Oct. 29, 1957 F. E. WATTIER 2,811,444

PRINTING PLATE CONSTRUCTION

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FIG. 1.

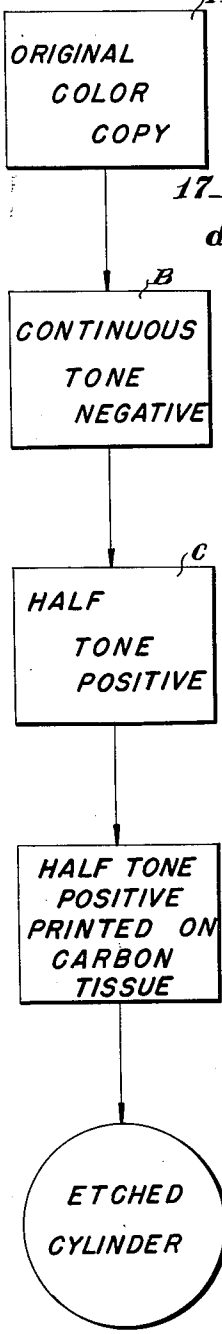


FIG. 2.

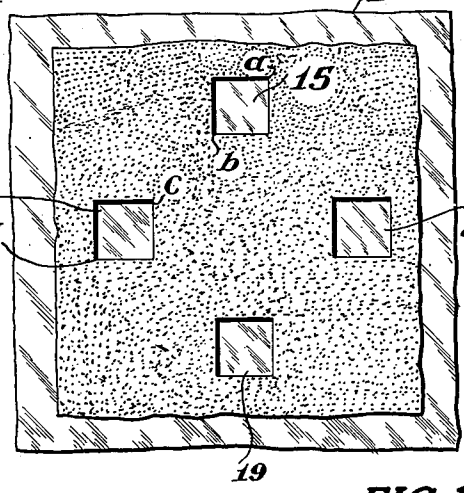


FIG. 12

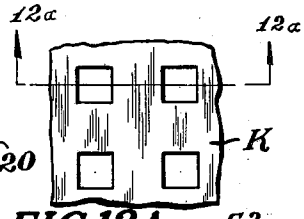
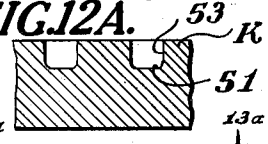


FIG. 12A.



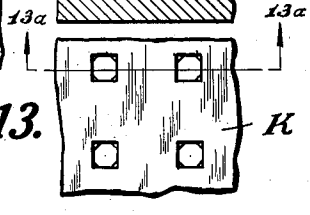


FIG. 13.

FIG. 10.

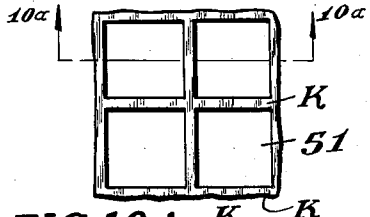


FIG. 10A.

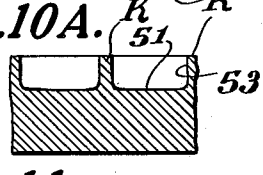


FIG. 13A.

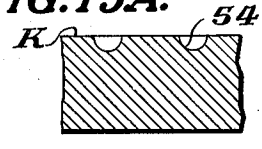


FIG. 14.

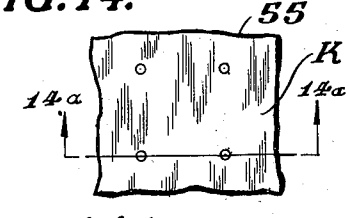


FIG. 11

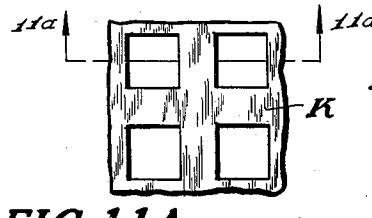


FIG. 14A.

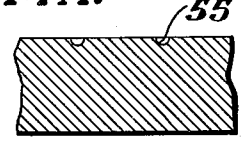
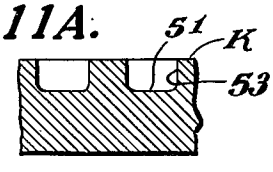


FIG. 11A.



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Oct. 29, 1957 F. E. WATTIER 2,811,444

PRINTING PLATE CONSTRUCTION

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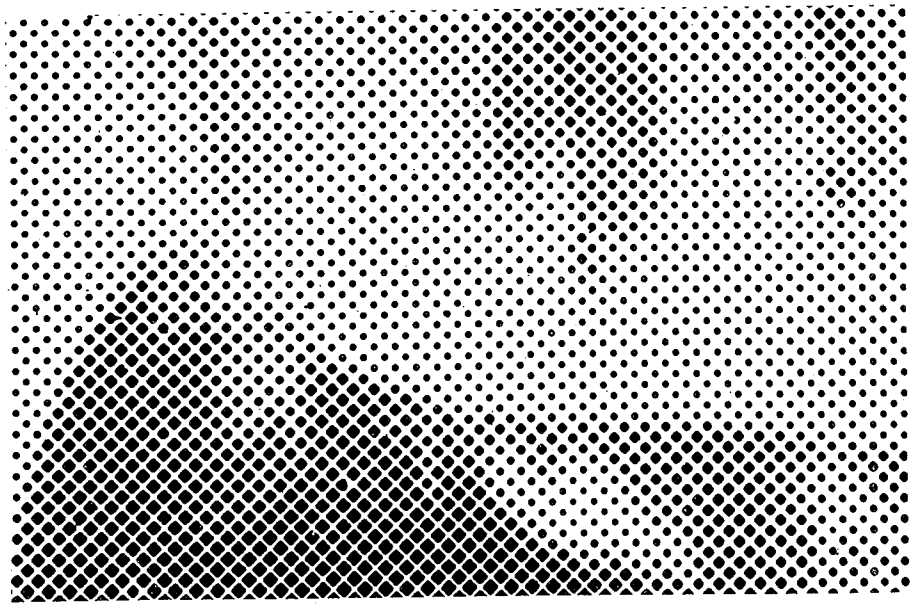

FIG. 3.

