

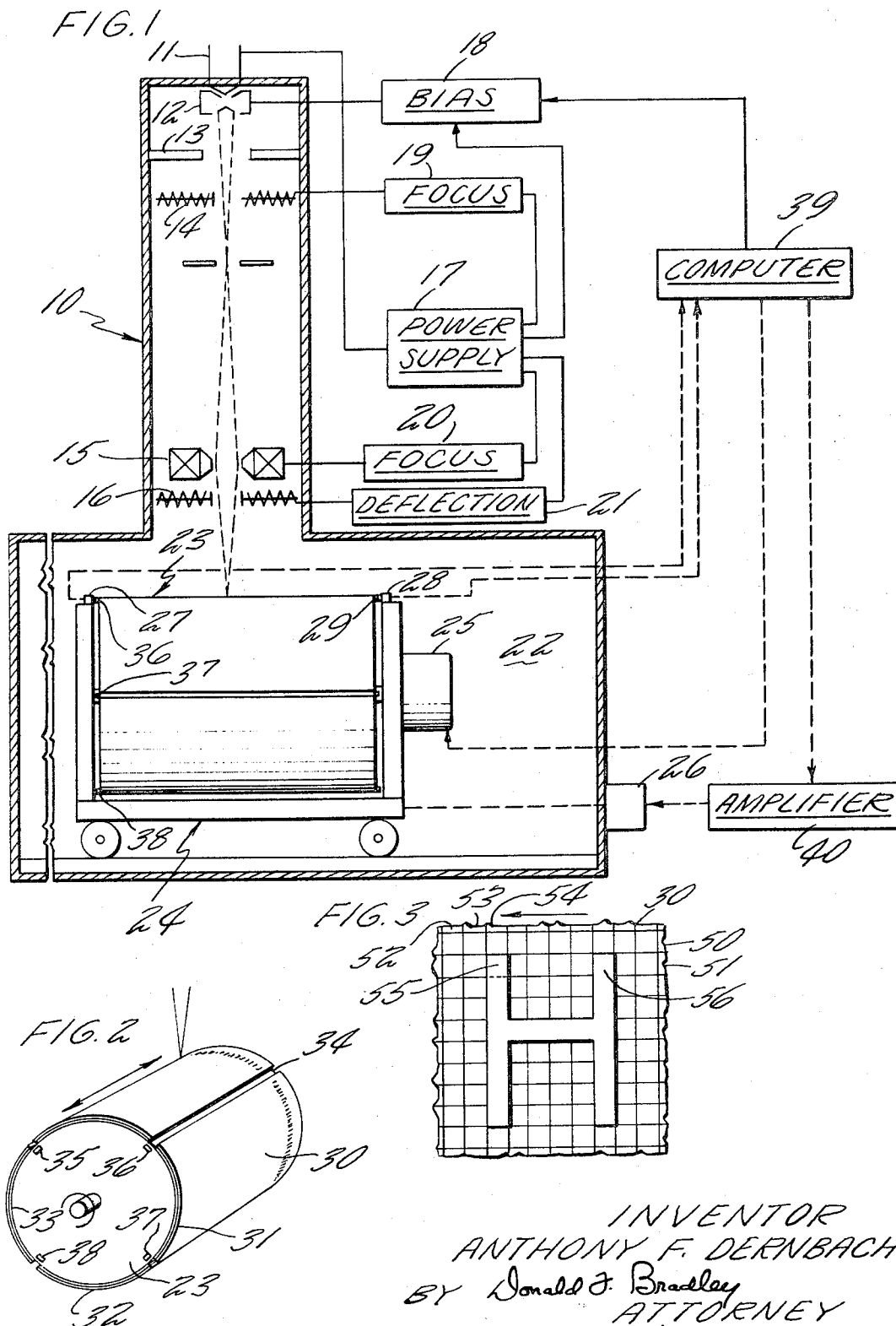
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A. F. DERNBACH

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ELECTRON BEAM CUTTING OF PRINTING PLATES

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ELECTRON BEAM CUTTING OF PRINTING PLATES

Anthony F. Dernbach, West Hartford, Conn., assignor
to United Aircraft Corporation, East Hartford, Conn.,
a corporation of Delaware

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ABSTRACT OF THE DISCLOSURE

This invention relates to a device for producing printing plates by means of a beam of charged particles such as an electron beam. The invention employs a drum on which a plurality of printing plates are mounted for rotation and translation under the beam of charged particles so that the beam scans the printing surface of the plates. A computer is tied into the beam generator and controls the removal of material from the plates by the beam to form printing characters on the plates in response to several detectors sensing the motion of the plates under the scanning beam.

This invention relates to a device for producing printing plates. More specifically, it relates to a device for automatically setting or forming type as an integral part of the printing plate.

