

Sept. 7, 1943.

A. N. HALE

2,329,160

SEWING MACHINE

Filed Jan. 8, 1942

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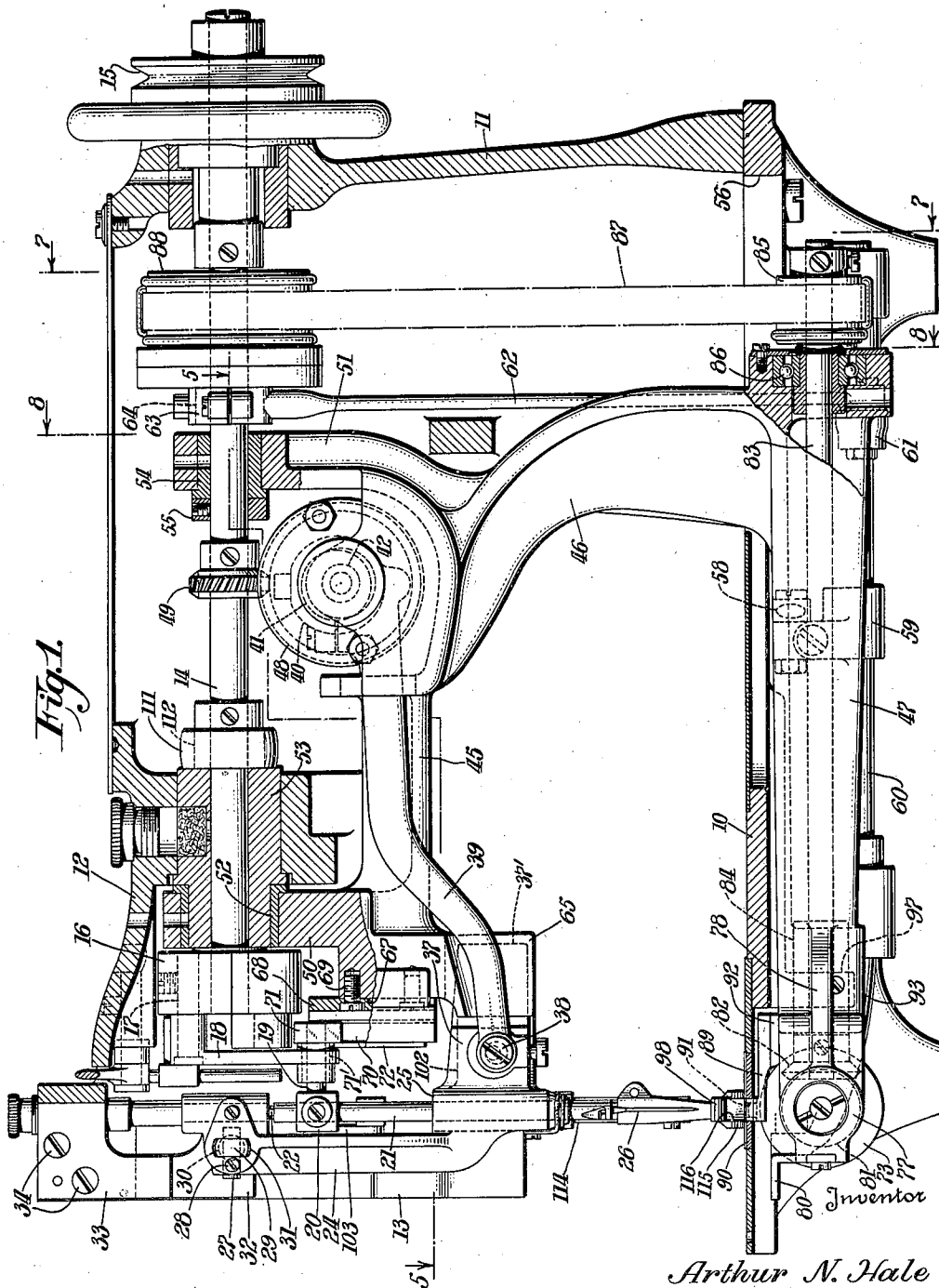


Fig. 1.

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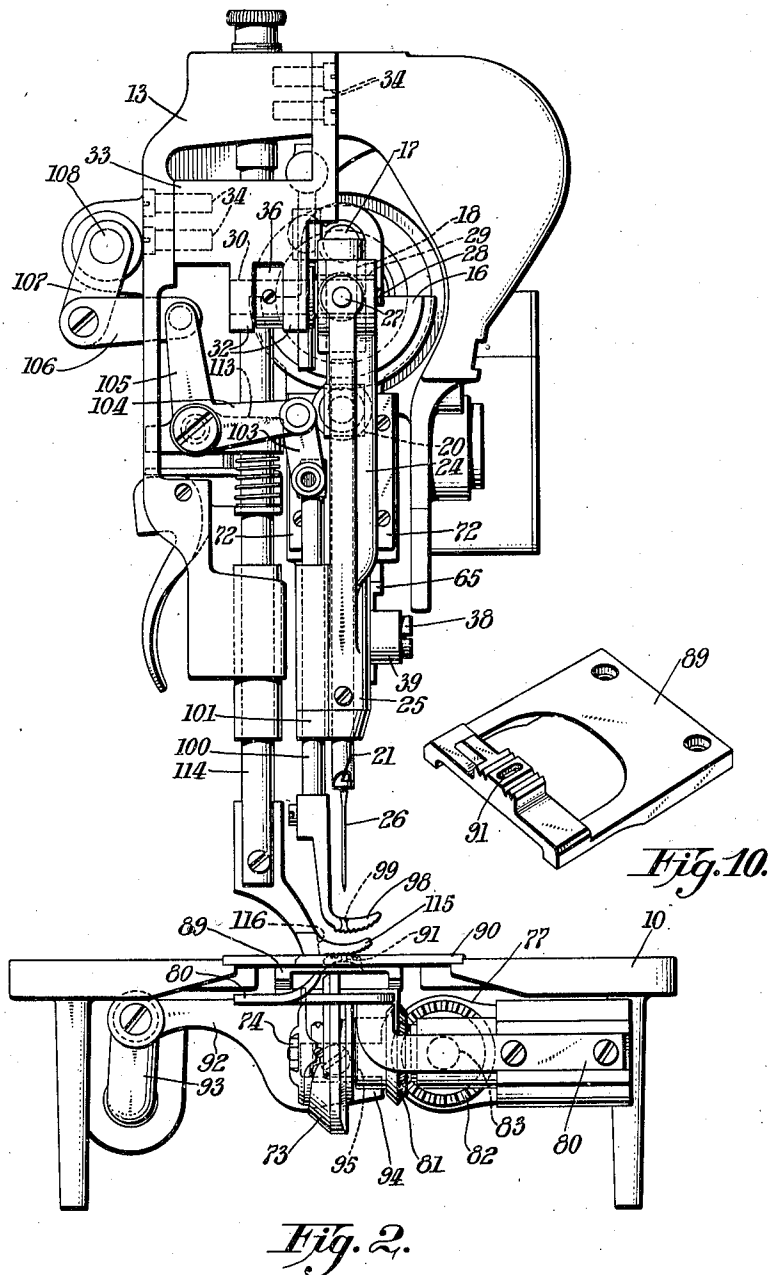
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SEWING MACHINE