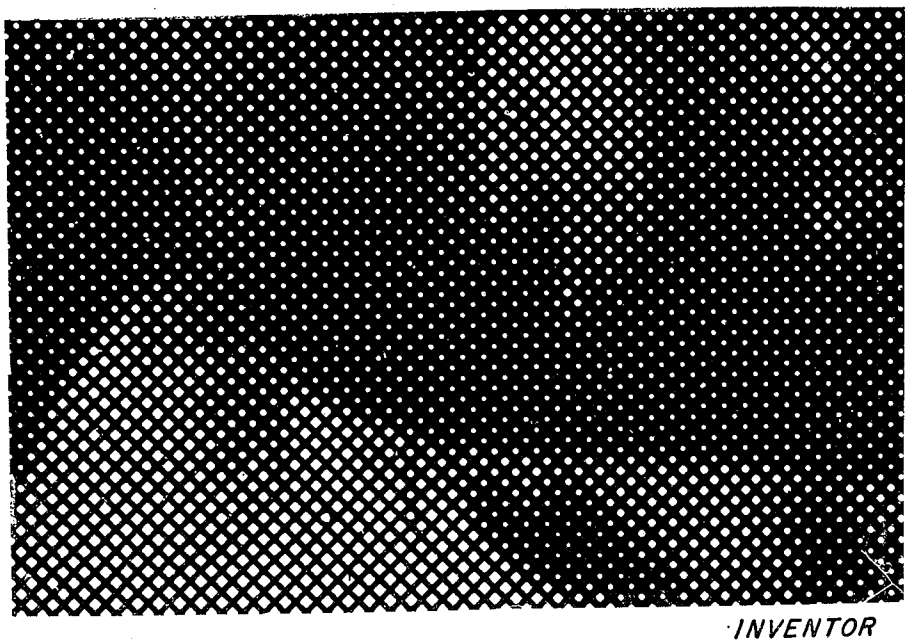

FIG. 3A.

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PRINTING PLATE CONSTRUCTION

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FIG. 4A.

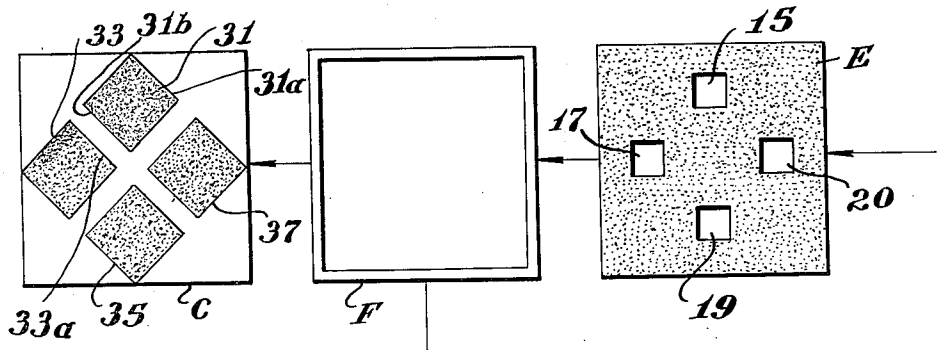


FIG. 4.

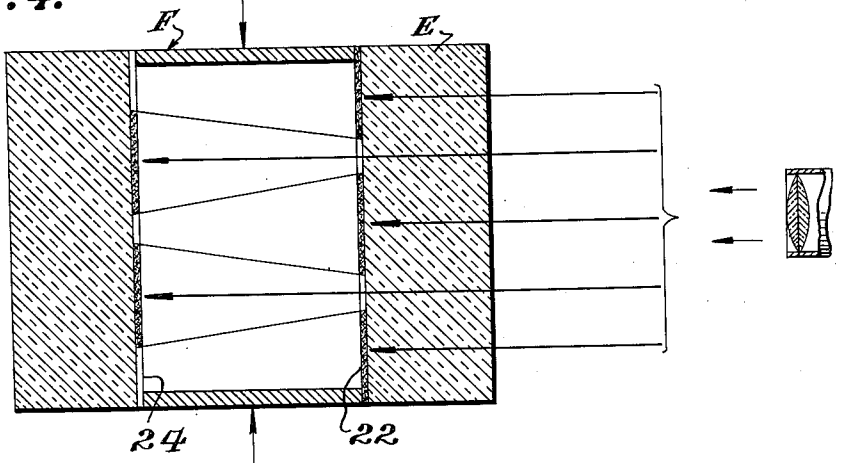
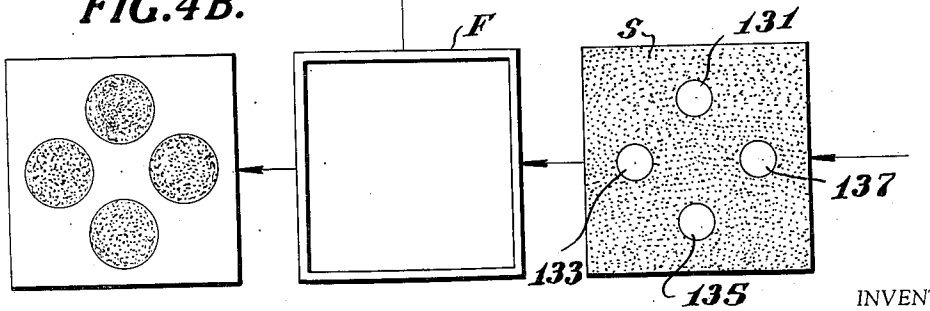


FIG. 4B.



