C. H. T. HAGELSTEIN.

SEWING MACHINE.

APPLICATION FILED MAR. 6, 1911.

1,009,408.

Patented Nov. 21, 1911.

4 SHEETS—SHEET 1.

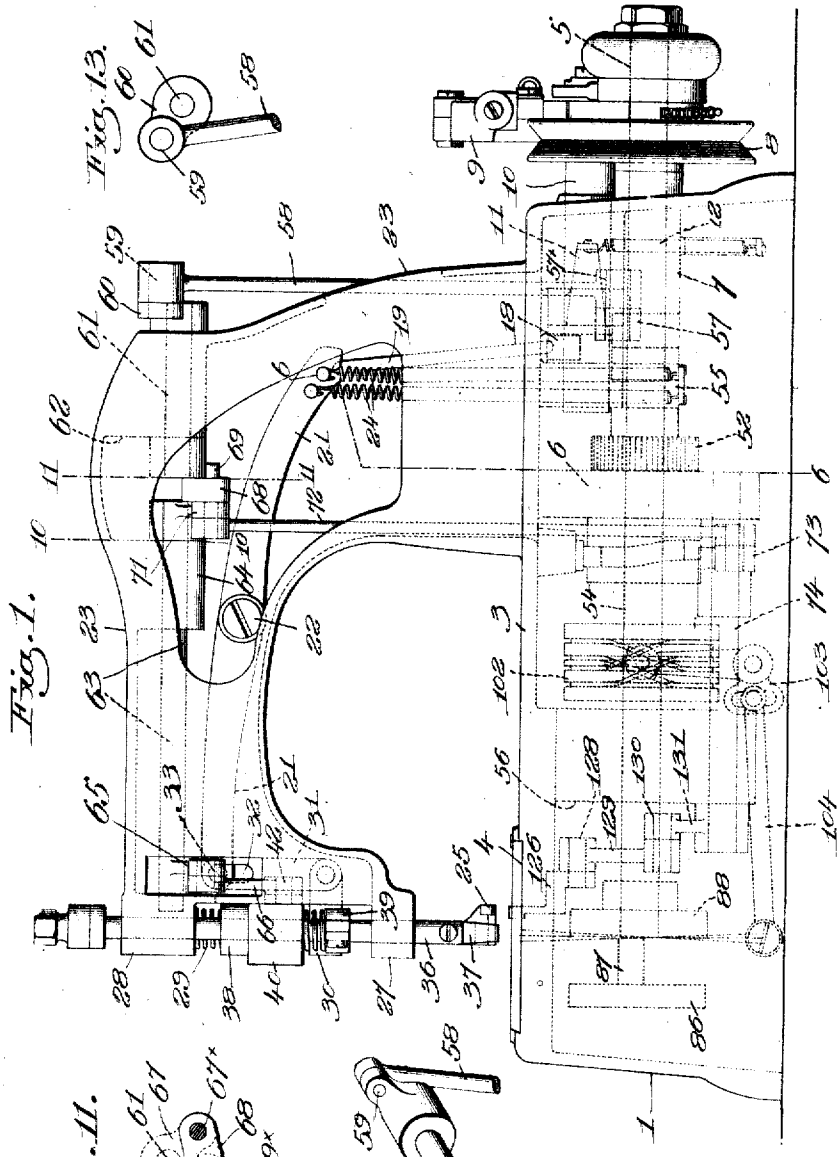

Fig. 1.

Fig. 13.

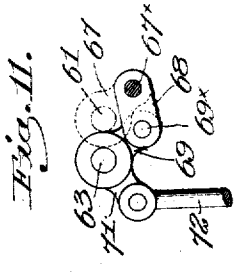

Fig. 11.

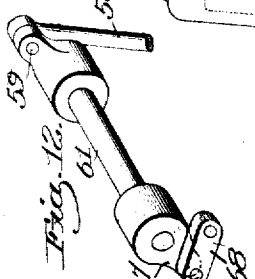

Fig. 12.

Witnesses:
Fred. S. Grumbach.
Joseph M. Ward.

Inventor,
Christian H. T. Hagelstein.
by Edmonds, Head & Smith
Attys

C. H. T. HAGELSTEIN.

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Fig. 2.

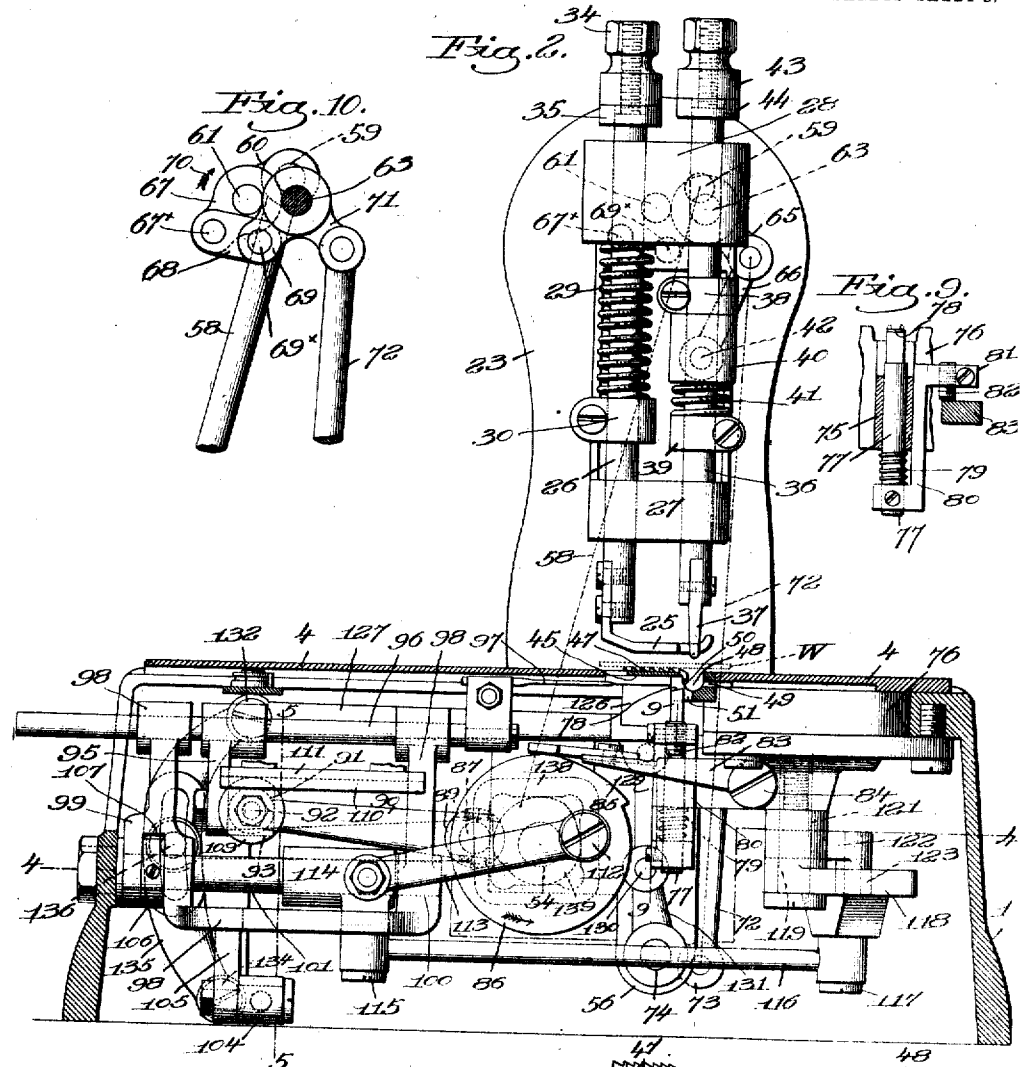


Fig. 10.

