Feb. 11, 1947. S. D. SWANN 2,415,450

ETCHING MACHINE

Filed Dec. 11, 1944 3 Sheets-Sheet 1

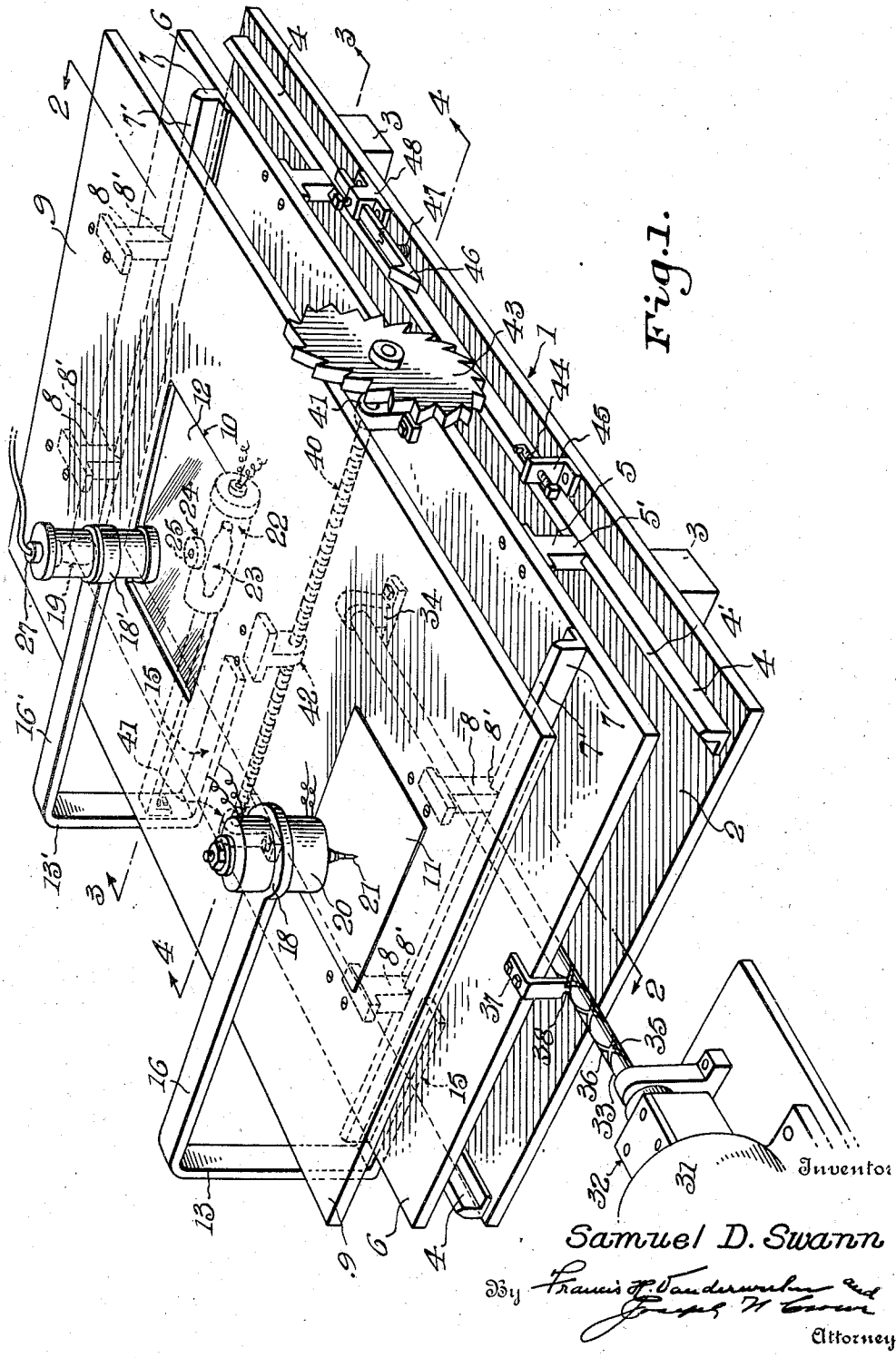


Fig. 1.

