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(71) Applicant: **English Electric Valve Company Limited**
106, Waterhouse Lane
Chelmsford, Essex, CM1 2QU(GB)

(72) Inventor: **Nixon, Ralph Desmond**
Jenkins Farm
Stisted Braintree Essex(GB)

(74) Representative: **Hoste, Colin Francis et al,**
The General Electric Company p.l.c. Central Patent Department (Chelmsford Office) Marconi Research Centre West Hanningfield Road
Great Baddow Chelmsford CM2 8HN, Essex(GB)

(54) Display arrangements.

(57) A large area display arrangement consists of an array of backlit apertures, the size of the apertures determining the brightness of individual pixels. Clusters of uniformly sized apertures could instead by used. By placing colour filters behind the apertures, colour displays result. The display is intended to be viewed from a distance such that the pixels merge to form a large picture-like pattern or data display. The apertures can be formed in flexible tape, which can be wound on reels to permit different pictures to be shown as required. By the use of bright sources of light to illuminate the apertures, very bright displays are produced.

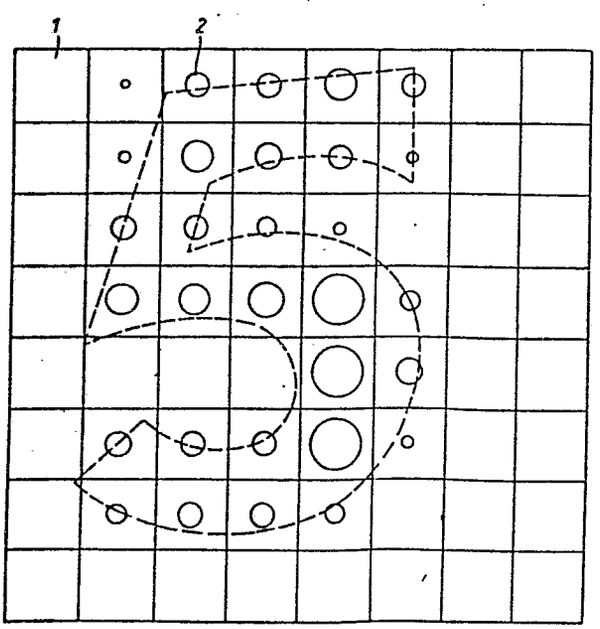

FIG. 1.

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DISPLAY ARANGEMENTS

This invention relates to a display arrangement in which a bright image can be presented in a particularly simple manner, even though the image may be of a complex nature, and may be readily interchangeable with other images.

A situation in which this kind of display arrangement may be required is to advertise products in arenas in areas where attention is focussed, for example, on either side of a scoreboard or video display.

At present, front-lit posters are used to convey such information. By their very nature, they are difficult to change for another poster, and therefore the same poster tends to remain on display for a long period of time. Alternatively, back-lit transparencies carrying an optical image can be used to present a bright display, but it is difficult and very expensive to produce a large area display of this kind, and they cannot easily be altered or updated.

The present invention seeks to provide an improved and more adaptable display arrangement.

According to a first aspect of this invention, a display arrangement includes an array of pixels consisting of illuminated back-lit apertures having light transmissive properties related to the degree of brightness required for the corresponding pixel and

arranged so that the brightness varies from one part of the array to another.

According to a second aspect of this invention a display arangement for presenting a two-dimensional colour display includes an array of individual pixels each of which consists of one or more back-lit apertures, each pixel being associated with a colour filter element and having light transmissive properties dependent on the degree of brightness required of the pixel arranged so that the brightness varies from one part of the array to another.

According to a third aspect of this invention a display arrangement for presenting a two-dimensional display includes a plurality of elongate masks each defining a line array of pixels, the masks being apertured to permit transmission of light falling upon the rear surface of each screen, the nature of the apertures being related to the degree of brightness required for the corresponding pixel so that the brightness varies from one part of the array to another.

