

Feb. 25, 1958

M. FARBER

2,824,905

PRINTING CONTROL CIRCUITS FOR PHOTOELECTRIC ENGRAVING MACHINES

Filed Dec. 8, 1953

2 Sheets-Sheet 1

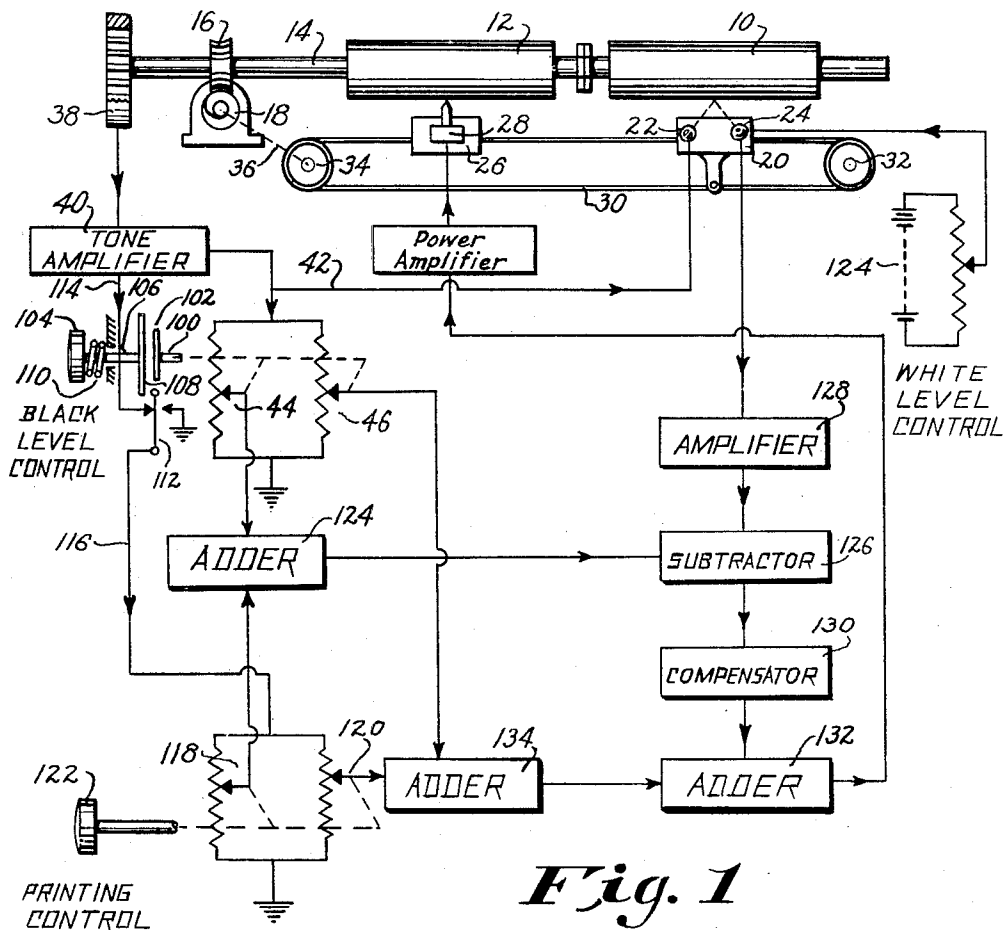


Fig. 1

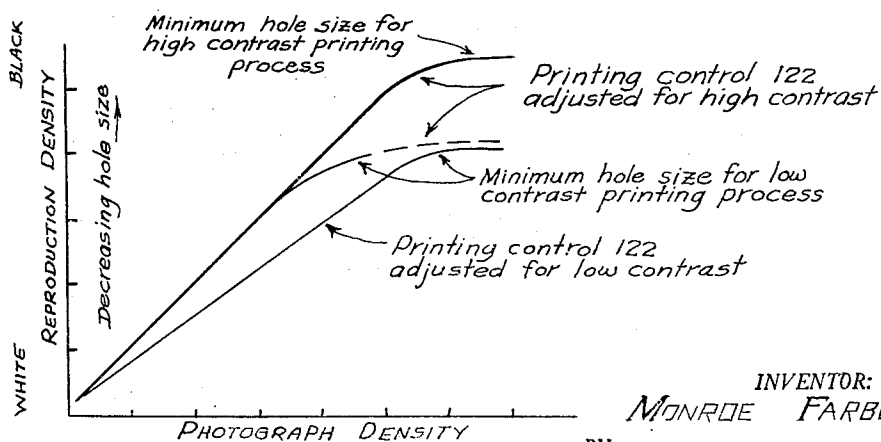


Fig. 2

INVENTOR:

MONROE FARBER

BY

Homer R. Montague

ATTORNEY

Feb. 25, 1958

M. FARBER

2,824,905

PRINTING CONTROL CIRCUITS FOR PHOTOELECTRIC ENGRAVING MACHINES

Filed Dec. 8, 1953

2 Sheets-Sheet 2

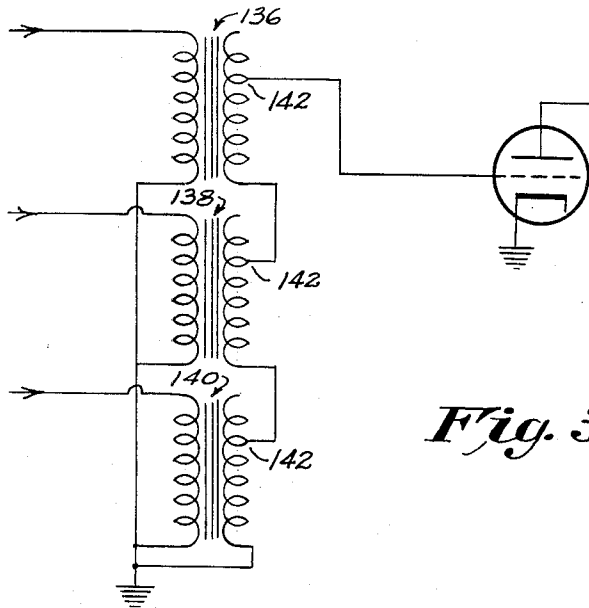


Fig. 3

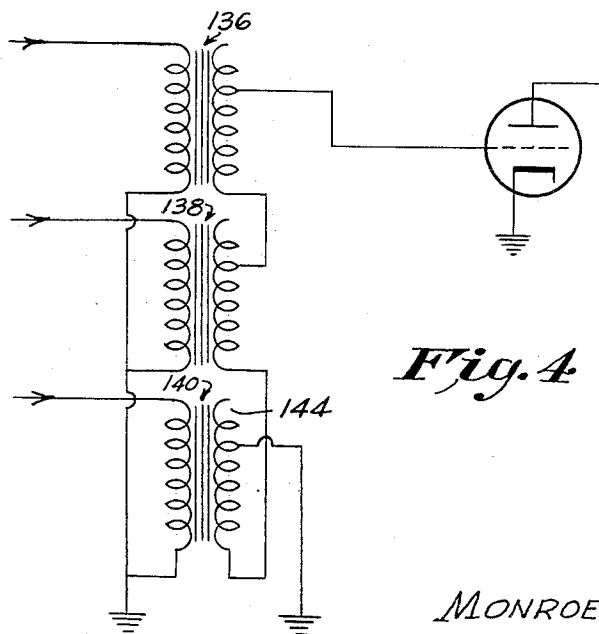


Fig. 4

MONROE FARBER,
INVENTOR.

BY *Homer R. Montague*
ATTY

1

2,824,905

PRINTING CONTROL CIRCUITS FOR PHOTO-ELECTRIC ENGRAVING MACHINES

Monroe Farber, Jericho, N. Y., assignor to Fairchild Camera and Instrument Corporation, a corporation of Delaware

Application December 8, 1953, Serial No. 396,952

5 Claims. (Cl. 178—6.6)

This invention pertains to photoelectric engraving machines, and more particularly to improvements in the operating and control circuits of such machines.

Apparatus of the type with which the present invention is concerned may take various forms, but for purposes of illustration herein, the invention is shown as applied to a machine of the type disclosed in U. S. patent to Boyajean, No. 2,575,546, issued November 20, 1951, to the assignee of the present application. In some respects, the apparatus to be described herein is also related to that disclosed in the copending application of Monroe Farber, entitled "Characteristic Correction System for Photoelectric Engraving Machines," filed December 8, 1953, Ser. No. 396,953, and also assigned to the owner of the present application. Such part of the above mentioned prior disclosures as is essential for an understanding of the instant invention is shown and described herein, but additional details not related directly to the present invention may be obtained by referring to those prior cases.

