

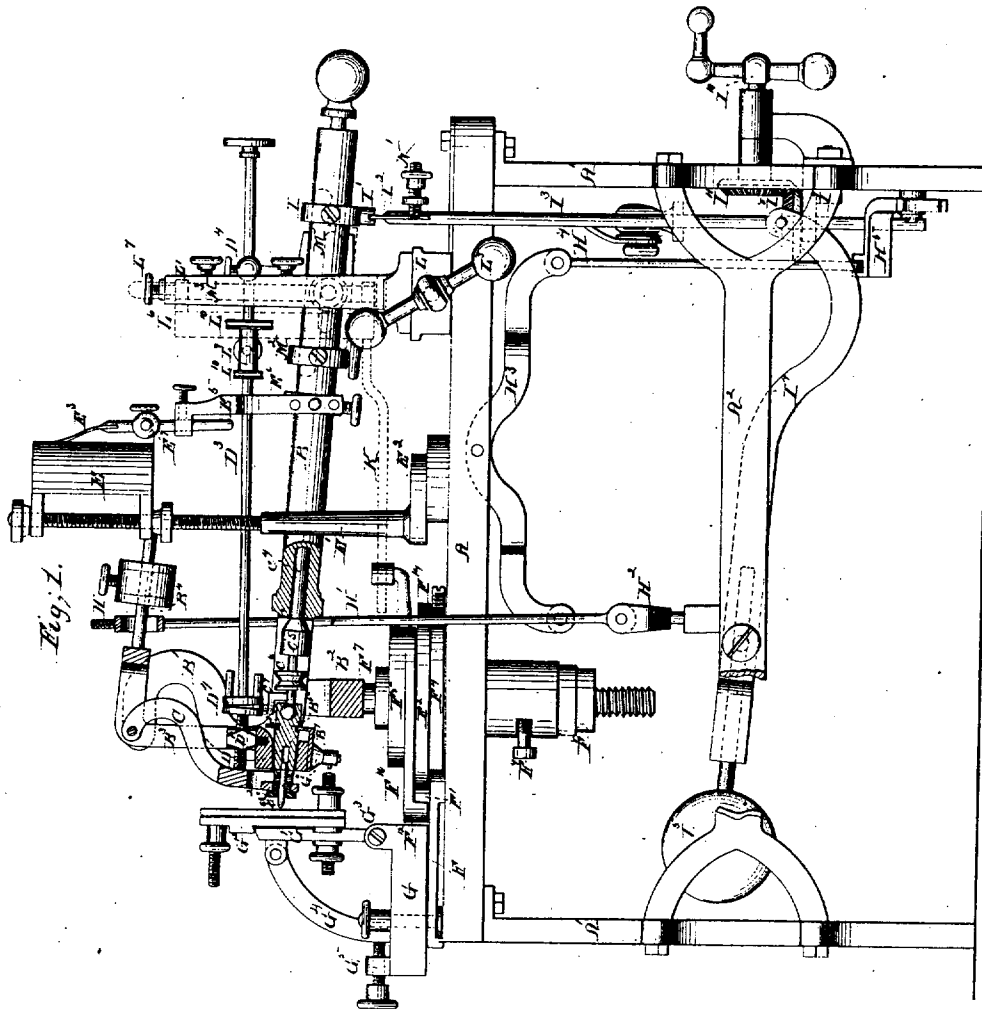
Guerrant & Field

5 Sheets, Sheet 1.

Engraving Machine.

N^o 83708.

Patented Nov 3, 1868.



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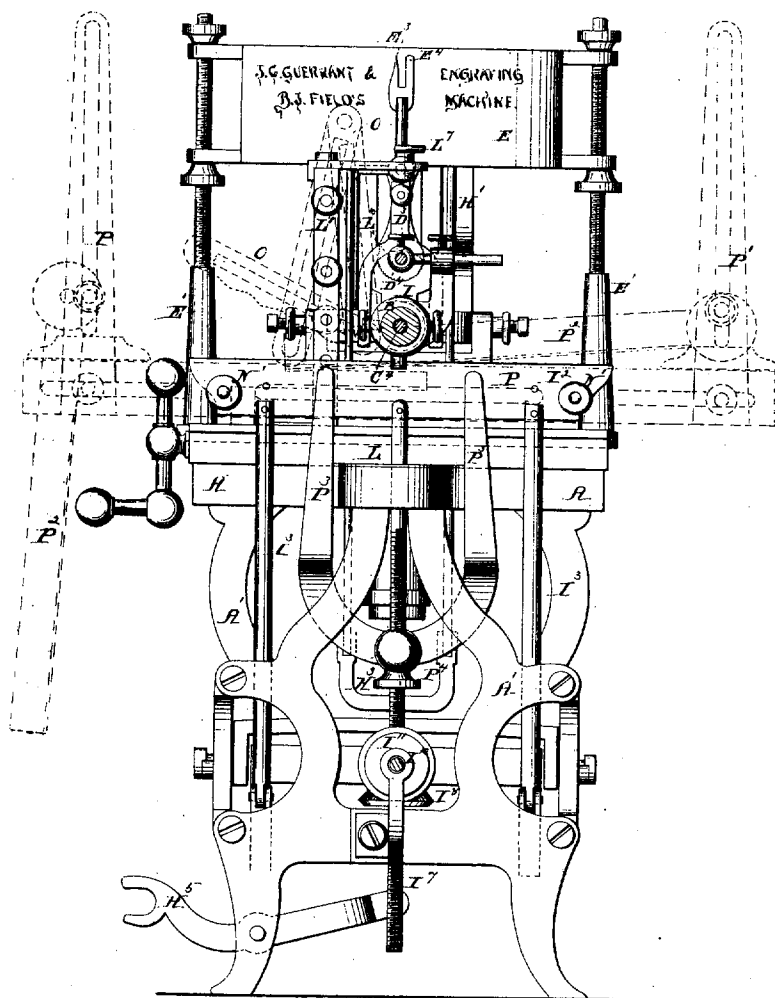
5 Sheets, Sheet 2.