Fig. 9.

Fig. 14.

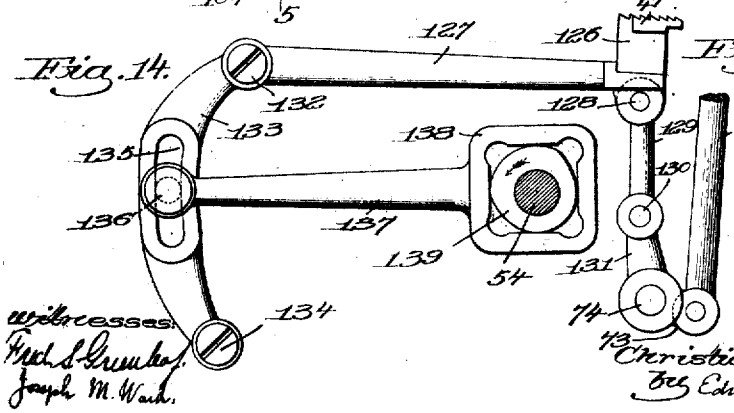
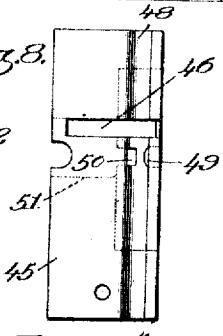


Fig. 8.



Witnesses:
Fred. L. Gruenke.
Joseph M. Wash.

Inventor,
Christian H. T. Hagelstein,
By Edmonds, Hend & Smith
Attys.

C. H. T. HAGELSTEIN.

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4 SHEETS—SHEET 3.

Fig. 3.

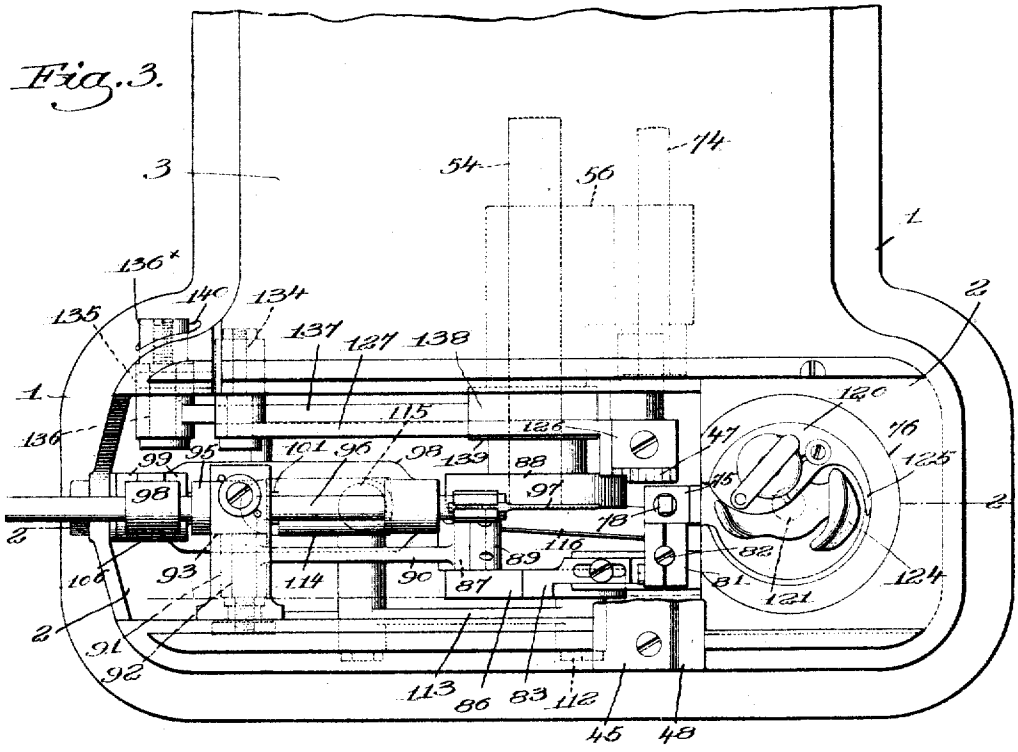


Fig. 4.

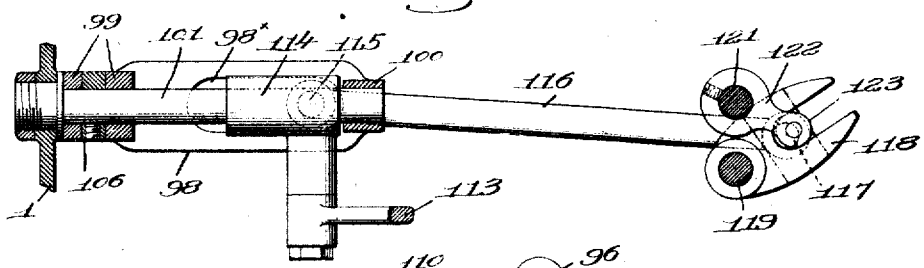
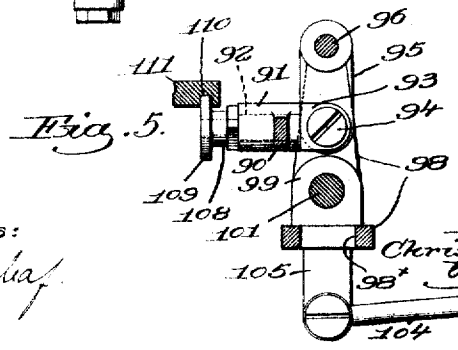


Fig. 5.



Witnesses:
Fred. L. Gruber
Joseph M. Ward.

Inventor,
Christian H. T. Hagelstein,
By Edmund Wood & Smith
Attys

C. H. T. HAGELSTEIN.

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4 SHEETS—SHEET 4.

Fig. 6.

