W. S. EATON.

PANTOGRAPHIC ENGRAVING MACHINE.

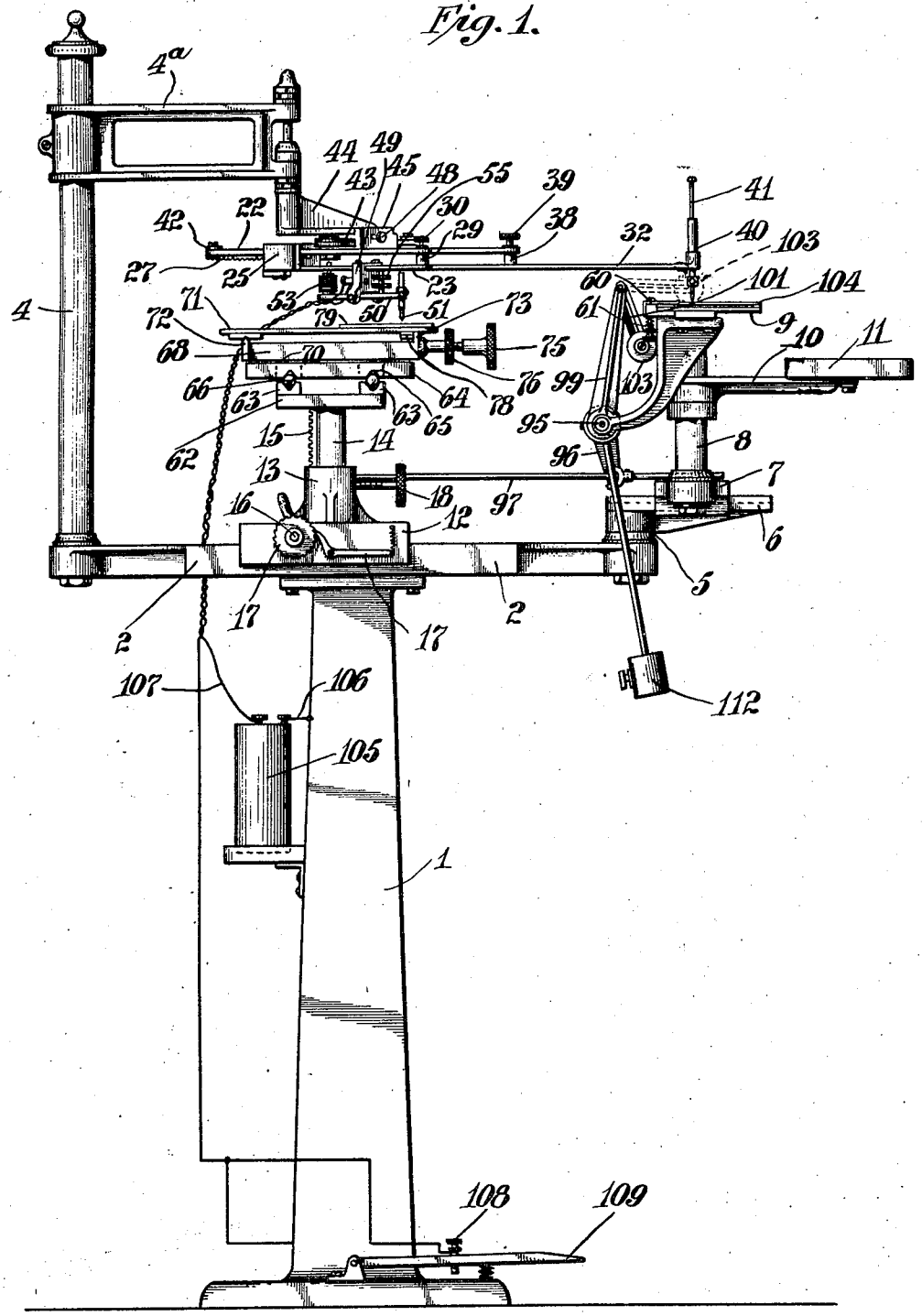
APPLICATION FILED JUNE 9, 1914.

1,235,668.

Patented Aug. 7, 1917.

5 SHEETS—SHEET 1.

Fig. 1.



Attest:

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Judith Barden

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by Frank P. Wentworth

his Atty.

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5 SHEETS—SHEET 2.

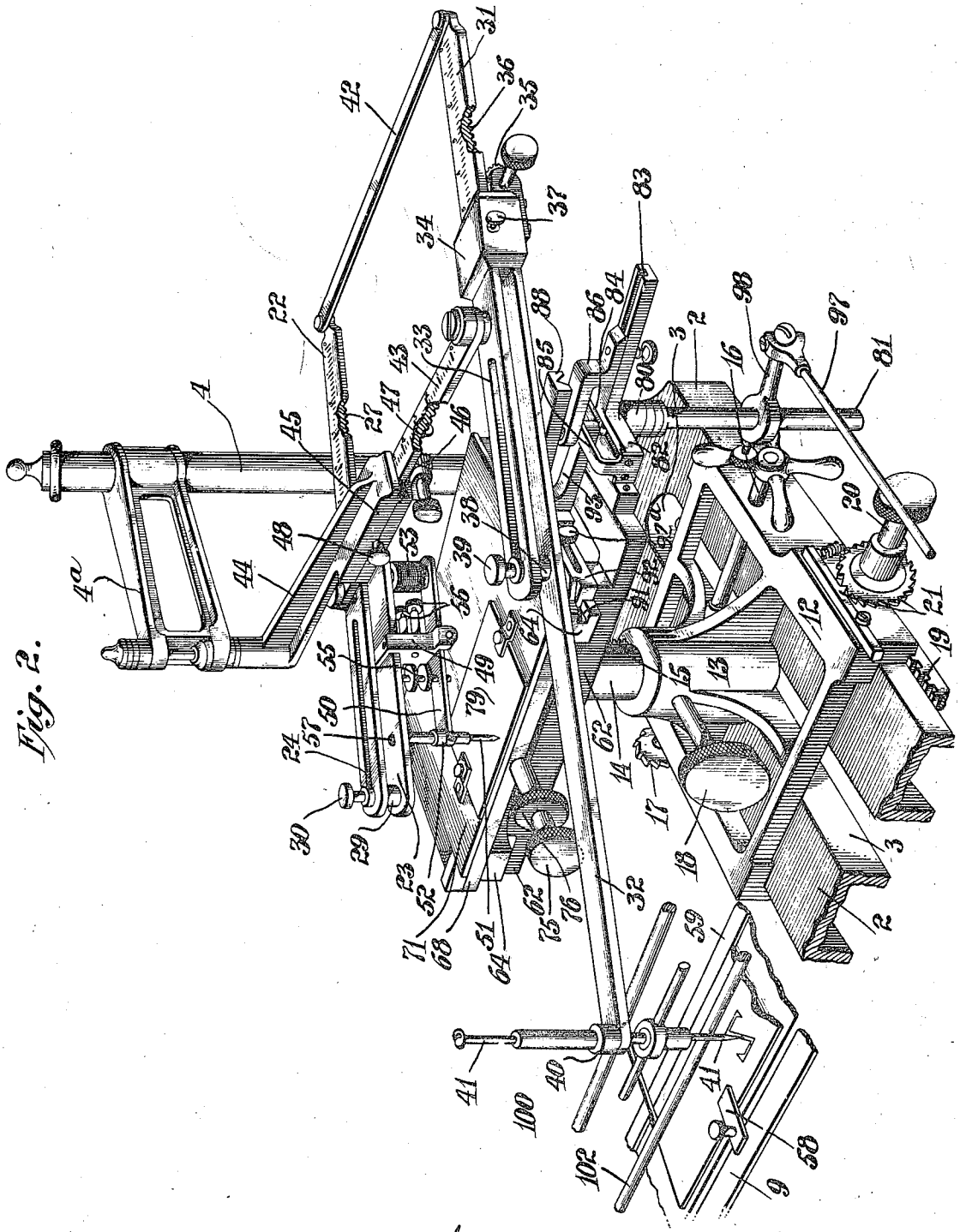


Fig. 2.

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5 SHEETS—SHEET 3.

Fig. 4.

