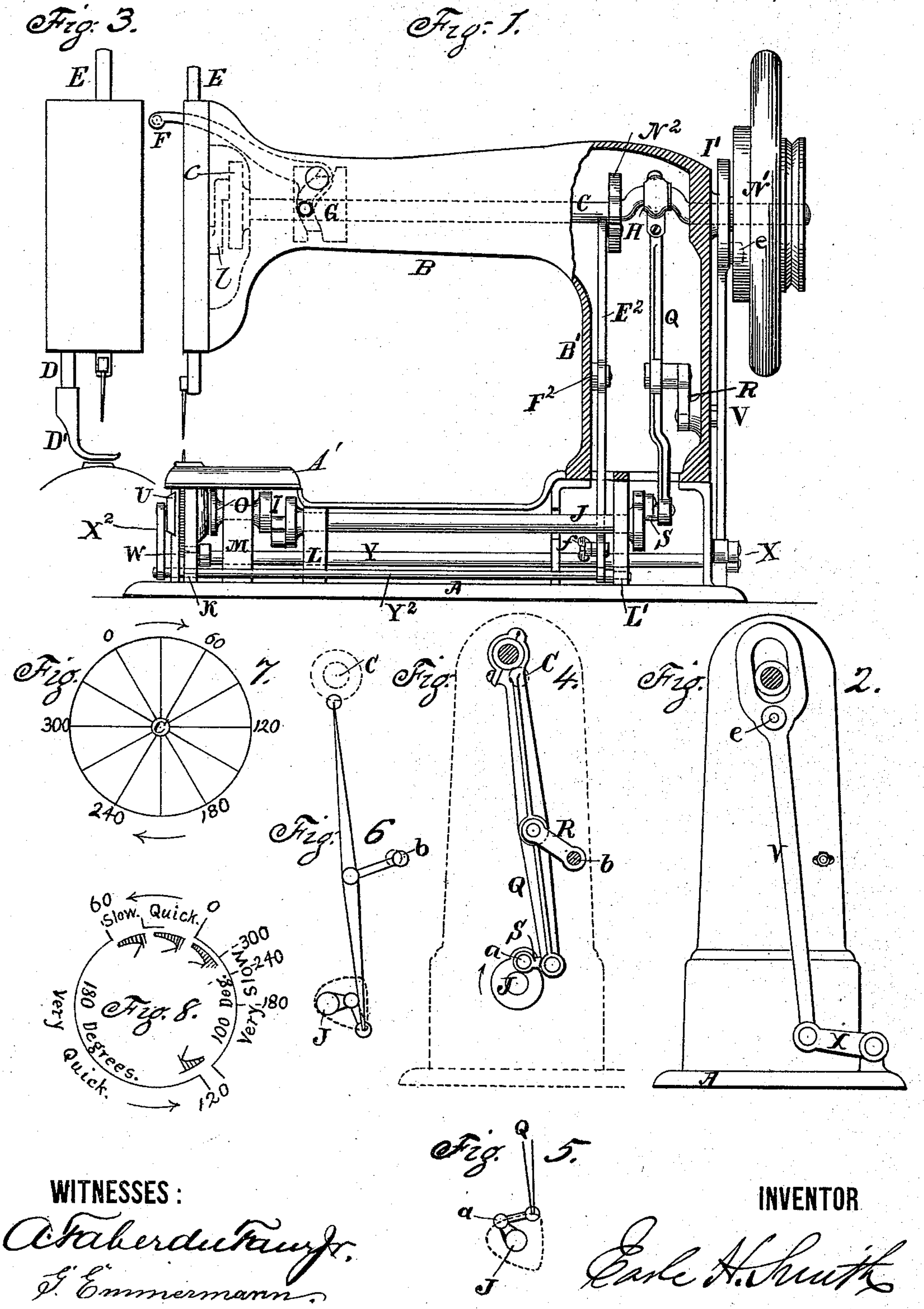
(No Model.) 3 Sheets—Sheet 1.

E. H. SMITH.

SEWING MACHINE.

No. 532,344. Patented Jan. 8, 1895.



WITNESSES:

A. Faberdu Faur Jr.

G. Emmermann

INVENTOR

Earle H. Smith

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 3 Sheets—Sheet 2.