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5 Sheets-Sheet 2



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SEWING MACHINE

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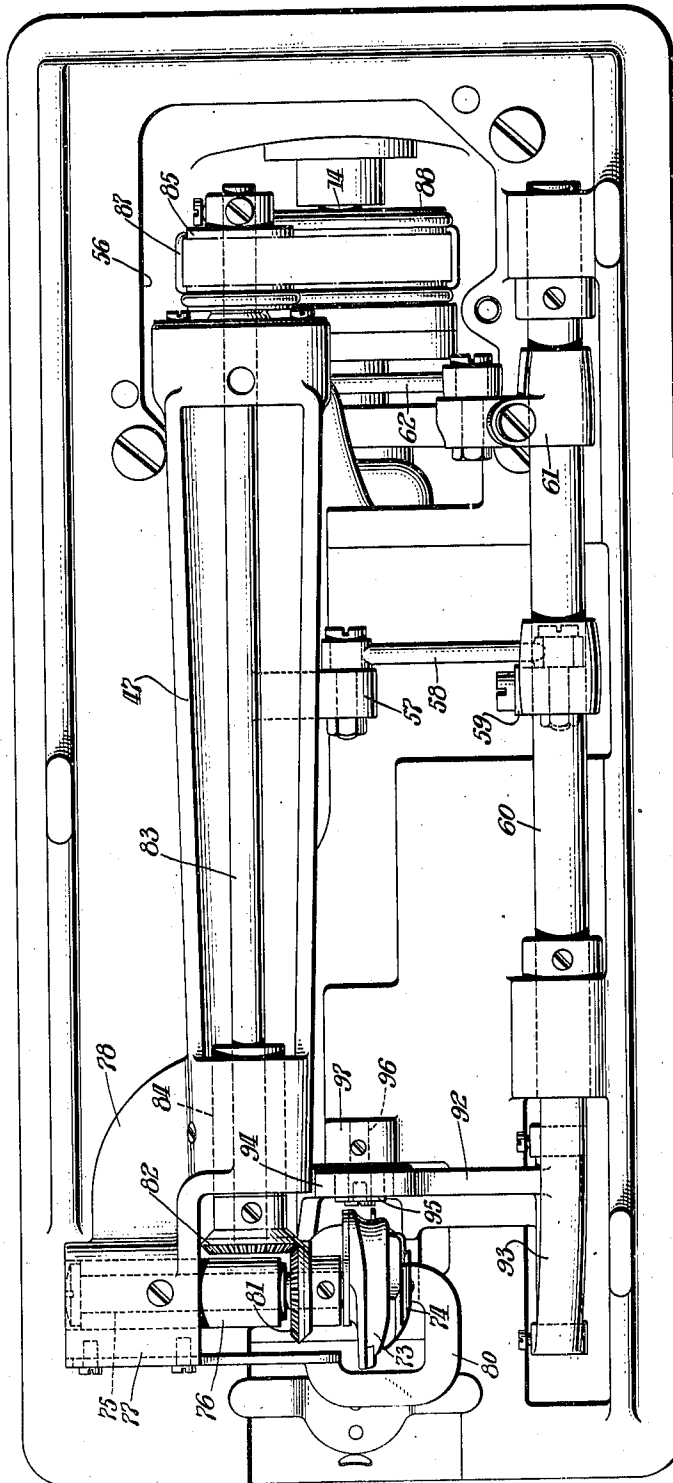


Fig. 3.

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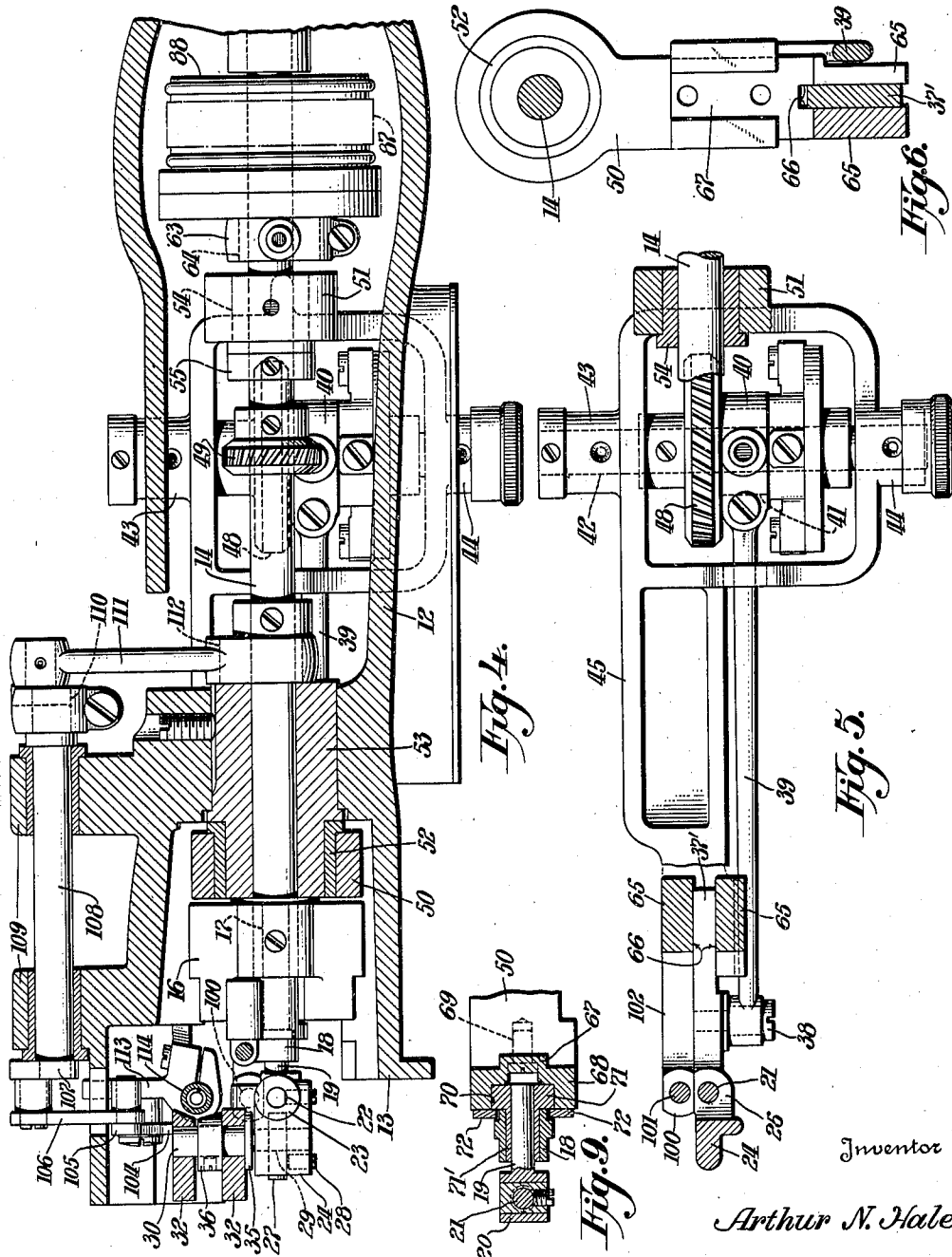
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SEWING MACHINE

