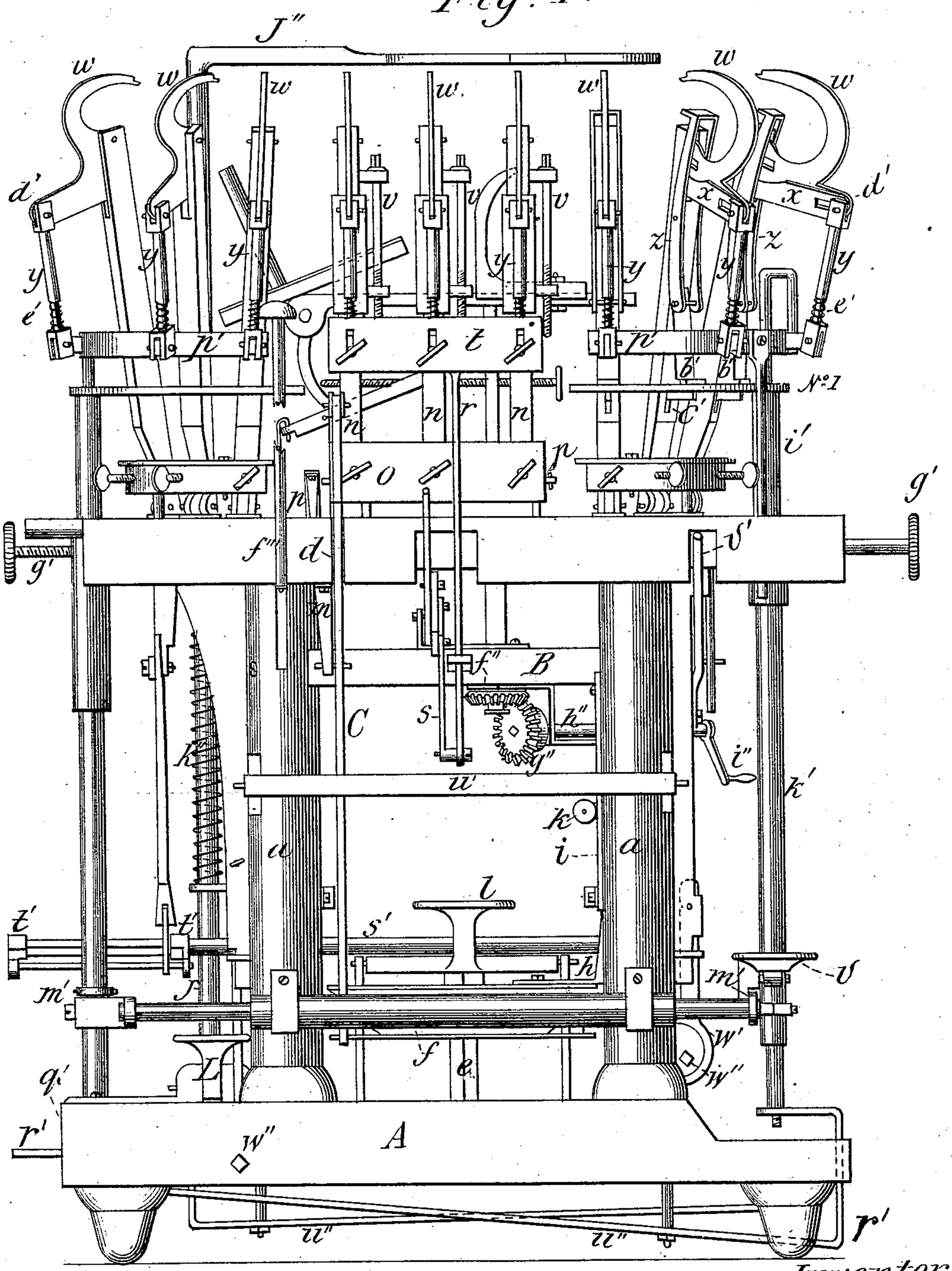
4 Sheets—Sheet 1.

O. REDMOND.

Machine for Lasting Boots and Shoes.

No. 227,132. **Patented May 4, 1880.**

Fig. 1.



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Inventor:
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Machine for Lasting Boots and Shoes.

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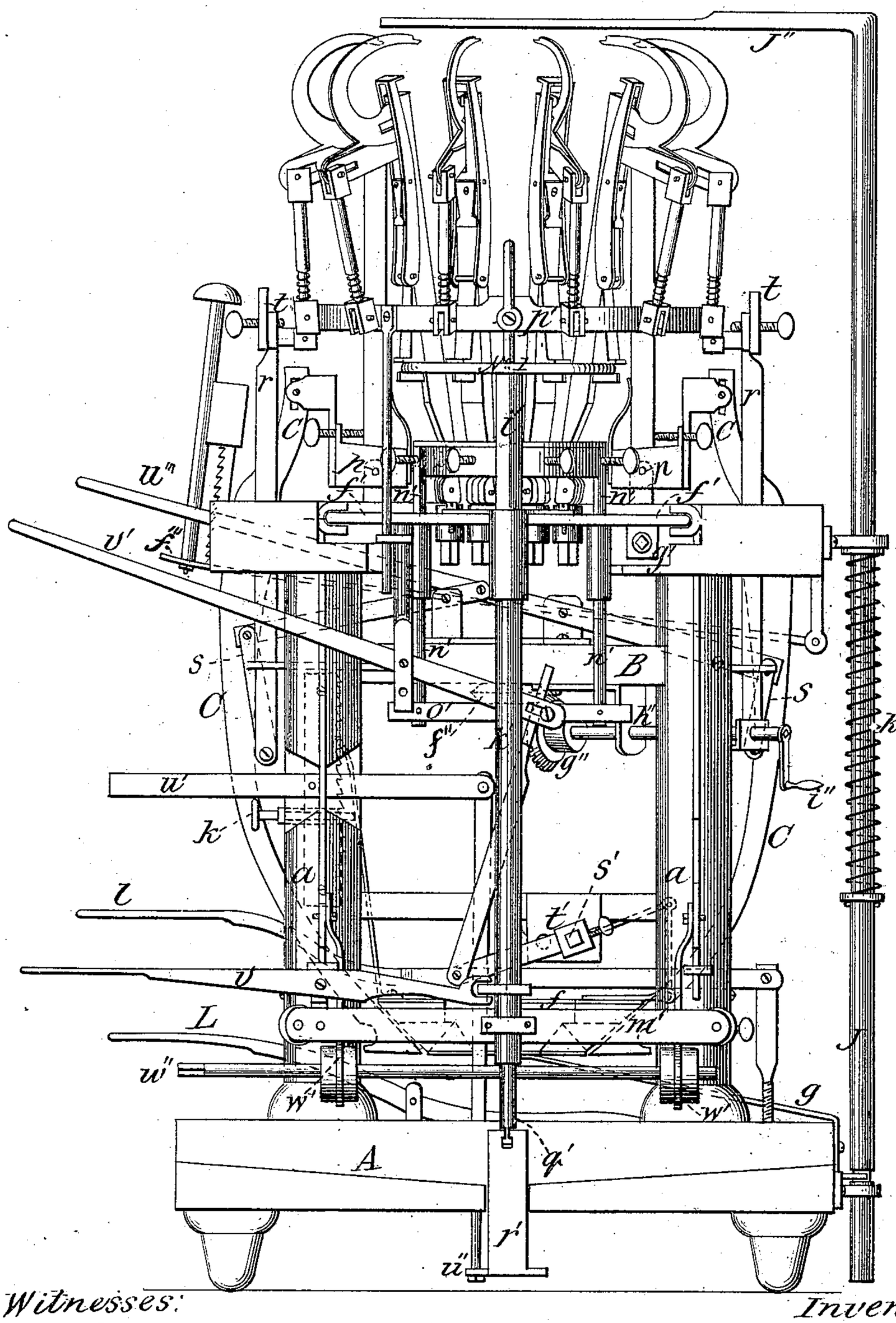
Fig. 2.



