(No Model.) 4 Sheets—Sheet 1.

A. E. AYER.

SHOE TYING MACHINE.

No. 411,565. Patented Sept. 24, 1889.

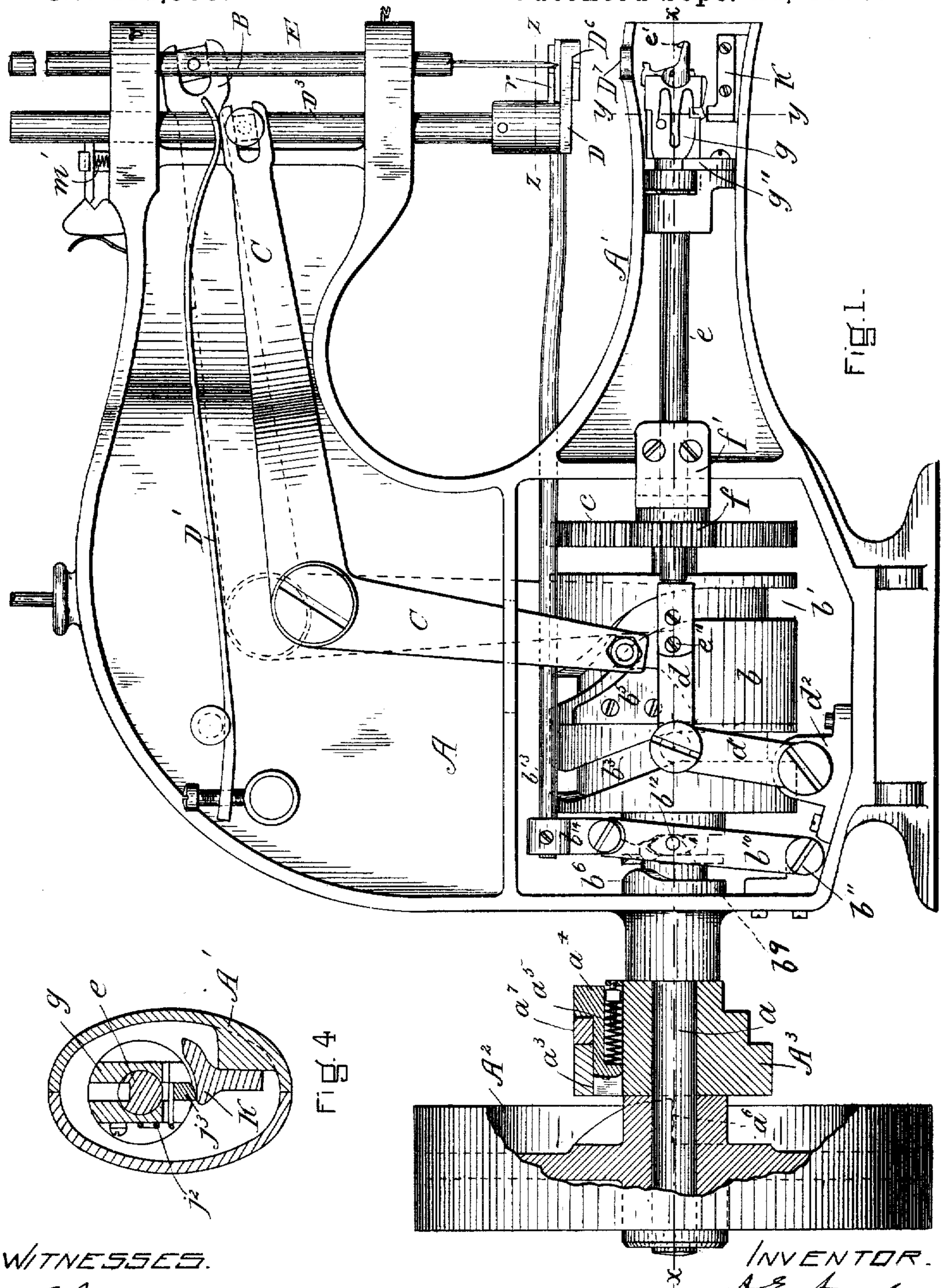

Fig. 1.

Fig. 4

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Charles E. Moss

INVENTOR.

A. E. Ayer

by Wright Brown Quinby & Otis

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A. E. AYER.

SHOE TYING MACHINE.

No. 411,565. Patented Sept. 24, 1889.

