

(No Model.)

3 Sheets—Sheet 1.

B. L. STOWE.
WARP KNITTING MACHINE.

No. 486,648.

Patented Nov. 22, 1892.

Fig. 1.

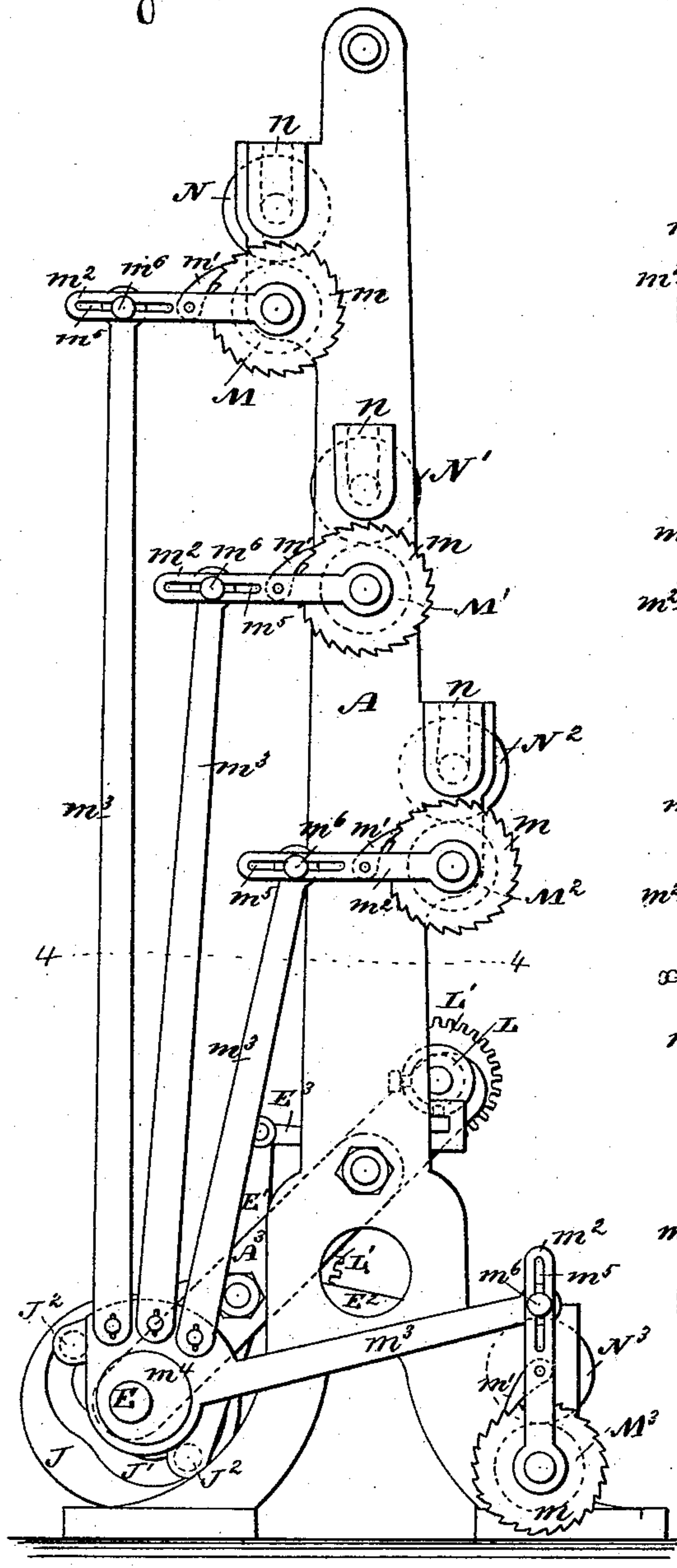
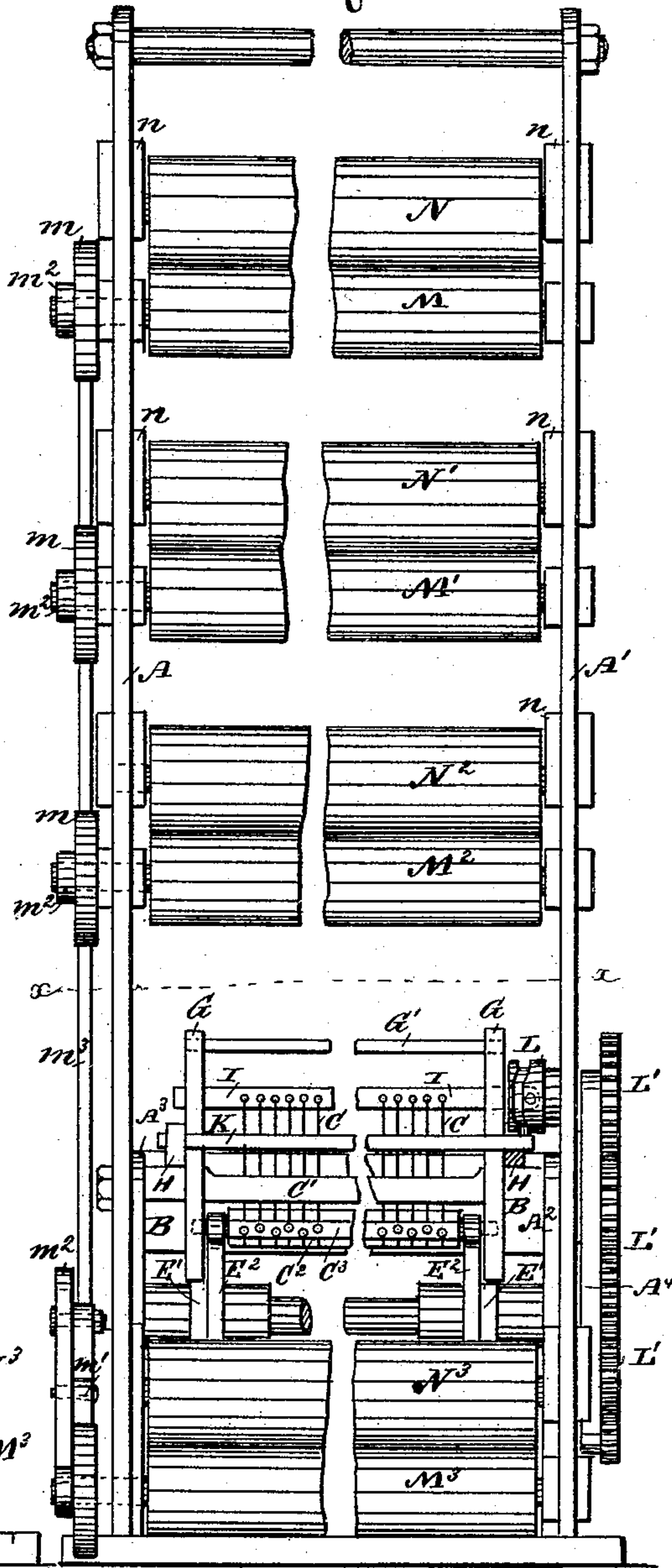


