5 Sheets—Sheet 1.

E. TIFFANY.

KNITTING-MACHINE.

No. 188,441. Patented March 13, 1877.

SHEET 1.

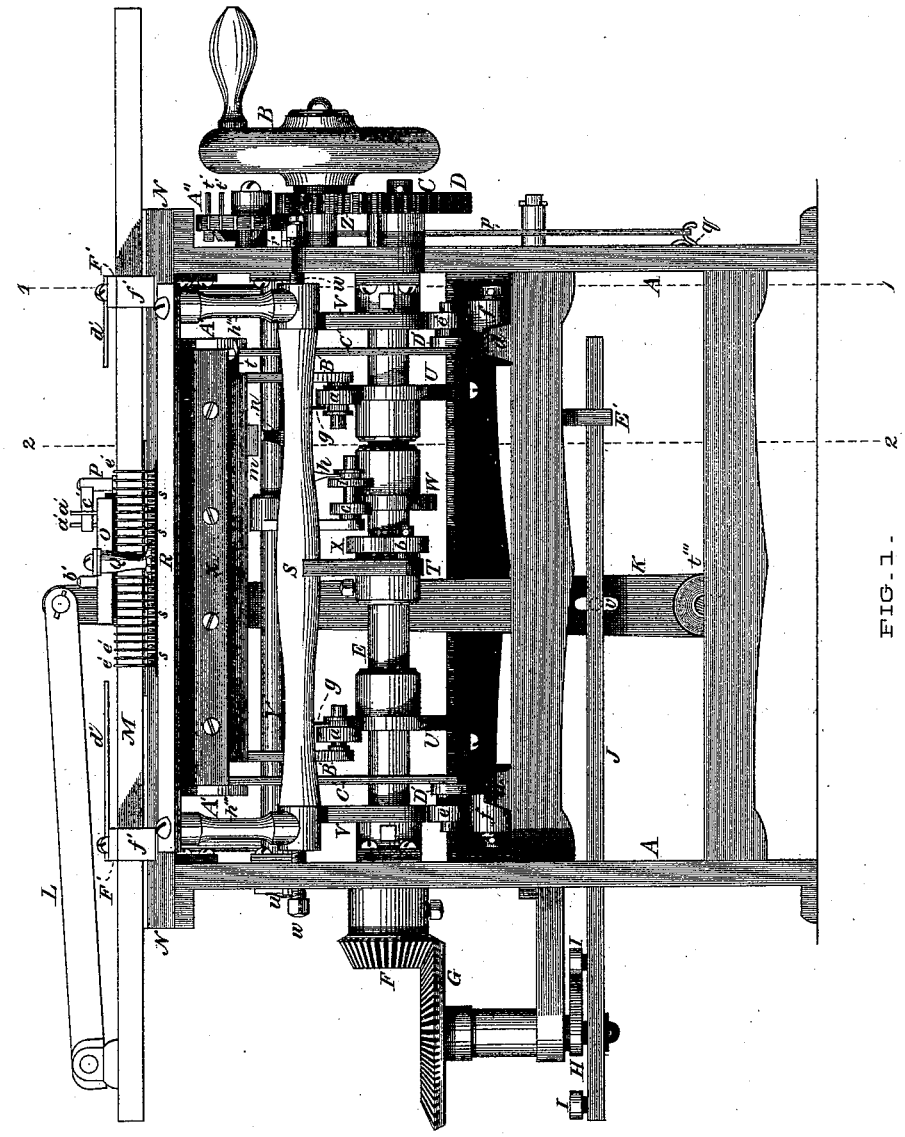

FIG. 1.

WITNESSES,

H. W. Gifford

Richard Welch

INVENTOR,

Eli Tiffany,

by his Attorney,

Franklin Scott

5 Sheets—Sheet 2.

E. TIFFANY.

KNITTING-MACHINE.

