No. 792,252. PATENTED JUNE 13, 1905.

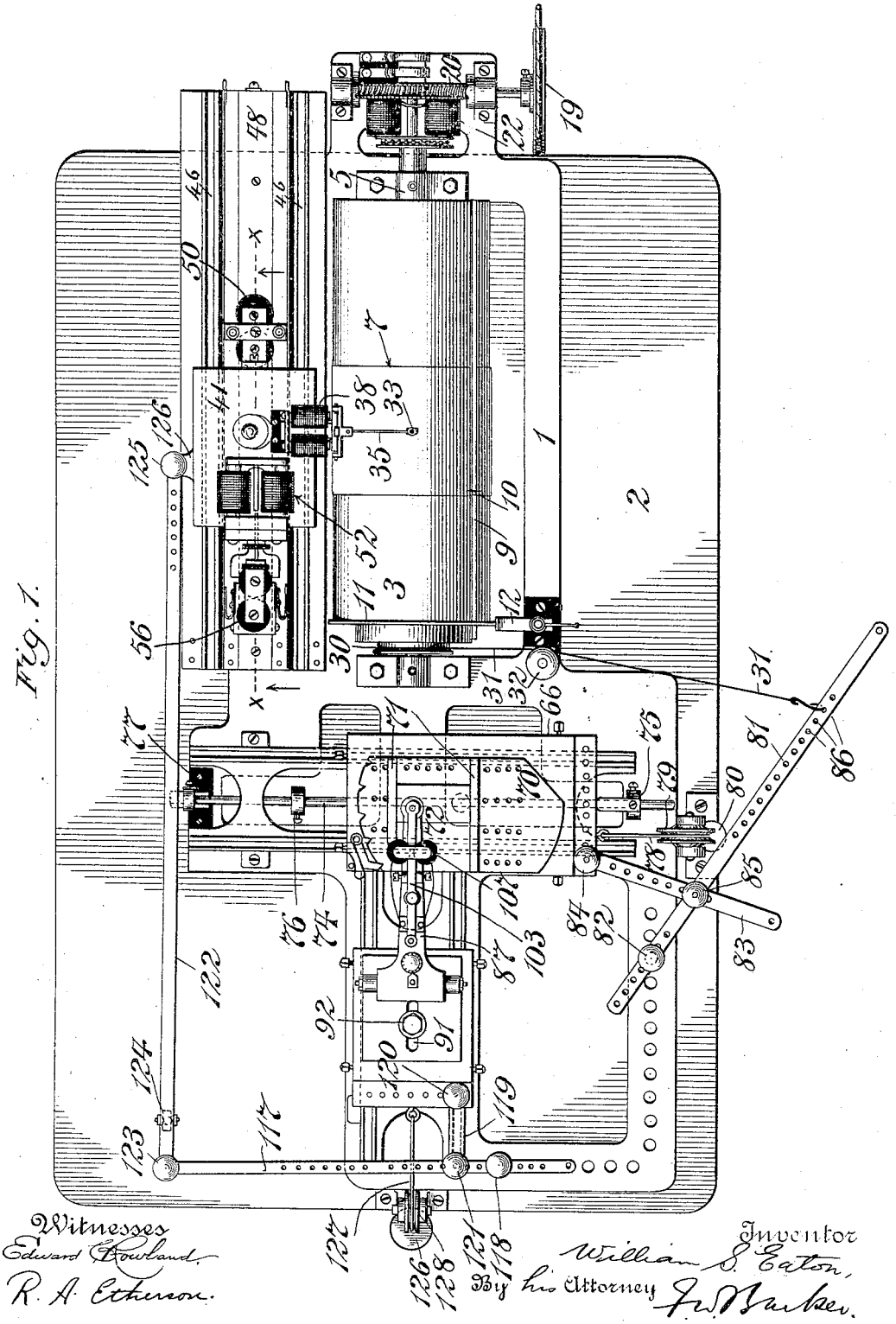
W. S. EATON.

ENGRAVING MACHINE.

APPLICATION FILED JULY 5, 1904.

6 SHEETS—SHEET 1.

Fig. 1.



Witnesses
Edward Rowland.
R. A. Etherson.

Inventor
William S. Eaton,
By his Attorney
F. W. Barker.

No. 792,252. PATENTED JUNE 13, 1905.

W. S. EATON.

ENGRAVING MACHINE.

APPLICATION FILED JULY 5, 1904.

6 SHEETS—SHEET 2.

Fig. 6.

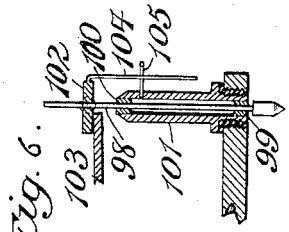


Fig. 2.

Witnesses
Edward Rowland,
R. A. Etherson

Inventor
William S. Eaton,
By his Attorney
F. W. Parker.

No. 792,252. PATENTED JUNE 13, 1905.

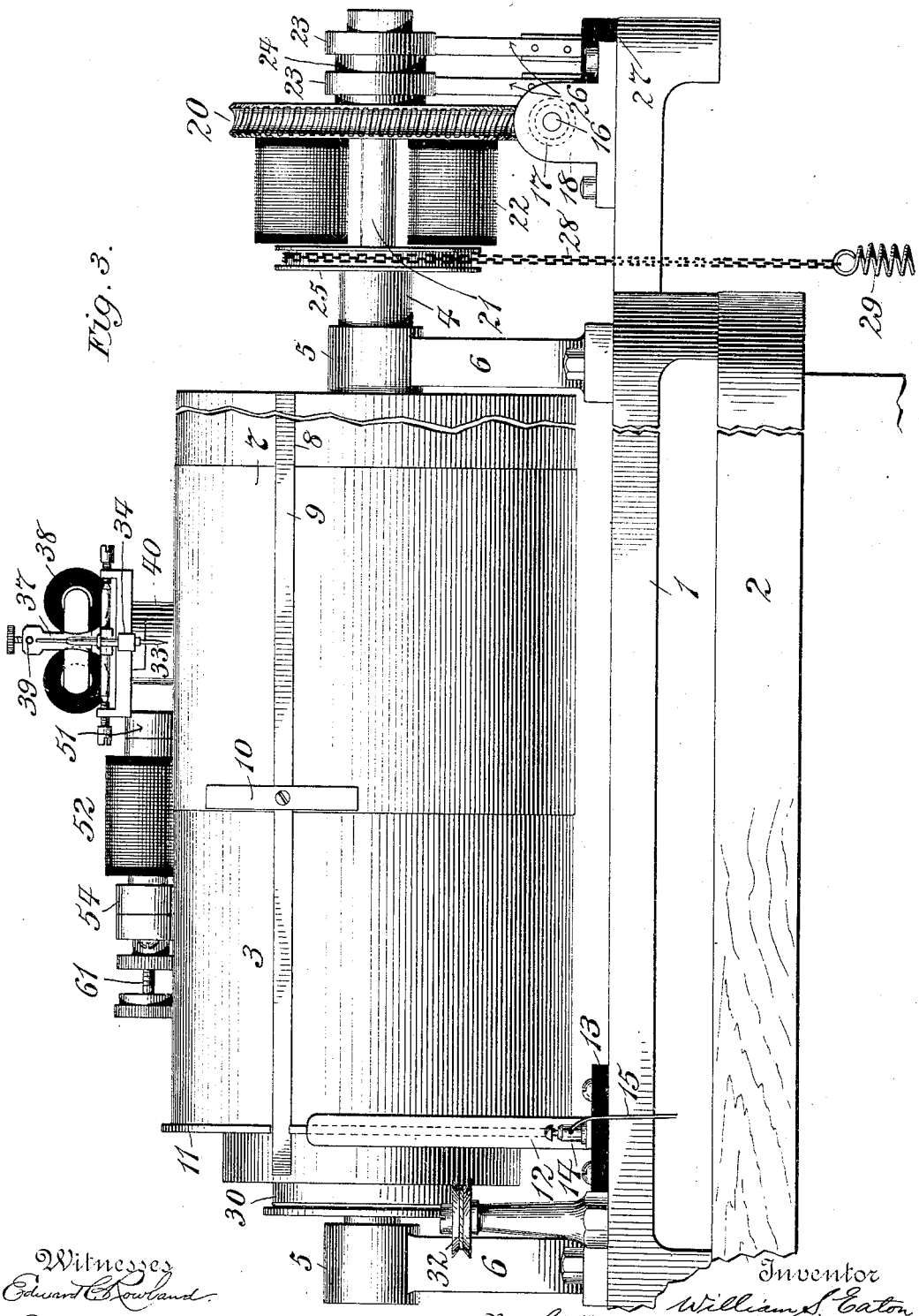
W. S. EATON.

