

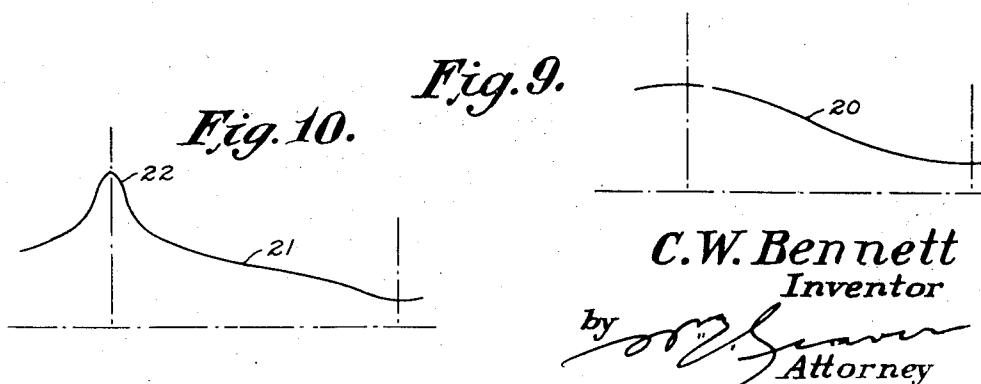
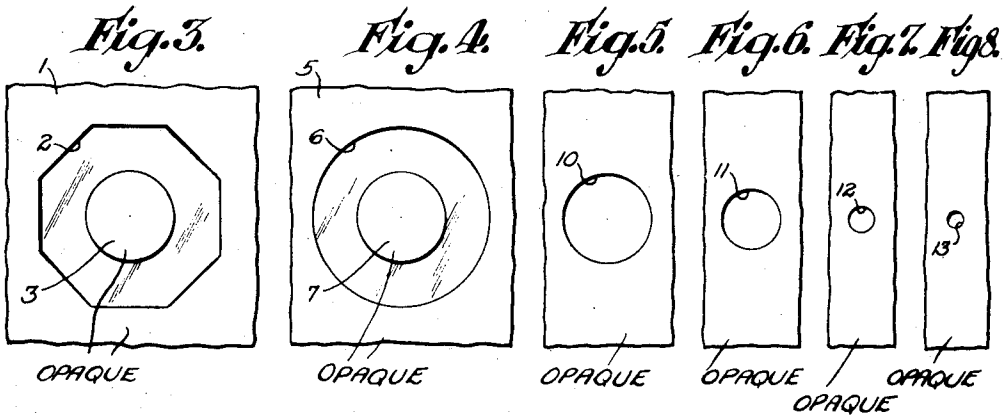
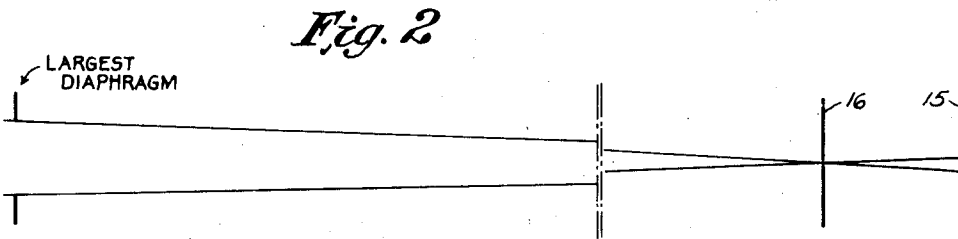
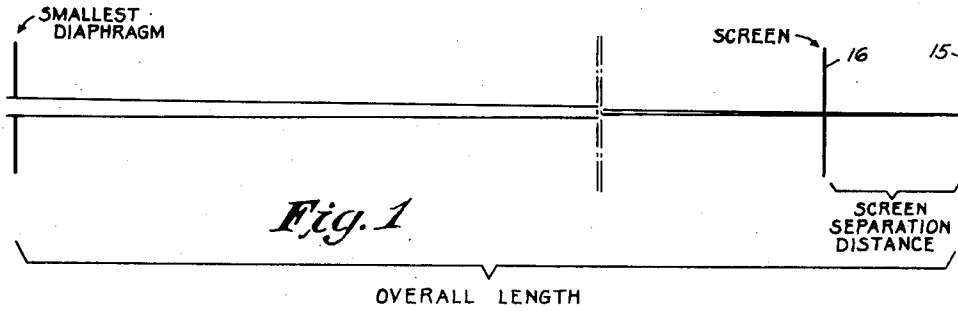
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2,095,909

UNIVERSAL SCREEN FOR PREPARING HALF TONES

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UNIVERSAL SCREEN FOR PREPARING
HALF TONESCharles W. Bennett, Rochester, N. Y., assignor to
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tion of New York

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4 Claims. (Cl. 95—81)

This invention relates to screens for making half-tones photographically and has for its object to provide a screen for universal application as well as a method of producing the same which will be cheaper in manufacturing costs and more efficient to use than those heretofore proposed.