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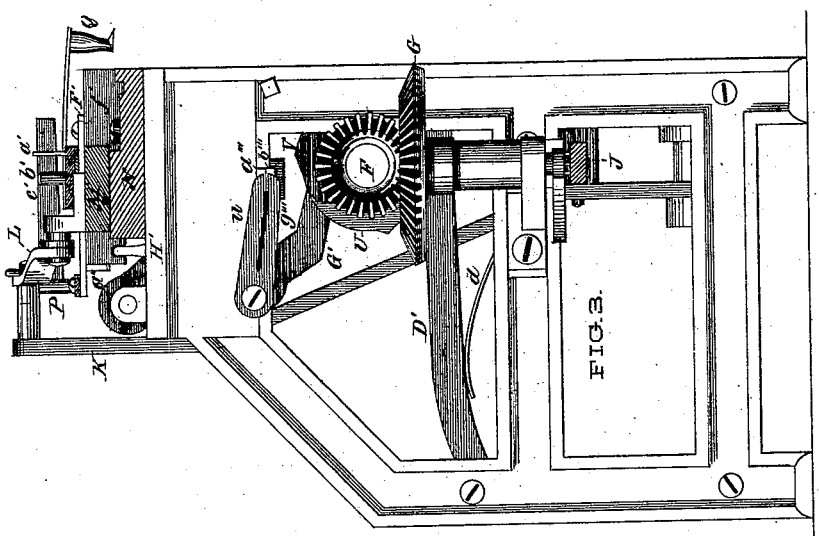

FIG. 3.

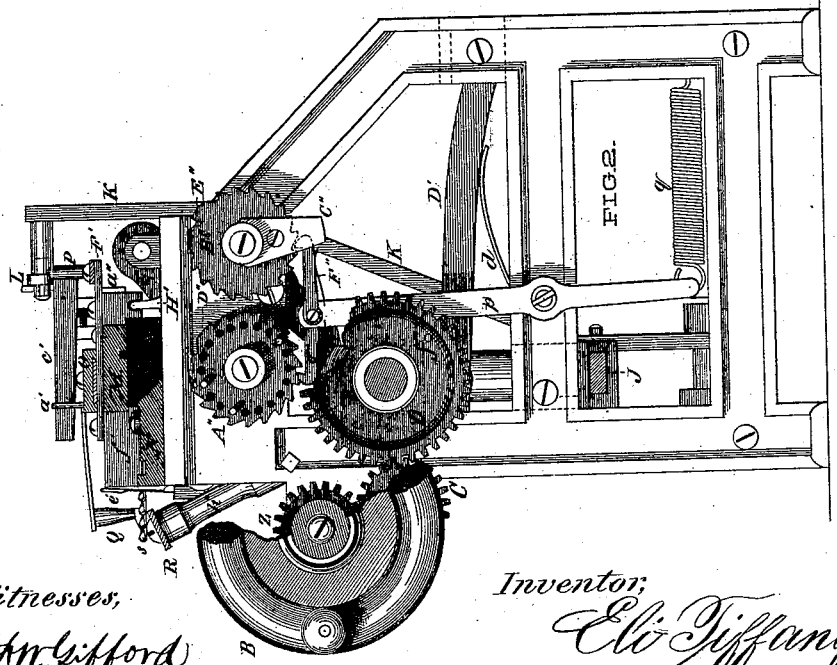

FIG. 2.

Witnesses,

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Franklin Scott.

5 Sheets—Sheet 3.

E. TIFFANY.

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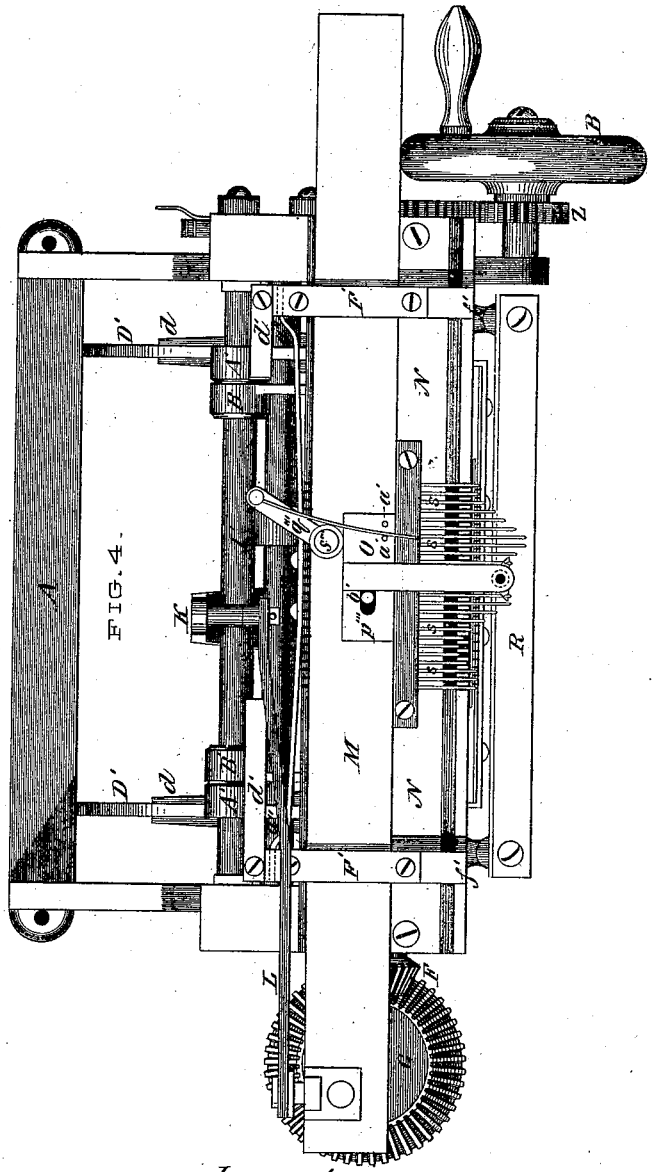