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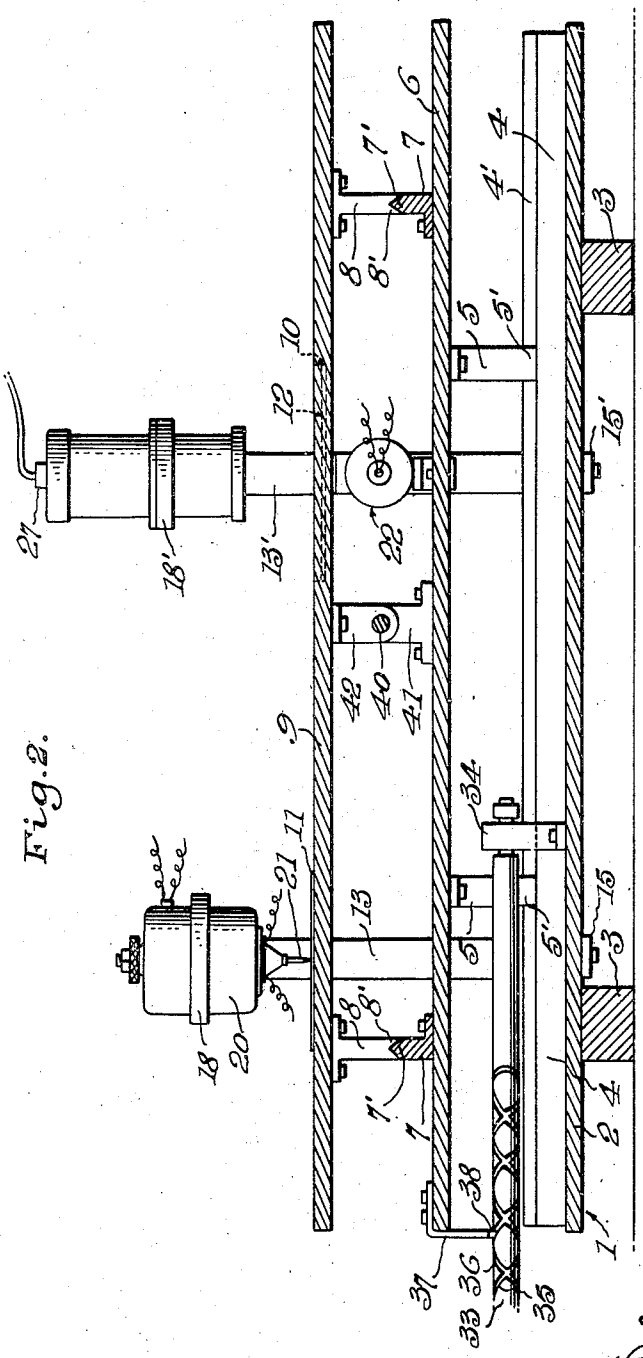


Fig. 2.

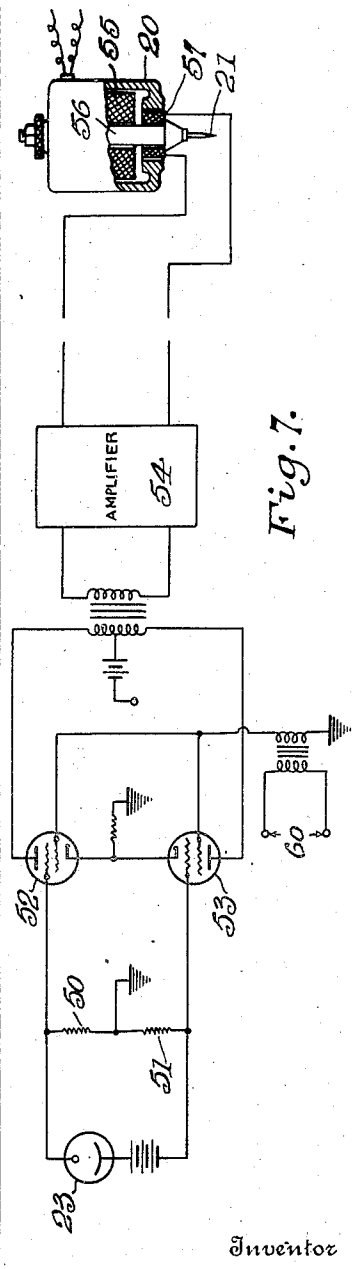


Fig. 7.