ENGRAVING MACHINE.

APPLICATION FILED JULY 5, 1904.

6 SHEETS—SHEET 3.

Fig. 3.



Witnesses
Edward C. Rowland
R. A. Etherson.

Inventor
William S. Eaton,
By his Attorney
F. S. Parker.

No. 792,252. PATENTED JUNE 13, 1905.

W. S. EATON.

ENGRAVING MACHINE.

APPLICATION FILED JULY 5, 1904.

6 SHEETS—SHEET 4.

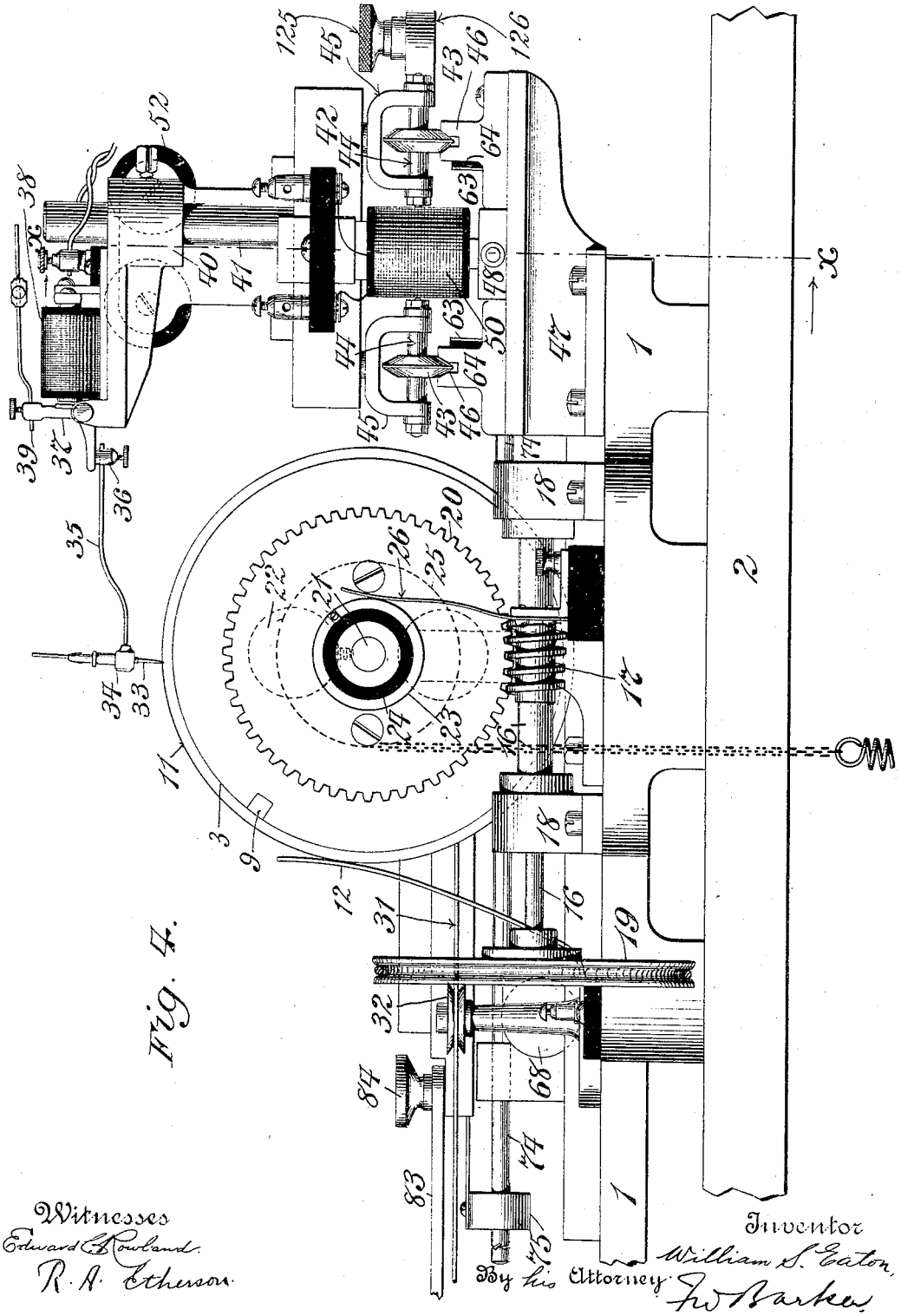


Fig. 4.

Witnesses
Edward C. Rowland.
R. A. Etherson.

Inventor
William S. Eaton,
By his Attorney
Fw Barker

No. 792,252. PATENTED JUNE 13, 1905.

W. S. EATON.

ENGRAVING MACHINE.

APPLICATION FILED JULY 5, 1904.

