

W. S. EATON.
ETCHING MACHINE.
APPLICATION FILED OCT. 29, 1910.

1,039,713.

Patented Oct. 1, 1912.

5 SHEETS—SHEET 1.

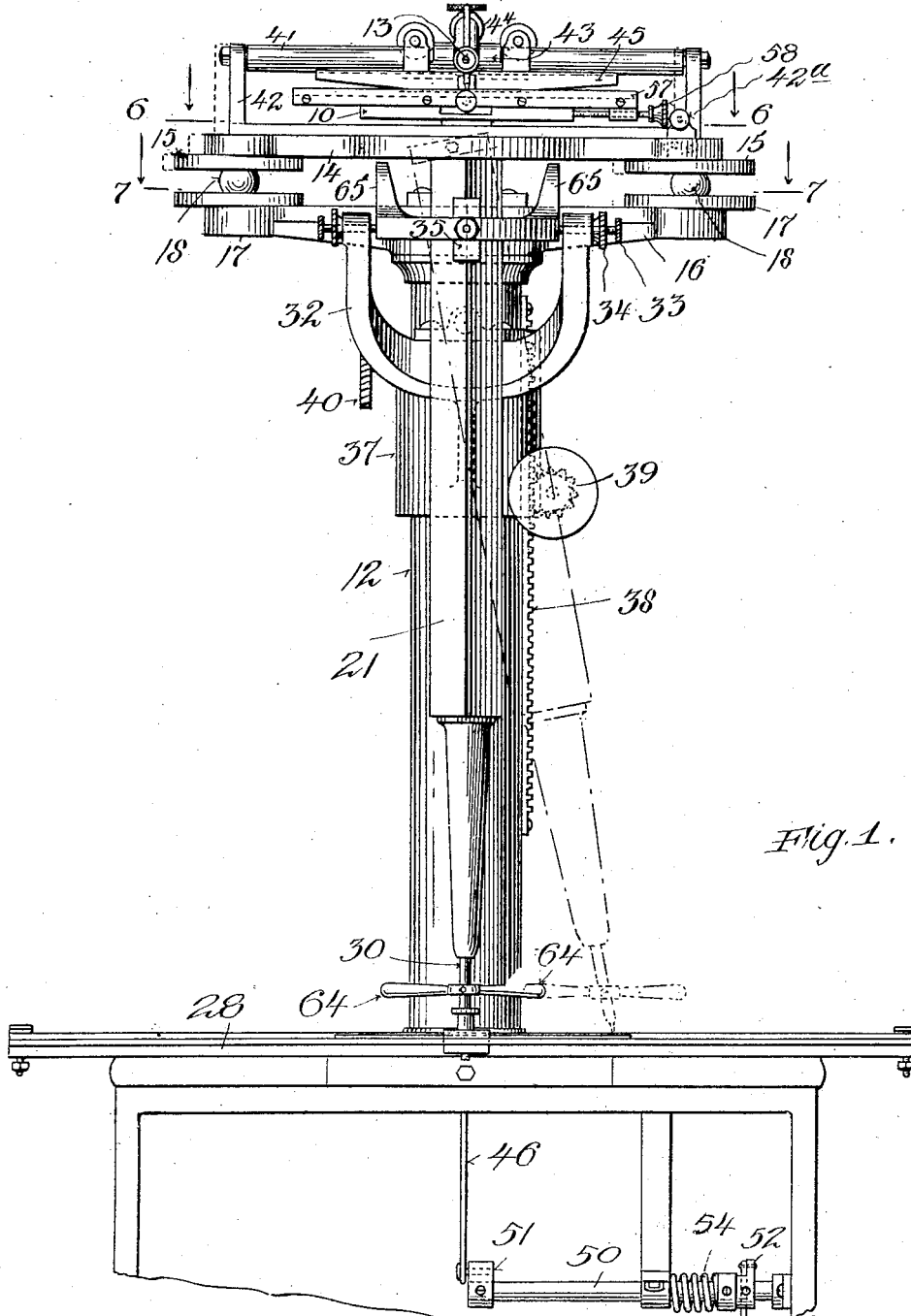


Fig. 1.

Witnesses:
Wm. W. W. W.
Engel W. W.