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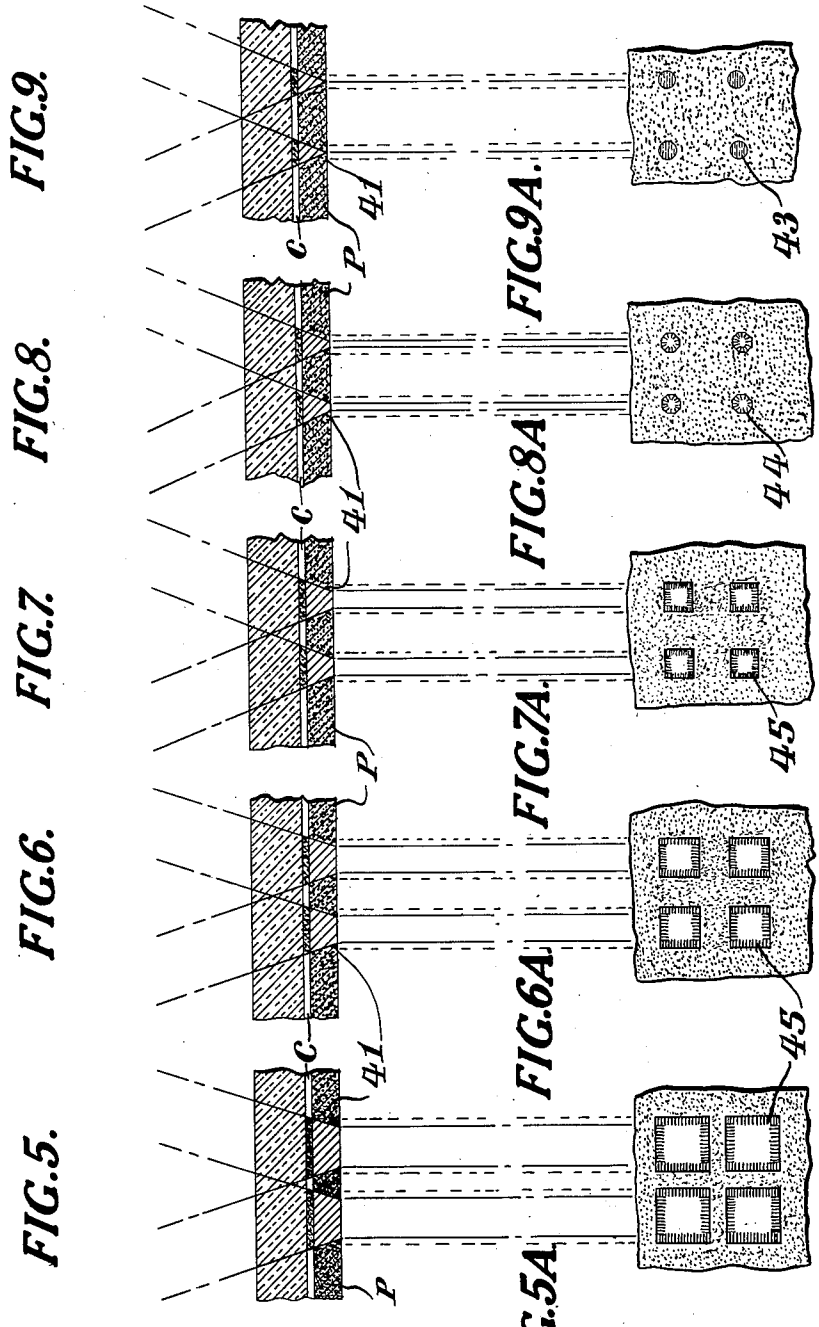
Oct. 29, 1957 F. E. WATTIER 2,811,444

PRINTING PLATE CONSTRUCTION

Filed Jan. 16, 1953 4 Sheets-Sheet 4



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ATTORNEY

United States Patent Office 2,811,444 Patented Oct. 29, 1957

2,811,444

PRINTING PLATE CONSTRUCTION

Francis E. Wattier, Mount Royal, Quebec, Canada

Application January 16, 1953, Serial No. 331,647

2 Claims. (Cl. 96—37)

This invention relates to intaglio or gravure engraving and printing.

In reproducing four-color work by the gravure process in order to correct the deficiencies in the color separations, the purity of the primary process inks and the reflecting power of the paper, hand work or retouching is required on the continuous tone negatives and the continuous tone positives.

In processes in use today, the quality of the color reproduction depends upon:

Firstly, the skill and color knowledge of the color retoucher in retouching the continuous tone negatives and the continuous tone positives.

Secondly, the skill of the printer in printing the continuous tone positives upon the carbon tissue as to exact tone values of the continuous tone positives.

Thirdly, the skill of the etcher to etch a continuous tone image upon the copper cylinder, as to exact tone value of the continuous tone positives.

With the present continuous tone methods of retouching, printing and etching as used with conventional gravure and News-Dultgen process (as in Patent 2,040,047), it has been proven difficult for the retoucher, printer and etcher to work to any degree of exactness and certainty in retouching the continuous tone negatives and positives, printing the continuous tone positives upon the carbon tissue and etching the continuous tone image upon the copper cylinder.

SUMMARY OF INVENTION

The present invention eliminates problems encountered in the continuous tone method of retouching, printing and etching as practiced in conventional gravure and News-Dultgen process. This is partly through being able to handle the color reproduction from the retouching of the positives, printing of the carbon tissue and etching of the printing surface by the half-tone dot method as practiced in the photo-engraving and deep-etch offset arts.

The invention also eliminates and simplifies the present multiple bath method of etching by using a straight line method of etching. This makes it possible to duplicate, with great fidelity, in etching the copper printing surface, the retoucher's dot-etched positive.

