

March 8, 1932.

W. S. EATON

1,848,465

ENGRAVING MACHINE

Filed April 15, 1926

3 Sheets-Sheet 1

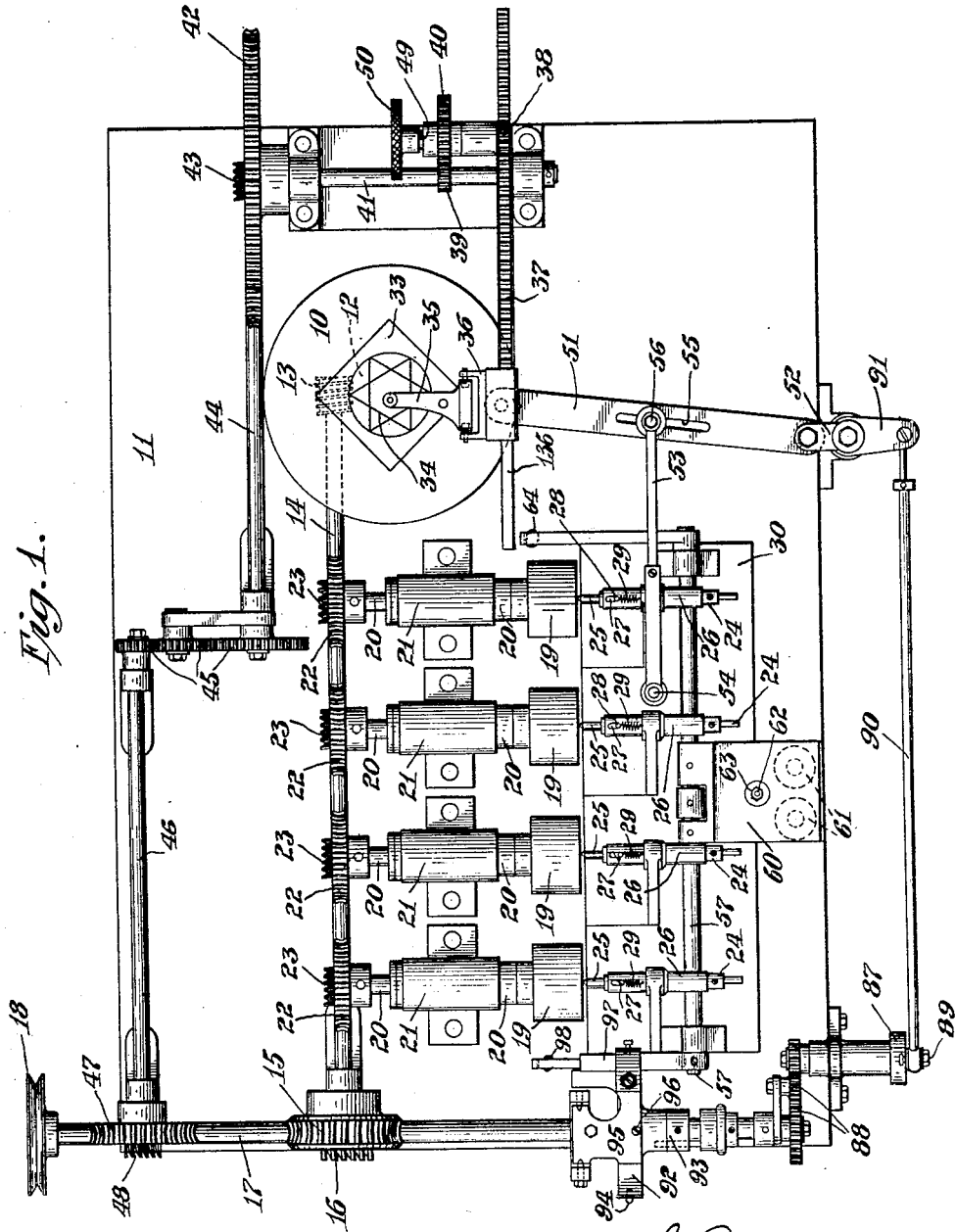


Fig. 1.

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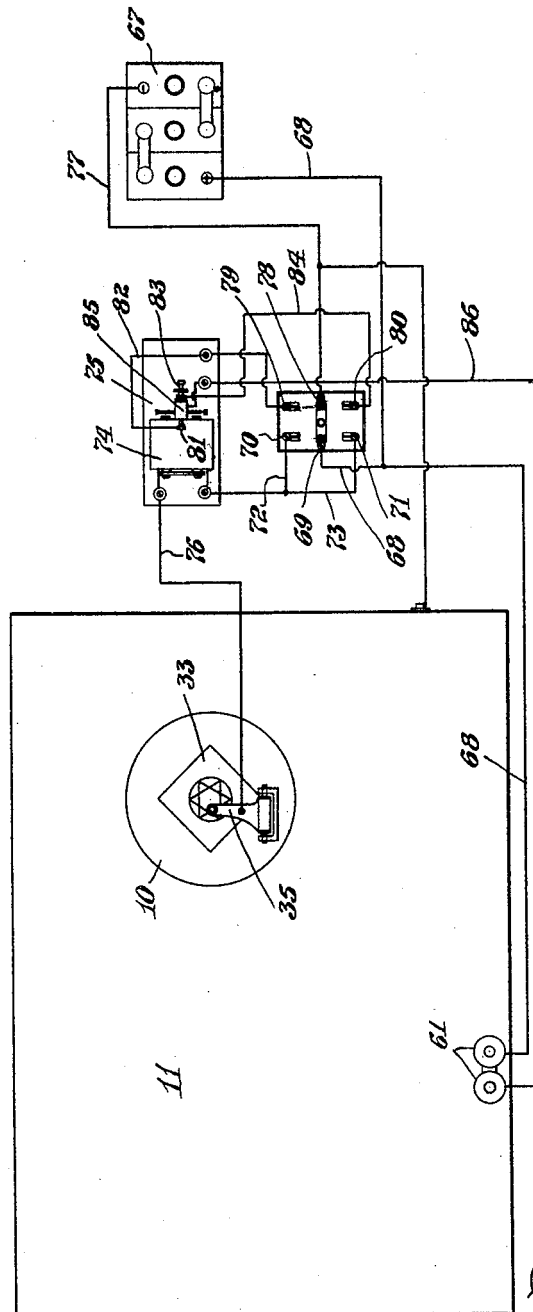
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3 Sheets-Sheet 3

Fig. 3.



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ENGRAVING MACHINE

Application filed April 15, 1926. Serial No. 102,157.

My invention relates to engraving machines, and more particularly to a machine capable of automatically producing artistic, engraved disks which may be used for the dials of watches or other purposes.

In engraving machines used for the production of designs upon a work plate in accordance with a master plate, it has long been the practice to use a machine in which the graver or other work point is caused to have movement transmitted thereto by a lever system carrying a tracing stylus which is caused to follow a course, or to have movement, as determined by the design upon the master plate, or to move the support for the work plate by a lever system in a similar manner.

