4 Sheets—Sheet 1.

I. M. SINGER.

SEWING MACHINE.

No. 60,433. Patented Dec. 11, 1866.

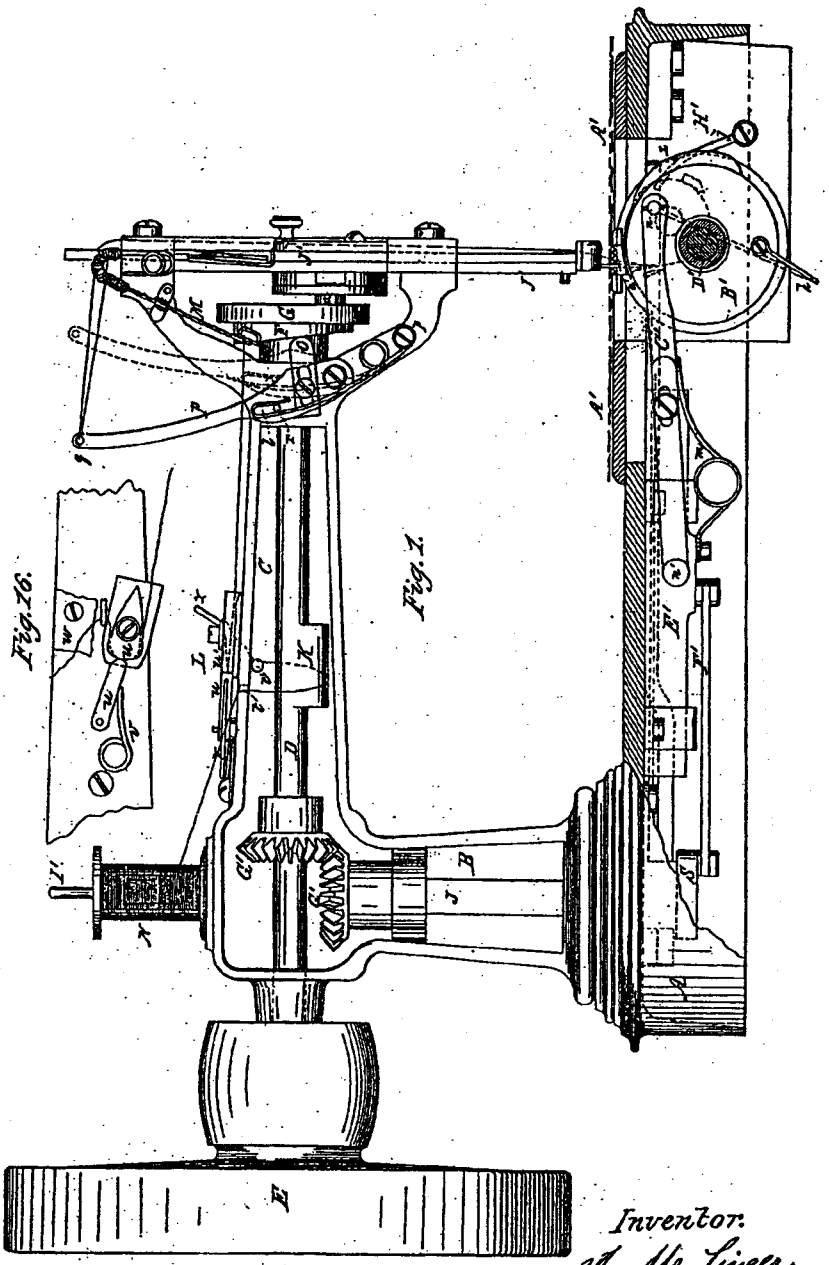

Fig. 1.

Fig. 1a.

Witnesses.
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Edw. H. Leonard.

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by his attorney
E. S. Renwick

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4 Sheets—Sheet 2.

I. M. SINGER.

SEWING MACHINE.

No. 60,433. Patented Dec. 11, 1866.

Fig. 2.