William A. Eaton, Inventor
By his Attorney
Frank J. Westworth

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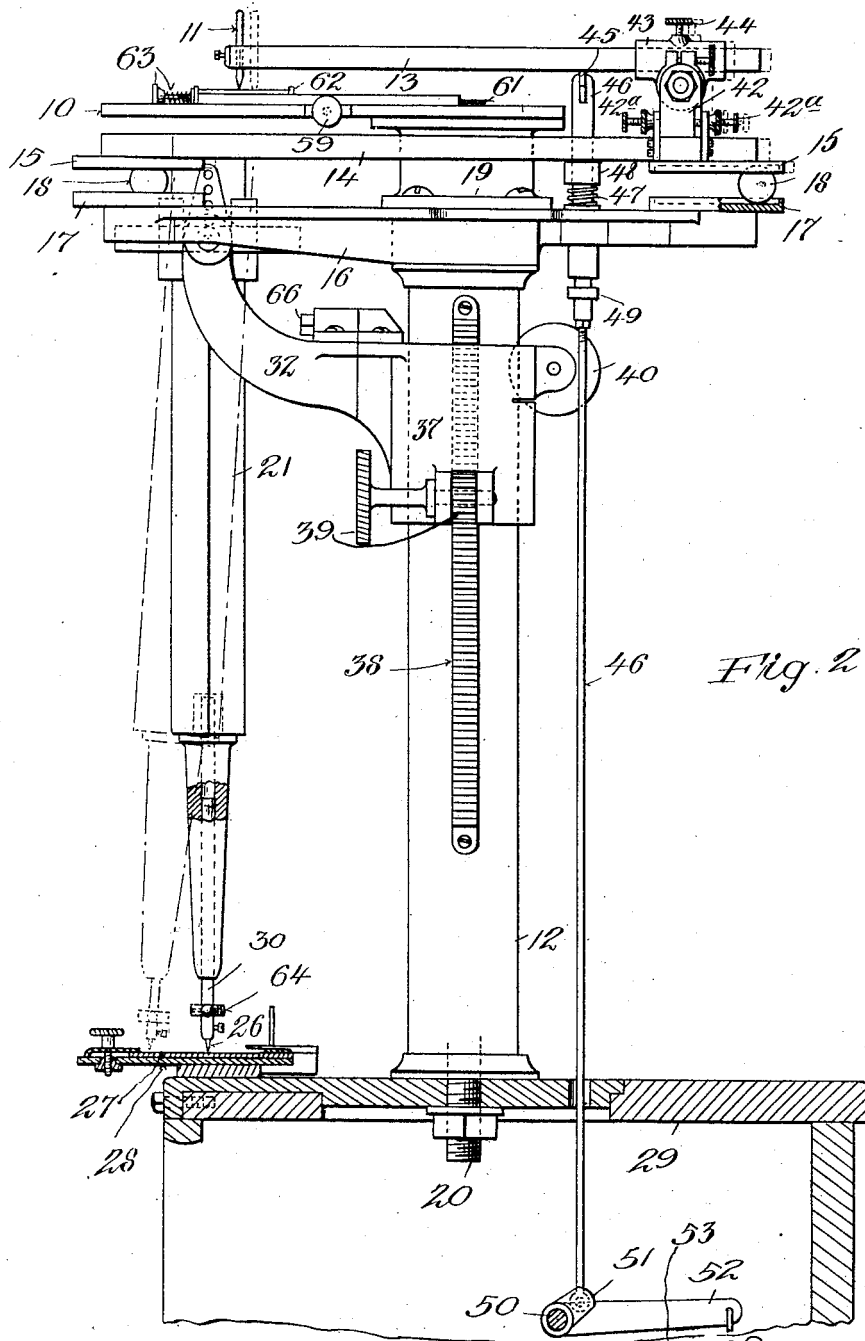


Fig. 2.

Witnesses:
W. H. Higgins
Eugene Menning

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5 SHEETS—SHEET 3.

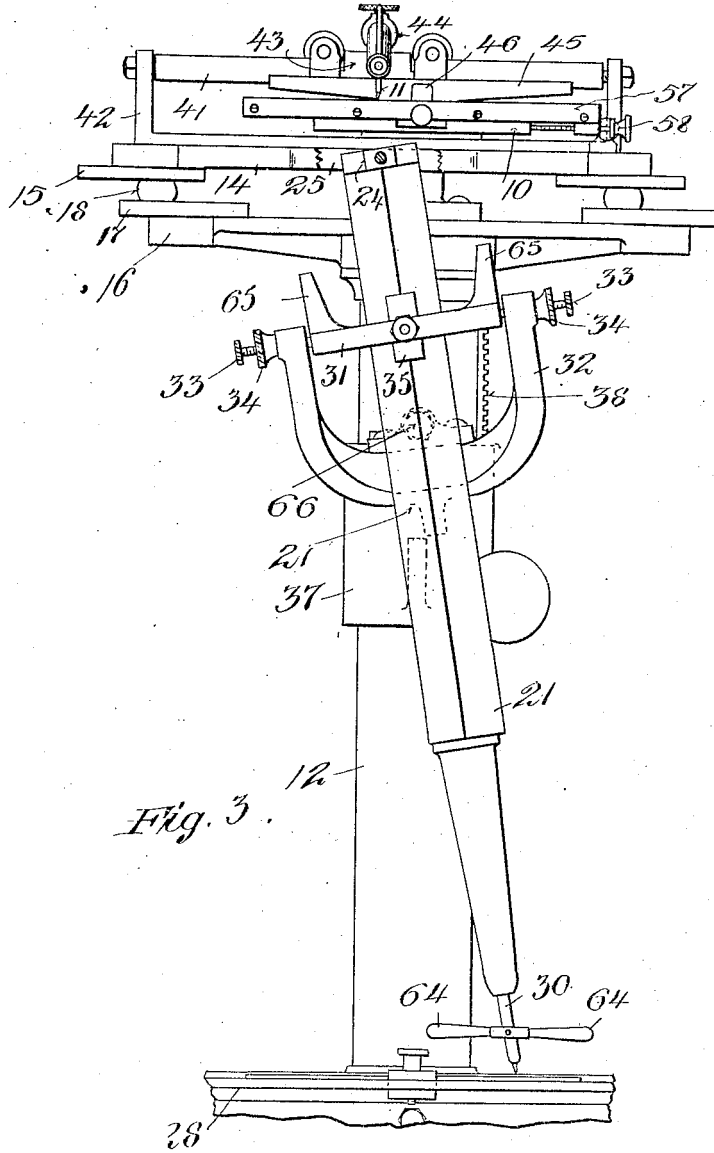


Fig. 3.

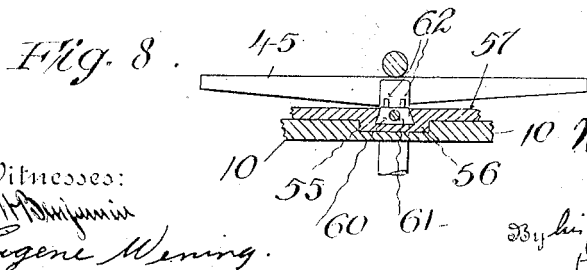


Fig. 8.

Witnesses:
W. M. Dunnington
Eugene Werning.

William S. Eaton
Inventor
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UNITED STATES PATENT OFFICE.

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

ETCHING-MACHINE.

1,039,713.

Specification of Letters Patent.

Patented Oct. 1, 1912.

Application filed October 29, 1910. Serial No. 589,667.

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 Etching-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 a machine adapted to mechanically remove the surface coating upon a plate to be etched, the actual removal of the metallic face of said plate being accomplished in an acid bath in the usual and well known manner.