Fig. 2.



WITNESSES:

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INVENTOR

Benjamin L. Stowe

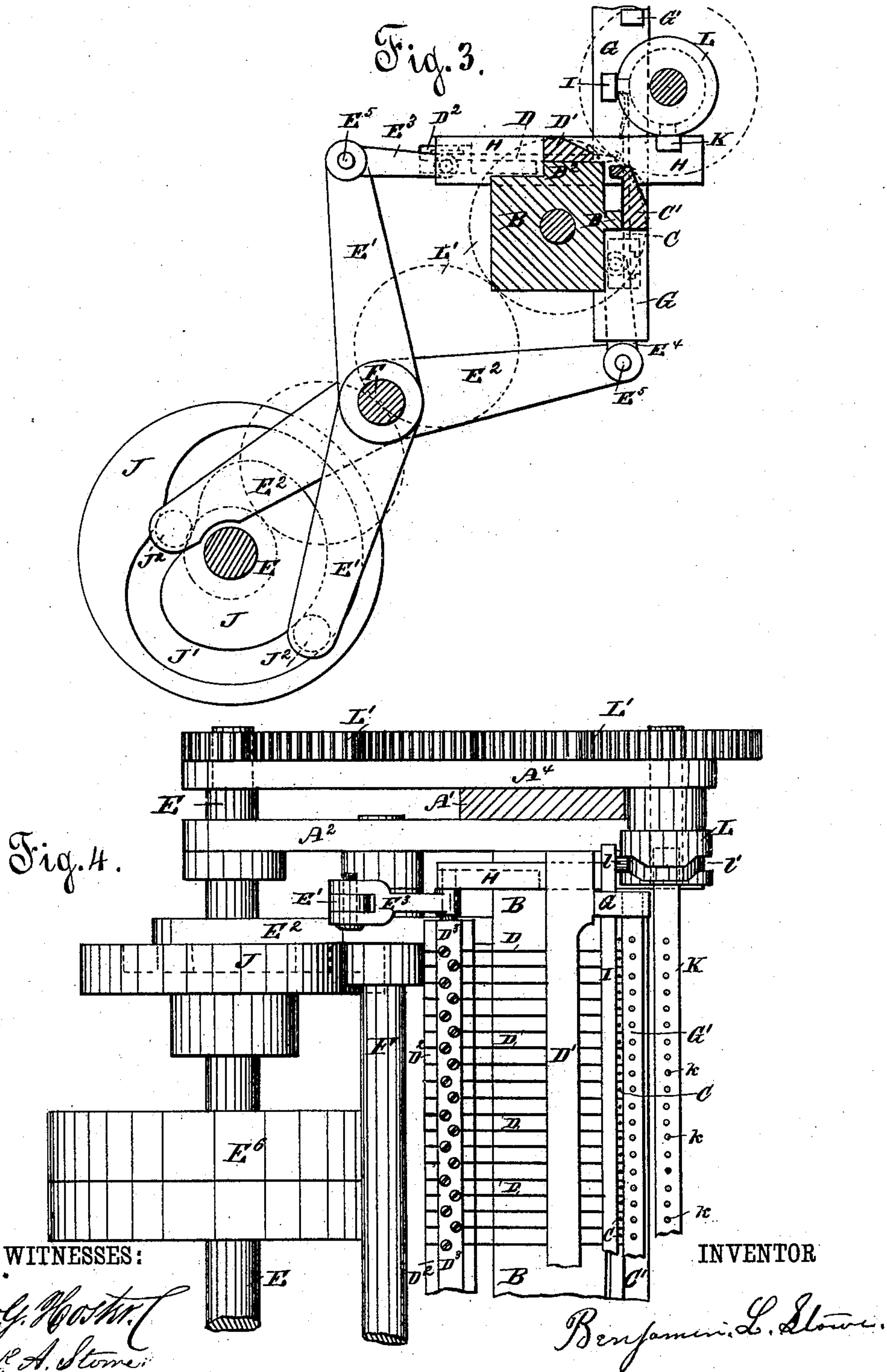
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3 Sheets—Sheet 2.

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3 Sheets—Sheet 3.

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Fig. 5.