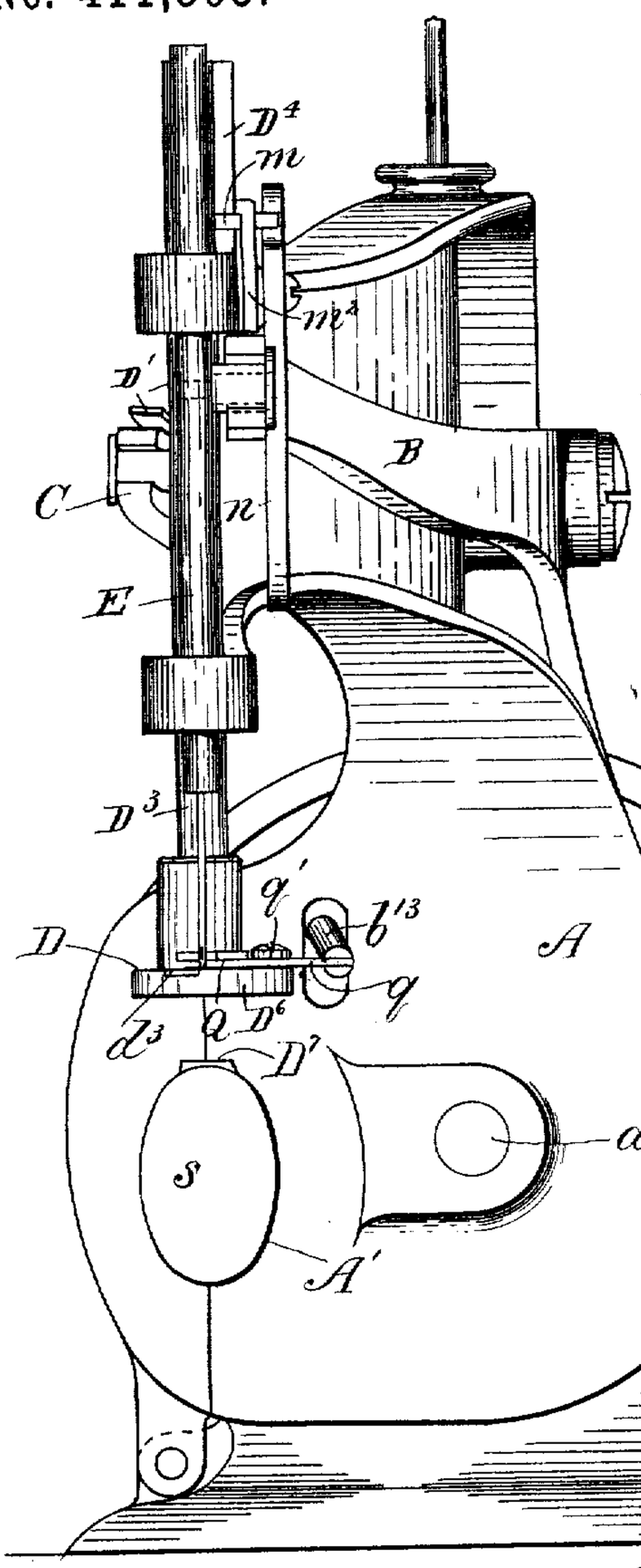

Fig. 2.

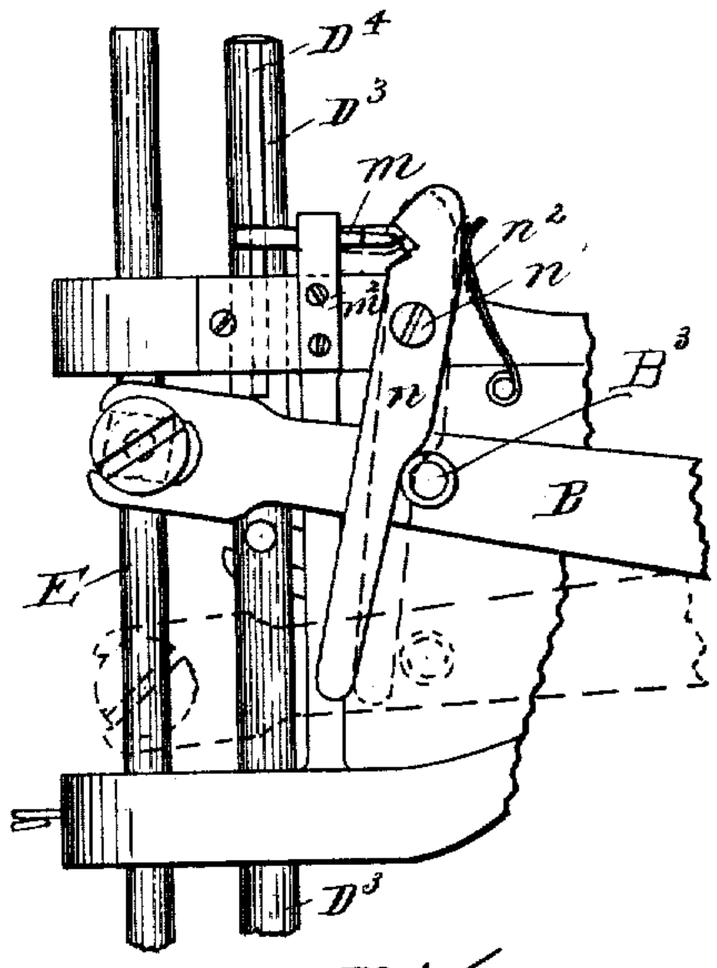

Fig. 6.

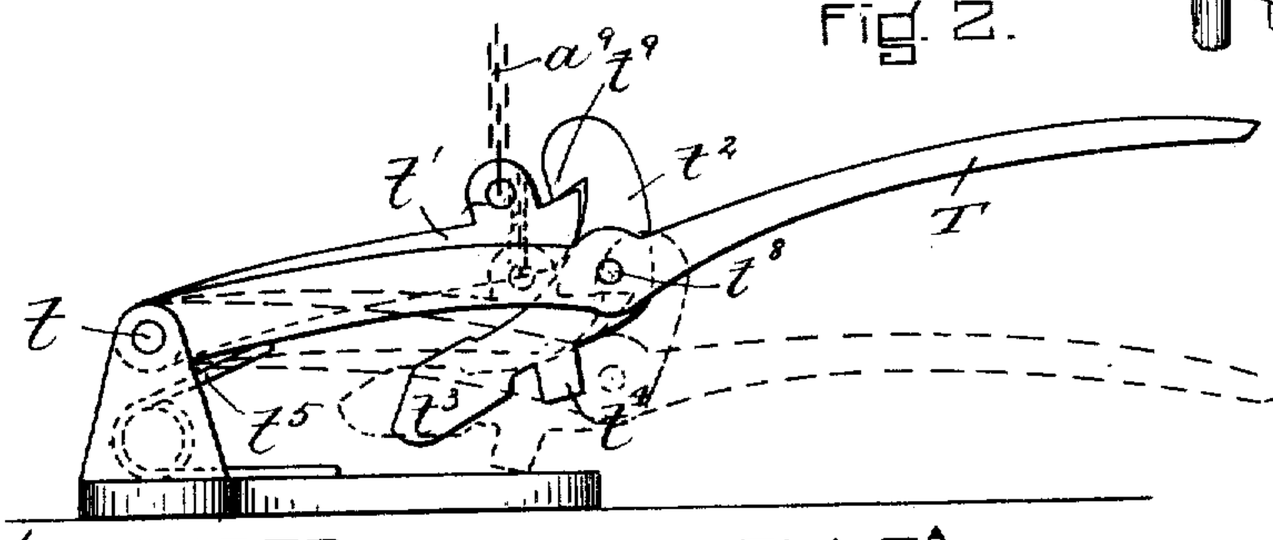

Fig. 2A.