The main object of the invention is to provide a machine adapted to remove the wax from the surface of a plate prepared for etching, to reproduce a design, as predetermined by a master plate or pattern, in the wax upon the surface of said plate in a manner to permit the subsequent acid etching of the plate, to reproduce the design of said pattern upon the metallic surface in under-cut or intaglio lines.

A further object is to provide a machine of this type wherein the operative plane of the needle will be such as to remove the wax only, without marking the surface of the plate in a manner to vary the depth of the acid etched lines, thus insuring uniformity in the action of the acid and in the capacity of lines of the same width to retain ink.

A still further object is to provide a machine of this type wherein the pressure applied to the needle will be controlled by the machine itself and thus eliminate the necessity for any delicacy in the handling of the machine, and permitting it to be operated by practically unskilled labor.

A still further object is to provide a machine of this type wherein the scale of reproduction from a pattern of given dimensions may be accurately determined by the adjustment of the machine, thus permitting the production of work of any desired size (within the operative scope of the machine) without varying the quantity of movement of the stylus point over the pattern, and making the quality of execution of the work dependent upon the adjustment of the ma-

chine instead of upon the fineness of touch, or skill, of the operator.

A still further object is to provide a machine of this type adapted for commercial work in producing, with accuracy and rapidity, shaded effects in letters or designs, such as is found in Old English letters.

A still further object of the invention is to provide a machine of this character wherein the design of the master plate or pattern may be exactly reproduced upon any desired scale, or wherein the reproduction from said master plate may be distorted, as in expanding or condensing the letter, or wherein the reproduction may be pitched either forwardly or backwardly, the character of the reproduction being determined solely by the adjustment of the machine.

A still further object is to provide quickly operated means for firmly securing the plate to be etched upon its bed, which means may be set to any desired size of plate, and quickly adjusted to and disengaged from said plate to permit the convenient removal thereof for purposes of inspection during the progress of the work.

A still further object is to provide a machine wherein the needle may be thrown out of engagement with the plate to permit the removal of the plate without disturbing the waxed surface thereof.

A still further object is to provide a machine wherein all parts will possess sufficient rigidity to prevent such vibrations as would tend to affect the character of the reproduction.

A still further object is to provide a machine of this type wherein the work bed and the pattern or master plate will occupy relatively fixed planes, the work being accomplished by the movement of the needle relative to the plate to be etched.

A still further object is to provide in a machine of this type a controlling or operating handle for the stylus arm which will remain in substantially the same position relative to the pattern or master plate irrespective of the movement of the stylus thereover, thus avoiding interference between the stylus arm and the pattern and permitting the stylus point to be moved over the same without obstructing the field of vision of the operator. And a still further

object is to provide a machine of this type wherein the support for the needle will be so mounted as to offer substantially no resistance to the movement thereof under the control of the stylus arm.

The invention consists primarily in the embodiment in a machine of the character described of a needle operative upon a single fixed plane, a work bed for supporting a prepared plate in a manner to cause the waxed surface thereof to be within the operative plane of said needle, and means for imparting to one of said members, relative to the other, a universal movement upon a single plane; 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 front elevation of a machine embodying my invention, the lateral movement of the stylus arm and needle carrier being indicated in dotted lines; Fig. 2 is a side elevation of the machine with the longitudinal movement of the stylus arm and needle carrier indicated in dotted lines; Fig. 3 is a front elevation of the machine showing that adjustment of the stylus arm requisite to secure an oblique reproduction from a straight pattern; Fig. 4 is a top plan view of the machine upon an enlarged scale; Fig. 5 is a vertical section on the line 5—5 of Fig. 4; Fig. 6 is a horizontal section upon the line 6—6 of Fig. 1; Fig. 7 is a horizontal section upon the line 7—7 of Fig. 1; and, Fig. 8 is a vertical section upon the line 8—8 of Fig. 4.

Like letters refer to like parts throughout the several views.

A machine made in accordance with my invention, an embodiment of which is shown in the accompanying drawings, is designed solely for preparing wax coated plates for the etching bath; and unlike many types of engraving machines, does not remove, and is incapable of removing, any portion of the metal of the plate. This essential characteristic eliminates one of the greatest difficulties of making engraving plates by machine, to wit, the regulation of the depth of the cut to secure uniformity in the quantity of ink secreted in the lines for making the imprint.

A machine such as is shown in the accompanying drawings, embodies therein a work bed 10 adapted to hold a prepared plate with the upper surface thereof upon a fixed plane, a needle 11 being positioned above the work bed and projected toward it in a manner to cause the operative plane of the needle to coincide with the plane of the prepared plate so as to cause the needle to remove portions of the waxed surface of the plate without affecting the metal surface of the plate

itself. In conjunction with the work bed and needle, I employ means, for imparting a universal movement of one of these parts relative to the other upon the operative plane of the needle, operated in conformity with a master plate or pattern, the design upon the waxed plate being a reproduction of that of the said master plate or pattern. To insure the proper relation of the needle and the work bed, and one which will not vary with the repeated operation of the machine, I mount both of these mechanisms upon a cylindrical column 12.

In the form of the invention shown in the accompanying drawings, the needle 11 is the movable member, said needle being adjustably mounted upon a weighted arm 13, pivotally mounted upon a carriage 14 having a plurality of bearing cups 15, by means of which said carriage is mounted so as to be universally movable upon a fixed frame 16 mounted upon the central column 12. The frame 16 is provided with a plurality of upwardly presented cups 17 coinciding in position, number and dimensions with the cups 15. Mounted between each pair of cups 15 and 17 is a single bearing ball 18 of a diameter sufficiently small to permit the ball to have lineal movement relative to either cup and thus eliminate any substantial friction between said cups and said balls while permitting a free movement of the carriage 14 in any direction without the necessity for employing superposed carriages moving upon perpendicular tracks, a structure common in engraving machines. The arrangement of the triangular ball supports for the movable carriage minimizes likelihood of a loss of adjustment in said carriage, and by causing the base of the triangle to extend across the front of the machine, imparts stability to the carriage structure in addition to admitting of a construction of carriage adapted to facilitate the application of power thereto in a manner convenient to the operation of the machine.

