

Nov. 7, 1933.

J. W. DALTON

1,933,792

ENGRAVING

Filed July 19, 1932

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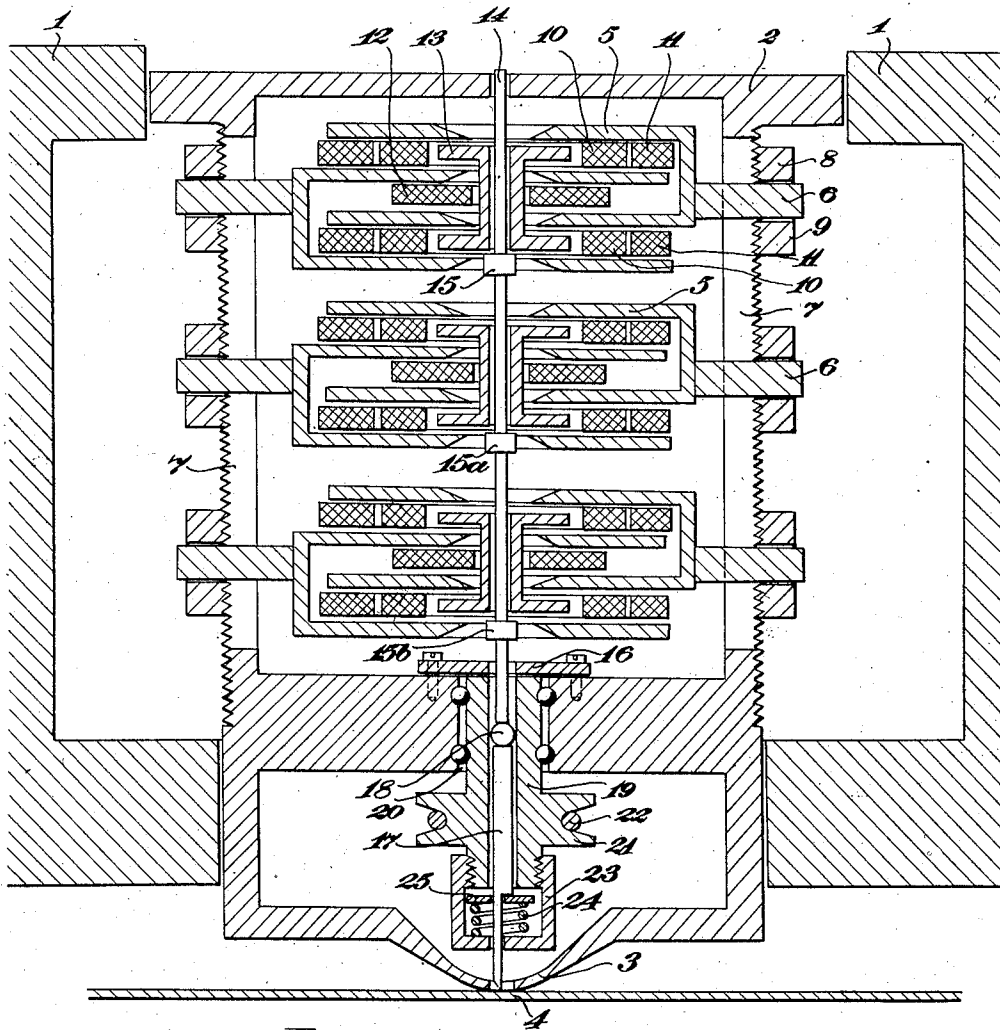


Fig. 1.