In general, machines of the type with which this application is concerned are intended for the making of printing plates by the photoelectrically controlled engraving of a suitable plate material, usually a plastic sheet, by burning or cutting indentations therein in response to an electric signal obtained by scanning an original such as a photograph. The pattern in which the indentations or individual excavations are produced upon the engraving plate is controlled by mixing the signal of the scanning device with a tone frequency whose frequency and amplitude are relatively fixed. If the degree of penetration of the stylus into the sheet material is related to the magnitude of the scan signal, and if the stylus is of proper shape, the dot structure of the final engraving plate will have a uniform screen pattern defined by regularly spaced excavations or recesses whose size depends upon the point-to-point reflectivity of corresponding portions of the original subject matter.

Machines of this type have been provided with various kinds of control circuits and adjustments whose purpose is to permit the operator to produce a satisfactory engraving under different conditions, and particularly from original matter having different reflection or tone scale characteristics. Thus, the patent referred to above provides a so-called white level control which in effect varies the magnitude of the amplified output of a photoelectric scanning means before applying it to further amplifiers and to a magnetoelectric motor producing movements of the engraving stylus toward and into the engraved sheet. That apparatus also includes a so-called black level control which governs the addition of a predetermined portion of the constant frequency output of a screen generator to the white level signal. By proper manipulation of these controls, satisfactory engravings may be made from a wide variety of different kinds of original matter.

Inasmuch as the engravings produced by such apparatus are intended for use either as printing plates or as masters

2

from which stereotype plates can be duplicated in a well known manner, and since the suitability of an engraving so prepared will ultimately be judged in terms of a printed copy produced thereby, it is apparent that other factors besides the nature of the original copy or photograph should be considered. A principal factor of this type is concerned with the particular nature of the printing process to be used, such as the kind of press, the kind of paper to be printed, the ink used, and so forth. With prior machines, while (given enough time) a very skilled operator might be able to make allowance for these factors in the preparation of the plate, the results are far from uniform and cannot be obtained with any accuracy by the ordinary user of the equipment. It is accordingly a principal object of the present invention to provide auxiliary or additional control circuits, and adjustable elements, for machines of this type, whereby the operator can make the desired correction in the engraving process to compensate for factors introduced in the use of the engraver plate after it has been prepared.

A further object of the invention is to provide a printing control circuit for inclusion in machines of the above type, which will involve only comparatively simple additions and modifications in more usual circuits which do not include this feature.

Still another object of the invention is to provide a circuit for photoelectric engraving machines which will include, in addition to black and white level controls, a control for establishing a predetermined and desired minimum hole size in the final engraved plate, in accordance with foreknowledge of the printing process in which the plate is to be used. As here employed, the term "hole size" refers to the area of the indentation or cavity produced in the engraving plate by the stylus, it being understood that under ordinary conditions this "hole" does not actually pass completely through the material of the plate. The establishment of a minimum hole size, where the product is a planographic printing plate, establishes a maximum ratio of printing area to non-printing area in the "blackest" portions of the plate.

The above and other objects of the invention will best be understood by referring now to the following detailed specification of a preferred embodiment thereof, taken in connection with the appended drawings, in which:

Fig. 1 is a schematic view illustrating the principal parts of a photoelectric engraving machine together with a combined block and schematic diagram of the electrical channels involved in the invention,

Fig. 2 is a graphical presentation relating stylus motor amplitude to various values of "smallest hole size,"

Fig. 3 is a typical wiring diagram for an addition circuit which may be used in the invention, and,

Fig. 4 is a similar diagram of a typical subtraction circuit.

As shown in Fig. 1 of the drawings, the general arrangement of the apparatus, in so far as concerns the scanning and engraving devices, and the drive system and screen tone generator, may be identical with those shown in the prior patent and the copending application referred to above. By way of review, it may be pointed out that the machine comprises the cylinders 10 and 12, mounted for synchronous rotation upon a common shaft 14 which may be driven as by reduction gearing 16 from a motor 18. One of the cylinders, such as cylinder 10, is arranged to have secured therearound an original, such as a photograph, of which an engraving is to be made. A carriage 20 is mounted to reciprocate along a path parallel to the axis of cylinder 10, as upon guides (not shown), and carries a suitable light source 22 directed upon a small spot of the original, from which the light is reflected to a photocell 24 also on carriage 20, so that the photocell output is a function of the reflectivity of the original.

tivity (or reflection density) of the successive regions of the original scanned by the device.