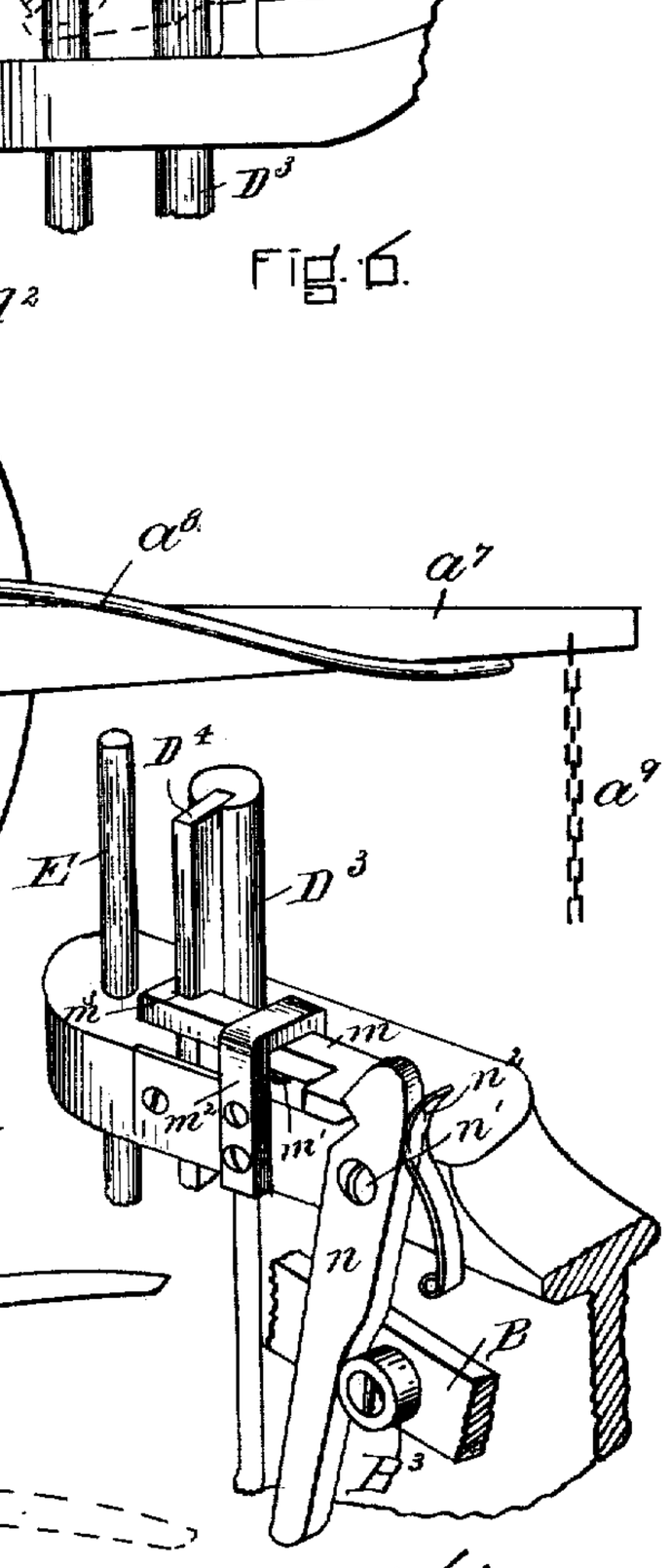

Fig. 6A.

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A. E. AYER.

SHOE TYING MACHINE.

No. 411,565. Patented Sept. 24, 1889.

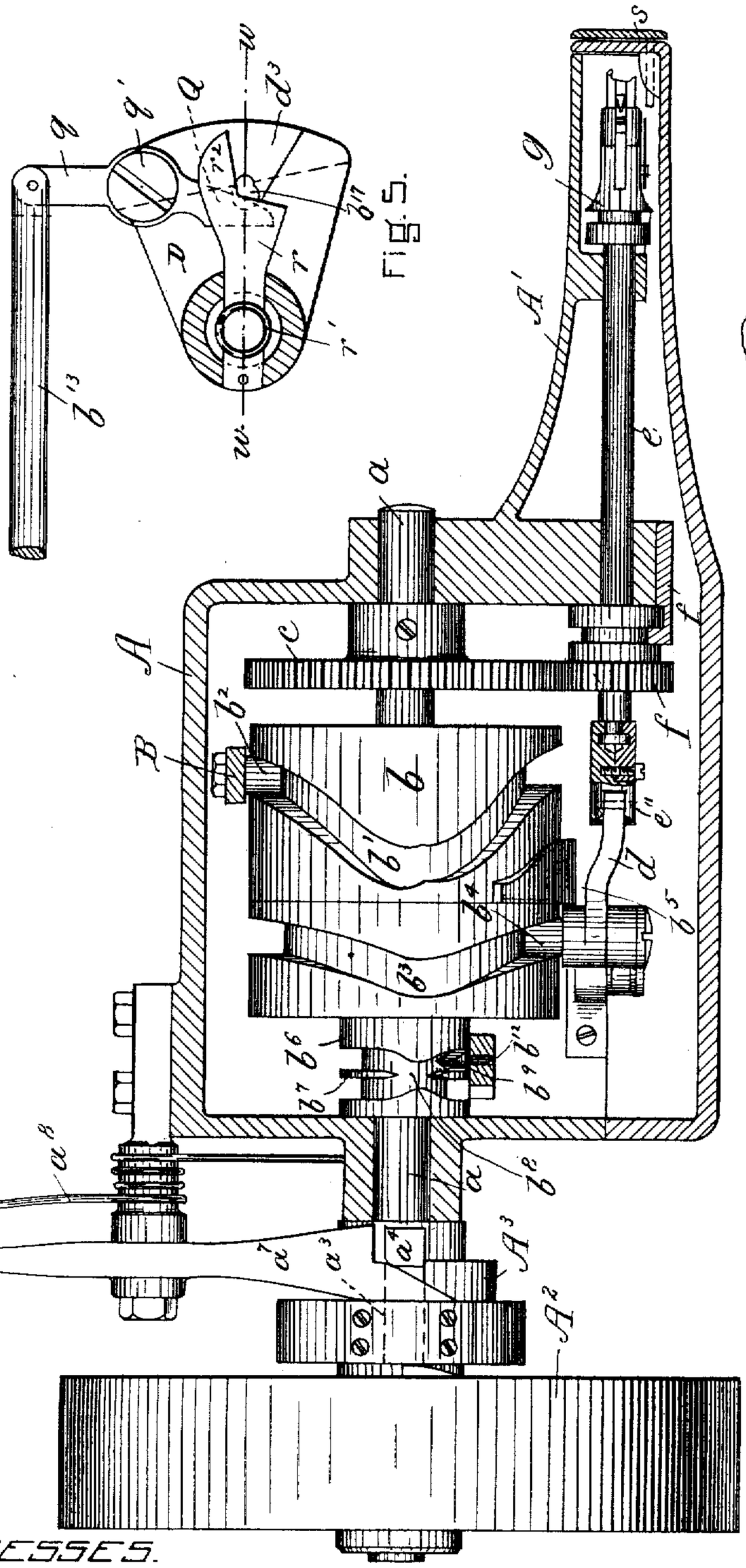

Fig. 5.

