June 30, 1959 R. HELL 2,892,887

APPARATUS FOR PRODUCING SCREENED PRINTING FORMS WITH AUTOMATIC CORRECTION OF TONE VALUES

Filed Oct. 28, 1955 4 Sheets-Sheet 1

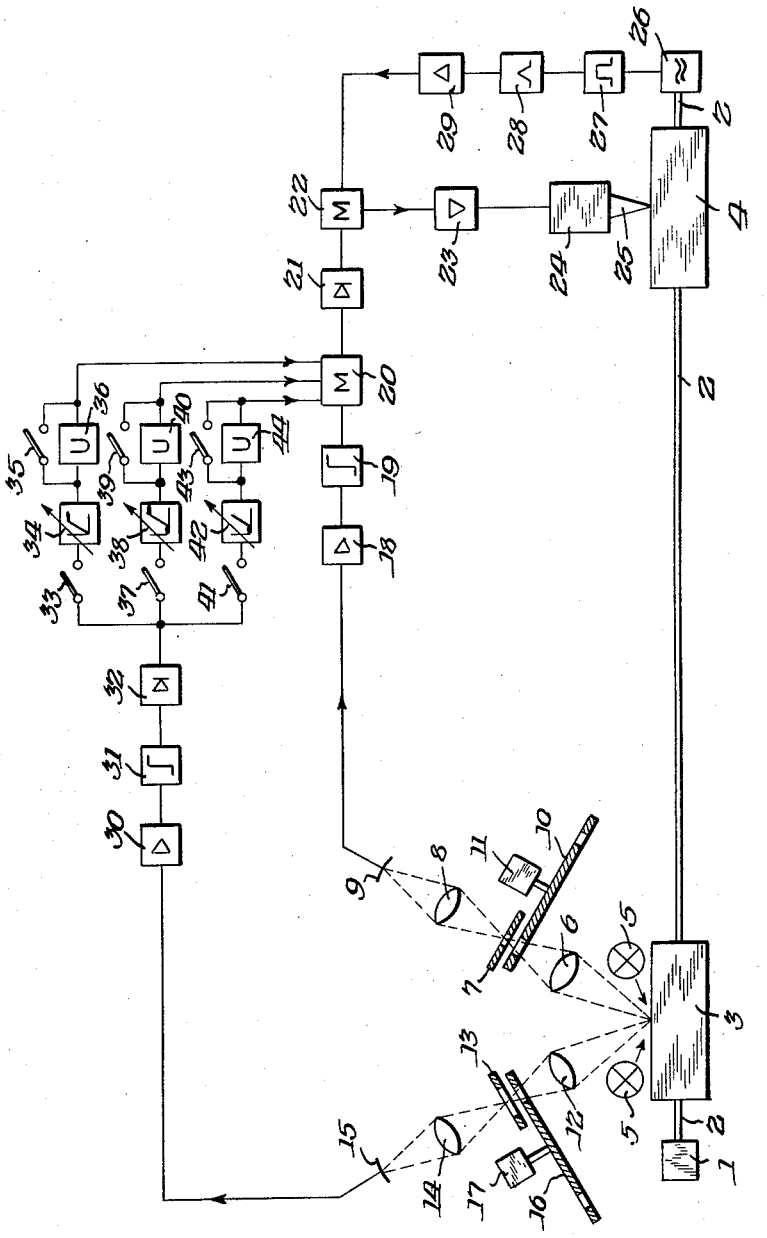

Fig. 1.

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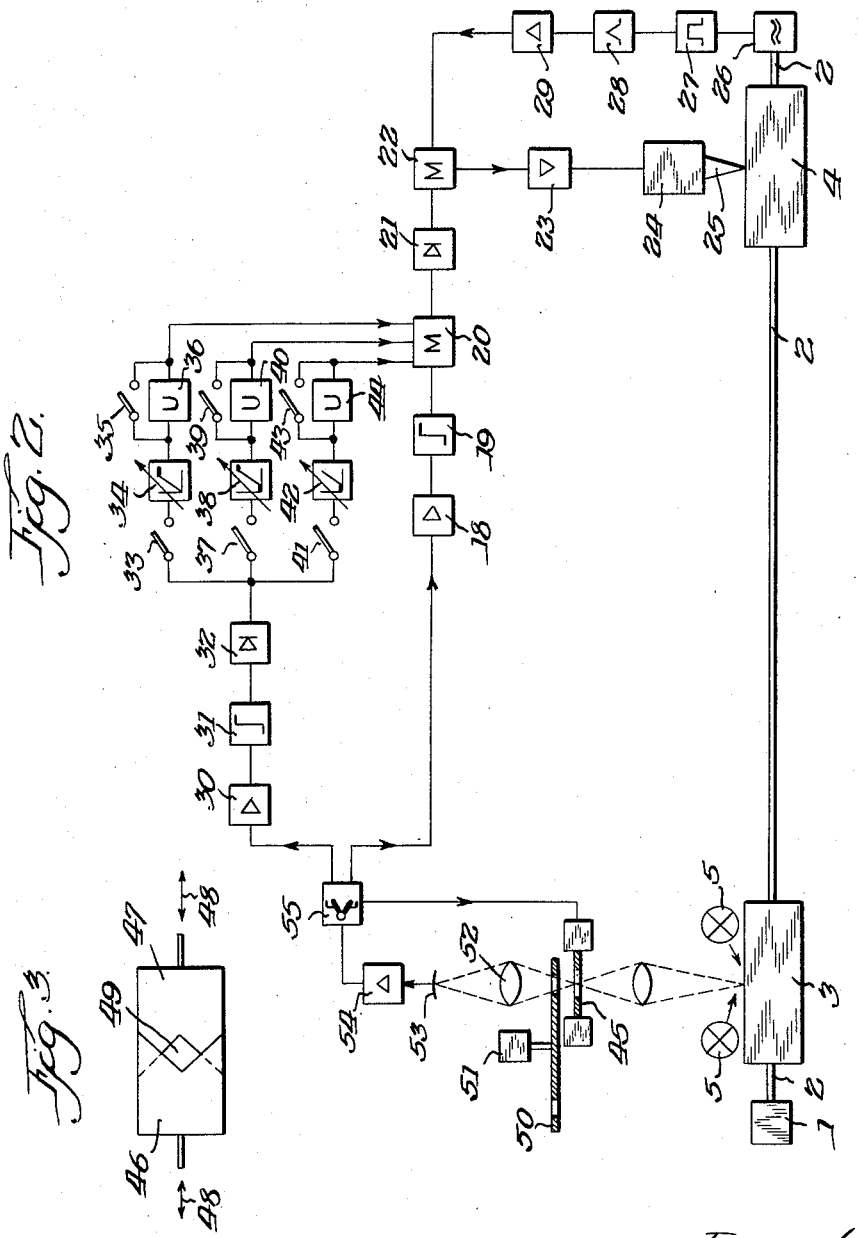