Principal phases of the invention are a printing element, for example a rotogravure printing cylinder, having a special etched surface, a special half-tone screen and special processing steps.

The printing element has a surface with ink wells of different areas representing different tone values, the ink wells being of a uniform depth through at least half the scale from the darker tones, and decreasing depths through lighter tones to the highlights. The ink wells also, at least in the darker tones, have a characteristic shape in cross section, those in the solid tones having a substantially flat bottom merging with substantially perpendicular sides, but in the lighter tones rounding off until they are substantially hemispherical. In a preferred construction, the ink wells are substantially square in area at their mouths

in the solid tones but round off in the lighter tones. The ratio of the bridging areas to the ink well areas (at a level flush with the bridging), i. e., at the mouths of the ink wells, is preferably about 1 to 4 in the solid tone areas.

In a preferred construction, the printing surface is further characterized as follows. The ink wells are of constant depth throughout over half the tone scale desirably between the 100 percent tone values and the about 40 percent tone values. The remaining ink wells, for example from the about 40 percent tone values to the highlight tone values gradually decrease in depth. Preferably, the ink wells between the 100 percent tone values and the about 40 percent tone values have a uniform depth within the range from about 10 to 12 ten thousandths and the intermediate tones between the about 40 percent tone values and the about 15% to 20% tone values have ink wells of a depth of about 4 to 7 ten thousandths and the highlights have ink wells of a depth of about 2 ten thousandths. About the 50% tone value the junctions between the sides and bottoms start to round off and at the highlights the ink wells are substantially hemispherical in form.

In the process of making the printing surface, according to the invention, there is employed a special screen which also forms a phase of the invention. This screen has uniform transparent areas or dots intervened by opaque bridging and the ratio of transparency to opacity is about 40 to 60. These dots are preferably square, and their sides parallel to the sides of the screen when the screen is used at a 45 degree angle. But, according to another aspect of the invention the dots may be circular in area.

In using this screen for making a half-tone positive, the exposure is preferably made with a screen separation of about $^{40}/_{1000}$ of an inch from the surface of the screen structure to the emulsion side of the photographic plate; no cover glass is used on the screen. A half-tone positive thus obtained will have an opacity to transparency ratio in the solids of about 4 to 1. The dots will vary in size from the solid tones towards the highlights. Preferably, when made with a screen having square openings, the dots in the solids are substantially square, but become round towards the highlights.

Special processing expedients are desirably employed as will be described in more detail. Some of these processing expedients also form a phase of the invention as does the final rotogravure print made with a printing element as above described.

For example, important steps in a preferred procedure in accordance with the invention are as follows. A continuous tone color-separation negative is made from the copy with the density in the highlights preferably about 1.70 and in the shadows preferably about 0.30. The continuous tone negative is exposed through a half-tone screen having uniform apertures which are preferably square and whose sides are parallel to the sides of the screen when the screen is used at a 45° angle the ratio of the screen as to transparency and opacity being about 40 to 60. The screen separation, i. e. the distance from screen to plate, is from about $^{30}/_{1000}$ of an inch to about $^{60}/_{1000}$ of an inch, depending on the resolving power of the photographic positive plate. A preferred separation is about $^{40}/_{1000}$ of an inch from the surface of the structure to the emulsion side of the photographic plate and no cover glass is used on the screen. There is thereby obtained a half-tone positive with opaque dots which, when a square screen is used, are square in the shadows and round in the highlights. The dots in the shadows are in a ratio of opacity to transparency of about 4:1. The half-tone positive thus obtained is used for printing the carbon tissue. The positive is placed in close contact

with the tissue and the printing is done preferably with a diffused source of light. This results in under-cutting the dots giving a print on the carbon tissue in which the fine highlights are completely veiled over and the middle and shadow tone dots have a feather edge with the feather edge in the quarter tone dots almost covering the dot. The printing surface is subsequently etched to give a printing surface which will be of the type described above.

In a rotogravure print made by using a printing surface according to the invention, the ink will be in a substantially continuous film of substantially uniform depth from the 100% tone values to the about 40% tone values. The bridging between dots will become perceptible in the lighter tones and discrete dots are perceptible in the highlights.

It will be understood that the above is a summary only of the invention and that various other aspects may only become apparent from the detailed description to follow. This detailed description is illustrated in the accompanying drawings, which show preferred aspects of the invention.

DRAWINGS SUMMARIZED

In the drawings:

Figure 1 is block diagram showing important steps in a preferred process according to the invention.

Figure 2 is a plan view of one form of screen used according to the invention for making half-tone negatives.

Figure 3 is a plan view of a portion of a half-tone positive in accordance with the present invention.

Figure 3*a* is a plan view of carbon tissue printed (negative) according to the invention.

Figure 4 is a diagrammatic view showing the manner cf exposing a half-tone positive, according to the invention.

Figure 4*a* is a plan view showing the exposing of a half-tone positive through the screen of Figure 2.

Figure 4*b* is a plan view showing the exposing of a half-tone positive through an alternative form of screen.

Figures 5 and 5*a* through 9 and 9*a* are pairs of diagrammatic side elevations and plan views, respectively, showing the applicant's theory of dot formation in printing the carbon tissue according to the invention.

Figures 10, 10*a* through 14, 14*a* are pairs of cross-sectional views and plan views, respectively, of a printing cylinder surface according to the invention showing progressively decreasing tone value sections of the printing cylinder.

DETAILED DESCRIPTION

There are important distinctions to be made with the prior art in order that the invention be fully understood. So, before going into a detailed description of the applicant's procedure the known methods of gravure engraving and printing will first be described as a basis for comparison.

CONVENTIONAL METHOD

In the usual method, the following steps are involved.

A. *Exposing continuous tone negatives.*—From a color original such as a carbon print, oil painting, wash drawing, color transparency, four continuous tone color separation negatives are made in the camera, using color standard filters.