In the first instance the support for the work plate is stationary, and the graver or other point is moved with relation thereto, while in the latter case the graver or other work tool is stationary and the support with the work plate thereon has movement. In both types of machine, the reproduction of the design results from a movement corresponding with the lines of the design of either the graver or other work point or the support for the work plate, although the employment of the lever system permits a variance in the quantity of such movement as compared with that of the stylus co-operating with the master plate.

In machines of the types above referred to, during the production of a design, the graver or other work point is continuously engaged with the work plate unless manually moved out of such engagement by the operator for the purpose of inspecting the progress of the work or upon the completion of the making of each separate line or character in the design. The operator is also required to manually move the stylus in accordance with the lines upon the master or pattern, which movements of the stylus, through the lever mechanism above referred to, will cause a relative movement of the holder for the graver or other work point and of the support for the work plate corresponding with the movements of the stylus.

Machines as above referred to are used largely for what is known as commercial

work such as the production of printing plates, matrices used in type casting machines, and other articles.

A machine embodying my invention as distinguished from the types of machines above referred to, is capable of automatically producing various engraved articles, such as the dials of watches, requiring no attention from the operator beyond the mounting of the work plate or disk in the holders and the removal of the finished product from the machine. The construction is such as to lend itself to the simultaneous automatic production of a plurality of such articles from a single master or pattern, all of such articles thus produced being substantially identical and of substantially uniform quality of workmanship. As distinguished from the older types of machines above referred to, an engraving machine embodying my invention, employs no tracing stylus and neither the work support nor the holder for the graver or work point have any relative movement as determined by the lines upon the master or pattern, the machine possessing none of the characteristics of the old and well known types of pantographic engraving machines above referred to.

In a machine embodying the invention, the production of the design results from the automatic movement of the holder for the graver or other work point, toward and from the support for the work plate or disk, the movements of the holder being under the control of an electrically actuated mechanism, the functioning of which is determined by electro-conductive and electro-nonconductive portions of the design upon a master or pattern.

The machine includes therein a support for a master or pattern bearing thereon a design to be reproduced, parts of which are of electro-conductive and other parts of which are of electro-nonconductive material. Associated with this support is a contact member which in co-operation with the pattern or master controls the circuit to a magnet, the functioning of which results in the engagement or disengagement of the graver or other work point and the work plate or disk upon

the work support, or a plurality of such gravers or other work points when a plurality of work supports are used.

The support for the pattern or master has continuous movement imparted thereto of a character to progressively bring different portions of the design thereon within the operative range of said contact member, and the contact member has movement transversely to the movement of the support, so as to ensure the operative engagement of the contact with every portion of the design upon the master or pattern. To ensure a substantial reproduction of the design upon said pattern or master, upon the work plate or disk, the supports for the said work plate or disk have imparted thereto movement simultaneously with and corresponding to that of the support for the pattern or master, and the holder or holders for the graver or gravers, or other work points, receive movement transversely of the support for the work plate or disk simultaneously with the movement of the contact member transversely of the master or pattern in order to bring each graver or work point into the operative relation with every portion of the work plate or disk upon which it acts. It is preferable, however, to impart to the said holders a smaller quantity of such movement in order to secure a reduction in the scale of the reproduced design as compared with that of the master or pattern.

The holder for each graver or work point is preferably spring-pressed toward the support for the work plate or disk with which it co-operates, and is acted upon by a retracting spring for ensuring a rapid disengagement thereof with the work plate or disk when the electrically actuated controlling mechanism operative upon these holders, has movement permitting such movement of the holder.

The means for imparting movement to the contact member transversely of the pattern or master is also utilized to impart similar movement to the holder or holders with relation to the support or supports for the work plate or disk, the mechanism used for this purpose being so constructed as to permit variation in the scale of the reproduction.

I also may provide in the machine, an electrical system which may be so set as to either permit a cameo reproduction of the design or an intaglio reproduction thereof, changes in the setting of the machine involving merely a change in the setting of the electrical system and not requiring any change or modification in other parts or mechanisms in the machine.

Under some conditions it is desirable to vary the depth of the lines in the reproductions, or to impart a wavy or zigzag effect in the lines. To meet this condition, I provide mechanisms which may be selectively used and which co-operate respectively with the actuating means for imparting movement to

the holders for the gravers or other work points, to modify the operative effect of this mechanism under the influence of the electrically actuated means acting thereupon, or with the mechanism for imparting movement of the holders transversely of the support for the work plate or disk, to impart a vibratory movement thereto while said holders are having such transverse movement. Either mechanism may be adjusted to vary its operative effect, or may be made entirely inoperative so as to cause the reproduced design to conform exactly with the design upon the pattern or master.

The supports for the master or pattern and for the work plates or disks, are actuated through the same mechanism, thus ensuring accuracy in the timing of the movements of the master or pattern and of the work plate or disk, or all of such when a plurality of work supports are used.

The invention consists primarily in an engraving machine embodying therein a support for a master, a support for a work plate, means imparting similar simultaneous movement to said supports, a holder for a work point adjacent the support for the work plate, a spring normally tending to move said holder away from said support, a spring actuated member operative upon said holder to move it toward said support against the tension of said spring, means controlling the movement of said member by its spring, a master bearing a design having portions of electro-conductive material and other portions of electro-nonconductive material, an electrical contact member co-operating with said master, means imparting movement to said contact member transversely of said master, operative connections between said means and said holder, whereby said holder is moved transversely of the work plate simultaneously with the movement of said contact member transversely of said master, and an electrically actuated mechanism operative upon said spring actuated member, the circuit to which is controlled by said master and said contact member, whereby said holder will be automatically caused to engage or disengage the work point with the work plate as determined by the opening or closing of an electrical circuit at said master; 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,

Fig. 1 is a plan view of an engraving machine embodying my invention;

Fig. 2 is an end view thereof from the left of Fig. 1; and

Fig. 3 is a diagram showing the electrical conditions in a machine.

Like numerals refer to like parts throughout the several views.

In the embodiment of the invention shown in the drawings, the support for the master or pattern is shown as being in the form of a turn-table 10 rotatably mounted in a bearing upon the base 11 of the machine. Said support 10 is continuously rotated about a vertical axis by means of a worm wheel 12 carried thereby and a worm 13 upon a worm shaft 14 meshing therewith. Said shaft 14 is driven through a worm gear 15 thereon and a worm 16 upon the main power shaft 17. The shaft 17 is driven from any desired source of power by means of the pulley 18.

Also mounted upon the base 11 are a plurality of supports each adapted to receive a work plate or disk, each of which is rotatably mounted to have movement about an axis at right angles to that of the support 10. The construction of each of these supports is identical with every other, and a plurality of such is used merely to permit the simultaneous production of a number of engraved plates or disks, each of which will conform exactly with every other. To simplify the description of the machine, but one of these supports will be described in detail, corresponding reference numerals being applied to the other supports, it being understood that the number of such supports may be increased or decreased, according to the desired output of a machine.