The term pixel is used to denote an individual picture point, and represents the smallest area which is intended to be separately resolvable by the eye so that the shape of an individual pixel is quite irrelevant as it is only the contributions from a number of pixels acting together which represent

meaningful information. However, each pixel may be formed by a cluster of closely spaced apertures which act together to provide the required degree of brightness and/or colour for that picture point. The information content of the display may take any required form, e.g. stylised data or life-like pictures and artistic compositions.

Preferably a plurality of common light sources will each light a plurality of pixels, which will lead to a uniform illumination of the apertures (assuming that no allowance need be made for absorption by any interposed filters).

Thus the display consists of a pattern of points of light which has no direct relationship with the overall nature of the displayed image, scene or data, but in which the individual points of light are defined by back-lit apertures having properties dictated by the nature of the pixel which it displays. Thus, the optical image so produced is intended to be viewed at a sufficiently great distance such that the separate pixels are at the limits of normal optical resolution of the eye, although the display may be viewed at much closer distances if the discrete nature of the picture points is intended to contribute to the overall effect.

The invention is further described by way of example, with reference to the accompanying drawings, in which:

Figure 1 is an explanatory diagram,

Figure 2 illustrates a module forming part of a larger two-dimensional display area; and

Figure 3 illustrates a large area display arrangement in an exploded diagramatic function.

Referring to Figure 1, a relatively small area display is utilised to explain the principle of operation of the invention, and to indicate the way in which visual information is presented to, and perceived by, a person viewing the display. The display consists of a regular two-dimensional array of pixels 1, each of which represents the finest resolvable picture element. In this example the array consists of eight rows and eight columns of pixels, making sixty-four separate pixels.

A stylised numeral '5' is used to illustrate the way in which the image is formed, and each pixel is arranged to emit light in proportion to that area of it which is notionally overlaid by the numeral, it being understood that the broken line used to represent the numeral is purely for purposes of explanation, and the display itself consists merely of an array of back-lit apertures 2, each aperture being located at the centre point of a pixel. The amount of light emitted by each pixel is, in this example, determined by the size of the aperture, it being assumed that all apertures receive exactly the same intensity of illumination. It will thus be realised that the array of apertures 2, when viewed from a sufficient

distance such that individual apertures appear to merge, is seen as the numeral '5'. Instead of the brightness of each pixel being determined by the size of a single aperture, a cluster of small apertures could be provided, the number in the cluster then controlling the brightness. In Figure 1, the display is in effect, in monochrome, i.e. its colour does not contribute to the information which it imparts, but by arranging that the pixels emit light in the three primary colours, a colour display results.

Referring to Figure 2, a module is shown, comprising sixty-four elemental display areas 3, each approximately 18 mm square and on a 25.4 mm centre. A colour filter is associated with each elemental area 3 either red (R), green (G) or blue (B), as shown. Each group 4 of elemental areas, (consisting of two green filters, one red filter and one blue filter) forms a picture point, and the filter properties are chosen such that equal areas of the filters forming a group integrate to white light. To form a display of pixels, an apertured screen is placed in front of the pattern of filters. One such implementation of a display arrangement is shown in Figure 3.

Referring to Figure 3, the display arrangement consists of three main parts, a source of illumination 10, a large pattern of colour filters 11, and an array of back-lit apertures 12.

The pattern 11 of colour filters consists of a large

number of the modules 18 which are shown in Figure 2, the modules being aligned to form rows and columns as shown. The source of illumination 10 consists of a number of troughs 13, each having two rows of fluorescent tubes 14, which overlap to give uniform illumination. Each trough has a reflective surface to direct the light in a forwards direction on to the pattern 11 of filters. When viewed from a distance, the red, green and blue pixels formed by illuminating the colour filters which make up the screen, appear white.

The array of apertures 12 is positioned in front of the pattern 11 of colour filters to perform, on a larger scale, the function of the pattern of apertures shown in Figure 1. In this case, for ease of manufacture, the apertures are formed in a plurality of opaque tapes 15 mounted side by side. Each tape 15 has a width corresponding to that of a module of colour filters, i.e. it carries eight pixels over its width.