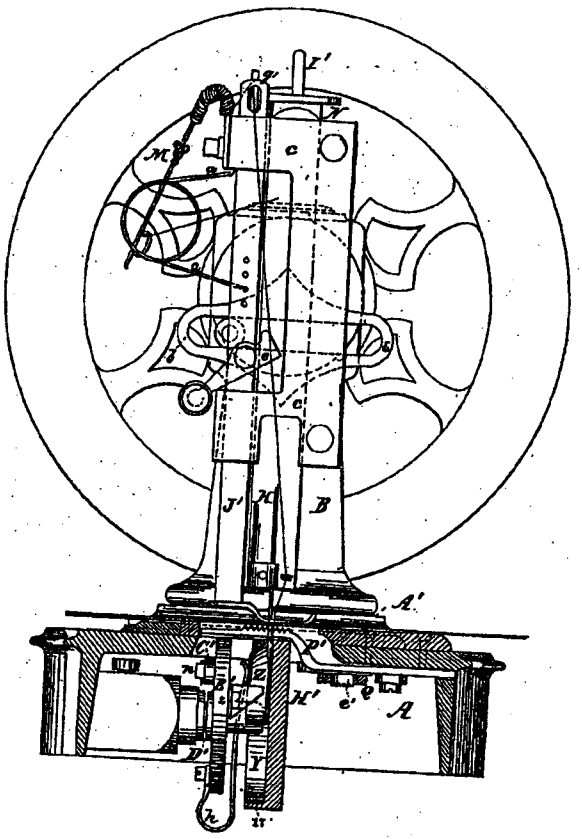
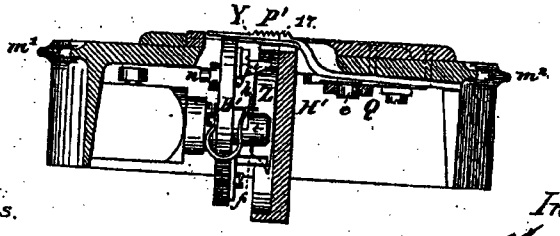


Fig. 4.



Witnesses.
F. W. Hunstet
Chas. H. Leonard

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P. S. Remick

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

4 Sheets—Sheet 3.

I. M. SINGER.

SEWING MACHINE.

No. 60,433. Patented Dec. 11, 1866.

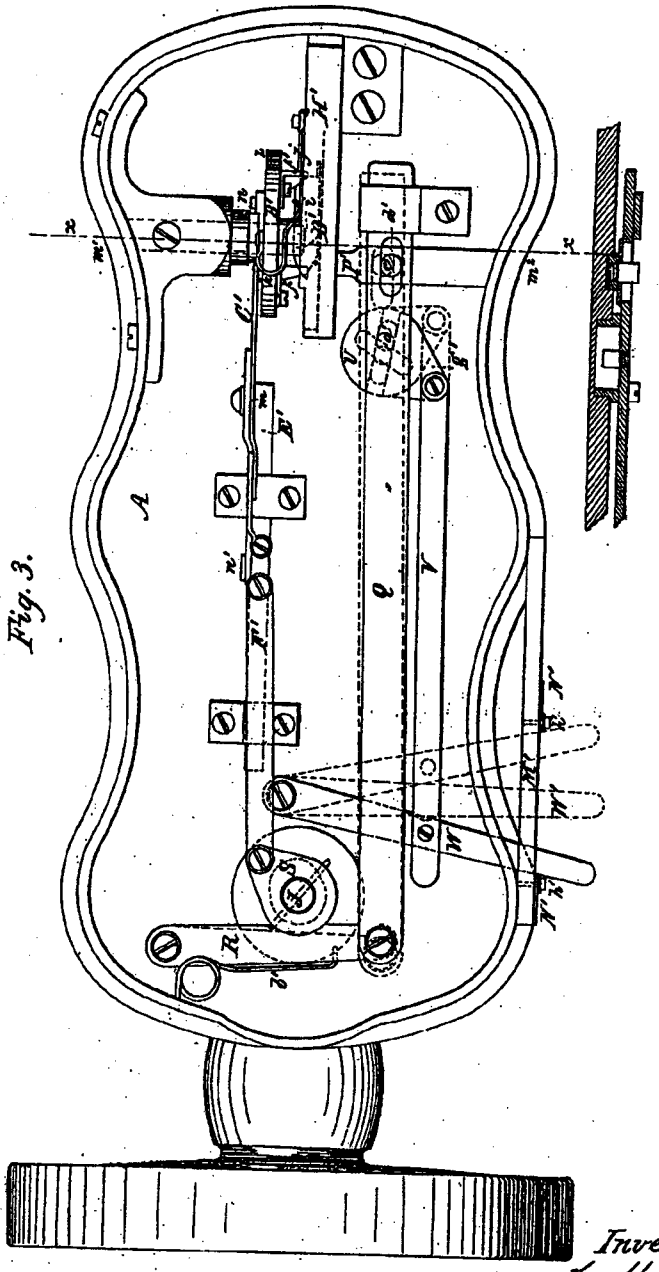

Fig. 3.