Engraving Machine

N^o 83,708.

Patented Nov. 3, 1868.

Fig. 2.



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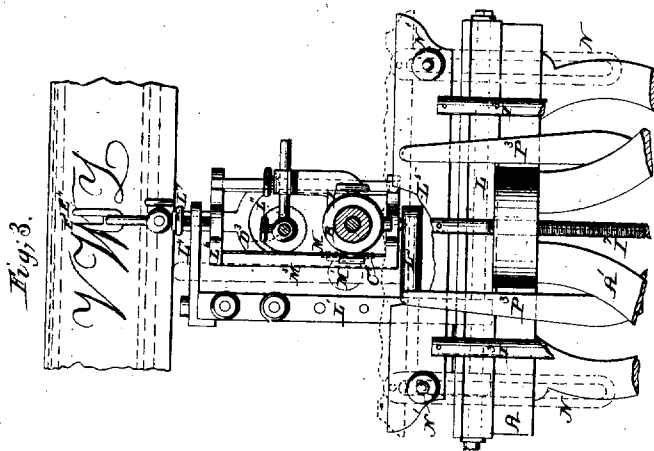
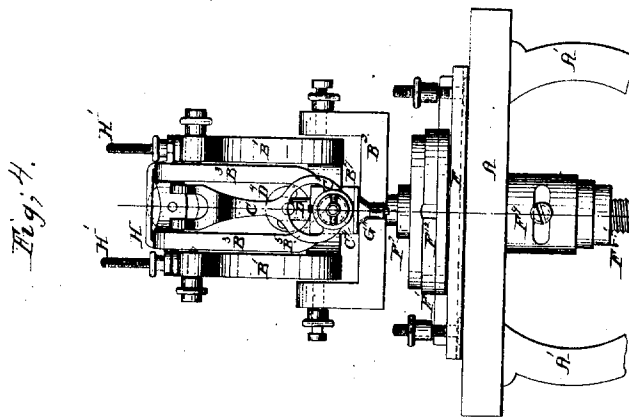
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Engraving Machine.

N^o 83708.

Patented Nov. 3, 1868.



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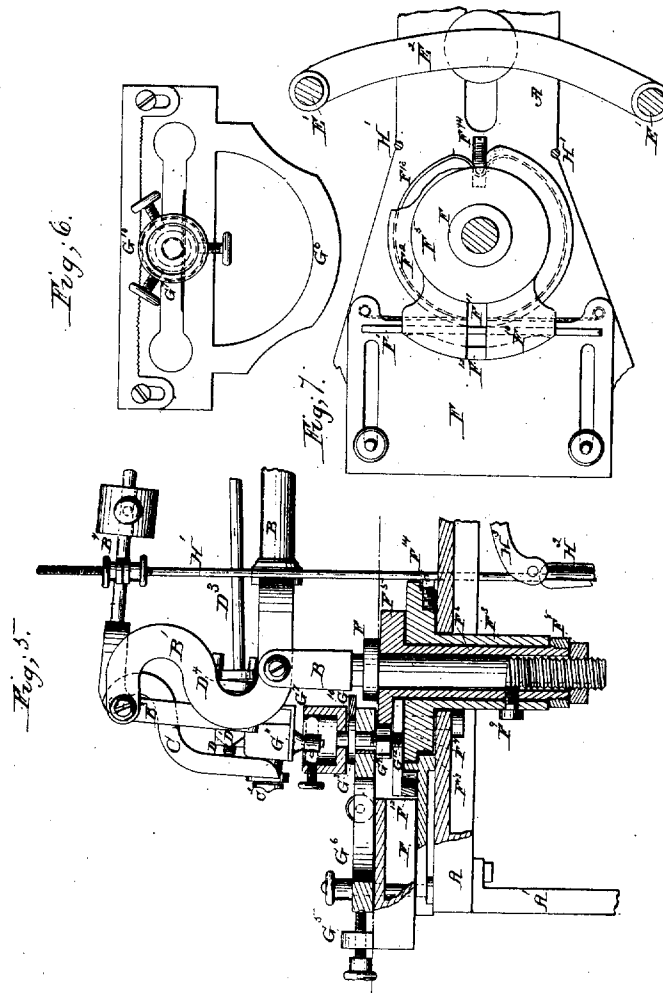
Guerrant & Field,

5 Sheets, Sheet 4.

Engraving Machine.