FIG. 4.

Witnesses,
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Franklin Scott

5 Sheets—Sheet 4.

E. TIFFANY.

KNITTING-MACHINE.

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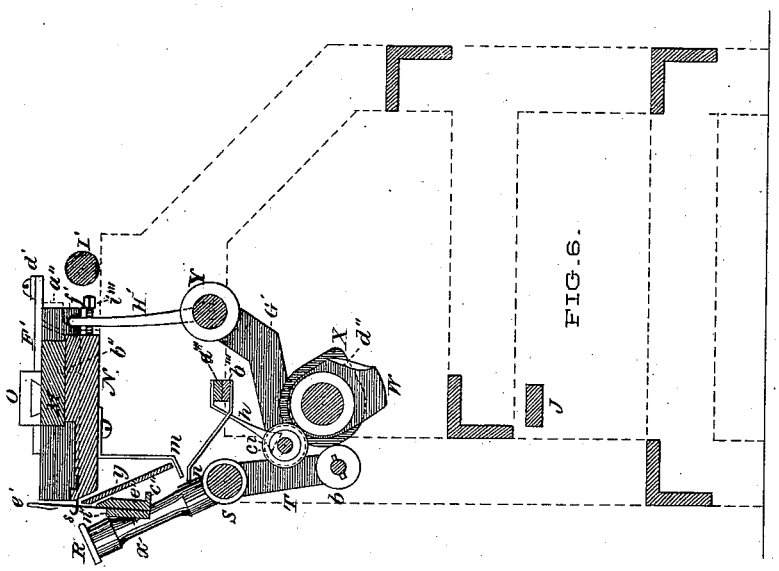

FIG. 6.

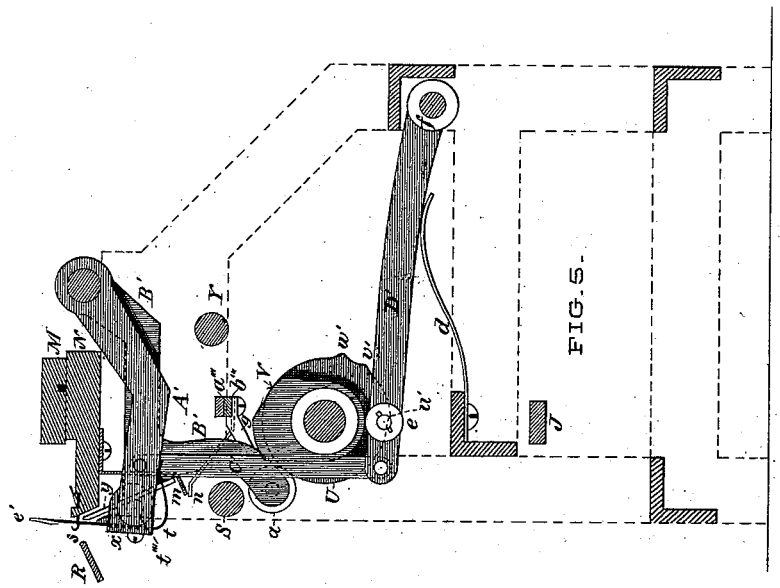

FIG. 5.

Witnesses,

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Franklin Scott.

5 Sheets—Sheet 5.

E. TIFFANY.

KNITTING-MACHINE.

No. 188,441. Patented March 13, 1877.

SHEET 5.

FIG. 7.