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5 Sheets-Sheet 4



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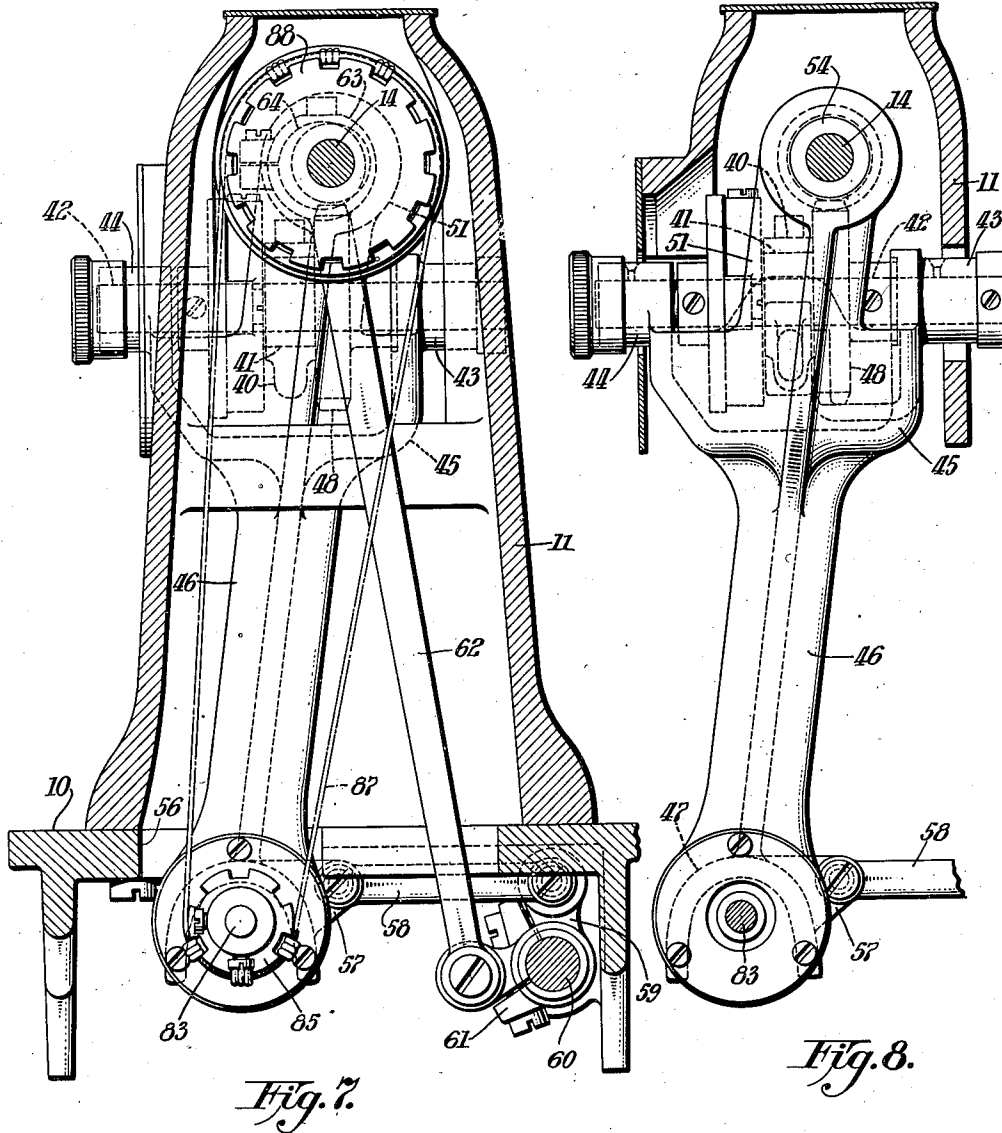
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SEWING MACHINE

Filed Jan. 8, 1942

5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

2,329,160

SEWING MACHINE

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Application January 8, 1942, Serial No. 425,971

32 Claims. (Cl. 112—158)

This invention relates to stitch-forming and work-feeding mechanisms for sewing machines and has for an object to provide improved means for laterally vibrating an endwise reciprocatory needle in transverse directions.

Another object of the invention is to provide simple and effective means of a positive character for transmitting work-advancing movements to an endwise reciprocatory needle which is also laterally vibrated while out of the work in the production of zigzag or other ornamental stitches.

The invention has also for its object to provide simple means effective to maintain the requisite coordination between an endwise reciprocatory needle, having vibratory movements about transverse axes, and its complemental loop-taker. The invention further aims to provide improved work-feeding mechanism coordinated with a work-advancing needle.

Other and more specific objects of the invention will be apparent from the following description and claims.

The invention consists in the devices, combinations and arrangements of parts relating to the needle- and feed- actuating and loop-taker compensating mechanisms as hereinafter described in connection with the accompanying drawings, which illustrate a preferred embodiment of the invention and in which:

Figure 1 is a longitudinal vertical section, partly in front elevation, of a sewing machine containing the present improvement. Fig. 2 is a front end elevation of the machine. Fig. 3 is a bottom plan view of the machine. Fig. 4 represents a longitudinal section of the bracket-arm of the machine, the section being taken in substantially the horizontal plane containing the axis of rotation of the main or needle-reciprocating shaft rotatably journaled in said bracket-arm. Fig. 5 represents a section of the bracket-arm taken substantially on the line 5—5 of Fig. 1. Fig. 6 is an enlarged detail view, in front end elevation and partly in section, of the upper yoke arm connected with the needle-bar frame. Fig. 7 is an enlarged transverse vertical section of the machine taken substantially on the line 7—7 of Fig. 1. Fig. 8 is an enlarged transverse vertical section of the machine taken substantially on the line 8—8 of Fig. 1. Fig. 9 represents a detail view in horizontal section, slightly enlarged, of the stud-pin connection between the needle-bar and its reciprocating link, together with the needle-bar steadying guideway associated with said stud-

pin. Fig. 10 is a perspective view of the lower feed-dog.

Referring to the drawings, the sewing machine has a frame comprising a work-support or bed-plate 10, from one end of which rises the hollow standard 11 of a bracket-arm 12 overhanging the bed-plate and terminating at its free end in a head 13.