N^o 83708.

Patented Nov. 3, 1868.



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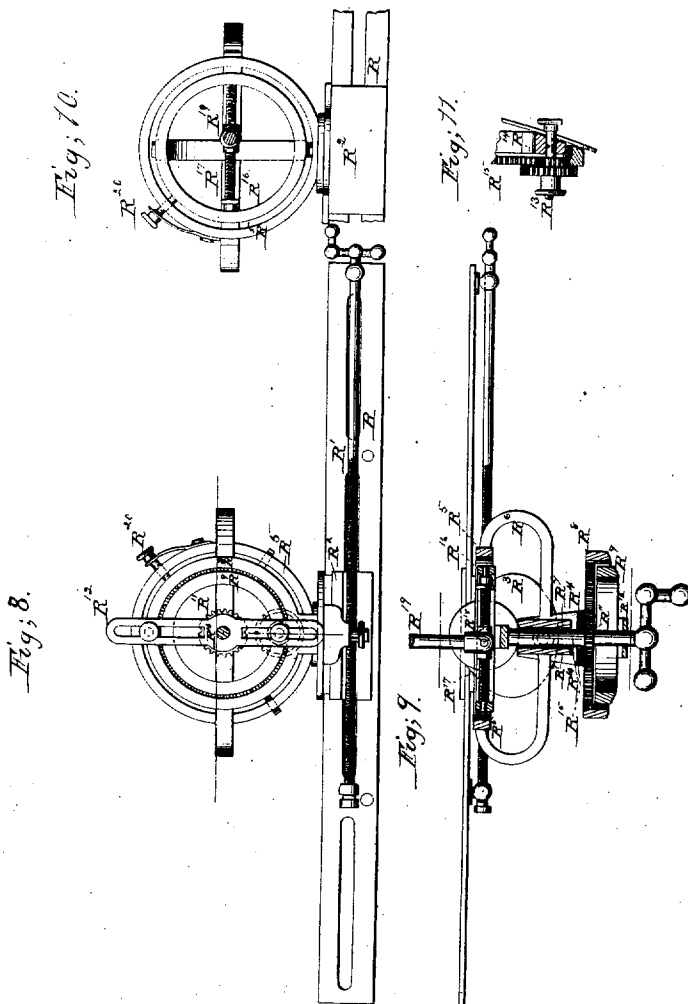
Guerrant & Field

5 Sheets Sheet 5.

Engraving Machine.

N^o 83708.

Patented Nov. 3, 1868.



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Letters Patent No. 83,708, dated November 3, 1868.

IMPROVEMENT IN ENGRAVING-MACHINES.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that we, JOHN C. GUERRANT and BENTON J. FIELD, of Leaksville, in the county of Rockingham, and State of North Carolina, have invented a new and improved Engraving-Machine; and we do hereby declare that the following is a full, clear, and exact description thereof, which will enable those skilled in the art to make and use the same, reference being had to the accompanying drawings, forming part of this specification.

This invention relates to improvements on the engraving-machine patented to us, December 18, 1866, No. 60,506, and November 5, 1867, No. 70,553.

It consists in improvements in the construction and arrangement of several material parts of the said machine, and in the addition thereto of improved apparatus to facilitate and control the operation of the graving-tools, whereby the field of usefulness of the said machine is materially extended, and whereby also the care and skill required to operate the said machine are materially lessened, as will be fully described on reference to the accompanying drawings, wherein—

Figure 1 represents a side elevation of our improved machine, with some parts broken away;

Figure 2 represents a front end elevation, with some of the guides for the stock of the graving-tool shown in red and some in blue;

Figure 3 represents a partial front end view, showing other guides for the graver-stock in red and blue;

Figure 4 represents a partial rear end elevation, showing the graver, and the arrangement of means for supporting it;

Figure 5 represents a side view of the rear portion of the machine, partly in elevation and partly in section;

Figure 6 represents a plan view of the means for holding cylinders or rings to be engraved;

Figure 7 represents a horizontal section of the rear part of the machine, taken on the line *x x* of fig. 5;

Figure 8 represents a front elevation of mechanism for actuating the staff to produce circles and ellipses;

Figure 9 represents a horizontal section of the same on the line *x x* of fig. 8;

Figure 10 represents a rear elevation of a portion of fig. 8; and

Figure 11 represents a detail of the same.

