Nov. 14, 1933. C. W. KANOLT 1,935,471

PRODUCTION OF STEREOSCOPIC PICTURES

Filed Aug. 7, 1930 3 Sheets-Sheet 1

Fig. 1.

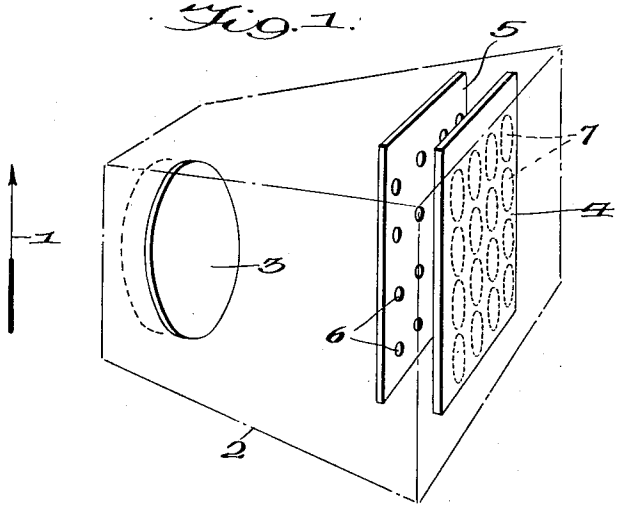


Fig. 2.

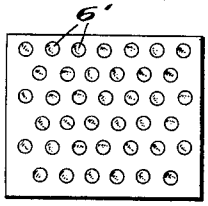


Fig. 3.

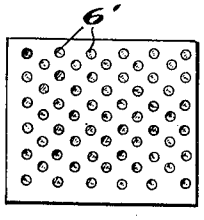


Fig. 4.

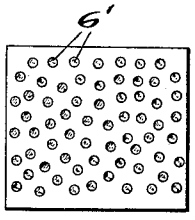


Fig. 5.

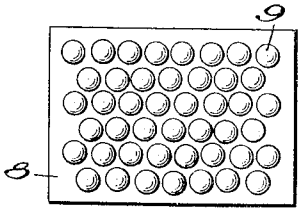
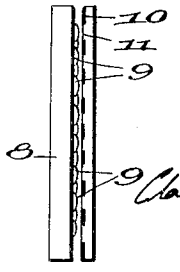


Fig. 6.



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Nov. 14, 1933. C. W. KANOLT 1,935,471

PRODUCTION OF STEREOSCOPIC PICTURES

Filed Aug. 7, 1930 3 Sheets-Sheet 2

Fig. 7.

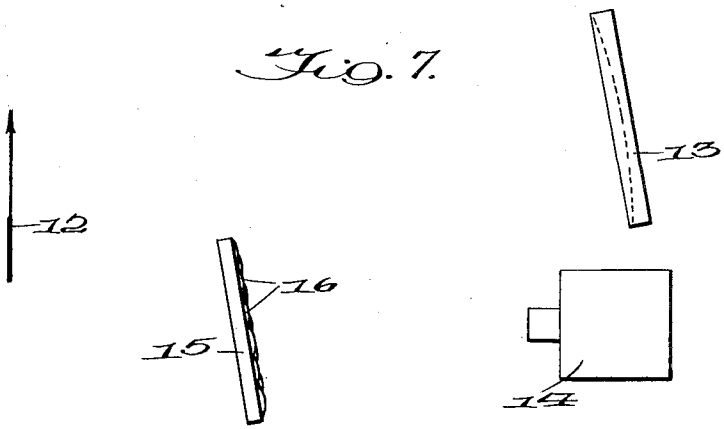
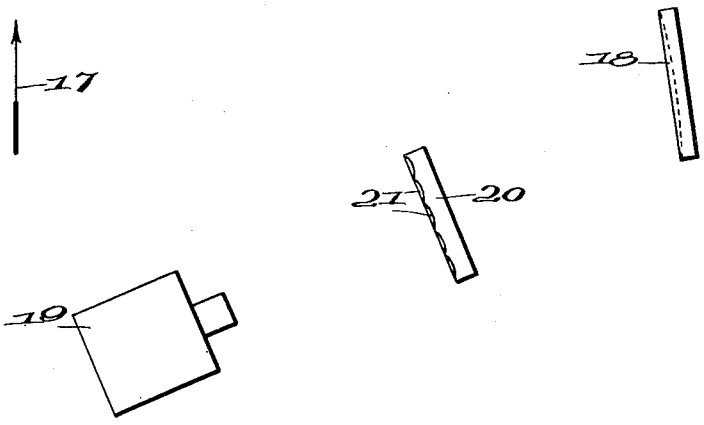


Fig. 8.