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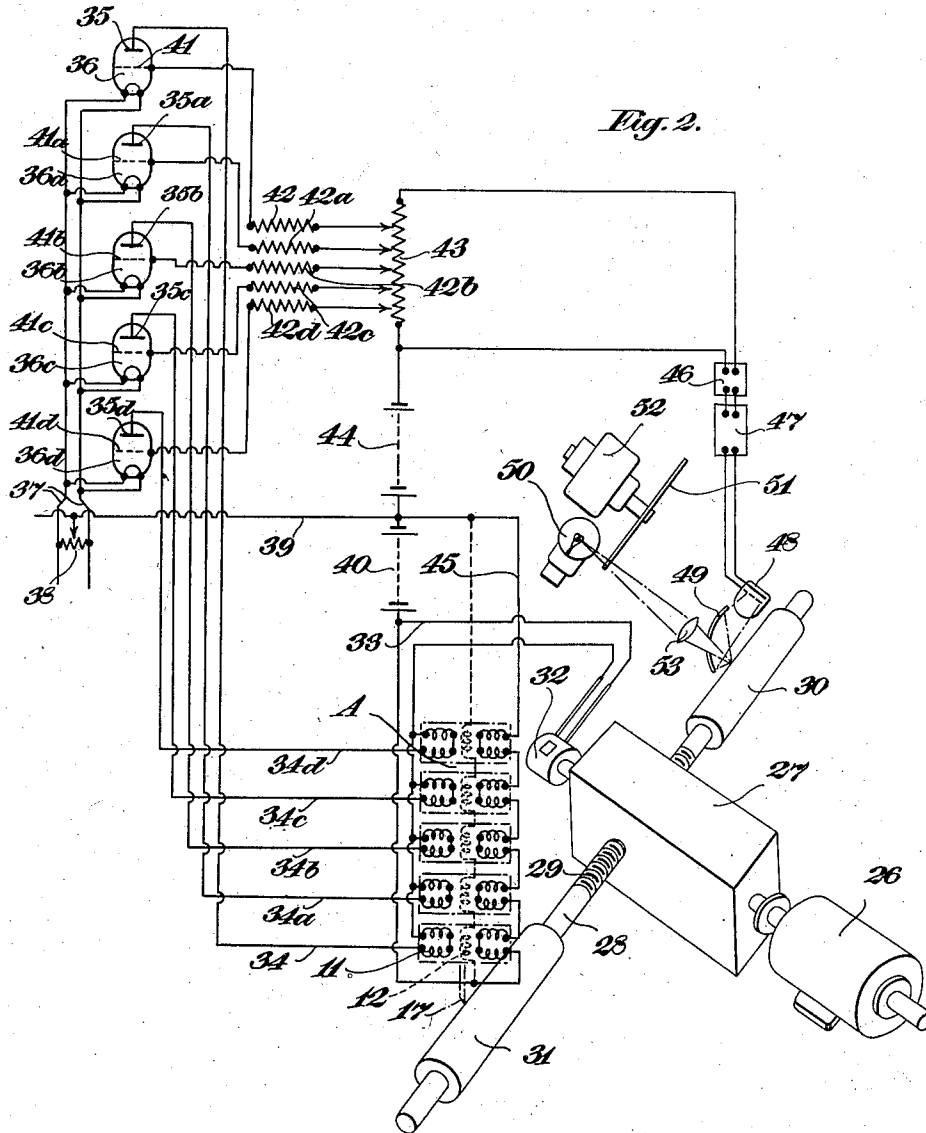
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Filed July 19, 1932

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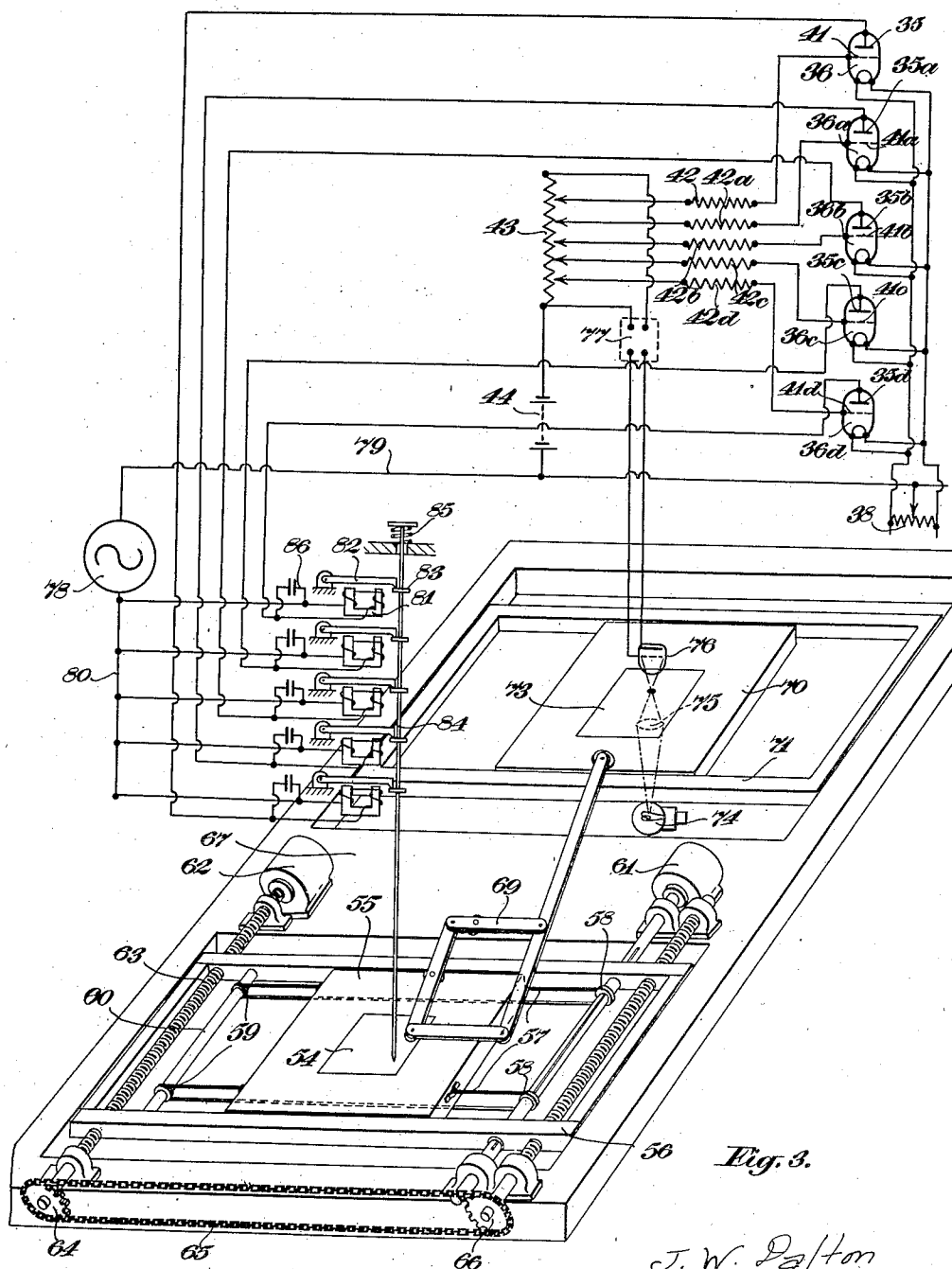
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ENGRAVING

