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(56) Documents Cited

GB 2317237 A	**GB 1231182 A**
GB 1222008 A	**GB 1125877 A**
WO 1997/046920 A1	**US 4067638 A**
US 3797907 A	**US 3677617 A**

(58) Field of Search
UK CL (Edition S) **G2J** J33BX
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(54) Abstract Title
Hologram viewing device with lenticular screen

(57) A hologram viewing device 1 includes a light transmittable photosensitive medium 2 for carrying a hologram, and a closely adjacent lenticular screen 4. The hologram may transmit white light and be in the form of a rainbow hologram. The lenticular screen 4 may be bonded at the front of the photosensitive medium 2 and be made of glass or plastics material. Also shown in the figure is a viewer at point 6 where a reconstruction beam 8 is depicted and illuminates the photographic emulsion producing a virtual image 10 with a vertical parallax of angle 12. However, the lenticular screen 4 focuses and distributes the light with a new, larger vertical parallax angle 18, producing also a second virtual image 16 which is achromatic.

Figure 1

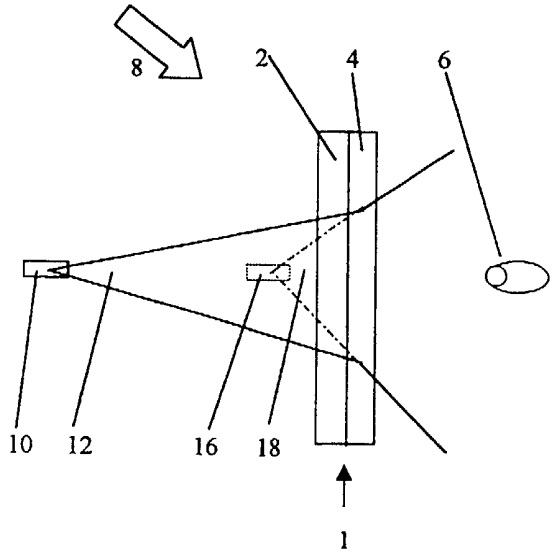

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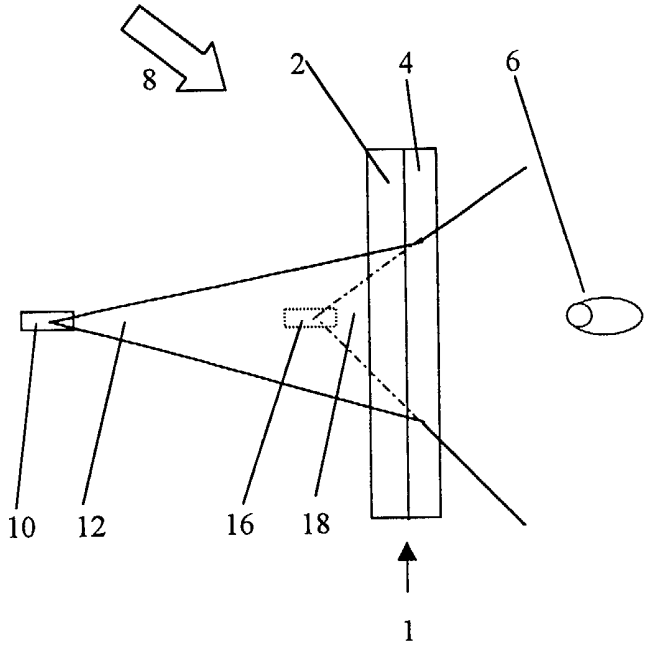
Figure 1



A HOLOGRAM VIEWING DEVICE

This invention relates to holograms and more particularly to a method and means of viewing a hologram.

A hologram is an image produced by an Imaging Technique which is a technique for recording and reconstructing a wavefront from an object.

The present invention has paricular but not exclusive reference to transmission holograms.

Transmission holograms are produced when two beams of light, one from a monochromatic coherent light source, known as the reference beam, and the second from an object, known as the object beam, are directed onto a photosensitive medium. The beams combine to form an interference pattern which is then recorded on the photosensitive medium.

In order to view a hologram a beam of light, known as a reconstruction beam, is directed onto the photosensitive medium and the interference pattern acts as a diffraction grating, reproducing the object wavefronts to form an image of the object which appears to be three dimensional.