Witnesses.
F. A. Wooster.
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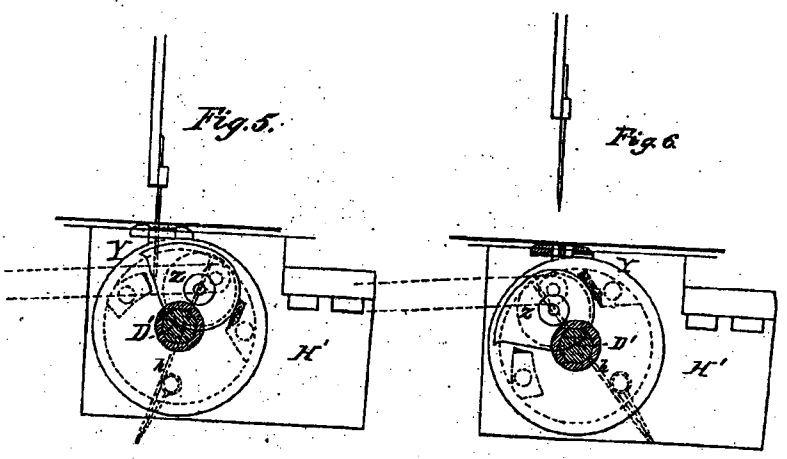
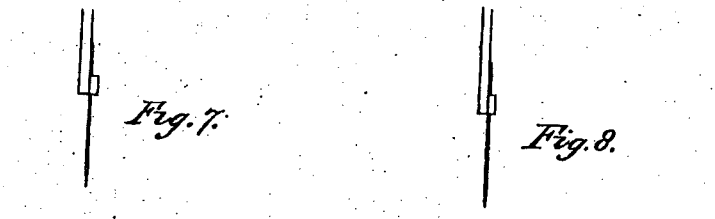
4 Sheets—Sheet 4.

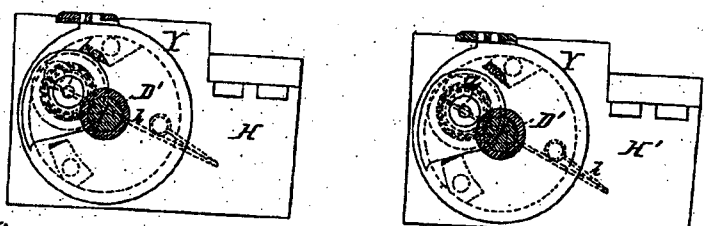
I. M. SINGER.

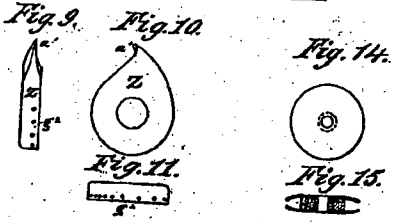
SEWING MACHINE.

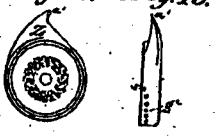
No. 60,433. Patented Dec. 11, 1866.











Witnesses.
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W. Le. Gennert.

Inventor.
Isaac M. Singer.
by his attorney
E. S. Renwick

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

United States Patent Office.

IMPROVEMENT IN SEWING MACHINE.

ISAAC MERRITT SINGER, OF YONKERS, NEW YORK.

Letters Patent No. 60,433, *dated December* 11, 1866.

The Schedule referred to in these Letters Patent and making part of the same.

TO ALL WHOM IT MAY CONCERN:

Be it known that I, ISAAC MERRITT SINGER, of Yonkers, in the county of Westchester, and State of New York, have invented certain new and useful improvements in Sewing Machines; and that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawing, in which—

Figure 1 represents a side elevation of a sewing machine, embodying my improvements.

Figure 2 represents an elevation of one end of the same with portions removed to show the members beneath the table plate of the machine.

Figure 3 represents a plan of the machine turned upside down, so as to show the members of the machine beneath the table plate.

Figure 4 represents an elevation of certain parts of the machine with the bed plate cut away at the line $x\,x$, of fig. 3, and with the members in different positions from those occupied by them in fig. 2.

Figures 5 to 8, inclusive, represent side views of the needle, shuttle and its appurtenances, in different positions.

Figures 9 to 15, inclusive, represent various views of the shuttle and bobbin or spool; and

Figure 16 represents a plan of a portion of the needle-arm and its appurtenances.