Each support comprises a head 19, to the face of which a work plate or disk may be secured in any desired manner, the center of this plate being accurately alined with the axis of the shaft 20 carrying said head and mounted in a horizontal bearing 21.

Carried by each shaft 20 is a worm wheel 22 in mesh with a worm 23 upon the shaft 14. By this construction each of the work plate or disk holders will have the same number of revolutions per minute as the support 10, since the various wheels 12 and 22 are of the same diameter, and the various worms 23 and 13 are of the same pitch.

Associated with each support 19 is a holder for a graver or work point, the number of such holders corresponding with the number of supports for work plates or disks. In the accompanying drawings four such supports 19 are shown, and consequently the machine will include therein four holders for gravers or work points. Each of these holders is identical in construction and mode of operation with every other, and a detailed description of but one of them will therefore be given, corresponding reference numerals being applied to the other holders and parts appurtenant thereto.

Each holder 24 for the graver or other work point 25 is movable towards and from the holder 19 with which it co-operates, as by being slidably mounted in a bearing 26 having a slot 27 in the top thereof through which a stud 28 carried by the holder 24, projects, so

as to be engaged by a spring 29 having a normal tendency to move the holder away from the support 19.

The bearing 26 is supported from a carriage 30 slidably mounted upon a support 31 by means of roller bearings and co-operating raceways 32, or any other mechanism which will permit the free movement of the carriage 30, and prevent such looseness thereof, or such play therein, as will permit any material movement thereof toward or from the support 19.

Mounted upon the support 10 in any desired manner is a master or pattern 33 bearing thereon a design, parts of which, as indicated by the lines 34, are of electro-non-conductive material, the master or pattern itself being of electro-conductive material and in electrical connection with the support 10 and therethrough with the base 11 of the machine.

Co-operating with the support 10 and the master 33 thereon is a contact member 35 pivotally mounted upon a slide 36, the pivots of this member being at right angles to the axis of the support 10 so as to permit the member 35 to descend by gravity into engagement with the master or pattern 33.

Means are provided for imparting movement to the contact member transversely of said support 10, which means are also operative to impart simultaneous movement to the holder for each graver or work point with relation to the support 19 with which it is associated.

In the form of the invention shown, the slide 36 has secured thereto a rack 37 meshing with which is a gear 38, the movement of which gear will impart lineal traverse to the carriage 36 and cause it to have movement transversely of the master or pattern 33 so as to bring every portion of the design both as to the electro-conductive and the electro-non-conductive portions thereof, within the operative range of the contact member as a result of the rotary movement of the support 10 and of the lineal movement of the member 36. The gear 38 is actuated by means of the entrained gears 39 and 40, the former of which is carried by a shaft 41 carrying a large worm gear 42, meshing with which is a worm 43 upon a shaft 44 driven by a speed reducing gear train 45 actuated from the shaft 46 by means of the worm wheel 47 and the worm 48 meshing therewith and carried by the shaft 17.

The gear 40 is idly mounted upon the shaft 49, carrying the gear 38, and is adapted to be connected or disconnected with said shaft by means of the manually operative clutch member 50. This clutch member is used to facilitate the setting and resetting of the machine. The means of driving the gear 38, and through it and the rack 37, imparting movement to the carriage 36, secures a reduction in speed of said gear as compared with

the shaft 17 to an extent which will result in a movement of the carriage 36 sufficiently slow to avoid any spiral effect in the reproduction, even though very fine lines are cut upon the work plate.

It being essential to cause traverse of the contact member 35 across the master or pattern 33, it will be obvious that the corresponding movement of the gravers or work points with relation to the work plates or disks carried by the supports 19 is also necessary, in order to cause the gravers or other work points to engrave or chase every portion of the work plate or disk in accordance with, or as controlled by, the master or pattern. To secure this simultaneous movement, I provide a lever 51 one end of which is pivotally connected with the slide 36, and the other end of which is pivoted to a member 52 spaced from said carriage, a link or pitman 53 being pivotally connected with the carriage 30, at 54, and with said lever at a point intermediate its ends, so that the travel of the holders for the gravers or work points will be even slower than that of the carriage 36. With the arrangement shown, the ratio of movement of the holders as compared with that of said carriage 36 will be as one to two, or approximately so. As a matter of convenience, I provide the lever 52 with an elongated slot 55 in which the pivot 56 of the link 53 may be adjusted and set so as to permit a variation in this leverage, or a setting of the machine for the production of designs upon the work plates or disks upon different scales. The link 53 is made in two telescoping sections connected by means of a set screw as shown, to permit this adjustment.

The spring 29 has a normal tendency to withdraw the holder 24 with its graver or work point 25 away from the support 19 for the work plate or disk, an electrically actuated mechanism operative upon said holder being provided, the circuit to which mechanism is controlled by the pattern or master 33 so that the holders will be automatically caused to move toward said support 19 to bring the graver or work point into operative engagement with the plate or disk thereon, or permit it to be moved out of such operative engagement. This electrically operated means comprises a shaft 57 having a crank 58 thereon engageable with a stud 59 carried by the holder 24, and movable in a slot in the bearing 26 for said holder. This permits a right-line movement of the holder.

Carried by said shaft 57 is an armature plate 60 co-operating with an electromagnet 61. Operative upon the armature 60 is a stop mechanism consisting, in the form of the invention shown, of a rod 62 passing there-through and carrying a stop member as the nut 63. Acting upon the shaft 57 is means, as the spring 64, having a normal tendency to rock the shaft in a manner to impart move-

ment to the holder or holders 24 in a manner to engage the graver or work point 25 with a plate upon the holder 19. This spring 64 is connected at one end with an arm 65 upon the carriage 30 and at other end with a crank 66 carried by the shaft 57.

The electrical connections in the machine are illustrated in the diagram shown in Fig. 3 of the drawings, the conditions therein illustrated being such that by the mere adjustment or change in the setting of the electrical switches in the machine, the design reproduced upon the work plate or disk may be made either in cameo or in intaglio from one and the same master.

In this wiring system the source is shown as being an ordinary storage battery 67, the lead 68 from the positive pole of which is connected directly with one terminal of the electro-magnets 61, and another lead from which is connected with one movable contact member 69 of a switch mechanism having contacts 70 and 71 connected respectively through the leads 72 and 73 with one terminal of the coils 74 of a relay mechanism 75, the other terminal of which windings is connected by a flexible wire 76 with the contact member 35. The negative pole of the battery 67 is connected by the lead 77 with the base 11 of the machine, and therethrough with the master or pattern 33. This lead 77 is also connected with a movable contact 78 of a switch mechanism adapted to engage contacts 79 or 80, one of which is connected with one fixed contact 81 of the relay by the lead 82, and the other of which is connected with another fixed contact 83 of said relay through the lead 84. The movable contact 85 of the relay is connected by the lead 86 with the other terminal of the magnet 61.