Rotatably journaled in the bracket-arm 12 to extend lengthwise thereof is a horizontally disposed main actuating or needle-reciprocating shaft 14. At one of its ends, the main-shaft 14 carries a combined belt-pulley and balance-wheel 15; the other end of said shaft carrying a counter-balanced crank-disk 16. The crank-disk 16 is provided with a crank-pin 17 connected by a link 18 to a stud-pin 19 extending from a collar 20 suitably secured to a needle-bar 21; said stud-pin having the usual swivel connection with the collar 20 to provide for swinging movements of the needle-bar.

To minimize the weight of the needle-bar and nevertheless provide an adequate bearing therefor, the needle-bar 21 is provided with a longitudinal bore and is slidably mounted for endwise movement upon a guide-rod 22 depending from and having its upper end suitably secured in a vertically apertured boss 23 of a vibratory frame 24. The needle-bar 21 is also externally journaled in a bearing-boss 25 formed at the lower end of the vibratory frame 24; the needle-bar 21 carrying at its lower end the usual eye-pointed needle 26.

The frame 24 is supported at its upper end by a universal-joint for vibration about transversely intersecting axes, one of which axes coincides substantially with the axis of rotation of the main shaft 14. To this end, a horizontally disposed fulcrum-pin 27 is secured by a screw 28 in a suitable aperture in the upper end of the vibratory frame 24; said fulcrum-pin being axially in substantial alignment with the main shaft 14 in a vertical position of the vibratory frame 24. The fulcrum-pin 27 is pivotally supported by a suitably apertured and flattened forward extension 29 of a transverse fulcrum-stud 30; the stud-extension 29 being disposed in an aperture 31 formed in the frame 24 to provide the necessary clearance for vibration of the frame about the fulcrum-pin 27. The fulcrum-stud 30 is pivotally journaled in horizontally spaced furcations 32 provided in a bracket 33 secured by screws 34 to the bracket-arm head 13 of the machine. The fulcrum-stud 30 is held against endwise move-

ment in the bracket 33 by a flange 35 of the fulcrum-stud and by a collar 36 suitably secured to said fulcrum-stud between the bracket-furcations 32. The point of intersection of the transverse pivotal axes afforded by the fulcrum-pin 27 and the fulcrum-stud 30 is preferably coincident with the longitudinal axis of the shaft 14.

At its lower end, the vibratory frame 24 has a lateral arm 37 adjustably connected, by an eccentric pivot-stud 38, to one end of a pitman 39. The opposite end of the pitman 39 has a strap 40 embracing an actuating element in the form of an adjustable eccentric 41 carried by a needle-vibrating shaft 42 disposed below and extending horizontally crosswise of the main-shaft 14. The eccentric 41 may be of any usual or suitable construction, being constructed and adjustable in the present case substantially as more fully disclosed in the U. S. patent to C. F. Gray, No. 1,020,089, Mar. 12, 1912. The cross-shaft 42 is rotatably journaled in bearing-bosses 43 and 44 extending from opposite sides of the upper horizontal member 45 of a horizontal U-shaped yoke which additionally includes a generally upright member 46 and a lower horizontal member 47. Suitably secured upon the cross-shaft 42 for rotation therewith is a spiral gear 48 engaged by a spiral pinion-gear 49 carried by the main-shaft 14. Through the described connections with the pinion-gear 49, the swinging frame 24 is vibrated about the fulcrum-stud 30 in substantially the vertical plane containing the axis of rotation of the main-shaft 14. In the present machine, the ratio of the gears 48 and 49 is such that the main-shaft 14 rotates twice for each rotation of the cross-shaft 42.

The upper member 45 of the yoke, in which the cross-shaft 42 is journaled, is preferably integrally provided with horizontally spaced arms 50 and 51 extending upwardly from said yoke-member 45. The yoke-arm 50 is horizontally apertured to receive a wear-sleeve 52 pivotally mounted upon a reduced end of a bearing-bushing 53 in which the main-shaft 14 is journaled. The other arm 51 of the yoke is likewise horizontally apertured to receive a wear-sleeve 54 pivotally embracing the main-shaft 14; the yoke being therefore pendulously journaled coaxially of the main-shaft 14. The yoke is held against movement endwise of the shaft 14 by the bearing-bushing 53 and by a collar 55 secured to the shaft 14 adjacent the wear-sleeve 54.

The upright member 46 of the yoke extends through an opening 56 provided in the bed-plate 10 below the bracket-arm standard 11. The lower member 47 of the yoke is disposed below the bed-plate 10 to extend lengthwise thereof; said member 47 being provided between its ends with a lug 57 pivotally connected to one end of a link 58 extending crosswise of the bed-plate 10. The other end of the link 58 is pivotally connected to a crank-arm 59 suitably secured upon a feed-advance rock-shaft 60. The rock-shaft 60 is journaled in suitable lugs depending from the bed-plate 10 at the rearward side thereof; said rock-shaft 60 carrying another crank-arm 61 pivotally connected to the lower end of a pitman 62 disposed generally vertically in the bracket-arm standard 11. The upper end of the pitman 62 has a strap 63 embracing an adjustable feed-advance eccentric 64 carried by the main-shaft 14. The eccentric 64 may be constructed in any usual or suitable manner, the present eccentric corresponding generally in structure to that more fully illustrated and described in the U. S. patent

to W. Myers, No. 2,128,031, Aug. 23, 1938. By means of the described mechanism, the pendulous yoke 45, 46, 47 is actuated to swing back and forth about the axis of rotation of the main-shaft 14; the amplitude of swinging movement of the yoke being selectively predetermined by adjustment of the eccentricity of the feed-advance eccentric 64.

The upper member 45 of the pendulous yoke is provided at one end with depending furcations 65 forming between them a guideway 66. Slidably disposed in the guideway 66 and confined by the furcations 65 for movement with the yoke member 45 is a flattened extension 37' of the needle-bar frame arm 37. Consequently, the needle-bar frame 24 is constrained by the pendulous yoke to vibrate about the fulcrum-pin 27 transversely of the length of the bracket-arm 12, i. e., to vibrate transversely of the vibratory movements imparted to said frame by the pitman 39. In the present machine, the vibratory movements in transverse directions of the frame 24 are timed with respect to the endwise reciprocations of the needle to effect the production of zigzag stitches; the needle being vibrated in the line of feed while the needle is in the work to assist in feeding the work, and the needle being vibrated crosswise of the line of feed during the return movement of the needle while out of the work. It is to be understood, however, that the present invention in its broader aspects is not limited to any specific timing of the needle actuating mechanism.

The end face of the arm 45 of the pendulous yoke, above the furcations 65 of said yoke, is grooved vertically to provide a recessed seat 67 for a guide-bracket 68 secured to the arm 45 by screws, as 69. The guide-bracket 68 has a vertically disposed guideway 70 for a guide-block 71 pivotally sleeved upon the stud-pin 19 extending from the needle-bar 21. The apertured lower end of the needle-bar reciprocating link 18 embraces the sleeve 71' of the guide-block 71, said sleeve 71' accommodating endwise movements of the stud-pin 19 within the sleeve during lateral movements of the needle-bar 21. The guide-block 71 is confined within the guideway 70 by gibs 72 suitably secured upon the guideway 70. Inasmuch as the needle-bar frame 24 is splined to the yoke-arm 45 for positive swinging movement with the pendulous yoke which has a pivotal axis coincident with that of the frame 24, the needle-bar 21 and the guideway 70 are constantly maintained in parallelism. The described guiding means minimizes side thrust upon the needle-bar 21 by the link 18 throughout the vibratory movements of said needle-bar.

