June 28, 1966 A. RIEMERSCHMID ETAL 3,258,341

CONTACT SCREEN

Filed May 31, 1963 2 Sheets-Sheet 1

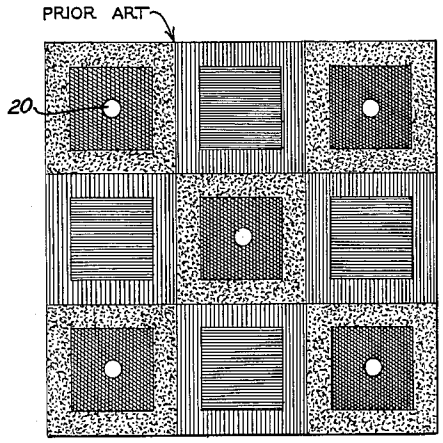

Fig. 1

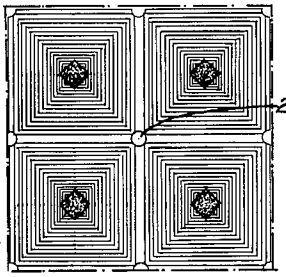

Fig. 2

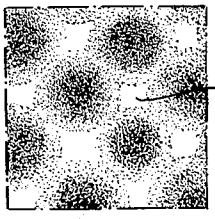

Fig. 3

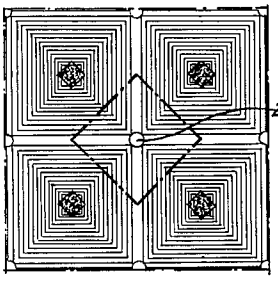

Fig. 4

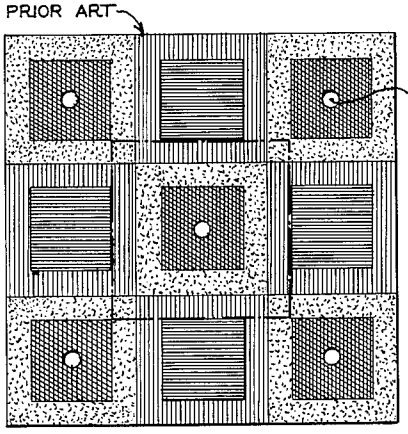

Fig. 5

June 28, 1966 A. RIEMERSCHMID ETAL 3,258,341

CONTACT SCREEN

Filed May 31, 1963 2 Sheets-Sheet 2

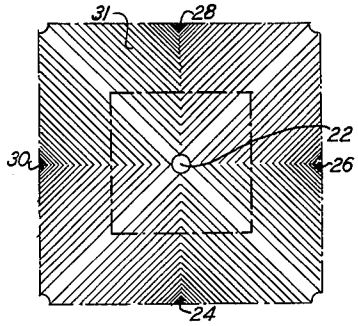

Fig. 6

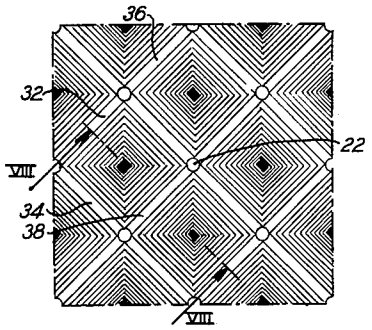

Fig. 7

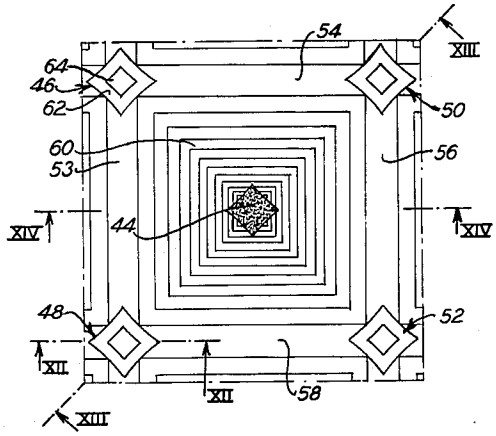

Fig. 11

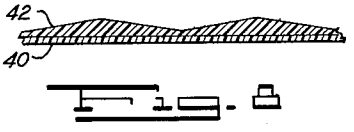

Fig. 8

Fig. 9

Fig. 10

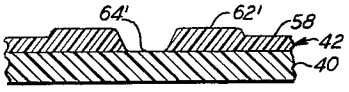

Fig. 12

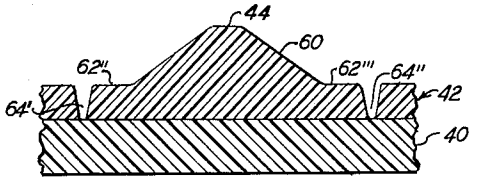

Fig. 13

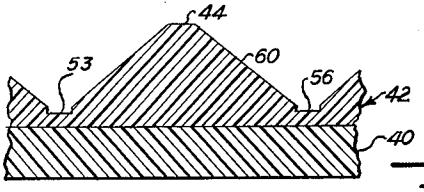

Fig. 14

United States Patent Office 3,258,341 Patented June 28, 1966

3,258,341

CONTACT SCREEN

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Filed May 31, 1963, Ser. No. 284,491
12 Claims. (Cl. 96—116)

This application is a continuation-in-part of our earlier application, Serial No. 591,074, filed June 13, 1956, and now abandoned.

This invention relates to contact screens.

It is an object of the invention to provide an improved contact screen.

It is a further object of the application to provide a universal or multi-purpose contact screen which may be used with equal facility in connection with offset and engraving techniques.

It is a further object of the invention to provide an improved contact screen which provides for reproductions of the highest quality.

Yet another object of the invention is to provide an improved contact screen wherein all tone ranges of an original are faithfully reproduced with substantially no tone distortion.

Still another object of the invention is to provide an improved contact screen which is independent of the density thereof.

A still further object of the invention is to provide an improved contact screen which permits a normal pre-exposure without the occurrence of tone flattening.

Yet another object of the invention is to provide an improved contact screen wherein contrasts may be increased or decreased with equal success.