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ETCHING MACHINE

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Fig. 3.

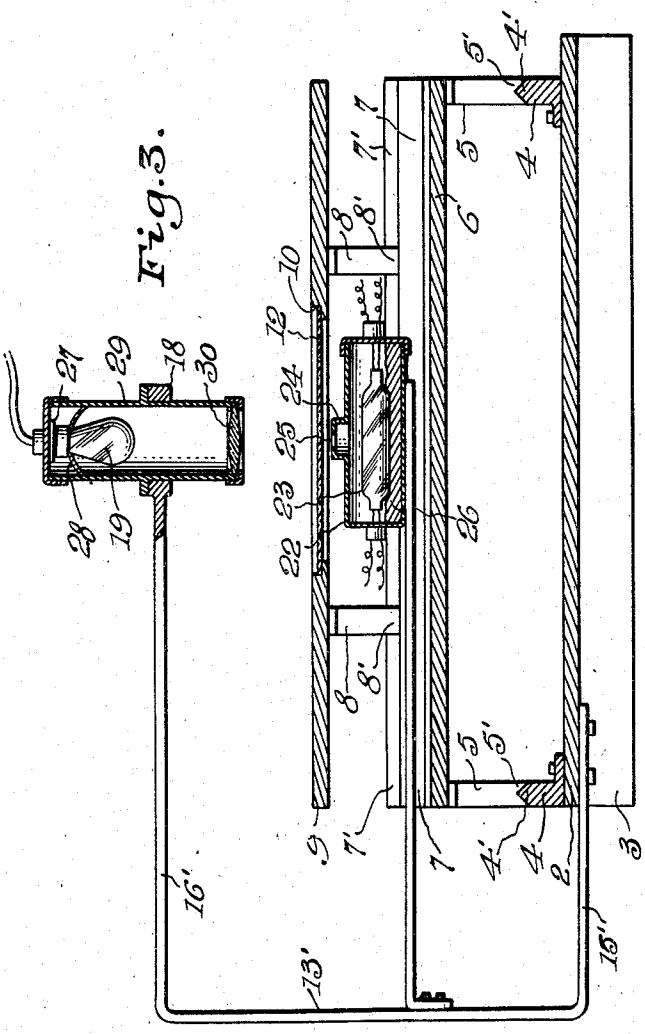


Fig. 4.

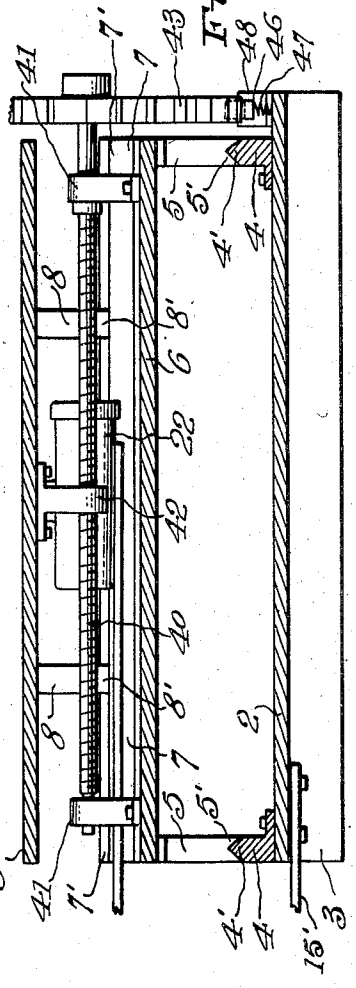


Fig. 5.

