is in the position indicated in Fig. 10. The front end of the lever is provided with two bearing blocks 108 arranged to engage the rear ends of the levers 95 and 96, and these blocks are so constructed that when the lever 105 is in the position of Fig. 10, the operating lever 95 for the gripper 90 is free to be operated by its spring 97, and this spring acts to force the gripper down against the end of the lacing with a spring pressure. The bearing block which engages the operating lever 96 is so shaped that when the lever 105 is in this position, the gripper 91 is retained in its upper position. At this time, also, the knife bar is maintained in its upper position by the action of the spring 103. When the shuttle needle carries the locking cord into position to be gripped by the gripper 91, the lever 105 is moved upward to allow the gripper 91 to be operated by its spring 97 to grip the cord. After the shuttle needle has been retracted a short distance, the upward movement of the lever 105 continues. During this continued movement of the lever it strikes an adjusting screw 109 in the end of the knife operating lever 102, and forces the knife downward to sever the cord. The lever 105 immediately moves downward far enough to allow the spring 103 to raise the knife bar to its upper position, but not far enough to operate either of the grippers 90 and 91. The lever 105 remains in this position until the ends of the lacing are about to be gripped by the jaws of the knotter, when the lever is moved down to its lowest position, operating both levers 95 and 96 to raise the grippers 90 and 91 and release the ends of the lacing. The lever 105 remains in this position until the laced upper has been discharged, and the shuttle needle has advanced and brought the free end of the thread carried thereby into position below the gripper 90, when the lever moves back to the intermediate position shown in Fig. 10. This movement allows the gripper 90 to be forced by its spring 97 against the free end of the cord, but is not sufficient to release the gripper 91.

During the return stroke of the shuttle needle, after it has given the free end of the cord to the gripper 90, and is laying the cord in position to be engaged by the hook of the looper needles, the cord between the gripper and the guide bar 98 is acted upon by a thread arm 110 which is arranged in front of the cord, and at this time is moved rearward to draw slack cord from the cord supply. When the looper fingers and looper needles are operating to form the loops in the cord, this thread arm again moves forward to give up its slack cord, so that the cord is supplied from both sides of the loop forming devices, the supply of cord for the right-hand loops being drawn from the cord given up by the thread arm, and the cord for the left-hand loops being drawn from the cord supply. This thread arm is also operated during the knot tying operation to lay the lacing into the jaws of the knotting mechanism, as will be more fully described in connection with the description of the knotting mechanism. The thread arm 110 is formed on the free end of a lever 111 which is pivoted at 112 to the under side of the plate 92, and is connected by a link 113 with a rod 114. The rod 114 is reciprocated to impart the proper movements to the thread

arm by a cam 115 (Fig. 4) which engages a roll carried by one arm of a lever 116, the other arm of which is connected by a link 167 with the rear end of the rod (Fig. 5). In order that the thread arm may operate to supply a proper amount of thread to the loop forming devices when they are operated to form different numbers of loops, means is provided for adjusting the amount of slack drawn off and given up by the thread arm. In the construction shown, this adjustment is provided for by connecting the front end of the link 113 to the thread arm lever 111 in such manner that the connection may be adjusted toward or from the fulcrum of the lever, and thus the motion imparted to the thread arm by the operating cam be varied. As shown, the adjustable connection consists of a series of holes 118 formed in the lever 111 and adapted to receive the pivot screw 119 which connects the end of the link 113 with the lever.