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Filed Aug. 7, 1930 3 Sheets-Sheet 3

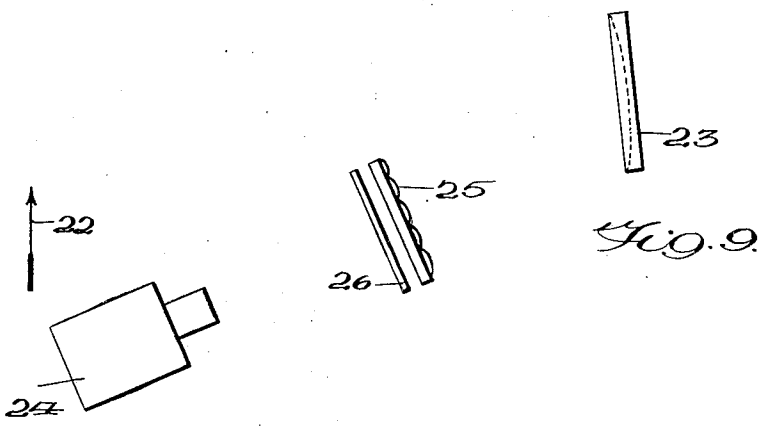


Fig. 9.

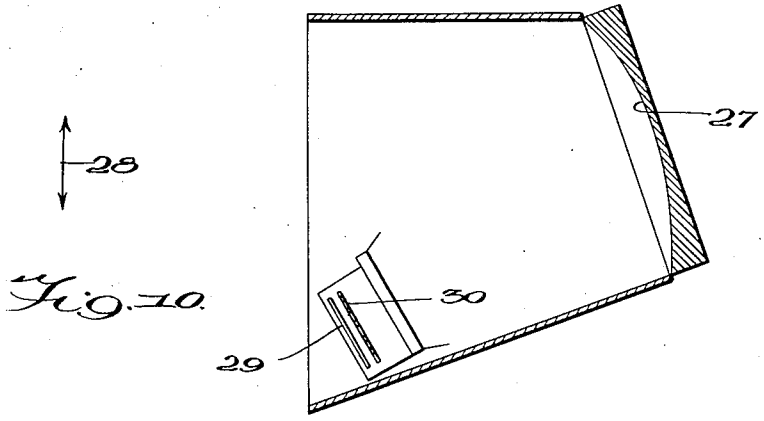


Fig. 10.

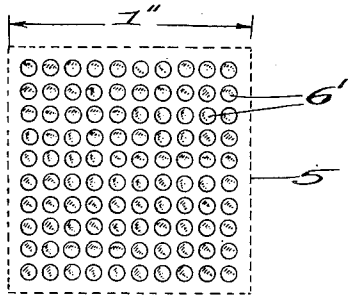


Fig. 11.

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1,935,471

UNITED STATES PATENT OFFICE

1,935,471

PRODUCTION OF STEREOSCOPIC PICTURES

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Application August 7, 1930. Serial No. 473,607

16 Claims. (Cl. 95—18)

This invention relates to an improvement in the production of stereoscopic pictures.

The methods now being used for making stereoscopic pictures by the use of lined screens produce pictures which present different aspects as the angle of view is changed in a horizontal direction. This renders them stereoscopic because the observer's eyes are separated horizontally and see slightly different views.

The present invention has for its purpose the production of pictures which present different aspects of an object when viewed from different vertical angles as well as from different horizontal angles.

The production of changing aspects with changing vertical angles has many uses, as for the production of pictures in which it is desired to present aspects of an object from as many different points of view as possible, for example, for scientific or educational purposes when it may be desired to picture an anatomical or geological specimen or a geometrical model.

The method will also help in giving reality to the appearance of stereoscopic pictures used for ordinary purposes. When one approaches a stereoscopic picture, his angular viewing position usually changes somewhat in a vertical direction.

Thus, if a stereoscopic picture is set below the level of the eye, as one approaches, he views it from increasing vertical angles, that is, he looks down upon it more than when he viewed it from a distance. A real object would present changing aspects from this cause. The lack of such a change in an ordinary stereoscopic picture detracts somewhat from its appearance of reality.