6 SHEETS—SHEET 5.

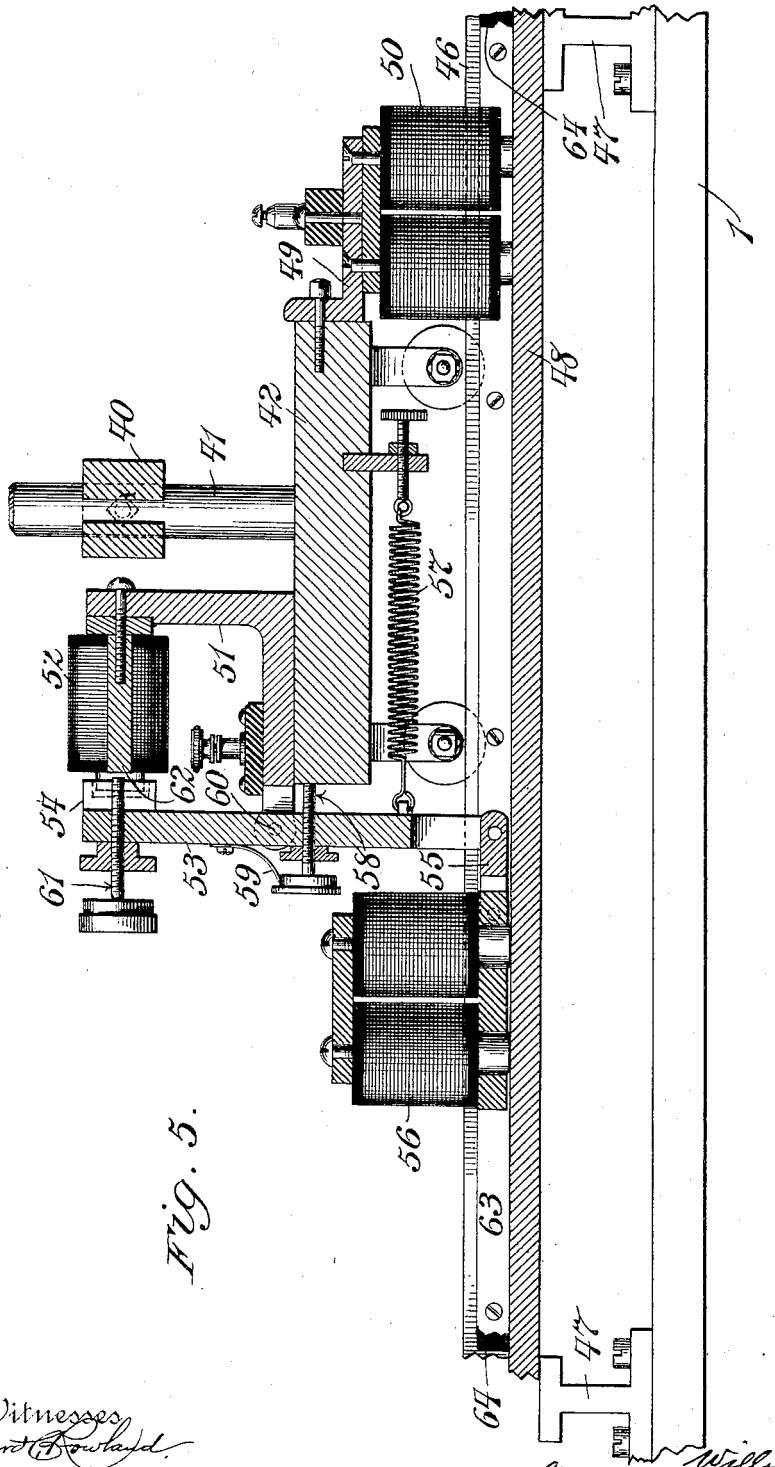


Fig. 5.

Witnesses,
Edward Rowland.
R. A. Etherson.

Inventor
William S. Eaton,
By his Attorney
Jno. Burke.

No. 792,252. PATENTED JUNE 13, 1905.

W. S. EATON.

ENGRAVING MACHINE.

APPLICATION FILED JULY 5, 1904.

6 SHEETS—SHEET 6.

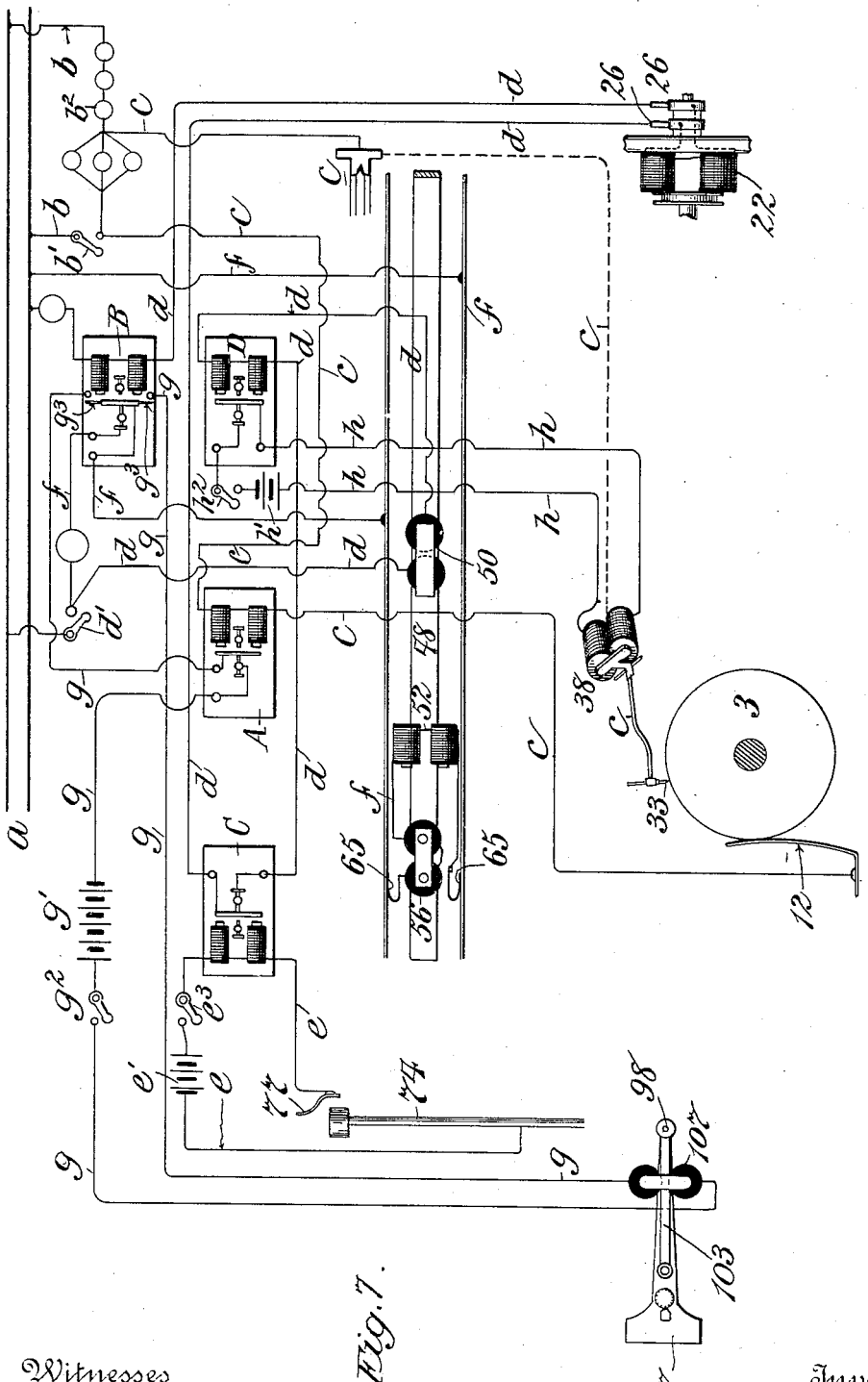


Fig. 7.

Witnesses
Edward C. Rowland
R. A. Etherson.

Inventor
William S. Eaton,
By his Attorney J. W. Parker

No. 792,252. Patented June 13, 1905.

UNITED STATES PATENT OFFICE.

WILLIAM S. EATON, OF SAG HARBOR, NEW YORK.

ENGRAVING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 792,252, dated June 13, 1905.

Application filed July 5, 1904. Serial No. 215,341.

To all whom it may concern:

Be it known that I, WILLIAM S. EATON, a citizen of the United States, residing at Sag Harbor, in the county of Suffolk and State of New York, have invented a new and useful Improvement in Engraving-Machines, of which the following is a specification.

This invention relates to engraving-machines of that character whose object it is to reproduce upon a metal plate by a series of parallel engraved lines a design or pattern comprising an original. This object I accomplish through the medium of an assemblage of various mechanisms deriving their motive power and direction, through various electromagnets and relays, from one or more sources of electrical energy and being in such relative coöperative arrangements as to be capable of unitedly automatically accomplishing the work set.

