May 27, 1952 O. W. GREENBERG 2,598,253

TOOL DRIVING MEANS AND CONTROL THEREFOR

Filed April 19, 1947 2 SHEETS—SHEET 1

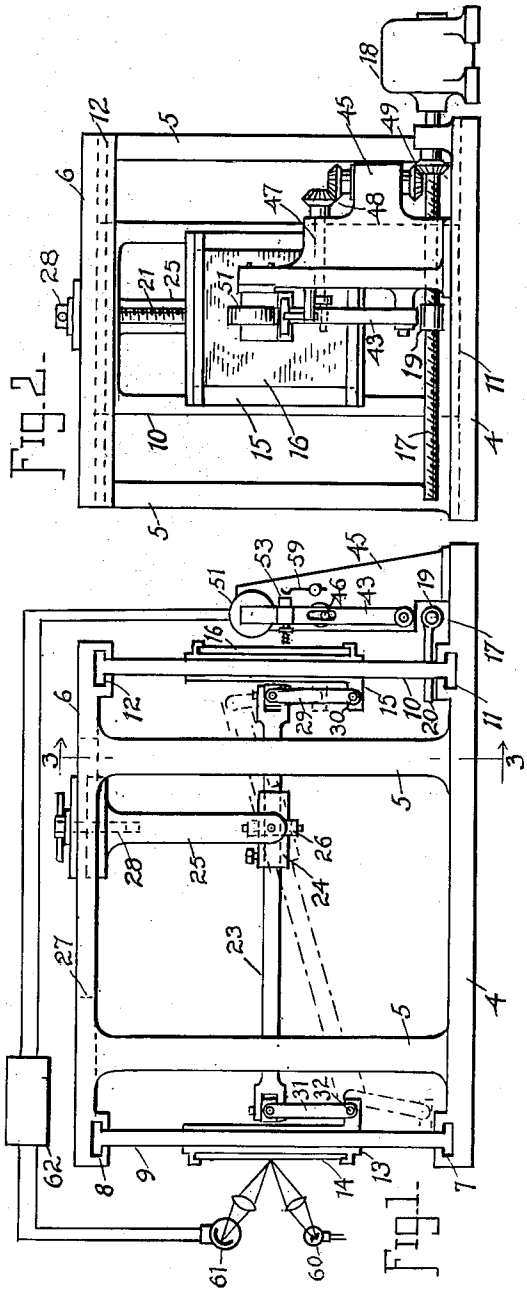


Fig. 1.

Fig. 2.

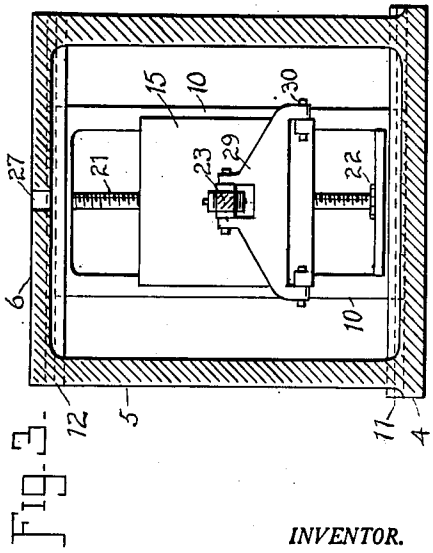


Fig. 3.

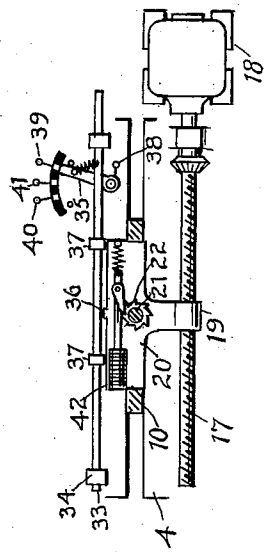


Fig. 4.