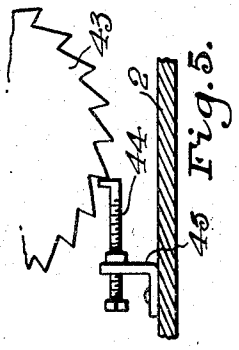
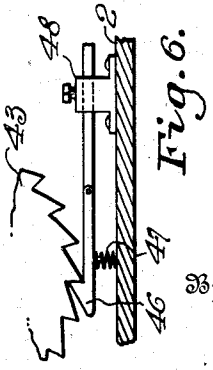


Fig. 6.



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UNITED STATES PATENT OFFICE

2,415,450

ETCHING MACHINE

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Application December 11, 1944, Serial No. 567,761

5 Claims. (Cl. 178—6.6)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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The invention described herein may be manufactured and used by or for the Government for governmental purposes, without payment to me of any royalty thereon.

This invention relates to a method of and means for forming the printing surface of a printing plate from which prints may be made by either intaglio or letter press methods.

One of the objects of the invention is to provide an etching machine including means for varying the amplitude of a cutting tool for etching a printing plate in accordance with the variation in intensity of illumination of a photoelectric cell.

Another object of the invention is to provide a printing plate etched in accordance with the illumination of a photoelectric cell.

Another object of the invention is to provide an etching machine having an excavating tool thereon for etching a printing plate, said tool being so designed and guided in the machine that a burr is cast up from the printing plate in addition to any excavation made therein, whereby the resulting photographic print produced by the plate is given a soft velvety appearance.

Another object of the invention is to provide an etching machine for automatically etching a printing plate suitable for immediate use from which prints may be made by either intaglio or press methods without the extensive use of the elements needed for photoengraving or other photochemical processes.

Another object of the invention is to provide an etching machine including a light source and means for producing enlargements or reductions of an original negative on a printing plate with the necessity of using an enlarging camera or the use of standard light filters in connection with a color film to produce a set of printing plates suitable for color printing.

Another object of the invention is to provide an entirely automatic etching machine which is simple and rugged in constitution, practical in operation and not liable to get out of order.

Heretofore the methods used to vary the amplitude of the stroke of a cutting tool for etching a printing plate required steps, fulcrums and work-moving devices, also, they required rotating chopping discs to produce pulsations in the photoelectric cell so that the output from the cell could be amplified by a conventional amplifier whereas in the instant invention the use of complicated devices are avoided and has the advantage of mechanical simplicity.

Briefly stated, the improved automatic etching

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machine embodies a photoelectric scanning device, a mechanism for imparting scanning movement to such device with respect to the surface of a suitably mounted pattern, means for amplifying the electrical impulses developed in the scanning device by variations in the light and shade of the pattern, a dynamic head including a cutter continuously reciprocated by a field coil within the head and connected with a source of electrical energy, the cutter being operatively mounted relative to the plate to be etched, which latter is adapted to be moved in synchronism with the scanning device and a floating armature coil in electrical circuit relation with the amplified output of the scanning device to limit the stroke of said cutter.

With the above and other objects and advantages in view the invention consists of certain features of construction and operation of parts which will hereafter be described and shown in the accompanying drawings in which:

Fig. 1 is a fragmentary perspective view of the automatic etching machine embodying the invention;

Fig. 2 is a longitudinal sectional view thereof taken on line 2—2 of Fig. 1;

Fig. 3 is a vertical transverse sectional view taken on line 3—3 of Fig. 2;

Fig. 4 is a fragmentary cross-sectional view taken on line 4—4 of Fig. 1;

Fig. 5 is a fragmentary detail view of toothed wheel, and a form of stop therefor used in carrying out the invention;

Fig. 6 is a fragmentary detail view of another form of stop engaging the toothed wheel; and,

Fig. 7 is a simplified schematic diagram of a photoelectric cell amplifying circuit and means whereby the output current is utilized to continuously reciprocate a cutter as well as control the depth of the excavations produced in a photographic plate by the cutter.