With these and other objects in view the invention resides in the novel steps and combinations of steps constituting the method of production, as well as in the novel article produced thereby, all as will be disclosed more fully hereinafter and particularly pointed out in the claims.

Referring to the accompanying drawing forming a part of this specification in which like numerals designate like parts in all the views,—

Figs. 1 and 2 are diagrams illustrating the method of determining the coverage with a light intercepting screen of given opening when using respectively the smallest diaphragm opening and the largest diaphragm opening;

Figs. 3 to 8 are elevational views of a series of transparent diaphragms, the opaque portions being indicated by cross-hatching; and

Figs. 9 and 10 are graphic illustrations of photographic density of a contact screen obtained respectively by a heretofore known method and by the present invention.

In order that the precise invention may be more clearly understood it is pointed out that contact half-tone screens heretofore produced are of a character which does not properly render the values of the picture to be reproduced. It is obvious that if extreme contrast must be registered, the screen must be capable of delineating a range of contrast from point black to point white. This necessitates a cut-out to the minimum light on one end of the scale and a complete cut-out of the maximum light on the other end of the scale. It may be seen therefore that what is required is a density wedge with maximum density at a point and sufficient to intercept at that point all of the maximum light. The density should decrease from the maximum point to a minimum point at which minimum point all of the minimum light reflected from a picture to be reproduced, should be cut out. It may readily be seen that this would enable the production of a tone scale ranging from black to white. The variation in between the two extreme points may be gradual or in steps.

In the production of such a density wedge for the purpose above meant, it is obvious that the extreme dense portions up to the maximum

point must be light enough so that a print through may be obtained by the maximum light. At the same time, on the other extreme, the density must be light enough so that feeble lights above the minimum are registered. This means that the total area of a usable screen must be covered but the extremes are limited as mentioned above. Contact screens have been made heretofore by interposing a cross line screen between a diaphragm and the screen supporting medium. This cross line screen has been placed in what is known as half-tone relation with respect to the screen supporting medium. It is pointed out that with the screen in half-tone relation to the screen supporting medium, a complete coverage of the areas extending between maximum and minimum density required, as pointed out above, could not be had without obtaining a density too great at the dense portion. It is obvious that for the production of a contrasty negative, a rather flat contact screen must be had.

I have discovered that the densest portion of the screen can be prepared with a gradual shading to the minimum portion by the method hereinafter set forth. The contact screen prepared according to this invention is the result of placing a photographically sensitive film medium in one end of a camera and admitting light to affect the sensitive film through the openings of a previously prepared screen; in other words this invention contemplates the use of an ordinary screen to make the improved universal screen for preparing half-tones. According to this invention a camera set up is obtained but without a quartz lens, with the light admitting diaphragms at the end of the camera opposite the contact screen supporting medium, and a cross line or other light intercepting screen interposed between the two, and although in the following disclosure reference is made by way of example to a cross line screen, it is to be understood that my invention contemplates screens having lines otherwise formed as well as lines, dots, or figures creating geometric or other designs. A light source is used which may consist of the light reflected upon or from a surface as for instance a sheet of paper with a set up as in ordinary process copy work, or the light may be transmitted through flash opal glass. This invention constitutes an improvement over that disclosed in the U. S. Letters Patent No. 1,995,958 granted March 26, 1935 to Charles W. Bennett and entitled Universal screen for preparing half-tones.

When the light intercepting screen is placed in half-tone relation with the contact screen medium, no matter what the camera extension or diaphragm size may be, there cannot be obtained photographic action which approximates a point in extent by ordinary photographic development alone. It has been found that if the screen separation is increased to approximately double that of the so-called half-tone relation, there is a diaphragm size and a camera extension which will produce photographic action approximating a point in extent by photographic development alone. Therefore it is a principal feature of this invention to produce a contact screen which will give a point area.