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Machine for Lasting Boots and Shoes.

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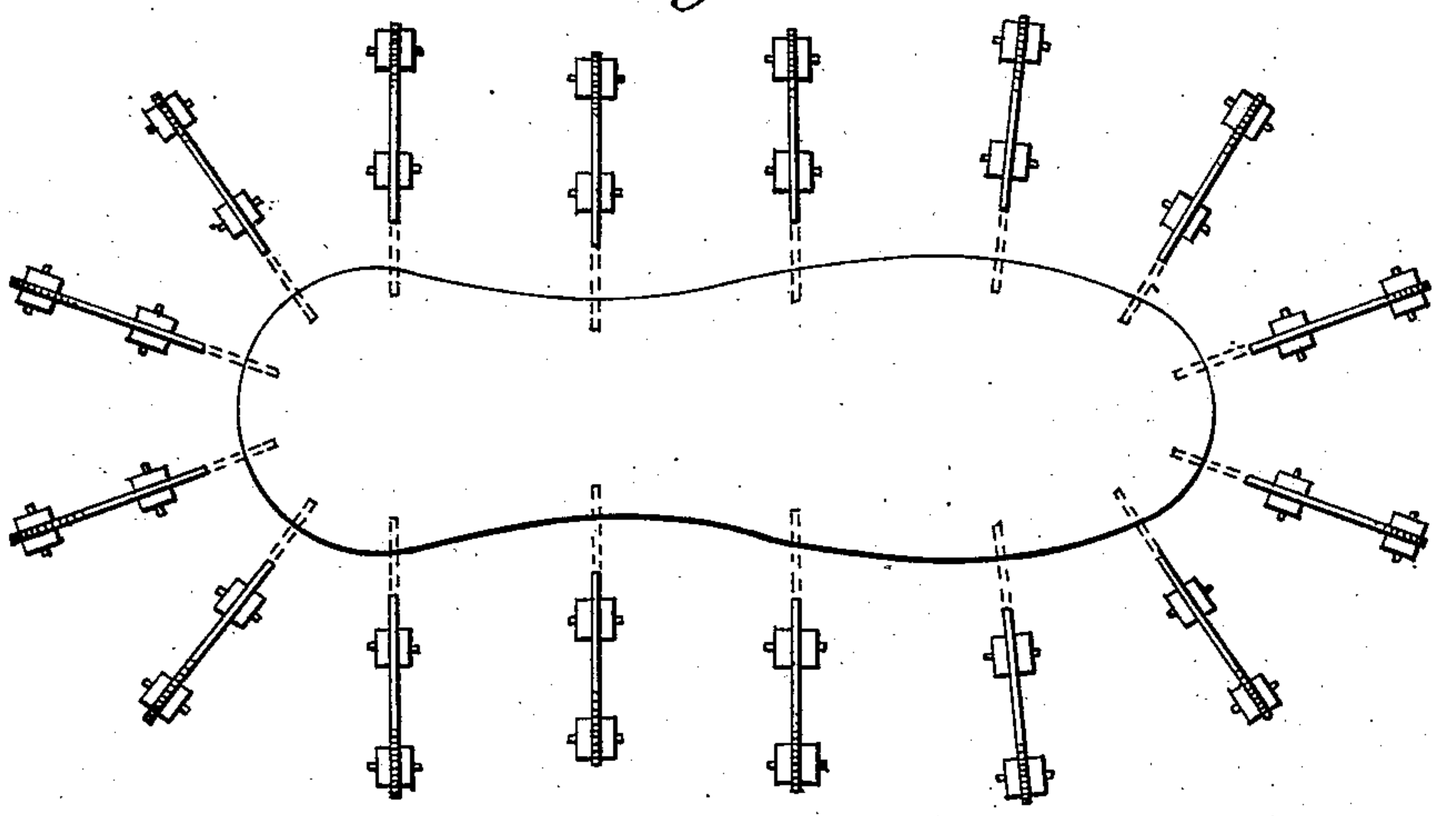
Fig. 3.



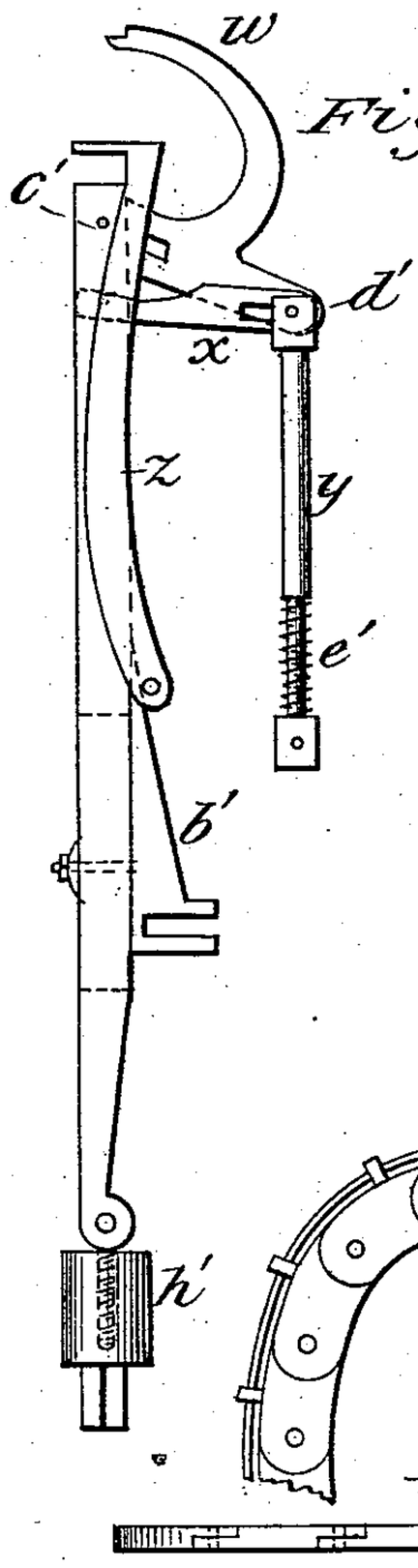


Fig. 4.