The four color separation negatives are a record of the yellow, red, blue and black printer. The negatives are exposed and developed to a suitable gamma and correct end densities. The usual end densities are 1.50 for the highlights and 0.30 for the shadows. A density range of 1.20 or 12 steps.

B. *Retouching continuous tone negatives.*—The continuous tone negatives are partially retouched for color correction and balance (continuous tone methods of retouching are used by the retoucher).

C. *Exposing continuous tone positives.*—From the retouched continuous tone negatives, continuous tone positives are made in the camera.

In exposing the positives in order to obtain satisfactory gradation of tone values and correct end densities the exposure must be timed as to photograph the original subject as much as possible on the straight portion of the H and D curve.

In developing, the positives are developed to a gamma of about 0.9 with end densities of 0.30 for the highlights and 1.50 for the shadows. A density range of 1.20 or 12 steps.

D. *Retouching continuous tone positives.*—The continuous tone positives are further retouched for final colour correction and balance (continuous tone methods of retouching are used by the retoucher).

It should be mentioned that as long as the finished positive is correct for color value and balance it is immaterial how the retoucher divides his retouched work between the negatives and the positives. This is a question of opinion and training. Some retouchers prefer to do most of their retouching on the negatives leaving little to do on the positives while others work just the opposite.

E. *Printing carbon tissue.*—The carbon tissue is first screened by printing from a master screen by contact in a vacuum printing frame using an arc lamp for illumination.

The screen contains 150 transparent cross lines to the inch and opaque squares.

The ratio of the screen is 1 to 3—one part transparent to 3 parts opaque. All of the opaque squares are of the same size in area.

In screening, the light filters through the transparent parts of the screen, the action of the light hardens the carbon tissue, rendering the exposed cross lines insoluble when developing the cylinder and acid resistant when etching the cylinder.

The light does not penetrate the opaque squares of the screen, consequently, the carbon tissue in these square areas remain unaffected.

The exposed screen parts of the tissue after the cylinder is etched, form the wall of the cells as well as the surface of the cylinder on which the doctor blade rides to wipe off the surplus ink from the cylinder.

After the carbon tissue is screened it is exposed a second time to a continuous tone positive. This exposure hardens the unexpected squares of the carbon tissue in direct proportion to the tonal values of the continuous tone positive.

These squares, after developing, contain carbon tissue of different thicknesses and become, after etching, the cells or ink pockets of the cylinder.

F. *Transferring carbon tissues.*—The printed carbon tissue containing both the screen and the continuous tone exposures is transferred face side of the print to the surface of a wet copper cylinder under the pressure of a rubber roller.

G. *Developing carbon tissue.*—The copper cylinder containing the carbon tissue is developed by rotation in a tray of hot water, starting with a temperature of 110° F. After the paper backing is removed the carbon tissue being in a wet state is very tender and great care and skill is required in handling. The developing must be carried on to where all of the unexposed carbon tissue is removed but no further. If the cylinder is over developed, there is a definite loss of detail in the shadow tones. After the cylinder is developed the temperature of the water is gradually lowered until it reaches room temperature. The cylinder is then dried, leaving the exposed carbon tissue on the cylinder in the screen exposure as solid cross lines and in the continuous tone exposure as squares of all the same size in area but of varying thicknesses.

H. *Etching the cylinder.*—In etching, several strengths of Baumé perchloride of iron (etching solution) is used. The etching acids attack the copper cylinder in the cells

or squares in direct ratio to the thickness of the carbon tissue on the cylinder. Where the carbon tissue is thin, the etching acid attacks quickly. Where the carbon tissue is of intermediate thickness the etching acid will not attack so quickly and where the carbon tissue is thick as in the screen portions, the etching acid will not attack the copper cylinder at all. Great skill, experience, and judgment are required in etching. The etcher applies the various strengths of etching acids to the cylinder manually, starting with the strongest solution and gradually working down to the weakest solution as the different tones are etched. The strong acid etches the darker tones first. As the etching continues, the intermediate tones are etched with an intermediate strength acid and finally the light or highlight tones are etched with the weakest solution of acid. By the time the highlight tones are etched the dark tones and the intermediate tones are also completely etched.

The etched cylinder is composed of a series of raised copper cross lines forming the bridges or walls of the cells and of hollow squares which are all the same size in area but of varying depths.

The etched squares are the ink wells that carry the ink in layers of different thicknesses, according to the depth of the cells to be printed upon the paper.

I. *Printing.*—In printing conventional gravure on a high speed rotary press and comparing the printed results with the continuous tone positives, it will be noticed that there is a loss of detail and gradation of tone values in the shadows and highlights of the printed reproduction, that is, the printed results will have a shorter range of tone value than the range indicated in the continuous tone positive.

The reason for this loss of tone range is due to the following:

(1) The formation of the screen structure.

(2) The continuous tone method of etching.

(3) The method of printing where the ink is transferred to the paper from large uniform cells in area but of different depths, producing a film of ink of different thickness, resulting in a continuous tone printing process.

The loss of detail and gradation in the shadows is due to the amount of ink carried in the deep etched cells between the solids and the 75 percent tones. In this range of tones, the ink overflows the narrow bridges or walls merging the tones together and printing them as one flat tone.

The loss of detail and gradation in the highlights is due to the large area and shallow etched cells. This combination carries ink in a very thin film. This thin film of ink, depending upon the viscosity of the ink, is hard to control; if the ink is on the dry side there will be a loss of tone in the highlights; if the ink is on the wet side the highlights will have a muddy appearance. Furthermore, due to the shallowness of the large highlight cells, the oscillation of the doctor blade creates a variation in printing the highlight tones. Still further due to the shallowness of the large highlight cells and the narrowness of the bridge, the life of the cylinder is shortened, caused by wear of the bridge in the highlights, resulting in printing the lighter tones of the subject as white.

