

## NEW PHOTOGRAPHIC METHOD FOR MAKING SUPERIOR HALFTONES

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**Abstract:** A new single negative technique for making superior halftones has been invented, utilizing an main exposure and a flash exposure. before making the flash exposure, a reflector card is placed on the copyboard holding the original continuous tone copy; the reflector card has a gray scale value of between about 45% and about 80% of the shadow density of the original copy and controls the flash exposure, so that dots formed during the main exposure in the highlight and middletone areas of the original copy are not affected, but dot formation in the shadow areas is enhanced. The result is a haze free reproduction with sharp definition and contrast.

### Introduction

The use of halftones in printing process to reproduce photographs, paintings, and other continuous tone original copy is well known. And the art has been widely established for many years. A halftone is produced by placing a screen in contact with a negative within a camera, mounting the continuous tone original copy on a copyboard in front of the camera, and then exposing the copy through the screen. The screen is designed to break the continuous tone original copy into a great multiplicity of very small dots, which produces a negative similarly having such dots and which is then used to make a printing plate.

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In making a halftone by the conventional single negative process, the continuous tone original copy is first secured to a copyboard in line with the lens of the camera, and a suitable screen is placed in the camera in contact with a negative. Then, a main exposure is made, wherein the camera lens is opened and copyboard is lighted. Light is reflected from the original copy, through the camera lens and the screen, and onto the negative. The screen serves to break the reflected light into dots, the lightest copy areas reflecting the most light and casting the largest, most closely spaced dots on the negative, and the darker copy areas reflecting less light and forming smaller, more widely spaced dots.

When the negative is developed and used to make a printing plate, the dot pattern on the plate is reversed. That is, the darker areas will have the greater dot intensities and thus will apply the most ink to the paper, while the highlight areas will contain the fewest dots and will apply the least ink. An ink print will contain a reproduction of the original copy, appearing as a pattern of minute dots. To the naked eye, the dot pattern on the ink print creates the illusion of continuous tone. However, the dot pattern can be seen under heavy magnification.

The problem in making halftones from continuous tone original copy containing a wide range of gray tones is as follows: if the main exposure is too long, so as to allow all of the middletone and darker areas to be reflected by dots on the negative, then the whiter highlight areas will become a mass of closely spaced large dots and will wash out when printed. On the other hand, if a short main exposure is made, there will be very few or no dots on the negative in the upper middletone and darker areas, and all definition in these portions of the copy will be lost. Thus, the typical main exposure must be a compromise unless the original copy has a narrow range of gray tones thereon. The result is that the dot pattern in most instances is not truly satisfactory in either the highlight or the darker areas, while the middletones may be generally accurate. The quality of an ink print is thus also compromised, and it will not be a true reproduction of the original copy.

For some continuous tone original copy, the main exposure will produce a satisfactory negative. However, it has been found that in most instances, the halftone resulting from the main exposure provides a less than satisfactory reproduction of the original copy, particularly when the original is a photograph containing a wide range of tones on the gray scale.

### Halftone-Making Techniques

Techniques known as flashing and bumping have been developed for making halftones. A flash is a short, supplementary nonimage exposure of the negative made through the screen, and is intended to compensate for the lack of light reflected from the darker parts of the original copy during the main exposure. It is commonly done by first placing a white card over the original copy on the copyboard, and then making a short exposure of the negative with screen in place. The purpose is to burn additional dots on all areas of the negative, resulting in dots where none may have previously existed in the darker areas, and the enlargement of dots made earlier during the main exposure. In addition to using the white card technique, flashing is also sometimes done by shining a light through the camera lens for a short period with the screen in place or by shining an overhanging light on the screen and negative sandwich exposed on an open camera back. In the latter instance, the overhanging light is usually fitted with a yellow filter.