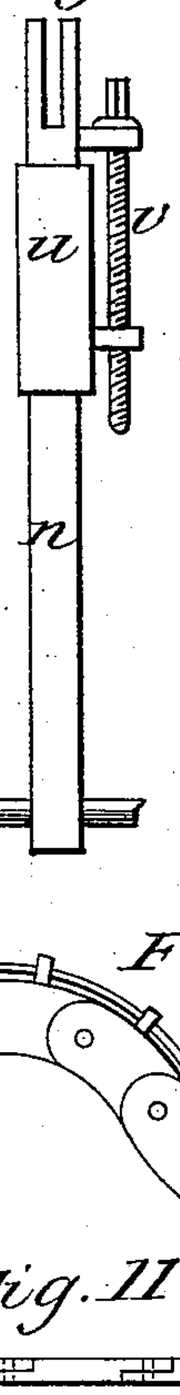


Fig. 5.

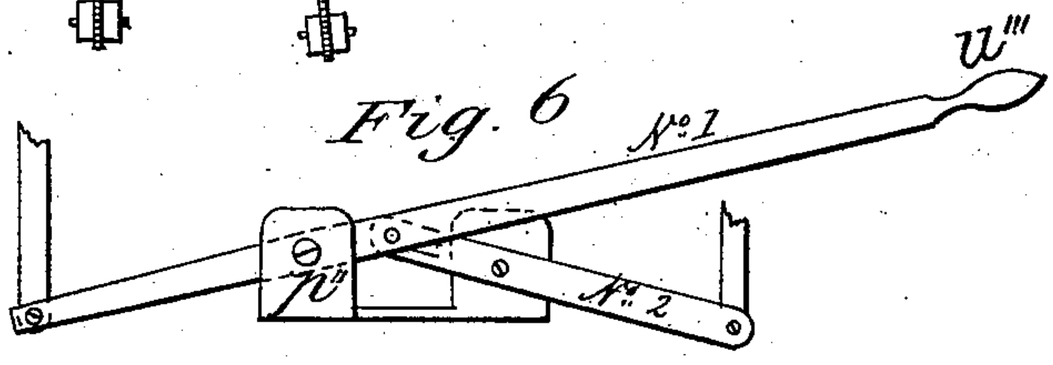


Fig. 6.

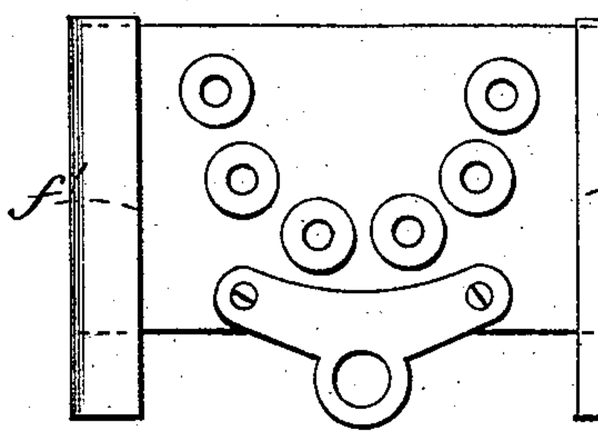


Fig. 7.

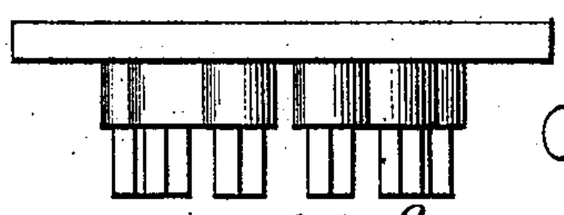


Fig. 8.

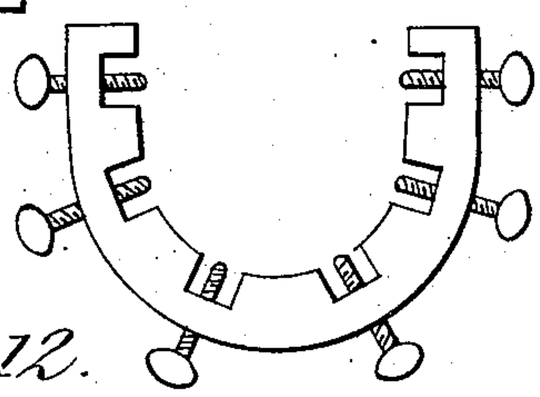


Fig. 9.

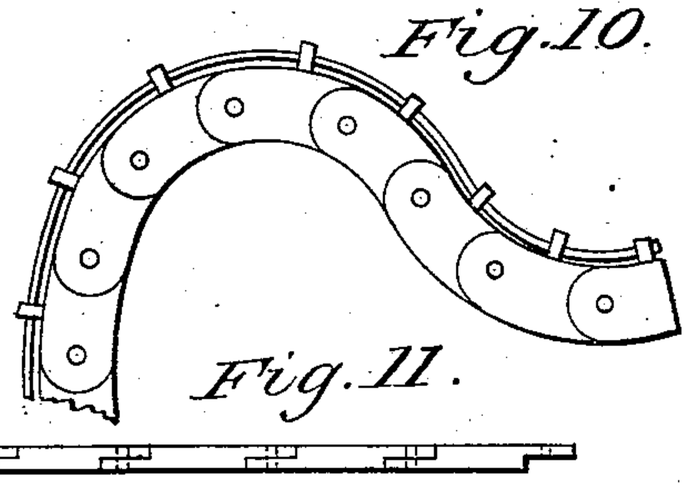


Fig. 10.

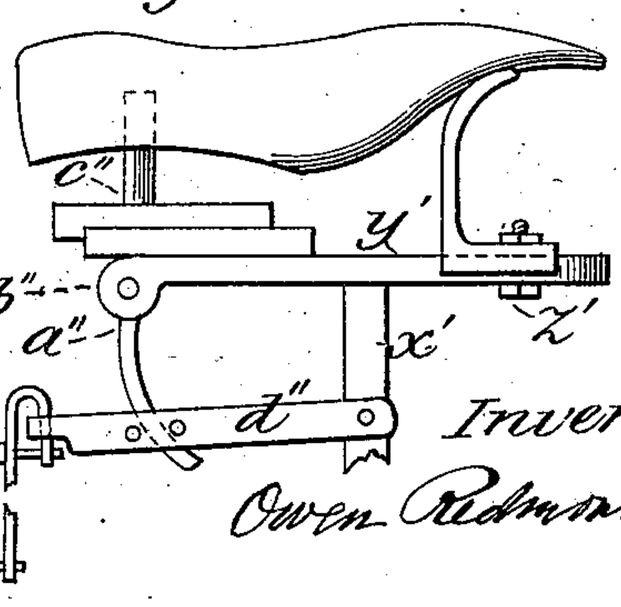


Fig. 12.

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Fig. 13.

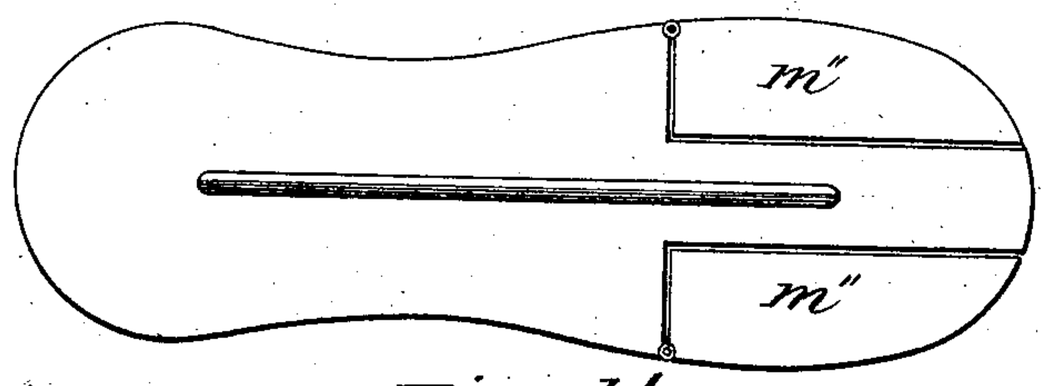


Fig. 14.