The above method produces a virtual or real image (depending on the direction of the reconstruction beam) of the object, but flipped and mirror-reversed. For a hologram to be viewed in the same orientation as the object, the real image from the first hologram produced can be used as an object for a second hologram. The second hologram is in the correct orientation but this method is limited to the use of a thin object, and can have smeared colours when viewed from the side. To overcome this aberration the first hologram can be masked to produce a slit the size

of the required area only, i.e. the size of the actual hologram, masking the surrounding area, thus producing a second hologram of the slit.

When the hologram has been made using a slit, as above, the final image produced is an image of the slit and therefore the vertical angle through which it can be viewed, the vertical parallax, is narrow.

If the reconstruction beam is white light, diffraction at the slit may cause a rainbow effect, whereby the white light is split into different colours, each colour diffracting through a different angle according to its wavelength. Thus the image of the slit can be seen at several different positions in different colours and varying light intensity. The hologram is then called a rainbow hologram, which produces an image of indifferent quality in terms of its viewability, clarity and consistency.

Holograms are always transparent, which can lead to them being of low brightness and sharpness. The photosensitive medium carrying the hologram may be backed with an opaque or reflective substance in order to improve the brightness and sharpness of the image, but this backing may be a disadvantage if the transparency of the hologram is considered a desirable feature.

An object of this invention is to increase the vertical parallax across which transmission holograms can be viewed.

Another object of this invention is to make the image from a rainbow transmission hologram achromatic.

A further object of the invention is to improve the brightness of a holographic image.

According to a first aspect of the invention there is provided a hologram viewing device including in combination a light transmittable photosensitive medium for carrying a hologram, and a lenticular screen in close adjacency thereto.

The lenticular screen is preferably located in front of the photosensitive medium.

It has been discovered that the use of a lenticular screen in this way has the surprising effect of increasing the vertical parallax of the hologram, and also making the hologram achromatic, i.e. black and white.

This effect is advantageous because the image can be viewed through a larger vertical parallax than would otherwise be possible, and it is easier to view in black and white than in a variety of colours.

The lenticular screen also focuses the light to produce a clearer image.

These effects are thought to be due to the structure of the lenticular screen. An array of micro-lenses within the screen collects the light and focuses it, leading to the increased clarity; and distributes the light, leading to the increased vertical parallax. The rainbow effect is cancelled out by the lenses as each micro-lens diffracts the beam but also focuses it, such that any splitting of the beam is corrected as the wavefronts from each micro-lens recombine after travelling through the screen to form an image.

For the invention to have the greatest effect the hologram is preferably a transmission hologram, more preferably a white light transmission hologram and most preferably a rainbow hologram.

The lenticular screen may be made from glass or plastics material or any suitable light transmitting material. The screen advantageously consists of a plastics material.

The density of the micro-lenses in the screen affects the clarity of the image. Conveniently the density lies in the range 45 to 75 lines per inch (17.7 to 29.5 lines per centimetre)

The object beam from which the hologram is generated may have originated from an illuminated object, or it may have originated from an optical fibre or other projection device carrying a broadcast, a still picture, a movie frame or a computer graphic.

The photosensitive medium may be a plastics or other suitable material. In the alternative, the photosensitive medium may be a photosensitive medium, photopolymer, silver halide, dichromate gelatin, or any other photosensitive material.

The hologram may be embossed or moulded in the photosensitive medium.

The photosensitive medium may be coated on a lenticular screen, and the photosensitive medium exposed to an object beam and reference beam to produce a hologram. In this case the hologram is carried by the screen.

In the event that the photosensitive medium is a plastics or other material, the screen may be bonded thereto by use of a suitable adhesive material.

In use, a reconstruction beam is directed onto the photosensitive medium, producing a virtual image of the object. The light then travels through the lenticular screen, where it is focused and distributed to sharpen and

brighten the image, and give it a larger vertical parallax. A viewer sees the image through the lenticular screen.

According to a second aspect of the invention, there is provided a method of viewing a hologram including the steps of placing a photosensitive light transmitting medium carrying the hologram adjacent to a lenticular screen and viewing the hologram with the aid of said screen.

According to a third aspect of the invention there is provided a method of manufacturing a hologram viewing device wherein a photosensitive medium is coated on a lenticular screen, and the photosensitive medium is exposed to an object beam and a reference beam to produce a hologram.

The following embodiment of a hologram viewing device and a method of viewing the hologram according to the invention are described by way of example only and with reference to the accompanying drawing which is a diagrammatic side view.