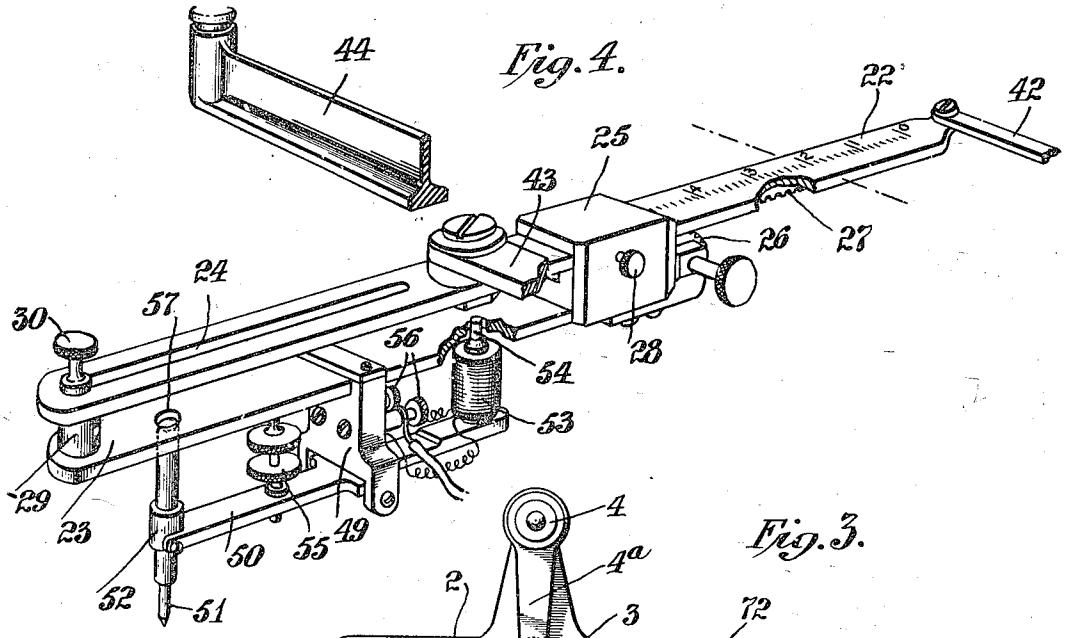
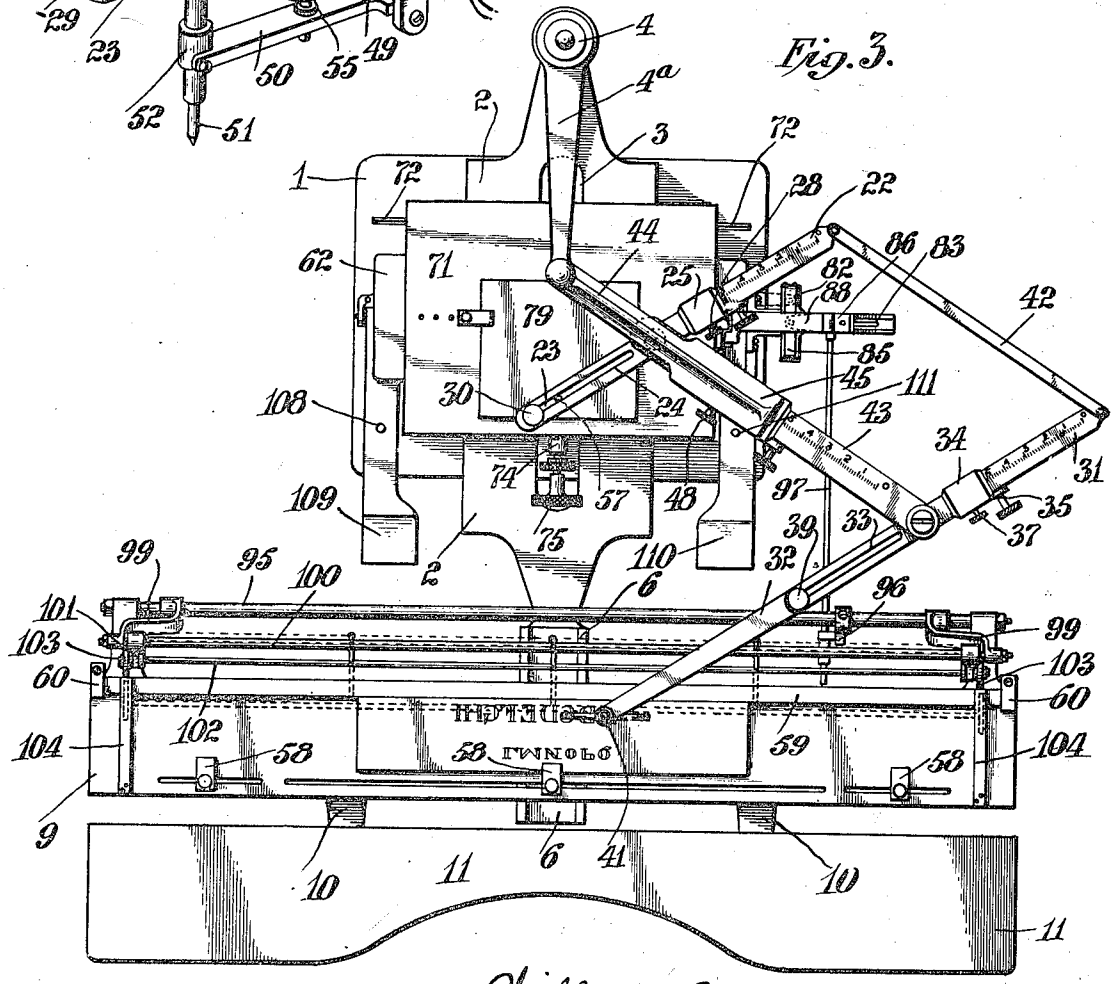


Fig. 3.



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5 SHEETS—SHEET 4.

Fig. 5.

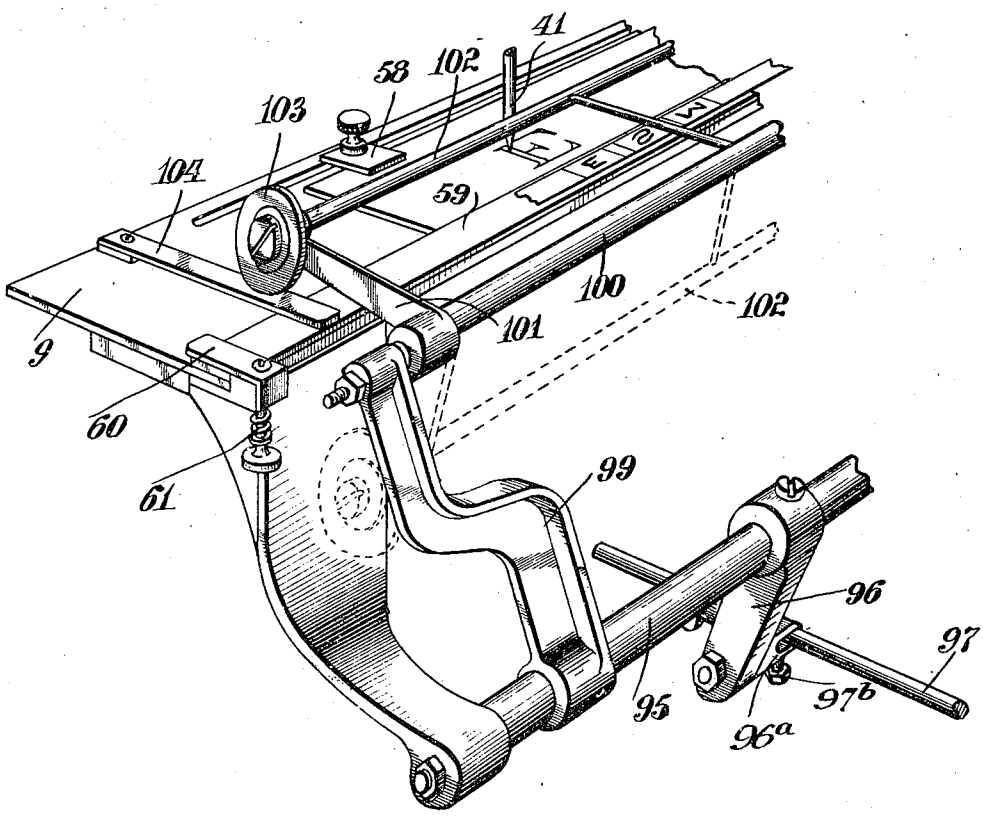


Fig. 8.



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5 SHEETS—SHEET 5.

Fig. 6.