In achieving the above and other of its objectives, the invention contemplates the provision of a contact screen comprising a substantially transparent sheet with a surface layer positioned thereon.

The surface layer is provided with perpendicularly disposed linear arrays of evenly spaced substantially opaque dots according to a preferred embodiment. Each group of four adjacent of the dots forms the vertices of a right quadrilateral from which all other of these opaque dots are excluded.

According to the preferred embodiment, the surface layer further includes a gradually varying grey tone portion extending from each opaque dot towards each dot adjacent thereto. Each grey tone portion diminishes to a minimum opacity zone midway between each opaque dot and the corresponding adjacent dot.

In accordance with a feature of the invention, the minimum opacity zones are in right quadrilateral alignments about respective of the opaque dots, the right quadrilateral alignments constituting the perimeters of varying opacity zones in which the opaque dots are centered.

Still further, the surface layer is provided with semi-transparent zones located at the vertices of the right quadrilateral alignments of the minimum opacity zones, the semi-transparent zones being located in perpendicular linear arrays.

In accordance with a further feature of the invention, the surface layer is further provided with substantially fully transparent dots centrally located in the semi-transparent zones.

According to yet another feature of the invention, the semi-transparent zones have about .5 to 5% the opacity of the opaque dots and the minimum opacity zones extend radially from the semi-transparent zones and have no more than about 10% less opacity than the semi-transparent zones.

According to still another feature of the invention, the areas of the semi-transparent zones have a ratio to the areas of the varying opacity zones of about 1:50 to 1:400.

According to still a further feature of the invention, the area of each transparent spot to the area of the associated semi-transparent zone is about 1:20 to 1:60.

Advantageously, the advantages of the invention and the structures provided in accordance therewith, are readily manufactured by the use of mass production techniques.