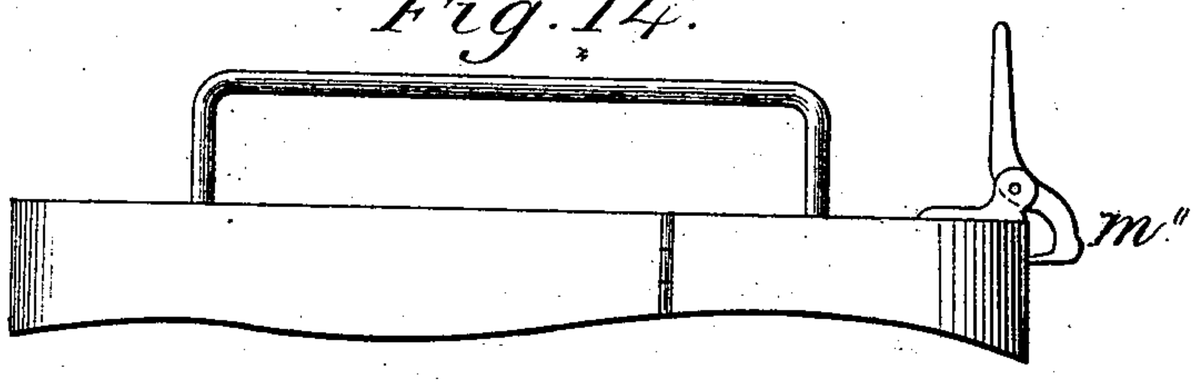
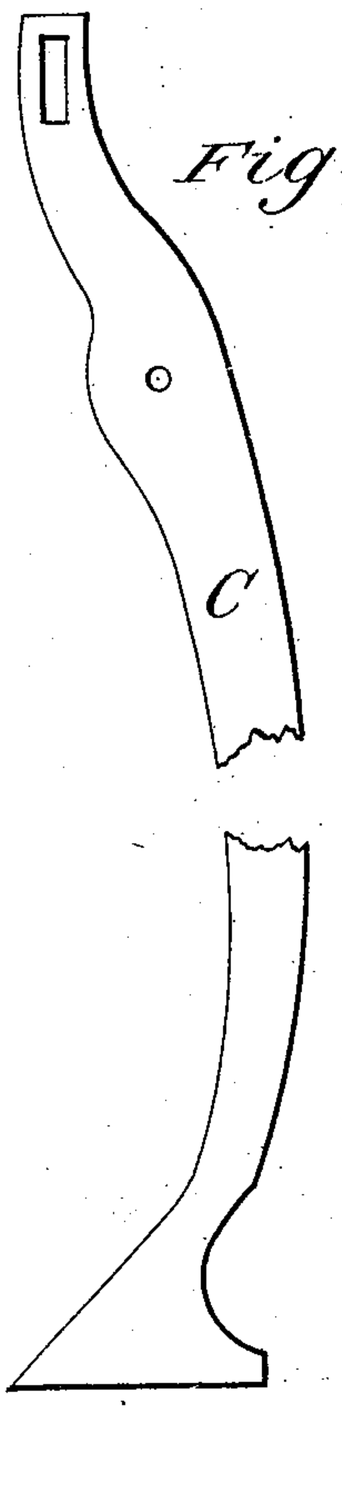


Fig. 15.



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UNITED STATES PATENT OFFICE.

OWEN REDMOND, OF ROCHESTER, NEW YORK.

MACHINE FOR LASTING BOOTS AND SHOES.

SPECIFICATION forming part of Letters Patent No. 227,132, dated May 4, 1880.

Application filed October 14, 1879.

To all whom it may concern:

Be it known that I, OWEN REDMOND, of Rochester, Monroe county, and State of New York, have invented a new and useful Improvement in Machines for Lasting Boots and Shoes, which invention is fully set forth in the following specification, reference being had to the accompanying drawings.

The object of my invention is to last boots and shoes, or, in other words, to rapidly turn the upper-leather or other material of a boot or shoe to be lasted in a perfect manner over the edge of the last, and so retain it until it is tacked or otherwise permanently secured to the insole, previously attached to the sole of the last.

Figure 1 is a side elevation of the machine. Fig. 2 is an end elevation thereof. The other side and end will be understood by these views. Fig. 3 is a horizontal view of all the upright levers surrounding the last. Fig. 4 shows one of the upright levers, with requisite attachments, which form the groups that last the toe and heel of a boot or shoe. All these levers and their attachments are similar. Fig. 5 shows one of the levers that operate on the shank of a boot or shoe, having an adjusting-screw attached for extending or contracting the lever. Fig. 6 is a view of a compound lever. Fig. 7 is a plane or horizontal view of a stock in which the levers for the toe or heel are inserted. Fig. 8 is a side view of Fig. 7. Fig. 9 is a horizontal view of a compound driver. Fig. 10 is a plan of a jointed flexible compressor having a wire spring running along one edge thereof through several eyelets, which are screwed into the edge of the compressor. Fig. 11 is an edge view of the aforesaid compressor. Fig. 12 is a view of the last-holder or device for holding the last in proper position while the boot or shoe is being lasted. Fig. 13 is a plan or horizontal view of a form or stay, which may be made of either iron or wood. Fig. 14 is an edge view of the same. Fig. 15 is a side view of one of the triangular cam-levers.

The machine ought to be composed of iron and steel, and the frame thereof could be made in one casting.

The frame A, Fig. 1, consists of a base fourteen inches square and about one inch thick and a top or platform consisting of two separate pieces. The base and top aforesaid are connected by four round or square columns, *a a*, about two feet high each, which stand near the angles of the base of the frame, and two of them are connected to a diagonal brace, B, which lies horizontally about six inches under the top of the frame. The two pieces which form the top of the frame stand about five inches apart, and each piece is supported by two of the columns. Including the space between them, they cover the same area as the base of the frame. The frame stands on four short feet (four inches long) cast in the base near its angles.

Two levers, C C, Fig. 2, similar in form, are made to enter slots, one at each side, in the top of the frame at *d*, and hang freely therein upon pins. The longer arm of each lever extends downward near to the base of the frame, and the shorter arm extends above the frame five inches, more or less. The lower end of each is formed into a triangular cam.

A square guide-bar, *e*, Fig. 1, is secured firmly in the center of the base of the frame in a vertical position, and a sleeve is fitted to move freely on this guide-bar, and the sleeve forms the center of cam *f*, Fig. 1. This cam is six or seven inches square, and it stands in a horizontal position, having its sides beveled, and when in position on the guide-bar it rests upon the triangular cams of the levers C C, and the bevels on the cams and levers coincide.