Cylinder 12 also has a carriage associated therewith, the same being designated 26, guided like cylinder 10 and carrying the magnetoelectric stylus motor and stylus indicated generally by 28. Cylinder 12 carries wrapped around it a plastic or like engraving sheet upon which the stylus cuts, burns, or otherwise forms an engraved image corresponding to the matter shown on the original copy sheet of cylinder 10. As more fully described in the prior patent referred to above, the carriages are connected to reciprocate alongside their respective cylinders in opposite directions as by being connected to opposite runs or passes of an endless flexible and inextensible belt-like connector 30 carried about opposite pulleys 32 and 34. One pulley is driven by suitable gearing, denoted by 36, from the same motor or gearing which rotates the cylinder shaft 14. Thus, the photocell system and the stylus system are reciprocated in timed relation to the cylinder rotation, and the illuminated spot and stylus trace out scanning helices upon the layers carried by their respective cylinders.

Since the final engraved plate must carry a representation equivalent to an ordinary screened printing plate for half-tone work, the apparatus includes means for generating a pattern signal governing the engraving motion of the stylus in a regular fashion, such signal being incorporated into the photocell output, as amplified and applied to the stylus motor. Such a generator is shown at 38 as driven synchronously from shaft 14, the details thereof being given in detail in the prior patent. The tone output, suitably amplified by a conventional amplifier 40, is applied to energize the gaseous illuminating lamp 22 over the path 42, and thus to modulate the photocell output voltage which also represents the variations in reflectivity of the original copy on cylinder 10, and the tone signal is also applied through other amplifiers and controls to the stylus motor 28.

The signal applied to the stylus motor is thus a composite signal made up of a component of fixed frequency and constant but adjustable amplitude, from the tone generator and intervening amplifiers and controls, and a component from the photocell and its output circuit which may be thought of as a varying direct current derived from the variations in reflection density of the original copy, superimposed or modulated upon a carrier at tone generator frequency injected by reason of the energization of the exciting lamp 22 from the generator 38. In the patent mentioned above, these two components are referred to as the black level signal and the white level signal, respectively, so called because in making a normal engraved plate, adjustment of the black level signal will control the minimum penetration of the engraving stylus (that is, in the absence of any illumination from the copy to the photocell), while the white level signal will control the magnitude of the increase in penetration resulting from the scanning of an area of the original which is capable of reflecting any sensible amount of light into the cell.

The manner of adjusting this apparatus for making suitable engravings from a particular original subject, such as a photograph, is described in detail in the prior cases, and since this procedure is not essential to the present invention, such description is omitted.

In the copending application, there are described the connections from amplifier 40 to ganged potentiometers 44 and 46 from the adjustable take-offs or contacts of which potentials are derived to control the stylus motor 28. As there described, the output of potentiometer 44 is subtracted from the amplified output of the photocell 24, as by a subtraction circuit, and the difference signal passes through a tone compensator to an addition circuit where it is added to the output from potentiometer 46 and the modified voltage so obtained is amplified and applied to the stylus motor 28.

In the present improvement, amplified tone signal from amplifier 40 passes over path 42 to excite the lamp 22 (and thereby to impose tone frequency modulation on the photocell output), and also passes to the ganged potentiometers 44 and 46. The common control shaft of these potentiometers is designated in Fig. 1 by numeral 100, and carries a clutch plate or element 102. A control knob 104 is carried by a concentric shaft 106 also terminating in a clutch plate 108, held normally spaced from clutch element 102 by a spring 110 urging knob 104 outwardly from the engaged position. A switch 112 is arranged so that when knob 104 is depressed to engage the clutch elements for making a black level adjustment, the channel 114 from tone amplifier 40 is interrupted, and the output lead or channel 116 from the switch is grounded to render ineffective certain parts now to be described. The arrangement of this switch for operation upon depressing knob 104 is merely illustrative, since other arrangements, including a separate manual switch, could be employed for the same purpose.

When the switch 112 is in the position shown in Fig. 1, a circuit is completed from lead or channel 114 to the lead 116 passing to another set of two ganged potentiometers numbered 118 and 120, the common control of which is shown as a manually operable knob 122 labeled "printing control." In its other position, the switch short circuits the potentiometers 118, 120.

