Nov. 29, 1960 H. TAUDT 2,962,548

DEVICE FOR INCREASING CONTRASTS AT TONE VALUE LEAPS AND CONTOURS IN PRINTING FORMS

Filed Aug. 12, 1958

Fig. 1.

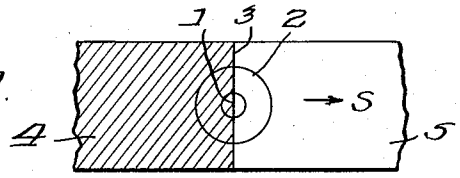


Fig. 2.

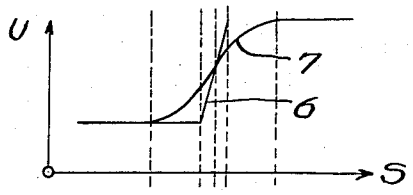


Fig. 3.

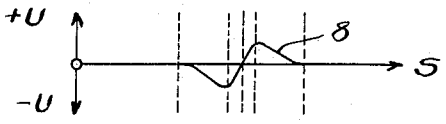
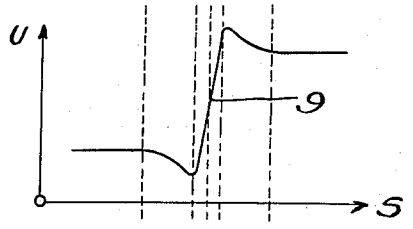


Fig. 4



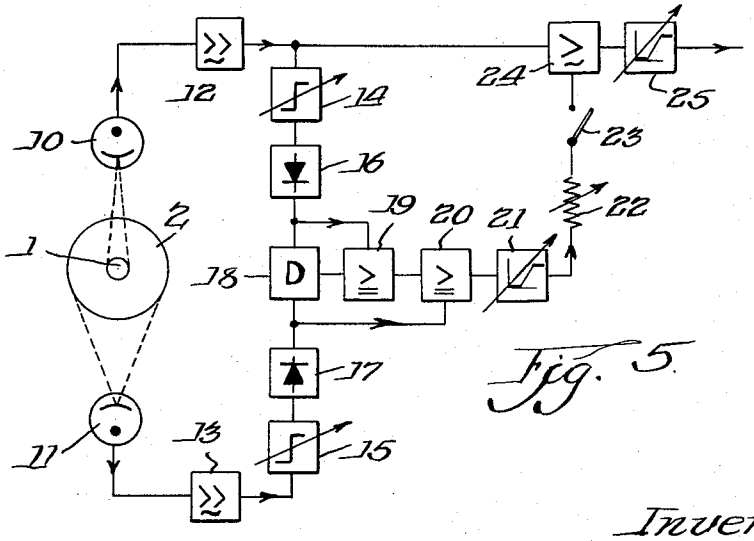


Fig. 5.

Inventor:
Heinz Taudt.
By
Atty.

United States Patent Office 2,962,548
Patented Nov. 29, 1960

2,962,548

DEVICE FOR INCREASING CONTRASTS AT TONE VALUE LEAPS AND CONTOURS IN PRINTING FORMS

Heinz Taudt, Kiel, Germany, assignor to Dr.-Ing. Rudolf Hell Kommanditgesellschaft, Kiel-Dietrichsdorf, Germany, a German company

Filed Aug. 12, 1958, Ser. No. 754,691

Claims priority, application Germany Aug. 14, 1957

7 Claims. (Cl. 178—6.6)

This invention is concerned with a method of and apparatus for artificially increasing contrasts at tone value leaps and contours in printing forms produced by means of electronically controlled machines employing scanning of surrounding fields. The term "tone value leaps" is intended to mean sudden or abrupt changes in the tone value of areas or regions of picture copies to be reproduced.

In reproduction methods for relief printing of pictures, there occurs a lessening or diminution of contrasts and sharpness with respect to individual tone value ranges and also at the borders of abrupt tone value transitions and contours, such lessening being mainly caused by the screening which is indispensable for the printing. This lessening or diminution of contrast and sharpness which becomes manifest in that the course of the transition from black to white or white to black extends in the print at the border of tone value leaps and contours more gradually than in the original, so that a narrow gray zone appears in place of a sharp border line or contour line, respectively, and further, in that black areas contain small white dots while white areas contain small black dots.