Complemental to the needle 26 in the formation of lock-stitches is a loop-taker 73 disposed below the bed-plate 10 and of the rotary hook-type having its axis of rotation extending horizontally crosswise of the bed-plate 10, whereby the loop-taker rotates in a vertical plane substantially parallel to the plane of vibration of the needle-bar frame 24 about the fulcrum-stud 30. Journaled in the loop-taker 73 is the usual thread-carrier 74 about which the needle-thread loops are cast by the loop-taker. The loop-taker 73 is carried by the rearward end of a horizontally disposed loop-taker shaft 75 rotatably journaled in a bearing-sleeve 76. The bearing-sleeve 76 is suitably secured in an apertured boss 77 formed upon the free end of an arm 78 extending horizontally forwardly from the lower arm 47 of the pendulous yoke. Attached to the yoke-boss

77 is the shank of a stop-arm 80 which engages and restrains the thread-carrier 74 from rotation with the loop-taker 73. Being carried by the arm 47 of the pendulous yoke keyed to the needle-bar frame 24, the loop-taker 73 follows the needle 26 in its lateral movements about the fulcrum-pin 27. As the loop-taker 73 also has the capacity, as usual, to accommodate limited lateral movements of the needle 26 about the fulcrum-stud 30, the loop-taker is adapted to cooperate with the needle 26 in the different positions of the needle incidental to the vibration thereof in transverse directions.

The loop-taker shaft 75 carries a bevel-gear 81 engaged by a bevel-gear 82 secured upon one end of a horizontally disposed loop-taker actuating shaft 83 extending lengthwise of the bed-plate 10 and substantially parallel to the main-shaft 14. The shafts 75 and 83 rotate in one-to-one relation. Adjacent the bevel-gear 82, the shaft 83 is rotatably journaled in a bearing-bushing 84 suitably secured in the free end portion of the yoke-arm 47. The other end of the shaft 83 carries a driven belt-pulley 85 and is rotatably journaled, adjacent said pulley, in a ball-bearing 86 provided in the pendulous yoke at the junction of the yoke-arms 46 and 47. The driven pulley 85 is connected by a clip-belt 87 to a driving pulley 88 carried by the main-shaft 14. The pulleys 85 and 88 are proportioned so that the loop-taker actuating shaft 83 rotates twice for each rotation of the main-shaft 14. As the loop-taker actuating shaft 83 is carried by the pendulous yoke which swings about the axis of rotation of the main-shaft 14, the pulleys 85 and 88 are maintained a fixed distance apart throughout the swinging movements of the yoke.

The needle 26 is assisted to advance the work by a feeding mechanism of the clamp-feed type which is commercially well known as a unison-feed mechanism. A lower two-motion and serrated feed-plate 89 operates back and forth through a suitably slotted plate 90 provided upon the work-support or bed-plate 10; the work-engaging teeth of said feed-plate 89 being constantly maintained substantially at the level of the upper face of the plate 90. The feed-plate 89 has a needle-slot 91 elongated lengthwise of the bed-plate 10, said feed-plate being secured upon a feed-bar 92 pivotally connected in any usual or suitable manner to a feed-rocker 93 at one end of the feed-advance rock-shaft 60. The feed-bar 92 has a fork 94 embracing a pivot-block 95 carried by an eccentric-stud 96 adjustably secured in a lug 97 depending from the bed-plate 10.

Opposed to the feed-plate 89 is a feeding-foot 98, having a serrated work-engaging face and provided with a needle-slot 99 parallel to the needle-slot 91 of the feed-dog 89. The feeding-foot 98 has the shank thereof suitably secured to the lower end of a vertically disposed feed-bar 100. The feed-bar 100 is disposed adjacent and substantially parallel to the needle-bar 21, said feed-bar being journaled for endwise reciprocation in a vertically apertured boss 101 formed at one end of a vertically flattened arm 102 comprising an extension of the rearward furcation 65 of the yoke-arm 45. The feed-bar 100 is therefore constrained to swing with the pendulous yoke about the rotation axis of the main-shaft 14 and with the needle in the swinging movements of the latter about the fulcrum-pin 27.

The upper end of the feed-bar 100 is pivotally connected to one end of a short link 103 of which

the opposite end is suitably pivoted to an arm 104 of a bellcrank lever 104, 105. The other arm of the bellcrank lever 105 is connected by a link 106 to a depending arm 107 of a rock-shaft 108 disposed substantially parallel to the main-shaft 14. The rock-shaft 108 is journaled in bearing-lugs 109 extending rearwardly from the bracket-arm 12; said rock-shaft 108 having another crank-arm 110 pivotally connected to one end of a pitman 111 provided with a strap embracing an eccentric 112 carried by the main-shaft 14.

The bellcrank lever 105 is fulcrumed upon a supporting-block 113 secured upon a vertically disposed and spring-depressed presser-bar 114. The presser-bar 114 is journaled for endwise movement in suitable bearings provided in the bracket-arm head 13. The lower end of the presser-bar 114 carries a presser-foot 115 yieldingly opposed to the work-support and having a feeding-foot clearance slot 116. The presser-foot 115 and feeding foot 98 are reciprocally raised and lowered in the usual manner by the described actuating mechanism to alternately engage the work. When the feeding-foot 98 descends, the work is clamped between said feeding-foot and the feed-plate 89 while the needle 26 is in the work. As the several feeding elements are all constrained to move with the pendulous yoke, they act in unison to advance the work engaged thereby. The presser-foot 115 functions to clamp the work against the stationary work-support during the return movement of the needle, feed-plate and feeding-foot.

In the operation of the machine, the feed-advance rock-shaft transmits co-directional movements in unison to the feed-plate 89 and to the pendulous yoke 45, 46, 47. As the needle-bar frame 24 is constrained to vibrate with the yoke-member and the upper feed-bar 100 is carried by said yoke-member, the several work-advancing elements comprising the needle 26, the feed-plate 89 and the feeding-foot 98 opposed to said feed-plate are actuated in unison to advance the work. Adjustment of the feed-advance eccentric 64 carried by the main-shaft 14 determines the amplitude of movement of the several feeding elements, and as the eccentric 64 is carried by the shaft 14 from which the needle-bar 21 derives its endwise reciprocation it will be understood that the work is advanced once for each complete reciprocation of the needle.