As noted above, flashing provides a supplemental exposure through the screen and affects all areas of the negative. While producing more intense dots in the middletone and shadow areas, it also produces shadow dots in the very dark areas, and enlarges the dots in the white or highlight areas. The result is to improve overall detail in the resultant print, but at the price of some deterioration in all of the gray tones, a general flattening out of the reproduction, and the creation of a general haze over the print reproduction. By adding shadow dots in the dark portions there is a resultant reduction in ink saturation in such areas, sometimes by as much as 0.40 on the gray scale; thus, blacks on the original copy may app-

ear dark gray on the reproduction. while there is a loss of detail if the shadow dot is missing, there is an accompanying loss of contrast when the shadow dots are burned on the negative. Thus, while flashing can provide an improved print over use of only a main exposure, the resultant gray tones of the reproduction are again a compromise and do not truly reflect the original copy.

Another technique of bumping is also sometimes used in addition to flashing. A bump is a very short exposure of the continuous tone original to the negative, with the screen removed from the copy camera. The effect of bump is to close up the tiny clear dots in the negative, or to perhaps simply drop them out. This will produce more contrast in that area, but with loss of detail. The commonly used single negative halftone techniques then can provide acceptable printing plates for most instances. But the quality of the reproduction is not truly faithful to the original copy for the reasons noted. The typical reproduction will contain shadow areas which are more poorly defined than on the original copy, and it will have a general light haze thereover.

Fontana and Lai(1) proposed another technique which can produce halftone of higher quality where in a plurality of negatives were made. In this method each negative has a different exposure to accurately represent one portion of the gray scale as such is contained on the original copy. The negatives are then combined to make the reproduction. While this multiple negative process produces better results than single negative process just described, it requires multiple exposures and is expensive. Further, considerable skill is required to practice the technique since there must be precise registration of the different negatives. Thus the multiple negative halftone process does not fully satisfy the need for an effective halftone making technique.

#### The New Method

Therefore there is need for an improved process and apparatus for making halftones, capable of producing reproductions of original copy that are faithful in tone, well defined and haze free, and