A flat steel spring, *g*, Fig. 2, is bolted at one end to the base of the frame of the machine, and the other end thereof rests under and forcibly presses up against the under side of the cam *f*, and a piece of flat steel of spring temper is screwed to the top of said cam at *h*, Fig. 1, close to one of the columns. The upper end of this piece, which stands upright, forms a pawl, which enters a ratchet that is screwed to the column at *i*, Fig. 1. A bolt enters through a sleeve or short tube attached to the said ratchet at *k*, and one end of this bolt rests against the pawl. The outer end of the bolt has a projecting knob at *k*, by which it may be pressed against the pawl when intended to disengage the latter from the ratchet.

Foot-lever *l*, Figs. 1 and 2, having its fulcrum at the back of the frame of machine, se-

cured in the base thereof, lies over the cam *f* near the center of it, and extends a few inches beyond the front or opposite side of the frame, and is provided with a flat piece or treadle at its end.

A spring, *m*, Fig. 1, is attached by one end to the top of the frame of the machine, and the other or lower end thereof overlaps a stud in the longer arm of lever C. A similar spring operates the other lever C on the opposite side of the frame, and thus, by the pressure of the springs, the long arms of the levers C C will always tend to move inward, while the shorter arms will have the opposite tendency.

The upright levers *n n n*, Fig. 1, which last the shank of a boot or shoe, are placed in two equal rows, one at each side of the last, (when the latter is in proper position in the last-holder,) opposite its shank, and they are mounted in an oblong frame, *o*—that is, each row of levers is supported on a round bolt which passes through a suitable hole in the lower end of each lever, and the bolt has its bearing at each end in the ends of the frame *o*, where it is secured by a pin, and this frame, together with the levers aforesaid, is made to rest in two bearings that are bolted to the top of the main frame at *p*, Fig. 1, so that the frame *o* and the upright levers are retained in position by the same bolt, and are free to partially rotate thereon, each independent of the others.

An adjusting thumb-screw is screwed through the side of frame *o* opposite to each upright lever, and the end of the screw is always in contact with the same lever. Each of the levers is pressed by a strong spring on the opposite side to that in contact with the set-screw. The springs being bolted to frame *o* at their lower ends, their upper ends press the levers. All of these upright levers intended for the shank of a boot or shoe are made to spread from each other at top in a direction lengthwise of the last, or to approach each other at pleasure, by turning the two long horizontal screws, which, respectively, control the proper adjustment of said levers at opposite sides of the last, for which purpose each screw is made with a right-hand thread one-half its length and a left-hand thread on the other half. (See Fig. 1.)

A compound or double lever, Fig. 6, is bolted to the diagonal brace B, Fig. 1, and it consists of levers Nos. 1 and 2. Lever No. 1 swings on a stud in the support *p''*, which is screwed to the brace B. The fulcrum is placed a few inches from the center of the lever, one arm of which extends flush with the back side of the frame of the machine, and the other end extends beyond the opposite or front side a few inches to form a handle, to be used in operating the machine. Each arm of this lever from its fulcrum is seven inches long, exclusive of the handle. Lever No. 2 swings on a stud in a separate standard or support from the foregoing, and its fulcrum is placed one inch and a half from one of its ends and two inches from the fulcrum of lever No. 1. These two levers lie close by and parallel to each other. A stud projects from an arm of lever No. 1 about two inches from its fulcrum, and enters a slot in the shorter arm of lever No. 2 at such a point that when the handle of lever No. 1 is depressed the opposite end of the same and the longer end of lever No. 2 are raised at the same moment, and the amount of elevation (two or more inches) at the ends of both levers is the same.

Two connecting-rods, *r*, Figs. 1 and 2, which slide vertically in studs attached to the frame of machine, are connected by links *s*, one to each of the two levers Nos. 1 and 2, aforesaid, at their lower ends, and are bolted at their upper ends, each to a cross-plate, *t*, which, with the connecting-rod *r*, is in the form of the letter **T**. These cross-plates have several vertical slots cut through them, corresponding with the number of upright levers *n*, which operate on the shank of a boot or shoe. These levers are made with a sliding joint, *u*, Fig. 5, for the purpose of extending and contracting them to correspond with the curves of the lasts at their shanks, and the extension is effected by the adjusting-screw *v*, attached to the lever.

The attachments to this lever for the shank of a boot or shoe are a curved piercing-lever, *w*, radial link *x*, an elastic connecting-rod, *y*, made such by a sliding joint and spiral spring, and the attachments to the lever for the toe and heel are a curved piercing-lever, *w*, radial link *x*, an elastic connecting-rod, *y*, made as above described, a flanged lever, *z*, extending nearly half-way down the upright lever and straddling the same, a flat spring screwed to upright lever and pressing the flanged lever, a movable inclined plane, *b'*, which operates the flanged lever, and a fixed inclined plane at the lower end of the upright lever.

The curved piercing-lever *w* is a piece of steel, made somewhat in the form of a sickle, about two and a half inches long from end to end in a straight line. One half of this piece is straight, one-eighth of an inch thick, and half an inch wide. The other half, which forms the curve or hook, tapers abruptly in width to the end, where it is made into a sharp square spur about one-eighth of an inch long, having a shoulder at the butt of the spur. It might be useful in some cases to have a pair of spurs in each piercing-lever set at a diverging angle, so that when pressed into the leather or cloth the lever will do its work more effectually.

There is a slot cut in the center of the piercing-lever at *c'*, three-eighths of an inch long and one-eighth inch wide, through which a fulcrum-pin enters, and a hole is drilled through the end at *d'* to receive a screw.

There is a slot cut through the upper end of the upright lever, in which the flat and straight part of the curved piercing-lever is made to fit, so as to move freely therein upon the fulcrum, which crosses the slot.

A radial link, *x*, is connected at one end by a screw to the flat end of the piercing-lever at *d'*, and the other end of it is connected to the upright lever by a screw or pin placed about half an inch below the fulcrum of the curved piercing-lever. If, now, the curved piercing-lever is caused to vibrate on its fulcrum it will describe an eccentric curve at its spur end, caused by the movement of the link *x* about its fulcrum. This peculiar motion of the curved piercing-lever is indispensable at the toe and heel of a boot or shoe, as by it the leather of the upper, while being turned over the edge of the last, will be stretched with a suitable strain to produce a close and perfect lap over the insole on the last.

The elastic connecting-rods *y*, of which there is one for each upright lever, are all similar. This rod is made with a telescope-joint, having a spiral spring, *e'*, encircling it between shoulders. The parts of the rod are retained in the desired positions by a slot and pin, which allow the joint to slide inward, and thus shorten the rod, and the reaction of the spring will extend it. The necessity for elastic connecting-rods arises from the irregular character of the work of lasting, so that if too much strain is brought on the leather at any one or more points the rods at or opposite these places will yield, and so check the strain. The lower ends of these connecting-rods are united by suitable joints to the slotted cross-plates which form the heads of the T-shaped connecting-rods *r*, Fig. 2, before described, and are provided with thumb-screws at their jointed ends below, by which they may be adjusted up or down in the slots of the T-formed connections.

The upper ends of the elastic connecting-rods are slotted to receive the ends of the piercing-levers *w*, together with the ends of the radial links *x*, in the same slots, all kept in place by a screw which passes through them, and on which they may move freely. The two T-shaped connecting-bars *r* are moved vertically by the compound lever Fig. 6.