As will more fully appear hereinafter, when the contacts 69 and 78 are connected respectively with the contacts 71 and 80, and the contact member 35 is engaged with the electro-conductive portions of the pattern or master 33, the magnet 61 will be de-energized and thus permit the spring 64 to move each holder 24 so as to engage the graver or work point 25 with the work plate or disk upon the support 19 with which it co-operates. With this setting, however, when the member 35 is engaged with the electro-nonconductive portions of the pattern or master 33, the magnet 61 will be energized and thus overcome the tension of the spring 64 and permit the spring 29 to disengage the graver or work point 25 with the work plate or disk upon the support 19 with which it co-operates.

On the other hand, if the contacts 69 and 78 be engaged with the contacts 70 and 79, the engagement of the contact member 35 with the electro-nonconductive portions of the pattern or master will cause the magnet 61 to be de-energized, thus permitting said

spring 64 to move each holder 24 so as to engage the graver or other work point 25 with said plate. When however, with this setting of the machine the contact member 35 engages the electro-conductive portions of the pattern or master, the magnets 61 will be energized and will thus overcome the tension of the spring 64 and permit the spring 29 to disengage the graver or work point 35 from the work plate or disk upon the support 19 with which it co-operates.

In the manufacture of the master or pattern, it is more convenient to engrave or etch the lines of the design to a considerable depth, and fill these lines with electro-nonconductive material, and in referring to the design upon this plate, these filled lines are considered as constituting the design, although strictly speaking, the exposed surfaces of the plate 33 and the filled lines 34 thereon, combined, form the design. Hence in the setting of the contacts 69 and 78 first referred to, the engraved portions of the reproduction will correspond with the electro-conductive portion of the pattern or master, and the design represented by the lines 34 will be in cameo. With the second setting of said contacts 69 and 78, however, the engraved lines upon the work plate or disk will correspond with the lines 34 and thus have an intaglio design formed thereon. Hence the relay 75 and the switch mechanisms 69, 70, 71, 78, 79 and 80 constitute means which may be operated to selectively secure a reproduction of the lines 34 either in cameo or intaglio.

When the contacts 69 and 78 are engaged with the contacts 70 and 79, the electrical conditions are the same as though no relay and no switch mechanism were used, since the engagement of the contact 35 with the electro-conductive portions of the pattern or master 33 will result in the closing of the circuit to the magnets 61 and the engagement of said contact 35 with the electro-nonconductive portions of the pattern or master 33, or the lines 34 will result in the opening of the circuit to said magnets 61.

There are two further adjustments in the machine, both of which may be selectively made operative or inoperative. The mechanism of one of such adjustments is for modifying the reproduction of the design upon the master or pattern, by imparting movement to the carriage 30 in excess of, or opposed to, the movement imparted thereto through the lever 52 and link 53, so as to secure a wavy or zigzag effect in the lines of the reproduction. The mechanism for the other adjustment is for varying the quantity of movement of the gravers or work points 25 with relation to the work plate or disk upon the supports 19, while the spring 64 is operative to engage said work point or points with said plate or disk, thus permitting a variable depth of cut

of said graver or work point in different portions of the design.

In the former mechanism, I provide means whereby movement may be imparted to the carriage 30 independently of the movement imparted thereto through the mechanism for causing the slide 36 and the contact member 35 to have movement across the pattern or master. This mechanism, in the form of the invention shown, comprises a crank disk 87 driven from the shaft 17 through the gear train 88. The crank 89 of this disk is mounted in a radially extending groove in the disk 87 so that it may be set at any desired radial distance from the axis of this disk in order to regulate the quantity of departure in the lines of reproduction from the lines upon the pattern or master. The crank 89 is connected with one end of a pitman 90, the other end of which is connected with a crank 91 upon the member 52. The operative effect of this mechanism is to impart an oscillatory movement to the member 52, and hence to the point of pivotal support of the lever 51 in a manner to impart a rocking movement to this lever about the point of its pivotal connection with the slide 36 which will impart a vibratory movement to the carriage 30 while it is receiving a very slow movement as a result of the action of the gear 38 upon the rack 37. This movement of the carriage 30 under the control of the disk 87 will cause a departure upon both sides of the normal line of action of the graver and will produce a zigzag effect in the line which is not present in the design upon the pattern or master 33. The extent of this movement may be varied by adjusting the crank of the disk 87 toward or from the axis of this disk.

The other adjustment above referred to for varying the depth of the cut is effected by a mechanism consisting of a wheel 92 idly mounted upon the shaft 17, but being adapted to be connected thereto by means of a clutch 93. This wheel 92 has a plurality of tappets 94 thereon which are engageable with a pivoted plate 95 which is engaged by an adjustable member, as the screw 96, mounted in an arm 97 upon the shaft 57.

The pivoted plate 95 is pressed toward the wheel 92 by a spring 98 and carries an adjustable member as the screw 99 bearing upon the wheel 92 at one side of the projections 94 to limit the operative effect of these projections as to the extent of movement of the plate 95 and the shaft 57 under the control of said wheel. In fact this screw 99 may be so set as to make the wheel totally inoperative.

The screw 96 may also be used to limit the oscillation of the shaft 57 in a manner to secure extreme nicety in the regulation of the depth of cut when very fine work is desired, this adjustment supplementing that secured by means of the stop 63.

The slide 36 is mounted upon a track 136

supported from the base 11 of the machine.

Any desired mechanism for mounting the master or pattern 33 upon its support 10 and a plate upon a holder 19 may be used, or said master or pattern and said plate may be secured in position by means of wax, or in any other desired manner which will cause said master or pattern or said work plate or disk to have movement with their respective supports, notwithstanding the resistance to such movement offered by the contact member 35 and the graver or work point 25.

The chuck for holding the graver or work point is not shown or described in detail since any desired old or well known construction may be used.

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

The machine of the present invention is designed particularly for the production of engraved or chased designs upon a flat surface, which designs have a general circular effect. The character of the design is subject to wide variation and may be simple or complex, as desired. It may be composed in part of lines of varying lengths, and in part of isolated areas, the operation of the machine placing no limitation whatever upon the character of the design beyond the difficulties encountered in producing the master or pattern, which difficulties are minimized because of the possibility of making the master or pattern upon a much larger scale than is required for the reproduced design.

In starting a run of the machine, a master or pattern 33 is mounted upon the support or turn table 10 with the geometrical center of the design in axial alinement with said support or turn table. A flat work plate or disk is then mounted in each holder 19 with its geometrical center in axial alinement with the shaft 20. Since the operation of the machine is the same whether a single or a plurality of work plates or disks are to be engraved, the presence or absence of such plates or disks in more than one of the holders is quite immaterial.