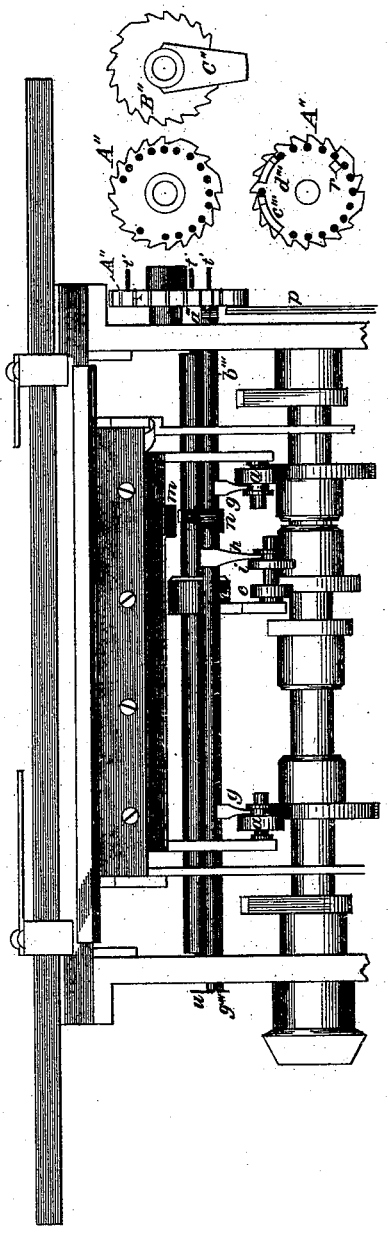


FIG. 10.

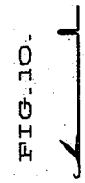


FIG. 8.

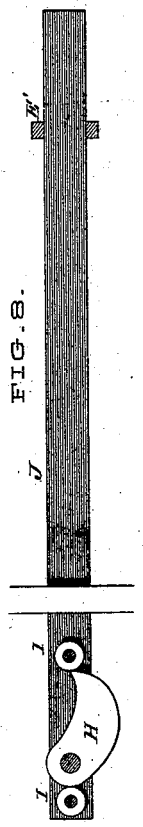
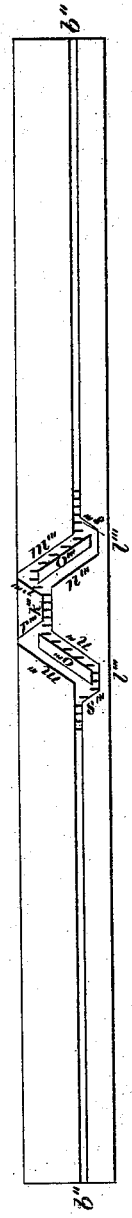


FIG. 9.



Witnesses,

F. W. Gifford
Richard Welch

Inventor,

Eli Tiffany,
by his Attorney,
Franklin Scott.

UNITED STATES PATENT OFFICE.

ELI TIFFANY, OF BENNINGTON, VERMONT, ASSIGNOR OF ONE-HALF HIS RIGHT TO CHARLES COOPER, OF SAME PLACE.

IMPROVEMENT IN KNITTING-MACHINES.

Specification forming part of Letters Patent No. **188,441**, dated March 13, 1877; application filed July 8, 1876.

To all whom it may concern:

Be it known that I, ELI TIFFANY, of the town of Bennington, in the county of Bennington and State of Vermont, have invented an Improved Knitting-Machine, of which the following is a specification:

This invention relates to that class of machines adapted to knit what are generally known as "flat ribs," which ribs are used as cuffs for knit shirts and bottoms for drawers.

Upon Sheet 1 of the drawings is exhibited a front elevation of my machine. Sheet 2 shows, in Fig. 2, an elevation of the right end of the machine, and Fig. 3 an elevation of the left end thereof. Upon Sheet 3 is exhibited a plan view of the top of the machine. Upon Sheet 4, in Fig. 5, is given a vertical cross-section of the machine, taken upon the line 1 1 of Fig. 1; and Fig. 6 exhibits another vertical section thereof, taken on line 2 2 of Fig. 1. On Sheet 5, in Fig. 7, is shown a front elevation of the upper part of the machine, with the presser-bar rock-shaft S removed. Fig. 8 is a view of the sliding bar which actuates the draw-lever K, with its attachments. Fig. 9 is a view of the under side of the slur-bar, and Fig. 10 is a view of one of the latch-needles.

Reference is herein made to the said drawings and to the several letters of reference marked thereon, which form a part of this specification.