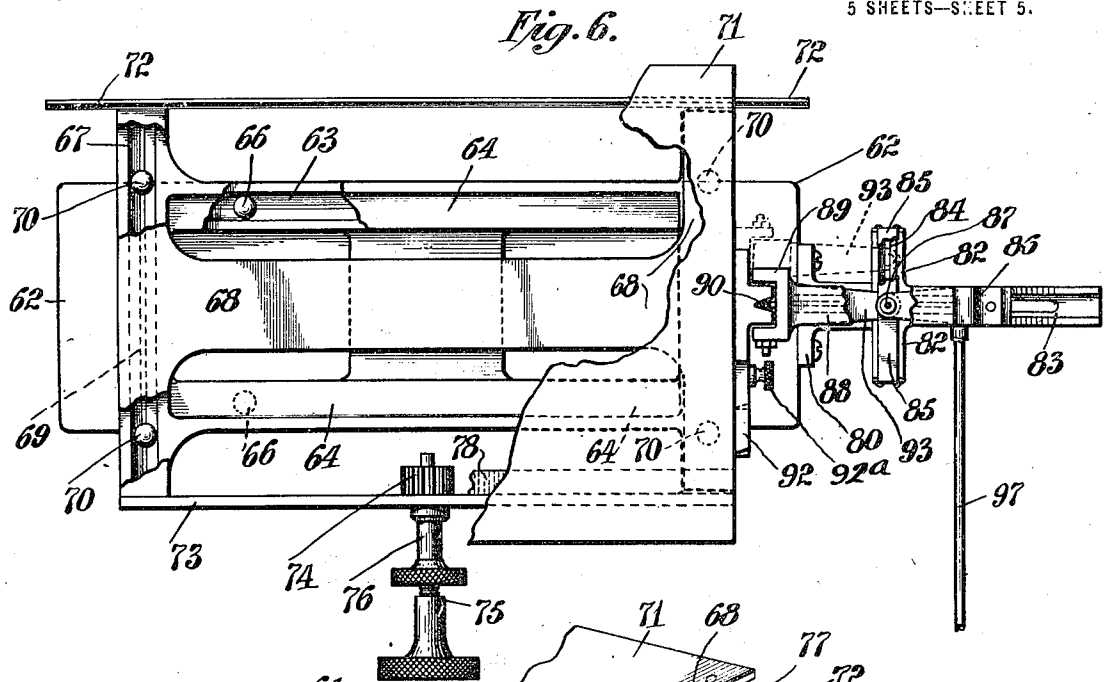
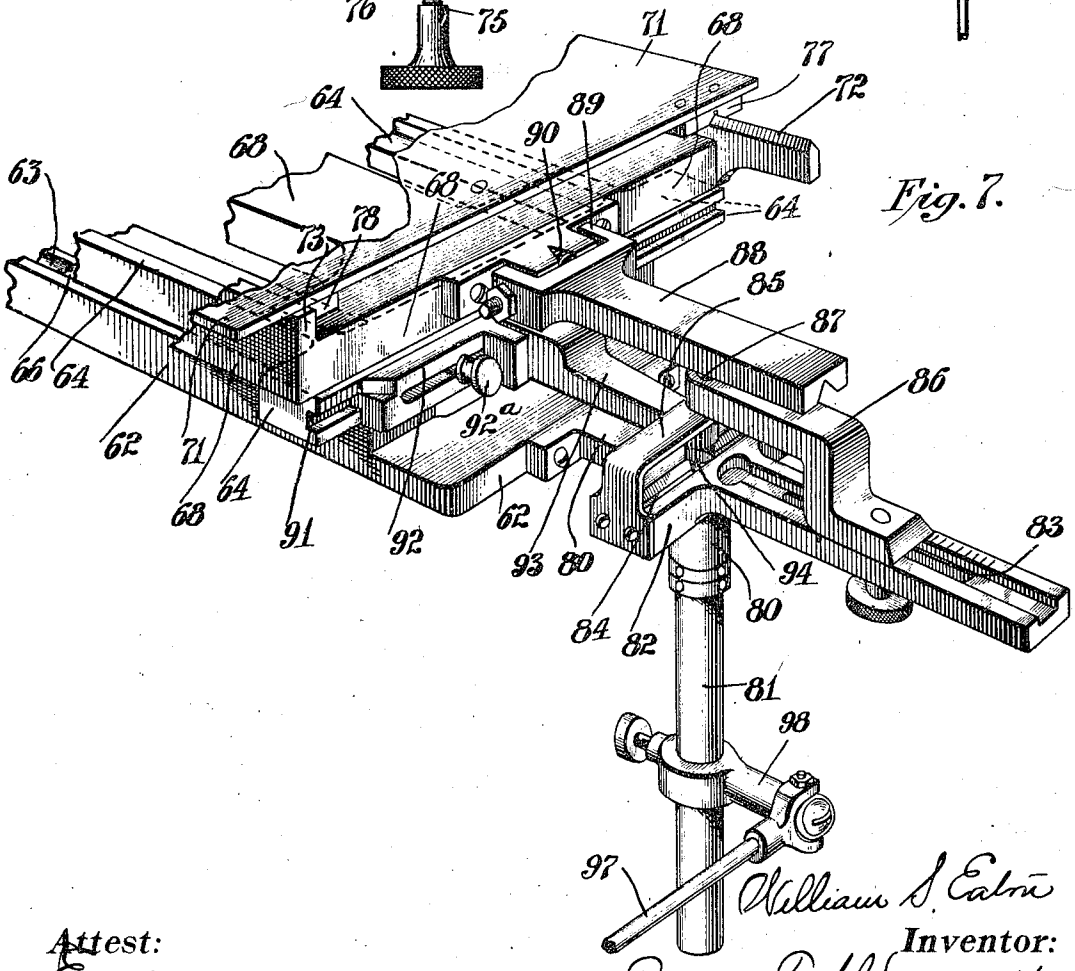


Fig. 7.



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UNITED STATES PATENT OFFICE.

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

PANTOGRAPHIC ENGRAVING-MACHINE.

1,235,668. Specification of Letters Patent. Patented Aug. 7, 1917.

Application filed June 9, 1914. Serial No. 843,956.

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 certain new and useful Improvements in Pantographic Engraving-Machines, of which the following is a specification, reference being had therein to the accompanying drawings, which form a part thereof.

My invention relates to pantographic engraving machines and more particularly to a type thereof wherein the reproducing point or tool has movement relative to the work-bed support.

Pantographic engraving machines have heretofore been extensively used in the printing trades, in engraving jewelry and in making dies in certain of the industrial arts but most machines so used have had a limited operative range; and have been so delicately adjusted and so complicated as to be nonadaptable for heavy work, and to introduce slight error in the reproduction. By my present invention, I aim to provide a machine, the pantographic element of which will be sufficiently rigid to insure accuracy in the operation of this mechanism and will be capable of such accurate and minute adjustment as to preserve the accuracy of the reproduction, irrespective of a change in the scale thereof; and wherein the work support will have a stability to adapt it to both light and heavy work. In constructing my machine, I preferably make the work supports adjustable both vertically and horizontally so as to adapt the support for use with work of different thickness and permit the movement of the work-bed so as to bring the work within the operative range of the reproducing tool or point. To aid in securing accuracy in the reproduction, I mount the parallel bars or levers constituting the pantographic mechanism upon a rigid pivotal arm moving about a fixed axis, and employ means whereby the effective leverage of all of the arms of this mechanism may be adjusted with relation to the effective leverage of the said supporting arm, which latter is adapted to be firmly connected with one of the connecting arms between the arm carrying the tracing stylus and the arm carrying the reproducing tool or point. I also provide an attachment whereby the reproduction may be extended, or condensed or inclined in either direction, which attachment may be made operative without the necessity for changing any of the adjustments of the pantographic lever mechanism.

A further incident of the invention is the supporting mechanism for the reproducing point or tool and the means by which it may be brought into contact with the work without necessitating a movement of the pantographic levers themselves while permitting such nicety in the regulation of the movement of said point as will insure uniformity in the operative engagement of the tool or point with the work irrespective of the number of times that it may be removed therefrom.

By the mechanism used for bringing the tool or point into contact with the work, I am enabled to secure the desired engagement of the tool or point with the work through a controlling mechanism actuated, if desired, by the foot of the operator, the controlling means being such as to avoid any distortion of the reproducing mechanism in case of excessive pressure applied to the controlling means.

In using a machine, made in accordance with my invention, for producing lettered plates for printing purposes, the text of the plate is first laid out by hand upon a strip of paper and the master type is set with relation to the layout upon this strip.

To adapt a machine for work of this character, I provide simple and convenient means for retaining a strip in the proper alinement with relation to the support for the master and also provide means whereby the strip and the master will be protected from the mechanism for distorting the reproduction, when such is used.

The invention consists in a pantographic engraving machine embodying therein a fixed support, an arm pivotally mounted upon said support, parallel pantographic levers, or bars adapted respectively to support a tracing stylus, and a work tool or point, parallel connecting bars having their opposite ends connected to said first named levers respectively, means connecting said pivotal arm with one of said cross-bars at a point intermediate said pantographic levers, a work-bed and a table for the master or

pattern; and in such other novel features of construction and combination of parts as are hereinafter set forth and described and more particularly pointed out in the claims hereto appended.

Referring to the drawings:

Figure 1 is a side elevation of a machine embodying my invention;

Fig. 2 is a view in perspective of the upper part of the machine;

Fig. 3 is a plan view of the machine;

Fig. 4 is a detail view in perspective of that pantographic lever which supports the work tool or point;

Fig. 5 is a view in perspective of a portion of the table for the master or pattern, and the actuating means for varying the operative effect of the pantographic mechanism;

Fig. 6 is a plan view of the pattern table broken away upon different levels to show the means whereby movement is imparted to the work-bed to vary the operative effect of the pantographic mechanism;

Fig. 7 is a perspective view of the said mechanism; and

Fig. 8 is a view showing the various operative effects which may be secured upon the machine.

Like letters refer to like parts through the several views.

In the embodiment of my invention shown in the drawings, 1 indicates the pedestal of a machine having a bed 2 having a longitudinal slot 3 therein. Supported at the rear of this bed is a vertical post 4, and at the forward edge of said bed is a post 5 for the pattern table for the master or pattern and the parts appurtenant thereto.

Carried by the post 5 is a channeled plate 6 in which is mounted a sliding cross-bar 7, carrying a plurality of pillars 8 to which a pattern supporting table 9 is firmly attached. Pivotally supported from the pillars 8 is a plurality of arms 10 carrying a laterally swinging arm rest 11 for facilitating the operation of the machine.