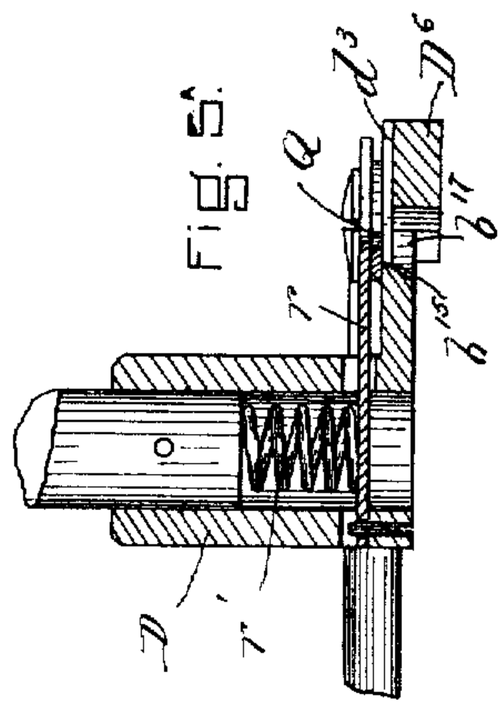

Fig. 5ª.

WITNESSES.

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SHOE TYING MACHINE.

No. 411,565. Patented Sept. 24, 1889.

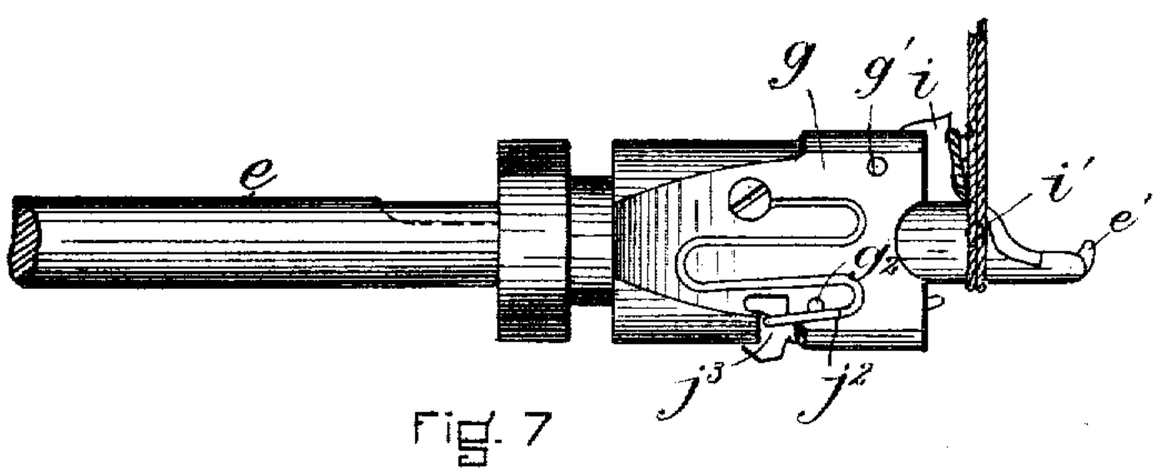

Fig. 7

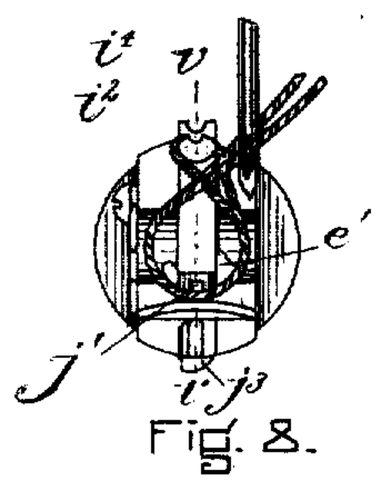

Fig. 8.

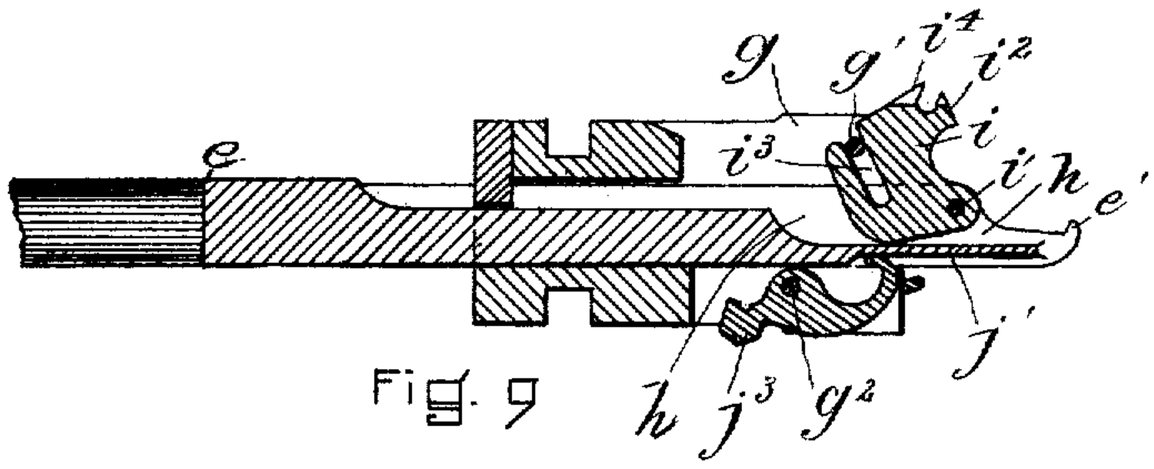

Fig. 9

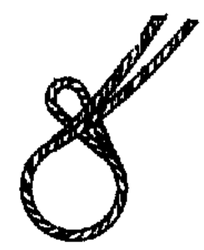

Fig. 12.