E. H. SMITH.

SEWING MACHINE.

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Fig. 9.

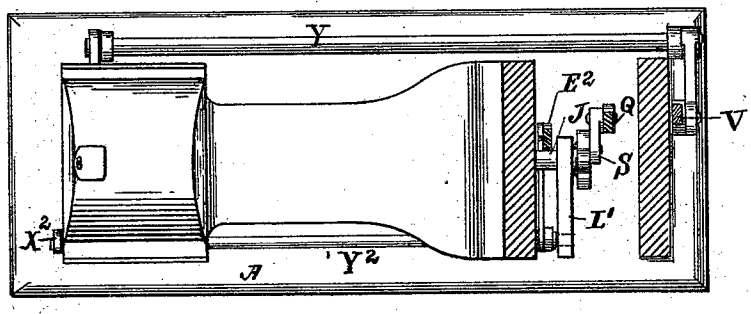


Fig. 13.

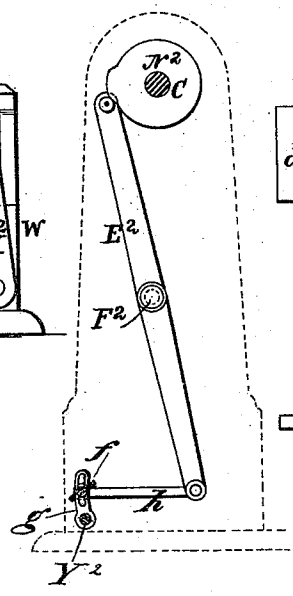


Fig. 10.

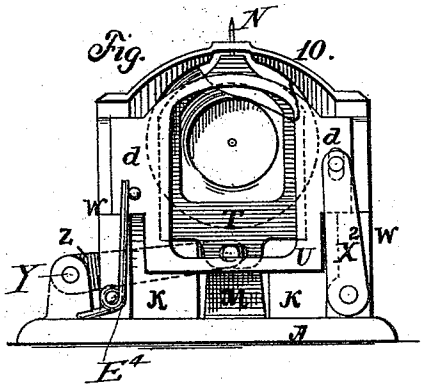


Fig. 11.

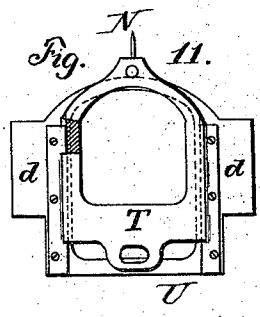


Fig. 12.

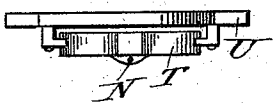


Fig. 14.

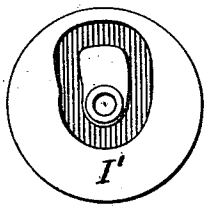


Fig. 17.

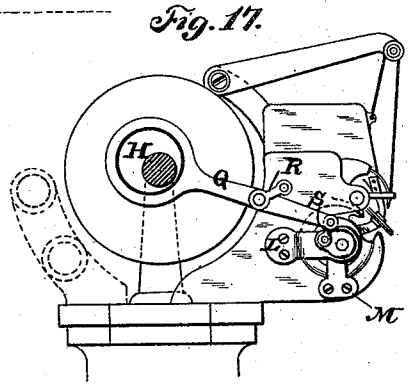


Fig. 15.

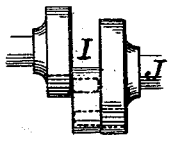
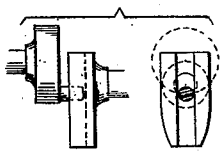


Fig. 16.



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(No Model.)

3 Sheets—Sheet 3.

E. H. SMITH.
SEWING MACHINE.

No. 532,344. Patented Jan. 8, 1895.

Fig. 18a.

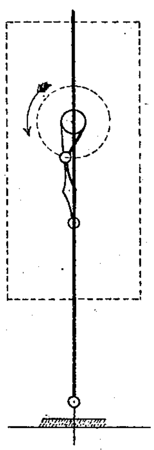


Fig. 19a.

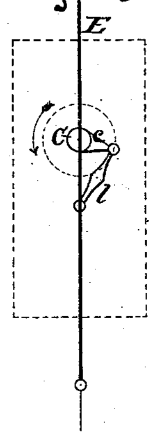


Fig. 20a.