After the shuttle needle has passed the locking cord through the loops held by the looper needles, and the cord has been gripped by the gripper 91 and severed by the knife 100, the two ends of the lacing cord extend side by side across the guide bar 98 to the grippers. The ends of the lacing are now in position to be acted upon by the knotting mechanism, which operates to tie the ends of the lacing together. In the construction shown, the knotting mechanism is constructed to form a loop in the lacing cord, and to draw a bight of the cords through the loop, and to then tighten the knot thus formed. As shown in Figs. 11 to 13, the knotting mechanism is provided with a looping post formed by the lower ends of two semi-cylindrical members 120 and 121. These members are mounted in a sleeve 122 and are provided at their lower extremities with operating jaws 123 and 124 for gripping the cord. During the tying of the knot the members are rotated to form a loop about their lower ends, and are also moved longitudinally to grip the cord between the jaws and draw it through the loop. The sleeve 122 is rotated to impart rotary movements to the members 120 and 121 through a pinion 125 which is engaged by a segmental gear 126. This gear is formed on the front end of a lever 127, the rear end of which is acted upon by a cam 128 (Figs. 2, 4, and 5). The members 120 and 121 are connected to the sleeve 122 by means of a bar 129 extending through a slot formed in the adjacent faces of the members, so that the members will rotate with the sleeve, while being free to move longitudinally therein. Longitudinal movements are imparted to the members by means of levers 130 and 131, the forward ends of which are connected to the members, and the rear ends of which are engaged by cams 132 and 133 (Fig. 2).

The looping post formed by the lower ends of the members 120 and 121 is provided with a cord retaining latch 134 formed on a lever which is pivoted at 135 in a recess formed on the inner face of the member 120. The latch is so formed that when its lower end is in engagement with the looping post it underlies the lacing cord, and retains the cord upon the post during the formation of the loop. A half sleeve 136 is secured upon the lower end of the sleeve 122, and is provided at its lower end with a finger 137 arranged to lie within a slot in the member 121 and to act to strip the loop off the looping post when the post is drawn upward within the sleeve. The latch lever is operated to move the end of the latch toward and away from the looping post, and to retain the latch in either open or closed position, by means of two arms 138 and 139 formed on the latch lever, and arranged to coöperate with a lug 140 and retaining surface 141 on the sleeve 136.

The knotting mechanism normally stands in the position indicated in Figs. 12 and 13. When the lacing has been inserted, and the ends are to be tied together, the members 120 and 121 are moved downward to carry the looping post formed by their lower ends and the latch 134 on opposite sides of the ends of the lacing cord, and thus bring the lacing cord into position to overlie the end of the latch when the latch is closed. After the lower end of the latch has passed below the lacing cord, the arm 139 on the latch lever strikes the lug 140, and the latch lever is swung about its pivot to bring the lower end of the latch against the looping post, and to hold it in this position. After the knotting mechanism has moved into this position, the upper is forced off the looping needles and falls away from the needles, so that it is supported from the ends of the lacing cord which pass over the latch 134 and are held by the grippers 90 and 91. When the upper falls into this position, the two strands of the lacing cord leading from the grippers over the latch of the knotting mechanism to the upper lie against a lateral extension 142 formed at the lower end of the guide bar 98. The front face of this extension 142 forms a fixed jaw against which the lacing is gripped by a clamp 143 during the knot tightening operation. The clamping plate is formed on the lower end of a lever 144, and is provided with a projecting finger 145 which underlies the fixed jaw 142 and prevents the lacing from swinging too far to the right when the upper is discharged from the needles. The clamping lever 144 is operated from the lever 127 which rotates the knotting mechanism by a link 146. The clamping lever is operated to clamp the thread as the members 120 and 121 of the knotting mechanism rotate to form a loop

upon the looping post at their lower ends. During the rotation of the members 120 and 121 the latch 134 supports the lacing cord on the looping post at the lower ends of the members, and carries the cord around the post so that a loop is formed. As the members complete their rotation, the thread arm 110 is moved rearwardly to carry the ends of the lacing between the knotter jaws 123 and 124, and these jaws are closed and the members 120 and 121 move upward. As the members move upward, the arm 138 on the latch lever rides against the under side of the lug 140 and against the engaging surface 141, so that the latch is opened to release the loop, and is maintained in open position. As the upward movement of the knotter jaws continues, the loop is cast off the end of the jaws by the finger 137, and the lacing carried by the jaws is drawn through the loop. About the time that the knotter jaws grip the lacing, the grippers 90 and 91 are operated to release the ends of the lacing. During the upward movement of the knotter jaws the lacing below the knot is gripped by the plate 143 at the lower end of the clamping lever, and the knot is effectively tightened by the relative movement between the knotter jaws and the knot tightening clamp. As the knotter jaws reach their upper position, the members 120 and 121 are operated to open the jaws, and the lever 127 returns to its normal position, thus operating the cord clamping lever 144 to release the lacing cord, so that the laced upper drops away from the machine.