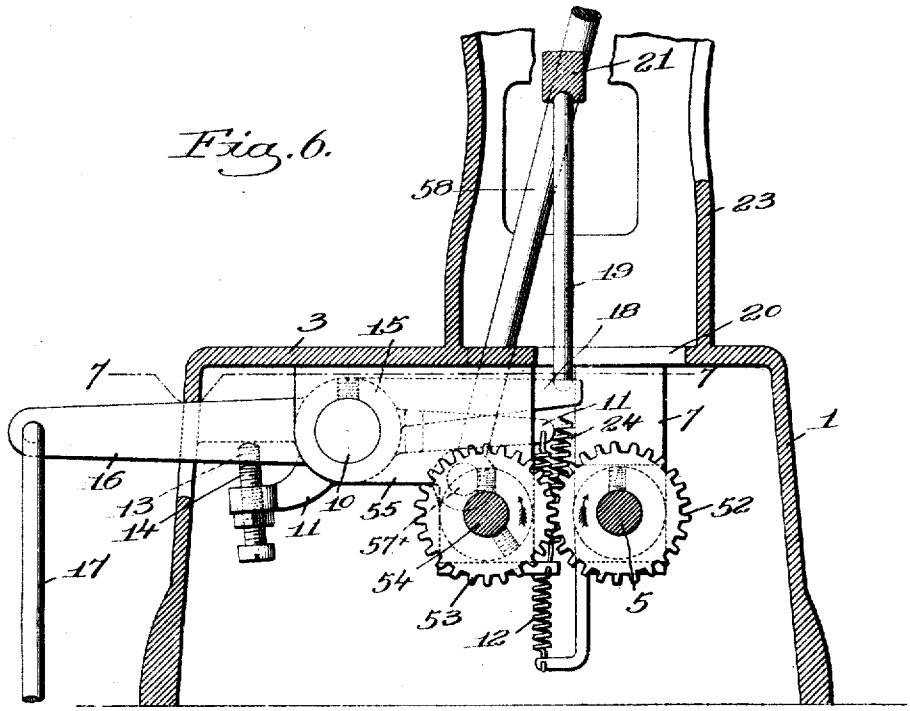
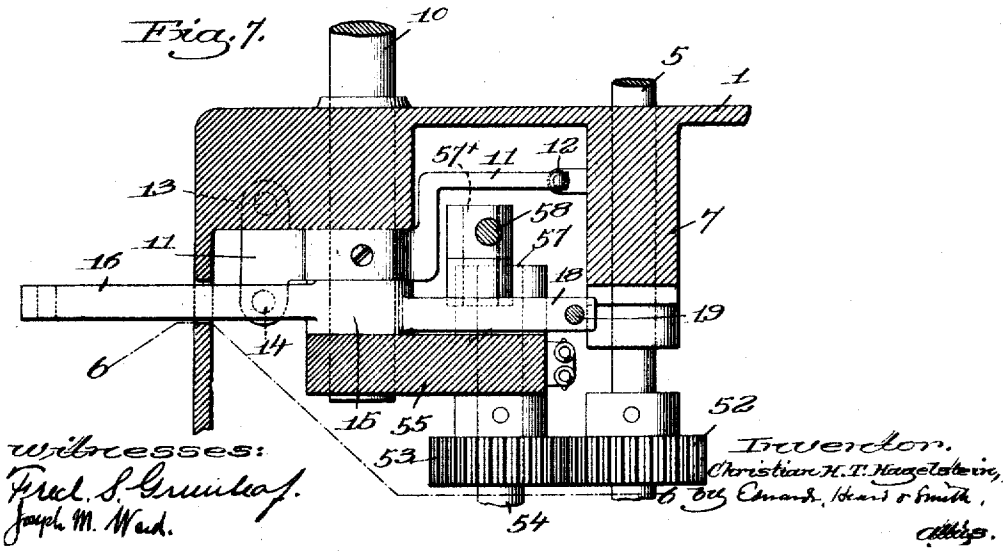


Fig. 7.



Witnesses:
Fred. S. Grinnell.
Joseph M. Ward.

Inventor.
Christian H. T. Hagelstein,
by Edmonds, Ward & Smith,
Attys.

UNITED STATES PATENT OFFICE.

CHRISTIAN H. T. HAGELSTEIN, OF DORCHESTER, MASSACHUSETTS, ASSIGNOR TO THE REECE BUTTON HOLE MACHINE COMPANY, OF BOSTON, MASSACHUSETTS, A CORPORATION OF MAINE.

SEWING-MACHINE.

1,009,408. Specification of Letters Patent. Patented Nov. 21, 1911.

Application filed March 6, 1911. Serial No. 612,670.

To all whom it may concern:

Be it known that I, CHRISTIAN H. T. HAGELSTEIN, a citizen of the United States, and resident of Dorchester, county of Suffolk, State of Massachusetts, have invented an Improvement in Sewing-Machines, of which the following description, in connection with the accompanying drawing, is a specification, like characters on the drawing representing like parts.

This invention relates to sewing machines of the type wherein the work is bent intermittingly for penetration by the eye-pointed needle of the stitch-forming mechanism to produce a blind stitch, machines of this character being extensively used for finishing buttonhole pieces for boots and shoes. In such machines the needle is not only reciprocated longitudinally to enter and be withdrawn from the bend formed in the work but said needle is also vibrated laterally on alternate thrusts to effect the formation of the desired stitching.

My present invention has for its object the production of an improved sewing machine of the type referred to, so constructed and arranged that the machine can be run at high speed without any disarrangement of the cycle of operations performed by the several component mechanisms, and without interfering with the certainty and accuracy of the operations and to this end I have provided for a very easy and smooth motion of the different parts of the machine, and I have reduced to a minimum the objectionable vibrations which the momentum of rapidly moving parts tends to set up.

The bender-carrier is rapidly reciprocated when the machine is in operation, and inasmuch as it is at rest more than one-half of each complete cycle of the machine it is necessary to move the bender-carrier at a high speed during the remainder of the cycle, and as such speed tends of itself to produce improper vibrations I have devised actuating mechanism to counteract or substantially prevent such vibrations. This actuating mechanism is so constructed that the maximum action exerted thereby upon the bender occurs when the latter is in engagement with the work, which is the proper time for the application of the greatest force, the force increasing as the speed of the bender on its active stroke decreases, and conversely, as the force diminishes on the return stroke the speed is increased.

I have also provided novel means for controlling the feed-motion directly and positively, from the bender-operating mechanism, so that the feed-block rises as the bender is retracted from the work and descends as the bender is moved into engagement with the work, so that a very accurate and positive relationship between such parts is effected.

An oscillating shuttle coöperates with the reciprocating needle, the oscillation of the one and the reciprocation of the other of such parts being effected in a novel and improved manner, as will be pointed out hereinafter.

These and other novel features of my invention will be fully described in the subjoined specification and particularly pointed out in the following claims.