The carriage 14 is cut away centrally thereof to afford clearance for the support 19 of the work bed 10 and permit the free movement of said carriage, the said support being attached to the frame 16 immediately above said column, a construction which permits said frame and all operating parts of the machine to be firmly secured to the column by means of the central tie rod 20. By this construction the work bed 10 is positioned between the needle arm 13, and the carriage 14, a construction which permits of an extended support for the latter while so positioning the work bed as to have it clearly within the line of vision of the operator.

The carriage 14 is moved by means of a transmitter 21 connected thereto by a universal, pivotal joint comprising a ring 22

mounted in an opening in said carriage by means of pivot screws 23, and an extended head 24 mounted in said ring by means of pivot screws 25. I use pivot screws to facilitate the adjustment of the several bearings and provide each screw with a lock nut in order to avoid a loss of adjustment. The frame 16 below the point of suspension of the transmitter 21, is forked, as shown, to position the cups 17 properly and allow a clear field for the movement of the transmitter in actuating the carriage 14. The transmitter 21 extends downwardly so that the stylus 26 may be caused to follow the master plate or pattern 27 carried upon a holder 28 mounted upon the top plate 29 of the machine. Said transmitter being suspended, in the manner above described, from the needle carrier frame, is free to oscillate in any direction; and to cause such oscillations to impart a movement to the needle carriage 14, similar to the movement of the stylus in following the pattern, I provide a universal pivotal bearing intermediate the ends of said transmitter which bearing serves as a fulcrum about which said transmitter oscillates. The pivotal suspension of the transmitter 21 from the needle carriage 14, causes its lower end to describe an arc with each oscillation thereof, and to compensate for this arc and permit the stylus 26 to follow the pattern, I make the transmitter of two telescoping sections, the lower of which, 30, has the stylus 26 removably mounted therein by means of a socket and set screw.

To prevent the upper pivotal support for the transmitter 21 from also describing an arc, and thus throw the carriage 14 off its level, and to compensate for the variance in leverage due to the automatic elongation of the transmitter 21, it is necessary to so construct the intermediate bearing, or fulcrum for said transmitter, as to permit a variance of the fulcrum point thereof, corresponding with the arc described thereby at the fulcrum point. This results in the transmitter 21 simultaneously oscillating upon its bearings on the carriage 14, and about a fulcrum intermediate its ends, the arc described by its free end being compensated for by the automatic variance of the fulcrum point of the transmitter, and the leverage of the arms of said transmitter, respectively, varying simultaneously and inversely in a proportionate degree, with each change of the fulcrum point.

The intermediate, fulcrum bearing above referred to comprises a ring 31 pivotally mounted in the bracket 32, carried by the central column 12, by means of the pivot screws 33, each of which is provided with a set nut 34. Pivotally mounted in the ring 31 is a plurality of oppositely disposed guide shoes 35 conforming to, and adapted to have a close sliding fit with, the transmitter 21.

Pivot screws 36 are used in mounting the shoes 35 to permit the adjustment of the said shoes relative to the said transmitter, to avoid lost motion between these parts.

To admit of a variance of the scale of reproduction, the bracket 32 is carried by a collar 37 slidably mounted upon the column 12, and adjustable thereon by means of the rack 38 on said column and the pinion 39 carried by said collar. A portion of said collar is split, and said collar and the parts supported therefrom are locked in any adjusted position upon said column by means of the clamp screw 40 acting upon the split portion of said collar. The vertical adjustment of the collar 37 results in a similar movement of the ring 31 and shoes 35, relative to the transmitter 21, thus varying the relative length of the transmitter arms upon opposite sides of said fulcrum with a resultant increase or diminution in the scale of reproduction.

The needle arm 13 is connected to a shaft 41, pivotally mounted in a frame 42 carried by the needle carriage 14, the means of attachment being a collar 43, attached to the said shaft 41 and projecting tangentially or at right angles to the axis thereof, and a set screw 44, by means of which said arm may be adjusted relative to said shaft and the work bed to increase the operative range of the machine and facilitate its adjustment for different classes of work. The frame 42 has movement relative to the carriage 14 for purposes of adjustment. Preferably this adjustment is accomplished by holding one of the ends of this frame in a fixed position relative to the said carriage 14, and providing oppositely disposed adjusting screws 42^a acting toward the other end of said frame, so that the entire frame may be adjusted radially of the shaft 41 about the fixed end as a center, to line up the frame relative to the straight edge of the work bed, and bring the arm 13 perpendicular to said straight edge. The adjusting screws 42^a are mounted in brackets carried by the carriage 14.

Mounted below the arm 13 and extending at right angles thereto, to an extent governed by the maximum lateral movement of the carriage 14, is a lifting bar 45 adapted to engage and raise the said arm 13 in a manner to disengage the needle or diamond point from the coated plate irrespective of the position of the carriage 14. This bar is supported from a stem 46 and is normally projected upwardly by means of a spring 47 seated between a collar 48 carried by said stem 46, and the frame 16. I also provide said stem with a stop collar 49 adapted to engage a boss upon the under side of the frame 16 and thus limit the upward movement of said bar to that required to disengage the needle or diamond point from the work plate and prevent the descent of the

arm (to reengage said plate) with sufficient force to injure the metallic surface of the plate. Carried by the frame of the machine below the top plate 29 is a crank shaft 50 carrying the cranks 51 and 52 connected respectively with the stem 46 and with a treadle 53 convenient to the foot of the operator, said treadle being normally raised by the torsion spring 54 encircling the said shaft.

It will be observed that the pressure upon the needle or diamond point upon the work plate is limited by the weight of the arm 13 which is weighted sufficiently to secure only that slight pressure required to remove the coating from said plate. The arrangement of lifting bar described permits a practically instantaneous disengagement of the needle from the plate, said bar having a normal tendency to automatically accomplish such disengagement.