It often becomes desirable to effect changes in the reproduction, for example, in the case of picture copies which are difficult to reproduce due to lacking contrasts or sharp contours, requiring falsification of the print as compared with the original copy to provide the desired improvement.

It is known in connection with modern electronic machines for producing printing forms or plates, in which the depth of penetration of an engraving tool into the material of a printing form blank is controlled by the brightness of photoelectrically scanned picture points of the copy to be reproduced, to impart to the gradation, that is, to the correlation between the brightness and the blackening of the print and the brightness and blackening of the copy, within certain limits a desired course, making it possible to effect an increased or diminished resolution of the black, gray or white tone value ranges and even to effect a tone value reversal without preparatory alteration (retouching) of the copy or subsequent alteration (partial corrective etching) of the printing form. This gradation alteration, however, effects all picture portions wherever identical blackening is encountered, without giving preference to sudden tone value leaps and contours. It is moreover known to make these gradation alterations locally variable and, by means of scanning surrounding areas, dependent upon the character of the local tone value, so that different picture portions with the same black shading are reproduced with different gradation.

The television technique employs for the improvement of the horizontal resolution of the television picture the method of differentiating distortion correction. For the compensation of the flattening of picture signals at a sharp tone value change, there is thereby achieved a

steepening of the transition in the signal, by subtracting from the picture signal the second differential quotient thereof. The effective operating range of this correction may be determined by the choice of the amplitude of the second derivation of the picture signal.

In accordance with the invention, an artificial contrast increase at tone value leaps or contours is obtained by reproducing in the immediate neighborhood on both sides of the tone value leap and the contour, respectively, the darker picture portion darker and the brighter picture portion brighter than at a greater distance from the corresponding leap or contour, respectively. This local tone value control produces a narrow demarcation line or seam (gloriole) on both sides of the tone value leap and the contour, respectively, which emphasizes the sudden change. The human eye tolerates such falsifications and recognizes them as increasing contrasts provided the emphasis is held within certain limits, that is, provided it is not overdone.

The invention is realized by deriving a difference signal from the picture signal and the surrounding area signal and additively or multiplicatively influencing the picture signal by the difference signal.

The various objects and features of the invention will be brought out in the course of the description which will be rendered below with reference to the accompanying drawing, in which

Fig. 1 shows the scanning light dot or spot and the surrounding field upon passing a sudden tone value change or leap;

Fig. 2 illustrates the course of the picture and surrounding field signal voltage on both sides of the tone value leap;

Fig. 3 indicates the course of the difference signal voltage;

Fig. 4 shows the course of the picture signal affected by the difference signal; and

Fig. 5 is a circuit for carrying out the desired correction.

In Fig. 1, numeral 1 indicates the scanning light dot or spot which may be in the form of a small circle, square or rectangle, with a diameter or length of the sides, respectively, on the order of the spacing between two neighboring screen lines. This small light dot or spot serves in known manner to scan the picture copy to be reproduced point by point in successive lines and to ascertain the brightness of the individual picture points photoelectrically. The fluctuating photo currents released in the photocell incident to illumination thereof by the reflecting scanning light, control in known manner the depth of penetration of the engraving tool into a printing form blank, corresponding to the fluctuating brightness of the scanned picture points of the copy to be reproduced. Numeral 2 indicates the circular auxiliary scanning light area for scanning the immediate neighborhood of the picture point, such area being conveniently referred to as surrounding field. The auxiliary scanning light area is larger than that covered by the scanning light spot 1 and surrounds such spot concentrically or eccentrically. The scanning of the surrounding field of the picture point does not determine details of the copy to be reproduced, but the average or mean (integral) brightness closely adjacent to the picture point being scanned. Numeral 3 indicates the border or demarcation line between a darker picture portion 4 and a brighter picture area 5, it being assumed for the sake of simplicity that the tone values of the corresponding portions remain constant in the close vicinity of the border line 3. The border line 3 usually will not be rectilinear but may be assumed to be rectilinear for a small part of the length which lies within the order of magnitude of the diameter of the surrounding field. It shall further be assumed that the scanning

light spot 1 and the auxiliary scanning light area 2 move during the scanning operation perpendicular to the border or demarcation line 3 in the direction of the arrow from the left to the right across the line 3. The scanning direction will generally not extend transverse to the contour. If it is oblique to the contour, the conditions will not change much; the tone value leap will then merely be passed over somewhat slower. If the scanning is effected for a portion parallel to or along the contour, the latter will be gradually passed over steplike due to the operation of the transverse advance of the scanning system perpendicular to the scanning direction after the scanning of each line. The following observations are independent of the angle obtained between scanning direction and contour.