Other objects, features and advantages of the invention will be apparent from the following detailed description of some preferred embodiments thereof, as illustrated in the accompanying drawing in which:

FIGURE 1 is a plan view of a contact screen in accordance with the prior art;

FIGURE 2 is a plan view of a section of a contact screen provided in accordance with the invention;

FIGURE 3 is a pictorial representation of a micro-photograph of the contact screen of FIG. 2, with light exposed through the same and rotated 45° relative to the showing of FIG. 2;

FIGURE 4 is a view similar to that of FIG. 2, illustrating the dot growth pattern of this screen;

FIGURE 5 is a view similar to FIG. 1, showing the dot growth pattern of the prior art contact screen;

FIGURE 6 is an enlarged view of the contact screen of the invention;

FIGURE 7 is a further enlarged view of a contact screen of the invention;

FIGURE 8 is a cross-section along line VIII—VIII of FIG. 7;

FIGURE 9 illustrates a dot configuration permissible in accordance with the invention;

FIGURE 10 illustrates a further dot configuration permissible in accordance with the invention;

FIGURE 11 is an enlarged view of a contact screen provided in accordance with the invention, the details thereof being illustrated diagrammatically;

FIGURE 12 is a cross-sectional view taken along line XII—XII of FIG. 11;

FIGURE 13 is a cross-sectional view taken along line XIII—XIII of FIG. 11; and

FIGURE 14 is a cross-sectional view taken along line XIV—XIV of FIG. 11.

Contact screens may be classified according to the arrangement of the dots in the screen. On this basis, two broad groups of screens may be designated, the one based on a checker board arrangement, the other on a so-called "in-line" arrangement of the invention.

The arrangement of the dots in the screen which follows the checker board pattern is shown in FIGURE 1. It will be noted that on a given line, each screen dot 20 is separated by an empty space, and that the lines of the dots above and below the given line follow the same order but are offset by one dot. This gives the familiar appearance of the conventional checker board pattern. The contact screens comprising this group are the single-purpose, offset-only and engraving-only screens.

The arrangement of the dots in the screens which follow the in-line pattern is the basis for the second group. This is designated the multi-purpose type and is shown in FIG. 2. It will be noted that on a given line of dots 22 in the screen, the dots are adjacent one another and follow each other in order. The line of dots above and below the given line are identical, and are all "in-line," one above the other all the way through. A reproduction of a micro-photograph of the multi-purpose screen is shown in FIG. 3. Some further characteristic features which cannot be reproduced photographically will be hereinafter described.

It is of interest to observe the manner in which the dot in the screened negative or positive is formed. Since the multi-purpose screen contains tiny clear areas between

four adjacent opaque dots, initial exposure of light passing through this area, results in tiny pin-point dots. Continued exposure of light results in the formation of progressively larger dots, which enlarge with exposure, the direction of growth occurring along the diagonals of a rectangle, until larger dots on a checker board pattern is formed. During the exposure, the dot structure of the screen is turned into another dot structure in the screened negative, or positive. As shown in FIG. 4 all the dots turned into a checker board pattern run in the angle of 45° to the border of the screened negative or positive.

In FIG. 5 of the drawings a similar dot growth pattern is shown, but the direction of the growth pattern is horizontally and vertically in the screened negative or positive.

Because of the density gradation of the dot in the screen, growth of the dot in the screened result is gradual, the end point being a reproduction of the tones of the copy, within the limits of the characteristics of the screen.

The multi-purpose screen may cover, for example, a density range of 1.6, i.e., from about .35 to about 1.95. Thus, the screen will give a halftone copy of this tonal range without need of flash exposure. For copy having a density range exceeding that of the screen, a flash exposure is used.

An interesting characteristic of the multi-purpose screen is indicated in the location of the middle tone values in the halftone when flash exposure is used. This may be illustrated by the following: If a ten step gray scale is photographed through the multi-purpose screen, without flash exposure, a slightly less than 50% dot is observed in the fifth step, and a slightly greater than 50% dot is observed in the sixth step. If normal flash exposures are used, together with the main exposure, this condition still prevails, and the exact middle tones show up essentially as 50% dots in the center of the gray scale, where they really belong. Flash exposures with the checkerboard type of screen, however, are observed to shift the 50% dots away from the center of the gray scale.