The various cams for operating the different parts of the machine are secured upon a cam shaft 147 which is driven through gearing from a pulley 148. The machine is provided with a stop mechanism indicated at 149 (Fig. 1), which operates to stop the machine with the parts in the position indicated in the main views. The stop mechanism is operated to start the machine through a treadle (not shown) connected with a rod 150. When the machine is thrown into operation, it makes a single revolution and then stops, ready for the application of another upper to the looper carrying needles.

Having explained the nature and object of the invention, and specifically described one form of machine in which the invention may be embodied, what I claim is:—

1. A machine for lacing shoe uppers, having in combination, means for forming a series of loops of lacing cord, and thereafter inserting said series of loops in the eyelet holes of an upper, and additional means for varying the amount of slack in the completed lacing, substantially as described.

2. A machine for lacing shoe uppers, having, in combination, means for inserting a lacing cord in the eyelet holes of an upper adjustable to vary the slack in the completed lacing, and a slack thread device for further increasing the slack in the lacing, substantially as described.

3. A machine for lacing shoe uppers, having, in combination, means for inserting a lacing cord in the eyelet holes of an upper, and a slack thread device arranged to engage the cord and supply slack in the completed lacing in addition to the slack produced by the lace inserting means, substantially as described.

4. A machine for lacing shoe uppers, having, in combination, means for inserting a lacing cord in the eyelet holes of an upper, a slack thread device arranged to engage the cord and supply slack in the completed lacing in addition to the slack produced by the lace inserting means, and means for varying the amount of slack supplied by the slack thread devices, substantially as described.

5. A machine for lacing shoe uppers, having, in combination, means for inserting a lacing cord in the eyelet holes of an upper, and a slack thread device adjustable to render it effective or ineffective to increase the slack in the lacing cord, substantially as described.

6. A machine for lacing shoe uppers, having, in combination, a plurality of needles, means coöperating therewith to form a series of loops in a lacing cord, means for adjusting the length of the loops to vary the amount of slack in the lacing, and a device for further varying the slack in the completed lacing, substantially as described.

7. A machine for lacing shoe uppers, having, in combination, a plurality of needles, means coöperating therewith to form a series of loops in a lacing cord, a slack thread device arranged to engage the cord on the supply side of the needles, and means for passing the cord through the loops, substantially as described.

8. A machine for lacing shoe uppers, having, in combination, means for passing a series of loops of lacing cord through the eyelet holes of an upper, means for passing a portion of the cord through the loops, and a slack thread device movable into and out of position to engage the cord between the loops and the means for passing a cord through the loops, substantially as described.

9. A machine for lacing shoe uppers, having, in combination, means for passing a series of loops of lacing cord through the eyelet holes of an upper, means for passing a portion of the cord through the loops, a slack thread device arranged to engage the cord between the loops and the means for passing the cord through the loops, and means for varying the amount of slack supplied by the device, substantially as described.

10. A machine for lacing shoe uppers, having, in combination, a plurality of needles, looper fingers coöperating therewith to form a series of loops in a lacing cord, a shuttle needle for carrying the lacing cord through the loops, a thread finger arranged to engage the cord between the loop forming devices and the shuttle needle, and means for rendering the thread finger effective or ineffective, substantially as described.

11. A machine for lacing shoe uppers, having, in combination, a plurality of needles, looper fingers coöperating therewith to form a series of loops in a lacing cord, a shuttle needle for carrying the lacing cord through the loops, a thread finger arranged to engage the cord between the loop forming devices and the shuttle needle, means for rendering the thread finger effective or ineffective, and means for operating the finger adjustable to vary the amount of slack supplied by the finger, substantially as described.