Fig. 2 shows in graphic representation the course of brightness resulting from the point or spot and from the surrounding field scanning or the photoelectric signal voltage U proportional thereto, in the close vicinity on both sides of the tone value leap, dependent upon the motion S of the scanning system. Curve 6 represents the course of the picture signal voltage produced by the scanning of the tone value leap by means of the scanning light spot 1. The voltage curve, in accordance with the assumed constant brightness, extends at the left of the change horizontally and leaps at 3 to a higher constant value corresponding to the assumed higher constant brightness at the right of the leap. The steepness of the voltage leap depends upon the sharpness of the transition of the two tone value regions at 3. Curve 7 represents the course of the surrounding field voltage which is produced by the scanning of the tone value leap by means of the auxiliary scanning light area 2 (surrounding field). This voltage curve which corresponds to the means or average (integral) brightness in the close vicinity of the scanned picture point, extends initially likewise horizontally, thereupon rising in S-shape due to the circular configuration of the surrounding field, the rise beginning prior to and spaced from the leap 3 and ceasing spaced from the leap in back thereof, the spacing corresponding to the diameter of the surrounding field. At the change or leap point 3, the surrounding field signal voltage is equal to the mean value lying between the two constant voltages. It is with respect to the picture signal voltage higher directly ahead of the voltage leap and lower directly in back thereof.

In Fig. 3, the curve 8 represents the course of the difference signal voltage which is obtained when the surrounding field signal voltage is subtracted from the picture signal voltage. The difference signal voltage which is initially zero, becomes negative at the point at which the surrounding field signal voltage begins to increase, assumes its minimum at the leap point, passes through zero at the center point of the leap, reaches maximum at the end of the leap, and drops to zero at the point at which the surrounding field signal voltage ceases to increase.

The curve 9 shown in Fig. 4 represents the course of the picture signal voltage (curve 6 in Fig. 2) upon being affected additively or multiplicatively by the difference signal voltage according to curve 8, Fig. 3, the additive or multiplicative modification being effected by superimposition or by using the difference signal as a regulation voltage for amplifying the picture signal. The curve 9 is at the start of the leap at a minimum which lies under the lower constant picture signal value at the left of the leap and is at the end of the leap at a maximum lying above the higher constant picture signal value at the right of the leap.

The consequence is that the engraving tool cuts into the material of the printing form blank at the beginning of the leap to a lesser depth than shortly before while cutting thereinto at the end of the leap somewhat deeper than shortly thereafter. This means that in the printed picture produced by means of the completed printing form, the black at the left of the one value leap will be somewhat blacker than the corresponding black in the original and that the white at the right of the end of the tone value leap will be somewhat whiter (insofar as this is possible) than the corresponding white on the original which is being reproduced. It is, however, the purpose of the correction to bring out or emphasize exactly the small (flat or dull) tone value leaps since the large tone value leaps which are rich in contrast are naturally easily recognizable and clearly visible. The result is that there will appear at each side of the tone value leap a narrowly extending respectively somewhat blacker or somewhat whiter demarcation line or seam (gloriole) which increases artificially the originally small contrast between the two mutually bordering tone value ranges.

Fig. 5 shows in the form of a block diagram a circuit arrangement for carrying out the correction.

Referring now to Fig. 5, numerals 1 and 2 respectively indicate the scanning light point or spot and the auxiliary or surrounding scanning field. The dash lines indicate in schematic manner the connections of the two optical scanning systems with the photocells 10 and 11 which respectively ascertain the brightness of the scanning point 1 and that of the surrounding field 2. Details of apparatus for carrying out the corresponding scanning operations are omitted to avoid unnecessarily encumbering disclosure; suitable devices being described, for example, in German Patents Nos. 930,491 and 949,443. The picture signal and the surrounding field signal may be produced either spatially by means of two different photocells or according to time by interlacing the two signals, or electrically by the use of different carrier frequencies. In the latter two cases, only one photocell will be needed. Accordingly, the two signals will either be initially spatially separated or they will be separated according to time by periodically controlled switches or, lastly, electrically by means of filters.