In the accompanying drawings:

Fig. 1 is a diagrammatic perspective view showing one form of the present invention;

Figs. 2, 3 and 4 are face views of slightly different forms of screens;

Fig. 5 is a face view of another form of screen;

Fig. 6 is an edge view thereof showing an opaque screen applied thereto;

Figs. 7, 8, 9 and 10 are diagrammatic views of slightly different arrangements from that shown in Fig. 1; and

Fig. 11 is a partial face view of one of the screens.

In Fig. 1, the object to be photographed is designated by the numeral 1. The camera is shown in dotted lines as at 2 and has the usual shutter. The relatively large lens is shown at 3, while a photographic plate or the like is designated by the numeral 4.

Spaced a slight distance in front of the photographic plate 4 is a screen 5 which is opaque except for a large number of small transparent openings or areas 6', as shown in Figs. 2, 3 and 4, or perforations 6 as shown in Fig. 1. These perforations should be sufficiently small and numerous that when the finished picture is viewed through its viewing screen, the assemblage of openings, each of which appears merely as a point of light sufficiently small that only a beam of light passes therethrough, forms an image possessing a useful degree of clearness.

The openings in the screen usually vary between forty and two hundred per square inch. These openings are greatly exaggerated in the drawings, although they may be of the approximate size shown in Fig. 11, in which a small portion of the screen 5 is illustrated with the perforations 6 therein.

An image of the object to be photographed is formed on the screen 5 through the lens 3. The part of this image that falls on a single transparent dot or hole 6 of the screen is formed by rays that are transmitted by all parts of the lens 3. As these rays pass through the dot and fall on the photographic plate 4, they spread out and separate into rays of light which come from different parts of the lens and therefore correspond to slightly different views of the object 1. These rays from one dot or hole 6 from one of the spots of light 7 shown in dotted lines on the plate 4.

If the photographic plate 4 is developed, forming a negative, and from this negative, a positive is printed, this positive may be viewed by placing a screen like the screen 5 slightly spaced behind it and registered with it. The combination of positive and screen when viewed by transmitted light will present a stereoscopic effect and will present different aspects as the viewing angle is changed either horizontally or vertically.

The distance between the camera screen 5 and the photographic plate 4 should be adjusted so that adjacent spots of light 7 on the plate will be very nearly, but not quite, in contact with each other at their boundaries.

In Fig. 1, the transparent dots or holes in the screen are arranged in regular rows. In Figs. 2 and 3 are other forms of screens, in which the dots or areas 6' are also arranged in regular rows but in different patterns. In Fig. 3, the areas are arranged closer together vertically than horizontally. Such a screen may be used when changes of aspect are not to be shown through as great a range vertically as horizontally. In Fig. 4, the dots or areas 6' are arranged irregularly.

Instead of using an opaque screen having trans-

parent dots or perforations, as in Figs. 1 to 4, a screen may be employed carrying a large number of very small lenses, such as may be formed by so shaping a piece of transparent material, such as celluloid, as to form a large number of small convex areas on its surface. Such a screen is shown at 8 in Fig. 5 with the lenses designated by the numeral 9. The advantage of this set of lenses over the screen shown in Fig. 1 with the perforations is that each of the lenses 9 will better separate the light that falls upon it into the rays that come from different parts of the large lens 3.

In Fig. 6, the screen 8 has associated therewith an opaque screen 10 carrying transparent portions 11 opposite the lenses 9 or opposite the central part of these lenses. The advantage of this form of screen is that it employs only the parts of the lenses 9 at which their optical qualities are good and screens off the surfaces between the lenses and, if desired, the outer margins of the lenses, where they may be imperfect in form. The opaque screen 10 may be represented merely by a filling of ink or other opaque material between the lenses 9.

A further modification of the invention is shown in Fig. 7, in which the object to be photographed is designated by the numeral 12, one or more concave mirrors at 13 and a camera at 14. A screen is shown at 15 corresponding to the screen 8 carrying on its surface convex portions 16 but having reflecting surfaces. These may be formed of white metal. These mirror surfaces 16 separate rays of light that reach them at different vertical angles as well as those at different horizontal angles. The portions of the surface between the convex reflecting areas 16 should be blackened to prevent them from reflecting light.

In the device shown in Fig. 8, the object to be photographed is designated by the numeral 17 and one or more concave members at 18 with a camera at 19. A screen is shown at 20 consisting of a lens or transparent body carrying on its surface small depressions 21 which act individually as small concave lenses. These depressions or lenses separate the rays of light that reach them at different vertical angles as well as those at different horizontal angles. The parts of the surface between the small lenses should be rendered opaque.