My improvements have reference to the sewing mechanism, thread-controlling, and tension mechanisms, and feeding mechanism of sewing machines, and although I believe the best result will be attained, when all my improvements are combined together in the same machine, some of them may be used separately from the others wherever such separate use may be expedient. The object of the first improvement or part of my invention is to prevent the formation of slack shuttle-thread between the guide eye of the shuttle from which the thread is delivered and the work upon the table plate; this part of my invention consists of the combination of a reciprocating needle-bar or carrier, with an oscillating shuttle having its delivery eye coincident or thereabouts with its centre of oscillation, so that the length of shuttle-thread extending from the eye to the seam is substantially the same in every position which the shuttle occupies in its oscillation. The object of the second part of the invention is to prevent the shuttle-thread extending from the seam to the shuttle from being split by the needle point in its descent, and from being in the way of the shuttle point in its movement. This part of my invention consists of the combination of an oscillating shuttle with a delivery eye arranged at one side of the plane of oscillation of the shuttle point, so that the shuttle-thread extending from the seam to the shuttle diverges laterally from the track of the needle point and the plane of oscillation of the shuttle point, and is out of the way of both these instruments. The object of the third part of the invention is to enable the shuttle to be held laterally in its place in the machine by a spring of sufficient rigidity to prevent its escape, and at the same time to permit the shuttle to move loosely during the greater part of its movement, so that the loop of needle-thread may pass freely over it. This part of my invention consists of the combination of the shuttle with a spring-holder at one side of it, and with a stop which prevents the spring-holder from bearing against the side of the shuttle when it is in its proper position in the machine. The object of the fourth part of the invention is to maintain the shuttle point, at the time it is passing by the needle for the purpose of entering the loop of needle-thread, always in the same position, so as to insure the seizure of the loop of needle-thread by the shuttle, while at other times the shuttle is held loosely. This part of the invention consists of the combination of the block or the equivalent instrument which holds the shuttle in place upon one side, with a shuttle guide so arranged at the opposite side of the shuttle, that it guides the shuttle only when its point is in the vicinity of the needle, leaving it free during the remainder of its movement. The object of the fifth part of the invention is to facilitate the movement of an oscillating shuttle by a reciprocating instrument; and it consists of the combination of oscillating shuttle drivers with a reciprocating connecting rod, and a spring acting crosswise to said rod, so that the shuttle drivers and shuttle are moved from the extremities of their ranges of motion towards the centres thereof, by a force which is made up of the force exerted by the connecting rod in the direction of its length and the force exerted crosswise to that direction by the spring. The sixth part of my invention has reference to the taking up of the slack needle thread left after the passage of the shuttle through the loop presented to it by the needle, and its object is to insure the tightening of the stitch. This part of my invention consists of the combination of the needle-holder and reciprocating shuttle with a vibrating take-up lever (or its equivalent) operated by a cam, (or its equivalent,) and a spring, in such manner that the

take-up lever yields up slack during the entrance of the loop of needle-thread by the shuttle, but resists the complete extension of the loop of needle-thread by the shuttle, and thereby enables the latter to draw the last stitch of needle-thread tight to the material. The object of the seventh part of the invention is to deliver the thread to the thread-tension apparatus, or thread tension as it is commonly called, without strain upon it, whatever be the varying resistance which the spool of needle-thread offers to unwinding. This part of my invention consists of the combination of the standard or other support for the spool, and the thread tension, with a thread-slackening mechanism arranged between the spool support and the thread tension, and operating to withdraw the thread from the spool and deliver it in a slack loop to the thread tension. The object of the eighth part of the invention is to enable both the direction in which the feeding instrument operates to be reversed, and the extent of its movement in either direction to be varied, by the change of posture of the same instrument. This part of my invention consists of the combination of the feeding instrument and a bar reciprocating crosswise to the movement thereof, with a turning regulating plate having its slot extended across the centre on which it turns, in such manner that both the direction in which the feeding instrument operates, and its extent of motion may be varied by changing the posture of the said regulating plate by turning it on its centre. The object of the ninth part of the invention is to enable the operator to regulate the length of the feed when reversing its direction without examination by the eye; and it consists of the combination of the reversing and regulating lever, or its equivalent, that controls the feed mechanism, with two adjustable stops which limit its movement in opposite directions, so that the feed may be reversed and the extent of feed determined by moving the regulating and reversing lever from one stop to the other.