It is customary to chop the scanning light for the picture point and for the surrounding field periodically either by the use of rotating perforated disks, to produce one carrier frequency or two different carrier frequencies, or else to modulate a carrier frequency or two different carrier frequencies with the direct current signals produced by the scanning operation in the two photocells 10 and 11, because alternating voltages are more easily controlled for amplification purposes. The photocells 10 and 11 are accordingly connected respectively with alternating current preamplifiers 12 and 13, thus producing an amplifier channel for the picture signal and for the surrounding field signal, respectively. These channels will be conveniently referred to respectively as picture channel and as surrounding field channel.

The picture channel comprises the preamplifier 12, a regulation amplifier 24, an amplitude filter 25, and further, not illustrated switching means, for example, a gradation regulator, a superimposing stage for supplying the screen or raster frequency, a rectifier, calibration means for the adjustment of the black level, the white level and the screen amplitude and, finally, an amplifier for controlling the drive of the electromagnetic engraving system. These further switching and control devices are not absolutely required for the understanding of the operation of the circuit which takes place in the initial stage.

The surrounding field channel comprises the amplifier 13 and, if needed, switching means 15 and 17. There is also provided a branch channel comprising, if needed, switching means 14 and 16 and, finally, the difference channel comprising subtraction switching means 18, regulation amplifiers 19 and 20, amplitude filter 21, potentiometer 22, and switch 23. The regulation amplifier 19 is controlled from the picture channel and the regulation amplifier 20 is controlled from the surrounding field channel.

The outputs of the amplifiers 12 and 13 are connected by way of the switching means 14, 15, 16, 17, which

will be presently explained, with the two inputs of the subtraction switching device 18 in which the surrounding field signal voltage is subtracted from the picture signal voltage. The subtraction may be carried out employing the alternating voltages of the signals. This presupposes, in order to avoid errors, that the two alternating voltages are completely alike in phase, that is, that they have the identical frequency, that they originate in the same carrier frequency generator, and that there are, up to the subtraction, no switching means that would displace the phases thereof in different manner. Since this can hardly be accomplished without auxiliary expenditure, it will be advisable to rectify the two alternating signal voltages prior to subtraction, in the rectifiers 16 and 17, which is also advantageous since the two signal voltages are also to be employed as regulation voltages. The subtraction may be effected in simple manner, for example, by connecting the two signal voltages in opposition. It may be necessary in some circumstances to insert distortion members 14 and 15 for the picture signal and for the surrounding field signal, respectively, ahead of the subtraction stage 18, such distortion members causing a tone value change (gradation variation) which may be different for each member.

The difference signal is amplified in the regulation amplifier 19, which is regulated by the picture signal, and thereupon again in the regulation amplifier 20, which is regulated by the surrounding field signal. The amplitude filter 21, following the regulation amplifiers 19 and 20, limits the regulated difference signal in either direction thereof.

The amplified and limited difference signal is conducted to the regulation input of the regulation amplifier 24, disposed in the picture channel, by way of the potentiometer 22 which may be used for adjusting the regulated and amplitude-limited difference signal voltage, and by way of the disconnect switch 23 serving for disconnecting the difference channel if desired. The amplifier 24 is connected with the amplitude filter 25 serving for limiting the regulated and corrected picture signal in either direction.

The following observations will aid in understanding the operation of the system.

In the bright picture regions, the demarcation line or seam may be whiter than the brightest white of the picture, whereby the picture points would be undercut in the seam. This may be disturbing in the case of subsequent uniform auxiliary etching that may be required in some situations in connection with metallic printing forms. Similarly, in the darkest picture regions, the seam might be blacker than the blackest shade of the picture to be reproduced. The consequence of this latter condition would be that the engraving tool would not at all affect the printing form blank, the black seam accordingly remaining unscreened and without small white dots. This is generally not disturbing but might be undesired in some circumstances. To remedy this condition, there is provided the amplitude filter 25 which suppresses picture voltages corresponding to tone values which are whiter than normal white and blacker than normal black.

