L. CARPENTER.

2 Sheets—Sheet 1.

Ellipsograph.

No. 2,894.

Patented Dec. 31, 1842.

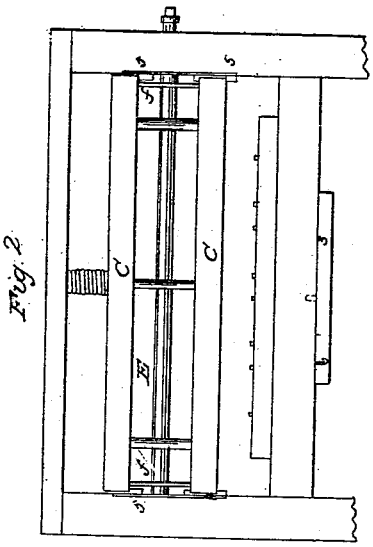

Fig. 2.

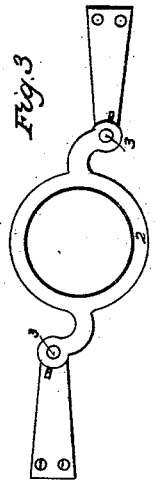

Fig. 3

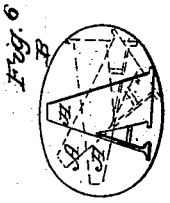

Fig. 6

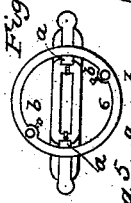

Fig. 4

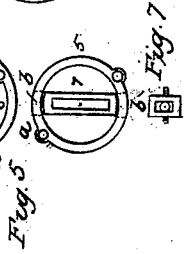

Fig. 5

Fig. 7

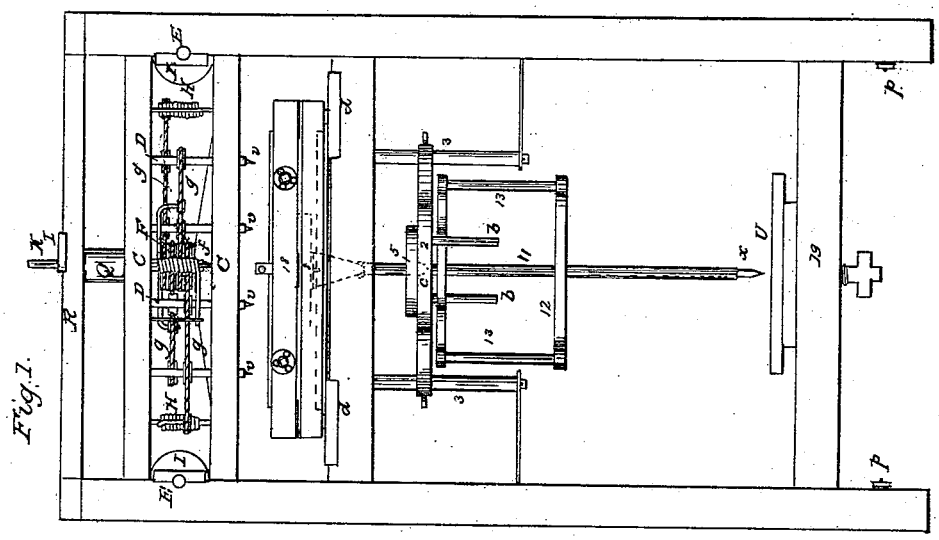

Fig. 1.