Figure 1 is a front elevation of a sewing-machine embodying my present invention, certain of the mechanism within the base of the machine being indicated by dotted lines to locate the same with relation to other parts shown in full lines, the machine being shown at rest; Fig. 2 is a left-hand end elevation and part vertical section, on a larger scale, of the machine shown in Fig. 1, the section being taken on the irregular line 2—2, Fig. 3; Fig. 3 is a top plan view, enlarged, of the left-hand end of the base with the cover-plate removed from the bed-plate and with the throat-plate almost entirely omitted; Fig. 4 is a detail in plan and horizontal section on the irregular line 4—4, Fig. 2, of the connection between the needle-reciprocating mechanism and the shuttle to oscillate the latter; Fig. 5 is a vertical sectional detail on the line 5—5, Fig. 2, looking toward the left, of a portion of the means for effecting lateral vibration of the needle; Fig. 6 is a vertical section taken on the irregular line 6—6, Figs. 1 and 7, to show the connection between the main or driving and auxiliary shafts, and parts adjacent thereto, looking toward the right, Fig. 1, and on an enlarged scale; Fig. 7 is a horizontal sectional detail of such parts on the line 7—7, Fig. 6, looking down; Fig. 8 is a top plan view of the throat-plate, detached; Fig. 9 is a vertical sectional detail on the line 9—9, Fig. 2, looking toward the

right, of the needle-guide and adjacent parts; Fig. 10 is a sectional detail, enlarged, on the line 10—10, Fig. 1, looking toward the right, to be referred to; Fig. 11 is a sectional detail of some of the parts shown in Fig. 10, but taken on the line 11—11, Fig. 1, and looking toward the left; Fig. 12 is a perspective detail of the actuating rocker-shaft for the bender, omitting the bearings therefor; Fig. 13 is a right-hand end elevation of said rocker-shaft and a portion of the operating pitman connected therewith; Fig. 14 is an enlarged detail view, principally in elevation of the feed mechanism shown in Figs. 2 and 3, in the position assumed at the end of the feed of the work.

Herein the longitudinally reciprocated eye-pointed needle enters transversely the bend formed intermittingly in the work, and as the feed of the work is parallel to the needle path, the needle is moved laterally in one direction for one thrust and in the opposite direction for the next thrust, in general as in United States Patent No. 404,863 granted June 11, 1889 to John Reece.

The base 1, of suitable shape and size to sustain the operating parts of the machine, has an elongated opening 2, Fig. 3, in the bed-plate 3, for the reception of a cover-plate 4, Figs. 1 and 2, and a throat-plate, to be referred to, and the main or driving shaft 5 extended longitudinally beneath the bed-plate is supported in bearings 6, 7, said shaft having a clutch device of any suitable character, including a band-pulley 8 which runs loose on the shaft except when the clutch is set in operation by elevation of an arm 9, Fig. 1, attached to a rock-shaft 10 mounted in the base. The clutch device is substantially the same as that forming the subject matter of United States Patent to Reece No. 367,063 dated July 26, 1887. A bent lever 11 fast on said rock-shaft has an attached returning spring 12, Fig. 6, the rear end of the lever carrying two upturned and adjustable screw-studs 13, 14, the former acting as a stop to limit spring-induced rotation of the rock-shaft. A hub 15 loose on the rock-shaft has a rearwardly extended starting arm 16 engaging the stud 14, so that when said arm is pulled down, as by a link 17, the rock-shaft 10 will be turned to elevate the controlling arm 9 and set the clutch in operation to start the machine. Said hub 15 has a frontwardly extended arm 18 which sustains the lower end of a longitudinally rigid link 19 passed up through a hole 20 in the bed-plate and at its upper end entering a socket in a lever 21 fulcrumed at 22, Fig. 1, in the overhanging arm 23 secured to or forming part of the base 1. Strong springs 24 fixedly held at their lower ends are attached at their upper ends to the lever 21 adjacent the link 19, and serve to elevate the outer end of said lever, which latter constitutes a presser-foot controller.

The presser-foot 25 is attached to a presser-bar 26, Fig. 2, vertically movable in bearings 27, 28 shown as forming a part of the outer end of the overhanging arm 23, a depressing spring 29 being coiled about the presser-bar between the bearing 28 and a collar 30 clamped on said bar and having a pivotally connected, upturned link 31, slotted at its upper end at 32, Fig. 1, to loosely receive a lateral stud 33 on the outer end of the presser-foot controller 21. When the starting arm 16 is depressed and the arm 18 is lifted the link 19 rocks the controller 21 against the springs 24, and as the stud 33 is thereby lowered the spring 29 is free to expand and depress the presser-bar, so that the presser-foot 25 will engage the work. When the rock-shaft 10 is turned to effect stoppage of the machine the springs 24, which are more powerful than spring 29, act through the intervening parts to elevate the presser-bar and release the work. It will be understood that the overhanging arm supports the presser-foot at such a point as will enable the work to be properly engaged when the machine is in operation. The depression of the presser-foot is limited by an adjustable nut 34 on the threaded upper end of the presser-bar, a leather or other suitable washer 35 surrounding said bar below the nut and engaging the top of the bearing 28 when the presser-bar descends under the action of the spring 29. While the latter enables the presser-foot to accommodate itself to slight variations in the thickness of a piece of work, and to the movements of the feed-block or bar the adjustment for a material change in the thickness of the work to be acted upon is provided by the nut 34.

Herein I have shown the bender-carrier as a bar 36 vertically reciprocated in the bearings 27, 28 and having attached to its lower end the bender 37, which latter has a blade-like tip of usual character, the width of the bender being in an upright plane at right angles to the needle path and line of feed of the work, the presser-foot 25 being cut away to clear the bender and prevent interference therewith. Collars 38, 39 are clamped upon the bender-carrier between the bearings 27, 28 and a sleeve 40 is loosely mounted on said carrier between the collars, said sleeve being held against the upper collar by a strong spring 41 which seats on the lower collar 39, the sleeve having a lateral stud 42 extended therefrom to the right, Fig. 1. The extreme descent of the bender is positively limited by an adjustable nut 43 on the upper end of the bender-carrier, and a suitable washer 44, the latter engaging the top of the bearing 28 when the

bender is in its lowest position, as will be apparent.

The throat-plate 45, shown separately in Fig. 8, fits into the cover-plate 4 and is slotted at 46 for the feed-bar 47, Figs. 1 and 14, a deep groove 48 in the throat-plate crossing the slot at right angles thereto, the work being bent or pressed intermittingly into the groove by the bender 37 in a well-known manner, and a needle-passage 49 is formed in one wall of said groove opposite the opening 50 in the opposite wall. Said throat-plate is cut away at its under side adjacent and communicating with the opening 50, as at 51, to accommodate the needle-guide, to be referred to hereinafter.