The work bed 10 has centrally thereof a longitudinally extending groove or channel 55, adapted to receive a tongue 56 upon the superposed work bed 57, said sections of the work bed being firmly secured together by means of the set screw 58. The forward edge of the upper bed 57 is provided with the straight edge 59 with which the shaft 41 is trued up in adjusting the needle arm 13. The bed 57 is also provided centrally thereof with a dove-tailed groove in which is mounted the traveler block 60, mounted upon a feed screw 61. Said block carries a plurality of stops 62 adapted to engage the plate and force it against the straight edge 59, or against a member interposed between said edge and said plate. To insure the proper clamping action of the stops 62 and at the same time permit the plate to be quickly released for purposes of inspection, or the substitution of another plate, without the necessity for readjusting the said stops, I preferably project the end of the feed screw 61 through the straight edge 59, said projected end having an enlarged head and being encircled by an expansion spring 63 acting between said enlarged head and said straight edge. By this construction the stops 62 need be set only approximately to the dimensions of the plate, the spring 63 compensating for any inaccuracy in the adjustment of the stops, and said stops setting under the control of said spring solely. This spring also limits the pressure exerted upon the plate when clamped upon the work bed and eliminates any possibility of the buckling of the plate through carelessness of the operator.

To secure good work it is necessary for the operator to closely follow the pattern or master plate with the stylus and to permit the use of both hands in operating the transmitter and at the same time afford a clear field of vision to the operator, including the

master plate or pattern and the stylus, I provide the section 30 of the transmitter with laterally extending grips 64 preferably pivoted to said section, in order to permit the hands of the operator to move laterally upon a horizontal plane, irrespective of the angle of inclination of the transmitter. These grips 64 also facilitate the telescopic action of the two transmitter sections in following the pattern and permit the concentration upon the transmitter of that force necessary to gradually and continuously move the carriage 14, which force is minimized by the long leverage at which the transmitter operates.

I have heretofore described that construction and design used to secure a change in the scale of reproduction, but in order to increase the range of work which may be done upon the machine, I also preferably employ supplemental adjustments for varying the dimensions of the reproduction from a given pattern, irrespective of the scale of reproduction. These variations of dimensions, or distortions, in the reproduction, consist of increasing or diminishing the lateral dimension of the reproduction, or pitching or imparting obliquity thereto in either direction. To accomplish the first of these adjustments, I provide the ring 31 with a plurality of axially extended lugs 65 having series of bearings therein, as shown in Fig. 2, each of which bearings is adapted to cooperate with the pivot pins 33. As these pivot pins define the axis about which the transmitter 21 oscillates longitudinally of the machine, which axis may be varied solely by the vertical movement of the collar 37 and brackets 32, it will be observed that this adjustment, without affecting the leverage of the longitudinal movement of the transmitter, drops the shoes 35 relative to the pivot pins 33, and thus changes the lateral leverage, increasing the comparative lateral dimension of the reproduction without varying the longitudinal dimension thereof. This adjustment results in the expansion of the letter, or pattern. If it be desired to condense the letter, or pattern, the ring 31 may be inverted, thus shortening the lateral stroke by reason of the raising of the fulcrum point of the transmitter 21. To secure an oblique reproduction, I mount the bracket 32 upon the collar 37 by means of the set screw 66, thus permitting this bracket to be tilted in either direction, as illustrated in Fig. 3, and occasion a tendency toward a lateral deflection of the stylus by reason of the pitch of the pivot pins of the transmitter, with a resultant reaction upon the carriage 14, due to the deflection above referred to being prevented by the master plate or pattern.

The operation of the herein described machine is substantially as follows:—The mas-

ter plate or pattern is first mounted upon the holder 28 and firmly secured in place. If an exact reproduction of the pattern is desired, but upon a reduced scale, the adjustment of the machine will be as shown in Figs. 1 and 2. The coated plate is then placed upon the supplemental bed 57 and the stops 62 are brought tightly up against same by means of the feed screw 61, the spring 63 yielding to cause the clamping action to be under the tension of this spring only. During the adjustment of the plate, which plate is indicated by the reference numeral 67, the arm 13 will be raised by the spring 47 acting on its stem 46 so as to raise the needle or diamond point 11 above its operative plane where it will not interfere with the plate 67. The operator then takes the grips 64, one in each hand, and brings the stylus to the starting point upon the pattern. If it be found that the position of the plate is not such as to secure the proper placing of the design thereon, the entire arm 13 may be adjusted radially of its supporting shaft 41 to secure the proper position of the needle or diamond point relative to the work plate. The treadle 53 is then depressed, drawing the lifting bar 45 downwardly so as to permit the arm 13 to descend, and the needle 11, under gravity only, to seek its operative level or plane which coincides with that of the prepared surface of the plate 67. The stylus 26, is then moved slowly and continuously over the pattern, transmitting a similar movement, in quantity determined by the scale to which the machine is set, to the carriage 14 and needle point 11, through the oscillation of the transmitter 21—30. While the distance between the stylus 26 and the shoes 35 varies, constantly increasing as the stylus moves from a center below the point of suspension of said shoes, which elongation of the transmitter is determined by the arc of a circle, with the ring 22 as a center, there is no variance in the leverage of said transmitter as a whole, as its axial movement relative to the shoes 35 results in a simultaneous increase in the length of the arms of the transmitter on opposite sides of said shoes, with a resultant proportionate, but inverse, variance in the leverage of said arms, but in that ratio determined by the scale to which the machine is set. This action eliminates all of those eccentricities in the reproduction of designs commonly found in pantographic machines, and permits the stylus to be mounted directly upon the transmitter. Said transmitter 21 is free to oscillate in all directions because of its universal point of suspension, and the universally movable fulcrum intermediate its ends, and its oscillations impart universal movement to the carriage 14 and its needle 11 through the arm 13. It will be observed that these two