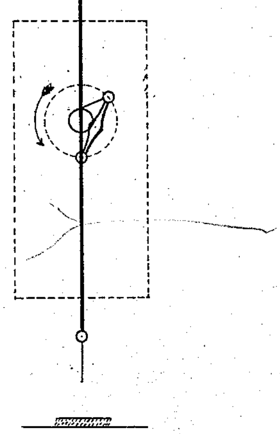


Fig. 18.

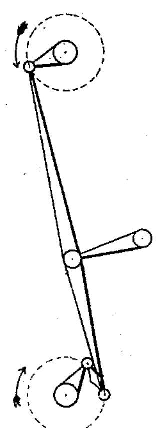


Fig. 19.

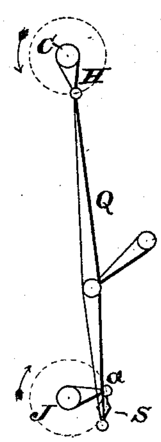
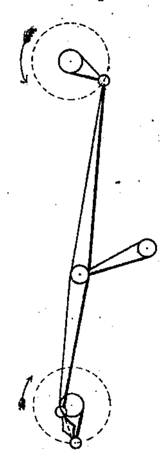


Fig. 20.



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UNITED STATES PATENT OFFICE.

EARLE H. SMITH, OF NEW YORK, N. Y.

SEWING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 532,344, dated January 8, 1895.

Application filed September 4, 1889. Serial No. 323,011. (No model.)

To all whom it may concern:

Be it known that I, EARLE H. SMITH, a citizen of the United States, residing in the city, county, and State of New York, have invented certain new and useful Improvements in Sewing-Machines, whereof the following is a specification.

The improvements relate especially to lock-stitch sewing machines of the class which employ a rotary thread-carrying loop-taker, by which is meant a revolving shuttle or hook that rotates around a stationary bobbin retained therein, that is, a bobbin having no motion except to pay off thread for each stitch as the sewing progresses.

The invention is applicable in machines for both wax-thread and dry-thread sewing; and embraces a special adaptation of variable motions for a rotary shuttle, to admit the use of an awl actuated by means independent of the needle-operating mechanism. The shape and structure of the parts will vary with the work for which the machine is designed.

To illustrate the invention I have shown the same herein as developed in a form of machine using an eye-pointed-needle; but the improvements also apply in other forms, and in machines which use the circularly curved as well as in those using the straight needle and awl.

Referring to the annexed drawings, Figure 1, is a side elevation of said machine. Fig. 2, is a rear elevation as with the balance wheel removed. Fig. 3, is a face view of the bracket arm head. Fig. 4, illustrates the pitman connections. Fig. 5, is a diagram indicating a modified arrangement of the pitman connection. Fig. 6, is a diagram of pitman lever motions. Fig. 7, indicates uniform speed of the main shaft. Fig. 8, is a diagram to show differential speed of the shuttle. Fig. 9, is a plan view from Fig. 1, as with the bracket arm cut off on a line with the work-plate. Fig. 10, shows the awl-carrier as seen from the front. Fig. 11, is a reversed view and Fig. 12 a top view of the same. Fig. 13, is a diagram of feed motion connections. Fig. 14, shows face of the awl-cam and cam groove therein (scale of Fig. 1). Fig. 15, shows (enlarged) the variable motion device or coupling connecting the lower shafts. Fig. 16, is a modification of such coupling. Fig. 17, is a diagram illustrating the rotary and variable motion connections for the rotary shuttle as applied to the style of machine using a circularly curved needle. Figs. 18 to 20 are diagrams illustrating the movement of the pitman connection and Figs. 18^a, to 20^a, are diagrams showing the corresponding motions of the needle driving crank and the needle bar.

A, is the bed-plate or frame, on which is secured the work-table A′, and the bracket-arm B and its post B′; the arm-head carrying a presser-foot and foot-bar D, D′ and needle-bar, E.