12. A machine for lacing shoe uppers, having, in combination, means for forming a series of loops in a lacing cord and retaining them in position to be passed through the eyelet holes of an upper, a work positioner, means acting to automatically change the relation of the work positioner and loop forming means to retain the upper in position, and means for passing a locking cord through the loops between the work positioner and the upper, substantially as described.

13. A machine for lacing shoe uppers, having, in combination, a plurality of needles, means coöperating therewith to form a series of loops in the lacing cord and retain them in position to be passed through the eyelet holes of an upper, a work positioning device, means to automatically change the relation of the needles and work positioning device to position the work on the needles, and means for passing a locking cord through the loops between the work positioning device and the upper, substantially as described.

14. A machine for lacing shoe uppers, having, in combination, means for forming a series of loops in a lacing cord and retaining them in position to be passed through the eyelet holes of an upper, means for passing a locking cord through the loops, a work positioner provided with an outward curve above its work engaging end for the passage of the locking cord, means acting to automatically change the relation of the work positioner and loop forming means to retain the work out of the path of the means for passing the locking cord through the loops, substantially as described.

15. A machine for lacing shoe uppers, having, in combination, means for forming a series of loops in a lacing cord and retaining them in position to be passed through the eyelet holes of an upper, a shuttle needle for passing a locking cord through the loops, a work positioning device acting to position the work on the needles and adjustable for different numbers of loops, and a guard underlying the needle and adjustable for corresponding numbers of loops, substantially as described.

16. A machine for lacing shoe uppers, having, in combination, a plurality of needles, a plurality of loopers coöperating therewith to form a series of loops in the lacing cord, a shuttle needle for passing a locking cord through the loops, a work positioning device acting to position the work on the needles and adjustable to co-act with the varying numbers of active needles, and a shuttle needle guard adjustable for corresponding numbers of active needles, substantially as described.

17. A machine for lacing shoe uppers, having, in combination, means for forming a series of loops in the lacing cord and retaining them in position to be passed through the eyelet holes of an upper, means for passing a locking cord through the loops, and a work positioning device including a rod movable laterally of the loops and carrying a work engaging finger, substantially as described.

18. A machine for lacing shoe uppers, having, in combination, a plurality of needles, a plurality of looper fingers cooperating therewith to form a series of loops in a lacing cord, a looper carrier, means for operating the looper carrier, and a work positioning device comprising a rod connected with the looper carrier to swing laterally of the series of needles and provided with a work engaging finger, substantially as described.

19. A machine for lacing shoe uppers, having, in combination, a plurality of needles, a plurality of looper fingers coöperating therewith to form a series of loops in a lacing cord, a looper carrier, and a work positioner comprising two rods pivotally connected with the looper carrier, one of said rods being mounted to swing laterally, and work engaging fingers at the outer ends of the rods, substantially as described.

20. A machine for lacing shoe uppers, having, in combination, a plurality of needles, a plurality of looper fingers, means for causing a relative movement between the needles and fingers to form a series of loops in the lacing cord and to discharge the upper from the needles, and means for varying the length of loops without varying the relative position of the loopers and needles in discharging the upper, substantially as described.

21. A machine for lacing shoe uppers, having, in combination, a plurality of needles, a plurality of looper fingers, operating mechanism acting to relatively advance the loopers to a uniform position at the ends of the needles, and to relatively retract the loopers to a position variable according to the length of loops to be formed, substantially as described.

22. A machine for lacing shoe uppers, having, in combination, a plurality of needles, a plurality of looper fingers coöperating therewith to form a series of loops in the lacing cord, and mechanism for advancing the looper fingers to a uniform position and for retracting the fingers a variable distance in accordance with the length of loops to be formed, substantially as described.