The sewing machine which I have represented in the accompanying drawings as an exemplification of a convenient mode of embodying my improvements, is like in its general arrangement many machines now in use; it has a horizontal table plate, A′, to support the material to be sewed, a vertical reciprocating needle-bar, H, to carry an eye pointed needle, to thrust it downwards through the material and to withdraw it therefrom, and it is provided beneath the table plate with a shuttle, Z, to interloop a second thread with the thread thrust through the work by the needle. The needle-bar or carrier, H, is supported in guides at the end of a needle arm, C, which is mounted upon the bed plate, A, of the machine; and this needle-bar is driven by a revolving crank wrist, *a*, which projects from the face of a disk, G, secured to a revolving shaft, D, and works in the groove of a transverse cam, *b*, secured to the needle-bar; so that the revolution of the shaft, D, causes the needle-arm to rise and descend in alternate succession, thereby thrusting the needle downward through an opening or throat formed in the table plate of the machine for its passage and raising it therefrom. The shuttle, Z, is thin and broad, and is supported edgewise in the machine; it has a curved point, *a′*, to enter the loop of needle-thread; and is provided with a flat spool or bobbin, *g*, figs. 14 and 15, upon which the shuttle thread is wound. The shuttle, when the machine is at rest, is supported by two drivers, *f* and *f′*, (shown in dotted lines in figs. 5, 6, 7, and 8,) which project from the face of a disk or hub, B′, that is secured to a shaft, D′. This shaft is caused to rock by connecting it by means of a connecting-rod, C′, with a slide, E′, to which a reciprocating movement is imparted from the wrist of a crank, S, (secured to an upright shaft, J,) by means of a connecting-rod, F′. The upright shaft, J, is connected with the needle-shaft, D, by means of mitre wheels, G′ G′, so that the needle and shuttle are caused to work in harmony; and the motions are so timed that the needle rises slightly before the point of the shuttle is caused to pass its line of motion, so that the needle-thread is caused to spread laterally from the needle for the entrance of the point of the shuttle as is customary in shuttle machines. The shuttle is so broad that its lower edge extends downwards to the axis of the rock-shaft, D′, or thereabouts; hence when the shaft, D′, of the shuttle drivers rocks, the shuttle is caused to oscillate, and the axis upon which it oscillates, (which is the axial line of the rock-shaft, D′,) is at or near its lower edge. The shuttle is provided with a delivery eye, *s*, for the passage of the shuttle-thread from it, at or near this centre of oscillation, so that the length of shuttle thread extending from this eye to the work lying upon the table plate above is substantially always of the same length, whatever be the position in which the shuttle is placed by its drivers; consequently there is practically no slack of shuttle-thread formed by its reciprocating movement. The shuttle is guided vertically in its oscillation by a shuttle-race, Y, consisting of a curb projecting from a block, H′, which is arranged opposite to the face of the disk, B′, of the shuttle drivers, and maintains the shuttle erect upon one side, and in practice the movement of the shuttle is so rapid, and the radius of the curb is so small, that a sufficient amount of centrifugal force is generated to cause the upper edge of the shuttle to bear against the curb, thereby keeping its front and rear alternately out of contact with that one of the drivers which precedes it in its movement, and leaving a narrow space between that driver and the shuttle, open for the passage of the loop of needle-thread. The delivery eye, *s*, by which the shuttle-thread passes from the shuttle, is arranged at one side of the plane in which the point of the shuttle moves, so that the thread extends from the seam formed upon the table plate above to the shuttle eye in a line which diverges both from the plane of movement of the shuttle point and from the line of movement of the needle point; hence the thread is not within the range of motion of either the shuttle point or the needle point, and consequently does not interfere with the former and is not liable to be split by the latter. The delivery eye may be at either side of the shuttle point, but I prefer to arrange it at the side thereof, which is furthest from the disk, B′, from which the shuttle drivers project. The requisite tension upon the shuttle thread is obtained by passing it through one or more of a series of holes, *g²*, formed in the shuttle case before it is passed through the guide hole, *s*, by which it leaves the shuttle. The shuttle is held edgewise in its place during the greater part of its movement by means of a spring, *h*, which is secured to the disk, B′, of the shuttle drivers and oscillates with them, but the range of motion of this spring holder towards the adjacent side of the shuttle is limited by a stop, *i*, secured to the driver disk, B′, so that the acting face of the spring holder is not permitted to approach the face of the block, H′, at the opposite side of the shuttle, nearer than a distance predetermined by the position of the stop and this