C, is the revolving main shaft, having its bearings in the bracket-arm, and therefore above the work-table, A′. The needle-bar is reciprocated from this shaft by a crank disk C, at the front end thereof. At the rear, said shaft has a crank H (or eccentric) from which rotary motion is transmitted to the prime shaft J, below, which shaft is mounted in standards L, L′ on the bed-plate A. A stout standard M furnishes the bearings for a short shaft, (dotted) from which the loop-taker is rotated. Such loop-taker, for the purposes of the machine I am describing, is a circular shuttle, properly adapted to carry shuttle-thread on an ordinary bobbin retained therein in any usual manner, such loop-taker having a nose or hook to take the loop from the needle, and propelled in one direction by a suitable shuttle-driver (O). Means are arranged on the opposite side of the work from the shuttle's place for manipulating the needle-thread, delivering the same to and drawing it from off the loop-taker in consonance with the motions thereof, here consisting of a lever F, termed a thread-lever. In the co-operation of the needle, shuttle, and thread-lever, the shuttle by its rotary motion takes the loop from the needle, distends it and rotates through it, whereby the interlock of the needle and shuttle threads by the shuttle, is effected by its rotary motion, as distinguished from the to-and-fro flight of a reciprocating shuttle; and the loop of needle-thread with which the shuttle-thread has been interlocked is immediately drawn from the shuttle and fully closed up, and the stitch completed, by the thread-lever, before another loop is taken from the needle. The thread-lever F is pivoted to the arm B near the outer end, and

operated from a cam G on shaft C near the front end of the shaft. For giving the loop-taker rotary motion, the prime shaft J has a crank at the rear end shown as a crank pin A, set in a crank disk fixed on this shaft. Rotary motion is communicated from the main shaft C to the shaft J by a pitman connection. Such pitman connection is here represented by a pitman-lever Q, fulcrumed between the ends. The upper end of this pitman embraces the crank H of the driving shaft C and the lower end connects as by a link S, with the crank *a*, of the lower or prime shaft J, whereby this shaft is rotated from the continuously-rotating driving shaft. The loop-taker is operated mediately from the shaft C, and is hence rotated in one direction only. It has a variably accelerated motion which is derived from two variable speed devices. Both are only needed, however, when the invention is applied to use in a machine using an awl. One of these devices is a differential coupling, shown as situated between shaft J, and the loop-taker shaft. The other resides in a certain arrangement of the relative position of the shaft J as to the lower and of the pitman lever, Q, and the connection from one to the other. When the crank H, of the shaft C imparts rotary motion to the pitman lever at its upper end, the lower end thereof describes an irregular orbit or path. If the lower end of the pitman be arranged relatively to shaft J so as to bring such path substantially concentric to the axis of said shaft, (see dotted line in diagram Fig. 5,) the movement received by the latter is approximately uniform; in which case the principal fast and slow movements of the loop-taker will come from the differential coupling device aforesaid.

In Figs. 4 and 6, the lower end of the pitman is disposed relatively to the axis of the shaft J, so as to bring this orbit into eccentric relation to the axis of shaft J, by which eccentricity the pitman imparts to said shaft and the loop-taker the accelerated motion common to variably rotated shuttles at the time of passing the bobbin through the loop. The motion of the needle is also quickened and slowed in conjunction with the quick and slow motions of the shuttle; and the fast and slow motions of the one, are made to occur in reverse order with respect to the other. The means of imparting such varying movement to the needle, as shown herein, is by a link *l* from the crank disk *c* to the needle-bar. Said link is made as short as practicable. The upper end receives the crank of disk *c* and it is attached by the lower end to the needle-bar. As thus arranged the motion received by the needle is much the slowest when out of the work, (when the crank is moving over the upper half of its circuit,) while the ascending and descending motion of the needle when entering and leaving the work, is quick. An analogous plan for conveying motion to the needle-bar, and superior in some situations, consists in a lever connected to the needle-bar and pivoted to one side of the arm head, said lever having an upwardly arching cam slot therein, which is traversed by the needle driving crank *c* as shown in my patent, No. 473,894, of April 26, 1892.

The pitman Q is shown as having its fulcrum on a radius bar R. Thus arranged, the movement of said fulcrum is in an arc governed by the radius-bar. The eccentric relation of the pitman Q to shaft J, before mentioned, is shown as obtained by properly locating the pivoted end of the radius-bar on the arm-post B′ (see dotted position of pivot *b*, Fig. 6); and when the pitman Q is arranged as described and has its irregular path set eccentrically to shaft J, as aforesaid, that shaft receives from the pitman a duplex variable motion.