Fig. 2.

Fig. 3.

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Fig. 4

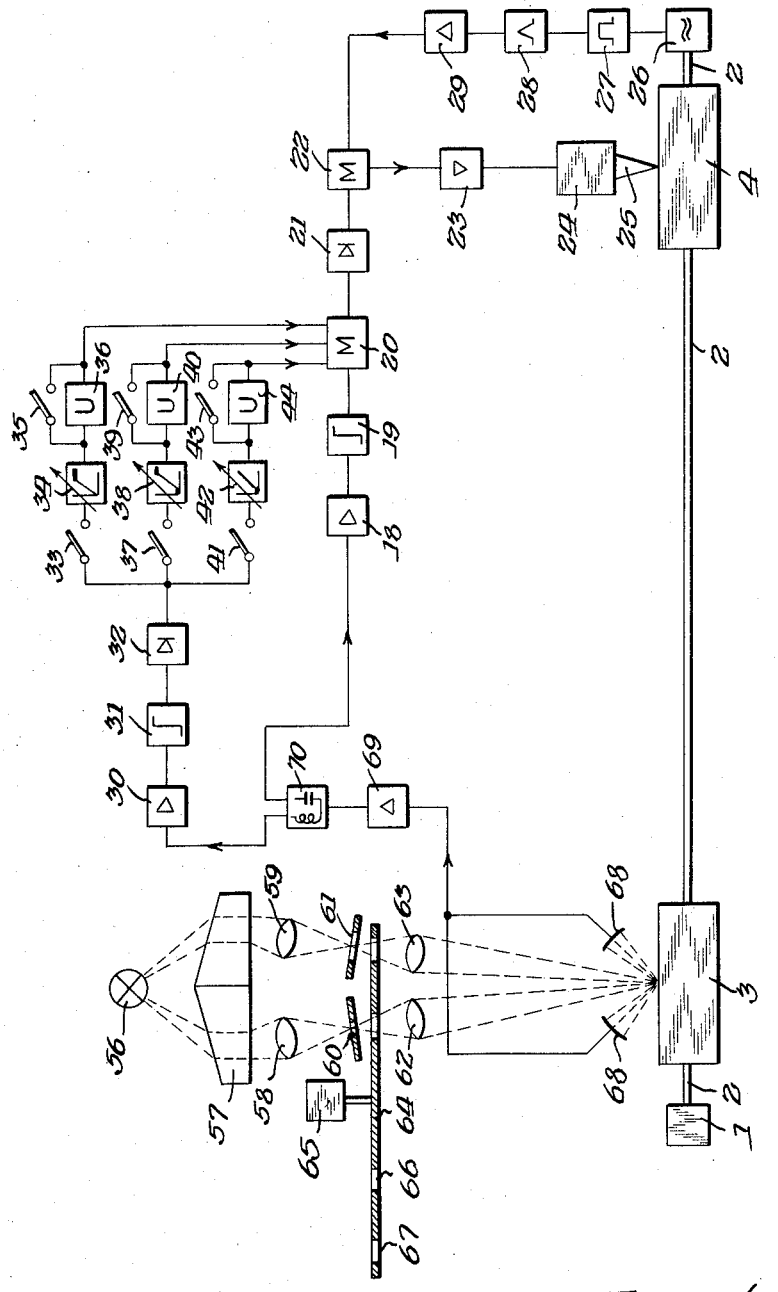

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Fig. 5.

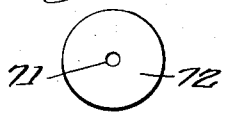


Fig. 6.

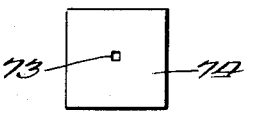


Fig. 7.

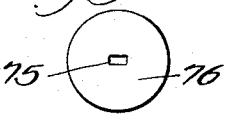


Fig. 8.