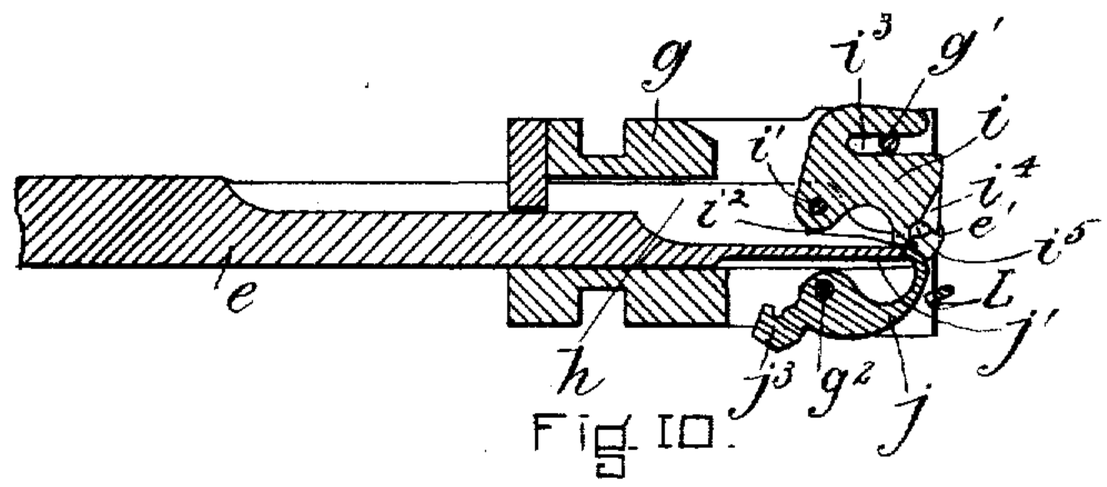

Fig. 10.

Fig. 13.

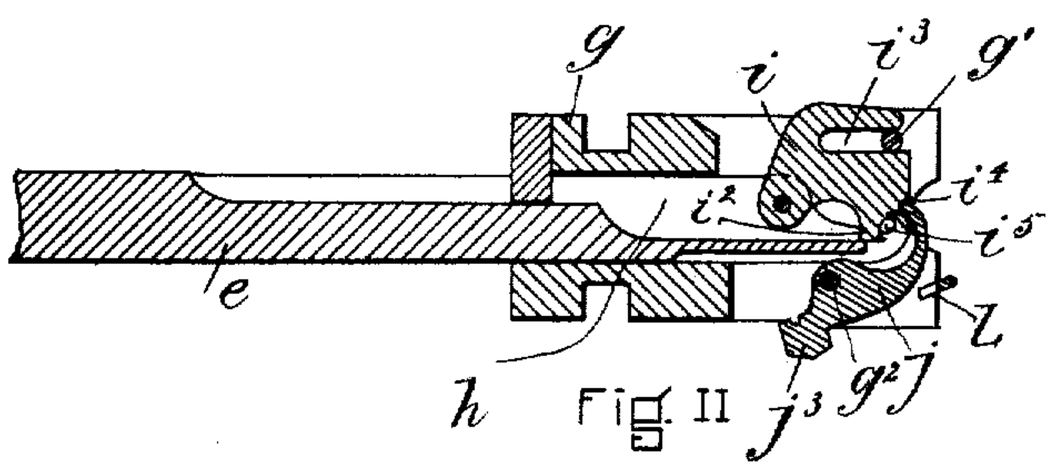

Fig. 11

Fig. 14.

WITNESSES

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Charles E. Moss

INVENTOR.

A. E. Ayer

by Wright Brown Quinby & Otis

Attys.

UNITED STATES PATENT OFFICE.

ALBERT E. AYER, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO FRANCIS H. HATHORNE AND ISAAC P. T. EDMUNDS, BOTH OF SAME PLACE.

SHOE-TYING MACHINE.

SPECIFICATION forming part of Letters Patent No. 411,565, dated September 24, 1889.

Application filed March 1, 1889. Serial No. 301,627. (No model.)

To all whom it may concern:

Be it known that I, ALBERT E. AYER, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Shoe-Tying Machines, of which the following is a specification.

My invention relates to machines in which a cord is used for connecting shoes together in pairs, said cord being put through the back of each shoe and secured thereto by knotting the thread within the shoe, the object of my improvements being to provide a more convenient, easily-operated, and simpler machine than any now in use.

To these ends my invention consists in the improvements which I will now proceed to describe and claim.

Of the accompanying drawings, forming a part of this specification, Figure 1 represents a side elevation of my improved machine, the side plate being removed to show the working parts more clearly, the clutch mechanism being drawn in section. Fig. 2 represents a front elevation of the same. Fig. 2^A represents a front view of a treadle used in operating the clutch mechanism. Fig. 3 represents a horizontal section on line $x\ x$ of Fig. 1. Fig. 4 represents a transverse section on line $y\ y$ of Fig. 1. Fig. 5 represents a horizontal section on line $z\ z$ of Fig. 1. Fig. 5^A represents a section on line $w\ w$ of Fig. 5. Fig. 6 represents a side view of part of the machine to illustrate a gripping device used in clamping the presser-foot in position when down. Fig. 6^A represents a perspective view of the same. Fig. 7 represents a detail showing in side elevation the mechanism for tying the knot. Fig. 8 represents an end view of the same. Fig. 9 represents a vertical section on line $v\ v$ of Fig. 8. Figs. 10 and 11 represent a similar section, showing the working parts in different positions; and Figs. 12, 13, and 14 show the cord at several stages of the tying operation.

A, Figs. 1, 2, and 3, is the frame-work of the machine, having formed with it a horn A′, over which the shoe is placed when the machine is in operation, the horn being in a substantially horizontal position.

a is the driving-shaft of the machine, having upon it the driving-pulley A^2 and the clutch mechanism or automatic stop-motion, which will be described farther on. The shaft *a* is supported in bearings provided in the frame of the machine and has affixed to it the cams $b\ b^6$ and gear *c*. The cam *b* is provided with two cam-grooves $b'\ b^3$, the former being used to give the necessary movement to the needle-bar E through the trundle-roll b^2 and bell-crank lever B, while the cam-groove b^3 is used to give a reciprocating movement through the trundle-roll b^4 and connecting-rod *d* to the shaft *e*, which carries the knot-tying devices and is located in the horn. Upon the periphery of the cam *b* is a wiper-cam b^5, which bears against one arm of the bell-crank lever C. The other arm of said lever is provided with a forked end, within which slides a square block pivoted to the presser-foot bar D^3. A flat spring D′ presses upon the forked end of the lever C, the tension of said spring being regulated by a set-screw, as shown. The gear *c* meshes with a gear *f*, which is connected by a spline or feather with the shaft *e*, so that it can not only rotate said shaft, but also slide longitudinally thereon. The proportion of the gears *c f* is such as to give three revolutions to the shaft *e* to one revolution of the driving-shaft. It will be seen, therefore, that the shaft *e* is provided with a rotary and reciprocating movement, the gear *f*, through which it slides, being held in place by the fixed plate *f′*, having a projection which fits into a groove formed in the hub of the gear *f*. With one end of the shaft *e* is engaged, by a flange entering a groove in said shaft, a sleeve or collar, which is connected by a pivot *e″* within one end of the connecting-rod *d*, the described engagement of the sleeve and shaft permitting the shaft to rotate independently of the sleeve, the latter being prevented from rotating by its connection with the connecting-rod *d*. The other end of said connecting-rod and the trundle-roll b^4 thereon are supported by a sleeve *d′*, which is fulcrumed on a bearing d^2, fastened to the frame of the machine. The shaft *e* passes through a head *g*, which is splined to it, so that the shaft rotates said head and is capable of sliding lengthwise in it. On the outer end of the shaft *e* is formed a hook *e′*,