With this object in view and recognizing that the various operations of the parts are controlled by electric circuits, as will be described in detail hereinafter, the several mechanisms included in my improvements may be briefly described as follows: first, a rotatable cylinder bearing a design or pattern partly conductive of electricity and partly non-conductive, a frictional contact therefor, a magnetic clutch carried by a driven gear to rotate said cylinder, and a spring to cushion the back throw of said cylinder; second, a stylus or tracer operatively resting with an adjustable degree of touch upon the surface of the pattern carried by the cylinder, closing an electric circuit when upon the conductive portion of said pattern (whereby the working tool is rendered inoperative) and opening said electric circuit when upon the non-conductive portion of said pattern, (whereby the working tool is rendered operative;) an electromagnet to lift the tracer out of contact with the pattern-surface during the back throw of the cylinder; a carriage supporting the tracer and adapted to travel upon ways arranged in parallelism with the axis of the cylinder; an electromagnet adapted to hold the carriage against movement while the cylinder is turning forwardly and to release such hold during the back throw of the cylinder; a tensionally-held rocking bar pivoted to the carriage and adapted during the back throw of the cylinder to move said carriage a predetermined step along its ways under the influence of two correspondingly-operating electromagnets and the tensional device, one of said magnets attracting the upper end of said bar, whereby, through the pivotal connection between the bar and carriage, the latter is moved a step in the desired direction, the lower end of the bar being meanwhile held from such movement through the action of the other magnet until upon demagnetization of both said magnets said bar becomes tensionally readjusted, thus completing the step taken by the carriage along the ways, and thereby bringing the tracer in position to describe a line parallel with the preceding line of its travel upon the pattern with the succeeding revolution of the cylinder; third, a work-table carrying a plate to be engraved and itself supported upon a carriage traveling in ways arranged right-angularly to the axis of the pattern-cylinder, together with a pair of pivotally-connecting bars, one of which is pivoted to the carriage, while the other is pivoted at one end to the machine-frame and at its other end connects, through a flexible connector, with a drum on the pattern-cylinder, said connector winding on said drum with the forward revolution of said cylinder and causing the work-table carriage to travel a given distance, and means whereby the clutch which actuates the pattern-cylinder is released when the work-table carriage has completed its travel, a weight then operating to retract said carriage and to throw back the pattern-cylinder; fourth, a tool-support with means for adjusting the tool and actuating it through an electromagnet, said support being pivoted to a carriage that is adapted to travel in ways arranged in parallelism with the tracer-carriage, together with a pair of pivotal levers, one of which connects with said tracer-carriage, while the other connects, through a pivotal link, with said tool-support carriage, whereby the step-by-step movement of the tracer-carriage is communicated proportionately to the tool-support carriage to prepare the tool for executing a parallel line upon the work.

My improvements further include the various novel constructions, arrangements, and combinations of parts, as will be described hereinafter, and particularly pointed out in the claims.

In the drawings accompanying this application, Figure 1 is a plan view of the entire machine, including the electromagnets, but not showing the various electrical circuits nor the relays. Fig. 2 is a front elevation of that portion of the machine including the work-table and tool, their carriages, and allied parts. Fig. 3 is a similar view of the other part of the machine, including the pattern-cylinder, magnetic clutch, the tracer, and its support, this figure when placed to the right of Fig. 2 forming therewith a complete front elevation of the machine. Fig. 4 is an end elevation taken from the right of Fig. 3. Fig. 5 is a sectional view taken on the line X X of Fig. 1. Fig. 6 is a detail illustrative of the tool and its associated parts; and Fig. 7 is a diagrammatic view illustrative of the various electrical circuits employed, also showing the electromagnets and relays.

Like numerals of reference indicate corresponding parts in all the figures.

The numeral 1 indicates the frame, which is preferably of metal for the sake of rigidity and supports the entire mechanical organism of the apparatus with the exception of the relays, switches, and resistance devices, which may be otherwise conveniently disposed. Said frame 1 is shown as supported upon a plane surface 2, which may be that of a table.

In order that a clear understanding of my improvements may be acquired with greater facility, I shall describe the several groups of mechanical parts under separate headings, follow with an explanation of the circuits and relays, and conclude with the *modus operandi*.

Pattern-cylinder and allied parts.—3 indicates a pattern-bearing cylinder, which is fast upon a shaft 4, that is journaled in bearings 5 5, carried by supports 6 6, which are mounted upon the frame 1. The cylinder 3 is preferably formed of wood or other non-conducting material, and the pattern-sheet, as 7, to be placed about its periphery may be a sheet of thin metal-coated paper or other thin conducting-surfaced sheet, upon which the design or pattern to be reproduced is provided by rendering non-conducting a portion of the surface of said sheet representing such design or pattern. This effect may be produced by printing or painting the design or pattern upon the conducting-surface of the sheet with material that is a non-conductor of electricity. In order that the pattern-sheet may be snugly and securely held about the cylinder, I form a longitudinal slot, as 8, in the periphery of the latter and bring the opposite meeting edges of sheet 7 over said slot and fit a bar, as 9, snugly into said slot, thereby binding the edges of said sheet therein. Said bar 9, being of metal and bearing against the conducting-surface of sheet 7, serves to convey current thereto. When thus placed, the exposed surface of bar 9 should be flush with the peripheral surface presented by sheet 7. I may also provide an additional contact-strip, as 10, placed transversely of bar 9 and bearing against the sheet 7. At one end of the cylinder 3 is placed a peripheral flange of metal, as 11, the bar 9 being placed contactingly in a slot therein, while said flange 11 is adapted to receive current throughout its revolution through a spring contact member 12, which bears tensionally thereon, said contact member being mounted upon a block of insulation 13, which is secured to the frame 1. A binding-post 14 to receive a circuit-wire 15 is placed upon the member 12.

The means for rotating the cylinder 3 comprise the following parts: A shaft 16, having a worm 17, is journaled in bearings 18 18 and is provided at one end with a pulley 19, which is adapted to be driven from a source of power. (Not shown.) Meshed with the worm 17 is a disk gear 20, which is loosely mounted upon an extension 21 of shaft 4 and carries upon one side an electromagnet 22, while contact-rings 23 23, connected with the respective coils of the magnet, are mounted upon an insulating-sleeve 24 at the opposite side of disk gear 20. An armature 25 in the form of a sheave is slidably but non-rotatably mounted on shaft 21, whereby upon energizing the coils of magnet 23 said magnet and armature unitedly form a magnetic clutch wherewith the rotating power of the gear 20 is communicated to shaft 4 and the cylinder 3. The spring-contacts 26 26, which are mounted upon insulating-block 27, serve to convey current to the rings 23 23. A flexible strand, as a chain 28, is secured to the sheave 25, being held by a spring 29 at its opposite end and adapted to wind upon said sheave during the back throw of the cylinder, whereby said spring forms a cushion. Secured at the opposite end of cylinder 3 is a drum 30, on which is attached and adapted to wind a cord or flexible strand 31, that passes over an idler 32 and connects at its other end with a part of the mechanism of the work-table, as will be described hereinafter.

The tracer, its support, carriage, step-by-step mechanism, and allied parts.—Resting lightly upon the pattern-sheet 17 is the point of a stylus or tracer 33, the same consisting of a pencil of graphite or other suitable material not calculated to scratch the surface traveling thereunder and to retain a satisfactory degree of sharpness of point. Said tracer is supported in a holder 34, that is held by an arm 35, which is adjustably secured, as by a binding-post 36, to one arm of a bell-crank lever 37, forming the pivotal armature of an electromagnet 38, the other arm of said lever 37 having a rearwardly-extending rod bear-

ing an adjustable weight 39, wherewith to balance the tracer-arm and regulate the degree of weight with which the tracer bears upon the pattern-sheet.