It will be appreciated that a contact screen of flat slope is required for the delineation of maximum contrast. The use of the usual quartz lens causes a columnation of light which is objectionable in the making of contact screens because this columnation works against the diffusing action of the light intercepting screen. Since the lens tends to concentrate the light in the center of the beam, the use of a quartz lens was discontinued. Furthermore it has been discovered that if the beam of light be tubular (having a darkened center) the diffusion of the light intercepting screen is much accentuated so that the picture resulting is of workable flatness; in other words, when used as a contact screen it will markedly increase the contrast of the copy. According to this invention most surprising results have been obtained by a combination of tubular and pencil rays of light, thereby permitting the admitted light to get in behind the cross lines of the light intercepting screen producing a contact screen of workable slope in all areas. While the screen produced according to the said patent 1,995,958 is well adapted to contrasty material, it is not satisfactory for use with the materials disclosed in U. S. Letters Patent No. 2,018,657 granted Charles W. Bennett on October 29, 1935 and entitled Photographic developer and method of preparing the same, and therefore efforts were directed to the production of the contact screen of this invention which is satisfactory for all known types of material.

Satisfactory fine line screens have been heretofore prepared with more facility than the 60-70 line screens. The reason for this presumably is that with the closer spacing of the lines there results the smaller openings, which brings into predominance images of the pin-hole character, while with the coarse screens having larger openings the pin-hole characteristic is less prominent. It is believed therefore that by using the combination of diaphragms hereinafter set forth, the benefits of a pinhole lens are combined with the results of all of the images produced, to give the highly satisfactory contact screen; while the exact reason for the improved result is not positively known yet it remains a fact that this screen is better than any heretofore known. The distance of the screen from the contact screen medium may be made as desired but this screen separation distance will have a definite relation to the sizes of the diaphragms used.

Figs. 3 to 8 illustrate a series of diaphragm openings which have been found to give the best results. The first of these (Fig. 3) comprises a member 1 having therein an octagonal opening 2 which preferably is of regular formation, and 3 designates a circular opaque center in said opening. It is contemplated that instead of an opening of a regular octagonal shape, one of irregu-

lar shape may be employed in certain instances as will be explained hereinafter. The second (Fig. 4) of this series of diaphragms consists of a member 5 provided with a circular opening 6, with 7 representing a circular opaque center in said opening, the member 7 being of the same diameter as the center 3, and the diameter of the opening 6 being equal to the diameter of a circle which could be inscribed within the octagonal opening 2. While the diaphragms of Figs. 3 and 4 may be made in various ways, it has been found suitable to form the same of some transparent material such as glass or celluloid film with an opaque center and opaque field portion made by cementing opaque material on the glass or using an opaque paint to form these portions. By this construction there is made possible a tubular beam of light which controls particularly the shadow and medium tone area of the contact screen medium. The next four diaphragms (Figs. 5 to 8) may be similarly formed or made of metal and provide respectively the circular light transmitting openings 10, 11, 12, and 13, the opening 10 having a diameter equal to the diameter of the opaque centers 3 and 7; the opening 11 having an area approximately one-half that of opening 10; and the opening 12 having an area substantially one-half that of opening 11. In Fig. 8 the diaphragm opening 13 is the smallest of the series and is of a size commensurate with the overall length of the camera and the screen separation distance, and under all conditions it must be relatively small. In order that an idea may be had of the sizes of these diaphragms to obtain the best results, the approximate dimensions are as follows: The openings 2 and 6 are each $1\frac{1}{8}$ "'; the diameter of 3, 7 and 10 is each $\frac{1}{4}$ "'; and the diameters of openings 11, 12 and 13 are respectively, $\frac{3}{16}$ ", $\frac{1}{8}$ " and $\frac{1}{16}$ " inches; the overall length of the camera, or the distance between the diaphragm opening and this contact screen medium is $87\frac{1}{2}$ inches; and with a 70 line screen of 1:1 variety the separation distance thereof from the contact screen medium is $\frac{1}{10}$ of an inch.