The greater the tone value leap, the stronger will be the difference signal. However, the intention is to bring out the small tone value leaps since the great leaps are naturally well visible. Assuming proportional action of the difference signal in the regulation amplifier 24, the demarcation lines or seams would become over-emphasized in the case of great tone value leaps. The amplitude filter 21 in the difference channel serves for limiting the difference signals.

It might be desirable in some cases to effect corrections only in one direction or stronger in one direction than in the other, or to affect the direction and degree of non-symmetry depending upon the brightness of the picture point or of the surrounding field or both, for example, to effect correction in the black region only in the direction of brighter tone values (only the black seam) but no correction in the white content in the direction of darker tone values (no white seam) or vice versa (only white seam; no black seam) and at the same time effecting correction in the intermediate tones in both directions from the darker to the brighter as well as from the brighter to the darker tone values (black seam and also white seam). For these purposes there are provided in the difference channel the regulation amplifiers 19 and 20 which are respectively affected by the picture signal and by the surrounding field signal.

The following applications are possible:

For example, if the shading and light parts lack contrast in the picture copy to be reproduced, the gradation for increasing the lacking contrast may be set by adjusting the tone value stage in the picture channel (in back of the limiter 25) so as to effect stronger resolution of shades and lights which, however, causes diminished resolution of the intermediate tones. The loss of intermediate tones which thus occurs is compensated at small tone value leaps by artificial contract increase in the seams by increased effectiveness of the difference signals within the region of the intermediate tones. The difference signal is thereby always less amplified with respect to shades and lights. An improved shade and light reproduction is in this manner produced by setting of the gradation and improved intermediate tone reproduction is effected from the difference channel. The appearance of tone values which are respectively blacker than the normal black and whiter than the normal white on the picture copy, and exaggerated corrections due to great tone value leaps are prevented by the action of the limiters 21 and 25.

In case the picture copy to be reproduced lacks contrast in the light contents, proper setting of the gradation in the picture channel will result in increasing the resolution of the light content while at the same time reducing the shades and the intermediate tones. The loss on shades and intermediate tones will again be compensated at the tone value leaps in the corresponding tone value regions, by increased effectiveness of the difference signals producing artificial contrast increase at the seams. The difference signals are thereby gradually always less amplified in the direction of the light portions. This will result in improved reproduction of the light parts due to the setting of the gradation and improved shade and intermediate tone reproduction by control from the difference channel.

If the shade portions are too dull and flat in the picture copy to be reproduced, the resolution of the shades may be increased and that of the light parts and intermediate tones may at the same time be diminished by suitable setting of the gradation in the picture channel. The loss in light portions and intermediate tones is again compensated at the tone value leaps in the corresponding tone value regions, due to increased effectiveness of the difference signal, causing artificial contrast increase at the seams. The difference signal is thereby always gradually less amplified in the direction of the shade parts. This results in improved shade reproduction under control of the gradation and improved light and intermediate tone reproduction by control from the difference channel.

Finally, if the intermediate tones in the picture copy to be reproduced are too soft, the resolution of such tones may be increased with simultaneous decrease of the resolution of the shades and lights, by proper setting of the gradation in the picture channel. The loss in shades and lights will again be compensated at the tone value leaps in the corresponding tone value ranges due to increased effectiveness of the difference signals, by artificial contrast increase in the seams. The difference signal is thereby always gradually less amplified from both directions to the intermediate tones, resulting in improved intermediate tone reproduction and improved light and shade reproduction by the action of the difference channel.

The action of the surrounding field channel upon the picture channel may be set to a desired value once for all, or may be calibratable, connectible and disconnectible, or regulatable continuously or in stages. These possibilities are indicated in Fig. 5 by the potentiometer 22 and the switch 23 which are disposed between the limiter 21 and the input of the regulation amplifier 24.

In the production of color extract forms for three- or four-color printing, the correction procedure described herein, in order to avoid undue complications will be limited to the blue and to the black extraction, respectively, since these extractions determine the contours.

In some instances, for example, in the case of picture copies with coarse paper structure or photographs with coarse granulation, over-emphasis of such structure, in the reproduction, may be avoided by the use of a scanning light spot with a diameter or length of the side thereof greater than normal, for example, two to three times the line spacing. In spite of the consequent primary loss of sharpness, there will result an advantage and improvement in the reproduction due to the emphasis of the tone value leaps.