The parts thus far described are supported upon a bracket 40, which is adjustably secured to a vertical post 41, that is mounted upon a carriage 42. Said carriage 42 is provided with two pairs of wheels 43 43, journaled on shafts 44 44, hung in yokes 45 45, pendent from said carriage. The wheels 43 43, whose peripheries may be V-shaped, as seen, are adapted to travel in correspondingly-shaped ways 46 46, which are mounted upon supports 47 47, secured to the frame 1, and are disposed in parallelism with the cylinder 3.

Intermediate the ways 46 46 is placed a flat strip of iron 48, and extending from one end of the carriage 42 is a bracket 49, to which latter is secured an electromagnet 50, the two cores whereof rest upon the surface of said iron strip 48, whereby when the circuit in which the coils of said magnet are included is open the magnet will slide along the surface of strip 48 with the movement of carriage 42; but when said magnet 50 is energized then with the strip 48 it becomes a magnetic clamp and holds the carriage 42 from movement upon its ways 46 46. Also secured upon the carriage 42 is an L-shaped bracket 51, to whose vertical arm is secured an electromagnet 52, while to its horizontal arm is pivotally hung a vertical bar 53, whose upper end carries the armature 54 for magnet 52, the lower end of said bar 53 being pivoted to a horizontal bar 55, which is secured about the core ends of an electromagnet 56, which latter is thereby carried upon said bar 55, the core ends of said magnet 56 being in sliding contact with the surface of strip 48. A coiled spring 57 is secured at one end to the carriage 42 and at its other end connects with the lower end of bar 53. An adjustable screw-stop 58 is passed through the bar 53 and bearing against the end of carriage 42 thereby limits the forward movement of the lower portion of said bar. The head of said screw-stop may be provided with a scale, and a pointer, as 59, secured to the bar 53, is adapted to indicate degrees thereon. When the magnets 52 56 are energized, the circuit of magnet 50 at that time being open, the armature 54 in its attracted movement causes the carriage 42 to move a step along its ways, this movement, however, being diminished at the point where communicated to the carriage—namely, at the pivot 60—where a shorter arc is described than at the point where the armature is secured to bar 53. Further, the extent of the attracted movement of armature 54 is limited and regulated by the point of an adjusting-screw 61, passed through the bar 53 and impinging against a stop 62. The magnet 50 then being energized and the circuits of magnets 54 and 56 opened, the spring 57 draws forwardly the lower end of bar 53 with the magnet 56, thus completing the forward step of the carriage 42 and placing the tracer in position to describe a new parallel line about the cylinder. Conductor-strips 63 63, placed lengthwise of the ways 46 46, but separated therefrom by insulation 64 64, serve to convey current to the coils of magnets 52 and 56 through the traveling spring-contacts 65 65.

The work-table, carriage, ways, and connecting parts.—66 indicates the work-table, which is supported by two pairs of yokes 67 67, having journaled therein wheels 68 68, adapted to travel in ways 69 69, which are mounted upon the frame 1. Said work-table 66 bears upon its surface an adjustable plate 70, having the holders 71 71, between which is placed and securely held a plate 72 to be engraved. As will be observed, the ways 69 69 are arranged at right angles to the ways 46 46.

Slidably mounted in bearings 73 73 is a rod 74, that is disposed beneath the work-table 66 parallel with the ways 69 69, and upon said rod 74 are fitted the adjustable collars 75 76, adapted, respectively, to be met by the table 66 during its travel back and forth and, according to the direction of travel of said table, moving one end of the rod 74 into and out of contact with a terminal 77 of an electric circuit. Assuming in the view shown in Fig. 1 that the work-table travels from front to back during the engraving process, it will be understood that the cord or strand 78, attached to the near end of the work-table and passing over a sheave 79, said cord 78 being provided with a weight 80, (see Fig. 2,) is intended by aid of said weight to return said table after the completion of its rearward travel.

Power to move the work-table rearwardly is communicated from the cylinder 3 through the cord 31, which in the rotation of the cylinder under the influence of the magnetic clutch winds said cord (which is attached to a lever 81) upon the drum 30. The lever 81 is pivoted to the frame 1, as at 82, and a link 83, that is pivoted to the forward end of the work-table, as at 84, intersects said lever 81, said lever 81 and link 83 being pivotally united, as at 85, at their point of intersection. Engaging holes 86 for the cord 31 are provided along the lever 81, whereby the point of attachment of said cord is rendered adjustable. Similarly a number of pivot-holes are provided between the bars 81 and 83, as well as in the work-table and frame, whereby any desired adjustment may be effected to regulate the extent of travel of the work-table upon its ways with the rotation of cylinder 3.

The tool-support, carriage, and connecting parts.—The tool-support comprises an arm 87, mounted at one end upon a horizontal

pivot 88, fitted in opposite bearings 89 89, that extend upwardly from a plate 90, which is adjustable longitudinally by means of a slot 91 and bolt 92 upon a boss 93, which latter is supported upon a carriage 94. Said carriage 94 is mounted upon two pairs of wheels 95 95, which are adapted to travel upon ways 96 96, arranged parallel with the ways 46 46, whereby with the movement of the carriage 94 the tool 97 (which is supported at the forward end of arm 87) may be advanced over the surface of the work-plate 72 for the purpose of engraving a new line and may be returned for the purpose of starting afresh.

The tool 97, whose point may consist of a diamond, depends from a slender rod 98, which latter is slidable in antifriction-bushings 99 100, placed, respectively, in the lower and upper ends of a tube 101, said tube being inserted within the end of arm 87. A transverse piece 102 is secured to the rod 98 and forms a stop in engagement with one end of an armature-lever 103 to support the tool out of contact with the surface of the work. A vertical wire 104, depending from the piece 102, is passed slidably through a guide-stud 105, that juts outwardly from the tube 101, the purpose thereof being to prevent binding during its sliding movement. The armature-lever 103 is pivoted at 106 to a vertical standard mounted upon the arm 87, said arm also carrying intermediate said standard and the tube 101 an electromagnet 107, whose upstanding cores include the armature-lever within their field. The armature-lever is held normally out of contact with its magnet by a spring 108, depending from a screw 109, passed through the rear end of armature-lever 103, the opposite end of said spring being suitably anchored and the tension of said spring being regulated by the nut 111, which is secured by a lock-nut 112. The extent of movement of the armature-lever 103 is regulated by a screw 113, that is threaded through said armature-lever 103, the end of said screw resting against a post 114, a nut 115 serving to set the adjustment. Current for the coils of the magnet is communicated through binding-posts 116 116, which for convenience are mounted upon insulation 110.

Movement of the carriage 94 upon its ways is communicated in a proportionately-reduced or desired scale from the carriage 42 in the following manner: A bar 117, provided with a number of pivot-holes for purposes of adjustment, is pivoted to the frame 1, as at 118, and a link 119, pivoted to the rear of the carriage 94, as at 120, is also pivotally connected to said bar 117, as at 121. A second bar 122, disposed substantially at right angles to bar 117, is connected thereto, as by pivot 123, said pivot being provided with a wheeled foot 124, whereby the bars may be movably supported upon the surface of the table 2. The opposite end of bar 122 is pivotally connected, as at 125, to a lug 126, extending from the side of carriage 42. Thus the movements of carriages 42 and 94 are synchronized, though adjusted to different degrees. A weight 126, suspended from a cord 127, passed over a sheave 128, and connected to the rear of carriage 94, serves to steady said carriage in its forward movement.