When the master or pattern and the plate or plates have been properly mounted, the clutch 50 is released and the slide 36 moved to the left Fig. 1, until the point of the contact 35 may be accurately registered with the edge of the design formed by the electro-nonconductive portion 34 of the design. When this contact member has been thus set, the clutch 50 is reset, and power is applied to the machine through the pulley 18 and shaft 17. The rotation of the shaft 17 will, through the shaft 14 and the worm wheels, simultaneously turn the support 10 and each of the supports 19, the revolutions per minute of each of said supports being the same as every other.

The movable switch member carrying the

contacts 69 and 78 is then thrown to either close the circuit through the contacts 71 and 80 or through the contacts 70 and 79, according to whether it is desired to have the parts of the design corresponding with the electro-nonconductive portions 34 in cameo or in intaglio.

Simultaneously with the rotation of the turn table 10 the shaft 49 will be turned at a very low speed, thus through the rack 37 and slide 36, moving the point of the contact member 35 toward the geometrical center of the design upon the plate 33. This movement is so slow as to result in no appreciable distortion in the reproduction since with one revolution of the support or turn table 10 the movement will be less than the width of any line which may be engraved. The alternate engagement or disengagement of the graver or work point 25 with the work plate or disk will also assist in preventing the development of any spiral trend in the design, however slight.

Assuming that the contacts 69 and 78 are engaged with the contacts 71 and 80, when the contact member 35 is engaged with the electro-nonconductive portion 34 of the design, the electromagnet 74 will be de-energized and the current from the battery 67 will flow through the lead 68 to the electromagnet 61, thence through the lead 86 to the vibrator 85, through the fixed vibrator post 83 through the contacts 78 and 80 back to the negative pole of the battery. As a consequence the armature plate 60 will be drawn downwardly, moving the cranks 58 out of engagement with the stud 59, and permitting the spring 29 to move the graver or work point 25 out of engaging relation with the work plate or disk. The magnet 61, when energized, overcomes the tension of the spring 64 so that immediately with the opening of the circuit to the magnet 61 said spring will impart a return oscillation to the shaft 57 and through the mechanisms above referred to, force the holder 24 and the graver or work point carried thereby into engagement with the plate. This construction has the advantage that the pressure of the graver or other work point against the work plate or disk is determined by the tension of the spring 64, the stop 63 or the adjusting screw 96 limiting the movement of the shaft 57 by said spring so as to control the depth of cut.

Immediately that the point of the contact member 35 passes from an electro-nonconductive portion to an electro-conductive portion, the electromagnet 74 will be energized, moving the vibrator 85 away from the fixed contact 83, thus opening the circuit to the magnet 61 and permitting the movement of the holder 24 in the manner immediately above referred to.

When the graver or other work point is

engaged with the plate, which may be during one or more full revolutions of the support 10 and the support 19, or during some part of a revolution thereof, the removal of the metal from the work plate or disk results from the rotary movement thereof with relation to the graver or work point.

The rotation of the master or pattern 33 will bring every portion thereof circumferentially of the design, at the same radius, into engaging relation with the contact member 35, while the travel of the contact 35 radially of the design or transversely thereof will constantly change the radius at which the member 35 contacts with the plate until the geometrical center of the design is reached. The contact 35 should not be moved past this center, since the graver or work point is ordinarily so constructed and set that in the event of its passing the center of the work plate or disk, the movement of said work plate or disk in relation to the graver or work point will be reversed and be in a direction which will preclude the removal of metal to form the design. The rotary movement of the support 19 and the pattern 33, and the lineal movement of the slide 36 and contact 35, will thus ultimately bring this contact into engaging relation with every portion of the pattern.

It will be noted that the contact 35 does not follow the lines of the design, but travels in a straight path and serves merely as an electrical contact member and not as a tracing stylus.

During the operation of the machine, the conditions at the work plate or disk are similar to those at the master or pattern, in so far as the movement of the graver or work point in relation to the work plate or disk is concerned, since the supports 19 have a rotative action corresponding exactly with that of the support 10, and the carriage 30 has lineal traverse imparted thereto through the lever 51 and link 53 parallel with the movement of the slide 36 along the guide 136, the quantity of this movement, however, being less than that of the slide 36 by reason of the employment of a lever 51 of the second class. There is this difference, however, that while the contact member 35 is always in engagement with the master or pattern 33, the graver or work point 25 is engaged with the work plate or disk or disengaged therefrom in accordance with the arrangement of the electro-conductive and electro-nonconductive parts of the design upon the master or pattern 33.

Since all of the holders 24 are secured to the carriage 30, and are actuated from the same shaft 57 as controlled by a single electro-magnet 61 and spring 64, it is apparent that the production of a plurality of engraved articles will be characterized by a substantial identity in all such articles, and

that irrespective of the number of supports 19 and holders 24 used in the machine, the working conditions about the machine will always be the same.

When it is desired to have the reproduction upon the work plate or disk exactly following that upon the pattern or master, the plate 95 is by means of the screw 99 so positioned as to be out of the operative range of the tappets 94, and the pivot 89 is set centrally of the disk 87.

It is possible to secure appreciable changes in the effect of the design, however, by varying the depth of cut of the graver or work point 25 in different parts of the design, or throughout the entire design.

It is also possible to secure different effects by using a zigzag or wavy line in the reproduction where the pattern or master has a straight line, and this may also extend to a part only of the design or throughout the entire design. It is possible also to secure still different effects by both varying the depth of cut and using zigzag or wavy lines in the reproduced design, and still different effects may be secured by setting the machine so as to increase or decrease the depth of cut when varied as described, or by increasing or decreasing the quantity of zigzag or wavy movement. Furthermore, the machine may be stopped at any time and the setting of the machine changed so as to introduce lines or spots of different characters in different portions of the reproduced design.

Adverting first to the varying depth of cut in different portions of the design, the set screw 99 is turned so as to permit the plate 95 to move toward the wheel 92 and into engaging relation with the tappet or tappets 94 thereon, it being possible to use any desired number of such tappets, although one or two will suffice because of the relatively high speed of the wheel 92 with relation to the speed of the supports 10 and 19. The set screw 96 may then be so set while engaged with the plate 95 as to predetermine the maximum depth of cut. With this setting the plate 95 will have oscillatory movement with each engagement of a tappet 94 therewith, the extent of such oscillatory movement being governed by the setting of the screw 99. The oscillations of the plate 95 by reason of the distance of the screw 99 from the axis of the shaft 57 will result in a very slight movement of said plate permits the spring 64 to increase the movement of the holder 24 and the graver or work point toward the support 19, and the upward movement of said plate reverses the movement of the holder 24. As a consequence, when the tappets 94 are not engaged with the plate 95, when the magnet 61 is de-energized, the reproduced line will have the greatest depth as determined by the setting of the screw 96; and with the engagement

of a tappet 94 with said plate 95, when the magnet 61 is de-energized, the depth of the line will be decreased as compared with the normal functioning of the machine when the wheel 92 is inoperative to effect any change in parts of the design. In fact the construction of the machine may be such as to permit a setting of the plate 95 in a manner to entirely disengage the graver or work point 25 from the work plate or disk when the tappers are in engagement with said plate. By this attachment a wide range of variance in the designs produced from one and the same pattern or master is possible so far as the effect upon the eye is concerned.