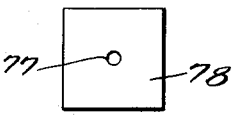


Fig. 9

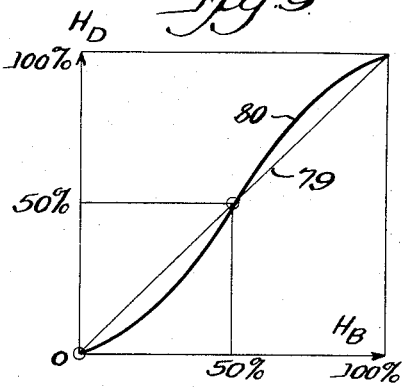


Fig. 10

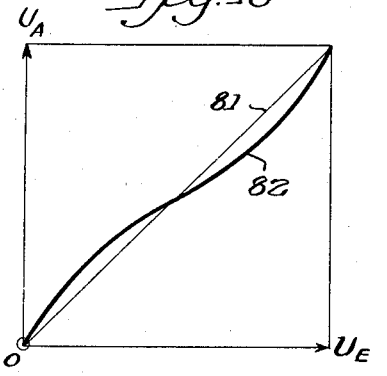


Fig. 11

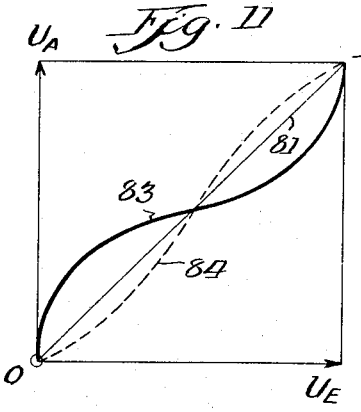
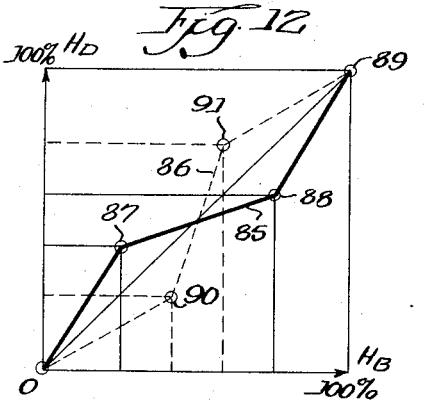


Fig. 12



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By [signature] Atty.

United States Patent Office 2,892,887 Patented June 30, 1959

2,892,887

APPARATUS FOR PRODUCING SCREENED PRINTING FORMS WITH AUTOMATIC CORRECTION OF TONE VALUES

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Application October 28, 1955, Serial No. 543,557

Claims priority, application Germany November 10, 1954

6 Claims. (Cl. 178—6.6)

This invention is concerned with a process of and apparatus for producing screened printing forms with automatic correction of tone values.

There are known electromechanical systems based on facsimile telegraph methods wherein an engraving tool is controlled by the photoelectric scanning of a copy, producing a screened plate which serves for the reproduction of the copy by printing. There exist in such systems between the brightness of the scanned surface element of the copy and the depth of penetration of the engraving tool into the printing form a functional relationship of the entire range of tone values, which is generally not linear due to the specific nature of the engraving process if a reproduction in true tone values is desired. The amplifier which controls the engraving tool for the copy voltages modulated in accordance with the brightness of the scanned surface elements must therefore contain suitable correcting means of such a nature that the functional relationship between the output and input voltage of the amplifier is inverse to the above-mentioned functional relationship so that the distortion of the engraving process is counteracted.

In general, there is desired a reproduction of the copy in the printing process which is of proper tone value. However, change in the tone values from those of the copy is sometime desired, either for the reason that the copy is excessively poor or rich in contrast as a whole or in certain parts thereof or that it is desired to emphasize fine details of the copy which are lost in excessive deep shadows or excessively high-lights by brightening the shadows or darkening the lights; in other words, if it is desired upon reproducing the copy in print, to improve it as a whole or only in one or more portions thereof.

A number of systems are known obtaining these improvements, which systems may be divided into manual and photographic processes. The manual processes consist either in retouching the copy or in a subsequent modification of the printing plate by changing the size of the halftone dots of certain regions by mechanical or chemical means. The photographic processes consist in the preparation of high-light, shadow or area masks, which are used together with the copy for the correction of the tone value. All of these known processes are cumbersome and time consuming and require great experience, so that they can only be performed by skilled persons.

The present invention relates to a system and process which effects the necessary corrections automatically in accordance with a predetermined program, without requiring any previous changes in the copy or any subsequent processing of the printing plate.

In accordance with the invention, the automatic correction of the reproduction of the tone values is achieved by having an additional scanning device scan, coincident with the scanning of a surface element, a larger area around such element on the copy and by employing

the average brightness value of the additionally scanned area to change the functional relationship in the entire range of tone values or only in one or more partial areas.

The starting and stopping of the changing of the tone-value reproduction upon approaching a portion of the copy, the brightness of which is to be reproduced with correction, is brought about in accordance with the invention by the additional scanning of the copy during the engraving process. Therefore, a distinction must be made between two scanning arrangements: On the one hand, there is blocked out of the copy a surface element which has the smallest possible extent in the direction of scanning and takes up the width of one scanning line at right angles to the direction of scanning. The brightness of this surface element, which is measured by means of a photoelectric cell, controls in known manner, with normal amplifier characteristic, the stroke of the engraving tool. On the other hand, an auxiliary scanning device blocks out an area of the copy which is considerably larger than the first scanning element and completely includes the latter. The average brightness of this auxiliary surface is measured by a second photoelectric cell independently of said first photoelectric cell. The auxiliary scanning arrangement by means of its large auxiliary surface which cannot resolve the details within this surface determines whether there is concerned a light, gray or dark portion of the copy. It therefore determines the general tone value of the copy at the area scanned. The main scanning device employing a small light spot cannot by itself make this determination if only for the reason that when scanning a very fine black detail in a white environment, its conclusion would be "black" and while scanning a very fine white detail in a black environment, its conclusion would be "white" although according to the general nature of the copy there is at the corresponding points "white" and "black" respectively. The photoelectric currents modulated in accordance with the brightness of the small surfaces scanned are conducted for further use to a main amplifier channel which contains a tone value correction stage and controls the engraving tool. The photo currents modulated in accordance with the brightness of the scanned auxiliary surfaces are fed to an auxiliary amplifier channel which may be used to affect the main channel within certain ranges of tone values. The tone value correction stage in the main channel, however, is only effective when the copy amplitudes of the auxiliary channel go above or below certain values. Accordingly, the auxiliary channel controls the tone value correction stage in the main channel in such a manner that the characteristic of the amplifier is properly varied either in the bright or in the dark region of the copy or in both at the same time. The invariable amplifier characteristic of the ordinary electromechanical engraving device is thus made flexible and may be changed at will within certain limits.