The circuits and relays.—The electric current used in energizing some or all of the electromagnets may be taken from the parallel electric-lighting wires, as a, and distributed as in the following manner: b indicates a circuit including the lamp resistance b^2 or other suitable resistance and adapted to be closed by the switch b'. c is a circuit leading from circuit b to the magnet 38 through the tracer 33, pattern 3, and spring-contact 12 to relay A, thence returning to the resistance-circuit b, by which it is controlled. d is a circuit emanating from the main circuit a and including a suitable resistance passing through relay B, the brushes 26 26, which actuate the magnetic clutch, the relays C and D, and the magnet 50, returning thence to the main circuit. A switch d' is included in circuit d. e is a circuit including a battery e', relay C, and switch e^2 and adapted to be mechanically interrupted by the contact of rod 74 or lug 144 with its terminal. Instead of receiving energy from the battery e' the circuit e may be connected with the main circuit a. f is a circuit emanating from the main circuit a', including the switch d' and closed through the armature of relay B when the coil of said relay is demagnetized, said circuit also including the magnets 52 and 56. g is a circuit including the battery g' and switch g^2 and having terminals upon the relay B adapted to be met by contact-wings g^3 upon the armature of said relay when the latter is attracted through the excitation of its magnet, but said circuit being broken between one of its terminals and the armature of relay A when the coils of said relay are energized. A circuit h, including a battery h', switch h^2, and the coils 38, being closed when the coils of relay D are deënergized serves at such time to lift the tracer 33 from the pattern.

Modus operandi.—The machine being set substantially as indicated in Fig. 1, the work-table being in position with the work under the tool for the beginning of a line, the pulley 19, worm 17, and gear 20 being in motion, driven by a motor (not shown) or other source of power, the several switches are closed and work commences, the machine responding to perform the engraving upon the work-surface, the same being a reproduction in parallel lines of the design upon the pattern-cylinder. Following the circuits we shall note that circuit d energizes the magnet 22, which attracts the sliding armature-disk 25, constituting a magnetic clutch, which imparts the

rotary movement of gear 20 to the cylinder 3. As said cylinder rotates it winds the cord 31 upon drum 30, thereby through the lever 81 and link 83 moving the work-table carriage along its ways, passing the work a full stroke beneath the tool. When in the course of its movement along the rod 74 the work-table meets the stop 76, said stop and rod are moved with the advance of the work-table until the rod end strikes the contact 77, thereby closing circuit *e* and energizing the magnet of relay C, the armature whereof in its attracted movement opens circuit *d*. Prior to closing of circuit *e* and during the engraving of a line upon the work-surface, as described, the following instrumentalities are exercising their functions: Electricity is flowing through circuit *c*, while a metallic portion of the pattern-surface upon the cylinder is in contact with the tracer 33. The effect of this closed circuit acting upon the relay A attracts the armature thereof to its magnet, thereby opening circuit *g*, whereby the armature 103, being released from magnet 107, lifts the tool 97 from the work, but while the tracer 33 is upon a non-conducting portion of the pattern, which forms a part of the design to be reproduced upon the work. Then the circuit *c* is thereby opened, and the magnet of relay A thus becoming deënergized, consequently its armature is released and closes the circuit *g*, thus permitting the tool to rest by gravity upon the surface of the work and engrave thereon such portion of a line as is represented by the extent of non-conductive design portion traversed by the tracer upon the pattern. Of course it will be readily understood that this making and breaking of circuits and consequent alternating activity and inactivity of the tool with respect to the work-surface is continued to the end of the line, accordingly as the design is represented by conducting and non-conducting portions on the pattern. During the above—as I may say, "operative traverse" of the work-table carriage—circuit *d* is closed and magnetizes the coils 50, which operating with the strip 48 constitute a clamp to hold the carriage 42 rigidly in its set position while the tracer 33, supported thereby, describes a true line about the revolving pattern. The circuit *d* also closes the circuit *g* through the relay B, the coils of said relay in attracting their armature causing said armature, through wings or extensions g^3 g^3, carried thereby, to make contact with opposite terminals of said circuit *g*. When the work-carriage reaches the end of a predetermined line and the table 66 causes the rod 74 to strike contact 77, closing the circuit *e*, at this point it is required that the work-table carriage shall return to the starting-point, the pattern-cylinder turn backwardly, the tool be raised from the work and the tracer from the pattern; also, that the cylinder-shaft be released from the magnetic clutch and the tracer-carriage and tool-carriage advanced a step for the production of a new line. These objects are attained electromechanically in the following manner with the closing of circuit *g:* In the first place circuit is thereby opened at relay C, thereby deenergizing the magnetic clutch and freeing the cylinder, whereupon the weight 80 returns the work-table carriage and through the link 83 and lever 81 unwinds the cord 31 from drum 30, thereby rotating the cylinder backwardly to the starting-point, the chain 28 then winding, under tension of spring 29, upon sheave 25 to cushion the back throw. Also the breaking of circuit *d* closes circuit *h* through relay D, whereby the magnet 38 attracts its armature, and thus raises the tracer from the pattern during the back throw of the cylinder. Also the breaking of circuit *d* closes circuit *f* through relay B and opens circuit *g*. The closing of circuit *f* (while magnet 50 of circuit *d* is deënergized) energizes both of magnets 52 and 54, enabling the carriage 42, as previously explained, to move a single predetermined step along its ways. Circuit *g* being open of course prevents the tool from operating during this return movement. When the work-table, having returned to a predetermined point, strikes against the stop 75 or an adjustable finger thereon, thereby the rod 74 is moved away from the contact 77, thus opening circuit *e* again when the *statu quo ante* occurs, and the machine automatically becomes operative again. In the movement of a step forward taken by the carriage 42 a corresponding and proportionately-adjusted step-forward movement has been communicated to the tool-carriage 90 through the bar 122 and lever 117 and the link 119.

As will be quite obvious from the foregoing description, no great depth of cut is effected by the tool upon the work, a mere scratching upon the surface thereof being all that is accomplished by the operation of this machine; but I resort to the well-known art of etching with acid to increase the depth of cut in the work to a desired extent.

Having now described my invention, I declare that what I claim is—

1. An engraving-machine comprising a rotatable pattern-cylinder, a tracer, a carriage supporting said tracer; a work-table, a carriage supporting said work-table, and means synchronizing the movement of the cylinder and work-carriage; a tool-holder, a carriage supporting said tool-holder, means synchronizing the movements of the tracer-carriage and tool-holder carriage, and a system of interacting electrical circuits and devices adapted to automatically actuate the several organisms of the machine, whereby a design upon the pattern-cylinder is engraved on a plate carried by the work-table.

2. In an engraving-machine, a frame, an oscillatory cylinder supported in bearings upon

said frame, a design or pattern sheet secured about the surface of said cylinder, the surface of said pattern-sheet being partly conducting and partly non-conducting, forming a design, a tracer suitably supported and adapted to impinge against the surface of said design or pattern sheet; a rotating member, and a magnetic clutch between said rotating member and cylinder to alternately move and release the latter.

3. In an engraving-machine, a frame, an oscillatory cylinder supported in bearings upon said frame, a design or pattern sheet secured about the surface of said cylinder, the surface of said pattern-sheet being partly conducting and partly non-conducting, forming a design, a tracer suitably supported and adapted to impinge against the surface of said design or pattern sheet, a rotating member, a magnetic clutch between said rotating member and cylinder to alternately move and release the latter, and means for automatically returning the cylinder when released.