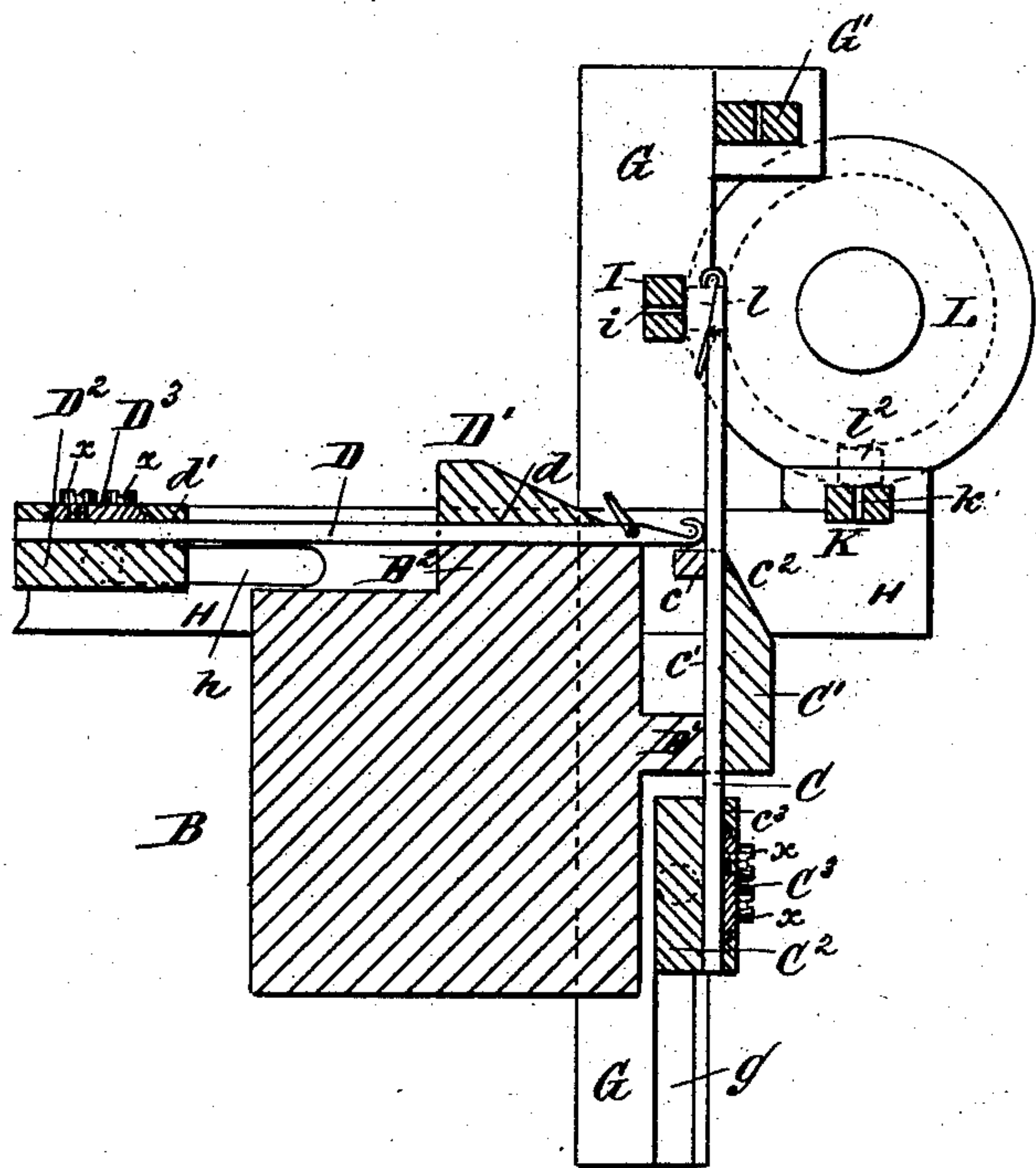
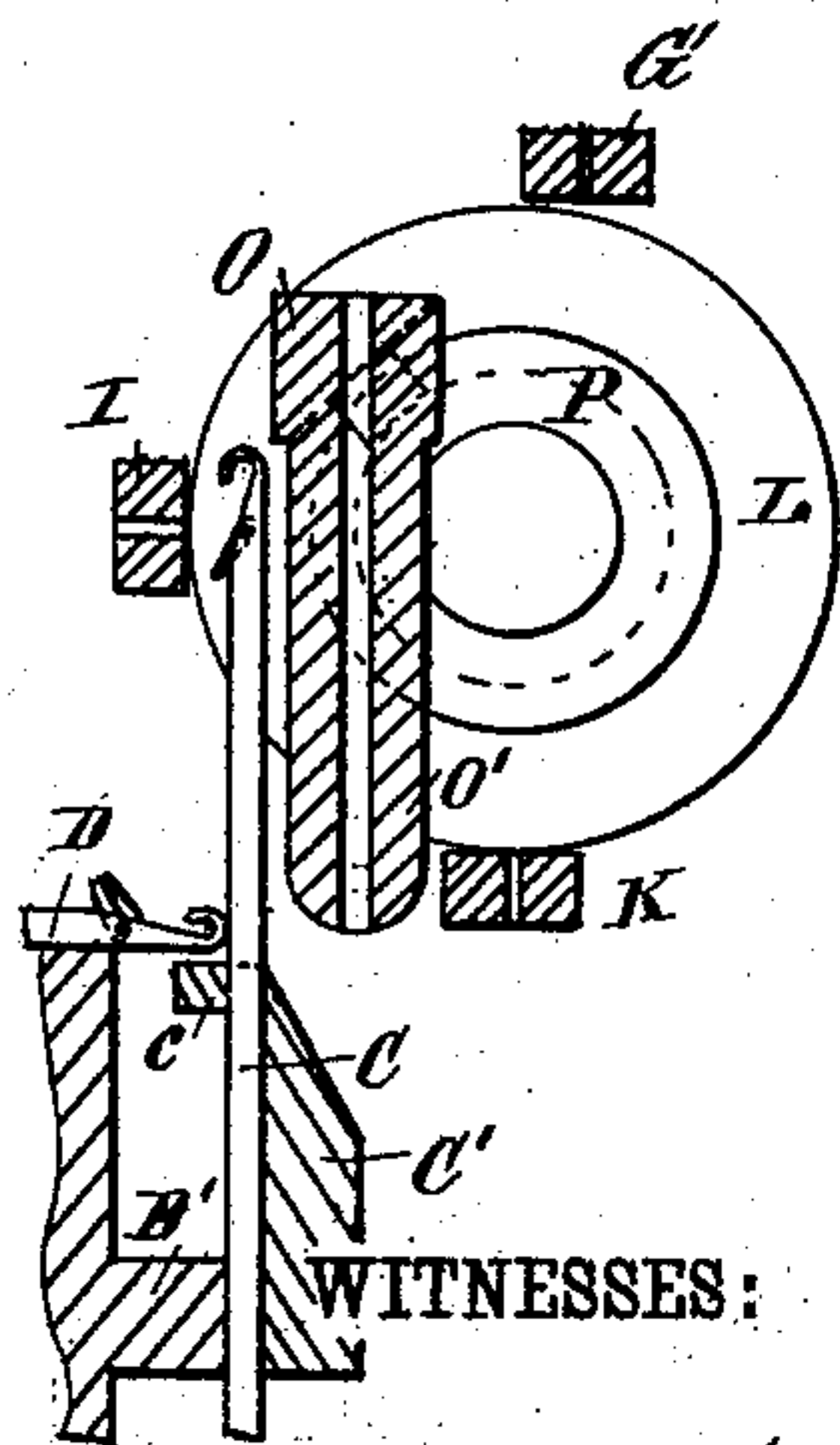