If a portion of the copy which is too dark is to be corrected in the production by a predetermined value, the auxiliary channel is provided with an amplitude limiter stage for suppressing the copy amplitudes which exceed an adjustable value. If a portion of the copy which is too bright is to be corrected, there is employed, in the auxiliary channel, an amplitude threshold stage which only passes copy amplitudes above an adjustable value. If finally a gray portion of the copy which lies in the medium tone range is to be corrected, the auxiliary channel is provided with an amplitude filter for suppressing copy amplitudes below an adjustable value and above another higher adjustable value.

In order now to be able to effect the three corrections

in the three tone value ranges black, gray and white, individually or simultaneously in any desired combination, the auxiliary channel may be subdivided into three channels, the first of which contains an amplitude (peak) limiter, the second an amplitude filter and the third an amplitude threshold. Each of these three auxiliary channels is provided with a device which permits the selective use of one or two channels or all three channels or even of none of the channels, as may be desired. The pass bands of the amplitude filters may be determined beforehand and adjusted individually independently of each other, in such a manner that the individual pass bands adjoin each other, overlap each other or do not have any parts in common. Furthermore, each of the three auxiliary channels may contain, in back of the corresponding amplitude filter, an inversion stage in order to reverse the polarity of the copy amplitudes which are passed through, if this should be necessary. The outputs of the three auxiliary channels are fed to a modulation stage disposed in the main channel, in which stage the control voltages of the correction channel may be superimposed on the control voltages of the main channel—either additively or subtractively as desired, by means of the inversion stages—in order to be able to amplify or weaken the effect of the main channel for a partial brightening of the copy or a partial darkening thereof. In a further modulation stage, a screen frequency is superimposed on the corrected picture voltages of the main channel. At the output of this modulation stage, there is provided a final amplifier which amplifies the corrected copy currents to the value necessary for the operation of the engraving tool. The amplified corrected copy currents finally control the stroke of the engraving tool in accordance with the functional relationship desired.

The various objects and features of the invention will now be described with reference to the accompanying drawings wherein

Figs. 1 to 4 show three embodiments of the invention;

Figs. 5 to 8 show different forms and combinations of the scanned surface element and the scanned auxiliary surface; and

Figs. 9 to 12 are diagrams showing copy and amplifier characteristics to aid the understanding of the description.

Fig. 1 shows in schematic manner a first embodiment of the invention. The motor **1** which runs at constant speed drives by means of a shaft or spindle **2** a drum **3** on which is arranged the original copy. On the same shaft there is a second drum **4** on which is fastened a blank which is to form the printing plate. Both drums carry out simultaneously a rotational motion about the axis of shaft **2** and a translatory motion axially of the shaft **2**. The translatory motions of the two drums are in the same or opposite direction, depending upon whether a laterally correct or laterally inverted halftone is desired. Instead of imparting translatory motions to the two drums, they may be caused only to rotate and the scanning and engraving devices to be described below may be guided for instance by a screw guide, parallel to the generatrices of the drums. In both cases, there is obtained a helical scanning of the copy and a helical engraving of the printing plate blank.

Instead of the two drums, **3**, **4**, there may also be used two flat carriages which carry out periodical line and translatory motions in two directions vertically to each other and to which the copy and the printing plate are fastened. In such arrangement, the copy is scanned in lines and at the same time, the printing plate blank is engraved in consecutive lines.

Finally, there may also be used a single flat carriage on top of which is disposed the printing plate blank while the copy is disposed on the bottom thereof. The engraving system is in such case arranged above the carriage and the scanning system below it in such a manner that a scanned surface element of the copy and the simultaneously engraved surface element of the printing plate blank lie vertically above each other.

The numerous specific mechanical possibilities of construction are without importance for the present invention, for which reason only one of them is shown schematically in the drawings.

One or more light sources **5** illuminate the copy on the drum **3**. The small surface element on the copy which is to be scanned is blocked out by means of a lens **6** and a small diaphragm **7**, and an image of it is formed in the photoelectric cell **9** by a further lens **8**. By means of the rotating apertured chopper disc **10** which is driven by a motor **11**, the photoelectric cell **9** is intermittently illuminated so as to produce a carrier frequency. The auxiliary picture surface is blocked out by a lens **12** and a larger diaphragm **13** and is projected by another lens **14** into the photoelectric cell **15**. By a rotating chopper disc **16** which is driven by a motor **17**, the photoelectric cell **15** is intermittently illuminated with another interruption frequency so as to produce a second carrier frequency. Instead of using rotating chopper discs to produce the carrier frequencies, periodically igniting gas discharge lamps may be used in place of the light sources **5**.

If the copy is transparent, the illuminating arrangement and the two scanning devices may be arranged on one side of the drum surface **3**, on the one hand, and the two photoelectric cells on the other hand can be arranged on different sides of the surface **3** of the drum.