Witnesses

Inventor

Lemuel Carpenter

2 Sheets—Sheet 2.

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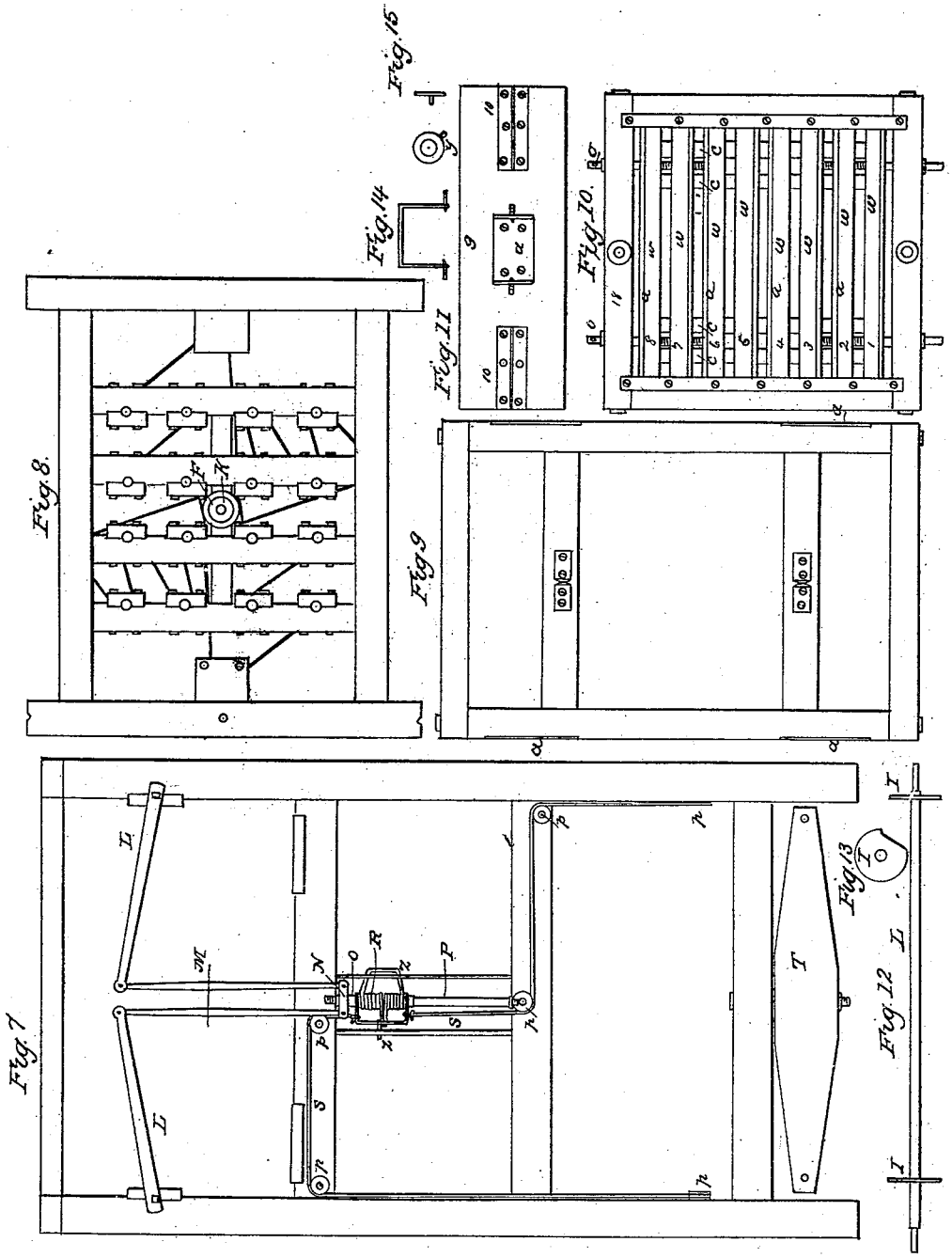

Witnesses
John A. Lee
Wm. Brown

Inventor
Lemuel Carpenter.

UNITED STATES PATENT OFFICE.

LUMAN CARPENTER, OF OSWEGO, NEW YORK.

COPYING-MACHINE.

Specification of Letters Patent No. 2,894, dated December 31, 1842.

To all whom it may concern:

Be it known that I, LUMAN CARPENTER, of the village of Oswego, in the county of Oswego and State of New York, have discovered a method of producing motion, the application of which is useful in the business of copying and of drawing ellipses and adjusting and proportioning all figures to any given ellipsis according to the laws of perspective and have constructed a machine by which said principle is applied to the art of typecutting, engraving, drafting, &c., which I have called "Carpenter's type-cutter and protractor;" and I do hereby declare that the following is a full, clear, and exact description of the method of producing motion so discovered by me and of the machine by which the application of such motion is illustrated and the mode of making, using and constructing said machine and the mode by which the principle of said motion might be applied to other machines for either of the purposes above specified, reference being had to the annexed drawings for an explanation of said principle and of said machine as constituting a part of this specification.