Similar letters of reference indicate corresponding parts.

A represents the table of the machine, provided with suitable supports, A¹, and bracing-ties, A².

B represents the staff, for actuating the graving-tool, and is provided, at its inner end, with the curved brackets B¹, by which it is jointed to the upper end of the vertical-oscillating shaft B².

B³ represents a swinging frame, jointed to the upper

end of the brackets B¹, and provided with a right-angled projection, to which the weighted arm, B⁴, is connected, and which supports, in a tapered hole through the lower end, a tapered holder, B⁵, the axis of which is coincident with the staff B.

The said holder is provided with a socket, wherein the tools, B⁶, are held.

The said tool-holder is tightened up in the holder B⁵, by means of the adjustable crocheted bracket, B⁷, which is adjustably secured to the under side of the frame B³ by a set-screw.

C represents another swinging frame, pivoted to the frame B³ at the top, and suspended in front of the graving-tool, where it is provided with a presser-plate, C², which is connected to the pendent frame in a manner to allow it to oscillate freely in any direction from the axis of the staff and graving-tool.

It is provided with a central opening for the tool, and with two or any other number of rounded projections, C³, (see fig. 4,) which bear upon the face of the plate which is being engraved, and govern the depth of the cut of the tool, as will presently appear.

The staff B is provided with an axial opening, wherein a rod, C⁴, is arranged, the outer end being provided with a suitable handle, and the inner end with an enlargement, C⁵, which is socketed to receive the short mandrel of a pulley, C⁶, the other end of which is connected by a ball-and-socket joint to the tool-holder B⁵, whereby the said holder may be admitted to be moved out of the same axial line with the rod C⁴, without cramping or preventing the efficient operation of the two together.

It is sometimes desirable, as in stencil-cutting, which is readily accomplished with this machine, to substitute a drill for the graving-tool, and give it rotary motion by applying a belt, from any suitable driving-mechanism, to the pulley C⁶, which may be conveniently done, and at the same time admit of all the necessary vibratory movements of the staff B to direct the tool, by reason of the arrangement of the said pulley C⁶ in the vertical and longitudinal axis of the said staff.

The shaft of the pulley is provided with a right-angled pin, C⁷, which communicates rotary motion to the tool-holder B⁵, by contact with a pin, C⁸, in the said holder.

D represents a screwed rod, which works in a stud, D¹, rising from the portion of the frame B³ which supports the tool-holder.

The inner end of the said screwed rod is arranged to bear upon the swinging frame C, to which the adjustable presser C² is secured.

The other end of the screwed rod D is connected to the rod D² by a connection at D³, which will admit the screwed rod D to be rotated by the rod D², while the

latter will not interfere with the longitudinal movement of the rod D, or with the movement of the latter around the axis from which it is suspended.

The outer end of the rod D³ is suspended in an adjustable bearing, D⁴, rising up from the staff B, near its front end.

E represents a curved pattern-plate, supported on the posts E¹, rising up from a curved bar, E², secured adjustably to the top of the table A; so that it may be readily adjusted to or from the centre of motion of the staff B.

The said plate may be made of glass, if preferred, whereby, when the copy, which is secured thereon in any suitable manner by clamps, is made on paper, the fine lines may be more distinctly seen.

E³ represents a spring-pointer or stylus, which is provided with a spring-guard, E⁴, and adjustably connected to the crocheted swinging support E⁵, which is also adjustably supported on an adjustable collar, E⁶, on the staff B.

The stock of the spring-pointer is provided with an adjustable arm, E⁷, whereon a magnifying-glass may be set up before the copy, when it is of such a nature as to require it.

F represents a sliding plate arranged upon the face of the table, at the rear end, best seen in fig. 7, which is designed for the support of the mechanism for holding the plates to be engraved. It is provided with a vertical flange, F¹.

F² represents a disk secured to the table A, and provided with a tubular extension, F³, projecting downwards through the table A, and provided also with an annular recess, F⁴, in the lower portion of its face.

F⁵ represents another disk arranged upon the disk F², and provided, also, with a tubular projection, F⁶, which fits into and projects through the extension F³ of the disk F².

The axial post B², which supports the staff B, is supported in the said extension F⁶, and is made adjustable vertically thereon, by means of the nuts F⁷ and F⁸, or by any other suitable means.

F⁹ represents a set-screw, entering the extension F⁶ through a slot in the extension F³, for the purpose of holding the said extension F⁶ and the axial post B² together, so that oscillating motion may be communicated from the said post to the disk F⁵.

The rear side of the disk F⁵ is provided with a radial extension, F¹⁰, having a central slot, F¹¹, and a ledge, F¹², projecting downward from the lower side, behind the flange F¹ of the plate F.

F¹³ represents a steel or other suitable belt, secured at each end to the plate F, near the ends of the same, and encircling the disk F⁵ in the annular recess F⁴.