the office of which will be presently explained. The head g is held in place and prevented from reciprocating with the shaft e by a fixed plate g'', which engages a groove in the head, as shown in Fig. 1, said plate permitting the head to rotate with the shaft e. The end of the shaft e is milled out to form a groove h, in which is pivoted at i' a swinging plate i. On the swinging plate i is formed a hook i^2, and in said plate is formed a slot i^3. A pin g', fastened to the head g, passes through the slot i^3, and during the backward movement of the shaft e constitutes a fixed pivot or fulcrum, whereby the swinging plate i is thrown from the position shown in Figs. 7, 8, and 9 to the position shown in Figs. 10 and 11.

Pivoted at g^2 on the head g is a hook j, the point of which slides in a groove j' in the shaft e. (See Fig. 9.) The point of the hook j is kept in contact with the shaft e by the tension of the spring j^2, Fig. 7, acting on the part j^3 of the hook. During the backward movement of the shaft e the point of the hook j is kept by said spring in close contact with the shaft, and as soon as the shaft has receded far enough the point leaves the groove j' and enters the groove i^4, as shown in Fig. 11. When the plate i is thrown over to the position shown in Figs. 10 and 11, a space i^5 is left between the hooks e' and i^2 for the shoe-tying cord or thread. The part j^3 of the hook j projects beyond the surface of the head g, as shown in Figs. 4 and 8, said projecting portion forming a cam-surface, which, during the rotation of the head g, comes in contact with a cam-plate k, affixed to the horn A', as shown in Fig. 4. The contact of the part j^3 with said fixed cam-plate k forces the rear end of the hook inwardly against the tension of the spring j^2 and throws the point of the hook j outwardly, thereby causing said hook to release the knot, as presently explained.

Affixed to the driving-shaft is a cam b^6, provided with two cam-grooves, said grooves being separated by a narrow rib b^7, (forming a part of said cam,) excepting at one point where the continuity of said rib is interrupted by an opening b^8, which connects said grooves. The sides of the rib near said opening are curved inwardly to a point, and the outer sides of the grooves are similarly curved to form inward projections at opposite sides of said opening, the form of the ends of the rib and of the sides of the grooves at this point being such that a runner or shoe b^9, pivoted to a lever b^{10}, hereinafter described, and formed with pointed ends, will be caused to pass from one groove to the other through the opening b^8, and thereby give said lever a lateral movement. The lever b^{10} is pivoted at b^{11} to an ear on the frame, and the shoe or runner b^9 is connected with said lever by a pivot b^{12} between the pivoted and swinging ends of the lever.

b^{13} represents a rod which has a collar b^{14} attached to it, said collar having an ear which is pivoted to the swinging end of the lever b^{10}. The opposite end of said rod is pivoted to an arm q, formed on the thread-cutting blade Q, which blade is pivoted at q' to the presser-foot D. The oscillating movements of the lever b^{10}, caused, as above described, by the action of the cam-grooves on the shoe or runner b^9, are communicated to the blade by the rod b^{13}, the cutting-edge of said blade being thereby moved alternately forward and back over the upper surface of the presser-foot, the blade moving forward and co-operating with a blade b^{15}, forming a part of the presser-foot in severing the cord after two shoes have been connected by the operation of the machine.

It is necessary to provide means for holding the end of the cord after the part which connects the shoes together has been severed; and to this end I provide a plate r, which is located over the swinging blade Q, and is pressed down upon the upper surface of said blade by a spring r', located in a cavity in the presser-foot sleeve D, one end of said plate passing into or through said cavity and receiving the downward pressure of the spring r'. The plate r has an arm r^2, which projects over and bears at all times on the oscillating blade Q, thus preventing the plate from falling below the blade. The main portion of the plate r is arranged so that it will bear on the blade only when the latter is forced forward to cut the cord. When the blade is thus forced forward, its upper surface comes under the main portion of the plate r just before the cord is cut, the lower end of the main portion of the cord being thus caught between the upper surface of the blade and the under surface of the plate r and held by the pressure of the spring r' on said plate. The blade Q remains in the position last described during the operation of forming the first knot in tying a pair of shoes, so that the end of the cord is clamped during said operation, as hereinafter described.

The shear-blade or cutting-edge b^{15} on the presser-foot is formed by the intersection of one side of an orifice b^{17} in the presser-foot with the upper surface of said foot, said side being beveled, as shown in Fig. 5^A. The orifice b^{17} also constitutes the hole through which the needle passes. The under side of the presser-foot is provided with a downwardly-projecting lip or flange D^6 at its outer end, said lip resting on one side of the needle-receiving throat D^7 on the horn when the presser-foot is depressed and keeping the remaining portion of the bottom of the presser-foot raised above said horn, so that there is always a space for the free passage of the thread between the horn and presser-foot.

d^3 represents a depression or recess formed in the upper surface of the presser-foot under the oscillating blade Q to permit the thread

to pass freely under said blade without being clamped or held thereby against the upper surface of the presser-foot.