It must be borne in mind that in all designs of this type the depth of cut is measured by a thousandth of an inch, and since an ordinary angular pointed graver or work point is used, this variance in the depth of cut will result also in a slight variance in the width of the cut. The stop 63 will have the effect of limiting the oscillatory movement of the armature 60, and when the adjusting screw 96 is used for controlling the depth of cut, no particular attention need be given the position of said stop beyond so setting it that under no circumstances can the armature pass from the field of the magnet 61.

When it is desired to impart a zigzag or wavy effect to lines in the reproduction, the crank 89 is moved radially of the disk 87 according to the desired magnitude of the lateral movement of the support 30 independently of its movement through the slide 36. Of course, when this crank 89 is set co-axially with the disk 87, no movement will be imparted to the pitman 90, and the movement will increase proportionately to the distance of the setting of the crank from the axis of the disk.

While the machine is in operation, the disk 87 will be turned at a relatively higher speed than the shaft and will impart oscillatory movement to the fitting 52 through the crank 91 upon said fitting. The result will be a rapid oscillatory movement of the point of pivotal connection of the lever 51 with said fitting 52, and thus impart movement to the carriage 30, in alternately opposite directions, at a very much higher speed than the travel of said carriage under the control of the slide 36. As a consequence, the work point 25 will move radially of the work plate or disk upon the holder 19, the rotation of this holder, however, simultaneously with the radial movement of the graver or work point resulting in the zigzag or wavy effect referred to.

As stated above, the pitman 90 may be so set with relation to the disk 87 as to make this disk inoperative to introduce any modification in the reproduction. This is also true as to the plate 95. In fact, the plate 95 and the disk 87 may be used one entirely independently of the other, or may be used con-

jointly for securing a desired modification in the reproduced design from the pattern or master 33, or both of these mechanisms may be made inoperative so as to secure an exact reproduction of the design upon the pattern or master upon a reduced scale.

By moving the pivot 56 toward or from the fitting 52, the scale of the reproduction may be decreased or increased as desired, although with the construction shown, where a lever of the second class is used, there will always be a reduction in the scale of the reproduction due to the fact that the carriage 30 will travel at a lower speed than the slide 36. This construction is used because of the fact that the work plate or disk is usually of a size and the number of fine lines of the design engraved thereon are such, as would make the production to the same scale of a pattern with its electro-conductive and electro-nonconductive portions, extremely difficult.

While the machine illustrated in the accompanying drawings has been found in actual practice to be capable of producing highly artistic watch dials, and to be capable of producing such dials in large quantities at low cost, with the design upon each dial an exact replica of that upon all others, it is apparent that there may be various changes in the detailed mechanisms of the machine which will secure the same operative effects.

I believe it to be broadly new to provide an engraving machine wherein the engagement and disengagement of the graver or work point with a work plate or disk is electrically controlled through the medium of a pattern or master, parts of which are of electro-conductive, and other parts of which are of electro-nonconductive material, which master plate co-operates with a contact member having movement in relation thereto while rotary movement is being imparted to said pattern or master and to the support for the work plate or disk so as to reproduce the pattern of said master solely as the result of the control of the movements of the graver or work point through varying electrical conditions in the machine.

By providing the relay and switch mechanisms in the electrical circuits as described, I am enabled to increase the range of work which the machine is capable of doing.

The design shown upon the pattern or master 33 as indicated by the line 34 in the drawings, is merely a conventional showing of a very simple design, the designs actually used upon said pattern or master ordinarily being highly artistic and more or less complicated in their nature.

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

Having described the invention, what I

claim as new and desire to have protected by Letters Patent, is:—

1. An engraving machine embodying therein a support for a master, a support for a work plate, means imparting similar simultaneous movement to said supports, a master bearing a design having portions of electro-conductive material and other portions of electro-nonconductive material, a slide adjacent said support for the master, a contact member pivotally mounted upon said slide, a rack and pinion mechanism operative upon said slide to impart slow movement thereto, a carriage slidably mounted adjacent the support for the work plate, a holder for a work point upon said carriage, a spring normally tending to move said holder away from said support, a spring actuated member operative upon said holder to move it toward said support against the tension of said spring, a lever pivotally connected to said slide and to a part of the machine, a pitman connection between said lever and said carriage, whereby said contact and said holder receive simultaneous lineal traverse with relation to said supports for the master and for the work plate respectively, and an electrically actuated mechanism operative upon said spring actuated member, the circuit to which is controlled by said master and said contact member, whereby said holder will be automatically caused to engage or disengage the work point with the work plate as determined by the opening or closing of an electrical circuit at said master.

2. An engraving machine embodying therein a support for a master, a support for a work plate, means imparting similar simultaneous movement to said supports, a master bearing a design having portions of electro-conductive material and other portions of electro-nonconductive material, a slide adjacent said support for the master, a contact member pivotally mounted upon said slide, a rack and pinion mechanism operative upon said slide to impart slow movement thereto, a carriage slidably mounted adjacent the support for the work plate, a holder for a work point upon said carriage, a spring normally tending to move said holder away from said support, a spring actuated member operative upon said holder to move it toward said support against the tension of said spring, a lever pivotally connected to said slide and to a part of the machine, a pitman connection between said lever intermediate its points of pivotal support and said carriage, whereby said contact and said holder receive simultaneous lineal traverse with relation to said supports for the master and for the work plate respectively, and an electrically actuated mechanism operative upon said spring actuated member, the circuit to which is controlled by said master and said contact member, whereby said holder will be auto-

matically caused to engage or disengage the work point with the work plate as determined by the opening or closing of an electrical circuit at said master.

3. An engraving machine embodying therein a support for a master, a support for a work plate, means imparting similar simultaneous movement to said supports, a master bearing a design having portions of electro-conductive material and other portions of electro-nonconductive material, a slide adjacent said support for the master, a contact member pivotally mounted upon said slide, a rack and pinion mechanism operative upon said slide to impart slow movement thereto, a carriage slidably mounted adjacent the support for the work plate, a holder for a work point upon said carriage, a spring normally tending to move said holder away from said support, a spring actuated member operated upon said holder to move it toward said support against the tension of said spring, a lever pivotally connected to said slide and to a part of the machine, a pitman connection between said lever intermediate its points of pivotal support and said carriage, whereby said contact and said holder receive simultaneous lineal traverse with relation to said supports for the master and for the work plate respectively, means whereby said pitman may be adjusted longitudinally of said lever to vary the scale of the reproduction, and an electrically actuated mechanism operative upon said spring actuated member, the circuit to which is controlled by said master and said contact member, whereby said holder will be automatically caused to engage or disengage the work point with the work plate as determined by the opening or closing of an electrical circuit at said master.