In the front face of the said disk, a radial socket is formed, and provided with a set-screw, F¹⁴, so arranged as to force the band F¹³ into the said socket, for the purpose of tightening it.

To the plate F is adjustably connected another plate, G, to which is pivoted the vertical plate G¹, for supporting the slide G², whereon the plate to be engraved is secured, also in an adjustable manner.

The plate G¹ is connected at each end, by set-screws, to the ears or lugs G³, and is provided on its rear side, near the centre, with the swinging brace G⁴, whereby the said plate may be adjusted to any desired inclination, with reference to the staff B, by means of a set-screw in the lug G³, on the plate G, or in any other manner.

H represents a yoke, supported by the rods H¹ upon another yoke, H², which is connected, through the lever H³ and connecting-rod H⁴, to the foot-treadle H⁵.

The arm by which the weight B⁴ is connected to the swinging frame B⁵, passes between the arms of the yoke H, the purpose of which will presently appear.

I represents an adjustable collar on the staff B, near the front end, having in its lower face a swivel-stud, I¹, provided with a slot in its head, which takes on to a

horizontal slide, I², resting in the top of the vertical rods I³, pivoted at the lower ends to the long arms of the balancing-frame I⁴, which is pivoted to the cross-ties A² of the frame, and provided with a balancing-weight, I⁵, at the rear end.

When a plate is to be engraved, it is secured, by adjustable clamps, to the holding-plate G², and properly adjusted, with reference to the graving-tool and the staff, so that the pointer will stand at about the centre of the proposed engraving; and the copy of the design to be engraved thereon is secured to the copy-holding plate E.

The support of the copy-holding plate E is then adjusted to or from the vertical support B² of the staff, in proportion as the engraving is to be reduced in size from the copy.

The pointer E³ is then adjusted on the staff, to admit it to stand at about the centre of the copy when the staff stands at right angles to the plate-holder G², both vertically and horizontally; and finally, the weight B⁴ is adjusted on its arm, to the proper position to cause the graving-tool to bear on the plate with sufficient force to cause it to make the hair-lines, when the machine is ready to be operated.

The operator, then taking the front end of the staff in his hand, and moving it so as to bring the pointer to the beginning of the copy, having first, by his foot applied to the treadle H⁵, raised the weighted arm of the swinging frame B⁵, so as to remove the tool from contact with the plate to be engraved, through the medium of the yoke H, will then, by moving it, so as to cause the pointer to follow the lines of the copy, produce on the plate a *fac simile*, in the opposite direction, of the copy, except as to size, which will bear the same proportion to the copy as the distance of the graving-tool from the centre of oscillation is to the distance of the pointer from the said centre.

The support of the staff B may be adjusted to or from the holding-plate G³ in the brackets of the axial post B², for the purpose of changing the vertical and horizontal measurements of the figure to be cut, with reference to each other, which will be effected by such change, by reason of the arrangement of the plate to move with the tool, to some extent, around the axis of the staff-holder in the hereinafter-described adjustment of the said plate at right angles with the staff.

To produce the heavy lines and swells, the rod D³ is rotated by the operator in either direction, proportioned in amount to the increase and decrease in the depth of the cut.

If the copy is of such length as would require the movement of the staff so far in the horizontal plane, around the axes of motion, as to interfere with the proper action of the graver on the plate, the same may be materially compensated for by adjusting the collar E of the pointer so as to incline the pointer in either direction to reach the copy, and yet admit the staff to remain perpendicular to the plate which is being engraved, and which may be adjusted on the holding-plate G¹ by moving the plate G² past the graving-tool from time to time.

But by reason of the arrangement which will now be described, the necessity for the above-described adjustments is materially lessened.

By reason of the connection of the plate F to the disk F², by means of the belt F¹³, and to the disk F⁵ by the flange F¹, and the ledges on the radial extensions F¹⁰, the plate to be engraved may be always maintained in a position at right angles with the staff B, and may also be passed along in front of the tool, for which purpose the rod K is provided and connected to the disk F⁵, and also connected to the staff B, near the front end, so that when the staff moves in the horizontal plane, it will move with it, and communicate motion to the said disk F⁵, but will not move with the staff in a vertical plane.

The movement of the disk F^a on its axis, in unison with the staff, will cause the plate F to change position on the table, and be maintained at right angles to the staff, but the belt F^b will prevent it from oscillating around the said centre of motion, whereby the extensions F^c of the disk F^a will slide on the said plate, and the point of the graving-tool will pass over the plate longitudinally, as the work progresses.

If, however, the copy is very long, both it and the plate will require to be changed from time to time, and the staff to be restored to the starting-point, care being taken, in making such changes, to set the point of the tool where it left off, and the same with reference to the pointer, and when such changes are made, the tool is withdrawn from the plate by the application of the foot to the treadle H , as before explained.

Thus far we have described the operation of our improved machine as being effected by the application of the hand to the staff, and the communication of the required movements thereto by the hand, unassisted by mechanical aids, as in the machines heretofore patented to us.