23. A machine for lacing shoe uppers, having, in combination, a plurality of needles, a plurality of looper fingers coöperating therewith to form a series of loops in a lacing cord, and mechanism for relatively actuating the looper fingers and needles, having provision for allowing a variable lost motion for varying the length of loops, substantially as described.

24. A machine for lacing shoe uppers, having, in combination, a plurality of needles, a plurality of looper fingers, a carrier for the looper fingers, an actuating slide, and means for securing a variable lost motion between the slide and carrier for varying the length of the loops, substantially as described.

25. A machine for lacing shoe uppers, having, in combination, a plurality of needles, means coöperating therewith to form a series of loops in a lacing cord, means for adjusting the length of the loops, and means for indicating the adjustment for different lengths of loops, substantially as described.

26. A machine for lacing shoe uppers, having, in combination, a plurality of needles, a plurality of looper fingers coöperating therewith to form a series of loops in a lacing cord, and actuating mechanism for relatively actuating the looper fingers and needles, including a manually adjustable lever and connections for varying the length of the loops, substantially as described.

27. A machine for lacing shoe uppers, having, in combination, a plurality of needles, a plurality of looper fingers coöperating therewith to form a series of loops in a lacing cord, actuating mechanism for relatively actuating the looper fingers and needles, including a manually adjustable lever and connections for varying the length of the loops, and means for latching the lever in adjusted positions and indicating the adjustment, substantially as described.

28. A machine for lacing shoe uppers, having, in combination, a plurality of needles, a plurality of looper fingers coöperating therewith to form a series of loops in a lacing cord, a carrier for the looper fingers, actuating mechanism for the carrier, a manually adjustable lever on the carrier, and a link connecting the lever and the actuating mechanism, substantially as described.

29. A machine for lacing shoe uppers, having, in combination, a plurality of needles, a plurality of looper fingers coöperating therewith to form a series of loops in a lacing cord, a carrier for the looper fingers, actuating mechanism for the carrier, a manually adjustable lever on the carrier, a link connecting the lever and the actuating mechanism, and means for latching the lever in adjusted position and indicating the adjustment, substantially as described.

30. A machine for lacing shoe uppers, having, in combination, means for forming a plurality of loops in a lacing cord, means for supplying cord from both sides of the loop forming means, and means for varying the supply from each side of the loop forming means in accordance with the number of loops being formed, substantially as described.

31. A machine for lacing shoe uppers, having, in combination, a plurality of needles, means coöperating therewith to form a series of loops in a lacing cord, means for feeding the lacing cord to the needles, means acting at one side of the needles to draw cord from the supply prior to the formation of the loops, and means for adjusting the amount of cord drawn from the supply in accordance with the number of loops to be formed, substantially as described.

32. A machine for lacing shoe uppers, having, in combination, a plurality of needles, means coöperating therewith to form a series of loops in a lacing cord, means for feeding the lacing cord to the needles, a thread arm arranged to engage the cord on one side of the needles, means for operating said thread arm to draw cord from the supply prior to the formation of the loops, and to give up said cord during the formation of the loops, and means for varying the operation of said thread arm in accordance with the number of loops to be formed, substantially as described.

33. A machine for lacing shoe uppers, having, in combination, a plurality of needles, means coöperating therewith to form a series of loops in a lacing cord, means for feeding the lacing cord to the needles, means for holding the free end of the cord, means acting on the cord between the needles and said holding means to draw

cord from the supply prior to the formation of the loops and to give up said cord during the formation of the loops, and means for varying the amount of cord drawn from the thread supply in accordance with the number of loops to be formed, substantially as described.

34. A machine for lacing shoe uppers, having, in combination, a plurality of needles, means coöperating therewith to form a series of loops in a lacing cord, means for feeding the lacing cord to the needles, means for holding the free end of the cord, a thread arm arranged to act on the cord between the needles and said holding means, and actuating means for the thread arm adjustable for varying numbers of active needles, substantially as described.