Referring more specifically to the drawings, the etching device comprises a support 1 which includes a longitudinally extending flat base 2 having transversally extending beams 3 mounted on the bottom thereof, which beams 3 are adapted to engage a floor or other surface (not shown).

The base 2 of the support, has longitudinally extending rails 4 mounted on its upper surface and adjacent to its longitudinal edges, said rails 4 being V-shaped at their upper edges 4', which V-shaped edges 4' are adapted to engage inverted V-shaped lower ends 5' of the block members 5 which are suitably mounted on and at the longitudinal lower edges of a platform 6, whereby the

platform 6 is longitudinally slidable on the base 2 in spaced relation therewith. The platform 6 has a pair of transversally extending rails 7 mounted on the upper surface and adjacent to the ends thereof, said rails 7 having V-shaped upper edges 7' adapted to engage the inverted V-shaped lower ends 8' of the block members 8 which are mounted at their upper ends to the lower surface of a table 9 and adjacent the ends thereof, whereby the table is transversely slidable on the platform 6 in spaced relation therewith.

The table 9 contains an aperture 10 adjacent to one end thereof and a smooth polished plate 11 is suitably mounted thereon adjacent to another end thereof. A holder 12 for a photographic negative or other translucent pattern is stationarily mounted in the table aperture 10. A pair of spaced substantially U-shaped brackets 13 and 13' are mounted along one longitudinal edge of the base 2 with the arms of the brackets being arranged one above the other. The lower arms 15 and 15' of the brackets 13 and 13', respectively, are suitably secured to the base 2 and the upper arms 16 and 16' of the brackets 13 and 13', respectively, extend inwardly toward and terminate above the middle of the table 9, with the outer end 18 of the arm 16 of bracket 13 being above the plate 11 to be etched and the outer end 18' of the bracket arm 16' being above the negative picture, or other pattern to be reproduced, in the table aperture 10. The source of illumination 19 is mounted on the outer end 18' of the bracket arm 16' and a cutting tool activating mechanism 20 including a cutting tool 21 is mounted on the outer end 18 of the bracket arm 16. A housing 22 for a photoelectric cell 23 is mounted on a bracket secured to vertical arm of the light source bracket 16'. It is positioned beneath the aperture 10 in the table 9. The cell housing 22 has a nipple or cap 24 containing a small, preferably square opening 25 formed on the upper arcuate surface thereof and adapted to receive condensed light rays from the source of illumination. The photoelectric cell 23 is preferably held in position in this housing by being partially imbedded in wax 26.

The source of illumination 19 is in the form of an electric lamp which is mounted in a light socket 27, and including a light shield 28 on the upper end of a vertically extending tubular housing 29 having a condensing lens 30 inclosed in its lower end.

A worm drive is attached to the longitudinally movable platform 6 to impart longitudinal movement of a negative suspended in the aperture 10 across the condensed ray of light emanating from the light source 19, and the etching plate 11 across the cutter or stylus 21. This worm gear arrangement comprises a motor 31 connected through a reduction gear 32 to a shaft 33 terminating in a bearing block 34 securely attached to the longitudinally movable platform 6. The shaft 33 is provided with camways 35 longitudinally spiralled the length of said shaft 33 and reversibly spiralled to provide a return camway 36, said camways joining at each end of the shaft. Securely attached to the longitudinally movable platform 6 is an angle member 37 having a leg thereof perpendicular to the longitudinal axis of the shaft 33 and terminating in a stud 38 engaging one of the respective camways 35 or 36, depending upon the direction of longitudinal movement of the platform 6.