universal joints are the only such in the machine, thus minimizing likelihood of a loss of adjustment through wear on the pivots of the universal joints. It will be observed further that the needle 11, in removing the coating from the plate 67, is operative upon a single fixed plane, which plane is defined by the metallic surface of the plate, thus bringing the said coating within the operative plane of the said needle. The needle 11, being an ordinary diamond point, does not chip the metallic surface of the plate, and bears thereon very lightly, the sole pressure resulting from the weight of the arm 13. Upon the completion of each full stroke of the stylus, as defined by a line upon the master plate or pattern, the treadle 53 is released, the lift bar 45 immediately disengaging the needle from the work plate. The pivotal support for the arm 13 permits the engagement and disengagement of the needle 11 from the work plate at the will of the operator, while permitting the actuation of said needle point upon a single fixed plane, as determined by the face of the work plate, thus also permitting the interruption of the lines of the reproduction. If it be desired to remove the plate either for purposes of inspection or for the substitution of a new plate, of substantially the same dimensions, it is merely necessary to press the feed screw 61 toward the straight edge 59, against the tension of the spring 63, thus disengaging the stops 62 from said plate. After another plate has been substituted, to secure the same in place it is merely necessary to release the screw 61, allowing the spring 63 to accomplish the instantaneous clamping of the plate, said spring at the same time automatically adjusting itself to any variance in the dimensions of the different plates. To vary the scale of reproduction, the clamp screw 40 is loosened and the collar 37, carrying with it the bracket 32, raised or lowered to the desired extent, the graduations upon the transmitter 21 facilitating exactitude in such adjustment. This adjustment merely varies the fulcrum point of the transmitter, and does not affect the mode of operation of the machine in any other respect. If it be desired to impart obliquity to the reproduction the set screw 66 is loosened and the bracket 32 tilted to the left, as shown in Fig. 3, or to the right, according to whether or not it is desired to impart a forward or backward tilt to the reproduction. When the bracket 32 is so adjusted, the oscillations of the ring 31 on its pivots in said bracket will tend to impart a lateral component of motion to the longitudinal oscillations of the transmitter, which tendency will be counteracted by the engagement of the stylus 26 with the master plate or pattern, causing a reaction upon the needle carriage 14, imparting a lateral com-

ponent of movement thereto, with the longitudinal reciprocations of the member 21, without affecting in any way the quantity of lateral movement thereof. If it be desired
5 to extend or condense the letters, the ring 31 will be raised or lowered relative to the bracket 32 in the manner above referred to, which adjustment, as stated, will vary the leverage of the transmitter as to the lateral
10 strokes without any variance as to longitudinal strokes, a result due solely to the fact that the pivots of the shoes 35 are the only pivots which are varied by this adjustment.

The universal support for the needle carriage shown in the drawings has been found
15 very effective in use, as the indeterminate run-way for the bearing balls 18 presents so little resistance to the movement of said carriage as to eliminate all substantial wear
20 resulting from friction.

In making an oblique reproduction, I have found that I can secure more effective work
by adjusting the arm 13 toward its shaft 41.

I believe it to be broadly new to provide a
25 pantographic machine wherein the needle is operative upon a single fixed plane, the work bed supports a prepared plate so as to bring the surface thereof within the operative
30 plane of said needle, and means are provided for imparting to one of said members a universal movement upon a single plane, the other member remaining stationary. I also believe it to be broadly new to provide a
35 pantographic machine wherein the transmitter is pivoted intermediate its ends in a manner to cause the oscillations of the transmitter to automatically vary the length of the arms upon different sides of its fulcrum, so
40 as to preserve the exact ratio of these arms as determined by the normal arc described by the opposite ends of the transmitter in
imparting movement to the carriage and in
45 following the pattern. It is not my intention to limit the invention to these broad features, however; nor is it my intention to
limit myself to the specific details of construction shown in the accompanying drawings, as the design of the machine may be
50 varied without departing from the spirit or scope of the invention.

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

1. In a machine of the character described,
55 a needle support operative upon a single fixed plane, a needle fixedly mounted therein, means whereby said arm is automatically actuated to bring said needle into a yielding
60 engagement with and maintaining it in constant relation to, the surface of a prepared plate, a work bed for supporting a prepared plate in a manner to cause the prepared surface thereof to be within the operative
65 plane of said needle, and means for imparting to one of said members, relative to the

other, a universal movement upon a single plane.

2. In a machine of the character described, a needle support operative upon a single
70 fixed plane, a needle fixedly mounted therein, means whereby said arm is automatically actuated to bring said needle into a yielding engagement with and maintaining it in constant relation to, the surface of a prepared
75 plate, a work bed for supporting a prepared plate in a manner to cause the prepared surface thereof to be within the operative plane of said needle, one of said members being adapted to have a universal movement
80 upon a single plane, relative to the other, a master plate or pattern support, or holder, a transmitter suspended by a universal joint from said movable member, whereby a stylus carried by said transmitter may be moved
85 over the pattern, and a fulcrum disposed intermediate the ends, and permitting universal movement, of said transmitter.

3. In a machine of the character described, a needle support operative upon a single
90 fixed plane, a needle fixedly mounted therein, means whereby said arm is automatically actuated to bring said needle into a yielding engagement with and maintaining it in constant relation to, the surface of a prepared
95 plate, a work bed for supporting a prepared plate in a manner to cause the prepared surface thereof to be within the operative plane of said needle, means for imparting to one of said members, relative to the other,
100 a universal movement upon a single plane, and means whereby said needle may be raised out of its operative plane to make it inoperative.

4. In a machine of the character described, a work bed for supporting a prepared plate
105 upon a fixed plane, a needle supporting arm, a needle fixedly mounted in said arm, said arm being mounted upon horizontal pivots so arranged as to permit movement of said
110 arm toward and from said work bed whereby said needle supporting arm may be so adjusted as to bring said needle within operative relation to the prepared surface
of said plate, means for imparting to one
115 of said members, relative to the other, a universal movement upon a single plane, and means whereby said needle arm may be raised to raise the needle out of its operative
plane and make it inoperative.