Filed July 19, 1932

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ENGRAVING

Filed July 19, 1932

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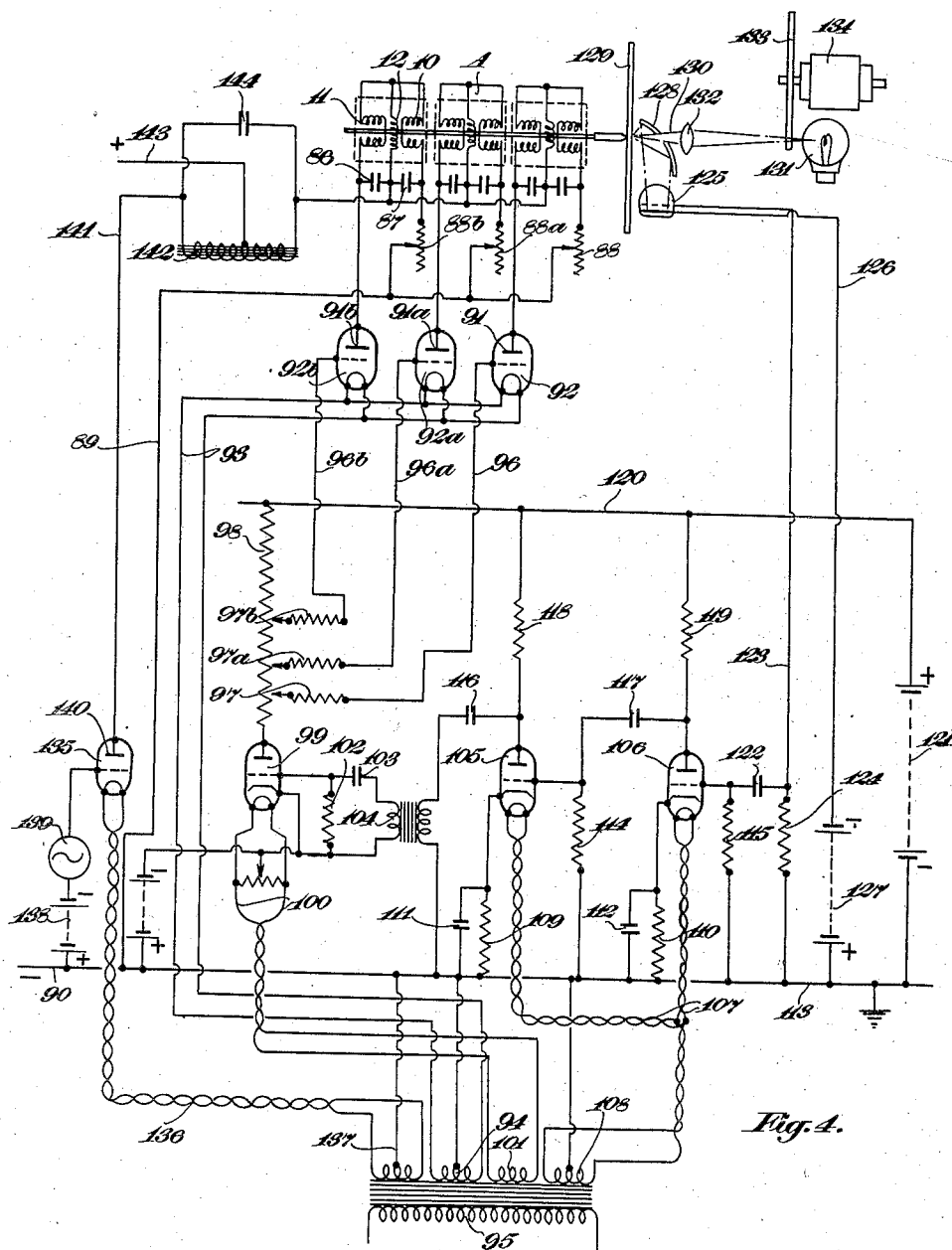


Fig. 4.