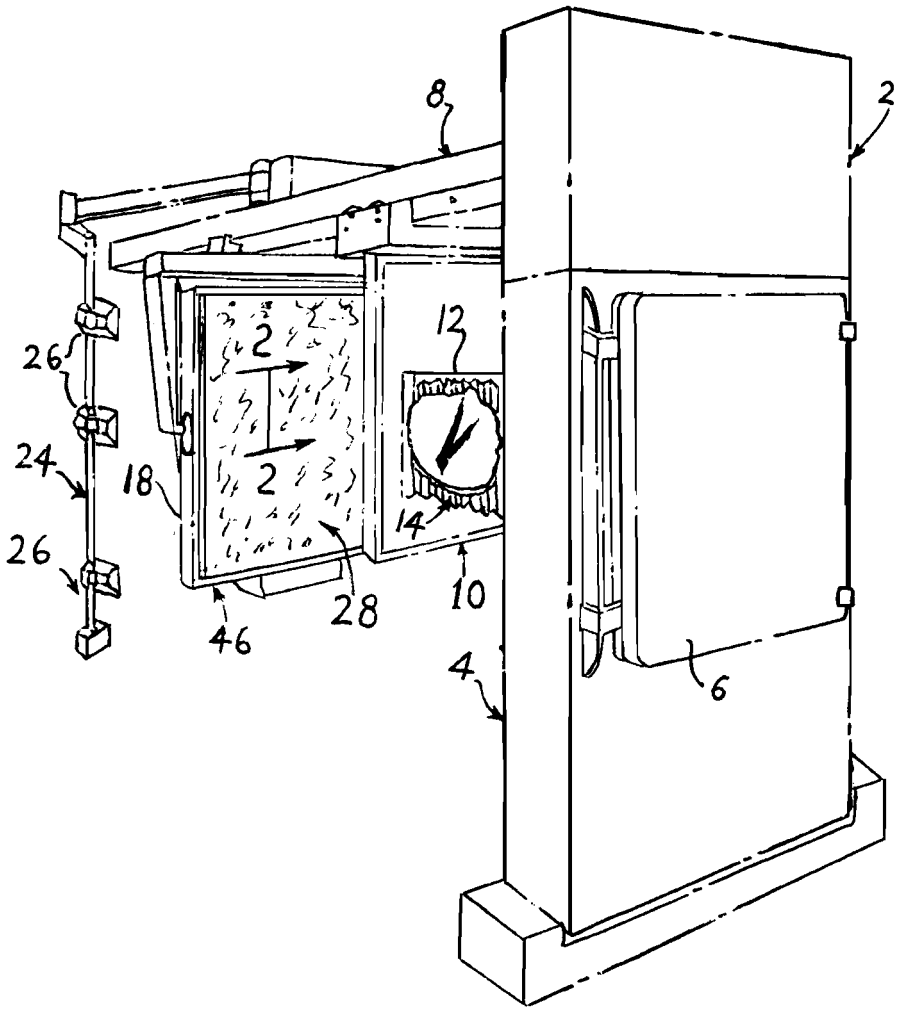


Figure 1. Process Camera Apparatus

which will not require expensive new equipment or modifications to existing equipment or great skill to utilize. Fontana's invention(2) can serve that need. He used a single negative technique to make halftones with an main exposure and a flash exposure. The result is a truly superior halftone which is well defined in all areas and free of haze as shown in Figure 2.

It is discovered that by confining the flash exposure of the negative to tones from the middle range of the gray scale and upwardly, the washing out of the highlight area which occurs with conventional flashing can be avoided and, at the same time, good definitions can be obtained in the darker, shadow areas. To put it another way, by avoiding further exposure of the negative in the highlight and middletone areas of the copy during flashing, the problems found with the present single halftone technique can be largely eliminated.

#### Process Camera and New Technique

The new technique is to utilize a novel reflector card for the flash as shown in Figure 1, one which is placed over the original copy on the copyboard, and which has a gray tone selected to be denser than the highlight and middletone areas of the original copy. A typical value for the reflector card will be about 1.30 on the gray scale, which has been found to provide a sharply defined halftone made from a photograph, one capable of producing an ink reproduction which is very close in appearance to the original photograph itself.

Referring to Fig.1, the process camera for making halftones is indicated at 2 and includes an upright camera frame 4. The rear of the frame 4 carries a hinged negative holder 6, which opens to allow insertion and removal of a negative. The screen(not shown) for making the halftone is mounted within the frame 4, the arrangement being such that the negative will be held in direct contact with the screen when the negative holder 6 is in its closed operative position. A horizontal bracket 8 extends forwardly from the camera frame 4 and mounts a lens holder 10 so that it is movable toward and away from the frame 4. A bellows 12