5. In a machine of the character described,
120 a work bed for supporting a prepared plate upon a fixed plane, a needle supporting arm, a needle fixedly mounted in said arm, said arm being mounted upon horizontal pivots
125 so arranged as to permit movement of said arm toward and from said work bed whereby said needle supporting arm may be so adjusted as to bring said needle within operative relation to the prepared surface of
130 said plate, means whereby said arm may be

adjusted substantially radially of its pivots, means for imparting to one of said members, relative to the other, a universal movement upon a single plane, and means where-

5 by said needle arm may be raised to raise the needle out of its operative plane and make it inoperative.

6. In a machine of the character described, a needle support operative upon a single

10 fixed plane, a needle fixedly mounted therein, means whereby said arm is automatically actuated to bring said needle into a yielding engagement with and maintaining it in constant relation to, the surface of a prepared

15 plate, a work bed for supporting a prepared plate in a manner to cause the prepared surface thereof to be within the operative plane of said needle, one of said members being adapted to have a universal movement upon

20 a single plane, relative to the other, a master plate or pattern support, or holder, a transmitter, consisting of a plurality of telescopic sections, suspended by a universal joint from said movable member, whereby

25 a stylus carried by said transmitter may be moved over the pattern, and a fulcrum disposed intermediate the ends, and permitting universal movement, of said transmitter.

7. In a machine of the character described, a needle operative upon a single fixed plane, a work bed for supporting a prepared plate in a manner to cause the prepared surface thereof to be within the operative plane of said needle, means for imparting to one of

30 said members, relative to the other, a universal movement upon a single plane, means tending to normally raise said needle above its operative plane to make it inoperative, and means making said last named means

35 inoperative whereby said needle is permitted to descend to its operative plane under gravity only.

8. In a machine of the class described, a tool holder, a work bed, one of said members

45 being universally movable on a single plane, relative to the other, a master plate or pattern support, a transmitter pivotally connected by a universal connection with said movable member, and a fulcrum acting intermediate the ends, and permitting universal movement, of said transmitter, said

50 fulcrum permitting the automatic variance of the fulcrum point on said transmitter, proportionate with the arc described thereby, whereby the arms of said transmitter, on

55 opposite sides of its fulcrum, will vary in length in the same ratio as said arms bear to each other.

9. In a machine of the class described, a

60 tool holder, a work bed, one of said members being universally movable upon a single plane, relative to the other, a master plate or pattern support, a transmitter connected with said movable member by a pivotal con-

65 nection having a compound axis, and a ful-

crum, acting intermediate the ends of said transmitter, embodying therein a pivotal member having a compound axis slidably mounted upon said transmitter whereby the fulcrum point of said transmitter is auto-

70 matically varied with the oscillations thereof, in proportion with the arc described thereby, and the arms of the said transmitter, on opposite sides of its fulcrum, will vary in length in the same ratio as said arms

75 bear to each other.

10. In a machine of the class described, a tool holder, a work bed, one of said members being universally movable upon a single plane, relative to the other, a master plate or

80 pattern support, a transmitter connected with said movable member by a pivotal connection having a compound axis, an immovable bracket having pivotally mounted therein an oscillatory frame, or ring, and a plu-

85 rality of oppositely disposed shoes, having a sliding fit upon said transmitter, pivotally mounted in said frame or ring upon an axis perpendicular to the axis of the pivots supporting said ring, whereby said transmitter

90 is free to oscillate in any direction and to have longitudinal movement in said shoes to automatically vary the fulcrum point of said transmitter proportionate with the arc described thereby, and to vary the length of

95 the arms of said transmitter on the opposite sides of said shoes, in the same ratio as said arms bear to each other.

11. In a machine of the class described, an immovable frame, having a plurality of

100 divergently arranged, indefinite run-ways, a movable frame having a plurality of similar, oppositely disposed run-ways, bearing balls seated between said run-ways and supporting said movable frame, a pivotally supported

105 needle bearing arm carried by said movable frame, an immovable work bed, for supporting a prepared plate, arranged between said movable frame and said needle supporting

110 arm whereby the prepared surface of a plate is brought within the operative plane of said needle, and means for imparting to said needle supporting frame or carrier, a universal movement upon a single plane.

12. In a machine of the class described,

115 an immovable frame, having a plurality of divergently arranged, indefinite run-ways, a movable frame having a plurality of similar, oppositely disposed run-ways, bearing balls seated between said run-ways and supporting

120 said movable frame, a pivotally supported needle bearing arm carried by said movable frame, an immovable work bed, for supporting a prepared plate, arranged between

125 said movable frame and said needle supporting arm whereby the prepared surface of a plate is brought within the operative plane of said needle, a master plate or pattern support, or holder, a transmitter suspended by a universal pivotal joint from

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said needle supporting carriage, and a fulcrum disposed intermediate the ends, and permitting universal movement, of the said transmitter.

13. In a machine of the character described, a work bed for supporting a prepared plate upon a fixed plane, a needle supporting arm mounted upon pivots so arranged as to permit movement of said arm toward and from said work bed whereby said needle supporting arm may be so adjusted as to bring the prepared surface of said plate within the operative plane of said needle, means for imparting to one of said members, relative to the other, a universal movement upon a single plane, and a lifting bar extending parallel to the pivots of said arm whereby the needle may be raised out of its operative plane to make it inoperative, irrespective of the position of the said supporting arm.

14. In a machine of the character described, a work bed for supporting a prepared plate upon a fixed plane, a needle supporting arm mounted upon pivots so arranged as to permit movement of said arm toward and from said work bed whereby said needle supporting arm may be so adjusted as to bring the prepared surface of said plate within the operative plane of said needle, means for imparting to one of said members, relative to the other, a universal movement upon a single plane, a spring tending to normally raise said lifting bar, and means for depressing said bar to bring the needle into engagement with the plate.