Bender actuating mechanism.—I will now describe the novel and peculiar mechanism for actuating the bender, the prime mover for said mechanism being the main shaft 5, which has a gear 52 fast thereon meshing with a like gear 53 fast on an auxiliary shaft 54 extended beneath the bed-plate to a point below and near the needle path, see Figs. 1 and 3, said shaft being supported in bearings 55, 56 forming a part of the base casting, and also in the bearing portion 6 before referred to. A short crank-arm 57 on the right hand end of the shaft 54 has pivotally connected therewith at 57× the lower end of a strong and rigid pitman 58 extended upward through the bed-plate hole 20 and pivoted at its upper end on a stud 59 on a rocker arm 60 fast on a short rocker-shaft 61, Figs. 1, 12, and 13, horizontally journaled in a bearing 62 on the overhanging arm 23, Fig. 1. In practice the radius of the path of movement of the stud 59 is greater than the radius of the path of movement of the stud 57×, so that the rotary movement of the shaft 54 is always converted by the pitman 58 into oscillatory movement of the rocker shaft 61, and thereby any tendency of the pitman to bend or twist and thereby revolve the shaft 61, when the machine is running at high speed, is effectually obviated. Such tendency is also diminished by making the pitman as strong and rigid as is compatible with weight, for in a high-speed machine the weight of rapidly reciprocating parts must be kept as low as possible. The pitman connection between the auxiliary and rocker shafts gives a very smooth and easy motion, however, and one well adapted to secure the best results in operation. A second, longer rocker shaft 63 is mounted at its inner end in a bearing 64 on the overhanging arm and at its outer end in the bearing 28 forming a part of the arm, the shafts 61 and 63 being laterally offset and in parallelism and separated from each other axially, as shown in Fig. 1. For convenience I shall designate the shaft 61 as the transmitter shaft and the shaft 63 as the bender shaft, the latter near its outer end having a rocker arm 65 to which is pivotally connected a short link 66, the lower end of the link being pivotally connected with the sleeve 40 on the bender-carrier 36 by the stud 42, so that a direct connection is provided between the said carrier and the rocker shaft 63. Between the nearer ends of the two rocker shafts I have interposed a differential connection so constructed that the regular oscillation of the transmitter shaft 61 imparts a differential oscillation to the shaft 63, whereby the latter causes the bender to descend with a gradually decreasing speed and to rise with a gradually increasing speed. To this end the differential connection comprises a short depending arm 67 fast on shaft 61 and pivotally connected by a short link 68, Figs. 10 and 11, with a depending and longer arm 69 fast on the shaft 63, the link pivoting on studs 67×, 69× projecting from the arms.

Referring to Fig. 10, when the pitman 58 moves downward the rocker shaft 61 is turned in the direction of arrow 70 and as the arm 67 is swung to the left and upward the arm 69 is swung in the same direction by the link 68, so that the rocker shaft 63 is turned in the direction of the arrow 70, tending to straighten the toggle 65, 66 and depress the sleeve 40 against the spring 41, to thereby cause the bender 37 to move toward the work. While the arms 67, 69 are thus operating the pivot 69× is moving toward the center of the shaft 61, diminishing the length of the effective lever arm, and consequently the power exerted upon the shaft 63 acts with increased force, and the speed with which said shaft 63 turns gradually decreases. Hence the sleeve 40 is depressed with a gradually decreasing speed but with gradually increasing force, until the full angular movement of the rocker arm 67 is completed, and as the rise of the pitman reverses the rotative movement of the transmitter shaft 61 the rocker arm 67 swings back to the position shown in Fig. 10, but in so doing the arm 69 is moved with a gradually increasing speed and the intervening connections elevate the sleeve 40 with gradually increased speed and diminishing force. The spring 41 normally holds the sleeve against the collar 38 on the bender-carrier, and when the sleeve is depressed as described the spring transmits the movement to the lower collar 39 and to the carrier 36, moving the bender 37 into engagement with the work (indicated by dotted lines W, Fig. 1) and bending it into the groove 48 in the throat-plate, and when further descent of the bender is stopped by the nut 43 the spring 41 yields while the angular movement of the shaft 63 is completed in the direction of the arrow 70, Fig. 10. Thus the bender is at rest during the latter part of the down stroke and the first part of the up

stroke of the sleeve 40, when the circular movement of the differential connection and the shafts 61, 63 is completed, reversed, and started in the opposite direction, the maximum force being exerted upon the bender while it is at rest and maintaining the work bent for penetration by the needle. By this application of maximum force the work is firmly held in proper position for the action of the stitch-forming mechanism thereupon, and it will be manifest that were it not for the spring 41 and nut 43 the bender 37 would not at any time be wholly at rest when in engagement with the work, the spring also performing the usual function of accommodating slight variations in thickness of the work.

The interposition of a spring between a fixed collar on a reciprocating bender-carrier and a slidable depressing member thereon is not of itself new, but this structure in combination with the differential connection between the transmitter and bender shafts 61, 63 and the variable action exerted by the same upon the bender, is new, so far as I am aware.

As all of the movements of the differential connection are in circular and relatively short arcs the motion is smooth and quiet, even at high speed, and the regular oscillation of the transmitter shaft 61 is transformed into a definitely variable oscillation of the bender shaft 63.

The bender 37 is stationary during more than half of the complete cycle of operations, equivalent to one complete revolution of the auxiliary shaft 54, so that the speeding up of the bender-carrier in the remaining period corrects the proper reciprocation of said carrier.

It will be manifest that by the adjustable stop-nut 43 the descent of the bender can be stopped positively at any desired point, and the spring 41 will yield more or less, when the sleeve 40 is depressed, according to the predetermined point of stoppage of the bender.

The hub of the rocker arm 69 has a second, frontwardly extended and downwardly inclined rocker arm 71 to which is pivotally connected the upper end of a link 72 jointed at its lower end to a crank arm 73 on one end of a short rock shaft 74 mounted in the lower portions of the bearings 6 and 56, see dotted lines Fig. 1, said rock-shaft being operatively connected with the feed-bar 47, as will be explained later. Said link 72 passes through the hole 20 in the bed-plate of the machine and for the greater part of its length is within the upright part of the hollow overhanging arm 23, as shown.

The part 75 of the shuttle-case 76 has a vertical hole drilled therein to form a bearing for the cylindrical shank 77 of the bevel-faced needle-guide 78, Figs. 2 and 9, raised and lowered at suitable intervals in the recess 51 of the throat-plate just behind the needle opening 50, see Fig. 2, said guide being raised on the forward thrust of the needle to penetrate the bend in the work, to prevent any downward deflection of the needle as its point is about to enter the work. A retracting spring 79 for said guide surrounds its shank between the bottom of the shuttle-case extension 75 and the foot of a bracket 80 clamped upon the shank, said bracket having an out-turned head 81 which carries an adjustable screw-stud 82 resting upon a rocking follower 83 fulcrumed at 84 and coöperating with the cam periphery 85 of a crank-disk 86. In practice said disk is rigidly connected by a crank-pin 87 with a similar disk 88 fast on the outer end of the shaft 54, said disks and the crank-pin being made as a solid forging or in any other manner whereby the requisite strength and rigidity are secured.