In the present machine, the endwise reciprocations of the needle 26 are timed so that said needle is in the work during the rearward or effective work-advancing movements of the feed-plate 89 and the feeding-foot 98. The needle 26 is additionally vibrated crosswise of the line of feed, while the needle is out of the work, from the needle-vibrating eccentric 41 to effect the production of zigzag stitches. Being carried by the pendulous yoke, the eccentric 41 and its connections with the needle-bar frame 24 swing with the yoke and the needle-bar frame, whereby an effective relationship of the parts is constantly maintained.

During the swinging movements of the pendulous yoke 45, 46, 47, the needle-vibrating eccentric 41 is slightly accelerated and retarded in its rotation by reason of the rolling action of the driven spiral gear 48 about its driving gear 49. A corresponding acceleration and retardation of the loop-taker 73 occurs at the same time by reason of the belt-connection between the main-shaft 14 and the loop-taker actuating shaft 83. As the endwise movements of the needle-bar 21

are also correspondingly affected by the swinging movements of the pendulous yoke, it will be understood that the described construction lends itself to maintenance of the timed relationship of the parts during the swinging movements of the pendulous yoke.

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

1. In a sewing machine, a rotary actuating shaft, an endwise reciprocatory and laterally vibratory needle, connections with said shaft for reciprocating said needle, means for laterally vibrating said needle in directions transverse to one another about a fixed pivot-point substantially coincident with the axis of rotation of said shaft, a loop-taker complementary to said needle in the formation of stitches, means for actuating said loop-taker, and means for pendulously swinging said loop-taker bodily about the pivot-axis of said needle in one direction of vibration of and with said needle.

2. In a sewing machine, a rotary actuating shaft, a vibratory needle-bar frame, supporting means providing for vibration of said frame about transverse pivotal axes, a needle-bar journaled for endwise reciprocation in said vibratory frame, means for endwise reciprocating said needle-bar, a member pendulously supported coaxially of said shaft, means for pendulously swinging said member, connections with said member for vibrating said frame about one of said transverse axes, and means for vibrating said frame relatively to said member about the other of said pivotal axes.

3. In a sewing machine, a rotary actuating shaft, a member pivotally supported for swinging movement, a vibratory needle-bar frame operatively connected to said member for movement therewith and for vibratory movement relatively thereto, supporting means for said frame providing for vibration of said frame about transverse axes, one of said axes being substantially coincident with the axis of rotation of said shaft, a needle-bar journaled for endwise reciprocation in said vibratory frame, means for endwise reciprocating said needle-bar, means for swinging said member, and means for vibrating said frame relatively to said member.

4. In a sewing machine, a laterally movable needle-bar frame, a needle-bar journaled for endwise movement in said frame, means for endwise reciprocating said needle-bar, a laterally movable needle-bar guide supported independently of said frame, and means for transmitting lateral movements in unison to said frame and guide.

5. In a sewing machine, a vibratory needle-bar frame, a pivotal support for said frame, a needle-bar journaled for endwise reciprocation in said frame, means for endwise reciprocating said needle-bar, a needle-bar guide supported independently of said frame and pivotally journaled for pendulous movement about an axis coincident with the pivotal axis of said frame, and means for swinging said frame and guide in unison.

6. In a sewing machine, a rotary actuating shaft, a vibratory needle-bar frame, a needle-bar frame support providing for vibrating said needle-bar frame about an axis substantially coincident with the axis of rotation of said shaft, a needle-bar journaled for endwise reciprocation in said frame, a crank carried by said rotary shaft, a stud-pin extending laterally from said needle-bar, a link connecting said crank and stud-pin for reciprocating said needle-bar, a

pendulous member journaled coaxially of said shaft and provided with a guideway lengthwise disposed substantially parallel to said needle-bar, a slide-block carried by said stud-pin and slidably disposed in said guideway, means for swinging said pendulous member, and connections with said member for vibrating said frame.

7. In a sewing machine, a supporting and actuating member, means for actuating said member, an endwise reciprocatory and laterally movable needle-bar, means constraining said needle-bar to move laterally with said member, means for endwise reciprocating said needle-bar, an actuating element supported by said member for movement therewith, operative connections with said actuating element for transmitting lateral movements to said needle-bar relatively to said member, and means for actuating said element.

8. In a sewing machine, a member pivotally supported for swinging movement about a fixed axis, means for actuating said member, a needle-bar constrained to vibrate laterally with said member about an axis substantially coincident with the pivot axis of said member, means for endwise reciprocating said needle-bar, a rotary actuating element carried by said member, connections with said rotary actuating element for imparting lateral movements to said needle relatively to and transversely of the swinging movements of said member, and means for rotating said actuating element.

9. In a sewing machine, a rotary actuating shaft, a pendulous member journaled coaxially of said shaft, means for swinging said pendulous member, a vibratory needle-bar frame, supporting means for said frame providing for vibration of said frame about transverse pivotal axes, a needle-bar journaled for endwise reciprocation in said frame, means for endwise reciprocating said needle-bar, means constraining said needle-bar frame to vibrate with said member about one of said pivotal axes and providing for vibratory movement of said frame relatively to said member about the other pivotal axis of said frame, a rotary actuating element carried by said member, operative connections with said actuating element for transmitting vibratory movements to said frame relatively to said member, and driving connections with said main-shaft for rotating said actuating element.

10. In a sewing machine, a rotary actuating shaft, a pendulous member journaled coaxially of said shaft, means for swinging said pendulous member, a needle-bar frame supported for lateral movements in transverse directions, a needle-bar journaled for endwise reciprocation in said frame, means for endwise reciprocating said needle-bar, means constraining said needle-bar frame to move laterally with said pendulous member, a cross-shaft rotatably journaled in said pendulous member to extend lengthwise transversely of said actuating shaft, gear connections between said shafts for rotating said cross-shaft, an actuating element carried by said cross-shaft, and operative connections with said actuating element for transmitting lateral movements to said needle-bar frame relatively to said pendulous member.

11. In a sewing machine, a rotary actuating shaft, a pendulous member journaled coaxially of said shaft, means for swinging said pendulous member, a laterally vibratory needle-bar frame, supporting means for said frame providing for vibration of the frame about transverse pivotal axes, a needle-bar journaled for endwise reciprocation in said frame, means for endwise reciprocating said needle-bar, means constraining said needle-bar frame to move laterally with said pendulous member, a cross-shaft rotatably journaled in said pendulous member to extend lengthwise transversely of said actuating shaft, gear connections between said shafts for rotating said cross-shaft, an actuating element carried by said cross-shaft, and operative connections with said actuating element for transmitting lateral movements to said needle-bar frame relatively to said pendulous member.