Another interesting characteristic of the multi-purpose screen lies in the fact that the tone reproduction quality is unaffected by the density of the screen. A lighter screen merely shoots faster. If a process camera or enlarger is used, this feature permits short exposures. On the other hand, if one attempts to use a low density screen in a contact frame, working control of the exposures becomes difficult. Consequently, the multi-purpose screen is furnished in a medium density which allows fast exposures in the camera, and provides reasonable control if the same screen should be used in a contact frame.

Other features of the multi-purpose screen worthy of mention include:

(1) Because of the density gradient in the screen dot, and the proportion of light to dark in the screen itself, this type of screen may be used interchangeably for producing both high contrast offset type negatives, and low contrast engraving type negatives, as desired.

(2) Since the screen is transparent, like the glass crossline screen, it can be used to produce screened negatives from colored copy for black and white production, and for direct, color separation work in the short run process.

(3) The density range coverage of the screen is high, approximately 1.6.

Referring next to FIGS. 6 and 7, two enlarged views of a portion of a contact screen such as that illustrated in FIGS. 2 and 4 are shown. To provide for correlation with FIGS. 2 and 4, a dot **22** is indicated.

In the contact screen of the invention, a plurality of substantially opaque dots are employed, preferably in rectilinear arrays which are perpendicularly disposed to one another, the opaque dots being evenly spaced therein.

In FIG. 6 four opaque dots **24**, **26**, **28** and **30** are illustrated. These will be considered to constitute a group of four adjacent opaque dots which form the vertices of a right quadrilateral (in this case a square) from which all other of the opaque dots are excluded.

In this right quadrilateral alignment, for example, opaque dot **24** will be considered to be adjacent opaque dots **26** and **30**, but not adjacent opaque dot **28**, whereas opaque dot **26** will be considered as being adjacent opaque dots **24** and **28**, but not adjacent opaque dot **30**, and so on.

In FIGS. 6 and 7 it will be further noted that each opaque dot is surrounded by a gradually varying grey tone portion extending from each opaque dot towards each dot adjacent thereto.

It will be moreover noted that each grey tone portion diminishes to a minimum opacity zone midway between each opaque dot and the corresponding adjacent dot.

It is to be noted that the minimum opacity zones are arranged in right quadrilateral alignments about respective of said opaque dots. For example, minimum opacity zones **32**, **34**, and **38** are three sides of a square encompassing the associated opaque dot. It may therefore be said that the right quadrilateral alignments of the minimum opacity zones constitute the perimeters of varying opacity zones in which the opaque dots are centered.

From the drawing it will appear that the preferred form of the surface layer to form the zones of varying capacity is that of a multitude of pyramids, the upper vertice of which constitutes the opaque dot. This is shown more graphically in the cross-sectional view which appears in FIG. 8, wherein the transparent layer **40** may be seen along with the covering or surface layer **42** formed of a material affording suitable opacity in accordance with its thickness. In FIG. 8 it will be seen that the grey tone is gradually varying rather than a step-by-step variation so that it will be clear that the increments indicated in FIGS. 6 and 7 are for illustration purposes only.

The shapes of the opaque dots, as well as the dots **22** (as will be described in greater detail hereinafter) may be square, as seen in FIGS. 6 and 7, or polygonal as shown in FIG. 9, or even star-shaped as shown in FIG. 10. Other configurations are also possible within the scope of the invention.

Reference is next made to FIG. 11 wherein the separate zones and areas contemplated in accordance with the invention are illustrated as being sharply delineated from one another. It will be appreciated, however, that in practice the different areas and zones merge into one another rather than having sharp lines of demarcation therebetween. The purpose of showing sharp lines of demarcation between the different zones is to enable a definition of the invention which will facilitate the use thereof by those skilled in the art.