The machine in question of which draft No. 1 hereto annexed Figure 1 is a front elevation is composed of the following principal members:

1. The compensating lever so called by me and of which I am the inventor, its bar is composed of two parts or an upper and lower member as exhibited in member 11 of said Fig. 1. For perfection and accuracy of work it is preferable that these parts should be made of cast steel. The lower end of the upper member is bored out so as to receive the lower member (*x*) which is a pin neatly fitted and extending into the upper member so as to act both freely and accurately thus constituting a lever capable of being lengthened and shortened as required in the operations of the machine. The upper end of the bar is fastened to the square hereinafter described by the alternate joint also hereinafter described and its lower end is tapered and rounded off to a point in a suitable manner for tracing. The two combined axes of the lever which regulate its motion and which constitute its principal peculiarity are described in connection with the two rings and their groove bars hereinafter mentioned.

2. The main bearing (Fig. 3) or supporter of the two rings (Fig. 4 member 6 and Fig. 5 member 5) and their groove bars (Fig. 4 member 5 and Fig. 5 member 7) hereinafter described. It is exhibited in member 2 Fig. 1 and also in Fig. 3. The plain of its ring is in a horizontal position and is supported by two main pillars (member 3 Fig. 1) an end view of which is also seen in Fig. 3 member 3. These pillars stand in a perpendicular position attached to the frame of the machine. The pillars pass through the main bearing which slides up and down the pillars and is fastened at any desired point of elevation by set screws.

3. The lower of the two rings (member 6 Fig. 4) and its groove bar (member 4 Fig. 4). This ring is of such dimensions as to fit into the ring of the main bearing (Fig. 3 member 2) which is made just large enough to receive it. This ring is made fast to the ring of the main bearing by set screws fastening it at any desired point it being always a concentric ring to the ring of the main bearing but capable of being revolved horizontally within it. Affixed to this ring is a groove bar (Fig. 4 member 4) having an axis coincident with a diameter line of said ring. The groove bar for the convenience of its operation is swung below the ring by two projections (*a*, *a*, Fig. 4 and *a*, *a*, Fig. 1) from the axis extending far enough to give sufficient motion to said groove bar without its coming in contact with the ring or the main bearing. This groove bar is at all times in a horizontal position or parallel to its axis. As this ring is concentric to the main bearing it is concealed by it in Fig. 1 but is exhibited in Fig. 4. The groove bar attached to this ring is marked 4 in that figure and also in Fig. 1. The space or aperture of said groove bar is made just large enough to enable the bar of the lever to move in it with freedom and accuracy.

4. Attached to this groove bar is a parallel groove bar marked 12 Fig. 1 lying in the same plain with it and suspended from it by two pillars marked 13, 13 Fig. 1 which are firmly attached to this parallel groove but at their lower ends and to the groove bar above described at their upper ends. The aperture of this parallel groove bar is like the one above described made just large enough for the lever to move in it with freedom and accuracy but is of course made longer as it is farther from the center of

the lever's motion. This parallel groove bar is not essential to the principle of the lever's motion but its office is to assist in keeping the groove bar of the lower ring above described parallel to its own axis.

5. The upper of the two rings and its groove bar marked (5) in Fig. 1 and represented in Fig. 5. This ring is supported by two pillars (*b b* Fig. 1 and an end view of them is seen in *a*, *a*, Fig. 5). These pillars are attached firmly to, and extend from opposite points in the circumference of said ring and made to slide up and down vertically through the lower ring above described and thus made capable of being elevated above the lower ring and let down so as to rest upon it as may be required in the various operations of the machine. It is fastened at any desired elevation by set screws (*b b* Fig. 4) from the interior of the lower ring. Its groove bar (marked 7 in Fig. 5) is supported by two projections (*c* Fig. 1 and *b*, *b*, Fig. 5) proceeding from opposite points of the lower edge of the ring.

These projections extend downward from the ring far enough to form an axis to the groove bar which will be exactly on a level with the axis of the groove bar of the lower ring when the upper ring is let down so as to rest on the lower ring so that when the two rings are in this position their axes are on the same level with each other. The upper ring should be small enough to allow its projections above described to pass down within the lower ring when the axes of the two groove bars are brought on a level with each other. The groove bar of the upper ring is at all times at right angles with the groove bar of the lower ring and the aperture of the groove bar of the upper ring should like that of the groove bar of the lower ring be just large enough to enable the lever to move in it with freedom and accuracy. The lever passes through the apertures of three groove bars above described and has its upper end fastened by an alternate joint (Fig. 7 and *a* Fig. 1) to a projection (Fig. 14 and *a* Fig. 11) from a runboard (Fig. 11) attached to the square hereinafter described and thus imparts to said square the combined motion hereinafter explained.