Intermittent transversal movement of the table 9, so the light source 19 and stylus 21 will pass over a new plane of the aperture 10 and etching plate 11, respectively, with each change of longitudinal direction is provided by a worm drive comprising a threaded shaft 40 supported by journal bearings 41 secured to the longitudinally movable platform 6 and engaging an internally threaded support 42 secured to the transversally movable table 9. A tooth gear 43 is securely fastened to the threaded shaft 40 and adapted to engage stop members which rotate said tooth gear 43 during the course of changing direction of longitudinal movement of the platform 6. One of these members consists of a stud 44 supported by an angle member 45 secured to the base 2 and adapted to contact the tooth gear 43, thus rotating the same when the longitudinally movable platform 6 approaches the source of power or motor 31. When the longitudinally movable platform 6 approaches the other extremity of its reciprocating path, a cam member 46 is forced down against the action of a spring 47 and locks over the tooth gear 43. As the longitudinally movable platform 6 changes direction and starts back towards the source of power the tooth gear is rotated around and out of engagement with the cam member 46. The cam member 46 is securely fastened by a clamp support 48 to the base 2.

It being an object of the invention to produce mezzotint plates, the stylus 21 has the general configuration of a needle with a small barb formed near the point so that in addition to making excavation in the plate 11 it will turn a burr upwardly from the plate surface. The resulting print made from such a plate is given the soft velvety appearance required by the art as the burr as well as the excavation catches ink.

In order to have the cutter or stylus stroke amplitude follow variations in the intensity of the photoelectric tube illumination, a balanced amplifying circuit is disposed between the photoelectric tube and the primary amplifier, as diagrammatically illustrated in simplified form to illustrate the principle in Fig. 7. The photoelectric tube 23 current flows through two ten-megohm resistors 50 and 51. The resultant voltage drop across one of the resistors 50 is applied as a negative bias voltage to the number one grid of an amplifier tube 52, and the voltage drop across the other resistor 51 is applied as a positive bias voltage to the number one grid of another and similar amplifying tube 53. The number two grids of these amplifying tubes 52 and 53 are connected in parallel and a 60-cycle voltage source 60 applied to them. In order to complete the balance circuit the plates of the amplifying tubes are connected in conventional push-pull relationship. The circuit is so adjusted that when there is no light on the photoelectric tube 23 the 60-cycle plate current of amplifying tube 52 balances out that of the tube 53 and there will be no 60-cycle input to the amplifier 54. When light falls on the photoelectric tube 23, the 60-cycle plate current of the amplifying tube 53 becomes larger than that of the other tube 52 and a 60-cycle signal is applied to the input of the amplifier 54. This signal causes the stylus 21 to strike with a certain force 60 times per second. When the light on the photoelectric tube increases, the unbalance of the push-pull plate currents becomes larger and the 60-cycle signal applied to the amplifier input increases and the stylus thereby strikes with a greater force. In this way, the cutter

stroke amplitude is made to follow variations in the photoelectric tube illumination. Hence, the density of the photographic negative will control the degree of illumination of the photoelectric tube, which in turn will regulate the amplitude of the stylus stroke.

The stylus 21 is designed to operate on a modification of the solenoid principle. A 60-cycle alternating current is passed through a field coil 55 which reverses the polarization of the field core 56 the same number of times per second that the current reverses. The amplified photoelectric current applied to the stylus coil 57 causes the coil to move in the magnetic field in a direction depending upon the flux direction. As the flux direction is reversed by the alternating current applied to the field coil 55, the stylus coil 57 moves up and down to maintain its sought position in the flux. The stylus coil is spring suspended so that its amplitude depends upon the amount of current in the stylus coil.

The intensity of the stroke may be varied with any one of the number of volume control methods disposed across the input of the final amplifier stage or intermediate of the amplifier and the stylus coil.

It is within the scope of this invention to dispose suitable standard light filter between the light source 19 and aperture 10, and use a color film such as photochrome or Technicolor and the like, to produce a set of printing plates suitable for color printing. It is also considered within the scope of this invention, the employment of an enlarging camera secured to the table 9 and focused on the aperture 10 so that enlargements or reduction of original negatives can be made directly on the etching plate 11.