The photoelectric current produced in the photoelectric cell **9**, which varies with the brightness of the scanned surface elements of the copy is fed to the amplifier channel **18—23**, which hereinafter will be called the main or picture channel. In **18**, the photoelectric current is amplified and thereupon corrected in **19**. After it has passed through circuit element **20**, it is rectified in a rectifier **21** and freed of the carrier frequency by filters. Thereupon it passes through the circuit component **22** into the final amplifier **23** to which the engraving system **24** is connected, the engraving tool **25** of which cuts the plate blank on the drum **4**. As engraving tool, there may be used in the known manner piercing, drilling, milling, cutting, burning, or chemically acting devices. A tone wheel **26**, driven by the shaft **2**, supplies the field frequency for the engraving system **24**. This field frequency is positively synchronized with the rotation of the drums **3** and **4** and with their translatory motions or with the translatory motions of the scanning and engraving system. **27** is a multivibrator which supplies square impulses, the frequency of which is synchronized by the tone-wheel frequency. In the circuit component **28**, the square impulses are shaped into saw tooth triangular impulses and thereupon amplified in an amplifier **29**. The amplified triangular impulses are fed to the modulation stage **22** in which the scanning (field) frequency is superimposed on the picture voltages of the picture channel **18—21**.

If the motor **1** is an A.C. synchronous motor, its feed frequency may be used to produce the field (scanning) frequency in place of the frequency produced by tone wheel **26**, there being filtered out of such feed frequency in a frequency multiplier a higher harmonic which may be used for synchronizing the impulse frequency of the multivibrator **27**.

The photoelectric current proceeding from the photoelectric cell **15**, which current varies with the average brightness of the scanned auxiliary surfaces of the copy, is fed to the amplifier channel **30—32** which hereinafter will be called the auxiliary or correction channel. The photoelectric current is amplified at **30**, corrected at **31** and demodulated and freed of the carrier frequency by filters at **32**. Thereupon, the correction channel **30—32** is split into the three partial channels **33—36**, **37—40** and **41—44**.

The partial channel **33—36** which may be called the "black" channel contains an amplitude limiter stage **34**,

which in known manner suppresses copy voltages of the correction channel above a certain value. The amplitude limiter or filter **34** may for instance be an electron tube whose control grid is controlled by the control voltage from **32** and whose plate voltage is conducted to the modulator **20**. The plate current is limited (cut off) by the action of the grid current which makes the control grid negative such that the plate current will not increase despite increase of the control grid potential. The control grid is biased such that the grid current becomes operative at the instant when the control grid potential reaches a value at which no further increase of the output voltage should occur. To this threshold value of the control grid potential corresponds a certain value of the plate current and therefore a certain value of the plate voltage at the plate circuit which remains constant beginning with such value.

The partial channel **37—40**, which may be called the "gray" channel, contains an amplitude filter which suppresses in known manner copy voltages of the correction channel below a certain value and above a certain larger value. The amplitude filter **38** may for instance be a triode or a pentode, the grid of which is so strongly negatively biased that the working point of the grid voltage-plate current-characteristic lies to the left of the lower bend of the characteristic. Accordingly, no plate current will flow up to a certain control grid voltage (lower threshold value). The tube is otherwise controlled into the grid current region, as described in connection with the filter **34**, a result of which, the plate current is limited, thereby also limiting the plate voltage upon further increase of the control grid voltage (upper threshold value).

The partial channel **41—44** finally, which may be called the "white" channel contains an amplitude threshold stage, which in known manner suppresses copy voltages of the correction channel below a given value. The amplitude threshold may for instance comprise an electron tube the grid of which is so strongly negatively biased that the working point lies to the left of the lower bend of the characteristic.

The pass band of the three amplitude filters may be adjustably changed independently of each other in such a manner that the three bands "black," "gray," "white" adjoin each other, overlap each other or have no part in common.

By means of three switches **33, 37, 41**, the three partial channels may be selectively connected and disconnected either individually or in any desired combination.

In back of the amplitude filters **34, 38, 42** there are the inversion stages **36, 40, 44** by means of which the polarity of the copy voltages passed by the filters can be reversed if a weakening of the copy voltages of the main channel in the sense of a darkening of one or more of the three tone-value bands "black," "gray," and "white" is intended. By means of three short circuit switches **35, 39, 43**, the inversion stages may be selectively bridged either individually or in any desired combination so as to make them inactive.

The outputs of the three partial channels are fed to the modulation stage **20** located in the main channel in which stage the copy voltages of the correction channel are superimposed on the copy voltages of the main channel, either additively or subtractively for a partial brightening or darkening of the copy depending on whether the inversion stages in the partial channels are or are not used. The modulation, which is an amplitude modulation, may for instance be effected in known manner by additive triode mixing or by multiplicative mixing in a multigrid tube or else by means of rectifier circuits.

The influencing of the main channel by the correction channel—if an electromagnetic or an electrodynamic engraving system is employed—may also be obtained in the manner that the engraving system has four separate windings one of which is connected to the main channel, omitting the modulation stage **20**, the other three of which are connected to the three outputs of the partial channels. Finally, the superimposing of the field frequency, omitting the modulation stage **22**, may also be effected by a fifth winding, which is connected to the amplifier **29**.