To prevent the presser-foot D from being lifted when the needle-bar begins to recede, (a common occurrence when heavy stock is being worked upon,) a device (shown in Figs. 6 and 6A) is provided to hold the presser-foot securely at any point to which it has dropped. Upon the upper part and upon one side of the presser-foot bar D^3 is provided a feather or spline D^4, acting as a guide for the bar and also as a projecting lip for the gripping-lever m to act upon. The gripping-lever m in its normal position—that is, when the machine is at rest—lies in a horizontal plane, being held in said position by the tension of a spring m', Fig. 1, pressing it upward against the flat surface of the strap m^2, fastened to the frame. One extremity of the gripping-lever m is provided with a rectangular-shaped notch m^3, fitting loosely over the feather D^4, while the other extremity is V-shaped and fits a corresponding notch in the lever n. The lever n is pivoted to the frame at n', and is provided with a spring n^2, the tendency of which is to force the notched arm of the lever n against the V-shaped extremity of the gripping-lever m. The lower arm of the lever n is made of such a form as to be moved out against the tension of the spring n^2 when the needle-bar arm B is on its upward throw, an anti-friction roll B^3 being provided on said needle-bar arm B to roll upon the edge of the lever n, as shown in the details. Upon the downward movement of the needle-bar (the presser-foot bar having already dropped upon the work) the upper arm of the lever n is forced in by the spring n^2 against the V-shaped end of the gripping-lever m. The V-shaped extremity of the gripping-lever is moved downward by having the correspondingly-shaped notch pressed against it, throwing said gripping-lever out of a horizontal position, forming a grip upon the feather D^4, and preventing any upward movement of the presser-foot bar. It will be seen that the presser-foot is securely held in any position that it may be in when dropped upon the various thicknesses of stock upon which it is used.

Loose upon the driving-shaft a is the driving-pulley A^2, while fast to said shaft beside the driving-pulley is the disk A^3, having a slot a^3, as shown in Figs. 1 and 3. In the slot a^3 is a sliding key or latch a^4, provided with a spring a^5, which normally throws the key into contact with a projection a^6, Fig. 1, on the driving-pulley. The key a^4 is forced away from the driving-pulley once during each rotation of the latter by means of the lever a^7, which is pivoted to an arm bolted on the main frame. The end of the lever which acts on the key a^4 is wedge-shaped, as shown in Fig. 3, and has a shoulder forming a stop for the key to engage. Said lever is also provided with a spring a^8, whereby it is yieldingly held down upon the disk A^3. To the other end of the lever a^7 is attached a chain a^9, which is carried down to a suitable treadle, the depression of which raises the wedge-shaped end of the lever a^7 and causes the latter to release the key a^4, whereupon said key is forced by its spring to position to engage the projection a^6 on the driving-pulley. The release of said treadle allows the wedge-shaped end of lever a^7 to return to position to force back the key a^4 when the latter is brought by the rotation of the driving-shaft to the point where said wedge-shaped end is located.

Operation; In tying two shoes together the operator takes the first shoe and places it on the horn until the heel-bearing surface of the inner sole rests on the adjustable stop s, the back of the shoe resting on the upper surface of the horn, the needle and presser-foot being raised. The oscillating shear-blade Q is at this time closed over the fixed blade on the presser-foot, this being the position assumed by the blade Q in severing the cord after the tying together of the shoes of the last pair. The shoe being in place, the operator starts the machine by engaging the driving-shaft with the driving-pulley in the manner described. On the commencement of the rotation of the driving-shaft the presser-foot is released and drops upon the work and becomes locked and the needle descends through the back of the shoe. The shaft e and head g are continuously rotated during the entire operation, and at this stage the relative positions of the shaft e, head g, and hooks i^2 and j are as shown in Figs. 7, 8, and 9. Upon the upward movement of the needle a loop is formed in the cord, which is immediately caught by the revolving hook i^2 on the head g, said loop being carried around the end of the spindle e by said hook, as shown in Fig. 8, the above being accomplished by the first rotation of the head g. As said head begins its second rotation the shaft e is moved longitudinally to the left, as viewed in Fig. 9, the loop or bight of cord on said shaft being moved with the shaft in the same direction, the hook e' on the end of the shaft preventing said loop from slipping off. The plate i, holding the end of the loop, is by this motion of the shaft thrown over on its fulcrum g' to the position shown in Fig. 10, carrying the end of the loop downwardly to the position shown in Fig. 13. After this the shaft e is moved still farther to the left, as shown in Fig. 11, thus allowing the hook j to force itself under the part of the loop first carried around the shaft e. The shaft e then begins its movement in the opposite direction and carries the partly-formed knot outwardly from the head, the point of the hook entering the groove i^4, as shown in Fig. 9, and holding the end of the loop, which is over the hook i^2 and which lies in the opening i^5, the end of the loop being thus drawn through the body of the loop. The position of the end of the loop as held by the hook i^2 is shown approximately

in Fig. 14. When the head g has nearly completed its last revolution, the hook is thrown off from the end of the loop by its end j^3 coming in contact with the cam-plate k, the loop being prevented from following the hook in its outward movement by two lips L, arranged on the head g, said lips being separated by a slot just wide enough to permit the hook to pass through without the loop. This completes the operation of forming a knot within the first shoe. When the needle-bar-operating lever B in rising has nearly withdrawn the needle from the work, it acts on the lever n and unlocks the presser-foot. As soon as the needle-bar again arrives at its highest point, the oscillating knife is moved to the position shown by the full lines in Fig. 5 and the presser-foot is raised. The stop-motion above described then disconnects the driving-shaft from the driving-pulley, leaving the machine at rest with the needle, presser-foot, and knife Q in the position last described, the driving-shaft having completed one rotation. The operator then removes the shoe from the horn and applies the other shoe of the pair thereto. The machine is again set in motion and another knot is formed, as before; but this time, after the needle has completed its upward movement, the oscillating blade q is closed upon the blade b^{15}, and thereby caused to sever the cord, the plate r and blade Q at the same time grasping the end of the main cord and holding it for the next operation. This completes the operation of tying together a pair of shoes, the machine being automatically stopped after the severing of the cord.

It will be observed that the horizontal arrangement of the horn and the vertical arrangement of the needle and presser-bars contribute materially to the convenience of the machine by enabling the operator to more easily apply and remove the work and to inspect the same during the operation.

The knot-tying mechanism is operated by the longitudinal movements of the shaft e within the horn, and the head g, shaft e, and the knot-tying devices operated thereby are arranged so that they take up but little room; hence the horn can be made slender or contracted, so that it can enter the smallest shoes.

As the several operations required in tying the knot are accomplished by one revolution of the main shaft, it is desirable to provide some means to prevent more than the one revolution at the time required. In Fig. 2^A a treadle is illustrated, which accomplishes the desired result. Hinged to a pivot t are the levers t' T, the former being connected to the lever a^7 by a chain a^9. T is the treadle proper, to which is pivoted at t^8 the tripping-lever t^2. Said lever t^2 is provided with a projecting lip t^9, resting upon the end of the lever t', and two projections t^3 t^4, which come in contact with the base when the treadle is forced down. A spring t^5 holds the treadle in its elevated position. When the treadle T is depressed, it carries with it lever t', by which, through the connected chain a^9 and lever a^7, the clutch is released and thrown into position, starting the main shaft. Further movement of the treadle downward brings the projections t^3 and t^4 in turn against the base, which throws the upper part of the lever t^2 outwardly, releasing the lever t' and allowing the spring a^8 to force the arm a^7 in position to engage the clutch-block as it completes its revolution. It will be seen that no further rotation of the shaft can be made by releasing the clutch until the foot is removed from the treadle T, allowing it to ascend and making the connection between the lip on t^2 and the end of the lever t'.