The foregoing portion of the specification is in some measure confined to a description of the mechanism by which the machine is made to do the lasting on the shank of a boot or shoe.

The continuation of the specification relates chiefly to the device for lasting the toe and heel of a boot or shoe on the same frame and at the same moment that the shank is lasted.

A platform or stock, Fig. 7, is made to slide in an adjustable frame, *f'*, Fig. 2, having grooves for that purpose, which frame is placed in the open space between the two separate pieces which form the top of the main frame of the machine. One such platform is intended for the toe, and a similar one is placed at the opposite end of the machine for the heel of a boot or shoe, and the platform is provided with a long screw, *g'*, by which it may be shifted backward and forward horizontally any suitable distance in the grooves, Fig. 2. The platform will be moved in a direction lengthwise of the last, the purpose of which is to adapt the machine to last boots and shoes of different lengths. The screw *g'* aforesaid is screwed into a stud in the side of the sliding stock, and it has a thickened end, in which there is a groove or neck. It tapers off from the groove to a point in a conical form.

A spring-latch is connected to the frame *f' f'*, in which the stock slides, and the end of it is fitted to enter the neck in the screw *g'*. This holds the screw and prevents it having any play endwise, allowing it to revolve freely at the same time. The use of this arrangement—the latch and neck—is to allow the whole of the toe and heel machinery to be withdrawn from the main frame readily whenever it may be necessary to remove it. The screw *g'* is for the purpose of fixing the stock at any required point in the frame *f' f'*.

Six or seven half-inch holes are drilled vertically through the platform or stock, and they are spaced evenly around semicircularly, or nearly so. (See Fig. 7.) An equal number of cylinders, having a square shank on the lower end of each cylinder, are fitted in the holes aforesaid. The cylinders, however, turn freely in the holes. Each cylinder has a quarter-inch hole drilled in its center to a depth of inch and half, leaving the square shank solid, and the holes are screwed or tapped with a coarse tap.

The cylinders are retained in their places in the stock by a shoulder below and a washer or collar above the stock, riveted over, so as to leave no end play in the holes. The square end is to receive a socket-key, by which the tubes may be turned in their seats.

The lower end of upright lever, Fig. 4, for operating on the toe and heel, is jointed to a screw, which is screwed into the cylinder aforesaid in the stock. By revolving the cylinder with a hand-key the upright lever will be raised or lowered, as may be desired, and therefore the whole of them for heel and toe may be adjusted at their upper ends to correspond with the curvatures of the toes and heels of different forms of boots and shoes. One lever described explains the others for toe and heel. The difference in the curves of the soles of boots and shoes is not great, yet, unless the machinery is made to vary with these differences, it will be less useful.

Lever *z*, Fig. 4, consists of two sides, a cap or top piece which connects the sides above and forms a projecting lip or flange and a stud which connects the sides at their lower ends. This lever is nearly half the length of the upright lever, on which it is mounted. The sides are distant from each other the exact thickness of the upright lever, which they straddle, and are connected to the said upright lever by a screw, which passes through the center of the flanged lever and through the upright lever at such a point that the flange of the straddling-lever will clear the top of the upright lever about one-eighth of an inch. This lever is curved from its fulcrum-point to its lower end enough to allow the stud

to which the sides are riveted to rest on the side of the upright lever, while the flange on the upper end will stand directly over the top of the upright lever, its edge flush with the side thereof opposite the side on which the stud rests.

A wedge-formed cam, *b'*, Fig. 4, is fitted to move its whole length in a slot through the upright lever. It slides freely on one side of the said lever, and is retained there by a right-angled lug, which passes through the slot and is held by a cross-pin. The thin end of the cam rests under the stud in the flanged lever. When the cam is caused to slide on the upright lever under the stud of the flanged lever it causes the flange at top to project over the top of the upright lever, and the extent of projection of the flange beyond the upright lever will be in proportion to the thickness of that part of the cam directly under the stud aforesaid. The cam is provided with a deep notch or recess at its thick end to receive into it an arm of a driver, *i'*, Figs. 1 and 2, which is common to all the cams—that is, it acts on all the wedge-cams at one end of the last at the same moment. This driver is a curved piece of horseshoe form, and is always seated in the recesses in the group of wedge-formed cams.

A long tubular stem, *k'*, is screwed at right angles in the side of the driver, and extends downward near the base of the frame of machine, where it enters a journal-box or sleeve attached to a horizontal sliding frame, *m'*, which is connected with the main frame near its base, and its upper end, close to the driver, passes through a sleeve on the sliding stock, (see Figs. 2 and 7,) so that the movement of the driver will be vertical.

There is a fixed inclined plane on the side of the upright lever, Fig. 4, at its lower end, which is for the purpose of receiving the impact of the driver, Fig. 9, in its upward movement. This driver is also of horseshoe form, and lies in contact with all the inclined planes of the group. It is firmly secured to two stout guide-rods, one at each side thereof. These rods *n' n'* enter a pair of short tubes in the sliding stock, Fig. 2. The tubes are a part of the stock, and must be riveted firmly or otherwise properly secured thereto.

The guide-rods *n' n'* are fitted to slide accurately in the aforesaid tubes, and their lower ends, after being passed down through the tubes, are secured to a stout cross-head, *o'*, Fig. 2, by mortise and pin.

Set-screws, equal in number to the number of upright levers used in the group for toe or heel, are screwed horizontally through the driver. The end of the set-screw which protrudes enters a bevel-piece, in which it turns freely and is retained therein. This bevel-piece touches the inclined plane on the upright lever, and the faces of both bevels are made hard and smooth in order to slide over each other with ease, or the bevel-piece might be omitted and let the screw itself strike the inclined plane. (See Figs. 1, 2, 4.)

The upright levers being all screwed into the stock at the joints below, and each lever in its appropriate recess in the driver, with the set-screw at the back of it, the levers all standing in a semicircular group, if now the set-screws are turned to the right all the levers, yielding on their joints below, will be moved inward at the top, and so diminish the size of the form or outline made by the levers, and if the set-screws be reversed the levers will diverge and enlarge the figure to whatever curve their combined cross-sections may have formed. Their outward movement is produced by the pressure of light springs attached to the sliding stock at their lower ends. It will be, therefore, seen that by means of the set-screws the levers may be made to adapt themselves to any required form of toe or heel of a boot or shoe.

There is a guide-piece, Fig. 9, made of thin steel, having recesses in it to fit the cross-sections of all the upright levers, screwed to the top of the driver. These guides will retain the upright levers in the proper places when being moved forward by either the set-screws or the upward action of the driver, causing them to converge accurately and vary the curve suitably to the work to be performed.

All the telescope connecting-rods *y*, Fig. 1, which operate on the toe and heel of a boot or shoe, are attached, each by a rule-joint, to semicircular frame *p'*, Figs. 1 and 2. This frame is screwed to the upper end of a long rod, *q'*, which is made to pass down freely through the tubular stem *k'* of driver No. 1, and it extends two inches below the tube *k'*, and rests on a horizontal lever, *w''*, Fig. 1, which lies under the base of the main frame, the end of which lever protrudes at *r'* and sustains the aforesaid rod. The frame *p'* is made steady by a guide-rod which moves in a stud in the sliding stock, Fig. 2.