Fig. 6.



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Fig. 7.

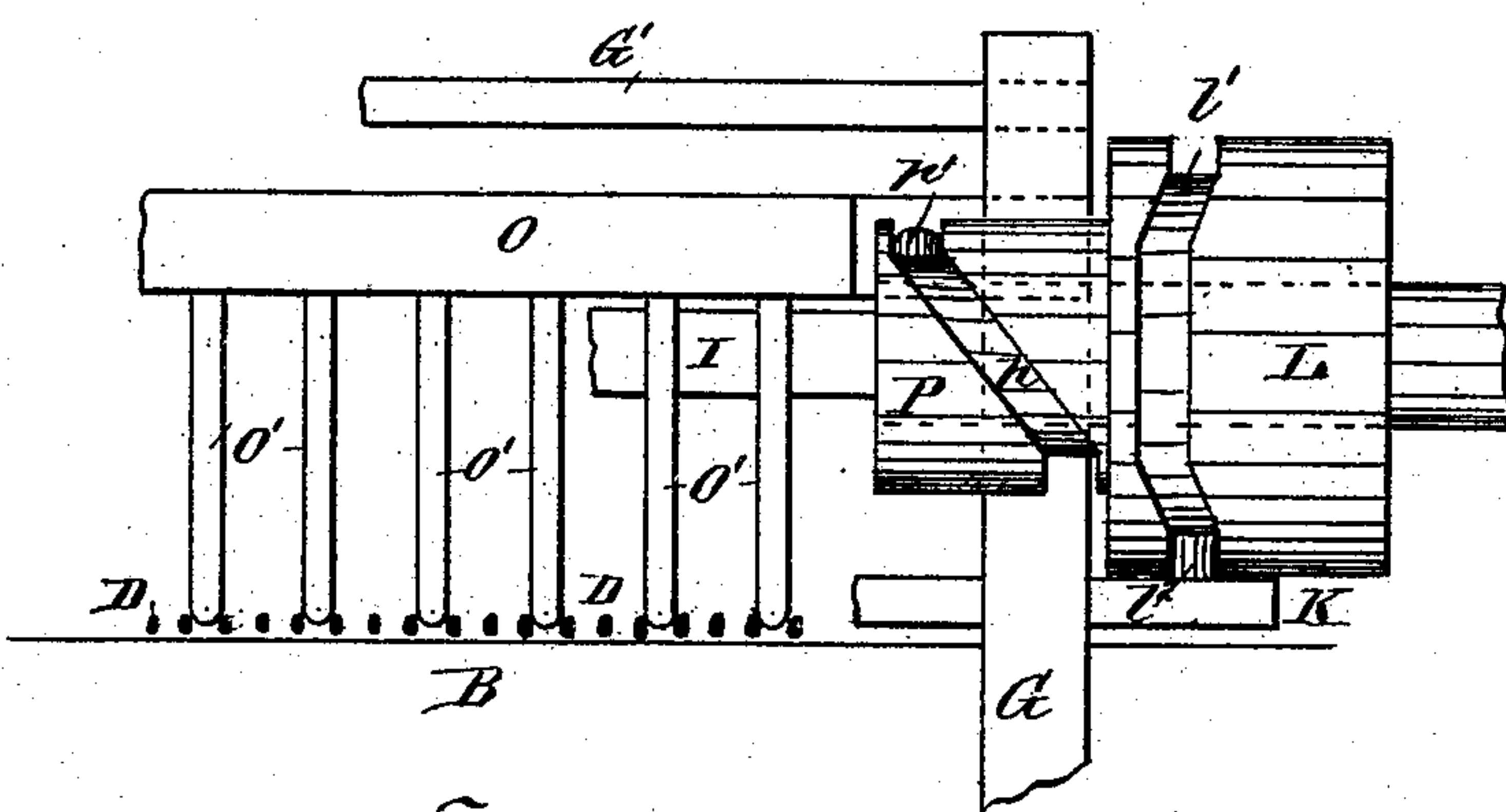
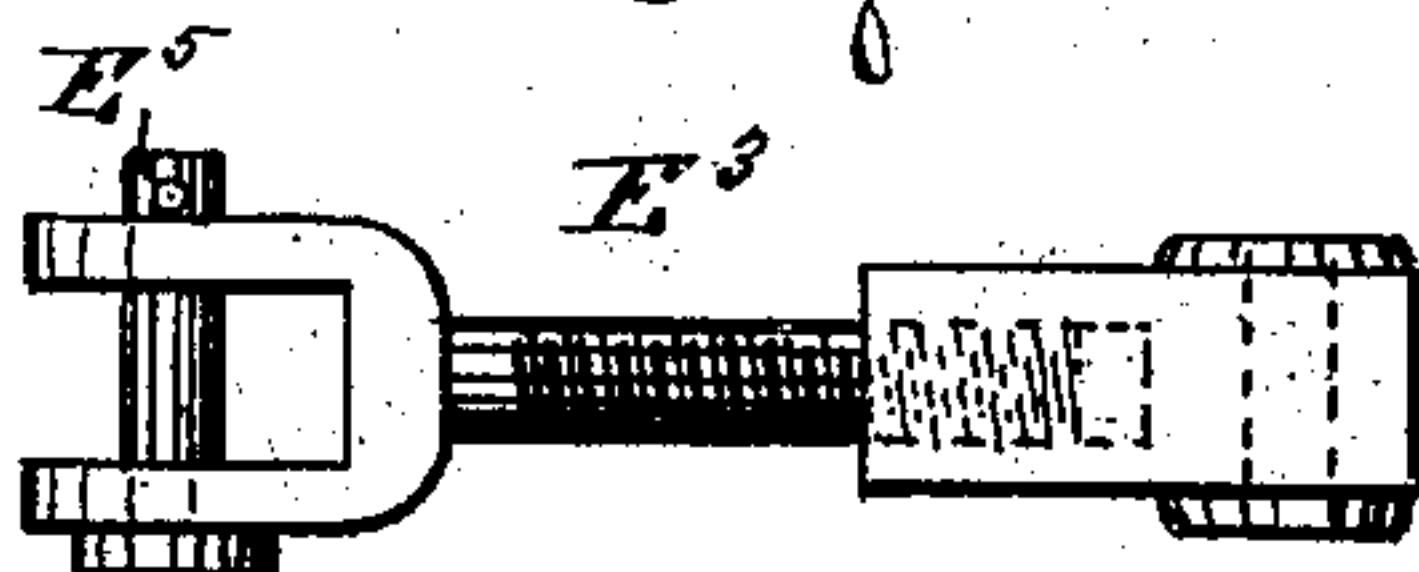