Slidably mounted upon the bed 2 is a frame 12 carrying a vertical sleeve 13 in which is mounted a column 14 adapted to support the work-bed and parts appurtenant thereto. The bore of the sleeve 13 is in register with the slot 3 in the bed 2 so as to permit vertical movement of the column 14. Said column is provided with a rack 15 in mesh with which is a gear (not shown) mounted upon the shaft 16. Said shaft also carries a holding mechanism as the pawl and ratchet mechanism 17. I also use a set screw 18 carried by said column to supplement the action of the pawl and ratchet mechanism 17 in holding the column 14 in any adjusted position and incidentally locking it in the sleeve in a manner to avoid any looseness of said column in said sleeve.

The table 2 carries a rack 19 extending longitudinally of the machine, in mesh with which is a gear (not shown) carried by the shaft 20, which also carries a pawl and ratchet mechanism 21.

By the construction described, I am enabled to vary the height of the work-bed and adjust it longitudinally of the machine, or toward or from the pattern supporting table or the post 4 carrying the pantographic mechanism. A construction such as that hereinafter described gives great operative range to the machine while affording a rigidity of structure calculated to minimize or eliminate such vibrations as would lead to inaccuracy in the reproduction.

In the further description of the case, I shall consider separately the pantographic mechanism; the work tool or point supporting mechanism; the pattern supporting table structure, and the mechanism for varying the character of the reproduction as distinguished from a mere change of scale.

In describing the pantographic mechanism, I shall, to avoid confusion, designate the arms or bars carrying the work tool or point, and the tracing stylus as pantographic levers, and the other arms or bars completing the parallelogram, as connecting bars.

The pantographic mechanism comprises two extensible pantographic levers adapted respectively to carry a work tool or point, and the tracing stylus. The lever carrying the work tool or point, comprises the two sections 22 and 23, one of which (22) has an elongated slot 24 therein to permit movement of the other section 23 relative thereto. The section 23, adjacent one end thereof, is provided with a block 25 slidably mounted upon the section 22, which block supports the gear 26 in mesh with a rack 27 upon the said section 22. Said block is also provided with a set screw 28 by means of which it may be firmly set in any adjusted position. The other end of the section 23 carries a distance stud 29, the upper end of which is reduced and forms a close sliding fit with the slot 24, a set screw 30 being provided to form a tight bond between the end of the section 23 and the section 22 when it has been suitably adjusted. The bar 23 carries the work tool or point supporting mechanism which will be more fully described hereinafter.

The lever carrying the tracing stylus comprises two sections 31 and 32, the first of which is provided with an elongated slot 33 similar to the slot 24 and the latter of which sections carries a block 34 provided with a gear 35 coöperating with a rack 36 upon the section 31 and a set screw 37, which parts are all similar in construction to the block 25 and its appurtenances. The bar 32 is provided with a distance stud, 38 and

clamp screw 39 similar in function and construction to the stud 29 and clamp screws 30 carried by the section 23. The end of the section 32 is extended beyond the stud 38, however, said extended end having a vertical bearing 40 therein for the tracing stylus 41, which may be of any desired construction.

The expansible pantographic levers heretofore described extend parallel with each other and are capable of such extension or contraction, as to length, as to permit accurate variation in the scale or reproduction.

The lever sections 22 and 31 are connected at the rear ends thereof by the connecting bar 42; and intermediate said bar and the slotted end of said levers, by a second connecting bar 43 parallel with the bar 42. The connecting bars 42—43 are pivotally connected with the pantographic levers and are of a stiffness to avoid any springiness therein during the operation of the machine. The lever sections 22 and 31 and the bar 43 are provided with graduated lines as shown to insure uniformity in the adjustment of said levers and said cross-bar when setting the machine for any desired scale of reproduction.

Carried by the bracket 4^a is a stiffened arm 44 one end of which is pivotally mounted for movement about a vertical axis in said bracket and the other end of which has an enlarged head 45 in which the connecting bar 43 is slidably mounted. Said enlarged head 45 carries a gear 46 in mesh with a rack 47 upon the bar 43. Said head 45 also carries a set screw 48 by means of which said bar may be firmly secured within said head after the pantographic mechanism has been set.

By the construction described, I provide a rigid pantographic lever system which will insure absolute accuracy in the reproduction, and which may be readily adjusted to vary the scale of such reproduction.

To insure the desired firm movement of the pantographic levers and connecting bars as well as of the swinging lever 44, I use ball-bearings in the various connections, wherever possible.

Carried by and forming a part of the lever section 23 is a block 49 in which is mounted upon horizontal pivots a rocking arm 50 adapted to support the work tool or point 51 by means of a chuck 52 mounted upon pivots parallel with the pivots of said arm 50. Carried by the other end of said arm 50 is an electro-magnet 53 which serves as a counterweight for normally raising the tool out of engagement with the work-plate and also as an actuating means for bringing said tool into operative engagement with said plate. This magnet has an elongated core 54 projecting through an opening in the lever section 23 to serve as a guide for said magnet. Carried by the arm 23 is an adjustable stop 55 by means of which the arm 50 may be set to determine the extent of penetration of the tool 51 in the work plate. This result is secured by limiting the oscillatory movement of the arm 50 under control of the magnet. By raising the stop the downward movement of the chuck 52 is diminished, while by lowering the stop this downward movement is increased, the said stop engaging the underside of the arm 50. The block 49 is provided with binding posts 56 by means of which electrical connection is made between the magnet, and the controlling means for the circuit thereto.

By pivotally mounting the chuck 52 in the forked end of the arm 50, the slight arc described by said arm is compensated for and the tool is given rectilinear movement, the upper end of said chuck being mounted in an opening 57 in the arm 23 to insure this movement of said chuck.

The chuck 52 is spaced away from the distance stud 29 to an extent sufficient to bring said chuck in axial alinement with the pivot of the arm 44, when the various lever arms, and connecting bars, are set at zero thus permitting the adjustment of the machine so that the movement of the stylus 41 will have no operative effect upon the work tool or point.

The pattern supporting table 9 is provided with suitable means, as the adjustable dogs 58, for securing the master or pattern plate in position upon said table while permitting it to be conveniently and quickly shifted from place to place thereon. Said dogs 58 are provided with screw clamps as shown, which clamps engage said dogs and pass through laterally extending slots in the table 9. This form of dog is old and well known in this art. In reproducing words, I preferably provide a master plate containing the entire alphabet, the plate being shifted to bring different letters as required into the desired operative relation. That side of the table positioned toward the work-bed is elevated slightly to form a platen 59 for a paper strip, and at the opposite ends of said platen are spring clips 60 adapted to hold said strip firmly in place upon said platen. These clips are provided with a stem projecting through the table and acted upon on the under side of said table by a spring 61 shown clearly in Fig. 5.

The mechanisms heretofore described are operative to reproduce upon a reduced scale any character represented by the pattern or master. The construction of the work-table support is as heretofore stated such as to admit of the support being adjusted vertically and longitudinally of the machine; and to permit a lateral adjustment of this support, I so mount the work table itself upon this supporting structure as to permit the surface bearing the work plate to be

shifted laterally of the machine, thus securing a universal adjustability of the work bed. The mechanism for securing this lateral adjustment will be more fully described hereinafter.

It may on occasion, however, be desired to extend or condense a letter or character; to tilt the same forwardly or backwardly; or to either extend or condense the letter or character while tilting it either forwardly or backwardly. To meet this condition, I so construct the work bed that it may be moved to any desired extent while the pantographic mechanism is in operation, thus modifying the operative effect of the work tool or point so as to secure the desired distortion or variation of the character or letter reproduced.

To permit the desired actuation of the machine, I provide, in conjunction with a universally movable work-tool or point, a work bed universally movable upon a single plane; and provide means operative from the tracing stylus whereby simultaneous movement will be imparted to the work tool or point and the work-bed. The mechanism which I prefer to employ is so constructed that it may be so set as to have no operative effect upon the work bed, or as to secure any of the desired variations in the reproduction. I preferably so construct the controlling means for actuating said mechanism that when it is not desired to distort or vary the reproduction, said controlling means may be thrown out of the operative relation to the stylus point and thus permit the machine to be actuated as freely as though no such mechanism were used upon the machine. By a construction such as that herein shown and described, the desired variation in the character of the reproduction may be secured without any variance in the adjustment of the pantographic mechanism.

To permit the desired movement of the work bed, I attach to the column 14 an immovable frame 62 having therein run-ways 63 extending laterally of the machine. Mounted upon said frame is a carriage 64 having laterally extending run-ways 65 upon the under side thereof registering with the run-ways 63 upon the frame 62. Ball-bearings 66 are positioned in and between said run-ways at separated points, so as to give a steady support for said carriage. The run-ways 63 and 65 are preferably V-shaped in cross-section. The carriage 64 is provided with run-ways 67 upon the upper surface thereof which run-ways extend perpendicularly to the run-ways 63 upon frame 62, or longitudinally of the machine. Superimposed upon the carriage 64 is a second carriage 68 having run-ways 69 upon the under side thereof registering with the run-ways 67. Said carriage is mounted on the carriage 64 by means of the ball-bearings 70 seated in and between the run-ways 67 and 69.