4. An engraving machine embodying therein a support for a master, a bearing therefor having a vertical axis, a support for a work plate, a bearing therefor having a horizontal axis, means whereby said supports are simultaneously rotated with the same number of revolutions per minute, a master bearing a design having portions of electro-conductive material and other portions of electro-nonconductive material, a slide adjacent said support for the master, a contact member pivotally mounted upon said slide, a rack and pinion mechanism operative upon said slide to impart slow movement thereto, a carriage slidably mounted adjacent the support for the work plate, a holder for a work point upon said carriage, a lever pivotally connected to said slide and to a part of the machine, a pitman connection between said lever and said carriage, whereby said contact and said holder receive simultaneous lineal traverse with relation to said supports for the master and for the work plate respectively, and an electrically actuated mecha-

nism operative upon said holder, the circuit to which is controlled by said master and said contact member, whereby said holder will be automatically caused to engage or disengage the work point with the work plate as determined by the opening or closing of an electrical circuit at said master.

5. An engraving machine embodying therein a support for a master, a bearing therefor having a vertical axis, a support for a work plate, a bearing therefor having a horizontal axis, means whereby said supports are simultaneously rotated with the same number of revolutions per minute, a master bearing a design having portions of electro-conductive material and other portions of electro-nonconductive material, a slide adjacent said support for the master, a contact member pivotally mounted upon said slide, a rack and pinion mechanism operative upon said slide to impart slow movement thereto, a carriage slidably mounted adjacent the support for the work plate, a holder for a work point upon said carriage, means operative to move said holder toward said support for the work plate, a spring acting thereon, means limiting the operative effect of said spring, a second spring having a normal tendency to move said holder away from said support for the work plate when the means operative upon said holder is made inoperative, an electromagnet the circuit to which is controlled by said master and said contact member, an armature co-operating with said magnet and operative upon said means for moving the holder, whereby the engagement or disengagement of the work point with the work plate is controlled by the opening or closing of an electrical circuit at said master, a lever pivotally connected to said slide and to a part of the machine, and a pitman connection between said lever and said carriage, whereby said contact and said holder receive simultaneous lineal traverse with relation to said supports for the master and for the work plate respectively.

6. An engraving machine embodying therein a support for a master, a bearing therefor having a vertical axis, a support for a work plate, a bearing therefor having a horizontal axis, a master bearing a design having portions of electro-conductive material and other portions of electro-nonconductive material, a slide adjacent said support for the master, a contact member pivotally mounted upon said slide, a rack and pinion mechanism operative upon said slide to impart slow movement thereto, a carriage slidably mounted adjacent the support for the work plate, a holder for a work point upon said carriage, means operative to move said holder toward said support for the work plate, a spring acting thereon, means limiting the operative effect of said spring, a second spring having a normal tendency to move said holder away from said

support for the work plate when the means operative upon said holder is made inoperative, an electromagnet the circuit to which is controlled by said master and said contact member, an armature co-operating with said magnet and operative upon said means for moving the holder, whereby the engagement or disengagement of the work point with the work plate is controlled by the opening or closing of an electrical circuit at said master, a lever pivotally connected to said slide and to a part of the machine, a pitman connection between said lever and said carriage, whereby said contact and said holder receive simultaneous lineal traverse with relation to said supports for the master and for the work plate respectively, a main power shaft, speed reducing gearing connecting said shaft with said supports respectively, whereby said supports are simultaneously rotated with the same number of revolutions per minute, and a speed reducing mechanism co-operating with said rack and pinion mechanism.

7. An engraving machine embodying therein a support for a master, a support for a work plate, means imparting similar simultaneous movement to said supports, a master bearing a design having portions of electro-conductive material and other portions of electro-nonconductive material, a slide adjacent said support for the master, a contact member pivotally mounted upon said slide, a rack and pinion mechanism operative upon said slide to impart slow movement thereto, a carriage slidably mounted adjacent the support for the work plate, a holder for a work point upon said carriage, a pivotal fitting adjacent said carriage, a lever, one end of which is pivotally connected with said slide, and the other end of which is pivotally connected with said fitting, a pitman connection between said lever intermediate its points of pivotal support and said carriage, whereby said contact and said holder receive simultaneous lineal traverse with relation to said supports for the master and for the work plate respectively, an electrically actuated mechanism operative upon said holder, the circuit to which is controlled by said master and said contact member, whereby said holder will be automatically caused to engage or disengage the work point with the work plate as determined by the opening or closing of an electrical circuit at said master, a rotatable crank disk, a crank upon said fitting, and a pitman connecting said crank disk with said crank, whereby a short reciprocatory movement may be imparted to said carriage through said fitting and said lever.

8. An engraving machine embodying therein a support for a master, a support for a work plate, means imparting similar simultaneous movement to said supports, a master bearing a design having portions of electro-conductive material and other portions of

electro-nonconductive material, a slide adjacent said support for the master, a contact member pivotally mounted upon said slide, a rack and pinion mechanism operative upon said slide to impart slow movement thereto, a carriage slidably mounted adjacent the support for the work plate, a holder for a work point upon said carriage, a pivotal fitting adjacent said carriage, a lever, one end of which is pivotally connected with said slide, and the other end of which is pivotally connected with said fitting, a pitman connection between said lever intermediate its points of pivotal support and said carriage, whereby said contact and said holder receive simultaneous lineal traverse with relation to said supports for the master and for the work plate respectively, an electrically actuated mechanism operative upon said holder, the circuit to which is controlled by said master and said contact member, whereby said holder will be automatically caused to engage or disengage the work point with the work plate as determined by the opening or closing of an electrical circuit at said master, a rotatable crank disk, a crank upon said fitting, a pitman connecting said crank disk with said crank, whereby a short reciprocatory movement may be imparted to said carriage through said fitting and said lever, and means whereby the operative effect of said crank disk may be varied.

9. An engraving machine embodying therein a support for a master, a support for a work plate, means imparting similar simultaneous movement to said supports, a master bearing a design having portions of electro-conductive material and other portions of electro-nonconductive material, a slide adjacent said support for the master, a contact member pivotally mounted upon said slide, a rack and pinion mechanism operative upon said slide to impart slow movement thereto, a carriage slidably mounted adjacent the support for the work plate, a holder for a work point upon said carriage, a pivotal fitting adjacent said carriage, a lever, one end of which is pivotally connected with said slide, and the other end of which is pivotally connected with said fitting, a pitman connection between said lever intermediate its points of pivotal support and said carriage, whereby said contact and said holder receive simultaneous lineal traverse with relation to said supports for the master and for the work plate respectively, an electrically actuated mechanism operative upon said holder, the circuit to which is controlled by said master and said contact member, whereby said holder will be automatically caused to engage or disengage the work point with the work plate as determined by the opening or closing of an electrical circuit at said master, a rotatable crank disk, a crank upon said fitting, a pitman connecting said crank disk with said

crank, whereby a short reciprocatory movement may be imparted to said carriage through said fitting and said lever, and means whereby the crank upon said disk may be adjusted radially thereof to vary the operative effect of said disk upon said carriage.