No claim is herein made to the particular construction of the needle-guide, its mounting, or the manner in which it is actuated, as it is substantially the same as shown and described in United States Patent No. 987,966 granted to me and another the 28th day of March, 1911.

The hub 89 of a link 90 embraces the crank-pin 87 and fits snugly between the inner faces of the disks, the other end of said link having a transverse and elongated sleeve-like hub 91 which is pivoted on a stud 92 horizontally extended from a block 93. Said block is pivotally mounted on a stud 94 carried by an arm 95 depending from and fixedly secured to the horizontal and longitudinally-reciprocated needle-bar 96 to which is secured the eye-pointed needle 97, the studs 92 and 94 being at right angles to each other. The needle-bar is slidably mounted in a yoke 98 having bearings 99, 100 which loosely embrace and rock upon a horizontal guide-rod 101 fixed in the base 1 of the machine at right angles to the shaft 54, and by a switch-cam 102 on the auxiliary shaft 54, see dotted lines Fig. 1, rocker 103 and link 104 said yoke and needle-bar are vibrated laterally, substantially as in Patent No. 404,863 previously referred to. The link 104 is pivotally connected to an arm 105 depending from the bottom of the yoke 98, as shown in Fig. 2, and longitudinal movement of said yoke on the guide-rod 101 is prevented by a collar 106 pinned to said rod and fitting into a slot 107 in the bearing 99. The stud 92 is reduced and threaded at its outer end to receive a retaining nut 108, which prevents any lateral motion of the link-hub 91, said nut having an annular head 109 which slides in a guide-groove 110, Fig. 5, in the under side of a fixed bar 11 secured to or forming a part of the machine base.

By means of the double pivot connection between the link 90 and the yoke 98 the slight lateral rocking or vibration of the latter to shift the needle laterally on alternate thrusts is permitted without any binding of the parts, the guide-bar 111 coöperating with the head 109, to maintain the stud 92 in a horizontal position as it is moved back and forth to reciprocate the needle-bar longitudinally. That is, when the yoke is vibrated laterally the arm 95 swings about the stud 94 as a fulcrum, and as said arm is fixedly mounted on the needle-bar 96 the latter will turn slightly, but as the length of the lateral arc through which the needle-bar is vibrated is in actual practice about $\frac{3}{32}$ of an inch the turning movement of the needle-bar is almost inappreciable. The faces of the crank-disks 86 and 88 coöperating with the adjacent ends of the large hub 89 of the link, in conjunction with the guide-bar 111, effectually prevent any tendency of the link 90 to twist or turn, and a smooth, even motion is attained.

As best shown in Fig. 2 the crank-disk 86 has at its outer face a wrist-pin 112 connected by a link 113 with a sleeve-like cross-head 114 longitudinally slidable on the guide-rod 101 between the bearings of the yoke 98, rotation of the disk reciprocating said cross-head in parallelism with the needle path. A stud 115 depends from the cross-head and extends freely through a slot 98′ in the bottom of the yoke, the rear end of a link 116 being pivoted on the stud, while the front end of the link embraces a pivot-stud 117, Figs. 2 and 4, eccentrically mounted on and depending from a horizontally swinging fork 118 fulcrumed on a fixed stud 119 in the bottom of the shuttle-case 76 at one side of its center. The oscillating shuttle 120, Fig. 3, of the well known "Singer" type, rests in the shuttle-case and its central spindle 121 extends downward through the bottom of the case and to the lower end of the spindle is fixed a radial arm 122, Fig. 4, carrying a roller or other stud 123 which enters the slotted fork 118. Said shuttle, fork, and the connections between the said parts are of well known construction.

While the wrist or crank-pins 87, 112 are not exactly opposite each other, owing to the different horizontal paths in which the other ends of the respective links 113 and 90 move, the said crank-pins are so nearly in opposition that, with the opposite movements of the connected parts, vibration is reduced to a minimum, the momentum of parts moving in one direction being substantially counterbalanced by the momentum of other parts moving in the opposite direction.

The oscillating shuttle shown in Fig. 3 has a curved shelf-like support 124 adjacent the hook 125 to support the point of the needle after it has passed through the bend in the work and while the shuttle hook enters the loop of thread, the support preventing any accidental displacement of the needle which might interfere with the proper function of the hook. The work is fed in the direction of the longitudinal reciprocation of the needle, each descent of the bender 37 forming a bend in the work, while the lateral vibration of the needle causes the latter to pass through the bend first at one and then at the other side of a fixed line, in a well known manner.

The auxiliary shaft 54 is in practice the common actuator or prime mover for the bender, the needle and the shuttle, said shaft being positively connected with each of said parts in such manner that they will always be properly timed in their movements relative to each other, cams and gearing having been completely eliminated, in all of the connections, so that the movements of the parts are smooth and free from improper vibration.

I have not herein shown the needle-thread nor the usual tension and take-up devices for controlling it as such devices may be of any usual or suitable character and form no part of my invention.

The feed-motion for the work.—The feed-motion is most clearly shown in Fig. 14, the feed-bar 47 forming part of a block 126 fixedly attached to one end of a link 127 having at its front end a lateral pin 128 on which is pivoted a toggle member 129, jointed at 130, to a second member 131 made as an arm fast on the rock shaft 74 hereinbefore referred to. As the toggle is alternately straightened and bent by the oscillation of the shaft 74 the feed-bar will be raised and lowered, respectively, into and out of feeding engagement with the under side of the work, the turning of the rock shaft 63 in the direction of the arrow 70, Fig. 10, first effecting a very slight lifting and then a material lowering of the feed-bar from the position shown in Figs. 2 and 14, wherein it is illustrated at the termination of the feed and just as the rock-shaft 74 is about to be rocked from left to right, Figs. 2 and 14. In order that the feed-bar may properly perform its functions it must remain free from any substantial vertical movement long enough to be moved from the beginning to the end of the feed stroke, as otherwise the engagement with the work would be of too short duration to effect feed thereof positively and definitely. The toggle members 129, 131 are so set as to be moved from one side of dead center to dead center, and then past it, and referring to Fig. 14 it will be seen that the middle joint 130 of said toggle is slightly at the left of a line joining the centers of the parts 128 and 74, the feed-stroke having been com-