4. In an engraving-machine, a frame, an oscillatory shaft supported in bearings upon said frame, a pattern-cylinder fast upon said shaft, an armature-disk fast upon said shaft, a driving member rotatable upon said shaft, an electromagnet borne by said rotatable member, a circuit including the coils of said electromagnet, and means for controlling said circuit whereby said electromagnet alternately moves and releases said shaft.

5. In an engraving-machine, a frame, an oscillatory shaft supported in bearings upon said frame, a pattern-cylinder fast upon said shaft, an armature-disk fast upon said shaft, a driving member rotatable upon said shaft, an electromagnet borne by said rotatable member, a circuit including the coils of said electromagnet, means for controlling said circuit whereby said electromagnet alternately moves and releases said shaft, and means for automatically returning said shaft when released.

6. In an engraving-machine, a frame, an oscillatory pattern-cylinder mounted in bearings supported by said frame, a pattern-sheet of thin material fitted about said cylinder, the outer surface of said sheet being of a conducting nature and bearing a design whose surface is non-conducting, and a conducting-bar securing said pattern-sheet to said cylinder; together with a stylus, a circuit including said pattern-sheet and stylus; a tool, a reciprocating work-table, a magnet and a circuit therefor controlling said tool, and means for automatically closing said last-named circuit with the opening of said first-named circuit.

7. In an engraving-machine, a frame, an oscillatory cylinder mounted thereon having a longitudinal slot in its periphery, a sheet of thin material whose outer surface is partly conducting and partly non-conducting, forming a design, said sheet being fitted about said cylinder with its ends extending over said slot, a conducting-bar fitting snugly in said slot over the sheet ends, drawing the latter into said slot, an electrical circuit, and means including said conducting-bar and (successively) the conducting portions of said sheet in said circuit.

8. In an engraving-machine, a frame, a pattern-cylinder rotatably mounted thereon having a longitudinal slot in its periphery and having an annular conducting-flange, a brush contacting with said flange, a sheet of thin material whose outer surface is partly conducting and partly non-conducting, forming a design, said sheet being fitted about said cylinder with its ends extending over said slot, a contacting bar fitting snugly in said slot over the sheet ends drawing the latter into said slot, said bar contacting with said flange, and a circuit closing successively with the conducting portions of said sheet as the cylinder rotates.

9. In an engraving-machine, a frame, an oscillatory shaft mounted in bearings upon said frame, a pattern-cylinder fast upon said shaft, a disk rotatable upon said shaft and carrying an electromagnet, means for driving said disk, an armature-disk slidable upon but non-rotatable about said shaft, and a circuit including said electromagnet, which, with the armature-disk, forms, when energized, a magnetic clutch between the rotatable disk and cylinder-shaft.

10. In an engraving-machine, a frame, an oscillatory shaft rotatably mounted in bearings upon said frame, a pattern-cylinder fast upon said shaft, a gear-wheel rotatable upon said shaft and carrying an electromagnet, a transverse shaft journaled in bearings on said frame and having a worm or thread in engagement with said gear-wheel to rotate the latter, an insulating-sleeve upon the shaft bearing two contact-rings, a brush for each of said rings, a circuit including said brushes, rings and the electromagnet, and an armature-disk slidable but not rotatable upon the shaft, whereby, when the circuit is closed, a magnetic union occurs between the cylinder-shaft and said gear, thereby communicating the rotating power of the latter to the cylinder.

11. In an engraving-machine, a frame, a pattern-cylinder rotatably mounted upon said frame, a tracer resting upon said pattern-cylinder, and a support for said tracer comprising a carriage mounted on ways arranged in parallelism with said cylinder; together with electromechanical means for imparting a step-by-step movement to said carriage.

12. In an engraving-machine, a frame, a pattern-cylinder rotatably mounted upon said frame, a tracer resting upon said pattern-cylinder, and a support for said tracer comprising a carriage mounted on ways arranged in parallelism with said cylinder; together with a rocking lever, an electromagnet and a tension device to actuate said lever; a strip of

iron, two electromagnets whose magnetic fields include said strip, and means for alternately energizing said last-named magnets.

13. In an engraving-machine, a frame, a pattern-cylinder rotatably mounted upon said frame, a tracer resting upon said pattern-cylinder, and a support for said tracer comprising a carriage mounted on ways arranged in parallelism with the cylinder; together with a strip of iron in the path of the carriage, an electromagnet upon the carriage, in magnetic relation with said strip, and a circuit including said electromagnet; a rocking lever pivoted to the carriage, an electromagnet, an armature therefor carried at the upper end of and adapted to move said lever, a tension device to retract said lever, means supporting another electromagnet, at the lower end of said lever, in magnetic relation with said iron strip, a circuit including both said magnets, and means for alternately closing and opening said circuits.

14. In an engraving-machine, a frame, a pattern-cylinder rotatably mounted upon said frame, a tracer resting upon said pattern-cylinder, and a support for said tracer comprising a carriage mounted on ways arranged in parallelism with said cylinder; together with a strip of iron located beneath the carriage, an electromagnet carried by the carriage, a circuit including said electromagnet, means closing the circuit during one period of the machine operation, whereby the electromagnet forms a magnetic clamp with the iron strip; a pair of electromagnets connected in series, a rocking lever pivoted to the carriage, intermediate said pair of magnets, a circuit including said pair of magnets, and means closing said circuit during another period of the machine operation; whereby one magnet of the pair, located at the lower end of the lever, forms a magnetic clamp with the iron strip; while the other magnet of the pair attracts the upper end of the lever, thereby moving the carriage through an impulse imparted thereto at the lever-fulcrum; and a spring to move the lower end of the lever when the first-named circuit is closed and the last-named circuit is opened, to complete the carriage movement.

15. In an engraving-machine, a frame, a pattern-cylinder rotatably mounted thereon, and means for rotating said cylinder; together with a work-table, ways on which said work-table is adapted to reciprocate, means for moving said table, and means intermediate said cylinder and table, whereby the movement of each one is communicated to the other.

16. In an engraving-machine, a frame, a pattern-cylinder rotatably mounted thereon, and means for rotating said cylinder; together with a work-table, ways on which said work-table is adapted to reciprocate, means for moving said table, means intermediate said cylinder and table, whereby the movement of each one is communicated to the other, and means for regulating the relative movement of said members.

17. In an engraving-machine, a frame, a pattern-cylinder rotatably mounted thereon, and means for rotating said cylinder in one direction; together with a work-table provided with wheels, ways therefor disposed at right angles to the axis of the cylinder, means for moving said work-table in one direction, and means connecting said cylinder and work-table, whereby the movement of each one is communicated to the other.

18. In an engraving-machine, a frame, a pattern-cylinder rotatably mounted thereon, means for rotating said cylinder in one direction, a drum upon said cylinder, and a cord to wind thereon; together with a work-table mounted on wheels, ways therefor disposed at right angles to the axis of the cylinder, a link pivoted at one end of said table, and a lever pivotally intersecting said link, being pivoted near one end to the frame, and near its other end connected to the cord; whereby the latter, in winding upon the drum, imparts motion in one direction to the work-table.

19. In an engraving-machine, a frame, a pattern-cylinder rotatably mounted thereon, means for rotating said cylinder in one direction, a drum upon said cylinder, and a cord to wind thereon; together with a work-table mounted on wheels, ways therefor disposed at right angles to the axis of the cylinder, a link pivoted at one end of said table, a lever pivotally intersecting said link, said lever being pivoted near one end to the frame, and near its other end connected to the cord; whereby the latter, in winding upon the drum, imparts motion in one direction to the work-table; and a cord connecting a pendent weight to the work-table, whereby the work-table is returned and the cylinder rotated backwardly.