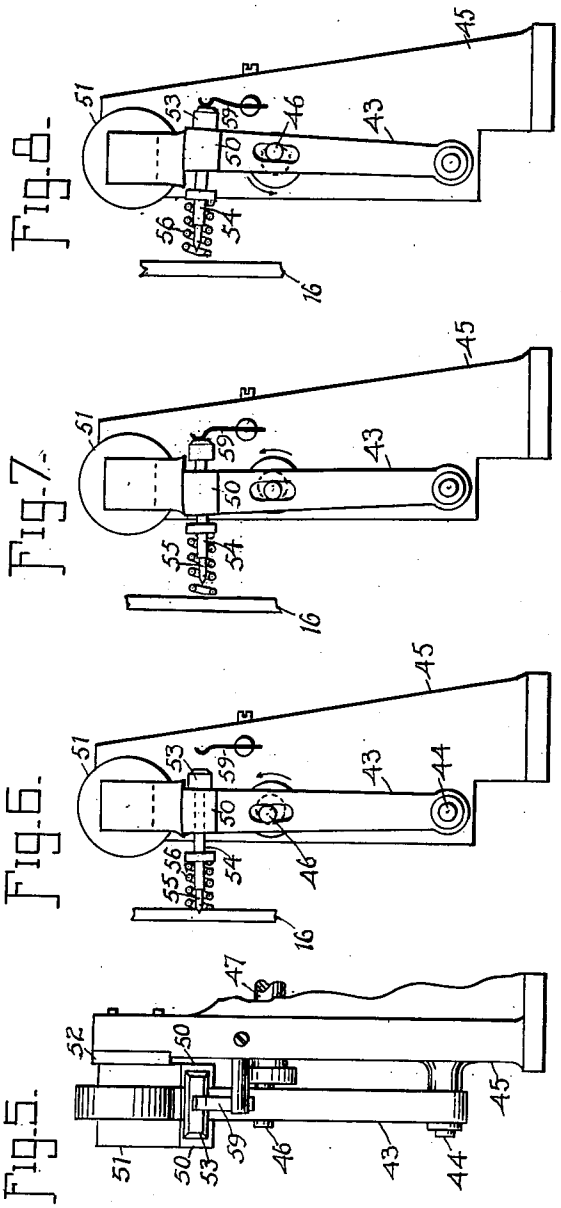
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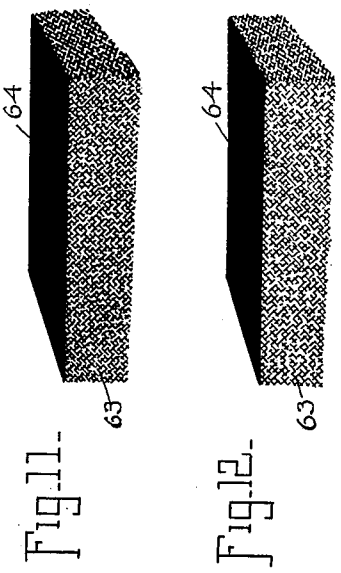
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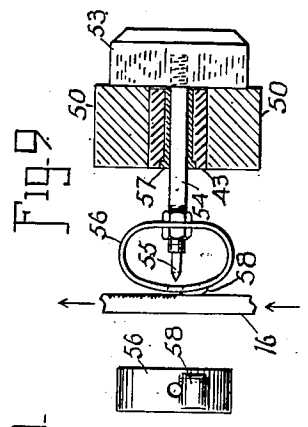
May 27, 1952 O. W. GREENBERG 2,598,253

TOOL DRIVING MEANS AND CONTROL THEREFOR

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TOOL DRIVING MEANS AND CONTROL THEREFOR

Otto W. Greenberg, Ocean City, N. J.

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3 Claims. (Cl. 78—13.1)

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This invention relates to the method and apparatus for the photo-electric production of halftone cuts employed for printing and has particular reference to the tool mechanism for forming depressions in the surface of a printing plate, to the plates and characteristics of the plates employed in connection with the methods of this invention and to the means for enlarging and reducing the reproductions.

The object of the invention is to obtain less critical or more positive reactions to the signals from the copy than has hitherto been obtained in machines of this class, at the same time to provide a simple, practical method for obtaining satisfactory printing plates from copies defective in tone values and to provide plates applicable for use in connection with the method employed in this invention. In general, this invention is an improvement over that shown and described in my Patent No. 2,086,798 of July 13, 1937.

The present invention may be carried out by means differing from those disclosed herewith without departing from the spirit of the invention. Therefore, the disclosures herewith are to be understood as illustrative rather than in a limited sense.

Fig. 1 is an assembly elevation of the machine, partly diagrammatic.

Fig. 2 is an end view of Fig. 1.