is a little greater than the thickness of the shuttle added to twice the thickness of the coarsest needle-thread which the machine is adapted to use; hence the shuttle is left loose in its place during the greater part of its movement, and neither the spring-holder, *h*, on one side, nor the block, H′, upon the other, offers an impediment to the free passage of the loop of needle-thread. When, however, the shuttle tends to escape laterally from its proper position by bearing the spring-holder, *h*, outward from the stop, such escape is resisted by the full force of that spring-holder. It is desirable that the shuttle point should always occupy precisely the same position at the time its point is entering the loop of thread carried by the needle in order that it may enter this loop with certainty. This result is attained by means of a shuttle guide, *j*, which projects upwards at one side of the track of the shuttle in a position to bear against one of its sides and press the opposite side of the shuttle closely against the face of the block, H′, for a short period while the shuttle point is passing the needle and entering the loop of needle-thread; as however, the shuttle guide is arranged to act upon the butt of the shuttle while it is in the vicinity of its most backward position, the shuttle is in contact with it for but a very small fraction of its movement, while during the remainder of its movement it is loosely held by the spring-holder, *h*, consequently the requisite precision of movement is obtained to insure the entering of the loop of needle-thread, while at other times the friction of the shuttle against the parts of the machine which hold it in place is but slight. The shuttle is caused to oscillate a distance of about a third of a revolution, which requires the connecting-rod C′ and the pin *n* of the driver disk, while at the extreme points of their strokes, to approach the straight line drawn through the pin *n′* of the slide E′ and the axis of the driver rock-shaft. In order to ensure the smooth working of the parts, notwithstanding this proximity, a spring *m* is so applied to the slide E′, beneath the connecting-rod C′, as to bear against the under side of the latter and force it upward, while at and near the extremities of its stroke in each direction; hence the force, which tends to move the shuttle-drivers and the shuttle towards the centres of their ranges of motion from the ends thereof, is the resultant of the forces imparted in the direction of the length of the connecting-rod C′ by the slide, and in a direction crosswise to the connecting-rod, by the spring *m*; and as the said resultant approximates to a tangent of the circular arc in which the pin *n* of the driver-disk moves, the oscillation of the shuttle is effected with great ease, notwithstanding the large angular distance which it traverses. As the passage of the oscillating shuttle through the loop of needle-thread greatly extends that loop, and leaves a considerable slack to be drawn up before the stitch can be tightened, a thread take-up is applied to the machine to draw up the slack of the needle-thread at each stitch. This take-up consists of an arm P, which is pivoted to the needle-arm C, is provided at its end with an eye *q*, through which the needle-thread is passed, and is caused to vibrate by means of a cam F (formed on the inner face of the disk G of the needle crank-pin) and a spring *l*. The needle-thread passing from the thread tension M, (which is one of a well-known construction,) is passed through an eye *q′* formed in the upper end of the slide J′ of the presser-foot; it is then passed through the eye *q* of the take-up, and is returned through the eye of the slide J′, before being conducted down the front of the needle-bar to the needle-eye. The cam F operates upon a projection O, secured to the arm P, and as the thread is doubled through the take-up, the cam F has only sufficient projection to move the upper end of the take-up arm half the length of the slack thread to be taken up. The acting face of the cam is also shaped in such manner as to permit the slack to be rendered up by the take-up arm, and drawn back as the movement of the shuttle requires, without leaving an excess of slack at any time, and without holding the thread too tightly. The spring *l* operates upon a pin *r*, projecting from one side of the take-up arm, and is arranged to operate in both directions, so that when the take-up arm stands at about the middle of its stroke, the spring exerts no force upon it; hence while the needle is entering the material, and while the shuttle is extending the loop of needle-thread after first seizing it, the spring *l*, tending to move the upper end of the take-up arm forward, gives up slack without exerting a strain upon the needle-thread; but when about half the slack has been yielded up, the spring begins to resist the further movement of the take-up arm, and thus causes the loop of needle-thread around the shuttle to hug it closely, thereby permitting the shuttle to draw the last stitch of needle-thread tight to the work. The fixed end of the spring *l* is formed into an eye, and is secured by a screw *p*; hence the position of the spring may be adjusted, (by slacking and retightening the screw,) to cause it to exert more or less force upon the needle-thread when the shuttle is extending the loop to its utmost limit, thereby adapting the strain to the greater or less fineness of the needle-thread. The needle-thread is supplied from a spool N, supported upon a standard I′ secured to the needle-arm, and is drawn from this spool by a positive mechanism which I term a thread-slackener, so that it is delivered to the thread tension under the same strain at all times, notwithstanding the difference in the diameters of the mass of thread on the spool at different times. The thread-slackener in the present case consists of a projection K, secured to the driving-shaft D of the needle-bar, and the thread from the spool is passed through an eye *t* above the shaft, thence around the shaft and the projection, and is then returned upwards through an eye *t′*, above the shaft, so that the thread surrounds the projection in a loop. The thread from the last eye, *t′*, is conducted through a spring, nippers L, and is then applied to the thread tension M. The spring nippers L consists of a movable jaw *u*, pressed by a spring *v* towards a fixed jaw *u′*, so as to offer a greater resistance to the drawing of the thread backwards towards the spool than the spool offers to the pulling of thread from it by reason of its friction upon the base on which it rests and upon the standard I′. The drawing of the thread into the seam by sewing, lessens the size of the loop surrounding the shaft D and its projection K, and the depression of this projection by the turning of the shaft D tends to expand the loop, and, as the thread is prevented from drawing backwards from the nippers, the quantity required to make the loop large enough to permit the projection K to turn in it is drawn from the spool. The projection K is so arranged relatively to the needle crank-wrist *a*, that it draws the thread from the spool in the intervals between the periods when the needle draws thread from the tension. The revolving projection K thus slackens the thread, so that it hangs in a loop and passes to the tension without material strain upon it, whatever be the resistance