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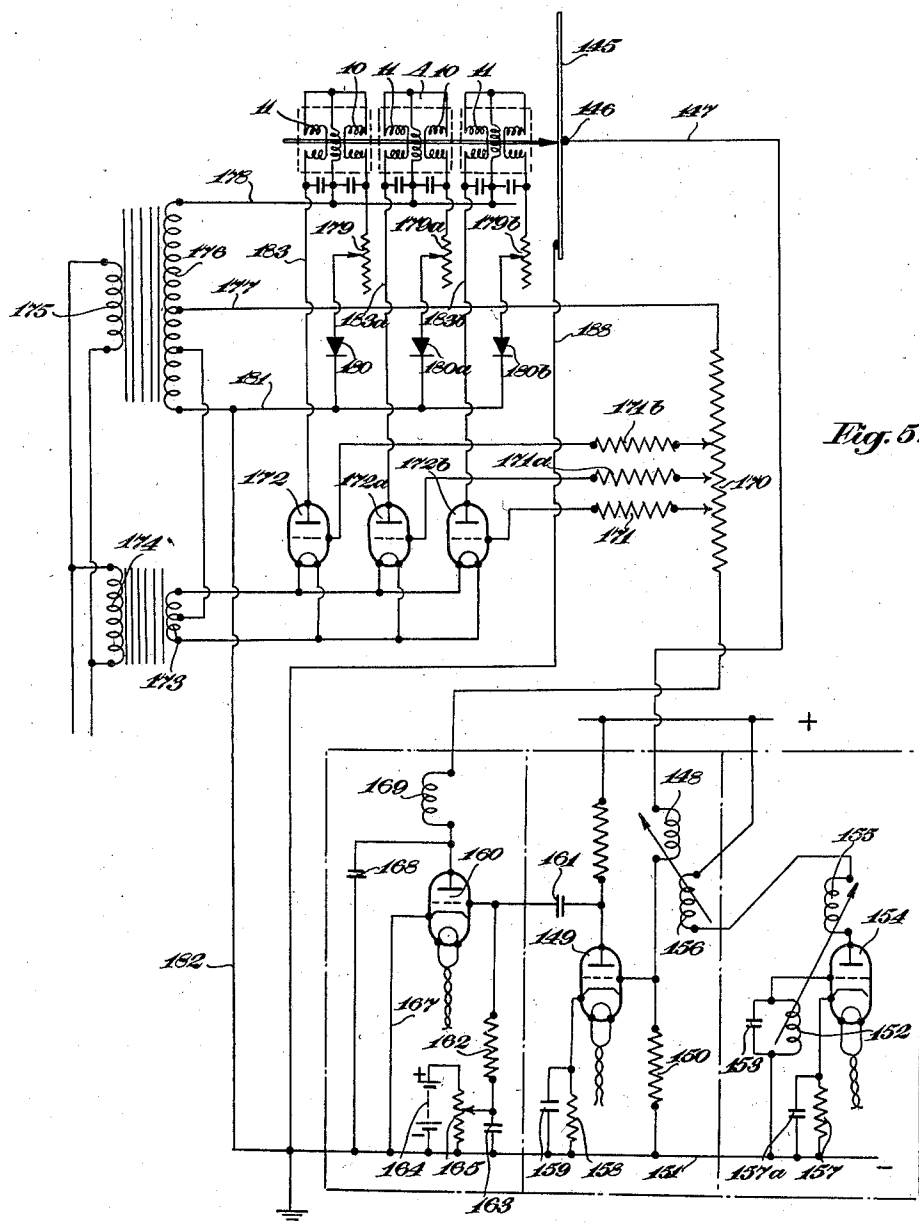
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UNITED STATES PATENT OFFICE

1,933,792

ENGRAVING

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Application July 19, 1932, Serial No. 623,425, and
in Great Britain June 9, 1931

5 Claims. (Cl. 173—5)

This invention relates to the production of engraved surfaces with the aid of a mechanical cutter, such as a drill, the operation of which is electrically controlled as to its depth or width of cut in accordance with the depth of tone of an original through the intermediary of means, for instance, an electro-magnet, adapted to impart a feeding motion to the cutter, proportionate with the tone of that part of the subject being scanned.

In the production of engraved surfaces in this manner the means in question has heretofore been of a character adapted to operate in such manner that within the limits of its working range the cutter may cut into the surface to be engraved to any distance, according to the tone of light reflected from or transmitted through or by successive small areas of a subject of which an engraved reproduction is desired in the systematic scanning thereof with the aid of a light sensitive cell adapted to control the operation of the electro-magnet.

The object of the invention is to provide an improved process and apparatus for the production of engraved surfaces in the manner first above specified, and more particularly to adapt such process and apparatus for the production of engraved surfaces for use in printing processes, as, for instance, in substitution for photo-mechanically produced surfaces or blocks, or in the treatment of such surfaces or blocks for the purpose of "underlaying", which is a measure resorted to for the purpose of increasing the contrast in prints produced with their aid by reducing the thickness of the plate on which the surface is formed, and thereafter subjecting the plate to pressure while supported on a resilient or elastic bed.

According to the invention the means for varying the feed of the cutter is of a character adapted to advance the cutter into the plate or the like, the surface of which is to be engraved through one of a plurality of distances or steps, predetermined as to number and relative magnitude, each corresponding with a given tone or range of tones.

As will be understood, in undercutting the drill or other cutting tool will be controlled as to its depth or width of cut in accordance with the character of the corresponding portions of the printing surface of the plate.

To secure electrical control of the mechanical device there may be employed any convenient means which is influenced in accordance with the depth of tone of the original, for instance, a light sensitive cell, or alternatively the electrical con-

trol may be secured by local variations in electrical resistance of the original or by capacity effects between an electrode and successive small areas of the original.

The cutter may be arranged to be fed through one of any number of predetermined distances, for instance, five different distances corresponding with five different tones or a greater or less number of tones in accordance with the number of gradations of tone of which it is thought desirable to obtain a reproduction.