6. The oblong carriage, a side view of which is seen in No. 8 Fig. 1 and a perpendicular view in Fig. 9. It rests in a horizontal position upon four ways (*d d* Fig. 1) one at each corner. Its length should exceed its breadth by the extent of its required motion. Its office is to carry the square hereinafter described which rests upon it in the direction of its shortest sides. The motion of the oblong is governed by two guides (an end view of which is marked 4 Fig. 2). These guides are placed on a bed piece (Fig. 2 marked 3) attached to the frame and pass under the center of the longest sides of the oblong for the purpose of keeping the motion of the oblong parallel to the frame of the machine. The extent of this motion is limited by the scope of the lever and is always coincident in its direction with its shortest sides:

7. The square above mentioned resting on the oblong. A side view of this square is seen in No. 18 Fig. 1 and a perpendicular view in Fig. 10. It is carried by the oblong as above described. For the convenience of operation it should be equal to the breadth of the oblong and all its sides are coincident with, or parallel to the corresponding sides of the oblong. It has also a motion independent of the oblong and runs on four ways one at each corner. An edge view of these ways is seen in Fig. 9 and marked *a*, *a*, *a*, *a*. The squares relative motion to the oblong is governed by two guides (Fig. 11, 10, 10) an edge view of which is also seen in Fig. 15. In the drawing accompanying this specification these guides project from a run board into a groove cut in a slat for that purpose affixed to the oblong. These guides might be otherwise constructed but they should be located in a line passing through the center of the square and lengthwise through the center of the oblong and parallel to its longest sides. Their office is to compel the square to move at right angles with the motion of the oblong so that the action of the lever as regulated by the axes of the two groove bars combined through the alternate joint at its upper end communicates an impulse to the square which impulse the square is enabled to obey through the agency of the guides and runners of the oblong and square above described. This through the joint agency of the guides of the square and of the oblong, the square will move in any horizontal direction which it may receive from the projection at its center through the agency of the lever. A motion may thus be given to said square alternate in its direction to any motion which the operator may choose to give to the lower end of the lever.

For the purpose of applying said machine to the business of type cutting or engraving, the drawing hereto annexed is provided with sixteen as a convenient number of spindles. These spindles are marked (D) in Fig. 1 and a top view of them is represented in Fig. 8 together with the frames in which they are confined. These frames lie in a horizontal position and parallel to each other and of equal dimensions to the length and breadth of the frame of the machine. They are far enough apart to accommodate any suitable length of the perpendicular spindles which are placed in them. These spindles run in boxes attached

to the bars of the frames. The two frames are made fast to each other at the requisite distance apart and are confined in the frame of the machine by ways (Fig. 2 marked 5, 5, 5, 5,) these ways are fastened on the corner posts of the said frame. The frames rest on four graduating wheels one at each corner that are fastened on two horizontal shafts. Fig. 12 represents a view of one of these shafts and an edge or side view of the graduating wheels fastened on it and Fig. 13 is a circumference view of one of said graduating wheels. These wheels are so graduated as to elevate or let down the frames containing the spindles the required distance while cutting and engraving. The ends of these shafts project out at the rear side of the frame so as to receive a horizontal lever. These levers are all of equal length and extend toward and nearly approach each other at the center of the rear side of the frame as is represented in Fig. 7 which is a front elevation of the rear side of the frame in which L, L, represents these horizontal levers. To the end of these levers is attached a perpendicular connecting rod M, M, which intersects the cross head N. The cross head is fastened on a pipe O, and slides up and down on a rod P, which is affixed to the frame of the machine. Also to the pipe O, is attached the spiral scale R, which operates on two rods T, T. The office of these levers is to turn by a simultaneous and equal motion the four graduating wheels attached as above described to the two horizontal shafts so as to raise or let down the horizontal frames as may be necessary in the operation of the machine.