Each tape 15, which is made for example from black anodised aluminium is flexible, and is several times longer than the width of the whole display. To determine the size of the aperture associated with each pixel, an analogue-to-digital converter is used to produce a stored set of digital numbers, which corresponds to the brightness of the coloured pixels in the picture which is to be reproduced as a still display. These numbers are used to control the size of holes which are punched in the

elongate tapes. Each hole determines the brightness of a particular pixel. These digital numbers may be used either to control the selection of a punch size for example, in a Wiedermann press, or to control the penetration depth of a compound punch.

An alternative method of determining the brightness of a pixel is to alter not the aperture size, but the aperture frequency. That is, the elongate tapes are punched with apertures of uniform size, one or more being associated with each pixel. In this method, the digital numbers referred to above will determine the position at which an aperture is punched. An alternative method of producing the holes in the tape is to use a photo-resist exposure and etching process.

Each tape 15, having been punched, is fed along slotted tracks 16 between the module rows, (which in practice could be mounted on the front surface of the structure carrying the pattern of filter) and carried at both ends on to drums 17. One or both drums may be motorised to assist movement and positioning of the tapes. Tensioning arrangements would be required for the drums. Alternatively, the tapes and their slotted tracks could be arranged to run vertically, as this would reduce the friction loading in the slotted tracks. When the tapes are in place, a colour picture in appropriate brightness and colour variation is reproduced. The motorised drums can be arranged to hold rolls of the

elongate tapes carrying a number of pictures which can be readily located and registered by indexing marks in the tapes, so that one displayed image can be easily and rapidly changed for another, or parts of it can be updated.

Although in this example the pattern of colour filters is positioned between the source of illumination and the back-lit apertures, this need not be the case as the relative positions of the filters and the apertures could be interchanged.

This display arrangement could be used for any size of display, including single digits and for pro-formas, for example, time-tables and airport displays, as well as projecting conventional picture images. The display can be very bright, as powerful and efficient lamps can be used to illuminate the apertures, and the discrete nature of the visual image becomes quite acceptable at a sufficiently great viewing distance, e.g. at the limits of optical resolution of the individual apertures. It is envisaged that the overall linear dimensions of the display will be of the order of several metres.

CLAIMS

1. A display arrangement including an array of pixels consisting of illuminated back-lit apertures having light transmissive properties related to the degree of brightness required for the corresponding pixel and arranged so that the brightness varies from one part of the array to another.

2. A display arrangement for presenting a two-dimensional colour display including an array of individual pixels each of which consists of one or more back-lit apertures, each pixel being associated with a colour filter element and having light transmissive properties dependent on the degree of brightness required of the pixel so that the brightness varies from one part of the array to another.

3. A display arrangement for presenting a two-dimensional display including a plurality of elongate masks each defining a line array of pixels, the masks being apertured to permit transmission of light falling upon the rear surface of each mask, the nature of the apertures being related to the degree of brightness required for the corresponding pixel so that the brightness varies from one part of the array to another.

4. An arrangement as claimed in claim 1, 2 or 3 in which each pixel is associated with one aperture, the size of which determines the brightness of the pixel.

5. An arrangement as claimed in claim 1, 2 or 3 in which each pixel is associated with one or more apertures of uniform size, the number of which determines the brightness of said pixel.

6. An arrangement as claimed in claim 3, 4 or 5 in which there is a plurality of elongate masks side by side extending across the full width or height of the display.

7. An arrangement as claimed in claim 6 in which the elongate masks are made of a flexible tape.

8. An arrangement as claimed in claim 7 in which each tape is much longer than the dimension of the display along which the masks extend, in order that there may be a number of different interchangeable displays.

9. An arrangement as claimed in claim 3, in which there is a plurality of common light sources each lighting a plurality of pixels, which leads to a uniform illumination of the apertures.

10. An arrangement as claimed in any of the preceding claims in which the apertures are formed by a photo-resist exposure and etching process.