THE NEWS-DULTGEN PROCESS

Another known process is the "News-Dultgen" process, described as follows:

With the introduction of the News-Dultgen process (for example see U. S. Patent 2,040,047), a definite improvement was made over the conventional method for the reproduction of color rotogravure.

With the News-Dultgen process, two sets of positives are used, a set of continuous tone positives and a set of half-tone positives.

The scale of the half-tone positives is about 40 percent in contrast as compared to a regular full scale half-tone positive.

The shadows of the half-tone positives are represented by disconnected checker-board dots and the highlights by small round dots.

The purpose of using two sets of positives is to obtain a finished cylinder with the screen dots varying in size and the etch varying in depth. The half-tone positives control the size of the dots and the continuous tone positives control the depth of the etch.

The News-Dultgen process of rotogravure and printing involves the following steps:

A. *Exposing continuous tone Negatives.*—A set of color separation negatives is made similar to the ones made for conventional gravure except they are exposed and developed to a contrast density range of 1.00 or 10 steps instead of 1.20 or 12 steps as for conventional gravure.

The reason for using a shorter contrast range negative is to prevent, when making the half-tone positive, the checker-board dots in the shadows from connecting.

If the negatives are of too great a contrast range, when exposing the half-tone positive, in order to obtain a small hard dot in the highlights, the checker-board dots in the shadows become overexposed and join at the corners thereby losing the wall or bridge in the shadow cells.

B. *Retouching continuous tone negatives.*—In retouching the continuous tone negatives, contrary to the methods used in conventional gravure, the negatives must be retouched at least 90 percent correct for color value and tone balance leaving only about 10 percent to be done on the continuous positives. The reason for this is, when making the positives, it is important to obtain in both the continuous tone positive and the half-tone positive the same scale of tone gradation and balance. (Continuous tone methods of retouching are used by the retoucher.)

C. *Exposing the continuous tone and half-tone positives.*—From the retouched continuous tone negatives, continuous tone and half-tone positives are made in the camera. Great care must be taken that both the continuous tone and the half-tone positives are made in the same plane of focus, to assure exact size, as they must register perfectly in printing upon the carbon tissue.

In exposing the half-tone positive, great care must be taken that the checkerboard dot (see Figure 1) in the shadows do not join at the corners and that the highlights are small with an opaque or hard core.

In exposing the continuous tone positives the same methods are used as in conventional gravure except that the positives are exposed and developed to a contrast density range of 1.00 or 10 steps instead of 1.30 or 13 steps as in conventional gravure.

The reason for using a short contrast density range continuous tone positive of 1.00 is to obtain, when used in conjunction with the half-tone positives which have a density rang of about 0.40, the correct range of tone values. Therefore, it is the combined contrast range of both the continuous tone positive of 1.00 and the half-tone positive of 0.40 that produced the final contrast range of 1.40 on the carbon tissue and subsequently on the etched cylinder.

D. *Retouching continuous tone positives.*—The continuous tone positives are further retouched for final color corrections and balance. (Continuous tone methods of retouching are used by the retoucher.)

It should be mentioned that the continuous tone negatives should be retouched to leave very little to be done on the continuous tone positives. If there is much work to be done on the continuous tone positives, it is an indication that the negatives are at fault and therefore the half-tone positive will be out of balance as to color corrections and tone values.

With properly retouched and balanced negatives, the half-tone positives, when correctly exposed and developed, will not require any hand work.

E. *Printing carbon tissue.*—In printing upon the carbon tissue, the same methods are used as in conventional

gravure, the carbon tissue is first screened using the half-tone positive, producing dots varying in size area, and then exposed a second time to the continuous tone positive which exposes and hardens the unexposed dots of the carbon tissue in direct proportion to the tonal range and tone values of the continuous tone positive.

In surprinting the continuous tone positive over the half-tone positive on the carbon tissue, great care must be taken to make sure that both prints are in exact register.

F. *Transferring carbon tissue to copper cylinder.*—Same methods used as in conventional gravure.

G. *Developing carbon tissue.*—Same methods as used in conventional gravure.

H. *Etching copper cylinder.*—Same methods used as in conventional gravure.

I. *Printing.*—In printing on a high-speed rotary press, a cylinder made by the News-Dultgen process will print more uniformly, it will reproduce better separation in the shadows and highlights and it will have a longer life on the press than a conventional etched cylinder.

Disadvantages of conventional and News-Dultgen processes are:

Firstly, the difficulty of obtaining consistent results in photographing both the continuous tone negatives and continuous tone positives as to correct gamma and end densities.

Secondly, the difficulty for the color retoucher, using continuous tone methods of retouching, to retouch the continuous tone negatives and continuous tone positives for balance and color correction to any degree of exactness and certainty.

Thirdly, the hazards, as in the News-Dultgen process, of judging tone values, in photographing and retouching from two positives, one continuous tone and one half-tone and to obtain the final correct tone values and density range on the etched cylinder.

Fourthly, the hazards, as in the News-Dultgen process, when making the positives in the camera, of obtaining in both the continuous tone positives and the half-tone positives, exact register.

Fifthly, the hazards, as in the News-Dultgen process, of printing the carbon tissue twice in exact register from two different positives, one continuous tone and one half-tone.

Sixthly, the difficulty in etching of duplicating two or more sets of cylinders or of matching the halves by a continuous tone method of etching, where several Baumé of etching solutions are used.

APPLICANT'S PROCEDURE

The following is a preferred procedure according to the invention. Reference will be made to the accompanying drawings.

I. *Exposing continuous tone negatives.*—Continuous tone color separation negatives B are made from the original copy A in the camera using similar methods as for conventional gravure except they are exposed and developed preferably to obtain a density 1.70 in the highlights and 0.30 in the shadows, a density range of 1.40 or 14 steps.