Bearing in mind that the purpose of the invention is to modify the action of the engraving in accordance with the operator's knowledge of the intended use of the finished engraving, as regards the printing process, paper, ink and the like to be employed, it will be realized that the modification in machine characteristic is not concerned with the character of the original copy, which may be assumed to be of normal tonal scale. Hence, the setting of the black level control 104 must be made without the introduction of any effect from the printing control 122 and its associated circuits. This is the reason for the provision of switch 112.

In making the printing control adjustment, it is essential that it be accomplished before at least the white level setting has been made. However, since ordinarily more than one plate is to be made from an original for one printing run, the adjustment will not have to be repeated for every plate. Thus, it is recommended that in practice, the printing control adjustment be accomplished (if it is to be used at all) before both the black and white level settings are made.

With the copy to be scanned in place on cylinder 10 and a plate secured to cylinder 12, and with the machine running but the clutches disengaged, and with the stylus out of engagement with its surface, the procedure may be as follows. The printing control knob 122 is manipulated to a setting corresponding to the type of printing process to be used (ink, paper and so forth). Carriage 20 and cylinder 10 are set so that a "blackest" part of the copy is in position to control the cell output. Knob 104 is depressed and rotated to produce a predetermined "minimum" hole size in a test portion (edge) of the engraving blank, as described in the prior patent and application referred to above. Depression of knob 104 cancelled the effect of potentiometers 118, 120, although a separate switch could have been used for this purpose. Thereafter, the cylinder 10 and carriage 20 are adjusted to scan a "whitest" portion of the copy, and the white level setting made by the potentiometer controlled voltage source 124. The carriages are returned to their starting positions, the clutches engaged to drive cylinder 10 (and the carriages by tape 30), and the stylus engaged with the sheet to be engraved.

The proper setting of control 122 may be established by reference to experience, but more systematically, the possible variations in paper, ink and press to be used may be tabulated and assigned factors which are combined to give a single adjustment of control 122 to provide

the minimum hole size or plate penetration (in the "black" areas of the plate) which the machine will produce. The knob 122 will accordingly preferably be provided with a scale and pointer, or other means permitting its accurate positioning.

The normal adjustment procedure for black and white levels will ordinarily produce a certain, unchanging minimum hole size in the engraving, because the adjustment of black level is made while visually observing the pits produced as the knob 104 is adjusted, as fully described in the prior patent. With the machine in this condition, the printing control correction cannot be made by simply increasing the signal amplitude from potentiometer 44, because to do so would alter the over-all characteristic of the machine. For example, an increase in this amplitude to provide a larger minimum hole size for a certain printing process will increase the stylus travel for all parts of the plate or original, and since the photocell output level would be unchanged, the whitest portions of the plate might be completely devoid of plate surface. A certain minimum size of "islands" between pits must be maintained even in the white areas of the plate if satisfactory printing is to be done.

The above circuit provides for altering the minimum hole size that will be produced in the darkest areas of the plate, by potentiometer 118, and automatically makes a corrective change in the effective photocell output amplitude, by reason of the potentiometer 120, so that the requirement of a certain shape of machine characteristic (and a certain maximum penetration even in the white plate areas) is maintained.

During the making of the essential black signal level adjustment, and with knob 104 depressed to ground circuit 116, there will of course be zero output from the ganged potentiometers 118 and 120. Therefore, the fractional tone output from potentiometer 44 passes unmodified through adding circuit 124 and is subtracted as by circuit 126 from the photocell output amplified at 128. The resulting signal passes through tone compensator 130 and adding circuit 132 to the power amplifier and stylus motor 28. Adding circuit 132 accomplishes the addition of another fraction of the amplified tone generator output from potentiometer 46 passing through adding circuit 134, but the latter does not modify such fraction in any way because there is zero output from potentiometer 120 at this time.

When the initial adjustments for printing parameters and the black and white signal levels have been completed, and the engraving commenced, a modified signal will be delivered to the power amplifier by adding the portion derived from 118, via adding circuit 124, to the signal subtracted from the photocell output in subtracting circuit 126. Also, the related fraction of the amplified generator output from potentiometer 120 is added at circuit 134 to the fraction derived from potentiometer 46 so that a composite added signal is furnished to adding circuit 132 to modify the final signal delivered to the power amplifier.