But while we find this a very efficient method for executing some kinds of work, we have found it necessary to provide means for assisting the operator in moving the staff, in case of work requiring to be very correctly executed, or in case of the work being performed by persons whose hands tremble, or by unskilled operators.

To this end we have devised and applied the hereinafter-described system of adjustable guides, and also mechanism for actuating the staff by screws.

To the horizontal guide I^2 , at the centre, is connected a vertical rod, I^1 , which is provided with a screw-thread on its lower end, and extends through a gear-wheel, I^3 , provided with a screwed central hole, and through a bracket, I^4 , shown in dotted lines in fig. 1, on the frame of the machine, whereon the hub of the wheel rests.

I^a represents a crank-shaft, arranged in a suitable horizontal bearing, and provided with a wheel, I^b , on its inner end, which gears into the wheel I^3 , and by which motion is communicated thereto from the hand-crank, conveniently arranged in front of the machine.

By means of this arrangement, horizontal lines may be made with great rapidity and exactness, by using the hand-crank to raise the staff to govern the distance between the lines, and by sliding the staff horizontally on the guide I^2 .

L represents ways, arranged transversely of the table of the machine, near the front end, whereon a slide L^1 is fixed, and arranged to be traversed back and forth on the said ways by a screw, shown in dotted lines in fig. 3, to which the hand-crank L^2 is secured.

The vertical slide L^1 is provided with brackets L^4 and L^5 , wherein a detachable frame, L^6 , may be secured by a screw, L^7 , and a stud, L^8 , in the bracket L^5 .

The said frame is intended to be used to hold the staff, in connection with the slide L^1 , when it is desired to actuate the disk F^a , as heretofore described, for which the rod K is connected to it.

It also serves another purpose. It is desirable at times to actuate the rod D^3 more accurately than can be done by hand for producing the swell or heavy lines.

For this purpose the rod is provided with a sleeve, L^9 , adjustable thereon by a set-screw, which sleeve is provided with rollers L^{10} , of various sizes, having roughened faces, which, when a swell is to be produced, are adjusted by means of the adjustable bearing L^{11} of the rod D^3 , so as to press against either of the vertical parts of the frame L^6 , according to the direction in which the tool is to be moved to make the swell; as, for instance, if the tool is to move upward, the wheel will be brought to bear against the right standard of the frame L^6 , and as the staff is moved down-

ward, the said wheel will be moved in the direction to turn the rod D^3 , so as to screw the rod D away from the swinging frame O , which supports the presser O^2 , by which the depth of the cutting is regulated, thereby allowing the weight B^1 to press the tool more deeply into the plate, and when the pointer has arrived at the point of the greatest depth of the copy, and it is desirable to withdraw the tool, the wheel L^{10} is adjusted to the other side standard of the frame L^6 , whereby the rod D is forced against the presser-frame O , and the tool gradually withdrawn.

If an abrupt swell is required, the smaller wheels are adjusted to act on the standard of the frame L^6 , and if a more gradual swell is required, a larger wheel is used.

Any suitable number may be secured to the sleeve.

When it is desirable to actuate the staff B in all directions by the hand-crank, a slotted plate, M , shown in blue in fig. 1, provided with a perforated sliding-stud, M^1 , is secured by set-screws to the collars I and M^2 on the staff, and a rod, M^3 , is inserted through the bracket L^4 , sliding stud M^1 , and into the bracket L^5 , where it is held by screw-threads or in any other manner whereby the staff is so connected to the slide L^1 as to be operated horizontally thereby in either direction.

When the staff B is confined to the said slide in the manner described, the operator may, by properly manipulating the cranks I^a and L^2 , produce any desired combination of movements of the staff B , and thereby any kind of work which may be effected within the limit of the vertical movement of the staff B , admitted by the said frame.

In fig. 3, a gauge for the staff is shown in red, which may be used for producing wave-lines.

It is provided with the slotted pendent supports N , whereby it may be secured to the guide I^2 by the set-screws N^1 , provided therein, either in a horizontal plane, or at any desired angle thereto.

When it is used, the swivel-stud I is set on it, and the staff may be moved over it either by hand or by the slide L^1 .

In fig. 2 an adjustable gauge, O , is shown in blue, attached to the slide L^1 , by means of set-screws for making either straight or wave-lines at any inclination from the vertical line, in the use of which the frame L^6 and the guide-rod M^2 are dispensed with, and the staff is moved over the gauge O by hand.

In the same figure is also shown, in red, a gauge, P , which may be used for producing work in perspective, which is also secured to the guide I^2 by set-screws, and is provided with the vertical-slotted supports P^1 , which are adjustably connected, near the ends, to the main part P , and to which are adjustably connected the guides P^2 at their outer ends.

The inner ends of these guides are arranged to rest on the upper grooved ends of the yoke P^3 , which has a vertical support on the nut P^4 , on the rod I^1 .