Referring to FIG. 11, a substantially opaque dot **44** is shown, surrounded by four zones **46**, **48**, **50** and **52**. Opaque dot **44** corresponds to the opaque dots **24**, **26**, **28** and **30** of FIG. 6 and zones **46**, **48**, **50** and **52** correspond to the dots **22** to which reference has heretofore been made.

Also illustrated are zones of minimum opacity **53**, **54**, **56** and **58**, these zones also corresponding to the zones of minimum opacity to which reference has previously been made.

From FIG. 11 it will be seen that, as indicated above, said zones of minimum opacity which extend radially from respective of zones **46**, **48**, **50** and **52**, cooperatively constitute the perimeter of a varying opacity zone **60**, constituted by the above-noted pyramidal variations in the surface layer.

It will now appear that the zones **46**, **48**, **50** and **52** are comprised of two separate and distinct parts. Referring, for example, to the zone **46**, it will now appear that this comprises a semi-transparent zone **62**, in which is centrally located a substantially fully transparent pinpoint dot or spot **64**.

With reference to FIG. 12, it will be seen that surface layer **42** located on transparent sheet **40** has a particular profile to provide for the aforegoing.

More particularly, the substantially fully transparent dot appears along section line XII—XII of FIG. 11, as

portion 64' in the surface layer 42, which portion represents substantially the absence of the surface layer 42 at this point.

Still further it will be seen that the semi-transparent zone appears along section line XII—XII as indicated at 62', the zone of minimum opacity appearing between adjacent of the opaque dots appearing in FIG. 12 as shown at 58.

The opaque dots, semi-transparent zones and zones of minimum opacity have a preferred physical relationship. More particularly, the semi-transparent zones have about .5 to 5% the opacity of the opaque dots, such as the dot 44. The zones 64' (see also dot 64) are preferably almost fully transparent. The minimum opacity zones (e.g., zone 58) have no more than about 10% less opacity than the semi-transparent zones.

The relationship of the opaque dots, zones of varying grey tone, the semi-transparent zones and the fully transparent spots is apparent from the cross-section given in FIG. 13, it being understood that the relative sizes shown in the drawing are not in correct proportion.

In FIG. 13 the opaque spot 44 is shown as being constituted by the peak of the associated pyramid or zone of varying opacity 60. Associated therewith are the semi-transparent zones 62'' and 62'''. Also seen in connection with FIG. 13 are the pin-point spots of full transparency, such as indicated at 64' and 64''. The relationship of the aforenoted pyramids and opaque dots to the associated zones of minimum transparency is apparent from FIG. 14, wherein are illustrated zones 53 and 56 of minimum opacity, located midway between opaque dot 44 and the adjacent of the opaque dots (not shown).

The specific lines of demarcation illustrated in FIG. 11 are intended for purposes of enabling the definition of the areas of the respective zones.

In this regard, the preferred embodiment of the invention provides that the area of a semi-transparent zone to the area of a varying opacity zone is in the order of about 1:50 to 1:400. More particularly and by way of example, the area of zone 62 to the area of zone 60 is in the range of from about 1:50 to 1:400.

A still further characteristic feature of the invention, which is believed essential to the practice thereof, involves a particular relationship between the area of the fully transparent dots to the associated semi-transparent zones. Thus, the area of fully transparent spot 64 to semi-transparent zone 62 is in the range of from about 1:20 to 1:60.

By way of review, the invention contemplates that the above contact screen is a multi-purpose contact screen adapted for use with both offset and letterpress techniques and that reproductions of the highest quality are obtained with such screens with all tone ranges of an original being faithfully reproduced with no tone distortion. Moreover, contact screens provided with the aforenoted features are independent of the density of the surface layer thereon. Still further, with a normal pre-exposure step, no tone flattening will occur with contact screens of the invention. Still further, contrasts may be increased or decreased with equal success in employing contact screens of the invention.

There will now be obvious to those skilled in the art many modifications and variations of the structure set forth above. These modifications and variations will not depart from the scope of the invention as defined by the following claims.