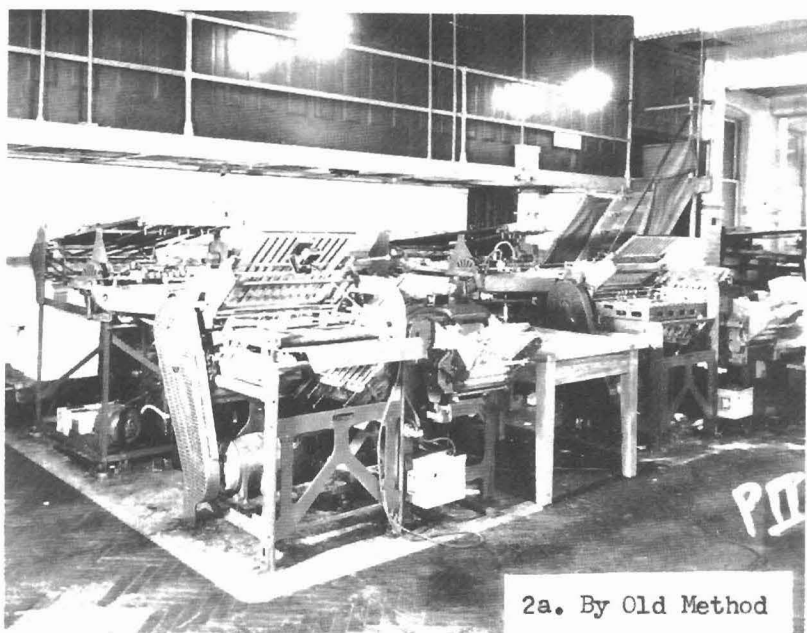


Figure 2. Halftones Reproduction

extends between the lens holder 10 and the frame 4 and a camera lens 14 is carried by the holder. A copy holder 16 is mounted on the bracket 8 outwardly of the lens holder 10, and includes a copyboard 18 having a glass cover sheet 20 which can be opened for placement of a continuous tone original copy 22 on the copyboard 18, the original then being clamped in position between the copyboard and the closed cover sheet. Light bracket 24 are suspended from the horizontal bracket 8, and carry exposure lights 26 which are activated by a switch to illuminate the copyboard.

A halftone is made with the process camera 2 by first mounting the original copy 22 in place on the copyboard 18, and placing a negative in the negative holder 6. A suitable screen(not shown) is mounted in the camera frame 4 to be in contact with the negative when the holder 6 is closed. The lens 14 is then set and the main exposure is made. A typical main exposure can be for about 16 seconds at a lens setting of f22. This will result in the placement of a pattern of dots on the negative, related to the whole range of gray tones found on the continuous tone original 22.

After the main exposure, a reflector board 28 is placed on the copy holder 16 to lie on the glass cover sheet 20. The reflector board 28 has a gray scale density placing it between the upper end of the highlight and middletone density of the original copy 22 and below the dark and black portion of the gray scale. Typically it will have a gray scale density of about 1.30. The dimensions of the reflector board 28 should be adequate so that all of the original copy 22 is covered and preferably all of the copyboard 18; no stray reflective areas should be left uncovered by the board 28.

With the reflector board 28 in place, a flash secondary or supplemental exposure of 5 seconds is made by illuminating the board and opening the camera lens. When this is done, light having a density range like that of the reflector board is reflected through the camera lens and the screen to fall on the negative. This will cause dots in the shadow areas of the original copy to be burned onto the negative. But since substantially no



light is reflected in the highlight and middletone areas, these dots on the negative are not adversely affected. Further, the production of shadow dots in the dark areas is minimal, with the result that heavier blacks are obtained over what is possible with conventional flashing.

### Results And Discussions

When the flash exposure is completed, the negative is removed from the process camera 2 and developed. No bumping is required, and indeed such would damage the quality of the halftone. Because the dots in the highlight and middletone areas of the negative were not added to by using the reflector card 28 for the flash, they will retain their sharp configurations as obtained during the main exposure and the haze usually found on halftones is eliminated. The light to deep shadow areas have had their dots enhanced, which brings out the fine detail found on the original. Finally, by stopping the flash exposure to the shadows short of about 1.80 on the gray scale, shadow dots are not placed in these areas. The ink saturation in the press is increased and the dark and black areas will receive a solid printing of black ink, providing more contrast in the reproduction while maintaining all the light to deep shadow detail. The result is a reproduction of very high quality.

The actual density used on the reflector card can be varied, depending largely on the density range of the original continuous tone copy. The highlights and middletones of an average photograph having a density range of from 0.00 to 2.00 on the gray scale will fall in the area of from 0.0 to 0.90. The density on the gray scale of the reflector card should be at or above the upper end of this highlight and middletone range, or at or above a density of 0.90. Further, the density of the reflector card 28 should not go above 1.60 on the gray scale. For the average photograph, then the range for the reflector card is from 0.90 to 1.60 on the gray scale and in most instances, a value of about 1.30 will provide satisfactory results.

To state the range in a more general way, it was found that the gray scale value for the re-

flector card 28 should fall between about 45% and about 80% of the shadow density of the original copy. The precise value on the gray scale for the reflector card 28 can be varied, depending upon whether the average shadow density of the original copy is higher or lower than 1.30. Such density can be measured by using a densitometer in the usual manner.