of the spool to unwinding. In order that the thread entering the nippers may not escape them, I find it expedient to pass it first over a soft surface, such as a piece of cloth, *w*, applied to the needle-arm, and then partly around a pin *x*. I also groove the edges of the stationary nipper-jaw *u'*, at each side of the place where the movable jaw nips the thread. It will be perceived that the thread-slackener above described does not measure out a precise length of thread at each movement, but simply pulls it suddenly from the spool; and as the latter may turn (by reason of the sudden pull) a distance sufficient to deliver thread enough to form several stitches, the thread-slackener does not necessarily operate upon the thread at each stitch, but only when the loop of needle-thread that hangs loose between the spool and the thread tension becomes too small to permit the movement of the slackener. The material to be sewed is moved forward at intervals by means of a toothed feed-bar P', whose head moves in an opening in the table-plate of the machine, and is moved upward against the under-side of the material, when it is to be fed by means of a cam *z*, projecting from the rim of the disk B' of the shuttle-drivers; when the feeding is completed, this cam *z* permits the toothed head of the feed-bar to descend in the opening of the table-plate. The feed-bar is caused to move horizontally by means of the lateral movement of a bar Q, to which a reciprocating movement in the direction of its length is imparted by connecting it with a lever R, moved in one direction by a cam secured to the upright shaft J, (as represented in dotted lines in fig. 8,) and in the opposite direction by a spring *b'*, which bears against the lever and operates antagonistically to the cam. The lateral movement of the reciprocating bar is effected by causing a pin projecting from its upper side, and represented in dotted lines at *a'*, fig. 3, to move in an inclined slot formed in a plate U; and the reciprocating bar Q is connected with the feed-bar P' by means of a longitudinal slot *d'* in the former, embracing a pin *g'* projecting from the latter. It is a great advantage in a sewing machine to be able to change the direction in which the feed moves the material, so that the seam may be reversed upon itself, or that sewing may be done in opposite directions, without the necessity of turning the work around the needle. It is also essential that the feed mechanism should be readily adjustable, so as to vary the length of the stitches. In order that such reversal and variation may be effected in the machine I am describing, the plate U has the form of a disk, and is arranged to turn upon its centre, in the socket in which it is set; and its slot, as represented in dotted lines in fig. 8, extends diametrically across the centre on which it turns, so that it is at both sides of that centre. The plate has an ear, *g'*, projecting from it, which is connected by a rod V, with a regulating lever W, one end of which is pivoted to the bed-plate of the machine, while its other end protrudes through an opening in the bed-plate, so that it may be moved by the operator to cause the plate U to turn in its socket, and thus change the direction of its slot relatively to the length of the reciprocating-bar Q. When this regulating lever is placed in the central position represented by the dotted lines W', in fig. 3, the slot of the plate U is in line with the reciprocating-bar, and consequently guides that bar by acting on its pin *a'* wholly in the direction of the length of the bar; and as the slot *d'* of the bar (which operates upon the pin of the feed-bar) also extends in the direction of its length, the movement of the reciprocating-bar Q, by its cam, then imparts no movement to the feed-bar P'. When, however, the plate U is turned by the lever W, so that the slot is inclined to the length of the reciprocating-bar Q, in the direction represented in black dotted lines in fig. 3, the movement of the reciprocating-bar, by the cam, will cause its pin, while moving in the slot of the plate U, to travel towards one side, m^1, of the machine, and, consequently, to feed the cloth in that direction. When the plate U is so turned by the lever W, that the slot is inclined to the length of the reciprocating-bar, in the opposite direction, as represented by the red dotted lines in fig. 3, the movement of the reciprocating-bar Q, by the cam, will cause its pin, while moving in the slot of the plate, to travel towards the side, m^2, of the machine, and, consequently, to feed the cloth in that direction, which is the reverse of the previous direction. The plate U is arranged, in the present case, to turn in either direction until its slot makes an angle of about 45° with the direction of the length of the reciprocating-bar Q, and the cam is of sufficient size to impart the greatest required movement to the feed-bar, when the plate is turned to these extreme positions; when the plate is turned to some intermediate position between its two extremes, the feed will be less, and the direction of the feed will be in one direction, or the reverse, according as the regulating lever W is set to one or other side of its central position. Hence, the plate U is a regulating plate, for regulating both the direction and extent of the feed, and the mechanism above described permits the direction of the feed to be reversed, and its extent to be regulated, by the movement of one instrument, (the regulating plate,) by the application of the hand of the operator to the regulating and reversing lever W, which controls the feed mechanism; this lever may be secured directly to the regulating plate U, although this is not expedient, as it would then be covered by the material. When the feed is reversed, it is frequently desirable that the operator should be able to set the feed mechanism so as to feed the material exactly at the same rate in the reversed direction as it was fed before reversing. In order that this may be effected without the necessity of examining the machine at the time of reversal, two stops, N', are applied to a gauge-bar M', which is secured transversely beneath the regulating and reversing lever W, so as to limit the movement of that lever in either direction. The stops are secured to the gauge-bar independently of each other, by means of screws *h'*, whose stems pass through slots in the stops, so that the stops may be set at any required distance from the central position of the lever W, when the screws are slacked, and may be secured by screwing up the screws. When the stops are thus set at equal distances on opposite sides of the central position of the lever W, the extent of feed will be equal in opposite directions, when the lever is moved alternately in contact with each stop. As, however, the stops are independent of each other, they may be set at different distances from the central position of the lever W, and then the extent of feed will be different in opposite directions, when the lever is alternately brought in contact with the stops. The operator thus has it in his power, by setting the stops, to determine the rate of feed in each direction; and when the stops have been set for a particular lot of work, the operator need not examine the lever W when he reverses the feed, as the stops form a better guide for its position than the eye.