The description above pertains to a machine employing tone compensation (element 130) for making possible good results in fine screen work. For coarser screens or lower quality of engravings, the compensator circuit may be omitted, in which case the potentiometers 44 and 118 will be unnecessary and will be omitted. The nature of the tone compensation system is fully described in the copending application of J. A. Boyajeau, Serial No. 248,755, filed September 28, 1951, now Patent No. 2,777,058, January 8, 1957, to which reference may be made for details.

Fig. 2 of the drawings shows graphically the change in reproduction density (obtained from an engraving when used in the selected printing process) introduced by the printing control circuits of the invention. The minimum hole size produced has been reduced by the amount indicated, at higher values of photographic density of the

original, without much change in the over-all characteristic of the machine for lower values of photographic density.

The adding and subtracting circuits of Fig. 1 may utilize either voltage addition and subtraction, or current addition and subtraction. Suitable circuits for these purposes are well known in the electronic field, but specific examples thereof are shown in Figs. 3 and 4. Fig. 3 represents a typical voltage adding circuit which combines the functions of the adders 132 and 134 of Fig. 1. In Fig. 3, numerals 136, 138 and 140 indicate three transformers whose primary windings are supplied with signals (to ground) representing the signals from potentiometer 46, potentiometer 120 and compensator 130 of Fig. 1. The secondary windings of the transformers (or selected fractions thereof, as indicated by the taps 142) are connected in series to deliver to the control electrode or input circuit of the following power amplifier a composite signal proportional to the sum of the three inputs. Where the transformers are made especially for a particular application, they can readily be designed so that the single output is obtained from a single secondary winding on a common core which also carries the three primary windings.

In Fig. 4, a similar circuit is illustrated, but which combines the functions of the adder 124 and subtractor 126 of Fig. 1. In this case, in which similar reference numerals are used to indicate the same elements as in Fig. 3, one of the secondary windings, designated 144, is reversed in phase (by reversal of terminals) to accomplish the subtraction of the signal from amplifier 128 from the sum of the signals from potentiometers 118 and 44.

While the invention has been described, by way of example, in connection with a preferred embodiment, it is to be understood that many variations thereof, and in its implementation, will occur to those skilled in this art. Therefore, the description above is to be taken as merely illustrative, and the invention is intended to include all such modifications as fall within the scope of the appended claims.

What is claimed is:

1. In a photo-electric engraving apparatus of the type having a photocell for sensing the reflection density of an original, and a light source for exciting said photocell, an engraving stylus and motor therefor for engraving a plate in accordance with signals derived from said photocell, a screen generator connected to said light source thereby to modulate the output signal of said photocell, and means for applying a part of the output of said generator to said stylus motor, the improvement which comprises an adjustable printing control including a first circuit means for deriving from said generator a first signal portion and for adding the same to the signal applied to said stylus motor, a second circuit means for deriving a second signal portion from said generator and for subtracting the same from the signal derived from said photocell means, and means for combining the resulting modified signals and applying the same additively to said stylus motor.

2. Photoelectric engraving apparatus in accordance with claim 1, including manually operable control means for concomitantly adjusting the magnitudes of the signals derived by said first and second circuit means.

3. Photoelectric engraving apparatus in accordance with claim 1, including manually operable switch means for simultaneously disabling said first and said second circuit means.

4. Apparatus in accordance with claim 2, in which said adjusting means comprises a pair of potentiometers connected respectively in the circuits of said first and second circuit means, and ganged manual control means for operating said potentiometers.

5. A control arrangement for photoelectric engraving machines of the type having photoelectric pickup means,

7

engraving means, and a constant frequency tone generator connected to both said photoelectric pickup means and said engraving means to energize the latter with a composite signal derived from said tone generator and from the output of said photoelectric means as modulated by said tone generator, comprising a first circuit means for deriving an adjustable portion of said generator signal and subtracting the same from the output of said photocell, a second circuit means for deriving another portion of said generator signal and combining the same with the difference signal obtained from said first circuit means, means for applying the combined signal to said engraving means, and printing control means adjustable to establish

8

a minimum selected amplitude of engraving, said printing control means comprising third circuit means for deriving a further adjustable portion of the output of said tone generator and subtracting the same from the output of said photocell, fourth circuit means for deriving a still another adjustable portion of the output of said generator and adding it to the composite signal applied to said engraving means, and means for concomitantly adjusting the portions of said generator signal derived by said third and fourth circuits means.

No references cited.