Fig. 8.



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UNITED STATES PATENT OFFICE.

BENJAMIN L. STOWE, OF NEW YORK, N. Y., ASSIGNOR TO J. VAN D. REED,
OF SAME PLACE.

WARP-KNITTING MACHINE.

SPECIFICATION forming part of Letters Patent No. 486,648, dated November 22, 1892.

Application filed February 3, 1882. Serial No. 51,815. (No model.)

To all whom it may concern:

Be it known that I, BENJAMIN L. STOWE, residing at New York, in the county and State of New York, have invented new and useful
5 Improvements in Warp-Knitting Machines, of which the following is a specification.

My invention relates to the class of machines known as the "straight-bar" knitting-machines, and is to a certain extent an adaptation to a straight machine of certain parts of the mechanism embodied in the circular-knitting machine, described in the specification of Letters Patent No. 221,628, granted to me November 11, 1879, in combination with certain other new and original devices. This
15 machine, like the said circular machine, employs two sets of needles, the needles of one set being placed at right angles to those of the other set, in such relative positions that the needles of one set would pass through the spaces between the needles of the other set if both sets were advanced simultaneously. The loops formed by both sets of needles are made upon one and the same side of the fabric
25 knitted, and longitudinal strands are laid into the fabric and retained by the looped stitches in a manner similar to the one described in the specification of the aforesaid Letters Patent. In most other respects the improved
30 straight-bar knitting-machine differs materially from the said circular machine, both in form and principle.

In this improved machine as many separate and distinct warp-threads are employed as there are needles in the machine, and each
35 warp is fed alternately to either one or the other of the two contiguous needles of the particular set to which the warp-thread belongs, and also the needles of each set are all supplied with yarn and all form their stitches simultaneously, which being done at the same time with the laying in of the longitudinal warps, produces a fabric entirely different from that produced by the aforementioned
45 circular-knitting machine.

In the drawings, Figure 1 is a side elevation of my improved knitting-machine. Fig. 2 is a front elevation of the same. Fig. 3 is a sectional elevation of a part of the same. Fig.
50 4 is a horizontal sectional view of a portion

of the improved knitting-machine, taken on line 4 4, Fig. 1. Fig. 5 is a central sectional view of a portion of the machine. Figs. 6 and 7 are views illustrating mechanism that is employed in connection with this machine, when
55 it is desired to insert a weft into the fabric. Fig. 8 is a detail view.

A and A' are the supporting side frames.

B is the needle-bed.

C are the vertical needles.