35. A machine for lacing shoe uppers, having, in combination, a plurality of needles arranged to pass a series of loops of lacing cord through the eyelet holes of an upper, an adjusting lever, and links directly connected to the lever and connected with the needles to move them varying distances in accordance with the eyelet holes in the upper to be laced, substantially as described.

36. A machine for lacing shoe uppers, having, in combination, a plurality of needles arranged to pass a series of loops of lacing cord through the eyelet holes of an upper, an adjusting lever, and links connected with the needles and with the lever at varying distances from its fulcrum for changing the relative lateral positions of the needles to space the needles in accordance with the spacing of the eyelet holes in the upper to be laced, substantially as described.

37. A machine for lacing shoe uppers, having, in combination, a plurality of needles arranged to pass a series of loops of lacing cord through the eyelet holes of an upper, needle carrying blocks, levers 21 connected with the blocks, and links 23 connecting the levers together, substantially as described.

38. A machine for lacing shoe uppers, having, in combination, mechanism for inserting a lacing cord in the eyelet holes of an upper, a knot tying mechanism arranged to act on the ends of the lacing, actuating mechanism for the knot tying mechanism, and a gripper actuated from said mechanism to grip the lacing on the work side of the knot during the tightening of the knot, substantially as described.

39. A machine for lacing shoe uppers, having, in combination, mechanism for inserting a lacing cord in the eyelet holes of an upper, a knot tying mechanism arranged to act on the ends of the lacing, a cam and connections for operating the knot tying mechanism, and a gripper actuated by said cam to grip the lacing on the work side of the knot during the tightening of the knot, substantially as described.

40. A machine for lacing shoe uppers, having, in combination, mechanism for inserting a lacing in the eyelet holes of an upper, a knot tying mechanism provided with a pivoted lace retaining latch, and means for swinging the latch on its pivot to retain and release the lace and for holding it in retaining position during the formation of the knot loop, substantially as described.

41. A machine for lacing shoe uppers, having, in combination, mechanism for inserting a lacing in the eyelet holes of an upper, a knot tying mechanism provided with rotary and reciprocating jaws, a latch pivotally mounted on the jaws, and means for swinging the latch about its pivot as the jaws are reciprocated and for holding it in retaining position during the rotation of the jaws, substantially as described.

42. A machine for lacing shoe uppers, having, in combination, mechanism for inserting lacing cord in the eyelet holes of an upper including a cord feeding device, grippers for grasping the ends of the lacing, a cutter for severing the lacing cord, and a single cam and connections for operating the grippers and cutter, substantially as described.

43. A machine for lacing shoe uppers, having, in combination, mechanism for inserting lacing cord in the eyelet holes of an upper including a cord feeding device, grippers for grasping the ends of the lacing, springs for imparting gripping movements to the grippers, and means for actuating the grippers against the force of the springs to release the lacing, substantially as described.

44. A machine for lacing shoe uppers, having, in combination, mechanism for inserting lacing cord in the eyelet holes of an upper including a cord feeding device, grippers for grasping the ends of the lacing, a cutter for severing the lacing cord, and an actuating lever and suitable connections for actuating the grippers and actuating the cutter to sever the cord, substantially as described.

45. A machine for lacing shoe uppers, having, in combination, means for passing a series of loops of lacing cord through the eyelet holes of an upper, means for passing a portion of the cord through the loops, and a slack thread device arranged to engage the cord between the loop passing means and the means for passing a cord through the loops and means for actuating the finger to draw slack thread, substantially as described.

46. A machine for lacing shoe uppers, having, in combination, a plurality of needles, looper fingers coöperating there-

with to form a series of loops in the lacing cord, a shuttle needle for carrying the lacing cord through the loops, a thread finger arranged to engage the cord between the loop forming devices and the shuttle needle and means for actuating the finger to draw slack thread, substantially as described.

In testimony whereof, I affix my signature, in presence of two witnesses.

WILLARD A. SMITH.

Witnesses:
CHARLES W. MCDERMOTT,
N. D. MCPHAIL.