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None

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G2J

(54) **Display apparatus having
edge-illuminated graticule**

(57) Display apparatus incorporates a graticule injection system, wherein a graticule (44) is edge illuminated by illuminator (46) to scatter light rearwardly to a beam splitting surface (42) spaced in front of the display screen (32), whereby the light from the display is transmitted forwardly through the beam splitter and light from the graticule is reflected forwardly from the beam splitter so that overlaid images of the display screen and the graticule are formed at the eye position (36) by a viewing lens (34).

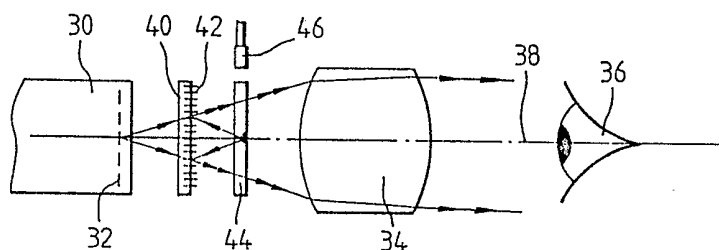
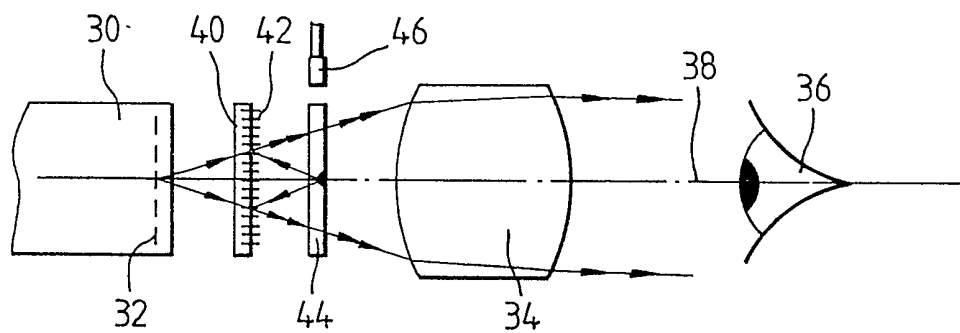
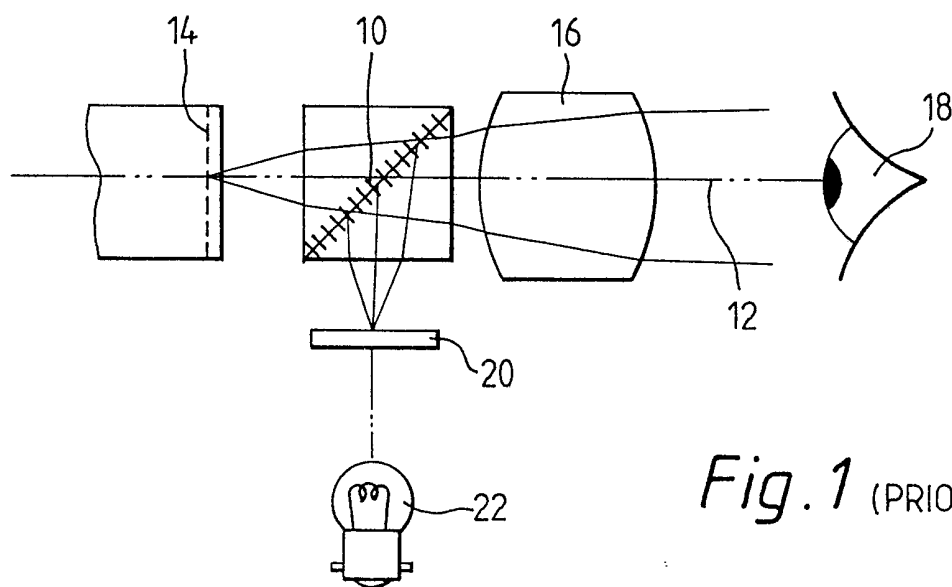


Fig. 2



SPECIFICATION

Display apparatus with graticule injection

- 5 This invention relates to display apparatus incorporating a graticule injection system.