While in Fig. 1, the surface element and the auxiliary surface are scanned simultaneously, in Fig. 2, they are scanned one after the other. For this purpose, the size of the diaphragm **45** is made adjustable. For instance there may be used two slides, **46** and **47** in Fig. 3, which are periodically moved towards and away from each other in the direction **48**. In this way, once a small diaphragm surface **49** is exposed and another time, a large diaphragm surface **49**. The diaphragm **45** in Fig. 2 is in known manner again imaged in the photoelectric cell **53** over a lens **52** by action of a rotating chopper disc **50** which is driven by a motor **51**. The photoelectric current amplified at **54** is fed to a periodically operating switch **55**, for instance a vacuum tube switch, which controls the motion of the pulsating diaphragm **45** and at the same time feeds the photoelectric current at the small diaphragm surface **49** to the amplifier **18** and at the large diaphragm surface **49** to the amplifier **30**. After this separation in time into the main channel **18—22** and the correction channel **30—32**, the further arrangement and manner of operation of the invention is exactly the same as shown in Fig. 1. The circuit components which correspond to each other bear the same numerals.

In Fig. 4, the rays of light emerging from a source of light **56** are split up by a double prism **57** and illuminate, over the lenses **58** and **59**, a small diaphragm **60** and a large diaphragm **61**. The two diaphragms are imaged by further lenses **62** and **63** on the picture on the drum **3**. A chopper disc **64** which is driven by the motor **65**, and which has two annular apertures **66** and **67**, interrupts the two beams with different frequencies, thereby producing two carrier frequencies. These carrier frequencies are separated by filters and fed respectively to the main channel and to the correction channel. The chopper disk has for this purpose a different number of apertures along **67, 66**. The light reflected by the copy illuminates photoelectric cells **68** which are connected in parallel. At **69**, the copy currents are amplified and are separated in accordance with frequency in the electric dividing network **70** which may comprise for instance a high pass and low pass connected in parallel. In this way, the photoelectric current modulated by the scanning of the light spot may be fed to the main channel **18—23** and the photoelectric current modulated by the scanning of the light surfaces may be fed to the correction channel **30—32**. The further treatment of the copy and correction currents is the same as indicated in Fig. 1. Corresponding circuit components bear the same numerals.

In Fig. 5, **71** is the surface of a scanning element which has the shape of a small circle and **72** is a circular auxiliary surface with which the adjoining vicinity of the scanning element **71** is scanned. The areas **72** are concentric to each other and have considerably different sizes.

In Fig. 6, there is shown another form of a small scanning element **73** and of a larger auxiliary scanning surface **74**. Both of them have in this case the form of squares or rectangles which are concentric with each other.

In Fig. 7, the small scanning element **75** has the shape of a small rectangle or square while the larger auxiliary scanning surface **76** is circular.

In Fig. 8, finally, the scanning element **77** is of circular shape and the auxiliary scanning surface **78** has the shape of a concentric square or rectangle.

Fig. 9 shows a diagram in which the percentage brightness H_B of the copy is plotted horizontally and the percentage brightness H_D of the print is plotted vertically. 0% brightness corresponds in this connection to deepest black and 100% brightness to brightest white. In case

of reproduction in correct one value H_D is proportional to H_B and the relationship between the two values is indicated by a straight line **79** which passes through the point of origin O. Numeral **80** indicates the typical course of a gradation curve of the print for instance if a linear engraving system, a wedge-shaped engraving needle and between the photoelecetric cell and the engraving system, a linear amplifier is used. The non-linear course of **80** is due to the fact that the size of the surface elements which is cut out on the plate is approximately proportional to the square of the depth of penetration of the engraving tool. As a result, there is produced a distortion of the tone value of the print as compared with the copy in the sense of a reduced resolution into black and white and an increased gray resolution. The slope of the curve **80** is a measure of the resolution of the tone value.

In the diagram of Fig. 10, the input voltage U_E is plotted horizontally and the output voltage U_A of the amplifier is plotted vertically. The straight line **81** shows a linear relationship between U_A and U_E which would result in the gradation curve **80** of Fig. 9. In order now to compensate for the distortion of the tone value of the print as compared with the copy, the amplifier must be imparted a characteristic the course of which is shown by curve **82** in Fig. 10. The function which is represented by the curve **82** must be inverse to the function represented by the curve **80** in Fig. 9.

Fig. 11 shows two deformed amplifier characteristics **83** and **84**, which are obtained from **82** in Fig. 10 by the action of the correction on the main channel so as to obtain an intended change in tone value of the print as compared with the copy. Compared with curve **82** of Fig. 10, there exists here an over and under compensation respectively of the compensation for the tone-value distortion necessary solely due to the non-linear engraving process.

Fig. 12 shows diagrammatically the effect of the deformations **83** and **84** of the amplifier characteristic **82** on the gradation of the print. The line **85** corresponds to the amplifier characteristic **83**. In its first portion, from **0** to **87**, an increased black resolution takes place as compared with **79**. In its second section from **87** to **88** the gray resolution is smaller as compared with **79**. In its third section from **88** to **89**, the white resolution is larger as compared with **79**. The line **86** corresponds to the amplifier characteristic **84**. In its first section, from **0** to **90**, the black resolution is smaller than in **79**, in its second section from **90** to **91**, the gray resolution is larger than in **79** and in its third section, from **91** to **89**, the white resolution is smaller than in **79**.

Changes may be made within the scope and spirit of the appended claims.

I claim:

1. Apparatus for producing printing plates for the reproduction of desired copies, comprising means for photoelectrically scanning surface elements of a copy to be reproduced, simultaneously photoelectrically scanning definitely delimited areas surrounding scanned surface elements, means for producing incident to said scanning two control voltages of different frequencies, a main channel, an auxiliary correction channel, amplifying means in each channel, modulating means in said main channel, means for feeding the voltages from said element scanning to said main channel, means for feeding the voltages from said area scanning to said correction channel, said correction channel containing an amplitude limiter and an amplitude filter and amplitude threshold means, means for selectively connecting said limiter and said filter and said threshold means with said modulator to modulate the voltages from said element scanning, an engraving tool for engraving a blank which is to form a printing plate corresponding to said copy, and means for controlling the operation of said engraving tool by the modulated voltages from said modulator.