In case of producing, in an electronically controlled machine, printing forms with variable reproduction scale, that is, forms which are enlarged or reduced as compared with the copy to be reproduced, there are provided shutters or diaphragms disposed in the path of the rays for the picture spot scanning and for the surrounding field scanning, respectively, such diaphragms serving the purpose of adjusting the size of the picture point or spot and of the surrounding field, which are to be scanned, in accordance with the variable spacing of the scanning lines.

The light surface covered by the surrounding field may be very large as compared with the scanning light spot for the picture point, for example, two to three times the size corresponding to the adjacent sharpness range of the light spot; it may also be sharply limited or may have a blurred or indistinct margin; and its light intensity may be constant or may diminish toward the border thereof. All these possibilities are provided for so as to adapt the surrounding field scanning to the diverse correction problems and requirements to be met in practice.

Changes and modifications may be made within the scope and spirit of the appended claims in which is defined what is believed to be new and desired to have protected by Letters Patent.

I claim:

1. In an electronically controlled machine for producing artificially increased contrast at tone value leaps and contours in printing forms having engraved thereon the contents of copies to be reproduced wherein the engraving is effected responsive to photoelectric scanning of the copy to be reproduced, the combination of means for line by line photoelectric scanning of the copy to be reproduced by a light spot, means for simultaneously photoelectrically scanning a field surrounding said light spot, means for deriving a difference signal from the signals resulting respectively from the light spot scanning and from the surrounding field scanning, and means utilizing said difference signal for additively or multiplicatively affecting the signals resulting from the light spot scanning to provide in the immediate vicinity on both sides of a tone value leap and of a contour dark copy portions darker and bright copy portions brighter than they appear on the copy to be reproduced.

2. A device according to claim 1, comprising means operatively related to said light spot scanning means for distorting the signals resulting from the light spot scanning prior to deriving said difference signals.

3. A device according to claim 1, comprising means operatively related to said light spot scanning means for distorting the signals resulting from said surrounding field scanning prior to deriving said difference signals.

4. A device according to claim 1, comprising means operatively related to both of said scanning means for additively or multiplicatively affecting the difference signals by the signals resulting from said light spot scanning and by the signals resulting from the surrounding field scanning.

5. A device according to claim 1, comprising means operatively related to said combining means for limiting the amplitude of the difference signals.

6. A device according to claim 1, comprising means for continuously regulating the effect of the difference signals upon the signals resulting from the light spot scanning.

7. In a system for producing, with the aid of an electronically controlled machine, printing forms having engraved thereon the contents of copies to be reproduced, wherein the engraving is effected responsive to line-by-line photoelectrical scanning of a copy to be reproduced by a light spot to ascertain point for point the relative tone values of said copy, a device for artificially increasing contrasts at tone value leaps and contours appearing in the copy to be reproduced, said device being operative to reproduce respectively in the immediate vicinity on both sides of a tone value leap and of a contour dark copy portions darker and bright copy portions brighter than they appear on the copy to be reproduced, said device comprising means for simultaneously photoelectrically scanning a field surrounding said light spot to ascertain the mean tone value of such surrounding field, means forming a picture channel including a preamplifier and a regulation amplifier and an amplitude filter, means for conducting to the input of said picture channel the signals resulting from said light spot scanning which signals are to be corrected, a picture branch channel extending from said picture channel in back of said preamplifier and containing signal distortion means and a rectifier, a surrounding field channel for receiving the signals resulting from the scanning of said surrounding field and comprising an amplifier and signal distortion means and a rectifier, and a difference channel comprising in serial relationship a subtraction device, a first and a second regulation amplifier, an amplitude filter, a potentiometer, and a switch, said subtraction device having two inputs for respectively receiving signals from said picture branch channel and from said surrounding field channel for subtracting the latter signals from the former signals, means for connecting said first regulation amplifier with said picture branch channel and said second regulation amplifier with said surrounding field channel, and means for connecting said switch with the regulation amplifier disposed in said picture channel.

References Cited in the file of this patent

UNITED STATES PATENTS

2,777,058	Boyajean	Jan. 8, 1957
2,880,270	Hell	Mar. 31, 1959
2,892,887	Hell	June 30, 1959