The said guides P^2 may be adjusted to any inclination from the horizontal line, and the guide O may be used in combination with it to produce lines at right angles to those produced by them, or at any other angle thereto.

When the line of sight is to be taken from the right of the central axis of the staff, the guide P^2 , on that side, is used, and when it is taken from the other side, the other guide P^2 is used.

In fig. 8, a mechanism is represented which is designed to actuate the staff to produce circles or ellipses.

R represents a guide-plate which is secured to the plate I^2 by the set-screws N^1 , in a manner similar to the plate P , shown in red in fig. 2, and which is provided with a screw, R^1 , and slide R^2 .

The slide is provided with a bed-plate, R^3 , whereon is pivoted an adjustable plate, R^4 , which supports a ring, R^5 , to which is secured a yoke, R^6 , having a bear-

ing, R^7 , the axis of which is coincident with the axis of the ring R^5 .

In front of the yoke R^6 is supported another ring, R^8 , by the adjustable plate R^4 , which is provided with internal gear-teeth, and with a plain internal surface.

R^9 represents another ring fitting within the plain portion of the ring R^7 .

The front faces of the rings R^7 and R^8 are curved to a radial line intersecting the vertical axis upon which the plate R^4 oscillates.

R^{10} represents a crank-shaft, which is supported in the bearing R^7 , and which is provided with a pinion, R^{11} , and is supported at its outer end in a curved slotted bar, R^{12} , which is adjustable from the horizontal axis of the rings R^8 and R^9 in any direction, and is secured to them by set-screws.

R^{13} represents a small shaft, having a bearing in the rim of the ring R^9 , and is provided with pinions, R^{14} and R^{15} , and with thumb-nuts on each end.

Within the ring R^9 is arranged a ring, R^{16} , which is provided with a screw, R^{17} , intersecting its axis at right angles, and having a sleeve, R^{18} , to which a rod, R^{19} , is connected by a universal joint.

The said rod is designed to be connected with the staff B , by inserting the end thereof in the axial bore of the staff, the rod C^1 being removed therefrom.

The said rod may be provided with an annular groove, whereby it may be held in connection with the staff by a set-screw.

The shaft R^{10} is connected to the screw R^{17} also by a universal joint, so that it may communicate rotary motion to the ring R^{16} , which supports the said screw.

To produce concentric rings on the plate to be engraved, the sleeve to which the rod R^{17} is connected is adjusted to one side of the axis of the ring R^{16} , and rotary motion communicated to it by the hand-crank shaft R^{10} .

If it be desired to produce a border of concentric rings, the position of the plate R^5 , which supports the mechanism shown in fig. 8, is changed by the hand-cranks I^0 and I^1 , after each single ring is made, and in order to arrest the rotary movement of the ring R^{16} , always at the same place to form the said rings correctly, and to leave the finished ring, and commence the new one always at the same point, a snap-pin, R^{20} , is provided in the ring R^5 , which drops into a socket in the face of the ring R^{16} .

To form an ellipse with the longest diameter in a horizontal direction, the plate R^4 is adjusted horizontally around its axis of motion, and to make an ellipse having its vertical diameter the longest, the slotted bar R^{12} is adjusted vertically, to present the face of the ring R^{16} at the same angle, relatively to the plate to be engraved vertically, that it presents to it horizontally when adjusted by the plate R^4 , as before described.

The slotted bar R^{12} may be also adjusted at any inclination from the vertical line, and thereby the ellipse may be made with its long or short diameters in any direction.

To produce borders of ellipses, the same movements may be given to the supports of the ring R^5 by the hand-cranks, as before described with reference to making borders of concentric rings.

It will be perceived that various figures and combinations of figures may, with great facility, be produced by this mechanism; as, for instance, by sliding the bar R^{12} , so as to bring the pinion R^{11} into gear with the pinion R^{14} , a series of concentric rings or ellipses may be made around a common centre, and by the use of the hand-cranks, as before described, borders or other figures of such devices may be made.

The slotted plate R^{11} is adjusted around the rings, and maintained in any position, by means of the pinion R^{14} , its axle, and the thumb-nuts, as will be readily understood.

To engrave the surface of a cylinder, or the internal

surface of a ring, the holding-plate G^1 is detached, and the holder G^2 is substituted, which is arranged to be connected to the plate G by set-screws.

The said holder is provided with a chuck, G^7 , which is connected to it by a shank, G^{12} , passing through a lateral slot in the holder, to which shank is connected, above the holder G^2 , a gear-wheel, G^8 , and below the holder it is provided with a nut, G^9 .

The lower termination of the shank works in the slot F^{11} , of the extension F^{10} , of the disk F^5 .

G^{10} represents a rack, which is adjustably connected to the upper face of the holder G^2 , so as to admit the teeth of the pinion G^8 to gear into the teeth of the said rack.