Thus, for example, in a hollow spindle adapted to be rotated, a cutter associated with a means adapted to retain the point of the drill normally out of contact with the plate or like member bearing the surface to be engraved may be slidably mounted and with the drill may be associated a rod arranged co-axially with the drill and furnished with a plurality of armatures with which a corresponding number of electro-magnets are arranged to co-operate in such manner that according to which of the individual magnets is energized the cutter will be fed varying distances into the member to be engraved.

For appropriately limiting the several distances through which the cutter is fed by the action of the several magnets, stops co-operating with the armatures may be provided. For instance, the rod with which, as well as with the drill, a spring may be associated in order to raise it into its normal position of rest, may be provided with a plurality of collars, a corresponding number of armatures being slidably mounted upon the spindle, the armatures and magnets being optionally so arranged that they co-operate to form stops for regulating the distance through which the rod will be moved consequent upon the energizing of the respective magnets.

The magnets may, with this construction, be mounted so that their axial position relatively to one another and to the collars may be adjusted.

Thus, for instance, the magnets which may be formed of a plurality of laminations arranged together to form radially extending U-shaped members, each set of U-shaped members forming or comprising two pole pieces adjacent to the armatures, the winding being disposed between the horns of the magnets, may be supported on plates conveniently of annular form provided with perforations adjacent to their periphery, the perforations in the several plates being arranged in register, screw-threaded rods passing through these perforations and associated with nuts, being provided for securing the plates in the desired relative positions.

Normally, the drill will be arranged vertically within, and connected, for instance, by a dog clutch or the like with, the hollow armature spindle of an electric motor secured to a bracket on a frame on which is mounted the magnets, the motor and its associated elements being mounted in such manner that they will be moved progressively with respect to the surface to be engraved and in accordance with the motion imparted to the means for scanning the original subject or, alternatively, the supply of electrical energy to the magnets may be controlled by the employment of a light sensitive cell or light sensitive cells subjected to the influence of light reflected from or transmitted by or through the subject.

For instance, a light sensitive cell subjected to the action of the light reflected from or transmitted by or through successive small areas of the subject may be associated with any suitable means whereby according to the amount of light influencing the cell, one or other or one or more of the magnets are energized.

The current flowing through the cells may, after suitable amplification, be used for energizing the magnets or, alternatively, the current flowing through the cell may be arranged to operate one or other or one or more of a plurality of relays adapted to control the flow of current through secondary circuits in which the windings of the magnet are arranged.

At this point may be mentioned that while in several instances reference has been made to controlling the feed of the drill in accordance with the tones of the successive small areas of the subject, the feed of the drill may vary directly or inversely with respect to the tone of the subject.

If, for instance, a printing surface of the character of a half-tone block is to be produced, as will be understood, the feed of the drill will increase in accordance with the lightness of the tone of the reproduction which is to be formed by the block. On the other hand, in the production of an intaglio printing surface the greater the feed imparted to the drill the deeper will be the tone produced by the printing surface.

The invention will be described further in detail with reference to the accompanying drawings, in which:—

Figure 1 is a sectional elevation of the mechanical cutting device showing the electro-magnets whereby the feed of the cutting tool is controlled;

Figure 2 is a diagrammatic representation of the cutting device as illustrated in Figure 1 in association with scanning means comprising a light sensitive cell with which is associated a suitable triode valve amplifier, the scanning means being arranged to operate upon an original mounted upon a cylinder while the cutting tool is designed to operate upon another cylinder both secured on a shaft formed as a lead screw and driven by a motor;

Figure 3 is a diagrammatic representation of an alternative arrangement in which a light sensitive cell is employed as a scanning means, the cutting tool being, in this case, arranged to operate upon a flat plate;

Figure 4 shows another arrangement of apparatus employing a light sensitive cell as a scanning means, this arrangement being more particularly adapted for use in underlaying;

Figure 5 shows a further arrangement adapted for use more particularly for underlaying, the control of the cutting tool being secured by capacity effect.

In the drawings, referring particularly to Figure 1, 1 is a guide in which is arranged the mounting 2, the lower end of which is provided with a convex portion 3 adapted to rest upon the surface of the plate 4.

Within the mounting there are arranged a plurality of electro-magnets, of which the pole pieces are indicated by the reference 5. The pole pieces are provided with extensions 6 passing through slots 7 in the mounting and associated with rings 8 and 9 constituting nuts whereby the axial position of the magnets with respect to the casing may be adjusted.

With the pole pieces there are arranged two windings 10, which will be referred to as restraining windings formed in two sections connected together in series and, further, with each magnet there are provided windings 11, which will be referred to as operating windings each formed in two sections connected together in series. In addition, with each of the magnets there is provided a field of winding 12 associated with the armatures 13 which encircle a spindle 14 on which are provided a plurality of collars 15, 15a and 15b. The clearances between the several collars and their associated armatures varies as will be seen from the drawings from a maximum in the lowermost magnet to a minimum in the uppermost magnet so that the movement imparted to the different armatures when their respective magnets are energized will cause the spindle 14 to be moved axially and in a downward direction through varying distances.

Thus it will be seen that if the lowermost magnet is actuated, the drill will be caused to penetrate into the surface for a relatively short distance while if the middle magnet is actuated, the drill will penetrate more deeply and if the uppermost magnet is actuated, still deeper penetration will take place.