What is claimed is:

1. A contact screen comprising a substantially transparent sheet and a surface layer on said sheet, said surface layer having spaced, substantially opaque dots, said surface layer including a gradually varying grey tone portion extending from each opaque dot towards each dot adjacent thereto, each grey tone portion diminishing to a minimum opacity zone between each opaque dot and the corresponding adjacent dot, the minimum opacity zones surrounding respective of said opaque dots, said surface layer further having semi-transparent zones distributed about the opaque dots and located between said minimum opacity zones, said surface layer further having substantially fully transparent spots located in the semi-transparent zones, said semi-transparent zones having about .5 to 5% the opacity of said opaque dots, the area of each transparent spot to the area of the associated semi-transparent zone being about 1:20 to 1:60.

2. A contact screen comprising a substantially transparent sheet and a surface layer on said sheet, said surface layer having arrays of spaced, substantially opaque dots, each group of four adjacent of said dots forming the vertices of a quadrilateral from which all other of said opaque dots are excluded, said surface layer including a gradually varying grey tone portion extending from each opaque dot towards each dot adjacent thereto, each grey tone portion diminishing to a minimum opacity zone between each opaque dot and the corresponding adjacent dot, the minimum opacity zones constituting the perimeters of varying opacity zones constituted by the varying grey tone portions and in which the opaque dots are centered, said surface layer further having semi-transparent zones located in the minimum opacity zones, said surface layer further having substantially fully transparent spots located in the semi-transparent zones, said semi-transparent zones having about .5 to 5% the opacity of said opaque dots, the areas of said semi-transparent areas having a ratio to the areas of said varying opacity zones of about 1:50 to 1:400, the area of each transparent spot to the area of the associated semi-transparent zone being about 1:20 to 1:60.

3. A contact screen comprising a substantially transparent sheet and a surface layer on said sheet, said surface layer having perpendicular linear arrays of evenly spaced, substantially opaque dots, each group of four adjacent of said dots forming the vertices of a right quadrilateral from which all other of said opaque dots are excluded, said surface layer including a gradually varying grey tone portion extending from each opaque dot towards each dot adjacent thereto, each grey tone portion diminishing to a minimum opacity zone midway between each opaque dot and the corresponding adjacent dot, the minimum opacity zones being in right quadrilateral alignments about respective said opaque dots, said right quadrilateral alignments constituting the perimeters of varying opacity zones in which the opaque dots are centered, said surface layer further having semi-transparent zones located at the vertices of the rectilinear alignments of said minimum opacity zones, said semi-transparent zones being located in perpendicular linear arrays, said surface layer further having substantially fully transparent spots centrally located in the semi-transparent zones, the areas of said semi-transparent areas being substantially less than the areas of said varying opacity zones, the area of each transparent spot being substantially less than the area of the associated semi-transparent zone.

4. A contact screen comprising a substantially transparent sheet and a surface layer on said sheet, said surface layer having perpendicular linear arrays of evenly spaced, substantially opaque dots, each group of four adjacent of said dots forming the vertices of a right quadrilateral from which all other of said opaque dots are excluded, said surface layer including a gradually varying grey tone portion extending from each opaque dot towards each dot adjacent thereto, each grey tone portion diminishing to a minimum opacity zone midway between each opaque dot and the corresponding adjacent dot, the minimum opacity zones being in right quadrilateral alignments about respective said opaque dots, said right quadrilateral alignments constituting the perimeters of varying opacity zones in which the opaque dots are centered, said surface layer further having semi-transparent zones located at the vertices of the rectilinear alignments of said minimum opacity zones, said semi-trans-

parent zones being located in perpendicular linear arrays, said surface layer further having substantially fully transparent spots centrally located in the semi-transparent zones, said semi-transparent zones having about .5 to 5% the opacity of said opaque dots, said minimum opacity zones extending radially from the semi-transparent zones and having no more than about 10% less opacity than the semi-transparent zones, the areas of said semi-transparent areas being substantially less than the areas of said varying opacity zones, the area of each transparent spot being substantially less than the area of the associated semi-transparent zone.