In the prior art, U.K. Specification No. 2068584 discloses an edge illuminated reticule disposed in the focal plane of an optical viewing device and, as

- 10 such, avoids the use of the beam splitting arrangement. This practice however suffers the disadvantage of not lending itself to the case where the focal plane occurs inside an optical element, such as a prism; is made inaccessible by a window, such as a face plate of a display tube; or where the image plane is non-plano, as in the case of a field flattening fibre optic output face plate of a display tube.

These limitations are commonly overcome as follows;

- 20 Referring to Figure 1 of the accompanying drawings, this shows a typical graticule injection system in current use, wherein a beam splitting surface 10 is disposed at 45 degrees across the optical axis 12 between a display screen 14 and a viewing lens 16 which forms a focussed image of the display seen by the eye 18. The display image is overlaid by a graticule image injected laterally by means of a graticule 20 illuminated by a light source 22.

- 30 This known arrangement can be disadvantageous due to its lack of compactness in the lateral direction and due to its weight.

It is an object of this invention to provide an alternative graticule injection system which offers potential for improved compactness and reduced weight.

- 35 According to the invention, there is provided display apparatus incorporating a graticule injection system, comprising a display screen for presenting an image to be viewed by the eye after focussing of light from the display screen through a viewing lens, a beam splitting surface disposed across the optical axis to transmit light from the display screen to the viewing lens, a graticule disposed across the optical axis in the path of the light passing from the beam splitting surface to the viewing lens, and an edge illuminator for the graticule, the system being arranged so that light from the edge illuminated graticule scattered towards the beam splitting surface is at least in part reflected therefrom to be formed into a graticule image seen in focus simultaneously with and overlying the image of the display whilst any light from the edge illuminated graticule scattered directly towards the viewing lens is substantially unobserved due to its out of focus condition.

- 50 It is a common user requirement for there to be contrasting colours between the display and the graticule. With the invention, the beam splitting surface can be a dichroic beam splitting surface which transmits substantially all light the colour of the display and reflects substantially all light the colour of the edge illuminated graticule.

- 65 The graticule is preferably constructed so that substantially all light scattered therefrom due to the edge illumination is initially directed towards the

beam splitting surface. For this purpose, the graticule may be etched into glass and the etched area filled or metal coated.

- 70 The display screen, which may be terminated with a fibre optic plate, may lie in a plane parallel to the optical axis or be curved about an axis collinear with the optical axis. This is equally true of the beam splitting surface and/or the graticule. In addition, the graticule may be laterally adjustable for sighting purposes and/or longitudinally adjustable along the optical axis to set the simultaneous focussing condition.

- 75 The edge illumination for the graticule, which may comprise one or more light emitting diodes or miniature tungsten lamps, may be adjustable in brightness, for example being automatically controlled according to the brightness of the display.

- 80 A lens or lenses may be incorporated in the system between the display and the beam splitting surface and/or between the beam splitting surface and the graticule, and said surface and graticule may be carried by separate optical components or a common optical component.

In the accompanying drawings:-

- 90 *Figure 1* shows a known graticule injection system as heretofore described; and

Figure 2 shows display apparatus incorporating a graticule injection system in accordance with the invention.

- 95 In *Figure 2*, the reference 30 denotes a display tube terminated by a display screen 32, for example in the form of a fibre optic plate. Light from the display is focussed through viewing lenses 34 to be seen by an eye at 36 on the optical axis 38. Spaced in front of the display screen 32 is an optical element 40 carrying a dichroic planar beam splitting surface 42. Spaced in front of the beam splitting surface 42 and to the rear of the viewing lenses 34 is an optical element 44 carrying a planar etched graticule. The graticule 44 is edge illuminated, as by means of one or more light emitting diodes or miniature tungsten lamps 46.

- 100 The illuminated graticule 44, for example of etched glass with the etched area metal coated, scatters towards the beam splitting surface 42 light of a colour contrasting with that of the display. The dichroic beam splitter transmits substantially all light received from the graticule.