I claim—

1. In a shoe-tying machine, the combination, with a horn or work-support, a presser-foot co-operating therewith, cutting mechanism carried by said presser-foot, and a thread-carrying needle, of a knot-tying mechanism composed of a rotating and longitudinally-reciprocating shaft within said horn, a head rotatively engaged with said shaft, a stop whereby said head is prevented from moving endwise with the shaft, a loop-engaging hook pivoted to said shaft and having a connection with the head, whereby it is moved inwardly when the shaft is moved endwise in one direction, and a second loop-engaging hook pivoted to the head and adapted to retain the end of the loop and draw the same through the body of the loop during the endwise movement of the shaft in the opposite direction, as set forth.

2. In a shoe-tying machine, the improved knot-tying mechanism composed of the rotating and longitudinally-reciprocating shaft having an end hook, the head g, rotatively engaged with said shaft and prevented from reciprocating therewith, the piece i, pivoted to the shaft and provided with a hook i^2 and with a slot i^3, engaged with a fulcrum attached to the head, and the spring-controlled hook j, pivoted to the head, as set forth.

3. In a shoe-tying machine, the combination of the rotating and reciprocating shaft e, the head g, rotatively engaged therewith, a stop, as g', whereby said head is prevented from moving endwise with the shaft, the loop-engaging hooks i^2 and j, pivoted, respectively, to the shaft and head, one of said hooks being engaged, as described, with a fulcrum in the head, while the other is pressed inwardly by a spring, and a fixed cam whereby the spring-pressed hook is displaced at a given point in the rotation of the head, as set forth.

4. In a shoe-tying machine, the combination, with the shaft e, head g, and hooks i^2 and j, of the link d, jointed to said shaft, the lever d', pivoted at one end to a fixed support and at the other end to the link d, and a driving-shaft geared to the shaft e and having a

cam engaged with the lever *d*, whereby the latter is oscillated and the shaft *e* reciprocated, as set forth.

5. In a shoe-tying machine, the combination, with a reciprocating needle, a work-supporting horn, and knot-tying mechanism within said horn, of the presser-foot having an opening, one side of which constitutes the shear-blade b^{15}, the shear-blade Q, pivoted to the presser-foot and co-operating with the blade b^{15}, and mechanism for oscillating said blade Q, as set forth.

6. In a shoe-tying machine, the combination, with a reciprocating needle and knot-tying mechanism, of the presser-foot having the fixed shear-blade b^{15} and the spring-pressed cord-holding plate *r*, the shear-blade Q, pivoted to said foot and pressed downwardly thereon by the plate *r*, and mechanism for reciprocating the pivoted blade, the said plate *r* holding the cord against the upper surface of the blade Q, as set forth.

7. In a shoe-tying machine, the combination, with a reciprocating needle and knot-tying mechanism, of the presser-foot having the shear-blade b^{15}, the shear-blade Q, pivoted to the foot, the sleeve or enlargement on the driving-shaft having the cam-grooves connected by an opening b^8, the pivoted lever b^{10}, having a pivoted shoe adapted to run in said grooves, and the rod b^{13}, connecting said lever with the blade Q, as set forth.

8. In a shoe-tying machine, the combination of the driving-shaft, the knot-tying mechanism composed of the shaft *e*, having the hook *e'*, the head *g*, and hooks *i*² *j*, the gears *e f*, connecting the driving-shaft with the shaft *e*, said gear *f* arranged to permit the reciprocating movement of the shaft *e*, means for reciprocating said shaft, the driving-pulley normally loose on the driving-shaft and provided with a projection, as a^6, a collar affixed to said driving-shaft and provided with a spring-impelled key or latch adapted to engage said projection, and a wedge-shaped lever which normally stands in position to retract the key or latch, as set forth.

9. In a shoe-tying machine, the combination of the horizontally-arranged horn or work-support, the horizontally-arranged driving-shaft, the non-reciprocating head *g* in said horn, the horizontal shaft *e*, adapted to move lengthwise through the head and in the horn, and knot-tying devices co-operating with said shaft and head within said horn, said shaft, head, and knot-tying devices being arranged so that the horn is enabled to be contracted in size, so as to be capable of entering the smallest shoes, connections between the shaft *e* and the driving-shaft, whereby the shaft *e* is horizontally reciprocated, the vertically-arranged needle and presser bars provided, respectively, with a needle and a presser-foot, and devices communicating motion from the driving-shaft to the needle and presser bars, as set forth.

10. In a shoe-tying machine, the combination of the horn or work-support, the knot-tying mechanism, the vertically-movable presser-foot D, the presser-bar D^3, having a rib D^4, the gripping-piece *m*, slotted to receive said rib and normally held by a spring in position to permit said rib to move freely, the needle-bar-actuating lever B, and intermediate devices whereby when said lever is depressed the gripping-piece is displaced and caused to lock the presser-bar, and when the lever B is raised the gripping-piece is released and allowed to resume its normal position, as set forth.

11. In a shoe-tying machine, the combination of the horn or work-support, knotting devices below the same, and the presser-foot having an orifice b^{17}, a portion of which constitutes a guide and lateral support for the needle, while another portion constitutes a guide between which and the needle the tying-cord passes, and a downwardly-projecting flange D^6 at one side of said orifice, whereby space is left for the cord under the cord-guiding portion of the orifice and between the presser-foot and the work-support, as set forth.

12. In a shoe-tying machine, the combination, with the knot-tying mechanism, of the oscillating blade Q, the presser-foot having the orifice b^{17}, one side of which constitutes a blade b^{15}, and the recess or depression d^8, for the passage of the cord under the oscillating blade, as set forth.

13. In a shoe-tying machine, the combination of the presser-foot having a shear-blade formed on it, the oscillating shear-blade pivoted to said foot, the clamping-plate vertically movable in guides in the foot and bearing on the oscillating blade, and a spring whereby said plate is pressed against said blade, as set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 25th day of February, A. D. 1889.

ALBERT E. AYER.

Witnesses:
F. H. HATHORNE,
C. F. BROWN.