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PATENT SPECIFICATION

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(54) METHODS FOR TAKING AND COMPOSING STEREOSCOPIC PICTURES

(71) We, DIMENSIONAL DEVELOPMENT CORPORATION, a corporation of the State of Georgia, having a place of business at 2403 Johnson Ferry Road NE, Atlanta, Georgia 30341 U.S.A., do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the production of stereoscopic pictures of the type employing a lenticular screen, and represents an improvement in or modification of the invention described in our Application No. 45325/73 (Specification No. 1,445,583) hereinafter referred to as the "parent specification".

Our parent specification describes techniques for the production of stereoscopic pictures of good quality. Successful production is related to a parameter termed the "parallax value" and in the parent specification we have claimed:—

(a) a method of obtaining an image record of a spatial object field that is useful in producing a stereoscopic picture of the type incorporating a viewing lenticular screen of lenticule width W, the stereoscopic picture to include a key subject matter element image in the plane of the picture and at least one of a foreground element image seemingly in front of the plane of the picture and a background element image seemingly behind the plane of the picture, comprising the steps of:

photographically recording an overall image of the object field through a lens of focal length (*f*) from a plurality (N) of different relative vantage points aligned in a path extending generally transversely of, and in generally uniform spaced relation to the object field; and

controlling at least one of (1) said focal length (*f*), (2) the distance between adjacent ones of said plurality (N) of vantage points, (3) the enlargement ratio (R) between the photographic record of said object field and the stereoscopic picture, (4) the distance (*a*) from the path of the vantage points to the nearest foreground element of the object field, (5) the distance (b) from the path of the vantage points to the farthest background element of the object field, and (6) the distance (*k*) from the path of the vantage points to the key subject matter element of the object field, so as to maintain the change between adjacent vantage points in the parallax value between the image of the key subject matter element and the image of said at least one element, as recorded at each of said adjacent vantage points, within a predetermined range of multiples of W/R.

(b) a method of producing a stereoscopic picture of a spatial object field of the type incorporating a viewing lenticular screen, the picture having the image of a key subject matter element of the object field in the plane thereof and at least one of an image of a foreground element of the object field and an image of a background element of the object field, comprising the steps of:

obtaining a plurality (N) of negatives by photographing the object field through a lens of focal length (*f*) from a corresponding plurality (N) of different relative vantage points aligned in a path extending generally transversely of, and in generally uniform spaced relation to, the object field;

exposing a photosensitive surface by projecting the object field image on each negative through a lenticular screen of lenticule width W with the projected image from each negative of the key subject matter element of the object field in registry with a reference point, the lenticular screen being positioned in overlying relation to the photosensitive surface such that the photosensitive surface is substantially at the focal plane of the lenticular screen; and

controlling at least one of (1) said focal length (*f*), (2) the distance between adjacent ones of said plurality (N) of vantage points, (3) the enlargement ratio (R) between the negatives and said photosensitive surface, (4) the distance (*a*) from the path of the vantage points to the nearest foreground element of the object field, (5) the distance (*b*)

from the path of the vantage points to the farthest background element of the object field, (6) the distance (k) from the path of the vantage points to the key subject matter element of the object field, (7) the number of said plurality (N) of negatives employed in exposing the photosensitive surface, and (8) the lenticule width W, so as to maintain the change between adjacent vantage points in the parallax value between the image of the key subject matter element and the image of said at least one element, as projected through said lenticular screen from the negative obtained at each of said adjacent vantage points, within a predetermined range of multiples of W.

The meaning and definition of the various terms used above (and below) are given in the parent specification, to which the reader is referred.

In preferred aspects of the invention claimed in the parent specification:—

(c) in method (a) specified above, wherein the change in parallax value between adjacent vantage points is maintained within the range determined by

$$\frac{cW}{R},$$

where c is within the range of from substantially 1.0 to substantially 5.0;

(d) in method (a) specified above, wherein the parallax value between the key subject matter element image and said at least one element image, as recorded as each of the endmost vantage points, is within the range determined by

$$\frac{cW}{R}(N-1),$$

where c is within the range of from substantially 1.0 to substantially 5.0;

(e) in method (a) specified above, wherein the stereoscopic picture is to include both a nearest foreground element image and a farthest background element image, and the change in parallax value between the key subject matter element image and the nearest foregound element image and the change in the parallax value between the key subject matter element image and the farthest background element image, as recorded at each of said adjacent vantage points, are each within the range determined by

$$\frac{cW}{R}$$

where c is within the range of from substantially 1.0 to substantially 5.0;

(f) in method (b) specified above, wherein the change in said parallax value between adjacent vantage points is within the range determined by cW, where c is within the range of from substantially 1.0 to substantially 5.0; and

(g) in method (b) specified above, wherein the total ($X_{T''}$) of (1) the parallax value between the key subject matter element image and the nearest foreground element image and (2) the parallax value between the key subject matter element image and the farthest background element image, as projected through said overlying lenticular screen from the negative obtained at each endmost vantage point, is within the range determined by $cW(N-1)$, where c is within the range of from substantially 1.0 to substantially 5.0.