D are the horizontal needles; E, the main driving-shaft; E⁶, the driving-pulleys of the machine, and A² and A³ are portions of the frame supporting the driving-shaft and the rod F.
65

The needle-bed B is made of a nearly-square bar, except that it has a narrow longitudinal tongue B' near its center, upon the front side, and a wide longitudinal tongue B², which reaches half-way across its top from the front.
70 This needle-bed B is bolted securely at its respective ends to one or the other of the arms A² or A³. The needle-guide bar D' is cut in its lower side into narrow lateral grooves d, one for each of the horizontal needles D, and
75 it is fastened upon the top of the wide tongue B² of the needle-bed, forming the guides through which the horizontal needles work. The needle-guide bar C' has a lip c upon its inner side, and through the lip c and into the
80 inner side of the bar itself are cut narrow lateral grooves c', one for each of the vertical needles. The bar C' is fastened to the narrow tongue B', the bottom of the bar C' and the bottom of the tongue being placed upon
85 a plane with one another, so that a considerable open space is formed between the needle-bed B and the guide-bar C' to permit the free play of the latches of the vertical needles. The guide-bar C' is chamfered off upon
90 its top and outer side to permit the knitted fabric to pass away easily from the needle at the point c² where it is formed. The lip c gives greater depth to the guide-grooves c' at this point c².
95

The needle-bar C², into which the vertical needles are fastened, and the needle-bar D², into which the horizontal needles are fastened, are alike, and each one is made of a long flat bar, which has a reciprocatory motion up
100

and down in the guideways *g* in the vertical cross-arm G or in or out in the guideways *h* in the cross-arm H, according as it is the vertical or the horizontal bar. The reciprocatory motion is imparted to these bars C² and D² by the cams J upon the main driving-shaft E by means of the levers E' and E², fulcrumed upon the rod F, and the connecting-links E³ and E⁴. The connecting-links E³ and E⁴, of which there is one pivoted loosely upon each end of each of the needle-bars C² and D², (the needle-bars being turned down for that purpose and to enter the guideways *g* and *h*,) are bifurcated at their lower or rear ends, so as to straddle the end of the lever E' or E², to which they belong and to which they are loosely pinned. The cam J has a groove J' cut into its face, into which the small friction-rollers J², revolving upon studs in the ends of the levers E' E², project. The groove J' is concentric with the axis of the cam J for rather more than half the cam's circumference, but approaches and recedes again from the center in the remaining portion, so that while the levers E' and E² are at rest in a position which holds the needles withdrawn for rather more than half the cam's revolution, they move to advance and recede the needles during the remaining portion of the revolution. (See Fig. 3.) The roller J² upon lever E' and the roller J² upon lever E² enter the groove J' of the cam J upon opposite sides of the shaft E, so that the vertical needles and horizontal needles alternate one with the other in their periods of motion and rest. The connecting-links E³ and E⁴ are each made in two parts. (See Fig. 8.) That part which is pivoted to the needle-bar is drilled longitudinally, and there is a female thread cut within it. The part which has the bifurcated end is turned down and has a screw cut upon it which fits the female thread cut within the other part of the link. This is to permit a slight adjustment of the throw of the needles by removing the pin E⁵ and slipping the bifurcated end clear of the lever E' or E² and turning its screw out of or into the other part of the link, so as to lengthen or shorten the link E³, as may be desired. Narrow lateral slots *c*³ or *d*³, to receive the needles C or D, are cut into one side of the needle-bars C² and D². A longitudinal dovetail groove of a somewhat less depth than the lateral groove *c*³ or *d*³ is also cut into the same side. A dovetail piece C³ or D³ is fitted to fill all of the longitudinal groove above the surface of the needles. Small set-screws *x*, one for each needle, are set through the dovetail piece C³ or D³, so that each needle is held firmly in its position by the said screw.

The yarn-guide bar I, which guides the warp-yarns to the hooks of the vertical needles C and the similar bar K, which guides other yarns to the horizontal needles D, each consists of a long slender rod, through which a series of eyes *i* and *k* is drilled, there being one eye for each needle of the set to which

the guide-bar I or K belongs. There is preferably one eye *i* or *k* more in the guide-bar I or K than there are needles in the corresponding set C or D.

The yarn-guide bar I, which supplies the vertical needles with yarn is placed so that the hooks of the vertical needles pass close against its side and at such a height that the said hooks rise to the vicinity of its upper side. This said guide-bar I is supported and held in position laterally by the vertical cross-bars G, through a slot in each of which it passes.

A drum L controls the position of the yarn-guide bar I longitudinally by means of a stud and friction-roller *l*, projecting from the end of the guide-bar I into groove *l'* cut into the periphery of the drum L. This drum L is arranged to give four periods of rest to the bar, during each of which periods each eye *i* in the bar I is midway between two contiguous needles C, and four periods of motion, two in succession in one direction and two in succession in an opposite direction, and each of these steps is equal to the distance from one needle to the next adjacent one, so that the maximum amount of longitudinal motion imparted to the said guide-bar I is equal to the distance from one needle to the second needle away from it. The first step of this longitudinal motion of the yarn-guide bar I is taken just as the needles C begin to rise, the second and final one while the needle is in its highest position.

The yarn-guide bar K guiding the warp-yarns to the horizontal needles D is similar in its construction to the one just described, and is located and operates relatively to the horizontal needles D, the horizontal cross-bar H, and the cam L in a manner similar to that in which the guide-bar I is located, and operates in relation to the vertical needles C, the vertical cross-bar G, and the said cam L, the periods of rest and of motion of the two yarn-guides I and K varying to correspond with the periods of rest and of motion of the system of needles C or D to which the said yarn-guides respectively belong. This required variation in the time of movement between the yarn-guide bar I and the like bar K necessary to make each conform with the movement of its respective set of needles is given by the different positions in the circumference of the cam L at which the friction-rollers *l* and *l'* of the respective guide-bars I or K enter the groove *l'*, they being set one-quarter of the cam's circumference apart, so that although they are both moved at one and the same time one of them is one step in advance of the other in the order of its movement. An arm A⁴, somewhat similar to the arms A² and A³ of the frame, and running parallel with them, is bolted upon the outside of one of the side frames A', and affords support to the cam L and a train of spur-gearing L', (see Fig. 4,) which connects the said cam L with

the driving-shaft E, from which it derives its motion. This cam L revolves at one-half the speed of the main driving-shaft E.