II. *Retouching continuous tone negatives.*—Very little retouching is required on the continuous tone negatives B, except for opaquing out tones that are not wanted and the reduction of complementary colors in each primary separation. However, all clean colors such as yellows, blues, pinks and light flesh tones will photograph short in the separation negatives and will require adjusting. The reason for this is in exposing to obtain shadow detail, the clean colors become overexposed and on the weak side. In order to obtain the correct strength of color values in the half-tones positives, it is necessary to back etch or open up these areas in the separation negatives using a reducing agent such as Farmer's reducer. All tone gradation, color correction and balance of end densities are left to be done on the half-tone positives where tone values can be judged easier and with greater accuracy than on negative or positive continuous tone plates.

III. *Exposing the half-tone positives.*—The half-tone positives C are exposed (see Figure 4) in the camera through a half-tone screen E. Preferably this screen has uniform square apertures **15**, **17**, **19**, **20** (see Figures 2 and 4*a*) the sides of the square apertures are at an angle of 45 degrees from the sides of the square apertures of a standard engraver's screen, i. e., in the applicant's screen the sides of the apertures are parallel to the edge of the screen when the screen is used at a 45° angle. The ratio of the screen as to transparency and opacity is within the range from about 40 percent to about 60 percent. That is, the distance between corner *a* to corner *b* of the transparent opening **15** is 40 percent to the opaqueness that separates each transparent opening say from *b* corner to corner *c*.

The screen separation is about 40 thousandths of an inch from the surface **22** of the screen structure (see Figure 4 in which the separation is greatly exaggerated) to the emulsion side **24** of the photographic plate. No cover glass is used on the screen, but a spacer F is used to obtain accurate spacing.

With the half-tone screen E and the screen separation as described and exposing from a continuous tone negative of a contrast density range of 1.40 with a lens aperture of F/22 at the same size, a half-tone positive C (see Figures 3 and 4*a*) will be obtained with square opaque dots **31**, **33**, **35**, **37** in the shadows, and round opaque dots (not shown) in the lighter tone values and in the highlights. The dots representing the solid tones are in a ratio of about 4 to 1 to the transparent bridging areas (see Figure 4*a* and Figure 4*b*), that is, the distance between the sides **31***a* and **31***b* of the dots is about four times the transparent line that separates the sides **31***b* and **33***a* of respective dots and so on. The formation of the dots in the shadows is similar to the dot formation in conventional gravure.

The reason for exposing to obtain 20 percent tone value in the highlights is to allow for sufficient latitude in correcting the tone values and to avoid back staging in dot etching the half-tone positives.

A half-tone positive photographed by this method will produce dots that are sharp and without any feather edge. The dots will stand prolonged etching without losing opacity or loss of printing density.

While the preferred screen E has been described, it is also possible to carry out the invention in certain of its other aspects using a screen having round openings, as shown diagrammatically, for example, the "S" of Figure 4*b*. This screen will be similar in certain respects to that of Figures 2 and 4*a*. For example, the transparency to opacity ratio will be substantially the same, that is, 4 to 1, so that the dots will be separated by substantially the same amount of bridging areas. The ink wells formed by such a screen, while round in the solid area, will have substantially flat bottoms in the solid areas merging with substantially perpendicular sides as shown in connection with the square dots in Figures 10 and 10*a*. In the ink wells representing lighter tones, the corners between the bottom of the ink wells and the sides will gradually round off and finally the ink wells will become hemispherical in form at the highlights.

IV. *Dot etching the half-tone positive.*—The half-tone positives are dot etched for color correction and balance as to end density using the same methods as used in deep etch offset and photo-engraving arts.

Dot etching for tone correcting has a great advantage over the continuous tone method of tone and color correcting.

Among the reasons are:

Firstly, the retoucher, with the half-tone dot in positive form, can judge and correct his tone values to a

greater accuracy than he can with continuous tone methods either in negative or positive form.

Secondly, the corrected dot positive, being virtually a line image, can be more easily duplicated with less chances of changes to occur in tone relationship in printing upon the carbon tissues and etching the cylinder, therefore, giving the retoucher very close control over the tones produced on the finished cylinder.

Thirdly, with a dot etched positive and a line etched cylinder greater accuracy is obtained in uniformity of quality and consistency in printing on the rotogravure press.

V. *Printing the carbon tissue.*—In printing, the half-tone positive C is printed in close contact with the carbon tissue P in a vacuum printing frame using a diffused arc lamp for illumination (see Figures 5 through 9*a*). The purpose of using a diffused source of light instead of specular is to create light irradiation in the layer of the sensitive coating of the carbon tissue P so that the light rays will spread under the dots or under cut the dots as at **41** while printing. The under cutting of light is more pronounced as the dots become smaller (see Figures 8 and 9). Therefore, the highlight dots **43** will receive more undercutting or coverage than the shadows e. g., **45**, giving a print upon the carbon tissue, whereby the fine highlight dots will be completely veiled over as at **43** the ¼ tone dots will have a feather edge which almost meets it at **44** and the middle and shadow tone dots will have a feather edge as at **45**.

After the half-tone positive is printed it is removed and the bare carbon tissue is given a short exposure or flash, to give a slight overall coverage to the dots.

The result is that the unexposed areas of the carbon tissue have feather edges as described. The carbon tissue thus formed is applied to the cylinder. The cylinder is then etched. The etch is retarded at the edge of the unexposed areas.

VI. *Transferring the carbon tissue.*—Same methods used as in conventional gravure.

VII. *Developing carbon tissue.*—Same methods used as in conventional gravure.

VIII. *Etching the cylinder.*—In etching, the cylinder surface K is first conditioned for two minutes in a 44 Baumé etching bath solution; there is no etching that takes place in this bath, the 44 Baumé bath is only to condition the carbon tissue and to bring its moisture contents to one level. After the two minute conditioning the cylinder is etched with a 40 Baumé etching solution.