While the new method is especially adapted to black-and-white usage, it can also be employed with color reproduction such as the conventional four color process for reproducing color photographs and paintings. Again, when making each of the negatives required for color reproduction, the reflector card 28 is employed for flashing, and no further exposures of the negatives occur in the highlight and middletone areas. At the same time, detail in the shadow areas will be greater than has heretofore been possible and the resultant color print will possess a brilliance very like that of the original copy.

### Conclusions

Obviously significant conclusions can be drawn from the method for making superior halftones. The process camera with copyboard and reflector card is the backbone of the new method.

The reflector card having a gray scale value of between about 45% and about 80% of the shadow density of the original copy is unique to improve the reproduction quality, comparable or even better to that obtained with the multiple negatives technique. It can be easily adapted to original copy of different densities and can be used when working in either black-and-white or color.

The method provides an improved single negative process and apparatus which is readily adaptable to existing equipment and is simple and economical to use for making superior halftones.

### Illustration

The commonly used gray scale measures the tones on a value scale of from 0.00 to 2.00 with 0.00 representing white and 2.00 representing black.

The highlight and middletone areas will typically be in the range of from 0.00 to about 0.90 on the gray tone scale for an average photograph. The darker shadows will fall in the upper end of the scale between 1.60 and 2.00 with 2.00 being black. As shown in Figure 2a, halftone reproduction was made by conventional method while Figure 2b is the result from the new method. The difference is clearly indicated by the haze free reproduction with sharper definition and contrast of Figure 2b. It is further illustrated by the numerical value of the reproduction density as shown in Figure 3 and Table 1.

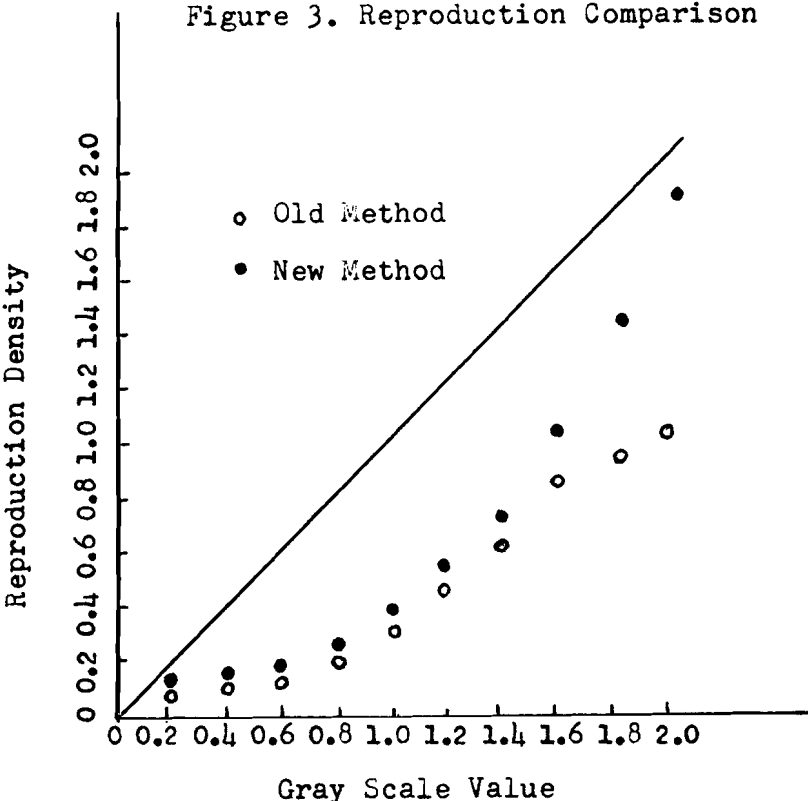


Table 1. Density of Reproduction

Tones	Highlight		Middletone					Shadow			
Cray Scale	0.00	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00
Old Method	0.00	0.05	0.09	0.11	0.18	0.29	0.47	0.73	0.83	0.98	1.05
New Method	0.00	0.07	0.11	0.17	0.24	0.37	0.51	0.61	1.20	1.45	1.91

### References Cited

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