It has been shown that the flange on the upper end of the flange-lever, Fig. 4, stands one-eighth of an inch above the top of the upright lever which, it straddles. The purpose of the space between the flange and the top of the upright lever is to receive within it a jointed flexible compressor, Fig. 10, made flexible edgewise and thin enough to be inserted in the aforesaid grooves and rest against small friction-rollers therein.

The flexible compressor is made long enough to lap around the toe or heel of a boot or shoe, or it might be made of any desired length, and as the joints are numerous and as near to each other as possible the compressor is adapted to conform to all the curves of the sole of a boot or shoe.

There is a wire spring attached to the edge of the compressor, which passes freely through several eyelets which are screwed into the edge of the compressor. The spring is bowed when made and inserted through the eyelets, and it is reduced in size when compressed, and when let free the spring will spread it outward. The compressor is kept in its place in

the grooves by being connected to a pin in one of the central flanges of the group, and the hand of the attendant, aided by the spring aforesaid, will adjust it to the work.

A rock-shaft, *s'*, Fig. 2, has its bearings in two supports that are bolted each to two of the columns of the frame of the machine, one at each end thereof. This shaft lies lengthwise of the machine. An arm extends from it to the back of the machine, and this arm is jointed to a short link, which is also jointed at its lower end to the upper edge of the square cam *f*, Figs. 1 and 2. Two other arms, *t' t'*, extend from the rock-shaft in the opposite direction to that of the arm described. Each is provided with a hub or thickened end, in which a square hole is cut to fit the end of the rock-shaft, which is made square at both ends to fit the holes in the arms. Two such arms are fitted on each end of the shaft, and each pair of arms are united at their outer ends by a round steel rod, which enters freely through suitable holes in the said arms.

A connecting-rod, which stands upright or nearly so, having a hole in its lower end, is slipped over the aforesaid round rod of the rock-shaft, and the upper end of the same rod is formed with a fork whose tines are three or four inches long, the use of which is to receive within it the cross-head *o'* of the driver, Fig. 2—that is, the connecting-rod being attached to the arms of the rock-shaft, as described, by its lower end, the upper end thereof is formed to a fork, in which the cross-head rests and by which the said cross-head may be raised more or less, at pleasure. The same combination is attached to each end of the rock-shaft.

Two levers, *u' u'*, Figs. 1 and 2, which have their fulcrums in two of the columns of the main frame, one at each end of the machine, are connected to each other by a cross-bar, Fig. 1, which is welded to the outer ends of said levers. This bar serves as a handle by which the two levers may be operated at the same time. The levers are jointed at their inner ends to two vertical rods, which pass down through the base of the frame of machine and enter the sides of two long levers, *u'' u''*, that lie horizontally under the said base, and are secured therein by nut and screw on the end of the rods.

The driver which moves the wedge-cams is operated by the foot-lever, Fig. 2, and the driver which converges the upright levers on the toe or heel is operated by the rock-shaft *s'*, Fig. 2. There is a supplemental lever, *v'*, by which the driver can also be worked. This lever has its bearing or fulcrum in a stud secured to the sliding stock, Figs. 7 and 8. The longer arm thereof extends beyond the front of the machine and forms a handle, and the inner arm has a slot through it at its end, which takes a flat-headed bolt that is secured into the cross-head *o'* of the driver No. 2 in the sliding stock, Fig. 2. This lever is capable of elevating or lowering the driver No. 2 to its utmost limit independent of the rock-shaft *s'*, and its usefulness consists in the fact that if, at any time, the upright levers should not be brought home around the toe or heel of the last correctly by the motion of the rock-shaft, which is moved by the foot-lever, then the attendant can bring them home by the aforesaid hand-lever. Similar levers are used for heel and toe.

The stock or platform, Figs. 7 and 8, slides in a frame, *f'*, which is supported by two upright bars permanently connected at right angles to the plane of the said frame, one at each side thereof. These bars pass accurately through slots in the top of the frame of the machine, and extend downward nearly to its base, where their lower ends enter a pair of slotted guides, which are screwed into the columns of the frame, one at each side of the machine.

Two connecting-rods, *w'*, Figs. 1 and 2, are attached at their upper ends, one to each of said upright bars, by a screw or stud, on which it plays, and the other ends of the rods are formed to a pair of similar rings, which fit on the two eccentrics or cams, which are keyed on the shaft *w''*, which lies across the machine, in bearings. The shaft has a square end to receive a socket-key, by which to revolve the cams when operating the machine in lasting.

Fig. 12 is a view of the last-holder or device for holding the last in proper position while the boot or shoe is being lasted.

x' is an upright square post of suitable size, having the transverse frame *y'* cast or forged solid to it at right angles. The frame *y'* has a slot through it about one inch and a half long to receive the bolt *z'*, by which the adjustable toe-rest is made fast to said frame at any desired point. The end of the frame at *b''* is jointed to the cam *a''*, which consists of a crooked arm that extends down a few inches below the transverse frame and a straight grooved piece forged solid to the crooked arm, which extends and swings lengthwise above the transverse frame. The groove in this piece is a dovetail groove and extends the full length of the piece, and its purpose is to receive within it the carrier *c''*, which consists of a beveled bar made to slide accurately in the groove of the cam *a''* and an upright arm that stands at right angles with the beveled bar. This arm is to receive the last upon it by means of a suitable hole made in the top of the same.

A link, *d''*, made of two flat pieces, is connected at one end to the post *x'* by a bolt, which goes through them, and on which it moves, and the other ends of the sides of the link are united by a stud, which keeps the sides apart about one inch, to which they are riveted.

The arm of the cam *a''* lies between the two plates of the link, and two bolts are fitted across the link, one at the concave side of the cam and the other at its convex side, close to the cam at both sides.

A connecting-rod having a turn or hook on its upper end is hooked over the stud in the end of the link, and is retained in its place by a screw which crosses the hook below the stud. The lower end of the connecting-rod is attached, by a fixed screw on which it plays freely, to the hand-lever *f''*, which lies across the frame of the machine, and which, by means of a pawl and ratchet, may be fixed at different positions to suit the requirements of lasting different sizes of boots and shoes.

The post *x'* is made to fit accurately and slide freely in a strong square tube, which stands upright and is fastened firmly in the diagonal brace B of the main frame of the machine. A long screw of suitable diameter is fitted, near to its lower end, in a fixed collar in the lower end of the square tube aforesaid. The screw is retained in the collar by a double shoulder to the bearing, so that it may revolve freely therein without the least motion endwise. The post *x'* has a hole of the proper size drilled through it lengthwise the full length of the screw, and is tapped or screwed the whole length to receive the convex screw aforesaid.

It may now be understood that if the post *x'* is placed in the tube it will rest on the end of the said screw, which, if it be revolved in its collar, will move the last-holder up or down, as may be required.

To produce the requisite revolution of this screw the two beveled-gear wheels are keyed one to the lower end of the screw and the other to the crank-shaft *h''*, to which a handle is attached at *i''*. By turning this shaft the last-holder may be raised or lowered to the desired point in a moment.