The work table 71 itself is supported upon the carriage 68 and is capable of movement laterally of the machine independently of the carriage 64. To secure this independent movement, I provide the carriage 68 with the V-shaped track 72 at the back thereof and the flat track 73 at the front thereof. Carried by the carriage 68 is a gear 74 mounted upon a screw threaded shaft 75 by means of which it may be rotated. I also mount upon said shaft a set screw 76 by means of which the gear 74 and the table 71 may be locked in any adjusted position. The table 71 is provided with a bearing plate 77 coöperating with the track 72 and a rack 78 with which gear 74 is adapted to mesh which rack also bears upon the rear face of the track 73 so as to secure a firm bearing for said table. The gear 74 is used solely to position the table 71 with relation to the work tool or point in properly placing the reproduction upon the work plate. The work plate proper, I have indicated at 79.

Mounted in a bracket 80 is a rotatable shaft 81 moving about a vertical axis and carrying at the top thereof a T-shaped fitting 82 having perpendicularly arranged keepers formed by grooves therein, one of said grooves 83, extending laterally of the machine and the other 84 extending longitudinally of the machine. Extending above the groove 84 is a strap or housing 85. Slidably mounted in the grooves 83 is a bracket 86 provided with a point bearing 87 upon the upper forward edge thereof. Coöperating with said bracket 86 is an arm 88 connected with the carriage 68. To compensate for any slight structural inaccuracy in the said arm 88 and also to insure the proper engagement of said arm with the bearing 87, I preferably mount said arm upon said carriage by means of horizontal pivots 89 and force said arm into engagement with said bearing by means of the spring 90. It will be observed that if the bearing 87 be so adjusted as to extend in axial alinement with the shaft 81 movement of the fitting 82 will have no operative effect upon said arm 88 or its carriage 68, but that if said arm 86 be adjusted toward or away from this position, so as to be out of alinement with said shaft 81, the oscillatory movement of said shaft will result in longitudinal movement of the carriage 68 through the stresses applied thereto through the arm 88.

Carried by one side face of the carriage 68 is a channeled plate 91 having mounted therein a bracket fitting 92. Mounted upon said bracket is an arm 93 provided with the bearing 94 seated in the groove 84. Said

arm is preferably mounted upon horizontal pivots as shown. Said fitting 92 is slotted as shown, so as to be capable of being set in any adjusted position by means of the set screw 92ª passing through said slot and engaging the plate 91. The channeled plate 91 is provided with graduations as shown so that the fitting 92 may be accurately adjusted. With respect to this construction, it will be observed that when the bearing 94 is positioned so as to be in alinement with the axis of the shaft 81, the rotary movement of this shaft will have no operative effect upon the carriage 68 but that if said arm 93 be adjusted longitudinally of the machine in either direction, oscillatory movement of said shaft 81 will through the T-shaped fitting 82 impart lateral movement to the carriage 64 and also to the carriage 68 and work table 71. It will be observed that by the construction shown, the work table 71 may be allowed to remain perfectly stationary while the pantographic mechanism is operative or may be caused to have lateral movement or longitudinal movement, or simultaneous lateral and longitudinal movement, according to the adjustment of the bracket 86 or the arm 93.

To insure the desired proportionate movement of the work table, I place the shaft 81 under the control of the tracing stylus, thus making the actuation of the work table entirely automatic, or co-incident with the actuation of the pantographic mechanism. This means for placing the said work table under the control of the tracing stylus, preferably comprises a crank shaft 95 having thereon a crank arm 96 connected by a link 97 with a crank arm 98 upon said shaft 81. The shaft 95 is provided with a plurality of brackets 99 in which is mounted a shaft 100 having pivotally mounted thereon a frame 101 carrying a contact bar 102 adapted to be engaged by the tracing stylus. The frame 101 is supported by rollers 103 bearing upon tracks 104 positioned upon and above the table 9, holding said rollers 103 out of engagement with the master or pattern plate and the work strip upon the platen 59.

The shaft 95 is provided with means, as a pendulous counterweight 112, to impart a normal forward thrust to the bar 102 and thus cause said bar to follow the stylus upon its return movement after having been displaced by a direct movement under said stylus.

The link 97 is adjustably connected with the crank arm by being passed through a fork 96ª in said crank arm and being engaged by said screw 97ᵇ, so as to permit elongation or shortening of said link in accordance with the adjustment of the frame 12 or column 14.

The electro-magnet 53 may be energized from any desired source of electrical supply such as the battery 105, the circuit leading from this battery and including the magnet being controlled in any desired manner. Preferably I connect one of the battery terminals 106 with the pedestal 1 of the machine and the other terminal 107 with one of the binding posts 56. The other binding post I connect with an insulated contact 108 carried by a depressible treadle 109, so that the circuit from the battery may be closed by the foot of the operator. I also provide a second depressible treadle 110 mounted upon the opposite side of the machine, which treadle carries an insulated contact 111 also connected with the same battery terminal 107, which is connected with the contact 108. This arrangement is one merely of convenience, however, and in fact any other means for closing the circuit to the magnet may be used without departing from the spirit and scope of the invention.

The operation of the herein described mechanism is substantially as follows:

A work plate 79, which may consist of a metal plate, a lithographic stone, a plate of glass, or a sheet of any desired material, is mounted upon the work table 71 and the said table is adjusted vertically, longitudinally or laterally of the machine as required to bring the desired portion of the plate within the operative range of the work tool or point 51. If vertical adjustment is required, this is secured through the actuation of the gear shaft 16, and rack 15, the set screw 18 being released to permit the upward or downward movement of the column 14, and reset when the table is at the desired height, so as to afford the desired rigidity in the support for the said table. The longitudinal adjustment is secured by means of the rack and pinion mechanism 19—20 and the lateral adjustment by means of the rack and pinion mechanism 74—78.

The work plate being thus in position, the master or pattern is mounted upon the table 9 by means of the dogs 58 or any of them, and after the machine is set for reproduction upon the desired scale, the design upon said master or pattern may be reproduced upon the work plate 79 by merely causing the stylus 41 to follow the lines in said master or pattern.

The longitudinal component of movement imparted to the reproducing point 51, results from the oscillation of the arm 44 about its point of pivotal connection with the bracket 4ª while the lateral component of motion results from the oscillation of the pantographic levers about the point of pivotal connection thereof with the connecting bar 43, the connecting bar 42 compelling and defining this oscillatory movement. A straight line in the reproduction or a curved line on any radius other than of the axis of

the arm 44 would result from a simultaneous oscillatory movement of both the arm 44 and the said pantographic levers.

Before the tracing stylus is moved about the pattern, it is necessary to set the work tool or point so as to secure the desired degree of penetration thereof, or bring it into the desired contact with the work plate. This is done by closing the circuit to the magnet 53 and adjusting tool 51 in its chuck 52, and setting the stop 55 so as to define the extension or oscillatory movement of the oscillatory arm 50. When the tool is so set and it is desired to begin work, either treadle 109 or 110 is depressed to close the circuit to energize the magnet to cause it and the end of the arm 50 upon which the magnet is mounted to move upwardly and bring the tool into engagement with the work plate 79.

If it is desired to reproduce a line of letters, the word or words are laid out upon a strip of paper (see Fig. 5), which strip is placed upon the platen 59 with the ends thereof projecting beneath the clips 60 and the tracks 104. When the strip is so placed, it is smoothed out and the clips are released so as to permit their spring 61 to close said clips upon the paper and thus hold it in any desired position upon said platen. The letters upon the master or pattern corresponding with the succeeding letters laid out on the strip are then brought consecutively into the desired relation and each letter is traced, thus securing the desired sequence of letters upon the reproduction as well as the desired spacing thereof.

Assuming that it is desired to vary the scale of reproduction, it is necessary to vary the effective leverage of one of the pantographic levers, relative to the other as well as the effective leverage of the pivotal supporting arm 44, which leverage, under all conditions, must, to secure accuracy in the reproduction, be the same as that of the lever 23. In constructing the machine, the relative effective leverage of the sections 23 and 32 is determined, but this leverage may be varied by shifting either or both sections with relation to the point of its or their pivotal support. The effective leverage of the arm 44, as to its operative effect upon the work tool or point, is determined by the distance between the axis of the pivotal support of said arm and the axis of the point of pivotal connection between the connecting bar 43 and the lever section 22, which, to secure the preservation of accuracy in the reproduction must be the same as the distance between the work tool and said point of pivotal connection between the section 22 and the connecting bar 43. Hence, to vary the scale of reproduction, it is necessary to not only vary the effective leverage of either or both of the pantographic levers, but also the effective leverage of the arm 44. To avoid skewing of the reproduction, it is necessary to adjust the section 23 and the bar 43 to the same extent. This may be done by means of the blocks 25 and the enlarged head 45 and the parts appurtenant thereto, the lever section 32 being also capable of adjustment by its block 34. The various graduated scales aid in securing exactitude in the adjustment.