2. Apparatus for electromechanically producing printing plates by photoelectrically scanning a copy to be reproduced dot by dot along consecutive scanning lines and simultaneously dot-cutting by means of an engraving tool under control of amplified photocell currents a blank which is to form a corresponding printing plate, a given invariable non-linear shape of the characteristic of the photocell amplifier means existing for the entire tone range, said characteristic compensating the non-linear relationship between the depth of penetration of the engraving tool and the area of the scanned element to be cut; said apparatus comprising, a first scanning device providing a small light spot to illuminate a small area element of the copy to be reproduced, the reflected light intensity of said small light spot corresponding to the brightness of the dot being scanned and controlling the depth of penetration of the engraving tool, a second scanning device providing a considerably larger light spot completely surrounding said small light spot to illuminate a delimited vicinity of said small light spot of the copy being scanned, the reflected light intensity of said larger light spot corresponding to the average brightness in the vicinity of the dot element being scanned and measuring the general tone value in said vicinity without resolving details of the copy, means for periodically interrupting the scanning light beams of said scanning devices to produce two different carrier frequencies, means for separating the two electrical signals generated by the conversion of light fluctuations into current fluctuations in the photocells of the scanning devices and originating from the two light spots, two separate amplifier channels, one of said channels constituting a main channel associated with said small light spot and the other channel constituting a correction channel associated with the larger light spot, means for conducting the respective signals from said light spots to the respectively associated channels, and means in said correction channel for controlling said main channel for the purpose of automatically altering the gradation relationship between the brightness of the copy being scanned and the brightness of the reproduction to be made by said printing plate.

3. Apparatus for electromechanically producing printing plates by photoelectrically scanning a copy to be reproduced dot by dot along consecutive scanning lines and simultaneously dot-cutting by means of an engraving tool under control of amplified photocell currents a blank which is to form a corresponding printing plate, a given invariable non-linear shape of the characteristic of the photocell amplifier means existing for the entire tone range, said characteristic compensating the non-linear relationship between the depth of penetration of the engraving tool and the area of the scanned element to be cut; said apparatus comprising, a first scanning device providing a small light spot to illuminate a small area element of the copy to be reproduced, the reflected light intensity of said small light spot corresponding to the brightness of the dot being scanned and controlling the depth of penetration of the engraving tool, a second scanning device providing a considerably larger light spot completely surrounding said small light spot to illuminate a delimited vicinity of said small light spot of the copy being scanned, the reflected light intensity of said larger light spot corresponding to the average brightness in the vicinity of the dot element being scanned and measuring the general tone value in said vicinity without resolving details of the copy, means for periodically interrupting the scanning light beams of said scanning devices to produce two carrier frequencies, means for separating the two electrical signals generated by the conversion of light fluctuations into current fluctuations in the photocells of the scanning devices and originating from the two light spots, two separate amplifier channels, one of said channels constituting a main channel associated with said small light spot and the other channel constituting a correction channel associated with the larger light spot, said main chan-

nel comprising an A.C.-photocell current amplifier, distortion means, a first amplitude modulator for modulating the main signal received with the control signal from said correction channel, a rectifier for demodulating the main signal from its carrier frequency, a second modulator for superimposing upon said demodulated main signal a screen frequency, a D.C.-power amplifier, and an engraving system comprising an engraving tool, means for conducting the respective signals from said light spots to the respectively associated channels, and means in said correction channel for controlling said main channel for the purpose of automatically altering the gradation relationship between the brightness of the copy being scanned and the brightness of the reproduction to be made by said printing plate.

4. Apparatus for electromechanically producing printing plates by photoelectrically scanning a copy to be reproduced dot by dot along consecutive scanning lines and simultaneously dot-cutting by means of an engraving tool under control of amplified photocell currents a blank which is to form a corresponding printing plate, a given invariable non-linear shape of the characteristic of the photocell amplifier means existing for the entire tone range, said characteristic compensating the non-linear relationship between the depth of penetration of the engraving tool and the area of the scanned element to be cut; said apparatus comprising, a first scanning device providing a small light spot to illuminate a small area element of the copy to be reproduced, the reflected light intensity of said small light spot corresponding to the brightness of the dot being scanned and controlling the depth of penetration of the engraving tool, a second scanning device providing a considerably larger light spot completely surrounding said small light spot to illuminate a delimited vicinity of said small light spot of the copy being scanned, the reflected light intensity of said larger light spot corresponding to the average brightness in the vicinity of the dot element being scanned and measuring the general tone value in said vicinity without resolving details of the copy, means for periodically interrupting the scanning light beams of said scanning devices to produce two carrier frequencies, means for separating the two electrical signals generated by the conversion of light fluctuations into current fluctuations in the photocells of the scanning devices and originating from the two light spots, two separate amplifier channels, one of said channels constituting a main channel associated with said small light spot and the other channel constituting a correction channel associated with the larger light spot, said main channel comprising an A.C.-photocell current amplifier, distortion means, a first amplitude modulator for modulating the main signal received with the control signal from said correction channel, a rectifier for demodulating the main signal from its carrier frequency, a second modulator for superimposing upon said demodulated main signal a screen frequency, a D.C.-power amplifier, and an engraving system comprising an engraving tool, means for conducting the respective signals from said light spots to the respectively associated channels, and control means in said correction channel for controlling said main channel for the purpose of automatically altering the gradation relationship between the brightness of the copy being scanned and the brightness of the reproduction to be made by said printing plate, said control means comprising an A.C.-photocell amplifier, distortion means, a rectifier for demodulating said control signal from its carrier frequency, three branch channels connected with said rectifier, each of said branch channels containing a switch for respectively connecting and disconnecting the corresponding branch channel, an amplitude filter with adjustable pass band, an inverting stage for the polarity of the D.C.-control signal, and a short-circuiting switch for shunting said inverting stage.