In order to obtain successful pictures, the permissible parallax value is thus related to the lenticule width W, and to variable c, as well as to other parameters, as specified above. The variable c is the shift factor which equals the number of lenticules or fractions thereof shifted between frames.

The maximum value of c suitable for any given set of photographic conditions, while not dependent entirely thereon, has been found to be significantly influenced by the lenticule width W of the viewing screen. Specifically, smaller values of W generally allow the use of larger values of c. This is because as W gets smaller, and particularly as it approaches a fineness at which it is imperceptible, or appreciably so, to the eye, the effect of a skipped lenticule on image quality, described in the parent specification in connection with Figures 4 and 5 therein, is not nearly as pronounced as with larger lenticules. Experiments showed that c values of up to 5.0 are generally useful with all commonly used lenticule widths, e.g.

$$W=0.48 \text{ mm},$$

depending upon the other factors of object image size, contrast, etc.

However, we have now found that c values in excess of 5.0 and as high as 10.0, may be safely used with extra narrow or fine lenticule widths on the order of 5.0 mils (0.125 mm) or less. It will be appreciated that 5.0 mils is not an absolute limit of W beyond which c values of greater than 5.0 cannot be used, but that, as a general rule, higher quality pictures will be obtained if c values of greater than 5.0 are restricted to use with such lenticule widths, that is to say, to lenticular widths of 5.0 mils or under.

As an example of the selection of c for a common lenticule width, say 0.48 mm, if the images of the object photographed are small in comparison to the lenticule width W of the lenticular screen (e.g. 10 W or less)

and/or a high contrast picture (e.g. between the key subject matter and background) is desired, *c* may lie between 1 and 3. However, when the images of the objects photographed are large in comparison to the lenticule width W and/or the resulting picture is to be of low contrast, *c* may range from 3 to 5.

For a W of 5.0 mils or less, it has been found that *c* values as high as 10.0 are acceptable. For example, pictures of good quality have been obtained with a lenticular width of ≃5 mils and a *c* factor of substantially 10. Of course, any lower value of *c* could be used, and the considerations in respect of lenticule width, contrast object image size, etc. as given in the parent specification will be understood to operate as constraints on the maximum value of *c* which may be used. For instance, excellent quality has been obtained with a lenticule width of 3.15 mils and a *c* factor of approximately 9. Likewise, it will be understood that the maximum permissible shift *c* might not result in every photographic situation, as the preceding example illustrates. Often, however, it is desirable for other reasons, relief effect, camera lens spacing, etc., to use or closely approach the maximum permissible value.

In accordance with the present invention we therefore provide methods as specified in (c) to (g) above, wherein additionally W is not substantially greater than 5.0 mils and wherein *c* is selected from the range of from 1.0 to 10.0 inclusive (preferably greater than 5.0 and up to 10.0) rather than just from the range of 1.0 to 5.0.

The modification to the invention described in the parent specification is an extension or alteration to the values of *c* and W, and it is hence unnecessary to give further details concerning practice of the present invention since the information given in the parent specification will suffice, subject to the variation in *c* and the use of fine lenticule widths W as specified above.

WHAT WE CLAIM IS:—

1. A method as claimed in claim 2 of Application No. 45325/73 (Specification No. 1,445,583) wherein, additionally, W is not substantially greater than 5.0 mils, and wherein *c* is selected from the range of from 1.0 to 10.0.

2. A method as claimed in claim 5 of Application No. 45325/73 (Specification No. 1,445,583) wherein additionally, W is not substantially greater than 5.0 mils, and wherein *c* is selected from the range of from 1.0 to 10.0.

3. A method as claimed in claim 9 of Application No. 45325/73 (Specification No. 1,445,583) wherein, additionally, W is not substantially greater than 5.0 mils, and wherein *c* is selected from the range of from 1.0 to 10.0.

4. A method as claimed in claim 11 of Application No. 45325/73 (Specification No. 1,445,583) wherein, additionally, W is not substantially greater than 5.0 mils, and wherein *c* is selected from the range of from 1.0 to 10.0.

5. A method as claimed in claim 15 of Application No. 45325/73 (Specification No. 1,445,583) wherein, additionally W is not substantially greater than 5.0 mils, and wherein *c* is selected from the range of from 1.0 to 10.0.

6. A method according to any of claims 1 to 5 wherein *c* is selected from the range of greater than 5.0 and up to 10.0.

7. A method according to any of claims 1 to 5 and substantially as hereinbefore described.

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