The mirror 15 and the lens 20 constituting the screens may be rendered convex both vertically and horizontally, as set forth in my copending application Serial No. 462,006, filed June 18, 1930, now Patent No. 1,882,648, granted October 11, 1932.

In Fig. 7, there is no surface which receives the composite image directly, but it is reproduced by a lens of the camera 14 on the surface of a photographic plate.

In Fig. 9 is a further modification of the invention, in which the object to be photographed is shown at 22 with the concave mirror 23 and a camera 24. Arranged between the camera 24 and the mirror 23 is a screen 25 which may be similar to the screens 5 or 8, and this screen 25 is so located as to receive the image of the object 22 formed by the mirror 23. At 26 is shown a translucent screen of ground glass or similar material so located as to receive the composite image formed by the screen 25 and this composite image on the translucent screen is presented to the camera 24 for photographing.

A modification of the light focusing means is shown in Fig. 10, in which the lens 3 of Fig. 1 is replaced by a concave mirror 27 to form an image of an object 28 and to present said image to a photographic surface 29 through a screen 30, which may be of the character of the screen 5 or 8 or the like.

The positive picture made from a negative produced as above described may be printed on either transparent or opaque material to be viewed by transmitted or reflected light or projected upon a screen. The viewing screen to be used in viewing the positive picture may be similar to any of the screens above described and be provided with perforations, lenses or the like, as described above with reference to the photographing of the image.

Perforations or lenses should be the same size and in the same arrangement as in the photographic screen, unless the picture has been enlarged or reduced relative to the original negative, in which event the viewing screen should be enlarged or reduced to the same ratio. It may be desirable to make the spacing of the elements, which has the perforations or lenses or the like of the viewing screen, very slightly different from the spacing of the corresponding elements of the positive by such an amount that when an observer is at a suitable distance from the picture, he may see each element of the positive in registry with the corresponding element of the screen which is spaced slightly from the positive. If the spacing of the two are exactly the same, this condition would be realized only when the picture was viewed from a great distance.

The small lenses 9 of Figs. 5 and 6, the lenses 25 of Fig. 9, the lenses 21 of Fig. 8, and the reflectors 16 of Fig. 7 may be arranged in various ways, as for example, those illustrated for the dots or perforations in Figs. 1, 2, 3, 4 and 11.

I claim:

1. In a device for the production of stereoscopic pictures, the combination of image forming means, and an assemblage of a relatively large number of small elements distributed throughout the image formed by said means and separating the light forming the image into the rays which come from different parts both vertically and horizontally of said image forming means, which rays correspond to different aspects both vertically and horizontally of the object photographed.

2. In an apparatus for the production of stereoscopic pictures, the combination of light focusing means, a screen having an assemblage of a large number of relatively small elements distributed throughout the image formed by said light focusing means, each of said elements being adapted to separate the light forming the part of the image that is coincident with it into the rays which come from different parts both vertically and horizontally of said light focusing means, which rays correspond to different aspects both vertically and horizontally of the object photographed.

3. In an apparatus for the production of stereoscopic pictures, the combination of light focusing means, a screen having an assemblage of a large number of relatively small elements distributed throughout the image formed by said light focusing means, each of said elements being adapted to separate the light forming the part of the image that is coincident with it into the rays which come from different parts both vertically and horizontally of said light focusing

means, which rays correspond to different aspects both vertically and horizontally of the object photographed, said elements being sufficiently small and numerous that when a finished picture is viewed through a viewing screen, this assemblage of elements forms an image possessing a useful degree of clearness.

4. In an apparatus for the production of stereoscopic pictures, the combination of light focusing means, a screen having an assemblage of a large number of relatively small elements distributed throughout the image formed by said light focusing means each of said elements being approximately the size of a point of light and adapted to separate the light forming a part of the image that is coincident with it into the rays which come from different parts both vertically and horizontally of said light focusing means, which rays correspond to different aspects both vertically and horizontally of the object photographed.

5. In an apparatus for the production of stereoscopic pictures, the combination of light focusing means, a screen having an assemblage of a large number of relatively small elements distributed throughout the image formed by said light focusing means, each of said elements being approximately the size of a point of light and adapted to separate the light forming a part of the image that is coincident with it into the rays which comes from different parts both vertically and horizontally of said light focusing means, which rays correspond to different aspects both vertically and horizontally of the object photographed, and a surface to receive the composite image formed by the assemblage of elements.