For the convenience of operation these levers may be raised or let down by the pressure of the foot on a treadle marked T, Fig. 7, at the rear base of the machine by two cords S, S, extending from the spring scale over pulleys (p, p, p, p, p, p, Fig. 7, and p, p, Fig. 1). Said two cords being extended over the pulleys in Fig. 7, then carried forward to the two pulleys in Fig. 1 representing the front of the machine, and then carried to each end of the treadle, Fig. 7.

In the center of these horizontal frames is a perpendicular shaft (k, Fig. 1, for an end view of it see k, Fig. 8), having its lower pivot (r, Fig. 1) resting on a bed piece (s, Fig. 1) fastened to the lower frame. Also on said shaft between the two horizontal frames is placed a drum (F, Fig. 1), the office of which is to drive the spindles. This drum as exhibited in the accompanying drawing has four creases each of which receives a band that drives four spindles. These bands pass around the pulleys of the spindles driven by them and are so adjusted that the pulley of the several spindles is on the same lever with the crease which receives the band driving those spindles so that the bands all move in a horizontal position when the spindles are revolving. For the purpose of preserving an equilibrium of motion while the machine is in operation the bands are extended over the pulleys in such a direction as to cause one-half of the spindles to revolve in one direction and the other half in the other direction. The spindles in the accompanying drawing (Fig. 1) and also perpendicular view, Fig. 8, are arranged for convenience in the form of a solid square composed of four tiers of spindles having four spindles in a tier. These spindles may be increased or decreased in number or changed in position at pleasure as may be found convenient in applying the mechanical principle herein defined to any operation to which it is applicable. The above mentioned shaft is continued through the upper horizontal frame and terminates in a box affixed to a bar marked T (Fig. 1). This bar is sufficiently elevated above the upper horizontal frame to enable the said shaft to receive a pulley marked Q, Fig. 1, to be located immediately above the upper horizontal frame so as to be in a situation to receive a belt from any given power which drives the shaft and with it the spindles in the manner above explained.

Each of the four bands above described is provided with a spiral tightener marked H, Fig. 1. These tighteners are so located as to receive the band directly from the drum. Each of them has a pulley attached to it around which the band passes and is carried thence around the spindles. The office of the spiral tightener is to render the strain of the band uniform.

The spindles are each drilled out at the lower end so as to receive a cutter which is inserted and fastened by a set screw firm to the spindle at any desired point. The cutters are marked (v) in Fig. 1. For convenience they should be made of different sizes and shapes as may be required in the different operations of the machine.

In the square hertofore described are contained eight bars, being two to each tier of spindles, marked W in Fig. 10. Each bar has a suitable projection upward marked (a) to enable it the better to hold in a firm position the type blocks to be cut or the material to be engraved. The type blocks or material should be held by the bars and their projections in a steady position and thus enable each cutter to perform a similar and simultaneous execution on the block or tablet subjected to its operation. These bars have four slats (marked c, c, c, c, Fig. 10) passing through them in a mortise at right angles to the bars of said slats and near each end as is represented in Fig. 10. These slats are fastened by a pin to each alternate bar in the manner represented in Fig. 10, in

which the pins are represented by dots. There are also four screws marked (*o*), two on each side, passing through the outside of the square and likewise through the first bar and operating in a nut, in the second bar so that the turning of the screws on either side of the square (for example, the screws at the lower side of Fig. 10) forward will shut the bars, inasmuch as it draws the bars 2, 4, 6, and 8 toward the head of the screws while the bars 1, 3, 5 and 7 remain stationary and turning them backward will in like manner open the bars. The object of having a set of screws at each of the two sides of the square is for the convenience of the machine in its various operations.

At the bottom of the machine is a cross piece or slat (marked 19, Fig. 1) passing through the center of its base. The use of this slat is to receive the pattern or design to be represented, so that when the machine is in operation the operator traces with the lower end of the compensating lever above described the outlines of the pattern which is represented under each of the spindles in the square above described.