The operation of the pitman-lever is illustrated partly by Figs. 1, 4, and 6; and also by diagrams 18, 18ª, 19, 19ª, 20, 20ª, which diagrams indicate the comparative motions of the pitman-lever, and those of the needle, as if seen from the rear end of the machine. Assuming the parts Q, *a*, S, to occupy about the position seen in Fig. 4, the main shaft C being revolved, when said parts arrive in a position indicated by diagram Figs. 18, 18ª, with the needle well in the work, the lower end of the pitman-lever moving in its irregular orbit briefly quickens the motion of shaft J, at the time when the needle is rising to form the loop for the shuttle point to enter. In diagram Figs. 6, 19, and 19ª, the pitman-lever by its irregular orbit momentarily retards the motion of shaft J (and hence of the shuttle), the needle at the same time being quickly drawn out of the work. After this takes place the motion of the shaft J, is rapidly accelerated as the lower end of the pitman passes near the axis of said shaft, (Diagram 20). This acceleration continues during the period in which the shuttle is passing through the loop. At the same time the needle is receiving its slowest motion (being virtually dormant) while its operating crank is traversing part of the upper half of its circuit (Diagram 20ª). After the aforesaid principal acceleration of the shuttle, there follows an interval of slow motion thereof continuing until the pitman connections arrive at and pass the position denoted by Fig. 4, as first above mentioned, during which time the needle is descending with a quick motion and entering the work, to begin a new stitch, as before, when the same operations are repeated, and so on. The increment of speed of shaft J, when accelerated, over that of shaft C, is noted by comparing the short distance made by the crank H of the main shaft in going from the position of Diagram 19ª to that of 20ª, with the longer space passed over by the crank *a* on the shaft J, in going from the position shown in Diagram 19 to that shown in Diagram 20.

For wax thread sewing, additional time is needed, in which to operate an awl to puncture the work for the next stitch, after each stitch is complete, and before the needle again enters the work. For this purpose I cause an intensified acceleration of the shuttle's rotary motion in order to gain such additional time. With this object the accelerated movement derived from the pitman-lever, is united with that of the differential coupling before mentioned, so that both take place at the same time. Said coupling is variously made. A well known structure is described in Patent No. 124,360, of 1872. The plan here adopted shown in Figs. 1 and 15, consists in placing the axes of the shaft J and the loop-taker shaft in different parallels, providing each with crank pins (see dotted lines in Fig. 15) and connecting the cranks by a link I. One of the crank pins is in a disk on the shaft J and the other is in a like disk or crank on the loop-taker shaft, the circuits of the two cranks being thus eccentric to each other. Fig. 16 shows an alternative wherein a radial groove formed in face of one crank receives the crank pin of the opposite one.

In uniting the variable motions from two different sources, both acting at the same time as aforesaid, I secure a cumulative effect, wherein the motion of said two variable speed mechanisms is compounded; the higher speed part of the revolution of shaft J, derived from the pitman lever as aforesaid, being superadded to that of the said differential coupling, and said speeding of both takes place during the period when the shuttle is passing through the loop, whereby the accelerated motion of the shuttle is augmented. In this way the shuttle gets the combined effect of two speeding mechanisms at once.

The compound or augmented speed of the shuttle, is appreciated by comparing the uniform speed of the main shaft seen in diagram Fig. 7, indicating the positions successively taken by the needle driving crank *c* in one revolution of the main shaft, with the corresponding positions occupied by the point of the shuttle (diagram Fig. 8) at the same moment of time, as shown by the same numeral marked on each, thus —0, 60, 120, &c. From this it will be seen that in the shuttle's motion the entire one hundred and eighty degrees, on half its circuit, is made while the main shaft C, rotating at a uniform speed, is preferably moving over about sixty degrees, or say in one-sixth of its revolution. As a result, there remains a long interval of time succeeding the accelerated motion in each revolution of the shuttle, when its motion is virtually dormant, in which interval the pull-up action of the thread-lever drawing up the entire loop of needle-thread, the puncturing operation of the awl, and the feed-motion, take place, (the needle being now above the work and moving slowly,) the thread lever finishing the stitch in advance of the operation of the awl and before another stitch is begun. The awl for puncturing the work, in wax thread sewing, is arranged to reciprocate in the same plane with the needle, and the shuttle point is at the front face thereof having its path in a plane parallel to the needle and awl. The awl is operated by mechanism separate and independent and as here shown, from the side of the work opposite to that where the needle enters.