This machine is operated by first casting onto the latch-needles, by means of attaching thereto a strip of knit cloth, a series of stitches, and appending to such cloth weights or their equivalents, to preserve the tension requisite for the knitting to progress properly. The machine is then started, the spring-needles being elevated, and the slur-bar, with thread-guide attached, traverses the latch-needles, in its passage paying into the hooks of the latch-needles, as they are successively presented to the thread-guide therefor, the yarn for the formation of the initial course of stitches. After the thread-guide, in its forward movement, has passed clear of the needle next immediately in its rear, such needle, by mechanism (hereinafter more particularly described) provided therefor, is caused to recede, and by such recessive movement draws the latch down as the same passes through the fabric or starting-piece previously alluded to, thus confining the yarn or stitch last fed in in the hook of the latch-needle, and, at same time, drawing the needle so far back that the starting-piece, or that part thereof first looped onto the latch-needle, is entirely cast off and drops or falls in rear of the knocking-over plate or bar. Simultaneously with this movement, the yarn so fed in is, by the recessive movement of the latch-needles, drawn in loops around the vertical spring-needles, passing alternately around the front of the stem of a spring-needle, and through the hook of a latch-needle, thus forming two adjacent ranks of stitches. The mechanism for drawing down the spring-needles then comes into play, and by such downward movement the rank of stitches so last formed thereon is drawn up under the barbs thereof. Upon the return of the spring-needles to their original elevated position, preparatory to a repetition of their movement, the stitch recently so held under the barb is, by the retractile power exerted by the take-up mechanism, relatively drawn down onto the stem or shank of the spring-needle, and there remains until the next depression of the spring-needle bar. Next in order comes a new traverse of the slur-bar, with a performance of the previously-described functions, after which the needle-bar is depressed a certain portion of its prescribed line of action to a point where its further progress is momentarily arrested, while the presser-bar is brought to bear on the barbs of the spring-needles, for the purpose of separating the old from the new stitch, and so as to allow the knocking-off bar at same time to shove the old stitch up over and outside of the barb preparatory to its being finally cast off by the knock-off bar at its next immediate movement, on the performance of which the old or outside stitch remaining on and near the top of the spring-needle will be entirely cast off. Slack courses are made by communicating to the latch-needles, by the mechanism more particularly described hereinafter, an extra recessive movement preceding the formation of the range of stitches which constitutes such slack course. Welts are formed by suspending the action of the spring-needles,

while three or any desired number of courses of stitches have been formed on the latch-needles, all of which are then at once cast off and the regular course of knitting resumed.

The points of invention especially elucidated in this case may be epitomized as follows: first, pivoting the arms to which the needle-bar and knocking-over bar are respectively attached on a common shaft or center, for the purpose of securing more perfect harmony and concert in their action; second, investing the slur-bar, which actuates the latch-needles, upon which the stitches are primarily formed, with a regular reciprocating transverse movement, for the purpose of tightening or closing up the work when the knitting is regularly progressing, and also with an additional backward movement, for the purpose of producing a slack course; third, the means provided for regulating the lead of the latch-opener and yarn-carrier, so that the leading point of the latch-opener shall be in its proper position with reference to the latch-needles in its forward or progressive movement, and with reference to the cam-grooves of the slur-bar, by which the latch-needles are actuated; fourth, the use of one and the same appliance, with its several attachments, for the purpose of throwing out of action the cams by which the spring-needle bar is actuated, and of locking or restraining from action such needle-bar during the formation of a welt.

The mechanism is mounted on a suitable frame, A, and motion is communicated to the main driving-shaft E through the driving-wheel B and train of gears Z, C, and D. Upon the left end of the shaft E is the bevel-gear F, which engages with and actuates the gear G, upon the lower end of the shaft of which is attached the draw-cam H. (Seen in plan in Fig. 8.) This cam rotates between the trucks I I, attached to the draw-bar J. Upon this draw-bar is a lug, which works in the slot *v* of the draw-lever K, which is pivoted to the frame A at *t'''*, and, through the pitman L, communicates a longitudinal reciprocating movement to the slur-bar M. Upon the shaft E, and nearest the frame, are the cams V V, which, in conjunction with the trucks *e e* on the levers D′ D′, connecting-rods C′ C′, and radial levers A′ A′, to the extremities of which the needle-bar *x* is attached, control and determine the downward movements of the spring-needles *e′ e′ e′*, the upward or return movements of which are effected by the springs *d d*.