15. In a machine of the class described, a tool holder, a work bed, one of said members being universally movable upon a single plane, relative to the other, a master plate or pattern support, a transmitter connected with said movable member by a pivotal connection having a compound axis, an immovable bracket having pivotally mounted therein an oscillatory frame, or ring, a plurality of oppositely disposed shoes, having a sliding fit upon said transmitter, pivotally mounted in said frame, or ring, upon an axis perpendicular to the axis of the pivots supporting said ring, whereby said transmitter is free to oscillate in any direction and to have longitudinal movement in said shoes to automatically vary the fulcrum point of said transmitter proportionate with the arc described thereby, and to vary the length of the arms of said transmitter on the opposite sides of said shoes, in the same ratio as said arms bear to each other, and means whereby the elevation of said bracket may be varied to vary the scale of reproduction.

16. In a machine of the class described, a tool holder, a work bed, one of said members being universally movable upon a single plane, relative to the other, a master plate or

pattern support, a transmitter connected with said movable member by a pivotal connection having a compound axis, an immovable bracket having pivotally mounted therein an oscillatory frame, or ring, a plurality of oppositely disposed shoes, having a sliding fit upon said transmitter, pivotally mounted in said frame, or ring, upon an axis perpendicular to the axis of the pivots supporting said ring, whereby said transmitter is free to oscillate in any direction and to have longitudinal movement in said shoes to automatically vary the fulcrum point of said transmitter proportionate with the arc described thereby, and to vary the length of the arms of said transmitter on the opposite sides of said shoes, in the same ratio as said arms bear to each other, and means whereby the elevation of the pivots of said shoes may be varied, relative to the pivots of said ring, to vary the scale of one dimension of the reproduction, without varying the scale of the other.

17. In a machine of the class described, a tool holder, a work bed, one of said members being universally movable upon a single plane, relative to the other, a master plate or pattern support, a transmitter connected with said movable member by a pivotal connection having a compound axis, an immovable bracket having pivotally mounted therein an oscillatory frame, or ring, and a plurality of oppositely disposed shoes, having a sliding fit upon said transmitter, pivotally mounted in said frame or ring upon an axis perpendicular to the axis of the pivots supporting said ring, whereby said transmitter is free to oscillate in any direction and to have longitudinal movement in said shoes to automatically vary the fulcrum point of said transmitter proportionate with the arc described thereby, said to vary the length of the arms of said transmitter on the opposite sides of said shoes, in the same ratio as said arms bear to each other, said ring being provided with diametrically opposite, axially projected lugs having a plurality of oppositely disposed bearings therein whereby the elevation of said ring may be varied to vary the position of said shoes relative to said transmitter without varying the pivotal point of said ring, and the scale of reproduction may be varied as to one dimension but not as to the other.

18. In a machine of the class described, a tool holder, a work bed, one of said members being universally movable upon a single plane, relative to the other, a transmitter suspended from said movable member by a pivotal joint having a compound axis, a master plate or pattern support, or holder, a fulcrum intermediate the ends of said transmitter comprising a pivotally supported frame having mounted therein upon pivots, the axis of which is perpendicular to

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that of the pivots of said frame, a member coöperating with said transmitter, and means whereby the axis of said last named member may be varied relative to said transmitter, without varying the axis of said frame, to vary one dimension of the reproduction without varying the other.

19. In a machine of the class described, a tool holder, a work bed, one of said members being universally movable upon a single plane, relative to the other, a transmitter suspended from said movable member by a pivotal joint having a compound axis, a master plate or pattern support, or holder, a fulcrum intermediate the ends of said transmitter comprising a pivotally supported frame having mounted therein, upon pivots, the axis of which is perpendicular to the axis of the pivots of said frame, a member coöperating with said transmitter, means whereby the axis of said last named member may be varied relative to said transmitter, without varying the axis of said frame, to vary one dimension of the reproduction without varying the other, and means for varying the relation of the pivots of said frame to said transmitter, whereby the scale of reproduction as to both dimensions may be similarly varied.

20. In a machine of the class described, a tool holder, a work bed, one of said members being universally movable upon a single plane, relative to the other, a master plate or pattern support, or holder, a transmitter suspended from said movable member by a pivotal connection having a compound axis, a pivotally supported frame having mounted therein by means of pivots, the axis of which is perpendicular to the axis of the pivots supporting said frame, a fulcrum disposed intermediate the ends of said transmitter, and means for imparting an inclination to the pivots of said frame whereby the pitch of the reproduction will vary from the master plate or pattern without varying either dimension of the reproduction from the scale set.

21. In a machine of the class described, a tool holder, a work bed, one of said members being universally movable upon a single plane, relative to the other, a master plate or pattern support, or holder, a transmitter suspended from said movable member by a pivotal connection having a compound axis,

a pivotally supported frame having mounted therein by means of pivots, the axis of which is perpendicular to the axis of the pivots supporting said frame, a fulcrum disposed intermediate the ends of said transmitter, means for imparting an inclination to the pivots of said frame whereby the pitch of the reproduction will vary from the master plate or pattern without varying either dimension of the reproduction from the scale set, and means adjusting the fulcrum of said transmitter to vary the scale of reproduction.

22. In a machine of the class described, a stylus, a transmitter having pivotally mounted thereon, adjacent to the stylus, a plurality of oppositely disposed, laterally projected grips to permit the operation of the stylus without obstructing the line of vision of the operator as to the master plate or pattern.

23. In a machine of the class described, a stylus, a transmitter comprising a plurality of telescopic sections, the section carrying the stylus having pivotally mounted thereon a plurality of laterally projected grips whereby the stylus may be guided without obstructing the line of vision of the operator as to the master plate or pattern.

24. In a machine of the character described, a work bed having a recess therein, a traveler block having stops projecting above the plane of said bed, and a feed screw carried by said bed and controlling said block.

25. In a machine of the character described, a work bed having a recess therein, a traveler block having stops projecting above the plane of said bed, a feed screw carried by said bed, and controlling said block, and a spring acting upon said feed screw, whereby said block may be fed separately by said screw, or said screw and said block may be fed simultaneously to close said stops upon the work under spring pressure.

In witness whereof, I have hereunto affixed my signature in the presence of two witnesses, this 26th day of October, 1910.

WILLIAM S. EATON.

Witnesses:

T. T. WENTWORTH,
P. FRANK SONNEK.