6. In an apparatus for producing stereoscopic pictures, the combination of image forming means, and a screen having a large number of relatively small transparent areas therein and distributed throughout the image formed by said means, each of said transparent areas being adapted to separate the light forming the part of the image that is coincident with it into the rays which come from different parts both vertically and horizontally of said image forming means, which rays correspond to different aspects both vertically and horizontally of the object photographed.

7. In an apparatus for the production of stereoscopic pictures, the combination of image forming means, and a screen having an assemblage of a large number of relatively small lenses therein and distributed throughout the image formed by said means, each of said lenses being adapted to separate the light forming the part of the image that is coincident with it into the rays which come from different parts both vertically and horizontally of said image forming means, which rays correspond to different aspects both vertically and horizontally of the object photographed.

8. In an apparatus for the production of stereoscopic pictures, the combination of image forming means, and a screen having an assemblage of a large number of relatively small lenses therein and distributed throughout the image formed by said means, each of said lenses being adapted to separate the light forming the part of the image that is coincident with it into the rays which come from different parts both vertically and horizontally of said image forming means, which rays correspond to different aspects both vertically and horizontally of the object photographed, and a surface adapted to receive the composite image so formed.

9. In an apparatus for the production of stereoscopic pictures, the combination of a reflector for forming an image of an object, photographic means for photographing the object presented by said reflector, and a screen having an assemblage of a large number of relatively small elements distributed throughout the image formed by the reflector, each of said elements being approximately the size of a point of light to separate the light forming the part of the image that is coincident with it into the rays which come from different parts both vertically and horizontally of said reflector, which rays correspond to different aspects both vertically and horizontally of the object photographed.

10. In an apparatus for the production of stereoscopic pictures, the combination of image forming means, and a screen having an assemblage of a large number of relatively small reflectors and distributed throughout the image formed by said means, each of said reflectors being adapted to separate the light forming the part of the image that is coincident with it into the rays which come from different parts both vertically and horizontally of said image forming means, which rays correspond to different aspects both vertically and horizontally of the object photographed.

11. In an apparatus for the production of stereoscopic pictures, the combination of a reflector arranged to form an image of an object, means for photographing the object presented by said reflector, and a screen having an assemblage of a large number of relatively small elements distributed approximately throughout the image formed by the reflector, to separate the light forming the part of this image that is coincident with it into the rays which come from different parts both vertically and horizontally of said reflector.

12. In an apparatus for the production of stereoscopic pictures, the combination of a reflector arranged to form an image of an object, means for photographing the object presented by said reflector, and a screen having an assemblage of a large number of relatively small elements distributed approximately throughout the image formed by the reflector, to separate the light forming the part of this image that is coincident with it into the rays which come from different parts both vertically and horizontally of said reflector, which rays correspond to different aspects both vertically and horizontally of the object photographed.

13. In a device for the production of stereoscopic pictures, the combination of image forming means, and a screen having an assemblage of a relatively large number of small elements distributed over the area thereof both vertically and horizontally and arranged to be distributed approximately throughout the image formed by the image forming means and separating the light forming the image into the rays which come from different parts both vertically and horizontally of the image forming means.

14. In a device for the production of stereoscopic pictures, the combination of image forming means, and a screen having an assemblage of a relatively large number of small elements distributed over the area thereof both vertically and horizontally and arranged to be distributed approximately throughout the image formed by the image forming means and separating the

light forming the image into the rays which come from different parts both vertically and horizontally of the image forming means, which rays correspond to different aspects both vertically and horizontally of the object photographed.

15. In a device for the production of stereoscopic pictures, the combination of image forming means, and a screen having an assemblage of a relatively large number of small transparent areas distributed over the area thereof and separated both vertically and horizontally and arranged to be distributed approximately throughout the image formed by the image forming means and to separate the light forming the image into the rays coming from different parts both vertically and horizontally of the image forming means.

16. In apparatus for the production of stereoscopic pictures, image forming means and a screen having an assemblage of a relatively large number of small elements distributed over the area thereof both vertically and horizontally and arranged to be distributed approximately throughout the image formed by the image forming means and separating the light forming the image into the rays which come from different parts both vertically and horizontally of the image forming means, in combination with a viewing screen placed behind the picture thus produced when subjected to transmitted light and having elements therein corresponding with the elements of the first-mentioned screen and registered with the picture areas formed thereby.

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