12. In a sewing machine, a rotary actuating shaft, a pendulous member journaled coaxially of said shaft, means for swinging said pendulous member, a laterally vibratory needle-bar frame, supporting means for said frame providing for vibration of the frame about transverse pivotal axes, a needle-bar journaled for endwise reciprocation in said frame, means for endwise reciprocating said needle-bar, means constraining said needle-bar frame to move laterally with said pendulous member, a cross-shaft rotatably journaled in said pendulous member to extend lengthwise transversely of said actuating shaft, gear connections between said shafts for rotating said cross-shaft, an actuating element carried by said cross-shaft, and operative connections with said actuating element for transmitting lateral movements to said needle-bar frame relatively to said pendulous member.

cation in said frame, means for endwise reciprocating said needle-bar, connection-means constraining said needle-bar frame to vibrate with said pendulous member about one of the pivotal axes of said frame, an actuating element carried by said pendulous member for rotation about an axis transverse to the axis of rotation of said actuating shaft, driving connections with said actuating shaft for rotating said actuating element, and operative connections with said actuating element for transmitting vibratory movements to said needle-bar frame about the other of its pivotal axes.

12. In a sewing machine, a rotary actuating shaft, a pendulous member journaled coaxially of said shaft, means for swinging said pendulous member, a laterally vibratory needle-bar frame, supporting means for said frame providing for vibration of the frame about transverse pivotal axes, one of said axes being substantially coincident with the axis of rotation of said shaft, a needle-bar journaled for endwise reciprocation in said vibratory frame, means for endwise reciprocating said needle-bar, connection-means constraining said needle-bar frame to vibrate with said pendulous member about the pivotal axis of said frame coincident with the axis of rotation of said actuating shaft, a cross-shaft rotatably journaled in said pendulous member to extend lengthwise transversely of said actuating shaft, gear connections with said actuating shaft for rotating said cross-shaft, an actuating eccentric carried by said cross-shaft, and a pitman connecting said eccentric to said needle-bar frame for vibrating said frame about the other pivotal axis of the frame.

13. In a sewing machine, a rotary actuating shaft, a laterally vibratory needle-bar frame, supporting means for said frame providing for vibration of the frame about transverse pivotal axes, one of said axes being substantially coincident with the axis of rotation of said shaft, a needle-bar journaled for endwise reciprocation in said vibratory frame, crank-and-link connections with said actuating shaft for endwise reciprocating said needle-bar, a pendulous member journaled coaxially of said shaft, means for swinging said pendulous member, needle-bar guiding means carried by said pendulous member, a spline-connection between said frame and member constraining said frame to vibrate with said member and providing for vibratory movement of said frame relatively to said member, a rotary actuating element carried by said member, driving connections with said actuating shaft for rotating said actuating element, and operative connections with said rotary actuating element for vibrating said needle-bar frame relatively to said member.

14. In a sewing machine, a yoke-member, a pivotal support for said yoke-member, a needle-bar frame operatively connected to said yoke-member for movement therewith and for movement relatively thereto, a needle-bar journaled for endwise reciprocation in said frame, a needle carried by said needle-bar, means for reciprocating said needle-bar, a loop-taker carried by said yoke-member and complementary to said needle in the formation of stitches, means for actuating said loop-taker, means for swinging said yoke-member and thereby transmitting lateral movements in unison to said needle and loop-taker, and means for transmitting lateral movements to said needle-bar frame relatively to said yoke-member.

15. In a sewing machine, a needle-bar frame supported for lateral vibration in transverse planes, a needle-bar journaled for endwise reciprocation in said frame, a needle carried by said needle-bar, means for reciprocating said needle-bar, a yoke-member pivotally supported for pendulous movement, means for swinging said yoke-member, connection-means constraining said needle-bar frame to vibrate laterally in unison with said yoke-member in one of said transverse planes, said connection-means providing for lateral vibration of said frame relatively to said yoke-member in the other of said planes, a loop-taker journaled in said yoke-member for rotation in a plane transverse to the plane of vibration of said frame with said yoke-member, means for rotating said loop-taker, and means for vibrating said frame relatively to said yoke-member.

16. In a sewing machine, a needle-bar having endwise reciprocatory movements in a plane of lateral vibration of said needle-bar, a needle carried by said needle-bar, means for endwise reciprocating said needle-bar, a swinging yoke-member connected to laterally vibrate said needle-bar in said plane, a support providing a pivotal-axis for said yoke-member, means for swinging said yoke-member about its pivotal support, a loop-taker complementary to said needle in the formation of stitches and carried by said yoke-member for movement therewith, said loop-taker being journaled in said yoke-member for rotation about an axis transverse to the pivotal axis of said yoke-member and in a plane substantially transverse to the plane of needle-vibration, and means for rotating said loop-taker.

17. In a sewing machine, a needle-bar having endwise reciprocatory movements in a plane of lateral vibration of said needle-bar, a needle carried by said needle-bar, means for endwise reciprocating said needle-bar, a swinging yoke-member connected to laterally vibrate said needle-bar in said plane, a support providing a pivotal-axis for said yoke-member, means for swinging said yoke-member about its pivotal support, a loop-taker complementary to said needle in the formation of stitches and carried by said yoke-member for movement therewith, said loop-taker being journaled in said yoke-member for rotation in a plane substantially transverse to said plane of needle-vibration with said yoke-member and about an axis transverse to the pivotal axis of said yoke-member, and actuating means for transmitting to said needle-bar lateral movements parallel to the plane of rotation of said loop-taker.

18. In a sewing machine, a vibratory needle-bar frame, supporting means providing for vibration of said frame about transverse pivotal axes, a needle-bar journaled for endwise reciprocation in said vibratory frame, a needle carried by said needle-bar, means for endwise reciprocating said needle-bar, a yoke-member pendulously supported for swinging movement about an axis substantially coincident with one of the pivotal axes of said frame, means for swinging said yoke-member, connection-means constraining said needle-bar frame to vibrate laterally with said pendulous member about one of the pivotal axes of said frame, means for vibrating said frame relatively to said yoke-member about the other pivotal axis of said frame, a loop-taker journaled in said yoke-member for rotation about an axis substantially parallel to the axis about which said frame is vibrated relatively to said

yoke-member, and means for rotating said loop-taker.

19. In a sewing machine having a work-support and a bracket-arm overhanging said work-support, an actuating shaft extending lengthwise of and rotatably journaled in said bracket-arm, a vibratory needle-bar frame, supporting means providing for vibration of said frame about transverse pivotal axes, one of said axes being substantially coincident with the axis of rotation of said actuating shaft, a needle-bar journaled for endwise reciprocation in said frame, a needle carried by said needle-bar, connections with said actuating shaft for endwise reciprocating said needle-bar, a yoke-member pendulously supported coaxially of said actuating shaft, said yoke-member having an arm thereof disposed below said work-support, means for swinging said yoke-member, connection-means constraining said needle-bar frame to vibrate with said yoke-member about the pivotal axis of said frame coincident with the rotation-axis of said shaft, means for vibrating said needle-bar frame relatively to said yoke-member about the other pivotal-axis of said frame, a loop-taker rotatably journaled in the arm of said yoke-member below the work-support, and means for rotating said loop-taker.

20. In a sewing machine, stitch-forming and feeding mechanism including an endwise reciprocatory work-penetrating and laterally vibratory work-feeding needle, means for endwise reciprocating said needle, a rotary loop-taker complementary to said needle in the formation of lock-stitches, means for rotating said loop-taker, and means for transmitting lateral work-feeding movements to said needle and bodily movements to said loop-taker in unison with the work-feeding movements of said needle.