Fig. 3 is a section on line 3—3 of Fig. 1.

Fig. 4 is a plan, largely diagrammatic, showing a means that may be employed to reciprocate and to feed the plate in relation to a tool.

Fig. 5 is an enlarged end view of the tool mechanism.

Figs. 6, 7 and 8 are side views of Fig. 5 showing various phases in the operation of the tool and associated parts.

Fig. 9 is an enlarged horizontal section in line with the stem of the tool.

Fig. 10 is a front view of a modified form of spring associated with the tool.

Fig. 11 illustrates an enlarged portion of a porous plate modified for use in my machine, diagrammatic and exaggerated for clarity.

Fig. 12 illustrates a similar plate with a higher percentage of pores.

The frame of the machine may consist of a base 4 and four similar uprights 5 supporting a top portion 6. At the copy side of the machine, the left as viewed in Fig. 1, a set of dovetailed grooves, one 7 in the base and the other 8 in the top portion provide tracks for sliding an upright rectangular frame 9, forward and backward. A second and similar upright rectangular frame 10 is adapted to slide forward and backward in a plane parallel to the first frame 9 in like dovetailed grooves 11 and 12.

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A copy carriage 13 for the copy 14, secured in any suitable manner, is mounted to slide up and down between tracks formed in the sides of the upright rectangular frame 9. A similar carriage 15 for the printing plate 16, secured in any suitable manner, is similarly mounted to slide up and down on the other rectangular frame 10.

Reciprocating motion, forward and backward is imparted to the rectangular frame 10 and with it the plate carriage and plate 16 by a threaded shaft 17 operatively connected to a reversing motor 18, by means of a nut 19 on a bracket 20 extending from the rectangular frame 10. Feeding motion is imparted to the plate carriage 15 and, with it, to the printing plate 16 by a threaded spindle 21 journaled above and below in the rectangular frame 10 and threaded in the plate carriage. A ratchet 22 at the lower end of the spindle provides means for revolving the spindle step by step, as will be more fully described hereafter.

Motion of the copy carriage 13, corresponding to the plate carriage 15, is obtained by means of a single bar pantograph 23. A sleeve 24, axially adjustable along the length of the bar 23, is mounted on the lower end of a standard 25 by means of a universal joint 26. The standard 25 is adjustably held in a slot 27 in the frame and secured by a bolt 28 at such point along the slot as will give the required reduction or enlargement. One end of the bar 23 is connected by a universal joint to a bracket 29 hinged, as here shown at 30, along the lower edge of the plate carriage 15 and is connected at the other end by a universal joint to a similar bracket 31 along the lower edge of the copy carriage 13 at 32. The brackets 29 and 31 widen out at their attachments to their respective carriages so that they will more readily transfer motion not only up and down, but sidewise as well. They may, in fact, be hinged to the sides of the carriages.

As shown in broken lines in Fig. 1, the brackets compensate for the apparent shortening of the pantograph bar as it sweeps into angular positions vertically or horizontally. It does this in a way mechanically more practical than in devices hitherto employed to this end wherein the pantograph bar is designed to telescope or wherein axially extensive devices are provided at the connecting ends of the bar. The brackets permit greater angular sweeps of the pantograph

bar without jamming and, as thus the bar can be shortened, the machine as a whole can be reduced in size.

Referring to Fig. 4, a rod **33** mounted to slide in supports **34** on the base of the frame **4** is employed to snap a switch **35** from one side to the other against stops, by the action of a spring on the rod **33**, when the rod is impelled to a position to the right or left by the reciprocating rectangular frame **10**, which, through a projection **36**, engages adjustable sleeves **37** on the rod **33** at the end of each stroke. When the switch **35**, establishes a connection between the binding posts **38**, and **39**, the wiring to the reversing motor **18**, is so connected that the electric circuit established causes the motor to revolve in one direction, and when binding posts **38** and **40** are connected, it revolves in the opposite direction.

When the switch **36** establishes a momentary connection between the binding posts **38** and **41** as it sweeps from one side to the other, the wiring to a solenoid **42** is such that it is momentarily energized by a current and actuates the pawl **22** to feed the plate carriage **15**. A spring fixed to an extension of the solenoid armature withdraws the armature from the solenoid.