In Figs. 1, 10, 11, and 12, N, indicates the awl, fixed in a carrier T. The latter is situated under the work-table in front of the shuttle, and has a large space or opening through which the shuttle may be replenished with thread. For advancing or feeding the work, the awl or needle, or other device may be employed. In this instance I make use of the awl. In its puncturing action, the awl is caused to move at all times in precise alignment with the needle. This is indispensable, especially where it is used for feeding; because such awl must always be withdrawn from the work precisely in the same line with the path of the needle, and not have any swinging motion, in order to insure the needle entering and following the perforation made by the awl. To provide this, the awl carrier T is arranged to move vertically in ways on the inside face of the frame U, (see reverse view Fig. 12,) which frame in turn is fitted to move horizontally at right angles to the needle's path, for which purpose the frame has wings D, adapted to slide in horizontal ways formed in standards W. The puncturing action of the awl is derived from a cam groove (Fig. 14), in the face of cam I′ part of the balance wheel N′. A bar V divided at the upper end, carries a roller *e*, that enters said cam groove. The lower extremity is jointed to an arm X, made fast to the rear end of a rock shaft Y, having at the front end a similar arm Z, that reaches the awl-carrier from behind, and engages the same by a pin entering a slot in the lower stile thereof. In its feeding action the awl is moved bodily with the lateral motion of the carrier frame U. The lateral motion is shown as derived from a cam N^2, on shaft C, which acts on a lever E^2. At the lower end this lever is connected by a rod *h* and pivot *f*, to an arm *g* fixed on the rear end of a rock-shaft Y^2 the same having affixed thereto at the front end an arm X^2, that reaches up and engages this frame U, by a pin. See Figs. 1, 9, 10, and 13. The cam N^2 gives the forward motion to this frame, a spring as E^4, Fig. 10, throwing it back; and cams I′ and N^2 are arranged on the main shaft, to cause the awl to move upward and forward for the feeding operation during the slow motion of the needle when out of the work. A thumb-screw and collar on the pivot *f*, allows of the adjustment of the pivot at different heights in a slot in arm *g*, whereby to alter the back throw of the awl carrier frame, and vary the length of the stitch; the feed or advance motion terminating in all cases when

the awl and needle are in line. The same means is applicable in like manner for adjusting the awl to the needle, if the machine be constructed to feed the work with the needle instead of an awl.

In the operation of the needle and awl it is the practice (especially in sewing the welts of shoes), not to force the awl entirely through, but to leave a portion of the puncture to be completed by the needle; wherefore the needle is in all cases a piercing needle, having but a single point.

By the terms "rotary," "rotating," "rotary motion" used herein, is meant that such motion is always forward, and never backward or oscillating.

The herein rotary shuttle improvements are applicable to machines having a crotchet or a circularly curved needle, as seen in Patent No. 356,935 and others; for illustration of which Fig. 17 is a diagram of the machine shown in Patent No. 369,563, in which diagram, the pitman-lever Q, and connections, are shown as applied to drive a rotary shuttle in such circular needle machine.

In the foregoing improvements I do not restrict myself to specific details, but shall vary the same within the invention as circumstances require while adhering to a rotary loop-taker which completes the stitch in connection with a needle and a thread-lever, substantially as hereinbefore described, and without the use of a reciprocating shuttle as seen in Patent No. 272,740, of 1883.

What I claim as my invention is—

1. The combination of the needle, mechanism for operating the same, the rotating shuttle or loop-taker co-operating with the needle, and continuous rotary motion mechanism constructed and arranged for imparting to the loop-taker a duplex variable motion, whereby the loop taker's motion is accelerated and retarded twice in each revolution.

2. The combination with a needle, and mechanism for operating the same, of a rotary shuttle, and mechanism constructed and arranged for rotating the shuttle with an augmented accelerated motion, such mechanism comprising two speeding devices arranged to co-operate, whereby such accelerated motion is augmented when the shuttle is passing through the loop.