10. An engraving machine embodying therein a support for a master, a support for a work plate, means imparting similar simultaneous movement to said supports, a master bearing a design having portions of electro-conductive material and other portions of electro-nonconductive material, a slide adjacent said support for the master, a contact member pivotally mounted upon said slide, a rack and pinion mechanism operative upon said slide to impart slow movement thereto, a carriage slidably mounted adjacent the support for the work plate, a holder for a work point upon said carriage, a pivotal fitting adjacent said carriage, a lever, one end of which is pivotally connected with said slide, and the other end of which is pivotally connected with said fitting, a pitman connection between said lever intermediate its points of pivotal support and said carriage, whereby said contact and said holder receive simultaneous lineal traverse with relation to said supports for the master and for the work plate respectively, an electrically actuated mechanism operative upon said holder, the circuit to which is controlled by said master and said contact member, whereby said holder will be automatically caused to engage or disengage the work point with the work plate as determined by the opening or closing of an electrical circuit at said master, a rotatable crank disk, a crank upon said fitting, a pitman connecting said crank disk with said crank, whereby a short reciprocatory movement may be imparted to said carriage through said fitting and said lever; and means whereby the crank upon said disk may be adjusted radially thereof to vary the operative effect of said disk upon said carriage, or make said disk operative or inoperative at will.

11. An engraving machine embodying therein a support for a master, a support for a work plate, means imparting similar simultaneous movement to said supports, a holder for a work point adjacent the support for the work plate, a master bearing a design having portions of electro-conductive material and other portions of electro-nonconductive material, an electrical contact member cooperating with said master; means imparting movement to said contact member transversely of said master, means whereby movement transversely of the work plate is imparted to said holder simultaneously with the movement of said contact member, an electrically actuated mechanism operative upon said holder, the circuit to which is controlled by said master and said contact member;

whereby said holder will be automatically caused to engage or disengage the work point with the work plate as determined by the opening or closing of an electrical circuit at said master; and automatically acting means whereby movement of said holder toward and from the support for the work plate may be imparted thereto independently of said electrically actuated mechanism to vary the depth of cut.

12. An engraving machine embodying therein a support for a master, a support for a work plate, means imparting similar simultaneous movement to said supports, a holder for a work point adjacent the support for the work plate, a master bearing a design having portions of electro-conductive material and other portions of electro-nonconductive material, an electrical contact member co-operating with said master, means imparting movement to said contact member transversely of said master, means whereby movement transversely of the work plate is imparted to said holder simultaneously with the movement of said contact member, an electrically actuated mechanism operative upon said holder, the circuit to which is controlled by said master and said contact member, whereby said holder will be automatically caused to engage or disengage the work point with the work plate as determined by the opening or closing of an electrical circuit at said master, adjustable means controlling the operative effect of said electrically actuated mechanism in determining the depth of cut, and automatically acting means whereby movement of said holder toward and from the support for the work plate may be imparted thereto independently of said electrically actuated mechanism, to vary the depth of cut.

13. An engraving machine embodying therein a support for a master, a support for a work plate, means imparting similar simultaneous movement to said supports, a holder for a work point adjacent the support for the work plate, a master bearing a design having portions of electro-conductive material and other portions of electro-nonconductive material, an electrical contact member co-operating with said master, means imparting movement to said contact member transversely of said master, means whereby movement transversely of the work plate is imparted to said holder simultaneously with the movement of said contact member, an electrically actuated mechanism operative upon said holder, the circuit to which is controlled by said master and said contact member, whereby said holder will be automatically caused to engage or disengage the work point with the work plate as determined by the opening or closing of an electrical circuit at said master, automatically acting means whereby movement of said holder to-

ward and from the support for the work plate may be imparted thereto independently of said electrically actuated mechanism to vary the depth of cut, and adjustable means whereby the extent of movement of the holder by said automatically acting means may be regulated.

14. An engraving machine embodying therein a support for a master, a support for a work plate, means imparting similar simultaneous movement to said supports, a holder for a work point adjacent the support for the work plate, a bearing for said holder permitting movement thereof toward and from said support for the work plate, a master bearing a design having portions of electro-conductive material and other portions of electro-nonconductive material, an electrical contact member co-operating with said master, means imparting movement to said contact member transversely of said master, means whereby movement transversely of the work plate is imparted to said holder simultaneously with the movement of said contact member, a rock shaft, a crank thereon, a stud carried by said holder engageable by said crank, a spring acting upon said rock shaft with a normal tendency to cause movement of said holder toward said support for the work plate, means limiting the operative effect of said spring, a second spring acting between said holder and said bearing with a normal tendency to move said holder away from said support or work plate, an electromagnet, the circuit to which is controlled by said master and said contact member, an armature carried by said rock shaft and co-operating with said magnet, whereby the engagement or disengagement of the work point with the work plate is controlled by the opening or closing of an electrical circuit at said master, an arm upon said rock shaft, an oscillatory plate in engageable relation with said arm and a tappet wheel co-operating with said plate whereby rocking movement may be imparted to said rock shaft independently of said armature.

15. An engraving machine embodying therein a support for a master, a support for a work plate, means imparting similar simultaneous movement to said supports, a holder for a work point adjacent the support for the work plate, a bearing for said holder permitting movement thereof toward and from said support for the work plate, a master bearing a design having portions of electro-conductive material and other portions of electro-nonconductive material, an electrical contact member co-operating with said master, means imparting movement to said contact member transversely of said master, means whereby movement transversely of the work plate is imparted to said holder simultaneously with the movement of said contact member, a rock shaft, a crank there-

on, a stud carried by said holder engageable
by said crank, a spring acting upon said rock
shaft with a normal tendency to cause move-
ment of said holder toward said support for
the work plate, means limiting the opera-
5 tive effect of said spring, a second spring act-
ing between said holder and said bearing
with a normal tendency to move said holder
away from said support or work plate, an
10 electromagnet, the circuit to which is con-
trolled by said master and said contact mem-
ber, an armature carried by said rock shaft
and co-operating with said magnet, whereby
the engagement or disengagement of the
15 work point with the work plate is controlled
by the opening or closing of an electrical cir-
cuit at said master, an arm upon said rock
shaft, an oscillatory plate in engageable re-
20 lation with said arm, a tappet wheel co-op-
erating with said plate whereby rocking
movement may be imparted to said rock shaft
independently of said armature, an adjusting
screw carried by said plate and adapted to
25 engage said tappet wheel to control the op-
erative effect of the tappets thereon upon said
plate, and an adjusting screw carried by the
second crank and engaging said plate.

In witness whereof I have hereunto affixed
my signature, this twelfth day of April, 1926.

30 WILLIAM S. EATON.

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