To exemplify the powers of this machine in the business of type cutting let the pattern or design of any letter (say the letter n marked *u* in Fig. 1) be affixed horizontally to the slat or cross piece above described (19 Fig. 1) having its center directly under the points of the lever (H Fig. 1) when standing in a perpendicular attitude. Also let one block to each spindle of any size designed to be cut be fastened by the bars of the square in the manner above described with its center directly under each of the cutters of the spindles. Let the spindles be then set in motion at a suitable speed by a given power applied to the pulley (marked 2 Fig. 1) in the perpendicular shaft above described (H Fig. 1) then let the horizontal frames be lowered down just so far that the cutters of the spindles in their operations will excavate to the required depth in cutting out the type. Let the operator at the same time with the lower end of the compensating lever (H Fig. 1) trace the outlines of the pattern (*u* Fig. 1). In doing so the cutters of the spindles will remove the wood which is brought in contact with them by the motion of the square in imitating the motion of the lower point of the lever. This imitating motion of the square will be either similar to that of the lower point of the lever cutting the type into exact copies of the pattern either on a greater or less scale, or it will be an imitation regulated by the laws of perspective at any given angle of view according to the relative position of the two axes of the groove bars as hereinafter explained.

To place the machine in a copying position so that the figure cut will be an exact simile of the pattern let the upper ring (5 Fig. 1) be let down so as to rest on the lower ring (2 Fig. 1) and thus bring the axes (*c* Fig. 1) of the two groove bars (7 Fig. 5 and 4 Fig. 4) in the same horizontal plane with each other. This position of these two axes brings the center line of their motion into the same horizontal plane crossing each other at right angles at the center of the lever and by thus uniting the two centers of motion causes the lever (11 Fig. 1) to move as in an alternate joint. The proportional size of the figure cut or engraved to that of the pattern is increased by lowering or decreased by raising the main bearing and fastening it at the desired point of elevation to its supporting pillars (3 Fig. 1) by set screws as above explained.

The machine can be adjusted so as to cut or engrave an elliptical or perspective view of the pattern to any given degree of elongation or contraction. This is done by simply sliding the upper ring (5 Fig. 1) upward from its copying position above described to the desired degree of elevation. By thus elevating the axes of motion of the upper groove bar (7 Fig. 5) above the axis of motion of the nether groove bar (4 Fig. 4) the relative motion of the square is decreased in proportion as the fulcrum of such motion is brought nearer the alternate joint at the upper end of the fulcrum. The two fulcrums of the lever's motion being thus removed from each other the square will move so as to describe an ellipsis while the lower end of the compensating lever is describing a circle. The eccentricity of the ellipsis thus described will be regulated by the distance which the two fulcrums of motion are removed from each other. By the same principle of this compounded motion of the lever the pattern of a plain letter such for instance as the letter u will be condensed or extended in the types cut by the machine to any required proportion. In order to do this the base of the pattern of the proposed letter should for convenience be placed parallel to the bars which hold the type block, then in cutting a condensed type let the lower ring be turned in the main bearing until its groove bar is brought in a line parallel to the base of the pattern, but in cutting extended type (with the pattern remaining in the same position) let the lower ring be turned until its groove bar is brought in a line at right angles with the base of the pattern.

In cutting slanting type from the same plain pattern, turn the lower ring until its groove bar (4 Fig. 4) lies in a line making an angle of about 45° with the sides of the square, then move the lower end of the lever

back and forth in such a direction as to produce a motion in the oblong without creating any relative motion in the square. When the direction of this motion of the lever is ascertained turn the pattern of the letter until its base is brought parallel to such direction of the lever. The object of bringing the pattern in this position is a matter of convenience as it brings the base of the type when cut parallel to the bars in which the type blocks are confined. In this position slanting letters will be cut in the type blocks by tracing the pattern of the plain letter with the lower end of the compensating lever as before. By this mode type may be cut to slant either way. When the direct slant is intended to be given to the type to be cut the lower ring should be turned in reverse of the sun's motion so as to bring its groove bar from its parallel position to the bars which hold the type to the said angle of about forty-five degrees. When the reverse slant is intended to be given the lower ring should receive a similar turn with the sun's motion instead of against it and the same rule is to be observed in placing the patterns as above described.

The quantity or degree of slant whether direct or reverse will like the eccentricity of the ellipses depend on the distance which the two fulcrums of motion are removed from each other.

When the machine is employed in cutting condensed type or extended type cutters should be provided for the spindles to cut the fine or hair lines of the type of such a reduced size as would be adapted to the condensed side of the type or the conjugate diameter of the circumscribing ellipses.