Referring to Figure 2 the largest diaphragm opening is indicated diagrammatically at one end with the contact screen medium 15 at the other, and a 70 line screen of 1:1 variety shown at 16. Therefore it will be seen that upon the sensitized surface of the contact screen medium 15 there is produced a plurality of pictures of the diaphragm at the opposite end of the camera, each produced by the light passing through an opening of the screen 16. When using a seventy line screen of 1:1 variety the area covered on the contact screen medium for each opening of the screen will be a square, the dimension of which is .0143 inches. In order to secure the best coverage on the surface of said medium, it has been found that these variable factors of diaphragm opening and screen separation are correlated and give the best results when they are of the values given above. A formula which may be satisfactorily used in this connection is:

Overall length minus the separation distance is to the separation distance as the diaphragm opening is to the total coverage required (.0143 inches for a seventy line screen). Hence with a camera of overall length $87\frac{1}{2}$ inches and a screen separation distance of $\frac{1}{10}$ of an inch, as values in the above formula, the largest diaphragm opening will be equal to $1\frac{1}{8}$ inches. In obtaining the dimension of the opaque center 3 or 7 it will be understood that the diametric dimension of the opaque center of the tubular band of light will,

in passing through the opening of the screen, become focused on the contact screen medium as shown in Figure 1 when calculated according to the following formula:

Overall length is to the screen separation as the diameter of the covered spot is to the light intercepting screen opening. (.00715" for a seventy line screen of the 1:1 variety) and when using this formula the diameter of the center spot will be equal to $\frac{1}{16}$ of an inch (.695 inch).

The smallest diaphragm opening is provided to give a hard sharp dot of minimum proportion and devoid of halation and/or fog, and obviously necessitates a longer period of exposure. With the diaphragms above described it has been found that a very clear and superlative screen may be produced when the following exposures are made; 7 to 8 seconds with each of diaphragm openings 2 and 6; 5 to 7 seconds with each of diaphragm openings 10, 11 and 12; and approximately two minutes exposure with diaphragm opening 13. The contact screen medium 15 is in this case and at these exposures kodolith orthochromatic film and the developer is one for registering tone. With other photographic material it may be found necessary to change the above times of exposure as will be understood. However, with this kodolith orthochromatic film a satisfactory developer is one containing pyrocatechin as disclosed in my said Patent No. 2,018,657 and the development is carried on for one and three quarters minutes or more at a temperature of 57° F. or lower. The source of illumination is reflected light from a white surface, or through flash opal glass with a plurality of arc lights or any other source of uniform diffuse illumination and it will be understood that shutters will be used in connection with the diaphragm openings.

The present invention differs from those heretofore known including that disclosed in my U. S. Patent 1,995,958 in that it gives (1) a different total coverage, (2) a different relationship between a medium tone and the high light area, and (3) an end point on the high light side which gives a workable quality not heretofore obtainable. The difference in total coverage is brought about by the outside shape of the larger diaphragm; the difference in relationship between the medium tone and the high light area is accomplished by the fact that with the diaphragms shown in Figs. 3 and 4 a definite slope is obtained which may be changed or modified by the use of those shown in Figs. 5, 6 and 7, the latter controlling particularly the high light area while the former control the shadow and medium tone area. By varying the ratio of the time exposure of the two closed center diaphragms shown in Figs. 3 and 4 the shadow area may be correspondingly varied and this shadow area may be further varied by making the octagon (defining the opening 2) irregular such as by extending or retracting the alternate sides thereof which correspond to the corners established by the light intercepting screen. Independent variation of individual diaphragm exposure, will modify the slope obtained in one tone, as well as between tones.

In other words the photographic density made possible according to this invention may be represented by the graphical illustrations constituting figures 9 and 10, the former representative of the density made possible by the use of the disclosure of said Patent 1,995,958, and the latter showing the improved density made possible by this invention. These graphic illustrations are made substantially in the plane passing through

the maximum and minimum point densities of the screen. From Figure 9 it will be observed that the density obtainable by the patented device has a rather sharp slope as indicated at 23 whereas that obtainable by this improved screen has a shallow slope indicated at 21 throughout a substantial length and then there is a relatively sharp and deep density as at 22 at the centers of the high light area. On the resultant contact screen medium 15 this density will be in the nature of a hard dot in the center due to the long exposure made possible through the smallest diaphragm opening. The object of this hard dense dot is to serve as a stop for the negative high light, whereby when said medium has been developed and is used as intended as a contact screen in further photographic work, the degree of exposure need not be critical. In other words with the contact screen disclosed by said patent a variation in exposure of as much as 20% may result in a plugging of the high lights, or over-exposure, whereas with the contact screen produced according to this invention an over-exposure of as much as 200% may be made without loss of the extreme high tones.