Having thus described a sewing machine which embodies all my improvements, what I claim as my invention, and desire to secure by Letters Patent, is—

1. The combination in a sewing machine of the following instrumentalities, viz., the reciprocating needle-carrier, and an oscillating shuttle having its delivery eye coincident with its centre of oscillation, substantially as set forth.

2. The shuttle, oscillating substantially as described, having a delivery-eye arranged at one side of the plane of oscillation of the shuttle point, substantially as set forth.

3. The combination in a sewing machine of the following instrumentalities, viz., the shuttle-spring-holder, and stop for the spring-holder, substantially as set forth.

4. The combination in a sewing machine of the following instrumentialities, viz., the block for holding the shuttle in place at one side, and a shuttle-guide for holding the shuttle at its other side, so arranged that it guides the shuttle only when its point is in the vicinity of the needle, leaving it free at other times, substantially as set forth.

5. The combination in a sewing machine of the following instrumentalities, viz., the oscillating shuttle-drivers, reciprocating connecting-rod, and spring acting crosswise to said rod, substantially as set forth.

6. The combination in a sewing machine of the following instrumentalities, viz., the needle-holder, oscillating shuttle, take-up lever, cam, and spring, substantially as set forth.

7. The combination and arrangement in a sewing machine of the following instrumentalities, viz., the spool-support, thread-tension and thread-slackening mechanism, substantially as set forth.

8. The combination in a sewing machine of the following instrumentalities, viz., the feeding instrument, bar reciprocating crosswise to the movement of said instrument, and turning slotted regulating plate, with its slot extended at opposite sides of the centre on which it turns, substantially as set forth.

9. The combination in a sewing machine of the following instrumentalities, viz., the reversing and regulating lever that controls the feed, and two stops, substantially as set forth.

In testimony whereof I have hereunto set my hand this sixth day of October, 1865.

ISAAC MERRITT SINGER.

Witnesses:

J. T. JONES,

BENAYAH LEFFINGWELL.