Irrespective of any adjustment of the pantographic levers, the sections 22 and 31 always have the same radius or the same effective leverage. Hence, the scale of reproduction will be determined by the relative leverages of the sections 23 and 32, and any variance in the scale of reproduction results from a variance in the effective leverages of said last named sections. It will thus be observed that adjustment for scale may be secured by a movement of either of said lever sections 23 or 32 in either direction; or the movement of both of said levers in the same or in opposite directions. If it be desired to increase the scale of reproduction, this may be done by moving the section 23 so that the end thereof carrying the work tool will move away from the bar 43 or the section 32 may be moved so that the end thereof carrying the tracing stylus will move toward said bar 43 or both said sections may be shifted, section 23 away from and section 32 toward said bar. If, however, it be desired to reduce the scale of reproduction, the section 23 may alone be shifted in the opposite direction or toward the bar 43; or the section 32 may be shifted away from the bar 43; or said sections may be both shifted, the section 23 toward and the section 32 away from, said bar 43, or said levers may be moved in the same direction and to the same or to a variable extent toward the bar 43. As long as the shortest effective leverage of the section 32 is greater than the longest effective leverage of the section 23, said section 32 may be moved toward the bar 43 to even a greater extent than the section 23, while yet reducing the scale of reproduction. In other words, the scale of the reproduction varies in proportion to the differential of the effective leverages of the sections 23 and 32, and any desired scale may be secured by the adjustment of either or both of said arms to the desired extent. Whatever, the adjustment of the section 23, however, toward or from the bar 43 there must be a similar and equal adjustment of the bar 43 toward or from the fixed axis of the supporting arm 44 in order to preserve accuracy in the dimensions, relative to those of that of the master or pattern. When the sections 23 and 32 have been adjusted to the desired extent, the bar 43 is shifted toward or from the axis of the arm 44 to the same extent as the movement of the section 22 and the said levers and said bars are locked in their adjusted position. By this adjustment

it will be observed that the point of pivotal connection between the bar 43 and the section 22 is shifted with relation to the point of pivotal support of the arms 44 to the same extent that the work tool or point 51 is shifted with relation to the point or pivotal connection of the section 22 and connecting bar 43. While the amount and direction of movement of the section 32 may be the same as, or differ from that of the section 23, it will be observed that the effective leverage of the arm 32 as compared with that of the arm 23 after any adjustment differs from the effective leverage before the adjustment, thus resulting in the desired variance in the scale of the reproduction. If the section 23 or the sections 23 and 32 and the connecting bar 43 be set at zero, it will be found that the axis of the pivotal connection between the bar 43 and the pantographic lever section, will be in exact alinement with the axis of the arm 44, and that the point 51 will also be in alinement with said axis, so that any movement of the stylus point will have no operative effect upon the work tool or point.

It will be observed that when reproducing the pattern or master to scale, the work table 71 remains in a fixed position and that the work tool or point 51 has movement with relation thereto. It will also be observed that the pantographic levers each have one arm having the same, and a fixed effective leverage, and that any variance in the scale of reproduction results from a variance in the effective leverage of the other arm.

Under ordinary conditions when reproducing to scale, the bar 102 will be swung downwardly below the plane of the table 9 so as to be out of the operative range of the tracing stylus. If, however, it be desired to vary the character of the reproduction, as, for example, to condense, extend or tilt, or incline it, this bar is raised and the wheels 103 are placed upon the tracks 104. When the parts are in this position the counterweight 112 will impart a forward thrust to the bar 102 and oscillate the shaft 81 and with it the T-shaped fitting 83. The projection of the bar 102 across the table 9 will result in the movement of this bar to the same extent, and in the same direction longitudinally of the machine, as the longitudinal movement of the stylus in following the pattern or master.

If it be desired to condense the letter or make the vertical dimension or height smaller relatively to the lateral dimension or width, as compared with the master, the bracket 86 is set with the bearing 87 between the axis of the shaft 81 and the carriage 68. When so set the oscillation of the shaft 81 in either direction will impart longitudinal movement to said carriage 68 simultaneously with the longitudinal movement of the work tool but to a considerable less extent and thus shorten the vertical, or height, lines described by said tool upon the work plate to the extent determined by the amount of the longitudinal movement of the carriage under the arm 88. The extent of this condensation may be controlled by the quantity of inward movement of the bracket 86. If, however, it be desired to extend the letter, or make the vertical dimension or height thereof relatively greater than the lateral dimension as compared with these dimensions in the master or pattern, the bracket 86 may be shifted away from the carriage 68 with the resultant effect that oscillatory movement of the shaft 81 will impart movement to said carriage counter to the movement of the work tool and thus increase the length of the lines by an extent measured by the quantity of movement of the said carriage.

If it be desired, however, to incline the design or letters backwardly or to the left of Fig. 3 in the drawings, the fitting 92 may be shifted rearwardly of the machine thus bringing the point bearing 94 thereof rearwardly of the axis of the shaft 81. The oscillatory movement of the shaft 81 upon the rearward movement of the stylus will then impart to carriage 64 a lateral movement to the right which movement will give the desired inclination or tilt to the letter. The extent of this inclination will be determined by the extent of movement of the fitting 92, the farther this is moved toward the rear of the machine, the greater being the degree of inclination of the reproduction. Likewise by shifting the fitting 92 toward the front of the machine, the oscillatory movement of the shaft 81 will upon rearward movement of the stylus move the work plate to the left of Fig. 3 and give a backward tilt or inclination to the letters. If it be desired to both incline the letters and extend or condense same, both the bracket 86 and the fitting 92 may be adjusted thus imparting to the work table a simultaneous lateral and longitudinal movement and modifying the reproduction accordingly. By using gage lines, accuracy in these adjustments may be secured and a duplication of any adjustment made possible.

The nature of the work tool or point used in connection with this machine is immaterial to the invention. It may be constructed merely to remove resist from the surface of a printing plate, to actually engrave on the plate, or otherwise remove metal, or the surface of a lithographic stone. It may be so formed as to merely outline the reproduction without penetrating the surface of the plate. In fact any old and well-known form of tool may be used in connection with the mechanism herein described, the tool itself forming no part of the invention.

It will be observed that the pivotal sup-

ports for the lever sections 22 and 31 are disposed upon the same radius or the axis of the pivotal support and the arm 44; and that absolute accuracy in the reproduction results from the constant leverage of said sections 22 and 31 irrespective of the scale for which the pantographic levers are adjusted.

It is not my intention to limit the invention to the precise details of construction shown in the drawings, it being apparent that such may be varied without departing from the spirit and scope of my invention.

Having described the invention what I claim as new and desire to have protected by Letters Patent is:

1. A pantographic engraving machine embodying therein a fixed support, an arm projecting radially of and having one end thereof pivotally mounted upon said support, parallel pantographic levers or bars adapted respectively to support a tracing stylus and to support a work tool or point, parallel connecting bars having their opposite ends pivotally connected to said pantographic levers, respectively, means fixedly connecting the other end of said pivotal arm with one of said connecting bars at a point intermediate said pantographic levers, a work bed and a table for the master or pattern.

2. A pantographic engraving machine embodying therein a fixed support, an arm projecting radially of and having one end thereof pivotally mounted upon, said support, parallel pantographic levers or bars adapted respectively to support a tracing stylus and to support a work tool or point, parallel connecting bars having their opposite ends pivotally connected to said pantographic levers respectively, means connecting the other end of said pivotal arm with one of said connecting bars at a point intermediate said pantographic levers, means whereby the scale of reproduction may be varied comprising means for varying the operative leverage of the pantographic lever carrying the work tool or point, and means for varying the operative leverage of said pivotally supported arm, and of the connecting bar carried thereby, a work bed and a table for the master or pattern.

3. A pantographic engraving machine embodying therein a fixed support, an arm projecting radially of and having one end thereof pivotally mounted upon, said support, parallel pantographic levers or bars adapted respectively to support a tracing stylus and to support a work tool or point, parallel connecting bars having their opposite ends pivotally connected to said pantographic levers respectively, means connecting the other end of said pivotal arm with one of said connecting bars at a point intermediate said pantographic levers, means for varying the operative leverage of the pantographic lever carrying the tracing stylus whereby the scale of reproduction may be varied, a work bed and a table for the master or pattern.

4. A pantographic engraving machine embodying therein a fixed support, an arm projecting radially of and having one end thereof pivotally mounted upon, said support, parallel pantographic levers or bars adapted respectively, to support a tracing stylus and to support a work tool or point, parallel connecting bars having, their opposite ends pivotally connected to said pantographic levers respectively, means connecting the other end of said pivotal arm with one of said connecting bars at a point intermediate said pantographic levers, means whereby the scale of reproduction may be varied comprising means for varying the operative leverage of the pantographic lever carrying the work tool or point, means for varying the operative leverage of the pantographic lever carrying the tracing stylus, and means for varying the operative leverage of said pivotally supported arm, a work bed and a table for the master or pattern.

5. A pantographic engraving machine embodying therein a fixed support, an arm pivotally mounted upon said support, parallel pantographic levers, parallel connecting bars having their opposite ends pivotally connected to said pantographic levers respectively, means whereby one of said connecting bars is slidably mounted upon said pivotal arm at a point intermediate said pantographic levers, one of said pantographic levers comprising two sections, one of which is pivotally connected with said connecting bars and the other of which is slidably mounted upon said first named section and is adapted to support a work tool or point whereby said connecting bars and said lever section carrying the work tool or point may be similarly adjusted to vary the scale of the reproduction, the other of said pantographic levers being adapted to support a tracing stylus, a work bed and a table for the master or pattern.