From the foregoing it will thus be seen that by this invention there is produced a contact screen which may be used for contact printing and the like, wherein there is formed a great plurality of areas each being a photograph of a composite diaphragm opening, said photograph being taken through the openings of a light intercepting screen, said openings being each in the nature of a pin-hole lens. Further, that in the production of this novel screen, each of said areas has a density which may be represented graphically by a curve the slope of which throughout its major portion is flat but which extends more or less abruptly away from the general direction of the slope adjacent the central portion of said area. This abrupt extension in the density curve corresponds to the hard dot in the center and created by the prolonged exposure through the minimum diaphragm opening.

Further the coverage must be accurately done; if the coverage is less than required in the making of the half-tone negative, a line connecting the shadow dots will appear much too early; if the coverage is too great, occasioning overlapping, the printing will not be sufficient in the areas between the negative high light openings. This is reflected in the cast relief in that the bottoms are not smooth and the projecting parts corresponding to the insufficiently unprinted areas between the negative high lights may even touch the ink roller and be reproduced as a blur upon the printed page.

It is obvious that those skilled in the art may vary the steps and combinations of steps constituting the method as well as vary the product obtained thereby within the scope of this invention without departing from the spirit thereof and therefore it is not desired to be limited to the foregoing disclosure except as may be demanded by the claims.

What is claimed is:

1. The method of producing a contact screen photographically in a camera which comprises establishing a source of light giving uniform diffuse illumination; placing a transparent contact screen medium having a light sensitive surface in one end of the camera; disposing a transparent screen having opaque lines thereon in the camera at twice the half-tone separation distance from the contact screen medium, interposing

an annular diaphragm opening and then a circular diaphragm opening between the light source and the screen; and exposing the light sensitive surface of the contact screen medium to the action of the light from said source admitted to the camera successively through each of the diaphragm openings, the time of exposure through the annular diaphragm opening being relatively much less than that through the circular diaphragm opening.

2. The method of producing a contact screen photographically in a camera which comprises establishing a source of light giving uniform diffuse illumination; placing a transparent contact screen medium having a light sensitive surface in one end of the camera; disposing a transparent screen having opaque lines thereon in the camera at twice the half-tone separation distance from the contact screen medium; interposing an annular diaphragm opening and then a circular diaphragm opening between the light source and the screen, the inside diameter of the annular diaphragm opening being substantially equal to the diameter of the circular diaphragm opening; and exposing the light sensitive surface of the contact screen medium to the action of the light from said source admitted to the camera successively through each of the diaphragm openings, the time of exposure through both openings being substantially the same.

3. The method of producing a contact screen photographically in a camera which comprises establishing a source of light giving uniform diffuse illumination; placing a transparent contact screen medium having a light sensitive surface in one end of the camera; disposing a transparent screen having opaque lines thereon in the camera at twice the half-tone separation distance from the contact screen medium; interposing successively a series of annular as well as circular diaphragm openings between the light

source and the screen, the circular diaphragm openings being of successively smaller diameter, the diameter of the largest circular diaphragm opening being substantially equal to the inside diameter of an annular diaphragm opening; and exposing the light sensitive surface of the contact screen medium to the action of the light from said source admitted to the camera successively through each of the diaphragm openings, the time of exposure through the annular diaphragm opening being relatively much less than that through the smallest circular diaphragm opening.

4. The method of producing a contact screen photographically in a camera which comprises establishing a source of light giving uniform diffuse illumination; placing a transparent contact screen medium having a light sensitive surface in one end of the camera; disposing a transparent screen having opaque lines thereon in the camera at twice the half-tone separation distance from the contact screen medium; interposing successively a series of annular as well as circular diaphragm openings between the light source and the screen, the circular diaphragm openings being of successively smaller diameter, the diameter of the largest circular diaphragm opening being substantially equal to the inside diameter of an annular diaphragm opening, the diameter of the smallest circular diaphragm opening being substantially one-fifth that of the largest circular diaphragm opening; and exposing the light sensitive surface of the contact screen medium to the action of the light from said source admitted to the camera successively through each of the diaphragm openings, the time of exposure through the annular diaphragm opening being substantially one-eighteenth that through the smallest circular diaphragm opening.

CHARLES W. BENNETT.