Referring to the drawing a hologram viewing device, 1, includes a photosensitive material in the form of a photographic emulsion 2 attached to a lenticular screen 4. The photographic emulsion has had a hologram recorded on it in a conventional manner. A reconstruction beam 8 is depicted and illuminates the photographic emulsion 2 on which the hologram has been recorded, producing a virtual image 10 with a vertical parallax of angle 12. The lenticular screen 4, however, focuses and distributes the light with a new, larger, vertical parallax of angle 18, producing also a new virtual image 16. The viewer at point 6 sees the second virtual image 16, and can view it over the new vertical parallax 18. The second virtual image is achromatic.

The lenticular screen 4 has a micro-lens density of 45 lines per inch (17.7 lines per centimetre), and is made of plastic.

The second vertical parallax 18 is approximately 90 degrees, whereas the first vertical parallax 12 is approximately 45 degrees, giving an improvement of 45 degrees.

The hologram viewing device according to the invention may be used as a security measure on items such as credit cards. This would be advantageous over the rainbow holograms used for this purpose currently, as the clearer image created by this invention would make a counterfeit item more easily identifiable.

CLAIMS

1. A hologram viewing device including in combination a light transmittable photosensitive medium for carrying a hologram, and a lenticular screen in close adjacency thereto.

2. A hologram viewing device according to claim 1 wherein the lenticular screen is located in front of the photosensitive medium.

3. A hologram viewing device according to claims 1 or 2, wherein the hologram is a transmission hologram.

4. A hologram viewing device according to claim 3, wherein the hologram is a white light transmission hologram.

5. A hologram viewing device according to claim 4 wherein the hologram is a rainbow hologram.

6. A hologram viewing device according to any of the preceding claims wherein the lenticular screen is a glass or plastics material.

7. A hologram viewing device according to any of the preceding claims wherein the lenticular screen has a micro-lens density in the range 45 to 75 lines per inch (17.7 to 29.5 lines per centimeter)

8. A hologram viewing device according to any of the preceding claims wherein the photosensitive material is a photographic emulsion, photopolymer, silver halide, or dichromatic gelatine.

9. A hologram viewing device according to any preceding claim wherein the photosensitive medium is embossed or moulded in a plastic material

10. A hologram viewing device according to any preceding claim wherein the lenticular screen is bonded to the photosensitive medium.

11. A method of manufacturing the hologram viewing device of claims 1 to 10 wherein the photosensitive medium is coated on a lenticular screen, and the photosensitive medium is exposed to an object beam and a reference beam to produce a hologram.

12. A method of manufacturing a hologram viewing device according to claim 11 wherein the object beam comprises the broadcast of a movie frame or computer graphic.

13. A method of manufacturing the hologram viewing device according to claim 11 or 12 wherein the object beam originates from an optical fibre.

14. A method of viewing a hologram including the steps of placing a photosensitive light transmitting medium carrying the hologram adjacent to a lenticular screen and viewing the hologram with the aid of said screen.

15. A hologram viewing device of the kind set forth substantially as described herein with reference to and as illustrated in the accompanying drawings.

16. A method of manufacturing a hologram viewing device of the kind set forth substantially as described herein with reference to and as illustrated in the accompanying drawings.

17. A method of viewing a hologram of the kind set forth substantially as described herein with reference to and as illustrated in the accompanying drawings.

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Application No: GB 0113160.6
Claims searched: 1 - 17
Examiner: Andrew P Jenner
Date of search: 24 September 2001

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): G2J: J33BX

Int Cl (Ed.7): G02B, G03H

Other: Online: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2317237 A	BURDER - whole document relevant	1 and 14 at least
X	GB 1231182 A	NATIONAL RESEARCH DEVELOPMENT CORP.- see figures 1- 3	1 and 14 at least
X	GB 1222008 A	RLM CORP. - see figure 1	1 and 14 at least
X	GB 1125877 A	INTERNATIONAL BUSINESS MACHINES CORP. - see figures 1 - 2 & 4 - 6	1 and 14 at least
X	WO 97/46920 A1	SIMIAN COMPANY INC. - see figures	1 and 14 at least
X	US 4067638 A	CANON - see figure 5	1 and 14 at least
X	US 3797907 A	USA NAVY - see figure 3	1 and 14 at least
X	US 3677617 A	BATTELLE DEVELOPMENT CORP. - see figure 2	1 and 14 at least

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Y Document indicating lack of inventive step if combined with one or more other documents of same category.
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