6. A pantographic engraving machine embodying therein a fixed support, an arm pivotally mounted upon said support, parallel pantographic levers or bars, parallel connecting bars having their opposite ends connected to said pantographic levers respectively, means connecting said pivotal arm with one of said connecting bars at a point intermediate said pantographic levers, one of said pantographic levers comprising two sections one of which is connected with said connecting bars and the other of which is slidably mounted upon said first named section and is adapted to support a tracing

stylus whereby the scale of reproduction may be varied, a work bed and a table for the master or pattern.

7. A pantographic engraving machine embodying therein a fixed support, an arm pivotally mounted upon said support, parallel pantographic levers, parallel connecting bars having their opposite ends pivotally connected to said pantographic levers, respectively, means whereby one of said connecting bars is slidably mounted upon said pivotal arm at a point intermediate said pantographic levers, one of said pantographic levers comprising two sections, one of which is pivotally connected with said connecting bars and the other of which is slidably mounted upon said first named section and is adapted to support a work tool or point, the other of said levers comprising two sections one of which is connected with said connecting bars and the other of which is slidably mounted upon said first named section and is adapted to support a tracing stylus whereby said connecting bars and said levers may be adjusted to vary the operative leverage of said supporting arm and said levers respectively, to vary the scale of reproduction, a work bed and a table for the master or pattern.

8. A pantographic engraving machine embodying therein a fixed support, an arm pivotally mounted upon said support, parallel pantographic levers or bars, parallel connecting bars having their opposite ends pivotally connected to said pantographic levers respectively, means connecting said pivotal arm with one of said connecting bars at a point intermediate said pantographic levers, means carried by one of said levers for supporting a tracing stylus, means carried by the other of said levers for supporting a work tool, comprising an oscillatory arm, horizontal pivots connecting said arm and said lever, a support for a work tool carried by one end of said arm, means operative on the other end of said arm whereby it may be oscillated to engage or disengage a work tool from the work, a work bed and a table for the master or pattern.

9. A pantographic engraving machine embodying therein a fixed support, an arm pivotally mounted upon said support, parallel pantographic levers or bars, parallel connecting bars having their opposite ends pivotally connected to said first named levers respectively, means connecting said pivotal arm with one of said connecting bars at a point intermediate said pantographic levers, means carried by one of said levers for supporting a tracing stylus, means carried by the other of said levers for supporting a work tool, comprising an oscillatory arm, horizontal pivots connecting said arm and said lever, a support for a work tool carried by one end of said arm, means operative on the other end of said arm whereby it may be oscillated to engage or disengage a work tool from the work, an adjustable stop mechanism for controlling the extent of oscillatory movement of said arm, a work bed and a table for the master or pattern.

10. A pantographic engraving machine embodying therein a fixed support, an arm pivotally mounted upon said support, parallel pantographic levers or bars, parallel connecting bars having their opposite ends pivotally connected to said pantographic levers respectively, means connecting said pivotal arm with one of said connecting bars at a point intermediate said pantographic levers, means carried by one of said levers for supporting a tracing stylus, means carried by the other of said levers for supporting a work tool, comprising an oscillatory arm, horizontal pivots connecting said arm and said lever, a support for a work tool carried by one end of said arm, an electro-magnet mounted upon the other end of said arm, means controlling the circuit to said magnet, a work bed and a table for the master or pattern.

11. A pantographic engraving machine embodying therein a fixed support, an arm pivotally mounted upon said support, parallel pantographic levers or bars, parallel connecting bars having their opposite ends pivotally connected to said pantographic levers respectively, means connecting said pivotal arm with one of said connecting bars at a point intermediate said pantographic levers, means carried by one of said levers for supporting a tracing stylus, means carried by the other of said levers for supporting a work tool, comprising an oscillatory arm, horizontal pivots connecting said arm and said lever, and a pivotal support for a work tool carried by one end of said arm, said lever above said work tool support having an opening therein through which said work tool support is adapted to pass to insure a rectilineal movement of said tool, an electro-magnet mounted upon the other end of said arm, means controlling the circuit to said magnet, a work bed and a table for the master or pattern.

12. A pantographic engraving machine embodying therein a fixed support, an arm pivotally mounted upon said support, parallel pantographic levers, parallel connecting bars having their opposite ends pivotally connected to said pantographic levers respectively, an enlarged head upon said arm whereby one of said connecting bars is slidably supported by said arm, a rack and gear mechanism carried by said enlarged head and said bar, locking means whereby said bar may be secured in any adjusted position with relation to said arm, said enlarged

head engaging said bar intermediate said levers, one of said pantographic levers comprising two sections, one of which is pivotally connected with said connecting bars and has an elongated slot therein and the other of which is slidable with relation to the other and provided with a block slidably mounted upon said first named section, a rack and gear mechanism carried by said block and said first named section, means for locking said block upon said first named section, the other of said levers comprising two sections one of which is connected with said connecting bars and has an elongated slot therein and the other of which is slidable with relation to the other and provided with a block slidably mounted upon the coöperating lever section, a rack and gear mechanism carried by said block and the section upon which it slides, means for locking said block upon said last named section, a stud carried by each of said slidable sections, a set screw passing through an elongated slot in each of said fixed sections and engaging the stud on the other section, the slidable section of one of said levers being adapted to support a work tool or point and the slidable section of the other of said levers being adapted to support a tracing stylus, a work bed and a table for the master or pattern.

13. In a pantographic engraving machine, a pantographic mechanism comprising a bar movable about a fixed axis, two levers pivotally mounted at different radial points of said bar, a second bar parallel with said first named bar and pivotally connected with both of said levers, a work tool or point support carried by one of said levers, a tracing stylus support carried by the other of said levers, means whereby the work tool or point support may be adjusted with relation to the point of pivotal support of its supporting lever, and means whereby said levers and said first named bar may be moved toward or from said fixed axis, to vary the scale of reproduction, a work bed and a table for the master or pattern.

14. In a pantographic engraving machine, a pantographic mechanism, comprising a bar movable about a fixed axis, two levers pivotally mounted at different radial points of said bar, a second bar parallel with said first named bar and pivotally connected with both of said levers, a work tool or point support carried by one of said levers, a tracing stylus support carried by the other of said levers, means whereby the work tool or point support and the tracing stylus support may be independently adjusted with relation to the point of pivotal support of its supporting lever, means whereby said levers and said first named bar may be moved toward or from said fixed axis, to vary the scale of reproduction, a work bed and a table for the master or pattern.

15. In a pantographic engraving machine, a pantographic mechanism comprising an arm movable about a fixed axis, a straight bar, means whereby said bar is slidably mounted upon said arm, two levers pivotally mounted at different points of said bar with the pivotal point of both the said levers in alinement radially of the axis of said arm, a work tool or point support carried by one of said levers, a tracing stylus support carried by the other of said levers, a second bar parallel with said first named bar and pivotally connected with both of said levers, means whereby the work tool or point support may be adjusted toward or from the point of pivotal support of its lever, means whereby the tracing stylus support may be adjusted with relation to the point of pivotal support of its supporting lever, means whereby said first named bar may be adjusted on said arm toward or from the axis of said arm, to vary the scale of reproduction, a work bed and a table for the master or pattern.

16. A pantographic engraving machine embodying therein a pantographic reproducing mechanism operative upon a fixed horizontal plane, a work table, a standard, a normally stationary work table supporting frame carried by said standard, means whereby said frame may be adjusted longitudinally of the machine, means whereby said frame may be adjusted toward and from said pantographic reproducing mechanism and a pattern supporting table.

17. A pantographic engraving machine embodying therein a pantographic reproducing mechanism operative upon a fixed horizontal plane, a work table, a work supporting plate mounted thereon, means whereby said plate may be moved laterally of said table, a standard, a stationary work table supporting frame carried by said standard, means whereby said frame may be adjusted toward and from said pantographic reproducing mechanism, and a pattern supporting table.

18. A pantographic engraving machine embodying therein a pantographic reproducing mechanism operative upon a fixed horizontal plane, a pattern supporting table, a work table occupying a plane parallel with that upon which said reproducing mechanism is operative, a work supporting plate movably mounted upon said work table and upon a plane parallel therewith, means whereby lineal movement may be imparted to said table, means whereby said plate may be moved at right angles to the direction of movement of said table and means whereby said table may be moved at right angles to the plane thereof.

19. A pantographic engraving machine embodying therein a pantographic reproducing mechanism adapted to reproduce a mas-

ter or pattern to scale, said mechanism including a tracing stylus support and a work tool support, a work table supporting frame fixedly mounted adjacent said reproducing mechanism, a work table, means whereby said table is movably mounted upon said frame, means operatively connected to said table and adapted to be actuated by said reproducing mechanism whereby a lineal horizontal movement may be imparted to said work table in the same direction as, simultaneously with, but to a lesser degree than, the movement of the work tool support of said reproducing mechanism, to diminish one of the dimensions of the reproduction relatively to that dimension of the master or pattern.