In Figure 1, as will be seen, only three armatures are shown. Any convenient number of armatures and corresponding number of magnets may be provided.

The axial movement of the spindle 14, which is occupied at its lower end in the collar 16 will feed the cutter 17 in a downward direction through varying degrees, the lower end of the spindle bearing upon the end of the cutter through the intermediary of the belt 18. The cutter is engaged in a collar 19 rotatably mounted in a bearing 20 provided in the casing and formed to provide a pulley 21 engaged by a band 22 providing a driving connection with an electric motor or the like.

The other end of the collar 19 is screw-threaded and there is engaged in engagement with it the cap 23 which has for instance a D-shaped slot engaging the forward edge of the cutter in such manner that by rotation of the collar 19, the cutter will be rotated and within the cap there is arranged a spring 24, one end of which bears upon the lower end of the cap and the other upon the washer 25 engaged about the cutter and operating to move the cutter in the opposite direction from that in which it is urged by the energizing of the several magnets.

In the construction shown in Figure 2, A represents the cutting device as a whole substantially as shown in Figure 1, 12 indicating the field windings and 11 and 10 respectively the operating and restraining windings of the magnets, 17 being the cutter.

In this construction 26 is an electric motor driving through the gear box 27 the shaft 28 on

which is formed the lead screw 29 and on cylinders 30 and 31 at the opposite ends thereof are arranged, respectively, the original of which the engraved reproduction is to be formed and the plate to be engraved.

On the end of the motor shaft there is provided a contact maker 32 connected by the leads 33 with the operating windings 11 and through them by way of the lead 34, 34a, 34b, 34c, 34d with the anodes 35, 35a, 35b, 35c, 35d of the valves 36, 36a, 36b, 36c, 36d, the filament heating leads of which are indicated by the reference 37, a potentiometer 38 being arranged between these leads and connected with the lead 39 with the source of anode voltage 40.

Grids 41, 41a, 41b, 41c, 41d are connected through the resistances 42, 42a, 42b, 42c, 42d with tapping points on the resistance 43 connected at one end to the grid bias battery 44, the positive of which is connected with the negative of the source of anode voltage, the common point being connected through the lead 45 with the restraining windings 10. The opposite ends of the resistance 43 are connected through a rectifier 46 and an amplifier 47 with the light sensitive cell 48 with which is associated a reflector 49, the purpose of which is to reflect on to the light sensitive cell the light projected from the source of illumination 50 to the interrupter disc 51 mounted on the spindle of the electric motor 52 and concentrated by the lens 53 to a pencil of rays projected through the lens on to the original mounted upon the cylinder 30. Variations in the amount of light falling upon the cell will cause variation in the voltage supplied by way of the amplifier and rectifier across the tapped resistance 43 thus causing one or other of the valves, which may be thermionic valves or mercury vapour valves, to be influenced and energize one or other of the windings 11.

The construction shown in Figure 3 operates generally in a similar manner to the construction previously described but in this case the surface to be engraved indicated by the reference 54 is mounted upon a support 55 slidably arranged in a frame 56 and adapted to be moved relatively to the frame through the intermediary of the bands 57 engaging pulleys 58 secured to the frame and passing over pulleys 59 on the spindle 60, the motor 61 operating to drive the pulleys 58 through gearing of any suitable construction adapted to cause reversal of the direction of movement of the support 55 at appropriate times.

Movement of the support and its associated frame in a direction at right angles to the direction of movement imparted to it through the bands 57 is secured by the motor 62 and the lead screw 63 on one end of which to provide a sprocket 64 engaging a chain 65 in driving engagement with the sprocket 66. The mechanism in question is secured to a base board 67 to which is connected a pantograph device 69 through which is imparted corresponding motion to the support 70 slidably engaged in the frame 71 in turn slidably mounted in the opening 72 in the base board, 73 representing the original to be operated upon which, in this case is a transparency, 74 indicating a source of illumination associated with a lens 75 adapted to concentrate a pencil of rays upon the original, a spot of light formed on the original illuminating in turn the light sensitive cell 76 which is connected with a rectifier 77, the output of which is connected, as in the case of the construction shown in Figure 2, across the resistance 43. This resistance and its associated resistances

and valves are connected up generally in the same manner as in the previous construction and hence similar references are used to denote equivalent parts. In this construction, however, a source of supply of alternating current 78 is provided instead of a source of continuous current, one lead 79 thereof being connected to the grid bias battery 44 and to the slider of the potentiometer 38. The other lead 80 is connected with the electromagnets of a cutter operating in a similar manner to the cutter previously described. However, in this case the details of construction are slightly different. 81 are the magnets, 82 being the armatures, 83 the collars provided on the spindle 84, 85 being a spring adapted to move the cutter in a reverse direction from that in which it is urged by the energizing of the magnets.

In this construction condensers 86 are shown across the leads connected with the magnets, the provision of similar condensers being desirable also in the case of the construction described in the preceding figure.

The construction illustrated in Figure 4 is an arrangement designed for continuous or stepwise operation with scanning by interrupted light reflected from the engraved original, the drilling being arranged to operate upon the opposite surface of the original as in underlaying photo-mechanically produced blocks.