3. The combination of a rotary shuttle or loop-taker, the loop-taker shaft, the needle and needle-bar, the needle-actuating shaft carrying a crank to operate the needle, means between said needle crank and needle-bar imparting variable motion to the needle and arranged to give the slowest motion to the needle when out of the work, a thread lever operated by a cam on the needle shaft during the said slowest motion of the needle, and rotary-motion mechanism connected with said needle shaft and said loop-taker shaft and communicating a variable motion to the loop-taker, so that it has a quick motion when passing through the loop, said quick motion taking place during the said slowest motion of the needle when out of the work.

4. The needle and needle-bar, the operating shaft therefor, a crank on said shaft, connecting mechanism between said crank and needle-bar imparting a variable motion to the needle the slowest motion occurring when the needle is out of the work, a thread-lever operated by a cam on the same shaft, said cam, a crank H on said shaft which communicates rotary motion to a prime shaft beneath the work, said prime shaft, a rotating shuttle or loop-taker, and rotary motion devices which impart fast and slow motions to the loop-taker from said crank H, such variable motions arranged to occur in reverse order to those of the needle as specified so that the quickest motion of the loop-taker takes place when it is passing through the loop and during said slowest motion of the needle, in combination with a feeding instrument and cam-moved mechanism constructed and arranged for causing said feeding instrument to engage and advance the work during the said slowest motion of the needle.

5. In combination, the rotary needle shaft C above the work, the needle-bar operated therefrom by a crank and link, the latter attached to the needle-bar by its lower end, the thread lever at the front end of said shaft operated by a cam thereon, the rotating prime shaft J beneath the work rotated from the main shaft by a pitman connection, a rotating shuttle, mechanism between the pitman connection and the shuttle imparting accelerated rotary motion to the shuttle, a feeding device, and cam-moved mechanism constructed and arranged for causing the feeding device to engage and feed the work during the interval succeeding the accelerations of the shuttle and while the needle is out of the work.

6. The combination of a main shaft rotating uniformly, a needle, a rotating shuttle, and an awl to puncture the work for the needle, of accelerative mechanism constructed and arranged to drive the shuttle through one hundred and eighty degrees of its circuit within a space of about sixty degrees of the main shaft's uniform revolution, substantially as set forth.

7. The combination of a single pointed piercing needle, means for reciprocating the same, an awl, a thread-carrying loop-taker, means for actuating the awl independent of the means from which the motion of the needle is derived, mechanism for revolving said looptaker in one direction only, and means for drawing the loop therefrom and fully closing up the same before taking another loop from the needle.

8. The combination of a needle, an awl, a rotary shuttle, means for reciprocating the needle and awl, independently, and mechanism adapted for rotating the shuttle with a varying speed while driving the same in one direction only and means for drawing up and finishing each stitch before another is begun.

9. The combination of a needle, an awl, a rotary shuttle, and a thread lever, working in co-operation, with accelerative mechanism constructed for causing the said shuttle to rotate with augmented speed through one hundred and eighty degrees of its revolution and thereafter be retarded, and with cam-moved devices which cause the thread lever and the awl to perform their office of puncturing the work, and of drawing in the stitch, during such retarded motion of the shuttle.

10. The combination of a rotary shuttle, a puncturing awl and reciprocating needle, means for separately operating the needle and awl, mechanism imparting an accelerated rotary motion to the shuttle, a thread lever, and a cam moving such lever to co-operate with the shuttle in delivering needle thread thereto, and drawing it back to finish the stitch, in advance of the operation of the awl.

11. The combination with a circular shuttle and shuttle race, a needle, and an awl, arranged for co-operation, of the awl-carrier disposed in front of the shuttle, and such awl carrier having a space or opening through which to replenish the shuttle with thread.

12. The combination of a needle and needle-carrier moving vertically, a circular shuttle moving in a circular race disposed in a plane parallel with the needle, an awl-carrier moving in the same plane with the needle in front of the shuttle, and in vertical ways which guide the awl both into and out of the work in lines precisely parallel with the needle's path, such awl-carrier ways controlled by a movable frame adapted to slide on horizontal ways, and cam moved mechanism for reciprocating the awl vertically and horizontally, to puncture and feed the work.

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