The etching begins in the middle tone Figures 11 and 12, and shadow tone dots, Figure 10. The etching solution starts to etch the dots from the center to the edge of the feather edge of the dots. As the etching is continued in the same Baumé of etching solution, the etching solution penetrates the feather edge of the middle and shadow tone dots at the same time the ¼ tone dots start to etch from the center.

By the time the etching solution etches the very fine highlight dots (Figure 14) all of the dots are completely etched to the final edge of each dot. At this stage the etching is carried on for one more minute to give the very fine highlight dots the necessary depth. The total etching time in the 40 Baumé solution is about 14 minutes, giving a depth in the shadow tones up to about 40% of 10 to 12 ten thousandths, the tones between 40% and 20% to 15% between 7 to 4 ten thousandths of an inch and in the highlights a depth of about 2 ten thousandths of an inch. The dots or ink wells in the shadows and middle tones have a flat bottom 51 and saucer shaped sides 53 and the ¼ tone 54 and highlights 55 are semi-circular in shape and depth.

IX. *Printing.*—In printing, a cylinder made by the dot etched method will print the full range of tones of the half-tone positives. The reason for this is that the area of the etched ink wells correspond exactly in size from 100 percent tone values to the highlight tone values to the area size of dots on the half-tone positives, therefore, each ink well will duplicate or print on paper the same amount of ink as represented by the dot size of the half-tone positives. In other words, the cylinder will print the same amount of steps that are in the half-tone positives without losing detail or tone separation in the shadows or highlight tone values.

And, a cylinder made by the dot etched method due to the ink well formation from the shadows to the highlights will give more control as to the dryness or wetness of the ink in printing than conventional gravure.

Further, a cylinder made by the dot etched method having a uniform depth of ink wells from the 100 percent tone values to the 40 percent tone values will deposit ink on the paper in a uniform film which will allow high speed printing without encountering any of the drying troubles as in conventional gravure or News-Dultgen process.

In addition, a cylinder made by the dot etched method will have a long life on the press due to the substantial bridge between each ink well.

A rotogravure print according to the invention is also an improvement over a rotogravure print made by ordinary methods. For example, the ink will be in the form of a substantially continuous film in the solid tones (100% tones to the about 75% tones). The dots and bridging structure will only become perceptible from the about 75% tones down.

GLOSSARY

Certain terms have been used throughout the specification to describe the various tones. For example, the 100% tones have been referred to as "solid tones," the 75% to 100% tones have been referred to as "shadow tones," the 25% to 75% tones have been referred to as "middle tones," and the tones of 25% and less have been referred to as "highlights." In addition to these parts of the scale, the applicant makes a division at the about 40% tones where the depth of the ink wells begins to vary and the about 20% and 15% tones where a further range variation of the ink-well depth takes place.

It will be understood that the printing surface of the printing element will be made of material from which intaglio printing surfaces are usually made, generally copper. The most usual type of printing element is a rotogravure cylinder, but the invention also has application to flat plates.

I claim:

1. A process of producing a rotogravure printing cylinder surface comprising the steps of making a continuous tone color separation negative from the copy in which the density in the highlights is about 1.70 and in the shadows about 0.30, retouching the continuous tone negative, exposing the continuous tone negative through a half-tone screen having uniform square apertures whose sides are at an angle of 45° from the sides of a standard engraver's screen, the ratio of the screen as to transparency and opacity being about 40 to 60, the screen separation being about 40-thousandths of an inch from the surface of the screen structure to the emulsion side of the photographic plate, no cover glass being used on the screen, thereby obtaining a half-tone positive with square opaque dots in the shadows and round opaque dots in the 20% tone values and in the highlights, the dots in the shadows being in the ratio of opacity to transparency of about 4 to 1, dot etching the half-tone positive for color correction and balance as to end density, using the half-tone positive thus obtained for printing carbon tissue, the half-tone positive being in close contact with the tissue and the printing being done with a diffused source of light, thereby to create light irradiation in the layer of the sensitive coating of the carbon tissue so that the light rays will undercut the dots giving a print on the carbon tissue in which the fine highlights are completely veiled over the middle and shadow tone dots have a feather

edge and the quarter tones the feather edge almost touching, subsequently giving the bare carbon tissue a short exposure to give a slight overall coverage to the dots, then etching the cylinder surface to give the dots or ink wells in the shadows and middle tones a flat bottom and rounded sides, and the one-quarter tone and highlights semi-circular shape and depth.

2. A process of producing a rotogravure printing cylinder surface comprising the steps of making a continuous tone color separation negative from the copy, retouching the continuous tone negative, exposing the continuous tone negative through a half-tone screen having uniform apertures, the ratio of the screen as to transparency and opacity being about 40 to 60, the screen separation being about 40-thousandths of an inch from the surface of the screen structure to the emulsion side of the photographic plate, no cover glass being used on the screen, thereby obtaining a half-tone positive with opaque dots in the shadows and round opaque dots in the 20% tone values and in the highlights, the dots in the shadows being in the ratio of opacity to transparency of about 4 to 1, dot etching the half-tone positive for colour correction and balance as to end density, using the half-tone positive thus obtained for printing carbon tissue, the half-tone positive being in close contact with the tissue and the printing

being done with a diffused source of light, thereby to create light irradiation in the layer of the sensitive coating of the carbon tissue so that the light rays will undercut the dots giving a print on the carbon tissue in which the fine highlights are completely veiled over the middle and shadow tone dots have a feather edge and the quarter tones the feather edge almost touching, subsequently giving the bare carbon tissue a short exposure or flash to give a slight overall coverage to the dots, then etching the cylinder surface to give the dots or ink wells in the shadows and middle tones a flat bottom and rounded sides, and the one-quarter tone and highlights semi-circular shape and depth.

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