Having thus described my invention, what I claim as new and wish to secure by Letters Patent is:

1. A plate engraving machine comprising a supporting base, a platform longitudinally movable with respect to said base, a table longitudinally movable with said platform and transversally movable with respect to said platform, an aperture in said table, means holding a photographic film in said aperture, a plate mounted on said table, an apertured cased photoelectric tube positioned beneath said table aperture and secured against movement, means imparting reciprocating longitudinal motion to said platform, means imparting intermittent transversal motion to said table at the change of longitudinal direction of said platform, a source of light suspended above said table aperture and secured to said base, a reciprocating stylus suspended above said plate and secured to said base, said stylus being constructed and arranged to reciprocate at a constant speed during the longitudinal movement of said platform in both directions, and means varying the amplitude of said stylus in accordance with variations in the intensity of said photoelectric tube illumination.

2. A plate engraving machine comprising a supporting base, a platform longitudinally movable with respect to said base, a table longitudinally movable with said platform and transversally movable with respect to said platform, an aperture in said table, means holding a photographic film in said aperture, a plate mounted on said table, a photoelectric tube positioned beneath said table aperture and secured against movement, a case surrounding said photoelectric tube, an aperture provided in said photoelectric tube case and positioned in a plane parallel to said table aperture, means imparting reciprocating longitudinal motion to said platform, means imparting intermittent transversal motion to said table at the change of longitudinal direction of said platform, a source of light suspended above said table aperture and secured to said base, a reciprocating stylus suspended above said plate, said stylus being constructed and arranged to reciprocate at a constant speed during the longitudinal movement of said platform in both directions, and means varying the amplitude of said stylus in accordance with variations in the intensity of said photoelectric tube illumination.

3. A plate engraving machine comprising a plurality of spaced apart plane surfaces, means imparting reciprocating longitudinal motion to at least one of said planes, means imparting intermittent transversal motion to a reciprocally longitudinally movable plane at the change of longitudinal direction of said plane, an aperture provided in said transversally movable plane, a plate secured to said transversally movable plane, a reciprocating stylus suspended above said plate, said stylus being constructed and arranged to reciprocate at a constant speed during the longitudinal movement of said plane in both directions, a photoelectric tube positioned beneath said aperture and provided with an apertured casing to permit a beam of light projected through a photographic film to contact said photoelectric tube, and means varying the amplitude of said stylus in accordance with variations in the intensity of said photoelectric tube illumination.

4. A plate engraving machine comprising a supporting base, longitudinal rails positioned on the upper surface of said base, a platform, guide members positioned on the lower surface of said platform and engaging said rails, transversal rails positioned on the upper surface of said platform, a table, guide members positioned on the lower surface of said table and engaging said transversal rails, a motor driven shaft, connected helical camways in said shaft, a stud secured to said platform and engaging said camways, a screw operably connected to said table, means intermittently rotating said screw, a source of illumination secured to said base, an encased photoelectric cell having an aperture aligned with said source of illumination, means securing photographic film to said table and positioned intermediate said source of illumination and said photoelectric cell, a reciprocating stylus secured to said base, said stylus being constructed and arranged to reciprocate at a constant speed during the longitudinal movement of said platform in both directions thereunder, a plate positioned beneath said stylus and secured to said table, means varying the amplitude of said stylus in accordance with variations in the intensity of said photoelectric tube illumination.

5. A plate engraving machine comprising a fixed source of illumination, an encased photoelectric tube having an aperture aligned with said source of illumination, a reciprocating stylus, a table, an aperture in said table intermediate said source of illumination and said photoelectric tube, a plate positioned beneath said stylus and secured to said table, means imparting reciprocating longitudinal motion to said table, means intermittently imparting longitudinal motion to said table at the change of longitudinal direction of said table, a balanced amplifying system positioned intermediate said photoelectric tube and stylus whereby the amplitude of said stylus is varied in accordance with variations in the intensity of

said photoelectric tube illumination and said stylus reciprocates during longitudinal movement of said table in both directions.

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