The faces of the yarn-guide bars I or K which are presented to the hooks of the needle sometimes have narrow lateral grooves, slightly widened at either end, cut into them between the eyes *i* or *k* for the better guidance of the hooks of the needles; but in this case the hooks must necessarily pass entirely through the said grooves and beyond the yarn-guide bars to permit such bars to move.

The guide-bar G' for guiding the longitudinal warps into their proper positions is similar in its construction to the yarn-guide bars I or K; but, unlike them, it has no longitudinal motion, being permanently fastened to the front face of the vertical cross-bar G near the top of said bar. It is intended to guide the longitudinal warps into the fabric that is being constructed in a position just in front of the vertical needles.

The three warp-beams N, N', and N², Figs. 1 and 2—one N for supplying warp to the vertical needles and one N' for the longitudinal strands and one N² for supplying warp to the horizontal needles and the cloth-beam N³ for receiving the knitted fabric—are all alike and all receive motion in a similar manner. The beams N, N', N², and N³ and the friction-rolls M, M', M², and M³, upon which they rest, each consists of a plain cylinder having a straight shaft for its axis. The shafts of the friction-rolls M, M', M², and M³ have each a bearing at either end in the frame A and A', and one end of the shaft projects sufficiently beyond the frame A to carry a ratchet-wheel *m*. The shaft of each of the beams N, N', N², and N³ is shorter and enters guideways *n*, cut in the bosses of the frame A and A', the said guideways *n* being deep enough to permit the whole weight of the beam to rest upon the friction-roller M and being open at the top to facilitate the removal of the beams. Motion is given to all of the friction-rolls M, M', M², and M³ and through their agency to the beams by means of the ratchet *m*, pawl *m'*, lever *m²*, connecting-rods *m³*, and eccentric *m⁴* upon the main driving-shaft E. The amount of motion transmitted to the rolls M is regulated to a certain extent by the slot *m⁵* in the lever *m²* and the bolt *m⁶*, which permits the end of the connecting-rod *m³* to be connected either nearer to or farther from the center of the ratchet.

Figs. 6 and 7 illustrate mechanism that may be used in connection with this machine when it is desired to insert weft-threads into the fabric in addition to the knitted and longitudinal warps.

Another sliding bar O, supported by bearings attached to the vertical cross-bar G, runs across the machine in a direction parallel with the yarn-guide bars I and K. This bar O, which I denominate the "weft-guide" bar, has a number of oblong tubes O', (as shown in the drawings, one for every three of the hori-

zontal needles,) which project downward from the lower face of the said guide-bar until their ends, which are well rounded, are about upon a level with the center of the horizontal needles. The oblong tubes O' are set with their greater diameters parallel with the horizontal needles, and it is requisite that whenever the sliding weft-bar O is at a standstill the tubes shall be in such a position that the horizontal needle D may be advanced without striking them. The weft-guide bar O is drilled to correspond with the openings through the center of the tubes O', so that the weft-yarns may be led from an additional beam similar to the warp-beams N, N', and N² down behind the longitudinal warp-guide bar G' and through the aforesaid weft-guide bar O and oblong tubes O', and into the fabric between certain of the horizontal needles D. An additional cam P is placed upon the same shaft as the cam L. This cam P has a groove *p* cut into its periphery, into which a stud *p'* and friction-roller, which project from the weft-guide bar O, enter. The cam P is arranged to give two periods of rest and two of motion to the weft-guide bar O, the motion which is communicated consisting of one forward and one backward step. The two points of motion are directly opposite to one another upon the cam's circumference, and either one or the other of the two steps is taken each time and while the horizontal needles are withdrawn. The amount of motion is preferably equal to the distance which the oblong tubes O' are set apart; but such amount of motion is governed entirely by the cam P, and may be arranged as desired, and even a larger cam, which shall be set upon a separate shaft and have a separate connection with the driving-shaft E in order that it may be driven at a slower speed, may be employed to give an irregular amount of motion to the weft-guide bar O when desired, the said cam P in this case having its groove *p* cut irregularly, of course care being taken to have the weft-guide bar O move only while the horizontal needles are withdrawn.

The operation of this machine is as follows, supposing all the warp-beams N, N', and N² to be supplied with warp, the yarns from the beam N leading through the eyes in the yarn-guide bar I to be supplied to the vertical needle C, the yarns from the beam N² leading through the eyes in the yarn-guide bar K to be supplied to the horizontal needles D, the yarns from the beam N' leading through the guide-bar G' and down in front of the vertical needles C for the longitudinal strands, and, further, supposing that sufficient fabric has been knitted to reach down behind the cloth-beam N³ and friction-roll M³ and around the friction-roll M³ to its top, where it passes between the said roll M³ and the beam N³ and then around the beam N³, to which its end is fastened. The warps lead from all the beams in a similar manner, to wit: They are wound upon their respective beams, passing between