In the natural operations of the machine when employed in cutting condensed or extended type the fashion of these type being regulated by the principles of perspective the hair lines which run lengthwise or transversely in the circumscribing ellipses of the type are proportionally condensed in their breadth with the other parts of the type while the hair lines that run at right angles with these lines are not condensed and will consequently be larger in the type than those running lengthwise while the lines that run obliquely will participate in the condensing principles according to the proximity of their direction to the transverse or lengthwise lines of the type. In case it should be desired to change this fashion by equalizing the breadth of all the hair lines of the type it may readily be done thus, after the type is cut as above described and without unfastening it from the bars let the pattern be moved in either direction at right angles from the axes of the groove bar of the lower ring the required distance, then retrace the outlines of the pattern of the letter in its new position with the lower end of the compensating lever and in so doing the hair lines will all be reduced to an equal breadth.

This machine may also be employed in cutting grotesque type of any given fashion from the same plain pattern. The grotesque type so cut may have its sides broken or refracted either horizontally, perpendicularly, or in any intermediate direction and the lines of refraction may pass either through the center of the type (as they usually do) or at any assigned distance from the center. The breaking or refracting angles of the type so cut may also be of any given degree of obliquity. The mode in which this operation is performed by the machine is as follows. Let the machine be set in the manner above directed for cutting slanting type so that the slant will be equal to one half the required angle of refraction of the grotesque type to be cut. Then draw a visible line across the face of the pattern of the plain letter in such a direction as is proposed for the line of refraction in the grotesque type to be cut then with the spindles in motion trace with the compensating lever that part of the pattern which lies on one side of the visible line in all its parts up to that line. After this is done turn the lower ring round so that its groove bar may be at right angles to its former position so as to make a reverse slant equal to the direct one, then with the compensating lever trace the other part of the pattern in all its parts up to the said visible line. This will produce a type with a part of its face slanting one way and the other part the other way. In applying the machine to the business of drafting whether it be copying or perspective drawing a plain board should be laid on the square on the upper side of which should be tacked or sealed the paper on which the drawing is to be inscribed. For the convenience of the operation it is recommended to remove the horizontal frames and their spindles and substitute a bar or slat to hold the drafting pen or pencil. This bar or slat should be sufficiently heavy to hold the pin or pencil steady and may be moved or laid on the frame in any position that may be required to bring the pen or pencil at any desired point on the paper. The pen or pencil should have such a spring or degree of elasticity as to enable it to produce a gentle and equal pressure on the paper and thus draw a uniform line. When it is intended to copy, the machine should be placed in the copying position as above described, the pattern or design is then laid on the slat as described above in type cutting, then with the lower end of the compensating lever steadily and carefully trace over the outlines of the pattern or design and while doing so the pen or pencil being stationary marks out a copy of the pattern or design on the paper as it is moved around by the square.

In perspective drafting whenever a circle or the arc of a circle is to be drafted it will of course be represented in an elliptical form the eccentricity of which will depend as above explained on the distance which the axes of the two groove bars are placed from each other.

Instead of using circles or arcs of circles for patterns a horizontal sweep may be provided with a slide to receive the lower end of the compensating lever. One end of the sweep should be fastened by a pivot at the point directly under the lever while standing perpendicular around which the sweep may revolve, the object of the slide is to move the lower end of the compensating lever to any given distance from the center and thus enable it to describe a circle or the arc of a circle of any given diameter. With the pattern of one of the teeth of a proposed gear wheel fastened at the proper point to the side of the sweep above described a perspective view of that wheel may be drawn in mathematical perfection by tracing the lower end of the compensating lever around the pattern of the tooth, then with the tooth pattern still fastened in the sweep revolve the sweep just far enough to bring the tooth pattern to the proper place to represent the situation of the next adjoining tooth of the proposed gear wheel, then with the tooth pattern in this new position trace around it as before with the compensating lever and so proceed moving the tooth pattern around in the sweep so as to represent successively the position of every tooth of the gear wheel around the whole circumference or so much of the wheel as is presented to the eye.

What I claim as my invention and desire to secure by Letters Patent are—

1. The construction and combination of the two groove bars so as to constitute two combined and variable axes of motion to the compensating lever.

2. The combination and adjustment of the square and oblong with the two groove bars so as to impart the motion of the lower end of the compensating lever to the square according to the principles explained in the above specification.

LUMAN CARPENTER.

Witnesses:
J. BROWN,
D. H. SUMMERS,
JOHN W. LESTER.