The cutter, which is again represented by the reference A, is of the construction shown in Figure 1, 12 indicating the field windings, 11 the operating and 10 the restraining windings. Across these windings are arranged condensers 86 and 87. The restraining windings are connected through the variable resistances 88, 88a, 88b, through the lead 89 to the negative 90 of the source of direct current supply and the operating windings are connected with the plates 91, 91a, 91b of the mercury vapour valves or thyratron tubes 92, 92a, 92b, the filaments of which are heated by current supplied thereto by way of the leads 93 from the secondary 94 of a transformer, the primary of which is indicated by the reference 95.

The grids of the valves are connected by leads 96, 96a, 96b through the resistances 97, 97a, 97b with tapping points on the resistance 98 in the plate circuit of a thermionic valve 99 designed to function as a leaky grid detector, this valve being as shown, of the indirectly heated cathode type, heating current being supplied by way of the leads 100 from the secondary 101 of the transformer, the primary of which is indicated by the reference 95. 102 indicates the grid leak associated with this valve and 103 the grid condenser.

104 is the inter-valve transformer coupling the valve with a second valve 105 also of the indirectly heated cathode type which, in turn, is connected with a similar valve 106, the heating current being supplied to these valves by way of the leads 107 from the secondary 108 of the transformer of which the primary is indicated by the reference 95.

The cathodes of these two valves are connected through grid bias resistances 109 and 110 shunted by condensers 111 and 112 by the lead 113 to earth, 114 and 115 indicating the grid leaks and 116 and 117 coupling condensers, 118, 119 being anode resistances connected, as also is the resistance 98, with the positive lead 120 from the anode battery 121, the negative pole of which is connected to earth.

The condenser 122 is arranged in the lead from the grid of the valve 106 and the lead 123 which

is connected through the resistance 124 to earth. The lead 123 extends to the light sensitive cell 125, the other lead from which 126 is connected with the light sensitive cell biasing battery 127.

5 The photo-electric cell is arranged in association with a mirror 128 which operates to reflect on to the cell the light which is in turn reflected on to it from the surface of the original 129 which is illuminated by the pencil of rays 130 from the source of light 131 concentrated by the lens 132.

10 In the path of the light from the source of illumination 131 there is arranged an interrupter disc 133 driven by a motor 134. The original is moved with respect to the pencil of rays projected on to it through the lens 132, in a stepwise or continuous manner as in the operation of scanning and the varying illumination of the cell supplies a varying input to the valve 106, the output of which, after amplification, is supplied to the valve 99 functioning as a leaky grid detector. Rectified current passing through the detector will operate to permit current to flow through one or other of the thyatron tubes 92, 92a, 92b. The property of these tubes is that once having been activated by raising their grid voltage to a particular value they will continue to allow current to pass and consequently it is necessary to provide means for interrupting the passage of current and this is effected by interrupting the anode voltage applied to them. The interruption of the anode voltage in this construction is effected with the aid of the valve 135 to which filament current is supplied by the leads 136 from the secondary 137 of the transformer, the primary of which is indicated by the reference 95.

In circuit with the grid biasing battery 138 of this valve is arranged an alternator 139 and the anode 140 of the valve is connected through the lead 141 with a centre tapped inductance 142 the centre tapping of which is connected by the lead 143 with the source of direct current supply of which the negative is indicated by the reference 90, one of the outer ends of the inductance being connected with the field windings 12 of the cutter. Across this inductance is arranged a condenser 144 and by this means there is supplied to the thyatron tubes at intervals current adapted to interrupt the operation of the tubes.

15 In the construction illustrated in Figure 5, control of the cutting tool is effected by a capacity effect which, assuming that a scanning member of a given area and functioning as an electrode is moved relatively to the engraved surface a layer of a di-electric extending between the electrode and the engraved surface, will vary in accordance with the variation in the effective area of the engraved surface adjacent to the electrode.

20 For instance, assuming that the engraved surface is of the type produced by the half-tone process, the total area of the faces of the elevation on any given area of the surface will vary in accordance with the tone of the impression which will be produced by the aid of such variation of the surface consequently when the electrode is over a portion of the surface which will give a dark impression the capacity will be greater than if the surface were of the character to give a lighter impression.

25 In this figure, A represents the cutting device as a whole and it is arranged to operate upon the rear face of, for instance, a photo-mechanically engraved plate 145, 146 is a metal plate which may be coated with a di-electric and is held in

spaced relationship with the engraved plate 145 so as to secure between it and the engraved plate a condenser effect. The plate 146 is connected by the lead 147 with an inductance 148 connected with a grid of the valve 149 which as shown is of the indirectly heated type, the grid being connected also by the resistance 150 with the lead 151 connected with the negative terminal of the source of supply of direct current. To the same negative lead is also connected through the inductance 152 shunted by the condenser 153 the grid of the valve 154 in the plate circuit of which is arranged an inductance 155 loose coupled with the inductance 152 and also the inductance 156 which is loose coupled to the inductance 148. The valve 154 is also, as will be seen, of the indirectly heated type and its cathode is connected through the resistance 157, with the negative lead in question, a by-pass condenser 157a being arranged in shunt with the resistance.