5. Apparatus for electromechanically producing printing plates by photoelectrically scanning a copy to be reproduced dot by dot along consecutive scanning lines and simultaneously dot-cutting by means of an engraving tool under control of amplified photocell currents a blank which is to form a corresponding printing plate, a given invariable non-linear shape of the characteristic of the photocell amplifier means existing for the entire tone range, said characteristic compensating the non-linear relationship between the depth of penetration of the engraving tool and the area of the scanned element to be cut; said apparatus comprising, a first scanning device providing a small light spot to illuminate a small area element of the copy to be reproduced, the reflected light intensity of said small light spot corresponding to the brightness of the dot being scanned and controlling the depth of penetration of the engraving tool, a second scanning device providing a considerably larger light spot completely surrounding said small light spot to illuminate a delimited vicinity of said small light spot of the copy being scanned, the reflected light intensity of said larger light spot corresponding to the average brightness in the vicinity of the dot element being scanned and measuring the general tone value in said vicinity without resolving details of the copy, means for periodically interrupting the scanning light beams of said scanning devices to produce two carrier frequencies, means for separating the two electrical signals generated by the conversion of light fluctuations into current fluctuations in the photocells of the scanning devices and originating from the two light spots, two separate amplifier channels, one of said channels constituting a main channel associated with said small light spot and the other channel constituting a correction channel associated with the larger light spot, said main channel comprising an A.C.-photocell current amplifier, distortion means, a first amplitude modulator for modulating the main signal received with the control signal from said correction channel, a rectifier for demodulating the main signal from its carrier frequency, a second modulator for superimposing upon said demodulated main signal a screen frequency, a D.C.-power amplifier, and an engraving system comprising an engraving tool, means for conducting the respective signals from said light spots to the respectively associated channels, and control means in said correction channel for controlling said main channel for the purpose of automatically altering the gradation relationship between the brightness of the copy being scanned and the brightness of the reproduction to be made by said printing plate, said control means comprising an A.C.-photocell amplifier, distortion means, a rectifier for demodulating said control signal from its carrier frequency, three branch channels connected with said rectifier, each of said branch channels containing a switch for respectively connecting and disconnecting the corresponding branch channel, an amplitude filter with adjustable pass band, an inverting stage for the polarity of the D.C.-control signal, a short-circuiting switch for shunting said inverting stage, and circuit means for connecting the outputs of said branch channels with the first modulating stage in said main channel.

6. Apparatus for electromechanically producing printing plates by photoelectrically scanning a copy to be reproduced dot by dot along consecutive scanning lines and simultaneously dot-cutting by means of an engraving tool under control of amplified photocell currents a blank which is to form a corresponding printing plate, a given invariable non-linear shape of the characteristic of the photocell amplifier means existing for the entire tone range, said characteristic compensating the non-linear relationship between the depth of penetration of the engraving tool and the area of the scanned element to be cut; said apparatus comprising, a first scanning device providing a small light spot to illuminate a small area element of the copy to be reproduced, the reflected light intensity of said small light spot corresponding to the

brightness of the dot being scanned and controlling the depth of penetration of the engraving tool, a second scanning device providing a considerably larger light spot completely surrounding said small light spot to illuminate a delimited vicinity of said small light spot of the copy being scanned, the reflected light intensity of said larger light spot corresponding to the average brightness in the vicinity of the dot element being scanned and measuring the general tone value in said vicinity without resolving details of the copy, means for periodically interrupting the scanning light beams of said scanning devices to produce two carrier frequencies, means for separating the two electrical signals generated by the conversion of light fluctuations into current fluctuations in the photocells of the scanning devices and originating from the two light spots, two separate amplifier channels, one of said channels constituting a main channel associated with said small light spot and the other channel constituting a correction channel associated with the larger light spot, said main channel comprising an A.C.-photocell current amplifier, distortion means, a first amplitude modulator for modulating the main signal received with the control signal from said correction channel, a rectifier for demodulating the main signal from its carrier frequency, a second modulator for superimposing upon said demodulated main signal a screen frequency, a D.C.-power amplifier, and an engraving system comprising an engraving tool, means for conducting the respective signals from said light spots to the respectively associated channels, and control means in said correction channel for controlling said main channel for the purpose of automatically altering the gradation relationship between the brightness of the copy being scanned and the brightness of the reproduction to be made by said printing plate, said control means comprising an A.C.-photocell amplifier, distortion means, a rectifier for demodulating said control signal from its carrier frequency, three branch channels connected with said rectifier, each of said branch channels containing a switch for respectively connecting and disconnecting the corresponding branch channel, an amplitude filter with adjustable pass band, an inverting stage for the polarity of the D.C.-control signal, a short-circuiting switch for shunting said inverting stage, and circuit means for connecting the outputs of said branch channels with the first modulating stage in said main channel, and a further channel containing a frequency generator, a multivibrator the frequency of which is synchronized with the frequency of said generator, means for shaping the impulses from said multivibrator to produce sawtooth impulses, an amplifier for amplifying said sawtooth impulses, and means for feeding said amplified sawtooth impulses to said second modulator of said main channel.

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