pleted. Now when the shaft 63 is rocked, as has been described, to depress the link 72 the rock-shaft is turned to first straighten the toggle and then to bend it, but to a greater extent to the right of its straight position, such latter bending lowering the feed-bar as the bender descends, and while actually the pivot 128 moves in an arc during the initial straightening and first part of the bending of the toggle such arc is so flat as to be practically a straight line, and the said pivot moves reversely through this flat arc when the toggle returns to the position shown. Consequently during the first part of the downward movement of the link 72, and during the latter part of its upward movement, the feed-bar is practically at rest so far as concerns vertical movement, and during these rest periods, as they may be termed, the fore and aft movement of the feed-bar is effected. The rear end of the link 127 is pivotally connected at 132 with the upper end of a lever 133 fulcrumed at its lower end on a fixed stud 134 carried by the base, said lever being arranged to swing in a vertical plane parallel to the line of feed of the work. An elongated slot 135 in the lever receives an adjustable stud 136 on which is pivoted the rear end of an arm 137 having at its front end an open head 138, Fig. 14, which surrounds and constitutes a follower for a feed cam 139 fast on the auxiliary shaft 54. The said cam acts through its follower, the lever 133, and link 127 to effect the fore and aft motion of the feed-bar, as will be manifest, there being no cam-induced movement of said feed-bar until the cam has made about one-quarter of a revolution from the position shown, during which period the feed-bar has been retracted from engagement with the work by the action of the toggle 129, 131. The continued revolution of the cam 139 brings its high part into coöperation with the right-hand end of the head 138 thereby swinging the lever 133 to the right, Fig. 14, and returning the feed-bar to a position ready to be again elevated into engagement with the work prior to the beginning of the feed-stroke. After the toggle 129, 131 is operated to raise the feed-bar into engagement with the work the cam operates upon the follower to effect the feed-stroke of the feed-bar and the work is fed to the left, viewing Figs. 2 and 14, this feed-stroke being accomplished during the latter part of the upward movement of the link 72 and consequently when the feed-bar has practically no vertical movement, as has been explained. The cycle is now completed and, generally speaking, is of the four-motion type well known in the art. The length of the feed-stroke is regulated by adjustment of the stud 136 toward or from the fulcrum 134 of the rocking lever 133, and to effect such adjustment conveniently the stud 136 and the clamping nut 136× thereon are extended through a slot 140 in the side of the base, see Fig. 3. As every movement of the feed-bar is effected positively and it is always under the control of either the feed-cam 139 or the mechanism, including the toggle 129, 131 for raising and lowering it, there is no lost-motion and the feed-motion will operate with accuracy and precision irrespective of the speed at which the machine as a whole is operated.

No further description of the operation of the machine is necessary in view of the foregoing explanation of the different instrumentalities, their functions, and the manner in which they operate.

Various changes or modifications in details of construction and arrangement may be made by those skilled in the art without departing from the spirit and scope of my invention as set forth in the annexed claims.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a machine of the class described, a horizontally-reciprocating needle-bar, having an attached eye-pointed needle, and a shuttle to coöperate with the needle, combined with a rotating shaft having two crank-pins at opposite sides of its center, a link operatively connecting one of the crank-pins and the needle-bar, a reciprocating cross-head, a link connecting it with the other crank-pin, the needle-bar and cross-head being moved in opposite directions, and operating connections between the cross-head and shuttle to oscillate the latter.

2. In a machine of the class described, a horizontally-reciprocating needle-bar having an attached eye-pointed needle, and a shuttle to coöperate with the needle, combined with a rotating shaft, two concentric disks rigidly connected by a crank-pin, one disk being rigidly and centrally mounted on the end of the shaft, and a second crank-pin on the other disk, said crank-pins being at opposite sides of the center of the shaft, and separate operating connections between the needle-bar and the shuttle, to reciprocate the former and oscillate the latter, the operating connections being moved in opposite directions to equalize strains and overcome vibration due to momentum of the moving parts.

3. In a machine of the class described, a horizontally reciprocating needle-bar having an attached eye-pointed needle, a laterally rocking yoke in which the needle-bar reciprocates, and a shuttle to coöperate with the needle, combined with a rotating shaft having substantially opposite crank-pins, a depending arm on the needle-bar, a block pivoted on said arm and having a lateral stud, a link pivotally connecting said stud

and one of the crank-pins, a cross-head movable in parallelism with the needle-bar, connections between the cross-head and shuttle to oscillate the latter, a link connecting said cross-head and the second crank-pin, to reciprocate the former, the cross-head and needle-bar being moved oppositely, and means actuated by the crank-shaft to rock the yoke and effect lateral vibration of the needle-bar.

4. In a sewing machine, means to form bends in the work, stitch-forming mechanism, including a horizontally-reciprocating needle-bar having an attached eye-pointed needle to penetrate the bends formed in the work on each forward stroke, a laterally-vibrated support for the needle-bar, and a shuttle to coöperate with the needle, combined with a rigidly attached arm depending from the needle-bar, a laterally extended stud fulcrumed on said arm parallel to the needle-bar, a rotating shaft having crank-disks rigidly connected by a crank-pin, a link having at one end a hub embracing the crank-pin and fitting snugly between said disks, the other end of said link having a transverse, elongated hub to embrace the said lateral stud, said link effecting reciprocation of the needle-bar, guiding means for the outer end of the stud, and connections between one of said crank-disks and the shuttle to oscillate the latter, the connection between said link and the needle-bar permitting lateral vibrational movement thereof.

5. In a sewing-machine, means to form bends in the work, stitch-forming mechanism, including a horizontally-reciprocating needle-bar having an attached eye-pointed needle to penetrate the bends formed in the work, a laterally-vibrated yoke in which the needle-bar reciprocates, and an oscillating shuttle combined with a fixed guide-rod parallel to the needle path, and on which said yoke rocks, a cross-head reciprocated on said guide-rod, connections between the cross-head and shuttle to oscillate the latter, a rotating shaft having two crank-pins at opposite sides of its center, a link connecting one of said crank-pins and the cross-head to reciprocate the latter, and independent connections between the other crank-pin and the needle-bar to reciprocate the same in the yoke while permitting lateral vibration thereof.

6. In a sewing machine, means to form bends in the work, including a vertically-movable bender-carrier and an attached bender, and a rock shaft operatively connected with the bender-carrier, stitch-forming mechanism, including a horizontally-reciprocating needle-bar having an attached eye-pointed needle to penetrate the bends formed in the work, and an oscillating shuttle, combined with a rotating shaft having a crank-arm at one end and double crank-pins at its opposite end, a pitman connecting said crank-arm and the rock-shaft, to rock it and effect reciprocation of the bender-carrier, and separate connections between the crank-pins and the needle-bar and shuttle, respectively, to reciprocate the former and oscillate the latter.

7. In a sewing-machine, a throat-plate having a bending groove, a bender coöperating therewith intermittingly to form bends in the work, a vertically movable bender-carrier to which said bender is rigidly attached, horizontal bender and transmitter shafts arranged in parallelism, a connection between the bender-shaft and bender-carrier to reciprocate the latter, means to oscillate the transmitter shaft, and a differential connection between it and the bender shaft to oscillate the latter from the former at variable speed, to depress the bender with a gradually decreasing speed and to elevate it with a gradually increasing speed.