5. A contact screen comprising a substantially transparent sheet and a surface layer on said sheet, said surface layer having perpendicular linear arrays of evenly spaced, substantially opaque dots, each group of four adjacent of said dots forming the vertices of a right quadrilateral from which all other of said opaque dots are excluded, said surface layer including a gradually varying grey tone portion extending from each opaque dot towards each dot adjacent thereto, each grey tone portion diminishing to a minimum opacity zone midway between each opaque dot and the corresponding adjacent dot, the minimum opacity zones being in right quadrilateral alignments about respective said opaque dots, said right quadrilateral alignments constituting the perimeters of varying opacity zones in which the opaque dots are centered, said surface layer further having semi-transparent zones located at the vertices of the quadrilateral alignments of said minimum opacity zones, said semi-transparent zones being located in perpendicular linear arrays, said surface layer further having substantially fully transparent spots centrally located in the semi-transparent zones, the areas of said semi-transparent zones having a ratio to the areas of said varying opacity zones of about 1:50 to 1:400, the area of each transparent spot to the area of the associated semi-transparent zone being about 1:20 to 1:60.

6. A contact screen comprising a substantially transparent sheet and a surface layer on said sheet, said surface layer having perpendicular linear arrays of evenly spaced, substantially opaque dots, each group of four adjacent of said dots forming the vertices of a right quadrilateral from which all other of said opaque dots are excluded, said surface layer including a gradually varying grey tone portion extending from each opaque dot towards each dot adjacent thereto, each grey tone portion diminishing to a minimum opacity zone midway between each opaque dot and the corresponding adjacent dot, the minimum opacity zones being in right quadrilateral alignments about respective said opaque dots, said right quadrilateral alignments constituting the perimeters of varying opacity zones in which the opaque dots are centered, said surface layer further having semi-transparent zones located at the vertices of the quadrilateral alignments of said minimum opacity zones, said semi-transparent zones being located in perpendicular linear arrays, said surface layer further having substantially fully transparent spots centrally located in the semi-transparent zones, said semi-transparent zones having about .5 to 5% the opacity of said opaque dots, the areas of said semi-transparent zones having a ratio to the areas of said varying opacity zones of about 1:50 to 1:400, the area of each transparent spot to the area of the associated semi-transparent zone being about 1:20 to 1:60.

7. A contact screen adapted for use with letterpress and offset printing techniques comprising a substantially transparent sheet and a surface layer on said sheet, said surface layer having perpendicular linear arrays of evenly spaced, substantially opaque dots, each group of four adjacent of said dots forming the vertices of a right quadrilateral from which all other of said opaque dots are excluded, said surface layer including a gradually varying grey tone portion extending from each opaque dot towards each dot adjacent thereto, each grey tone portion diminishing to a minimum opacity zone midway between each opaque dot and the corresponding adjacent dot, the minimum opacity zones being in right quadrilateral alignments about respective said opaque dots, said right quadrilateral alignments constituting the perimeters of varying opacity zones in which the opaque dots are centered, said surface layer further having semi-transparent zones located at the vertices of the quadrilateral alignments of said minimum opacity zones, said semi-transparent zones being located in perpendicular linear arrays, said surface layer further having substantially fully transparent spots centrally located in the semi-transparent zones, said semi-transparent zones having about .5 to 5% the opacity of said opaque dots, said minimum opacity zones extending radially from the semi-transparent zones and having no more than about 10% less opacity than the semi-transparent zones, the areas of said semi-transparent zones having a ratio to the areas of said varying opacity zones of about 1:50 to 1:400, the area of each transparent spot to the area of the associated semi-transparent zone being about 1:20 to 1:60.

8. A screen as claimed in claim 7 wherein the varying opacity zones are pyramidal in shape.

9. A screen as claimed in claim 7 wherein said sheet is a right quadrilateral and the linear arrays are arranged at 45° to the sides of the sheet.

10. A screen as claimed in claim 7 wherein the dots are quadrilateral.

11. A screen as claimed in claim 7 wherein the dots are polygonal.

12. A screen as claimed in claim 7 wherein the dots are star-shaped.

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