- 110 It can be readily be arranged that the viewing lenses form a display image overlaid by a graticule image with both images focussed at the eye position, whilst any light scattered forwardly from the graticule directly into the viewing lens is so defocused as not to be observed and, in addition, does not present an objectionable obstruction to the observer's eye. In fact, with the graticule construction above mentioned, substantially all light scattered off the graticule is initially directed towards the beam splitter.

- 125 The graticule may be laterally movable for sighting purposes and adjustable along the optical axis to set the simultaneous focussing condition, whilst the edge illuminator may be automatically adjustable in brightness according to the brightness of the display.

- 130 The illustrated system is of the simplest possible

form. It may sometimes be desirable for one or more of the display screen, the beam splitting surface and the graticule to be curved, and for a lens or lenses to be incorporated between the display and the beam splitter and/or between the beam splitter and the graticule. Furthermore, it may sometimes be desirable to incorporate the beam splitting surface and the graticule into a single optical component.

The system of Figure 2 clearly offers potential for greater compactness than the conventional system of Figure 1, especially in the lateral direction, and thereby also offers potential for reduced weight.

CLAIMS

1. Display apparatus incorporating a graticule injection system, comprising a display screen for presenting an image to be viewed by the eye after focussing of light from the display screen through a viewing lens, a beam splitting surface disposed across the optical axis to transmit light from the display screen to the viewing lens, a graticule disposed across the optical axis in the path of the light passing from the beam splitting surface to the viewing lens, and an edge illuminator for the graticule, the system being so arranged that light from the edge illuminated graticule scattered towards the beam splitting surface is at least in part reflected therefrom to be formed into a graticule image seen in focus simultaneously with and overlying the image of the display whilst any light from the edge illuminated graticule scattered directly towards the viewing lens is substantially unobserved due to its out of focus condition.
2. Display apparatus according to claim 1, wherein the beam splitting surface is a dichroic beam splitting surface which transmits substantially all light the colour of the display and reflects substantially all light the colour of the edge illuminated graticule.
3. Display apparatus according to claim 1 or claim 2, wherein the graticule is constructed so that substantially all light scattered therefrom due to the edge illumination is initially directed towards the beam splitting surface.
4. Display apparatus according to claim 1 or claim 2 or claim 3, wherein the display screen lies in a plane normal to the optical axis or is curved about an axis collinear with the optical axis.
5. Display apparatus according to any one of claims 1 to 4, wherein the beam splitting surface lies in a plane normal to the optical axis or is curved about an axis collinear with the optical axis.
6. Display apparatus according to any one of claims 1 to 5, wherein the graticule lies in a plane normal to the optical axis or is curved about an axis collinear with or parallel to the optical axis.
7. Display apparatus as claimed in any of claims 1 to 6, wherein the graticule position is adjustable transversely to the optical axis.
8. Display apparatus as claimed in any of claims 1 to 7, wherein the graticule is adjustable along the optical axis.
9. Display apparatus according to any of claims 1 to 8, wherein the display screen is terminated with a

fibre optic plate.

10. Display apparatus according to any of claims 1 to 9, wherein the system includes one or more lens elements between the display screen and the beam splitting surface and/or between the beam splitting surface and the graticule.

11. Display apparatus according to any of claims 1 to 10, wherein the edge illuminator comprises one or more light emitting diodes or miniature tungsten lamps.

12. Display apparatus according to any of claims 1 to 11, including means for adjusting the brightness of the edge illuminator.

13. Display apparatus according to claim 12, wherein said means operates automatically to control the brightness of the edge illuminator according to the brightness of the display.

14. Display apparatus according to any of claims 1 to 13, wherein the beam splitting surface and the graticule are incorporated in separate optical elements.

15. Display apparatus according to any of claims 1 to 13, wherein the beam splitting surface and the graticule are both incorporated in a single optical element.

16. Display apparatus substantially as hereinbefore described with reference to the accompanying drawings.

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