8. In a sewing machine, a throat-plate having a bending groove, a bender coöperating therewith intermittingly to form bends in the work, a vertically movable bender-carrier to which said bender is rigidly attached, horizontal bender and transmitter shafts arranged in parallelism, a connection between the bender shaft and bender-carrier to reciprocate the latter, a rotating shaft having a crank-arm, a crank-arm of greater radius on the transmitter shaft, and a pitman connecting said arms, to oscillate the said transmitter shaft, combined with a differential connection between the transmitter and bender shafts, to turn the latter with decreasing speed and increasing force on the down stroke of the bender and to turn said bender shaft in the opposite direction with increasing speed and decreasing force on the up stroke of said bender.

9. In a sewing machine, a throat-plate having a bending groove, a bender coöperating therewith intermittingly to form bends in the work, a vertically movable bender-carrier to which said bender is rigidly attached, horizontal bender and transmitter shafts arranged in parallelism, a connection between the bender shaft and bender-carrier to reciprocate the latter, means to oscillate the transmitter shaft, and a differential connection between it and the bender shaft to oscillate the latter at variable speed, said connection comprising rocker arms of unequal length attached respectively to the adjacent ends of the bender and transmitter shafts, and a link connecting said arms, the differential connection causing the bender shaft to act with maximum force on the bender when the latter is forming a bend in the work.

10. In a sewing machine, a throat-plate having a bending groove, a coöperating

bender to form bends intermittingly in the work, a bender-carrier to which the bender is fixedly attached, separated collars fixed on the carrier, a sleeve slidable thereon between the collars, a spring between the sleeve and the lower collar, a shaft having an attached rocker arm, a link connecting said arm and the sleeve, and means to oscillate the bender shaft with decreasing speed and increasing force as the sleeve is depressed and with increasing speed and decreasing force as the sleeve is elevated, to thereby apply through the spring the maximum force at minimum speed to the bender when it is forming a bend in the work, the spring yielding during the period when said bender is at rest in engagement with the work.

11. In a sewing machine, a bed-plate provided with a throat-plate having a bending groove, an overhanging arm on the bed-plate, horizontal transmitter and bender shafts mounted in parallelism on the overhanging arm, a bender-carrier having an attached bender and vertically movable in said arm, the bender coöperating intermittingly with the throat-plate to form bends in the work, means to impart a regular oscillating motion to the transmitter shaft, a differential connection between it and the bender shaft to oscillate the latter at a speed decreasing on the down stroke and increasing on the up stroke of the bender-carrier, and operating connections between the bender shaft and bender-carrier, to reciprocate the latter and the attached bender.

12. In a sewing machine, a bed-plate provided with a throat-plate having a bending groove, an overhanging arm on the bed-plate, horizontal transmitter and bender shafts mounted in parallelism on the overhanging arm, a bender-carrier having an attached bender and vertically movable in said arm, the bender coöperating intermittingly with the throat-plate to form bends in the work, a continuously rotating shaft, a pitman operatively connecting it with the transmitter shaft to impart to the latter a regular oscillating motion, a differential connection between the bender and transmitter shafts, comprising rocker arms and a connecting link, to oscillate the bender shaft at a varying speed and with inversely varying force, and an operating connection between the bender shaft and bender-carrier to reciprocate the latter with variable speed and force.

13. In a sewing machine, means to form bends intermittingly in the work, including a vertically movable bender-carrier having an attached bender, two parallel and horizontal rock shafts, each having a depending arm, said arms being on the adjacent ends of the shafts and of unequal length, a link pivotally connecting the arms, an operating connection between one shaft and the bender-carrier, to reciprocate the latter, and means connected with the other shaft to oscillate it with a regular movement, the connection between said shafts imparting a variable oscillating movement to the shaft connected with the bender-carrier.

14. In a sewing machine, means to form bends intermittingly in the work, including a vertically movable bender, an oscillating shaft, and an operating connection between it and the bender to reciprocate the latter, combined with a rotating shaft having a feed-cam thereon, means independent of the connection between the oscillating shaft and the bender and intermediate the rotating and oscillating shafts to oscillate the latter from the former, a feed-bar, connections between it and the feed-cam to impart positive fore and aft movement to the feed-bar, and separate, positively acting connections between the oscillating shaft and the feed-bar and independent of the connection between said oscillating shaft and the bender, to raise and lower the feed-bar as the bender is raised and lowered.

15. In a sewing machine, stitch-forming mechanism, including a horizontally-reciprocating and laterally vibrated eye-pointed needle, intermittingly operating means, including a vertically-reciprocating bender, and a connected, oscillating bender shaft, to form bends in the work transverse to the needle path and to be penetrated by the needle on each forward thrust, combined with a rotating shaft having a feed-cam thereon, independent connections between said shaft, the bender shaft, and the needle, to oscillate the bender shaft and reciprocate the needle, a feed-bar movable parallel to the needle path, connections between the feed-cam and said feed-bar to impart a fore and aft stroke to the latter, a toggle connected with the feed-bar to raise and lower it, and means operatively connected with the bender shaft to actuate the toggle.

16. In a sewing machine, stitch-forming mechanism, including a horizontally-reciprocating and laterally vibrated eye-pointed needle, intermittingly operating means, including a vertically-reciprocating bender, and a connected, oscillating bender shaft, to form bends in the work transverse to the needle path and to be penetrated by the needle on each forward thrust, combined with a rotating shaft having a feed-cam thereon, independent connections between said shaft, the bender shaft, and the needle, to oscillate the bender shaft and reciprocate the needle, a feed-bar movable parallel to the needle-path, a link fixedly connected at one end with the feed-bar, a lever pivotally connected with the other end of the link and having a fixed fulcrum, a follower member connecting said lever and the feed-cam to

rock the lever and through said link impart a fore and aft stroke to the feed-bar, and means operatively connected with and actuated by the bender shaft to raise and lower the feed-bar.

17. In a sewing machine, stitch-forming mechanism, including a horizontally-reciprocating and laterally vibrated eye-pointed needle, intermittingly operating means, including a vertically-reciprocating bender, and a connected, oscillating bender shaft, to form bends in the work transverse to the needle path, and to be penetrated by the needle on each forward thrust, combined with a rotating shaft having a feed-cam thereon, independent connections between said shaft, the bender shaft, and the needle, to oscillate the bender shaft and reciprocate the needle, a feed-bar movable parallel to the needle path, a link fixedly connected at one end with the feed-bar, a lever pivotally connected with the other end of the link and having a fixed fulcrum, a follower member connecting said lever and the feed-cam, to rock the lever and through said link impart a fore and aft stroke to the feed-bar, a toggle connected with the feed-bar, to raise and lower it by straightening and breaking movements, respectively, of the toggle, and toggle-actuating devices connected with and operated by the oscillating bender shaft.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

CHRISTIAN H. T. HAGELSTEIN.

Witnesses:

JOHN C. EDWARDS,

FREDERICK S. GREENLEAF.