20. A pantographic engraving machine embodying therein a pantographic reproducing mechanism adapted to reproduce a master or pattern to scale, said mechanism including a tracing stylus support and a work tool support, a work table supporting frame fixedly mounted adjacent said reproducing mechanism, a work table, means whereby said table is movably mounted upon said frame, means operatively connected to said table and adapted to be actuated by said reproducing mechanism whereby a lineal horizontal movement may be imparted to said work table in a direction opposite to, simultaneously with, but to a lesser degree than, the movement of the work tool support of said reproducing mechanism to increase one of the dimensions of the reproduction relatively to that dimension of the master or pattern.

21. A pantographic engraving machine embodying therein a pantographic reproducing mechanism adapted to reproduce a master or pattern to scale, said mechanism including a tracing stylus support and a work tool support, a work table supporting frame fixedly mounted adjacent said mechanism, a work supporting table, means whereby said work supporting table is mounted to have lineal movement longitudinally of said frame and means operatively connected to said table and adapted to be actuated by said reproducing mechanism whereby a horizontal movement may be imparted to said work table in the same direction as, simultaneously with, but to a lesser degree than, the movement of the work tool support of said reproducing mechanism, to diminish one of the dimensions of the reproduction relatively to that dimension of the master or pattern.

22. A pantographic engraving machine embodying therein a pantographic reproducing mechanism adapted to reproduce a master or pattern to scale, said mechanism including a tracing stylus support and a work tool support, a work table supporting frame fixedly mounted adjacent said mechanism, a work supporting table, means whereby said work supporting table is mounted to have movement longitudinally of said frame and means operatively connected to said table and adapted to be actuated by said reproducing mechanism whereby a horizontal movement may be imparted to said work table in a direction opposite to, simultaneously with, but to a lesser degree than, the movement of the work tool support of said reproducing mechanism to increase one of the dimensions of the reproduction relatively to that dimension of the master or pattern.

23. A pantographic engraving machine embodying therein a pantographic reproducing mechanism adapted to reproduce a master or pattern to scale, said mechanism including a tracing stylus support and a work tool support, a work supporting frame fixedly mounted adjacent said reproducing mechanism, a work table, means whereby said table is adapted to have lineal movement laterally of the machine, and means operatively connected to said table and adapted to be actuated by said reproducing mechanism whereby a horizontal movement laterally of the machine may be imparted to said work table simultaneously with the longitudinal movement of the work tool support of said reproducing mechanism to tilt the reproduction.

24. A pantographic engraving machine embodying therein a pantographic reproducing mechanism adapted to reproduce a master or pattern to scale, said mechanism including a tracing stylus support and a work tool support, a work supporting frame fixedly mounted adjacent said reproducing mechanism, a work table, means whereby said table is adapted to have lineal movement laterally of the machine, means operatively connected to said table and adapted to be actuated by said reproducing mechanism whereby a horizontal movement laterally of the machine may be imparted to said work table simultaneously with the longitudinal movement of the work tool support of said reproducing mechanism to tilt the reproduction and means whereby the direction of said lateral movement may be regulated.

25. A pantographic engraving machine embodying therein a pantographic reproducing mechanism adapted to reproduce a master or pattern to scale, said mechanism including a tracing stylus support, a work tool support, a work table supporting frame fixedly mounted adjacent said reproducing mechanism, a work table, means whereby said table is movably mounted to have movement upon said frame longitudinally of the machine a movable fitting mounted adjacent said table, a laterally extending keeper on said fitting a bracket adjustably mounted in said keeper, an arm carried by said work

table and operatively engaging said bracket, and means operatively connected with said fitting and adapted to be actuated by said reproducing mechanism whereby said bracket may be actuated to vary the height of the reproduction.

26. A pantographic engraving machine embodying therein a pantographic reproducing mechanism adapted to reproduce a master or pattern to scale, including a tracing stylus support and a work tool support, a work support normally occupying a fixed position, supporting means for said work support whereby it may be moved laterally of the machine, a movable fitting having a longitudinally extending keeper, an arm carried by said work support, and operatively engaging said keeper, means whereby said arm may be adjusted longitudinally of said support and means whereby said fitting may be actuated to tilt the reproduction.

27. A pantographic engraving machine embodying therein a pantographic reproducing mechanism adapted to reproduce a master or pattern to scale, including a tracing stylus support and a work tool support, a work support normally occupying a fixed position, supporting means for said work support whereby it may be moved both laterally and longitudinally of the machine, and means whereby simultaneous longitudinal and lateral movement may be imparted to said work bed for varying the height of and tilting the reproduction.

28. A pantographic engraving machine embodying therein a pantographic reproducing mechanism adapted to reproduce a master or pattern to scale, including a tracing stylus support and a work tool support, a work bed normally occupying a fixed position, supporting means for said bed whereby it may be moved longitudinally of the machine, an oscillatory shaft a reciprocatory bar adapted to be moved under the control of the tracing stylus, a crank shaft, connections between said crank shaft and said bar, connections between said crank shaft and said oscillatory shaft and connections between said oscillatory shaft and said work bed whereby said work bed will have lineal movement simultaneously with the movement of said work tool.

29. A pantographic engraving machine embodying therein a pantographic reproducing mechanism adapted to reproduce a master or pattern to scale, including a tracing stylus support and a work tool support, a work bed normally occupying a fixed position, supporting means for said work bed whereby it may be moved longitudinally of the machine, an oscillatory shaft a reciprocatory bar adapted to be moved under the control of the tracing stylus, a crank shaft, pivotal connections between said crank shaft and said bar, whereby said bar may be removed from within the operative range of the stylus, connections between said crank shaft and said oscillatory shaft, and connections between said oscillatory shaft and said work bed whereby said supporting means for said table will have lineal movement simultaneously with the movement of said work tool.

30. A pantographic engraving machine embodying therein a pantographic reproducing mechanism adapted to reproduce a master or pattern to scale, including a tracing stylus support and a work tool support, a work support normally occupying a fixed position, supporting means for said work support, comprising two superimposed carriages movable respectively in perpendicular lines whereby said work support may be moved both longitudinally and laterally of the machine, an oscillatory shaft, a fitting carried and movable therewith having a laterally and a longitudinally extending keeper therein, a bracket adjustably mounted in said laterally extending keeper, an arm carried by one of said carriages, and operatively engaging said bracket, an arm carried by said other carriage and operatively engaging said longitudinal keeper, connections adjustable longitudinally of the machine, between said last named arm and its carriage, a reciprocatory bar adapted to be moved under the control of the tracing stylus, and connections between said bar and said shaft carrying said fitting whereby said fitting may be actuated to impart longitudinal or lateral movement, or both longitudinal and lateral movement to said support simultaneously with the actuation of said reproducing mechanism to vary the height or to tilt; or to both vary the height of, and to tilt the reproduction.

31. A pantographic engraving machine embodying therein a pantographic reproducing mechanism, a support for the work plate, a support for the master or pattern comprising a table having a raised platen at the rear edge thereof, spring pressed clips at the opposite ends of said platen whereby a strip of paper may be held in relation to said table and a plurality of dogs attached adjacent the forward edge of said table whereby a pattern or master plate may be adjustably connected with said table with its rear edge thereof bearing against the edge of said platen.

32. A pantographic engraving machine embodying therein a pantographic reproducing mechanism, a support for the work plate, a support for the master or pattern comprising a table having a raised platen at the rear edge thereof, spring pressed clips at the opposite ends of said platen whereby a strip of paper may be held in relation to said table, a plurality of dogs attached adjacent the forward edge of said table where-

by a pattern or master plate may be adjustably connected with said table with the rear edge thereof bearing against the edge of said platen, and means whereby said table may be adjusted toward and from said support for the work plate.

33. A pantographic engraving machine embodying therein a pantographic reproducing mechanism, a support for the work plate, a support for the master or pattern comprising a table having a raised platen at the rear edge thereof, spring pressed clips at the opposite ends of said platen whereby a strip of paper may be held in relation to said table, a plurality of dogs attached adjacent the forward edge of said table whereby a pattern or master plate may be adjustably connected with said table with its rear edge thereof bearing against the edge of said platen, a plurality of vertical pillars supporting said table and a plurality of brackets mounted upon said pillars and an arm rest carried by said brackets whereby said rest may be moved toward and from said table.

34. A pantographic engraving machine embodying therein a pantographic reproducing mechanism, comprising parallel pantographic levers, each consisting of a fixed section and a section movable relatively thereto, a connecting bar having its opposite ends pivotally connected to the fixed section of each of said levers, a connecting bar parallel with said first named connecting bar and having its opposite ends pivotally connected to the fixed section of each of said levers, a pivotal support at one end of said first named connecting bar whereby said bar in its entirety has movement about a fixed axis and means whereby the movable sections of each of said levers may be adjusted upon the fixed section, a tracing stylus support carried by one of said movable sections and a reproducing tool or point support carried by the other of said movable sections.

35. A pantographic engraving machine embodying therein a work bed, a pantographic mechanism operative in a fixed plane above said work bed and a work tool support carried by said mechanism including therein a rocking lever, an electromagnet adapted to oscillate said arm to move the work tool support toward or from said work bed and means for controlling the circuit to said magnet.

In witness whereof I hereunto affix my signature in the presence of two subscribing witnesses, this 8th day of June, 1914.

WILLIAM S. EATON.

Witnesses:
F. T. WENTWORTH,
CLARICE FRANCK.