Next in order, on the shaft E are arranged the cams U U, which, by their peculiar shape, in conjunction with the trucks *a a*, which are attached to depending arms of the radial levers B′ B′, communicate motion to, and regulate the movements of, the knocking-over bar or plate *y*, which is attached to the front extremities of the arms B′ B′. The said arms A′ A′ are hung by their rear ends upon the same shaft as the arms B′ B′ of the knocking-over bar, the two bars thus having their motion upon a common axis, which renders their co-operation with each other more perfect. The downward movement of the knocking-over bar *y* may be effected either by gravity, a spring, or any suitable mechanical appliance. The trucks *a a* are provided with a necking to receive the end of a spring shipping-clutch, *g g*. These clutches or shipping-springs are attached to a horizontal sliding bar, *b'''*, as seen in Fig. 7, which extends across the machine. The shippers *g g* are of themselves elastic springs, and are so made because the shipping movement of sliding bar *b'''* and the actual shipping of the trucks *a a* do not occur simultaneously. The bar *b'''* is first thrown into position; but the trucks do not follow suit until they have been released from contact with cams U U, which occurs after such cams have revolved to a point where, by reason of that part thereof which is of lesser diameter coming into juxtaposition with the trucks, contact between the two is destroyed, when the shipping of the trucks is effected by the force exerted on them by the springs *g g* alone. Motion is communicated to this bar by the cams *c'''* and *d'''* of the ratchet-wheel A″, which, in turn, is actuated by the pawl *e'''*, attached to the upper end of the oscillating lever *p*, as seen in Fig. 2.

During the formation of a welt it is essential that the action of the spring-needles should be suspended during a prescribed number of courses, the knitting meanwhile proceeding on the latch-needles alone. To the rear side of the spring-needle bar is attached the projecting lug or catch *c″*, and when the needle-bar is depressed by the cams to its lowest limit, the lug *c″* is carried to a position just opposite to, and beneath, the dependent stop *m*, and sufficiently below said stop *m* to permit the introduction therebetween of the projecting arm *n*, which is attached to sliding bar *b'''*. Now, while the knitting of the body of the cuff is progressing, said projecting arm *n* occupies a dormant position outside the path of reciprocal travel of lug *c″*; but when the moment arrives for the formation of a welt, the needle-bar having first been drawn down, lug *c″* being in position underneath the projection *m*, the sliding bar *b'''* is brought into action through the influence of the lug on the ratchet-wheel A″, and thereby projection *n* thereon is thrust between projection *m* and lug *c″*, and there remains until the cam on ratchet A″ has advanced in its course so as to release bar *b'''*, and thus leave spring *g'''* at the other end thereof free to thrust bar *b'''*, with arm *n*, out of action. The oscillating lever *p* depends for its movements upon a lug or pin, *f'''*, on the back side of the gear D, and the retractile force exerted by the spring *q*, attached to its lower end and to the frame A. The lever *p* is pivoted to the frame A, as seen in Figs. 1 and 2.

The cam W on the shaft E is constructed with a face of sufficient breadth to co-operate with two independent trucks, *c* and *i*, which revolve upon the same axis or stud. The truck *c* revolves in a fixed position as regards

lateral movement, but in constant contact with the edge or face of the cam W; but the other truck, *i*, is axially movable, which axial movement is regulated by the clutch *h*, which is attached to the sliding bar *a'''*, and receives its progressive movement from the cam projection *r* of the ratchet-wheel A'', and its opposite movement from the spring *u*, Figs. 3 and 7. The contours of both sides of the cam W are coincident, with the exception of a small portion of the periphery of the right side of cam W, upon which the truck *i* runs, (shown at *d''*, Fig. 6,) which is cut away to admit of the shipping of truck *i* from the position seen in Fig. 1 to a position over or opposite the right-hand edge of the cam W. This cutting away is made necessary from the fact that the trucks *c* and *i* are of different diameters. The function performed by the combination and co-operation of the cam W, trucks *c* and *i*, arm G', fulcrum-shaft Y, and arms H' H' is to communicate transverse reciprocating movements, through the sliding boxes *f' f'*, which guide the slur-bar M, to the horizontally-working latch-needles *s s s*. When knitting the body of a cuff or any plain knitting, the truck *c* alone is used, and the movement communicated through it, by means of the intermediate mechanism, to the sliding guide-boxes *f' f'* is determined by the shape of the cam, which is shown at W in Fig. 6, and is a regularly advancing and receding movement. By means of this movement the stitches are drawn up and the fabric made tight or loose, as may be desired. When a slack course is to be knit the truck *i*, by the mechanism before described, is brought into engagement with the cam W, and, by reason of its greater diameter, the entire system of the slur-bar and needles is carried and performs its functions a little farther back from the work, thereby elongating the loops and making a slack course. The extent of this transverse movement of the slur-bar is adjusted and regulated by means of the set-screw *i'''*, which passes through the upper part of the arm H', and finds a seat or abutment against the rear edge of the bed-plate N, as shown in Fig. 6. The cam X on the shaft E, acting through the truck *b* upon the arm T of the rock-shaft S, having arms *h''' h'''*, communicates the desired movements to the presser-bar R, the function of which is to depress the points of the barbs of the spring-needles *e' e' e'*, when such needles, in process of knitting, are drawn down by the action of the cams V V to an elevation where such points of the barbs, when so depressed, will separate the newly-formed loop or stitch from the one last previously formed, (both stitches still remaining on the spring-needle,) and, as a consequence, the last-formed or new stitch is retained under the barb, and the previously-formed or old stitch is left in position, on the completion of the downward movement of the spring-needles, to be cast off the needles by the action of the cast-off or knocking-over bar *y*.