The vertical rod J, Figs. 1 and 2, having its bearings in the frame of the machine, has an arm, J'', at right angles from its top. The arm terminates in a plate or flattened piece, which, when swung around, lies horizontally over the middle of the last when the latter is placed in the last-holder. The rod J is encircled by a spiral spring, *k''*, which presses the rod downward, and the lower end of the rod rests in the end of a foot-lever or treadle, L.

Fig. 13 is a plan or horizontal view of a form or stay, which is a most essential part of the machine, without which it would be found inoperative. It is made of iron or wood, and its outline is somewhat like to that of the sole of a shoe.

Fig. 14 is an edge view of the same, and if made of iron its edge all around must be serrated to save the spurs or pointed ends of the curved piercing-levers from injury in piercing the leather. It is about three-fourths of an inch thick.

A different-sized form must be used for every different length of boot or shoe. It is formed on its under side to lie closely on the insole when placed on the last.

The edge of a wooden form should be made with soft straight-grained wood, and the grain thereof must be vertical when the form rests upon the last. For this purpose pieces a quarter of an inch thick, or more, may be glued on around the edge of the form, and the edge is beveled, making the form smaller at the bottom than at top.

Three or four claws, *m'' m''*, are hinged to the upper side of the form at toe and shank. Their use is that when the upper is placed on the last, the latter having the insole tacked to it, the form is then placed on the last (over the insole.) Two or three short spurs in the under side of the form hold it steady to the insole. The margin of the upper is now drawn up by hand over the edge of the form, on the toe first and shank next. The claws *m''* are then stuck into the leather by pressing their levers, and they hold it to the form.

That part of the form which lies over the toe of the last should be made with a pair of hinges, in order that it may be expanded to vary the width of the toe at pleasure by a lever and cam or some other contrivance, the reason for which is that when the upper is placed on the last it stands nearly at right angles with the sole thereof all around, except around the toe, where it forms a much greater angle with the sole and flares considerably. Therefore the form ought, as nearly as possible, to be made to extend toward the leather, that when the piercing-levers strike into the latter they shall be much diverged, so that during the inward movement of the upright levers, as well as during the turning of the leather over the edge of the last by the piercing-levers, the uppers shall be crimped around the toe uniformly previous to pressing the flexible leveler over it.

In lasting boots and shoes it may be found the most expeditious method to have several lasts of the same size and as many forms, and that an expert assistant should attach the insoles, forms, and uppers to the last previous to placing the latter in the machine for operation. The upright levers being now all expanded, the attendant operator places a last having the upper and form attached thereto, as already described, in the last-holder, and, adjusting it to the proper height and position, clamps it firmly by pressing down the knob of hand-lever *f'''*.

The operation of the machine is as follows: Foot-lever *l* is pressed down by the operator, which causes all the upright levers to converge and press against the upper, bringing it up to the edge of the form all around. The compound lever, Fig. 6, and the double lever *w' w'* are next pressed down by both hands at the same moment, which causes all the curved piercing-levers to seize and penetrate the upper opposite the edge of the form, the latter serving as a stay against the upper while being pierced. This being done the operator swings the arm J'' of the upright rod J around, and while doing so he lifts the rod in its bearings by pressing on foot-lever L, allowing the arm to rest under the handle of the form, Fig.

14. The operator now presses on the same lever, and suddenly lifts the form from the last and swings it back, and at the same moment he presses again upon the compound lever and the double lever *w' w'* with both hands at the same time, which causes the curved piercing-levers to turn the upper over the edge of the last all around with suitable stretching force. The operator now treads forcibly on lever *v*, which forces the wedge-cams *b'* upward under the flange or straddling-levers, causing the flanges of the said levers to be thrown forward over the leather that just before had been turned over the edge of the last by the curved piercing-levers, in doing which the flexible compressor, which always lies under the flanges, is pushed forward over the upper, compressing it suitably. The compressor having thus clamped the upper down close on the insole, it holds it there, and the piercing-levers at the toe and heel are now disengaged from the upper by reversing the double lever *w' w'*, leaving the edge of the upper, which extends beyond the compressor, to be tacked down to the insole either by hand or by a tacking-machine, or by what might answer the purpose as well as tacks—good cement.

It may not be necessary to apply the flange-levers and compressor on the shank of a boot or shoe, as there will be ample space between the piercing-levers on the shank and sides to tack the upper before removing the piercing-levers from there, and the upper at the sides being easily adapted may not require the application of the compressor.

It may be found best to swing the arm J'' of the lifting-rod J so that it will press on the handle of the form when the latter is on the last to keep it steady while the levers are piercing the upper, and then at the proper time slip the arm under the handle and lift the form from the last and swing it back out of the way until required for the next operation.

All the upright levers may now be made to recede from the last and caused to expand by pushing on the knob *k* of the disengaging-bolt and reversing, lifting the handle of the supplementary lever *v'*, and the last is disengaged from the last-holder by lifting the knob of lever *f'''*. The machine is then ready for repeating the operation.

I am aware that it is not novel to use a differential screw or screws for the purpose of adjusting this class of machines to adapt them for different-sized lasts, and such I do not claim as my invention.

I claim—

1. In a lasting-machine, the upright levers grouped around the boot or shoe to be lasted, in combination with the curved piercing-levers *w* and radial links *x*, as described.

2. In a lasting-machine, the upright levers grouped around the boot or shoe to be lasted, in combination with the curved piercing-levers *w* and the form or stay, as described.

3. In a lasting-machine, the form or stay, in combination with the claws *m'' m''*, upright levers, and curved piercing-levers, as and for the purpose described.

4. In a lasting-machine, the jointed flexible compressor, in combination with the upright levers and flanged or straddling levers *z*, as described.

5. In a lasting-machine, the flanged or straddling levers *z*, in combination with the upright levers, which are grouped around the boot or shoe to be lasted, and curved piercing-levers, as described.

6. In a lasting-machine, the sliding stock in which the upright levers grouped about the toe or heel of a boot or shoe are mounted, consisting of the bed-plate, revolving cylinders, (for elevating or lowering the upright levers singly,) the sleeves for carrying the drivers, and horizontal adjusting-screw *g'*, in combination with the upright levers, as described.

7. In a lasting-machine, the combination of the mechanism in which the sliding stock is made to move horizontally and by which it is elevated, consisting of the two circular cams and axle *w''*, the connecting-rods which lap the said cams, and the two grooved horizontal pieces *f''*, in which the bed-plate of the stock slides, in combination with the sliding stock, as described.

8. In a lasting-machine, the combination of the sliding wedge-cams *b'*, semicircular or curved driver, upright levers, curved piercing-levers, and flanged or straddling levers, as described.

9. In a lasting-machine, the combination of the sliding stock with the horizontal sliding frame *m'* and the curved driver whose vertical stem is carried by the said stock and sliding frame *m'*, as described.

10. In a lasting-machine, the combination of the mechanism for raising, lowering, sliding to the right or to the left horizontally, or holding in a fixed position, at pleasure, the last upon which the upper of a boot or shoe is attached to be lasted by a lasting-machine, the combination consisting of the sliding post *x'*, transverse frame *y'*, cam *a''*, carrier *c''*, link *d''*, gear-wheels *f''* and *g''*, crank-shaft *h''*, hand-lever *f'''*, pawl and ratchet, toe-rest, and elevating-screw, as described.

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Witnesses:
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