21. In a sewing machine, stitch-forming and feeding mechanism including a needle, actuating mechanism effective to impart endwise reciprocatory work-penetrating and lateral work-feeding movements to said needle, a rotary loop-taker complementary to said needle in the formation of lock-stitches, said loop-taker being journaled for rotation about an axis substantially parallel to the line of feed of the work, means for rotating said loop-taker, and means for transmitting bodily movements to said loop-taker in unison with the lateral work-feeding movements of said needle.

22. In a zigzag-stitch sewing machine, an endwise reciprocatory needle, means for transmitting to said needle lateral work-feeding movements and lateral movements crosswise of said work-feeding movements, a rotary loop-taker having its axis of rotation substantially parallel to the line of feed of the work, means for rotating said loop-taker, and means for transmitting co-directional lateral work-feeding movements to said needle and bodily movements to said loop-taker in unison.

23. In a sewing machine, a rotary needle-reciprocating shaft, an endwise reciprocatory and laterally vibratory needle, operative connections with said shaft for reciprocating said needle, a yoke-member pendulously supported coaxially of said shaft, a rotary loop-taker complementary to said needle in the formation of stitches, a loop-taker actuating shaft rotatably journaled in said yoke-member and disposed substantially parallel to said needle-reciprocating shaft, driving connections between said shafts, means for swinging said yoke-member, and means constraining said

needle to vibrate laterally with said yoke-member.

24. In a sewing machine, a rotary needle-reciprocating shaft, an endwise reciprocatory and laterally vibratory needle, operative connections with said shaft for reciprocating said needle, a yoke-member pendulously supported coaxially of said shaft, a loop-taker journaled in said yoke-member for rotation about an axis transverse to said needle-reciprocating shaft, a loop-taker actuating shaft rotatably journaled in said yoke-member and disposed substantially parallel to said needle-reciprocating shaft, driving connections with said loop-taker actuating shaft for rotating said loop-taker, belt-and-pulley connections between said needle-reciprocating and loop-taker actuating shafts, means for swinging said yoke-member, and means constraining said needle to vibrate laterally with said yoke-member.

25. In a sewing machine, the combination with an endwise reciprocatory and laterally vibratory needle, of a vibratory supporting member, a loop-taker rotatably journaled in said supporting member, means for rotating said loop-taker, a work-feeding element, a feed-advance rock-shaft operatively connected to said work-feeding element, connections with said rock-shaft for vibrating said supporting member, and means for actuating said rock-shaft.

26. In a sewing machine, in combination, an endwise reciprocatory needle having lateral work-feeding movements, means for endwise reciprocating said needle, a rotary loop-taker complementary to said needle in the formation of lock-stitches, means for rotating said loop-taker, a work-advancing element, and means for imparting co-directional movements in unison to said needle, loop-taker and feeding element.

27. In a sewing machine, in combination, an endwise reciprocatory needle having lateral work-feeding movements, means for endwise reciprocating said needle, a loop-taker complementary to said needle in the formation of stitches, means for actuating said loop-taker, opposed work-feeding elements, and means for imparting co-directional movements in unison to said needle, loop-taker and feeding elements.

28. In a sewing machine having a work-support and a bracket-arm overhanging said work-support, in combination, a rotary bracket-arm shaft, an endwise reciprocatory and laterally vibratory needle, operative connections with said bracket-arm shaft for reciprocating said needle, a pendulously supported yoke-member having an arm disposed below said work-support, a work-advancing feed-dog operating through said work-support, a loop-taker journaled in said arm of the yoke-member for rotation about an axis substantially parallel to the line of feed, a loop-taker actuating shaft rotatably journaled in said arm of the yoke-member and disposed substantially parallel to said bracket-arm shaft, driving connections for rotating said loop-taker from said actuating shaft, driving connections with said bracket-arm shaft for rotating said loop-taker actuating shaft, a feed rock-shaft disposed below said work-support, means for actuating said rock-shaft, operative connections with said rock-shaft for actuating said feed-dog, operative connections with said rock-shaft for swinging said yoke-member, and operative connections with said yoke-member for laterally vibrating said needle.

29. In a sewing machine having a work-support and a bracket-arm overhanging said work-

support, a rotary bracket-arm shaft, a vibratory needle-bar frame, supporting means upon said bracket-arm providing for vibration of said frame about transverse pivotal axes, a needle-bar journaled for endwise reciprocation in said frame, connections with said bracket-arm shaft for endwise reciprocating said needle-bar, a yoke-member pendulously supported for swinging movement about an axis coincident with one of the pivotal axes of said needle-bar frame, a work-advancing feeding element, a loop-taker disposed below said work-support and rotatably journaled in said yoke-member, a loop-taker actuating shaft rotatably journaled in said yoke-member, driving connections between said bracket-arm shaft and said loop-taker actuating shaft, a feed rock-shaft, means for actuating said rock-shaft, operative connections with said rock-shaft for swinging said yoke-member, operative connections with said yoke-member for imparting work-advancing movements to said feeding element, operative connections with said yoke-member for laterally vibrating said needle-bar frame about the pivotal axis thereof coincident with that of the yoke-member, and means carried by said yoke-member for transmitting vibratory movements to said needle-bar frame about its other pivotal axis.

30. In a sewing machine having a work-support, in combination, an endwise reciprocatory and laterally vibratory needle-bar disposed above said work-support, means for endwise reciprocating said needle-bar, an endwise reciprocatory and laterally vibratory feed-bar disposed above said work-support adjacent and substantially parallel to said needle-bar, means for endwise reciprocating

ing said feed-bar, means for transmitting lateral movement in unison to said needle-bar and feed-bar, and means for transmitting lateral movements to said needle-bar relatively to said feed-bar.

31. In a sewing machine, having a work-support, in combination, a rotary actuating shaft, an endwise reciprocatory needle-bar journaled above said work-support for lateral vibration about transverse pivotal axes, connections with said shaft for endwise reciprocating said needle-bar, an endwise reciprocatory and laterally vibratory feed-bar disposed above said work-support adjacent said needle-bar, means for endwise reciprocating said feed-bar, means for laterally vibrating said needle-bar and feed-bar in unison, and means for transmitting lateral vibrations to said needle-bar transversely of the lateral vibrations of said feed-bar.

32. In a sewing machine, in combination, a rotary actuating shaft, a yoke-member pivotally supported for swinging movement, a vibratory needle-bar frame operatively connected to said yoke-member for movement therewith and for vibratory movement relatively thereto, a needle-bar journaled for endwise reciprocation in said frame, means connected to said actuating shaft for reciprocating said needle-bar, a feed-bar journaled for endwise reciprocation in said yoke-member, means for endwise reciprocating said feed-bar, means for swinging said yoke-member, and means for vibrating said needle-bar frame transversely of the swinging movements of said feed-bar with said yoke-member.

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