20. In an engraving-machine, a frame, a pattern-cylinder rotatably mounted thereon, a circuit, a rotating member, and a magnetic clutch to connect said rotating member and cylinder; together with a work-table, ways on which said work-table is adapted to reciprocate, means for moving said table, means intermediate said cylinder and table whereby the movement of each one is communicated to the other, and means in the path of said table adapted to close said circuit to cause the return of the table.

21. In an engraving-machine, a frame, a pattern-cylinder rotatably mounted thereon, a circuit, a rotating member, and a magnetic clutch to connect said rotating member and cylinder; together with a work-table provided with wheels, ways therefor disposed at right angles to the axis of the cylinder, interconnecting means whereby the movement of the cylinder in one direction is communicated to the work-table; a rod loosely supported in parallel relation with the work-table, means communicating movement from the table to said

rod at a predetermined point in the path of the former, a circuit, and means whereby the movement of said rod closes said circuit to release the cylinder-rotating means.

22. In an engraving-machine, a frame, a pattern-cylinder rotatably mounted thereon, a circuit, a rotating member, and a magnetic clutch to connect said rotating member and cylinder; together with a work-table provided with wheels, ways therefor disposed at right angles to the axis of the cylinder, interconnecting means whereby the movement of the cylinder in one direction is communicated to the work-table, a rod loosely supported in parallel relation with the work-table, means communicating movement from the table to said rod at predetermined points in the path of the former; a circuit, means whereby the movement of said rod in one direction closes said circuit to release the cylinder-rotating means, and means whereby the movement of said rod in the other direction opens said circuit to reengage the cylinder-rotating means.

23. In an engraving-machine, a frame, a pattern-cylinder mounted thereon, means oscillating said cylinder, a tracer, a carriage therefor, and a work-table; together with a tool-support, a carriage therefor, and means whereby the movement of said tracer-carriage is communicated to said tool-carriage.

24. In an engraving-machine, a frame, a pattern-cylinder mounted thereon, means oscillating said cylinder, a tracer, a carriage therefor, ways parallel with said cylinder for said carriage, and a work-table; together with a tool-holder, a carriage therefor, ways parallel to said tracer-carriage ways for said tool-carriage, and means whereby the movement of said tracer-carriage is communicated to said tool-carriage.

25. In an engraving-machine, a frame, a pattern-cylinder rotatably mounted thereon, means rotating said cylinder, a tracer, a carriage therefor, ways parallel with said cylinder for said carriage, and a work-table; together with a tool-holder, a carriage therefor, ways parallel to said tracer-carriage ways for said tool-carriage, and means communicating the movement of said tracer-carriage to said tool-holder carriage; said means comprising a pivotally-connected bar and lever, said bar being pivoted to the tracer-carriage, and said lever being pivoted to the frame; and a link pivotally uniting said lever with the tool-holder carriage.

26. In an engraving-machine, a frame, a pattern-cylinder mounted thereon, means oscillating said cylinder, and a work-table; together with a tool-carriage mounted on ways supported by said frame, means impelling said carriage in one direction with a step-by-step movement, and tensional means to steady such movement.

27. In an engraving-machine, a frame, a pattern-cylinder mounted thereon, means oscillating said cylinder, a tracer, a carriage therefor, and a work-table; together with a tool-carriage mounted on ways supported by said frame, a tool-arm pivotally carried by said carriage, a tool, and electromechanical means to alternately engage and disengage the tool with and from the work.

28. In an engraving-machine, a frame, a pattern-cylinder mounted thereon, means oscillating said cylinder, a tracer, a carriage therefor, and a work-table bearing work; together with a tool-carriage mounted on ways supported by said frame, a tool-arm pivotally carried by said carriage, a tool supported at the free end of said arm, means for regulating the distance between the point of the tool and the work-surface, and electromechanical means for rendering the tool alternately operative and inoperative with relation to the work.

29. In an engraving-machine, a frame, a work-table bearing work, a tool-carriage mounted on ways supported by said frame, a boss upon said carriage, a slotted plate adjustably secured to said boss, a tool-arm pivoted in bearings extending from said plate, a tool supported by said arm, an electromagnet upon said arm, an armature, a pivotal support for said armature, means for regulating and adjusting said armature relatively to its magnet, and a circuit; and means whereby, when said circuit is closed, the armature permits the tool to descend by gravity and operate upon the work-surface; and whereby, when said circuit is open, the armature removes the tool from the work-surface.

30. In an engraving-machine, a tool-holder comprising a pivotal arm extending horizontally from its bearings, a tube vertically mounted upon said arm, antifriction-bushings located within said tube, a vertical rod slidable within said antifriction-bushings, and a tool at the lower end of said rod; together with an electromagnet upon said pivotal arm, a pivotal armature therefor, a projection from said vertical rod in the path of said armature, and a guide for said vertical rod in its movement.

31. In an engraving-machine, a frame, an oscillatory pattern-cylinder supported thereby, a tracer-carriage, mechanism imparting a step-by-step movement to said tracer-carriage; an electromagnet supported by said tracer-carriage, a pivotal armature for said magnet, and a tracer held by said armature; together with a circuit including said magnet, said tracer impinging against the pattern when said circuit is open, and removing therefrom in the attracted movement of the armature with the closing of the circuit.

32. In an engraving-machine, a frame, a pattern-cylinder supported thereby, a tracer-carriage, an electromagnet supported thereby, a pivotal armature for said magnet, a tracer held by said armature, and means for adjustably balancing said tracer; together with a circuit including said magnet, said tracer im-

pinging against the pattern when said circuit is open, and removing therefrom in the attracted movement of the armature with the closing of the circuit.

33. In an engraving-machine, a rotatable cylinder bearing a pattern that is partly conducting and partly non-conducting, a tracer, a magnet, a pivotal armature therefor carrying said tracer, and a tool; a source of electrical energy, a relay, and a circuit including the tracer, the conducting portions of the pattern, and the relay; together with an electromagnet controlling the tool, a circuit therefor, and means in said relay whereby the closing and opening of the tracer-circuit correspondingly opens and closes the tool-circuit.

34. In an engraving-machine, a rotatable cylinder bearing a pattern that is partly conducting and partly non-conducting, a rotating power member, and a magnetic clutch between said cylinder and power member; a tracer, an electromagnet whose armature supports said tracer, a carriage therefor, a magnetic clamp, and a magnetic step-by-step mover for said carriage; a source of electrical energy, and a circuit including said magnetic clamp, a relay that controls the circuit for the carriage-mover, and a relay that controls the tracer-magnet.

35. In an engraving-machine, a rotatable cylinder bearing a pattern that is partly conducting and partly non-conducting, a rotating power member, a magnetic clutch between said cylinder and power member; a tracer, a magnet controlling said tracer, a tool, a magnet controlling said tool, a carriage for said tracer, and a magnetic clamp and magnetic step-by-step mover for said carriage; together with a source of electrical energy, a series of circuits and relays controlling the operation of the machine during the revolution of the cylinder in one direction, and an auxiliary circuit including a relay adapted to reverse the influence of said circuits, magnets, and relays; said auxiliary circuit being mechanically closed at a predetermined point in the forward operation.

WILLIAM S. EATON.

Witnesses:
ADELE DURIEU,
ERNEST J. W. MÜLLER.