It is desirable in the printing industry to fabricate printing plates fast and economically. A device adaptable to be controlled by a digital computer would serve this function well. The data and program stored in the computer may then be used to control the device to produce suitably recessed (negative) or raised (positive) characters on printing plates either of the offset, regular, or wraparound letter pressure type.

An electron beam machine may be advantageously applied to a computer control device for the production of printing plates. An electron beam has been used in the past successfully for cutting and drilling holes, and this ability may be successfully applied to the printing industry for a rapid and automatic production of printing plates.

It is therefore an object of this invention to produce a device capable of automatic production of printing plates.

It is another object of this invention to control an electron beam with a digital computer to produce printing plates of either the positive or negative type.

These objects and others will be more readily apparent upon a review of the following description in which:

FIGURE 1 schematically shows the plate fabrication device in combination with the digital computer.

FIGURE 2 shows a drum on which the printing plates are mounted.

FIGURE 3 shows a typical letter printed by this invention.

According to this invention, an electron beam of high intensity is caused to impinge in a controlled manner upon a plate to etch the letter. The relative movement of the plate with respect to the beam as well as the beam intensity are controlled by a digital computer to produce the desired characters at the proper places on the plate.

In FIGURE 1, 10 generally indicates an electron beam machine in combination with a working chamber. The electron beam may be of the type such as is disclosed in U.S. Patent No. 2,793,281, issued May 21, 1957, to K. H. Steigerwald. The beam comprises a cathode 11 at a high negative potential which is supplied by a power supply 17. An electrode 12 controlled by bias control 18 is arranged adjacent to the cathode to vary the intensity of the beam and turn it either on or off. The bias control 18 may be

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a simple resistance network with means for short-circuiting a portion of the resistance between the cathode and high voltage source and function in the same manner as the grid in a triode-type vacuum tube. The accelerating anode 13 is at ground potential and accelerates the electrons towards the workpiece. An optional focusing control 14 may be used and its current derived from power supply 17 through network 19. At 15 a further electromagnetic focusing control is shown, the power for which is derived from power supply 17 through network 20, and a deflection control 16 for fine positioning of the electron beam relative to the workpiece is provided. The deflection control 16 derives its voltages from power supply 17 through network 21. The workpiece generally indicated by 22 is placed along with the electron beam components in a vacuum chamber 10 which is maintained at a sufficiently low pressure necessary for electron beam working. The pumping mechanism which does not form a part of this invention is not shown.

The workpiece 22 comprises a drum 23 on which the printing plates are mounted. The drum 23 is rotatably mounted on a carriage 24 with the axis of rotation in the plane of the drawing and perpendicular to the beam axis. The drum is rotated by a motor 25 which maintains the drum at a high constant rotational speed. The carriage 24 is moveable in a precise manner along a direction parallel to the drum axis and is controlled by actuator 26 mounted outside of the chamber 10.

FIGURE 2 shows the drum 23 on which are mounted four printing plates, 30, 31, 32, and 33. The drum may be designed to accommodate any number of plates. These printing plates are separated by small gaps such as indicated at 34. The plates are removable but during printing by the electron beam are fixedly mounted to the drum 23.

Further on the wheel carriage 24 are mounted two magnetic detectors 27 and 28. In addition, on the drum are mounted five permanent magnetic inserts. Four of these inserts 35, 36, 37, and 38 are mounted at the end of the drum directly adjacent the grooves separating the printing plates. The fifth magnetic insert 29 is mounted at the other side of the drum to identify one of the plates. As the drum rotates, the magnetic inserts 35, 36 and 37 and 38 are rotated past the detector 27 and the insert 29 is rotated past detector 28. The outputs of the detectors 27 and 28 are fed as an input to computer 39. The number of magnetic detectors may vary according to the number of plates.

The drum 23 is rotated at a high constant speed past the relatively stationary electron beam so that by axial displacement of the drum the whole face plate may be exposed to the beam. Actuator 26 which is driven by amplifier 40 axially advances the drum by a mechanical linkage a precise small amount for each or alternate drum revolutions. The computer 39 controls the input to amplifier 40 and selects the rate of axial travel.

In order for the electron beam to perform the cutting operation on the printing plates, it is necessary to provide it with the high power density necessary. This, as is described in the referenced Patent No. 2,793,281, is well within the capabilities of the art. A beam intensity of 10^9 watts per square inch is obtainable by focusing the beam to a very small spot size of approximately 0.002 in. diameter. If the beam is thereupon turned ON for several microseconds, an area approximately the size of the electron beam cross section will be cut out of the printing plate. Since the beam has such small size, the lettering to be cut out in the printing plates in negative or positive form will be accomplished with minute incremental steps. Assuming an ON time of 1 microsecond and a drum rotation of 1000 r.p.m., the minimum area cut out by the beam will be about .002 x .002 inch. The beams may be shaped elliptically for optimum results.