The bed-plate N is firmly secured to the top of the frame A, and is transversely grooved for the reception of the latch-needles *s s s*. Near each end of the bed-plate a transverse way is cut, in which the sliding guide-boxes *f' f'* work. As before described, these boxes have an intermittent transverse reciprocating movement, the progressive part of which is produced by the action of cam W, and the recessive by the action of the spring *a''*, which is centrally attached to the bed-plate N, and has lateral arms, which reach out behind and impinge against the rear ends of the sliding guide-boxes, as seen at *a''*, Figs. 2, 3, and 4.

The latch-needles used in the machine are constructed as shown in Fig. 10, by bending up in the plane of the hook the rear portion of the wire which forms the needle, thus forming a shank, by the use of which, in conjunction with the grooves in the slur-bar M and guide-slots in the bed-plate N, the movements of the latch-needles are determined and controlled.

Fig. 9 shows the under side of the slur-bar M, a top view of which is seen in Fig. 4. This bar is provided with means for giving to the latch-needles during each traverse thereof two advancing and two receding movements, the extent and character of which may be seen by inspection of the position of the latch-needles in Fig. 4.

The position of the needles here shown is when the bar is moving from left to right. For the purpose of giving to the needles proper and like movements during the traverse of the slur-bar in both directions, I have constructed on the under side of the bar, at or near the center thereof, two sets of parallel diagonal grooves or ways, *m''' n''' m''' n'''*, the grooves of each of which pairs or sets are separated by the fixed abutment *o'''*, and having their angles of inclination, with respect to the edge of the slur-bar, opposed to each other, as shown. When the slur-bar is placed in position in the machine the shanks of the needles *s s s* enter and work in the grooves therein, and when, in moving from left to right, (presupposing all the latch-needle shanks to be lying in that part of the groove *b''* on the right of the cam-grooves,) the abutment *o'''* impinges against the needle-shanks, they are forced into the cam-groove *m'''*, and traverse that groove until struck by the cam-face *r'''*, when they are forced into the short rectilinear groove K'''. Here they are caught by the cam-face of the other abutment *o'''*, and forced by means thereof along the cam-groove *n'''*, into the short rectilinear groove *b'''*; thence, by means of the cam-face *s'''*, into the main groove *b''*, and, in like manner, vice versa for the return movement of the slur-bar.

In order to secure a proper and accurate operation of the latch-opener and feed-guide Q, it is apparent that at the end of each stroke of the slur-bar the position of the latch-opener should be shifted so as to correspond with the changed position of the needle-shanks in