The scanning elements which are associated with the copy **14** to be reproduced are shown diagrammatically and include a light source **60** optical system and photo-electric cell **61**. The output of the photo-electric cell is shown connected to the input of an aperiodic amplifier **62** whose output in turn is connected to the electromagnetic control mechanism for the tool.

A non-magnetic metallic lever **43** is employed to reciprocate the tool mechanism to and from the surface of the printing plate **16**. It is fulcrumed at its lower end on a stud **44** projecting from a standard **45** and reciprocated by an eccentric pin **46** revolving in a slot formed in the body of the lever **43**. The eccentric pin **46** is carried on the end of the shaft **47** geared to the motor **18** by two sets of bevels **48** and **49**, shown in Fig. 2.

The poles **50** of an electro-magnet **51** are fixed to each side of the upper end of the non-magnetic lever **43** and reciprocate with it. To avoid reciprocation of the entire electro-magnet, core and coil included, I have devised a novel construction. For clarity of description, the core may be said to have been cut off from the poles, in an arc with the fulcrum **44** of the lever **43** as center and then fixed in a position such that substantial continuity of magnetic flux will be maintained between the core and poles, though the latter are reciprocated. The core and coil of the electro-magnet **51** are shown fixed to the upper end of the standard **45** but separated therefrom by a non-magnetic disk **52** to avoid stray magnetic flux.

An armature **53**, bridging the poles, is attached to a non-magnetic stem **54**, the free end of which carries a tapered indenting tool **55** and a spring **56**, hereinafter again referred to. The stem **54** preferably square in cross section, has free axial play in bearings **57** embedded between the poles, Fig. 9. When the electro-magnet is energized, the armature is held against the poles by the magnetic attraction, which together with the tool and spring **56**, reciprocates with the poles.

The point of the tool is positioned in close enough relation to the surface of the printing plate **16** to enable it to penetrate the surface a maximum depth on each forward stroke, provided the driving force, derived from the motor **18** is not discontinued by release of the armature from the poles.

The reaction to the work of compression increases, of course, from zero to maximum from the instant the point of the tool makes contact with the plate until maximum depth is attained. When the tool reaches a depth such that the reaction overcomes the magnetic hold on the armature, the armature is released and the compression ceases for that throw of the tool. The strength of the current flowing through the electro-magnet at any given time is a function of the light reflected from the unit area of the copy picked up by the photo-electric cell and determines at what depth of compression the armature releases, which in turn determines the area of the dot that will appear white in the print.

However, due to the inertia of the armature and tool elements, the point of the tool will penetrate the surface of the plate to a certain depth independently of that due to the current in the electro-magnet. Thus, the depths obtained are not truly a function of the strength of current. I overcome this defect in reproduction by adjusting the spring **56** to lead the point of the tool in contacting the plate, an amount such that when compressed, it will react against the tool and the force of inertia behind it.

Furthermore, at low current strengths, just above zero, the hold on the armature is too critical to produce proportionally minute depths of depression. I overcome this defect in satisfactory reproduction by adding tension to the spring **56** to provide greater resistance to the tool, so that the current strength in the electro-magnet can be increased to a satisfactory minimum.

The spring **56** also serves to withdraw the point of the tool away from the plate quickly at the instant of armature release. Another function of the spring **56**, is to protect the point of the tool and prevent its scratching the surface of the plate when inserting or removing the plate from its carriage.

The spring **56** is shown in the form of a coil except in Figs. 9 and 10, where a blade spring is shown formed into an oval-like shape. This spring or resilient element may take any one of many shapes and forms and be mounted in a variety of ways without departing from the spirit of the invention. To prevent it pressing too heavily against finished or indented areas of the plate, the spring is designed to contact the surfaces not yet indented. This is illustrated in Figs. 9 and 10, where a boss **58** is shown formed on the blade spring just below the tool opening, the advancing direction of the tool in relation to plate travel as indicated by the arrows.

Referring to Figs. 6, 7 and 8, a succession of phases in the reciprocation of the lever and the tool mechanism is illustrated. In Fig. 6, the forward throw is nearly completed. The tool spring is shown compressed with the tool penetrating the plate. In the next phase, Fig. 7, the throw forward is at its maximum, the armature released from the poles and the spring relieved of pressure. When the poles reverse to move forward, a high degree of acceleration must be imparted to the armature, and unless the machine is operated at a low speed, the hold of the armature on the poles will fail. Fig. 8 illustrates how I overcome this objectionable condition. A blade spring **59**, operates to urge the armature forward, following it up until it is fully accelerated. This spring also serves to assure proper and like contacts for each forward throw of the armature.