If the cylindrical article is to be engraved on the inside, it is secured to the chuck, as shown in fig. 5, and presented to a tool suspended from a stud, G^{11} , on the under side of the bracket B^1 , and as the holder is vibrated and caused to slide past the tool, as heretofore described, by the action of the disks F^2 and F^3 , the projection of the shank G^7 into the slot F^{11} will cause the chuck to be maintained in the axial line of the staff B , whereby the holder must slide with reference to it, and as the rack G^{10} moves with the slide, it will communicate rotary motion to the chuck on its own axis, thereby revolving the article to be engraved as the work is progressing.

When a cylindrical article is to be engraved on the outside, the rack G^{10} is changed to the opposite side of the pinion, which causes it to rotate in the opposite direction, the other parts working in the same manner as above described.

Dotted lines may be produced, when desired, by the application of the foot to the treadle H^2 , so as to alternately move the tool into and out of contact with the plate.

It will be obvious that the construction and arrangement of the various appliances which have been hereinbefore described, for effecting the varied movements of the staff and the holding-apparatus, may be very materially varied without departing from the spirit of our invention.

We, therefore, do not limit ourselves to the particular construction and arrangements which we have described, but propose to avail ourselves of such modifications and changes of construction and arrangement as may seem best adapted for effecting the operations of the graving-tools and holding-plates hereinbefore described.

We claim as new, and desire to secure by Letters Patent—

1. The combination, with the graving-tool, of an adjustable presser, substantially as and for the purpose described.
2. The stock C^5 of the graving-tool, provided with the pulley C^6 , for communicating rotary motion thereto, substantially as and for the purpose described.
3. The disk F^2 , provided with the recess and set-screw F^{14} , for tightening the belt F^{13} , substantially as and for the purpose described.
4. The combination, with the slotted holder G^2 and the slotted disk F^5 , of the chuck G^7 , provided with the shank G^{12} , substantially as and for the purpose described.
5. The combination, with the holder G^2 , of the toothed rack, and the pinion G^8 , on the shank of the chuck, or the equivalent thereof, substantially as and for the purpose described.
6. The chuck G^7 , adjustable in a horizontal plane, coincident with the vertical axis of the graver-support, substantially as and for the purpose described.
7. The chuck G^7 , provided with means for giving it rotary motion on its own axis, while it is adjusted in the horizontal plane of the vertical support of the graving-tool, substantially as and for the purpose described.
8. The combination, with the weighted graver-sup-

porting frame, of the yoke H and treadle H², suitably connected thereto, substantially as and for the purpose described.

9. The combination, with the presser-support C, of the screwed rod D and the rod D³, adjustably connected to the said end D, substantially as and for the purpose described.

10. The combination, with the rod D³, of the rollers L⁹ and L¹⁰, and the frame L⁸, or its equivalent, for actuating the said rollers, substantially as and for the purpose described.

11. The combination, with the staff B, of the slide L¹, provided with a vertical guide connected to the staff, substantially as and for the purpose described.

12. The combination, with the staff B, of a vertically-adjustable rest, I², substantially as and for the purpose described.

13. The combination, with the staff B, of a counterpoised frame, I¹, substantially as and for the purpose described.

14. The combination, with the staff B and adjustable rest I², of the adjustable gauge, for producing wave-lines, substantially as and for the purpose described.

15. The combination, with the staff B and slide L¹, of the adjustable gauge O, substantially as and for the purpose described.

16. The combination, with the staff B and adjustable rest I², of the gauge P, substantially as and for the purpose described.

17. The combination, with the staff B and adjustable rest I², of the mechanism, substantially as described, for producing circles and ellipses, as and for the purpose specified.

18. The combination, with ring R⁵, of the ring R¹⁶, yoke R⁸, and crank-shaft R¹², connected to the screw R¹⁷, by a universal joint, substantially as and for the purpose described.

19. The combination, with the crank-shaft R¹², of the rings R⁸ and R⁹, slotted plate R¹², shaft R¹³, and pinions R¹⁵ and R¹⁶, substantially as and for the purpose described.

20. The mechanism for actuating the staff, for producing circles, arranged for adjustment in a horizontal plane, substantially as and for the purpose described.

21. The combination, with the rings R⁵ and R¹⁶, of the spring-snap R²⁰, substantially as and for the purpose described.

22. The combination, with the crank-shaft R¹² and yoke R⁸, of the adjustable slotted plate R¹² and rings R⁸ and R⁹, for effecting the adjustment of the ring R¹⁶, substantially as and for the purpose described.

23. The combination of the adjustable copy-holding plate with the adjustable pointer, and with the graving-tool, substantially as and for the purpose described.

24. The pointer F⁸, provided with the presser-gauge E¹, substantially as and for the purpose described.

25. The arrangement of the pointer-support, for adjusting it axially, with reference to the staff B, and vertically, substantially as and for the purpose described.

JOHN C. GUERRANT.
BENTON J. FIELD.

Witnesses:

FRANK BLOCKLEY,
ALEX. F. ROBERTS.