their reversed or new path of travel through the diagonal grooves of the slur-bar. The action of the needles which the thread-guide has just passed is not the reverse of the action of those it is just approaching, and the advance of the needles during one movement of the slur-bar is by a different groove from that which retracted them in the previous movement; and adjustment thereto of the thread-guide and latch-opener is therefore necessary. To accomplish this purpose the latch-opener and feed-guide Q are attached to a head, O, which is adapted to slide on the slur-bar in a direction parallel with its line of movement. On the slur-bar is erected a stud, b', which protrudes through a slot, p''', in the head O, the free or open portion of which slot coincides with the distance between the centers of the diagonal cam-grooves m''' and n''', measured on a line parallel with the line of movement of said slur-bar. Upon the top of the head O are two pins or studs, a' a', between which oscillates a flat spring, c'. The rear end of this spring is rigidly fixed in a stud, P, erected on the outer end of a radial arm, q''', which is pivoted with a compressive spring at s''' onto the top of the slur-bar. To the rear end of the caps b' of the guide-boxes f' f' are attached the two projecting stops or abutments d' d', against which the stud P impinges just before the slur-bar M completes each traverse, and the remainder of the movement of the slur-bar necessary to complete its stroke before commencing a return movement is just sufficient to cause a reversal of the position of the radial arm q''' by thrusting it around in an opposite direction, so that the thrust of the spring c', instead of being exerted against one of the studs a', is transferred over to and is exerted against the other pin a', and, as a consequence, the head O, yielding to the force of the spring c', is moved longitudinally just the length of the free portion of the stop p''', or into position for the latch-opener to co-operate with the latch-needles in delivering the yarn thereto.

The needle-bar x is pivoted at its extremities to the front ends of the arms A' A', as shown at t''', Fig. 5, and the vertical position of the needles is maintained by the force of the spring t, attached to the bottom edge of the needle-bar, working against the under side of the lever or arm A'.

This arrangement of devices serves to keep the needles in a proper upright position, and to permit the needle-bar to accommodate itself to the changed position of the several parts resulting from the curvilinear direction or movement of the end of the arm A'.

The ratchet-wheels A'' and B'', together with the levers, pawls, and cams connected therewith, are commonly known as the "end tackle," and through their action the following results are attained, viz: the length of the web between the welts is determined, the mechanism for putting in the welt is brought into operation, and also the mechanism for putting in the slack course. The face of the wheel A'' is perforated with a circular range of holes, as shown in Fig. 7, for the insertion of the pins t' t'. Whenever a pin is inserted in one of these holes, one of the notches of the ratchet a certain distance in rear of the pin is filled up, as seen at D'' in Fig. 2, so as to neutralize the action of the pawl e'''. Upon the ratchet B'' is a projection, C'', which is designed to act upon the pins t' t' when moved around into position to do so. At a definite distance in rear of the projecting arm C'' a notch is filled up, as shown at E'', Fig. 2, which, when brought round into position, prevents the operation of the pawl F''.

The carrying of either of the ratchets forward so that its blind tooth may pass its pawl, and the action of the latter be re-established, is accomplished by the action of projection C'' of one upon a pin of the other, or the converse, for the arrangement of these two ratchets is such that no blind tooth of either of them can be brought into position opposite the hook of the pawl, so that the pawl will cease to propel the wheel, without the other wheel in its forward movement has been advanced so that its own blind tooth has passed the hook of the pawl by which it is actuated, so as to leave such pawl free to act upon the last-named wheel. Now the addition of a pin and the closing of a notch at the proper distance behind the said pin of the ratchet-wheel A'' will secure an additional complete revolution of the ratchet B'', the ratchet A'' remaining stationary meanwhile, and, as a consequence, just as many additional courses will be added to the web of the fabric being knit as there are teeth in the wheel B''.

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

1. The needle-bar x and knocking-over bar y, attached to the levers or arms A' and B', respectively, and pivoted on a common center, I, substantially as specified.

2. The described means for producing the transverse reciprocating movement of the slur-bar during the progress of the knitting between welts, consisting of the left edge of cam W, truck c, arm G', fulcrum-shaft Y, arms H' H', spring a'', and sliding boxes f' f', all combined and operating as described and set forth.

3. The described means for producing the extra transverse backward movement of the slur-bar for making slack courses, consisting of the right-hand edge of cam W, laterally-movable truck i, arm G', fulcrum-shaft Y, arms H' H', spring a'', and sliding boxes f' f', all combined and operating as described and set forth.

4. The described means of shipping the trucks a a, and locking down the needle-bar during the formation of a welt, consisting of the ratchet-wheel A'', cams c''' and d''', slid-

ing bar b''', projection n, lug c'' on needle-bar, and dependent projection m, combined and arranged substantially as specified.

5. The described mechanism for shifting position of the latch-opener at each stroke of the slur-bar, consisting of the sliding head O, stud b'', slot p''', oscillating arm q''', spring c', and abutments d' d', all arranged and combined substantially as set forth.

In testimony whereof I have hereto affixed my hand at Bennington, Vermont, this 1st day of July, A. D. 1876.

ELI TIFFANY.

Witnesses:
F. W. GIFFORD,
M. B. SCOTT.