the said beams and the friction-rolls and down in front of the friction-rolls to their proper guides, as previously described. Now we will suppose that the hooks of the vertical needles C have each just seized a yarn leading from the yarn-guide bar I and are descending and that the yarn-guide bar I is at rest in its extreme right-hand position, in which case the horizontal needles D will be withdrawn and the yarn-guide bar K will be in its central position. Immediately after the vertical needles C reach their lowest point the horizontal needles D will begin to advance. When their hooks about reach the eyes in the yarn-guide bar K, the said yarn-guide-bar K will begin to move toward the right, and before the horizontal needles D have been out to their most forward position and returned again sufficiently to bring their hooks upon a line with the eyes k in the yarn-guide bar K the yarn-guide bar K will have reached its extreme right-hand position. Simultaneously with the moving of the yarn-guide bar K to the right the yarn-guide bar I will have moved one step to the left for the purpose of preventing the yarns leading through it from being seized again by the hooks of the same needles C which last seized them, when the hooks again come up. The horizontal needles D will now be withdrawn, their hooks each seizing a yarn as they recede, and the vertical needles C will rise until their hooks reach the level of the eyes in the yarn-guide bar I, when the said yarn-guide bar I will begin moving and will continue its movement until it reaches its extreme left-hand position just before the hooks of the needles C, which in the meantime have risen to their highest position, get again to the level of the eyes i in the yarn-guide bar I. Simultaneously with this movement the yarn-guide bar K will have taken one step to the left. The hooks of the vertical needles will now each seize a yarn; but in consequence of the previous movement of the yarn-guide bar I two steps to the left an individual needle will not seize the same yarn that it seized the last time it was up, but the next yarn upon the left of that one. The first step of the movement of the yarn-guide bar I having carried the yarns to the left of the needles C, upon which they were previously knitted, and the second and final step having carried them to the left of the next needle to the left of the one just mentioned, the vertical needles will descend and the horizontal needles will advance, and when they arrive at the proper position, as previously described, the yarn-guide bar K will take its second step to the left, and the yarns will be led to one needle to the left of the one which they were led to for the previous stitch by a process similar to that described for a like purpose in connection with the vertical needles. The yarns will now each lead from the hooks of the needles to which they have been respectively supplied to the last stitch formed by the same yarns, which

will now be at the knitting-point c^2 and upon the needles next to the right of the ones just supplied. As a result of this the longitudinal warp-threads, which run from the guide-bar G' into the fabric between the horizontal needles, will each have a yarn crossing from one needle to another in front of it, which when the horizontal needles are withdrawn and form their stitches will cause the said longitudinal strands to be bound firmly into the fabric by such stitches. The further progress of the work of the machine will be but a repetition of the methods just described. The stitches will be formed alternately upon the vertical and horizontal needles, the yarn-guide bars I or K moving at the required times and in harmony with the system of needles to which they respectively belong and the longitudinal warps being bound in by the operation of the horizontal needles. The individual needles C or D will form stitches alternately from one or the other of two contiguous yarns, the feeding devices connected with the friction-rolls N , N' , and N^2 will cause the warp to be fed off the warp-beams M , M' , and M^2 at the requisite speed, and the like devices, in connection with the cloth-beam M^3 , will cause the knitted fabric to be taken away from the needle as it is knitted, all by the means and in the manner previously described.

The operation of the weft-supplying devices illustrated in Figs. 6 and 7 is as follows, supposing the horizontal needles to be withdrawn and to have just finished forming their stitches, and that a weft-yarn leads from each of the oblong tubes O' back and into the fabric at a point directly behind the tube O' from which it comes. Now if the weft-guide bar O is moved along a certain distance the tube O' will carry the weft-yarns along until each one will reach diagonally across the path, through which a number (according to the amount of travel of the weft-guide bar O) of the horizontal needles will advance, the tubes O' being short enough (their well-rounded ends assisting) to prohibit them as they move along from catching the warp-strands that extend from the warp-guide bars K to the horizontal needles; but yet long enough so that as the horizontal needles advance they will pass over the diagonally-extended weft-threads. All of this operation is performed back of the longitudinal warps, so that when the horizontal needles return and form the stitches, which will bind the longitudinal warps into the fabric the weft-thread will also be bound into the fabric jointly by the said stitches formed by the horizontal needles and the said longitudinal warp-threads. If the amount of travel of the weft-guide bar O was equal to the distance which the tubes O' are set apart the result will now be that the several weft-yarns in succession will form a single line, reaching entirely across the fabric, one yarn beginning where another terminates. If an irregular movement be given to the weft-guide bar O , a variation in the texture of the

5 fabric may be made or by the use of colored
yarn a variety of coloring may be introduced
into the fabric by the same agency. I do not
restrict myself to the precise arrangements
of mechanism herein described. The timing
of the operations of the vertical and hori-
zontal needle-bars in their relation to each
other is sometimes changed.

I claim—

10 1. The combination, substantially as here-
inbefore set forth, of the vertical and hori-
zontal needles C and D and the longitudinal
warp-guide bar G' with the yarn-guide bar I,
arranged to deliver a separate yarn to each
15 of the vertical needles, the yarn-guide bar K,
arranged to deliver a separate yarn to each
of the horizontal needles, and mechanism for
reciprocating said yarn-guide bars I and K.

20 2. The combination, with a needle-bar hav-
ing lateral grooves for the reception of the
needles and a longitudinal groove cut in one

of its faces, of the dovetail piece or holder
adapted to the longitudinal groove in the
needle-bar, the set-screws in said dovetail
piece, and the series of needles, substantially 25
as and for the purposes set forth.

3. The combination of the needle-guide bar,
its lateral grooves, the needles, and the nee-
dle-bar B, provided with tongue, substantially
as and for the purposes set forth. 30

4. The combination of the driving-shaft E,
the cam J, the levers E' E², and the adjustable
connecting-links E³ E⁴, with the needle-bars
C² D², the vertical cross-bars G, provided with
the guideways *g*, and the horizontal cross- 35
bars H, provided with guideways *h*, substan-
tially as hereinbefore set forth.

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Witnesses:

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JAMES SPOTTON.