The electron beam is adjusted to cut the printing plate at the rate of five hundred lines per inch where a line is herein defined as that scanned by the electron beam with each revolution of the drum. Assuming a newspaper plate requires eight character lines per inch, then each character line will have a width of approximately $\frac{1}{16}$ of an inch with similar spacings between lines. With 500 scan lines per inch by the electron beam, each line of characters will be produced by approximately 31 electron beam scans. These scans may be increased to accommodate overlap or decreased when such fine resolution is not required. Resolution adjustment is made by varying the computer program.

In FIGURE 3 the letter H is shown cut out by the use of this invention. For clarity, 10 scan lines are shown only. As the drum rotates past the electron beam and the scan line 50 is under the beam, the electron beam bias control 18 is not activated so that no material is cut out of the plate 30. A pulse from detector 28 informs the computer 39 that the drum has completed a revolution. The computer then forwards a signal to the amplifier 40 instructing the actuator 26 to advance the drum a single increment to place the line 51 under the beam and prepares the cutting data necessary for this new scan line.

From the signal from detector 28 the computer realizes which plate is underneath the beam at that time. To preserve proper synchronization, the computer is informed each time a new plate is rotated under the beam by pulses from the detector 27. By providing the computer program with the size of the incremental step cut out and the speed of the drum, the computer will know how many positions along line 51 the beam must be activated to commence the cutting of the letter H. Thus, the computer 39 counts down the necessary number of increments 52, 53 and 54 and activates the bias control at just the proper time to cut out the small spot 55. Further along line 51 the spot 56 is cut out in a similar manner. In this fashion with subsequent scans and advancements of the drum, the whole letter H may be cut from plate 30. Obviously, many characters will be positioned adjacent each other to form a printed line. In this instance, a negative printing plate is formed although it is, of course, a simple matter to rearrange the computer program whereby all the material of plate 30 but that where the letters are to be located is cut away to form a positive printing plate.

In a typical example, the drum may be rotated at the speed of a 1000 r.p.m. and the electron beam has such intensity to require only two microseconds ON time. If the beam then is 0.002 in. wide in diameter and 500 lines per actual inch are used for cutting out the characters from the plates, four plates may be cut out in twelve and one-half minutes. This is considering an ON time of the beam for each character of two microseconds to cut out an incremental step of 0.002 in. x 0.004 in. with each pulse. The power required for the electron beam to cut the material from the plate is dependent upon the material properties of the plates, the heat of vaporization of the material, and the available effective power of the electron beam. The material of which the printing plates are made may be, for instance, zinc or steel covered by a material having a low heat or vaporization constant to thereby reduce the power requirements of the electron beam.

The initial setup of the system involves alignment of the electron beam relative to the plates so that the computer knows precisely where the beam is. Thereafter, synchronization is maintained by the pulses from the detectors

27 and 28. Although each revolution of the drum may be used for a cutting operation, a slight helix will be produced on the plates where the actuator 26 continuously advances the drum. For most applications such slight slope across the printing plate will not be objectionable. In the event the slight slope is unacceptable, alternate revolutions of the drum can be used for cutting operations, and the axial displacement would then be confined to occur during those drum rotations where no cutting takes place. Again, this method of operation of this device may be easily programmed within the computer 39.

It is to be understood that the invention is not limited to the specific embodiment herein illustrated and described but may be used in other ways without departure from its spirit as defined by the following claim.

I claim:

1. A device for the manufacture of printing plates with a program stored in a computer comprising in combination:

means for generating a beam of charged particles along a beam path;

a carriage positioned in the beam path and movable transversely of the beam path;

a drum mounted on the carriage and in the beam path and rotatable about an axis parallel to carriage movement with respect to the path;

a plurality of printing plates mounted on the outer surface of the drum;

first actuator means for rotating the drum about the axis and producing a first beam scan line on the printing surface of the plates;

second actuator means for moving the carriage transversely of the beam path, the second actuator means co-acting with the first actuator means to produce a second beam scan line contiguous with the first beam scan line;

first detector means mounted on the carriage for producing a first signal indicative of one completed revolution of the drum and applying the first signal to the computer;

second detector means mounted on the carriage for producing a set of second signals indicative of the occurrence of beam scan lines on the individual printing plates mounted on the drum;

means responsive to the first signal and the set of second signals for synchronizing the computer program with the relative position of the beam with respect to the plurality of plates;

means responsive to the computer program for producing a third signal indicative of the characters to be placed on the printing surface; and

means responsive to the third signal for varying the intensity of the beam.

References Cited

UNITED STATES PATENTS

3,140,379	7/1964	Schleich et al.	219-121
3,146,335	8/1964	Samuelson	219-121
3,151,231	9/1964	Steigerwald	219-121
3,172,989	3/1965	Nelson	219-121
3,192,318	6/1965	Schleich et al.	219-121
3,246,079	4/1966	Teucher	219-121
3,308,264	3/1967	Ullery	219-121

RICHARD M. WOOD, *Primary Examiner.*

W. D. BROOKS, *Assistant Examiner.*