30 Similarly, a resistance 158 and condenser 159 are associated with the indirectly heated cathode of the valve 149. In addition, the grid of the valve 150 which is coupled through the condenser 161 with the anode of the valve 149 is connected through the resistance 162 and condenser 163 with the negative lead 151 and to the negative lead is also connected the grid bias battery 164 and the potentiometer resistance 165, the slider 166 of which is connected with the lead in which the resistance 162 is located. The cathode of this valve is connected by the lead 167 with the negative lead in question while the plate of the valve is connected through the condenser 168 with the negative and in addition it is connected through the choke 169 with one end of the resistance 170 with which a plurality of tapping points are connected through resistances 171, 171a and 171b, these resistances being in turn connected respectively with the grids of the valves 172, 172a and 172b. These valves may be thermionic or mercury vapour valves (thyatron) and the filament current is supplied thereto by the secondary 173 of a transformer, the primary 174 of which is connected with a source of alternating current supply. Further, with this source of alternating current is connected the primary 175 of a transformer the secondary 176 of which is provided with a centre tapping 177 connected with one end of the resistance 170, one end of the secondary winding being connected by the lead 178 with the field windings of the electro-magnets of the cutter which, in the construction described in Figure 5 is provided with by-pass condensers. The restraining windings of these magnets are connected through the variable resistances 179, 179a, 179b, 179c, 179d, with, respectively, rectifiers 180, 180a, 180b, which may be of the valve type or metallic rectifiers with the lead 181 connected with the other end of the transformer winding 176 and also by way of the lead 182 with earth and a common negative lead 151.

The operating windings 11 of the cutter are connected by the leads 183, 183a, 183b, respectively with the plates of the valves 172, 172a, 172b and, as will be seen, the earth lead 182 is connected by the lead 184 with the engraved plate 145.

35 As the engraved plate is moved with respect to the electrode 146, the capacity in the grid circuit of the valve 149 will be varied and the frequency of the oscillations set up therein by the oscillator valve 154 will likewise be varied and the oscillating current thus set up will, after rec-

tification by the valve 149, be amplified by the valve 160 and applied across the resistance 170 and according to the magnitude of the current, one or other of the valves 172, 172a, 172b, will be actuated with the result that corresponding electro-magnets will be energized and the feed of the cutter into the rear face of the engraved plate 145 will be varied.

With this arrangement, as will be seen, the alternating current is supplied to the valves 172, 172a, 172b so that if they are of the mercury vapour type, the passage of current therethrough will be interrupted at a frequency corresponding with the periodicity of the alternating current supplied from the source of alternating current to feed the primary 174, 175 of the transformers.

In conclusion, it is to be pointed out that the above description is furnished for the purpose of explaining the nature of the invention and various changes may be made in the details of construction and arrangement above referred to without exceeding the scope of the present application.

Having now described my invention what I claim as new and desire to secure by Letters Patent is:—

1. Apparatus for producing on a suitable surface an engraved reproduction of an original subject comprising a cutter, a plurality of electromagnets associated with the cutter, and means magnetically associated with the electromagnets and mechanically associated with the cutter adapted, according to which of the individual electromagnets is energized, to advance the cutter into the surface to be engraved through one of a plurality of distances predetermined as to number and relative magnitude.

2. Apparatus for producing on a suitable surface an engraved reproduction of an original subject comprising a cutter, a plurality of electromagnets, armatures mechanically associated with the cutter co-operating with the electromagnets and adapted according to which of the individual magnets is energized to advance the cutter into the surface to be engraved through one of a plurality of distances, predetermined as to number and relative magnitude.

3. Apparatus for producing on a suitable surface an engraved reproduction of an original subject comprising a cutter, a plurality of electro-

magnets, armatures mechanically associated with the cutter co-operating with the electromagnets and adapted according to which of the individual magnets is energized to advance the cutter into the surface to be engraved through one of a plurality of distances, predetermined as to number and relative magnitude, and stops co-operating with the armatures adapted appropriately to limit the several distances through which the cutter is fed by the action of the several magnets.

4. Apparatus for producing on a suitable surface an engraved reproduction of an original subject comprising a cutter, a plurality of electromagnets, armatures mechanically associated with the cutter co-operating with the electromagnets and adapted according to which of the individual magnets is energized to advance the cutter into the surface to be engraved through one of a plurality of distances, predetermined as to number and relation magnitude, stops co-operating with the armatures adapted appropriately to limit the several distances through which the cutter is fed by the action of the several magnets, and means adapted to permit adjustment in an axial direction of the magnets relative to one another and to the stops.

5. Apparatus for producing on a suitable surface an engraved reproduction of an original subject comprising a hollow spindle, a cutter slidably mounted within the spindle, means adapted to retain the point of the cutter normally out of contact with the surface to be engraved, a plurality of electromagnets associated with the cutter, each consisting of a plurality of laminations arranged together to form radially extending U-shaped members so as to form two pole pieces, windings disposed between the pole pieces and means for adjusting the several magnets relative to one another and to the spindle, a rod within the hollow spindle arranged co-axially with the cutter, armatures associated with the rod and located adjacent to the pole pieces of the electromagnets adapted according to which of the individual magnets is energized to advance the cutter into the surface to be engraved through one of a plurality of distances predetermined as to number and relative magnitude.

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