The characteristics of the plate for reproducing a printing plate from a copy by my method is closely related to the means I employ in producing the depressions. It is quite essential that the texture of the plate contains minute pores evenly distributed, so that the substance displaced by the indenting tool in forming the depressions be absorbed in the increased density of the plate, instead of being displaced upward above the surface or sidewise into neighboring depressions.

Porous printing plates such as vulcanized fiber, treated micro-porous rubber, hard rubber containing a large percentage of wood flour and other preparations have been used. However, these possess undesirable properties, common to all or some of which are warping, absorption of moisture, excessive elasticity to indentation and fragility.

Porous malleable metal plates, especially of copper or bronze, produced in the well known art of powder metallurgy, having a porosity of the order of 20% to 30%, would otherwise be satisfactory for indenting with the tool, were it not for the open pores on the surface of these plates, which when inked and printed show white spots. The pores on the surface can, of course, be very much reduced and even eliminated in the process of production by employing higher pressures in compacting the metal powders, but then the resulting plate density would not permit the absorption of the quantity of metal displaced for the high light effects. These require a porosity of the order of 20% to 30% as stated and roughly illustrated at **63** in Figs. 11 and 12 respectively.

To overcome the difficulty presented by the surface pores, I provide the surface with a thin continuous metallic layer **64**, the same in kind as that of the plate or of other metals suitable for the purpose. This is done in one of several ways, such as by so-called tinning the surface; by placing a thin sheet of metal in thickness of the order of .001 of an inch against the bottom surface of the mold employed for the production of these porous plates, against which the metal powders are then compressed by the high pressures used in this art; by continual grinding or sandpapering until the adjoining metal has been drawn or peened over the open pores and then polishing or by electrolytic deposition into the open pores after the surface of the plate in general has been rendered electrically non-conductive.

The porosity of the plates produced by powder metallurgy is controllable to a high degree and can be standardized as to percentage of porosity. This enables the production and supply of special plates for reproducing satisfactory prints from defective copies, namely such as are too flat or such as are too "contrasty."

It will be readily understood that the tool will penetrate deeper in a plate of greater porosity, diagrammatically illustrated in Fig. 12, than in one of less porosity, Fig. 11. The former would be advantageously used to reproduce flat copies and the latter contrasty copies. This is analogous to the soft and contrast photographic printing papers.

It is to be understood, of course, that references to pores in the plates, in the specification and claims, do not include blow-holes occurring in manufactured castings.

What I claim is:

1. A device for indenting surfaces to various depths in accordance with electrical impulses comprising an indenting tool, an indenting tool mount, means for reciprocating said tool mount substantially perpendicular to a work surface with substantial uniform reciprocations, means mounting said indenting tool on said mount for free bodily movement with respect thereto, magnetic means for causing said indenting tool to move with said mount in accordance with the amount of current supplied to said magnetic means, and spring means secured to said tool and extending beyond the working end of said indenting tool to prevent work engagement of said tool when said magnetic means is inactive.

2. A device for indenting surfaces to various depths in accordance with electrical impulses comprising an indenting tool supported for free bodily movement to and from the work surface, a reciprocating drive, magnetic means for causing said tool to move with said drive for penetrating said surface in accordance with the amount of current supplied to said magnetic means, spring means for urging said tool forward toward said surface when said tool is accelerating, and spring means secured to said tool and extending beyond the working end of said tool to prevent work engagement of said tool when said magnetic means is not activated by said control current.

3. A device for forming depressions in the surface of a blank to various depths in accordance with electrical impulses comprising a fixed immovable electro-magnet, a movably free portion of the pole of said electro-magnet, means for reciprocating said free portion in close proximity to said electro-magnet in a direction perpendicular to the lines of magnetic flux passing into said free portion, an armature movably mounted with respect to said free portion, a tool connected to said armature for forming depressions in the surface of a blank, and a circuit for advancing said magnetic means for causing said armature and therefore said tool to be coupled with and to move with said free portion to penetrate said surface in accordance with the amount of current supplied to said electro-magnet.

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