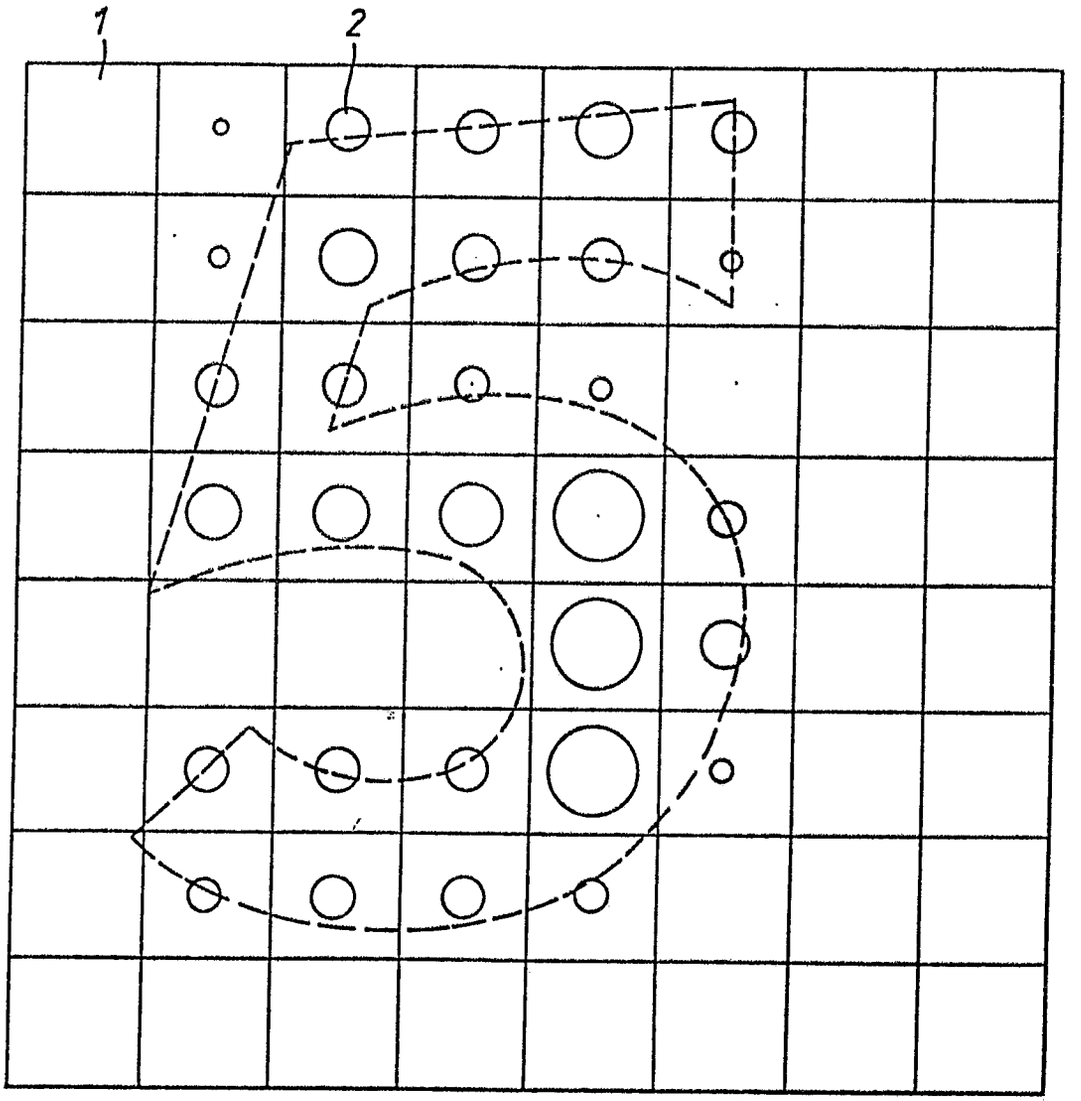
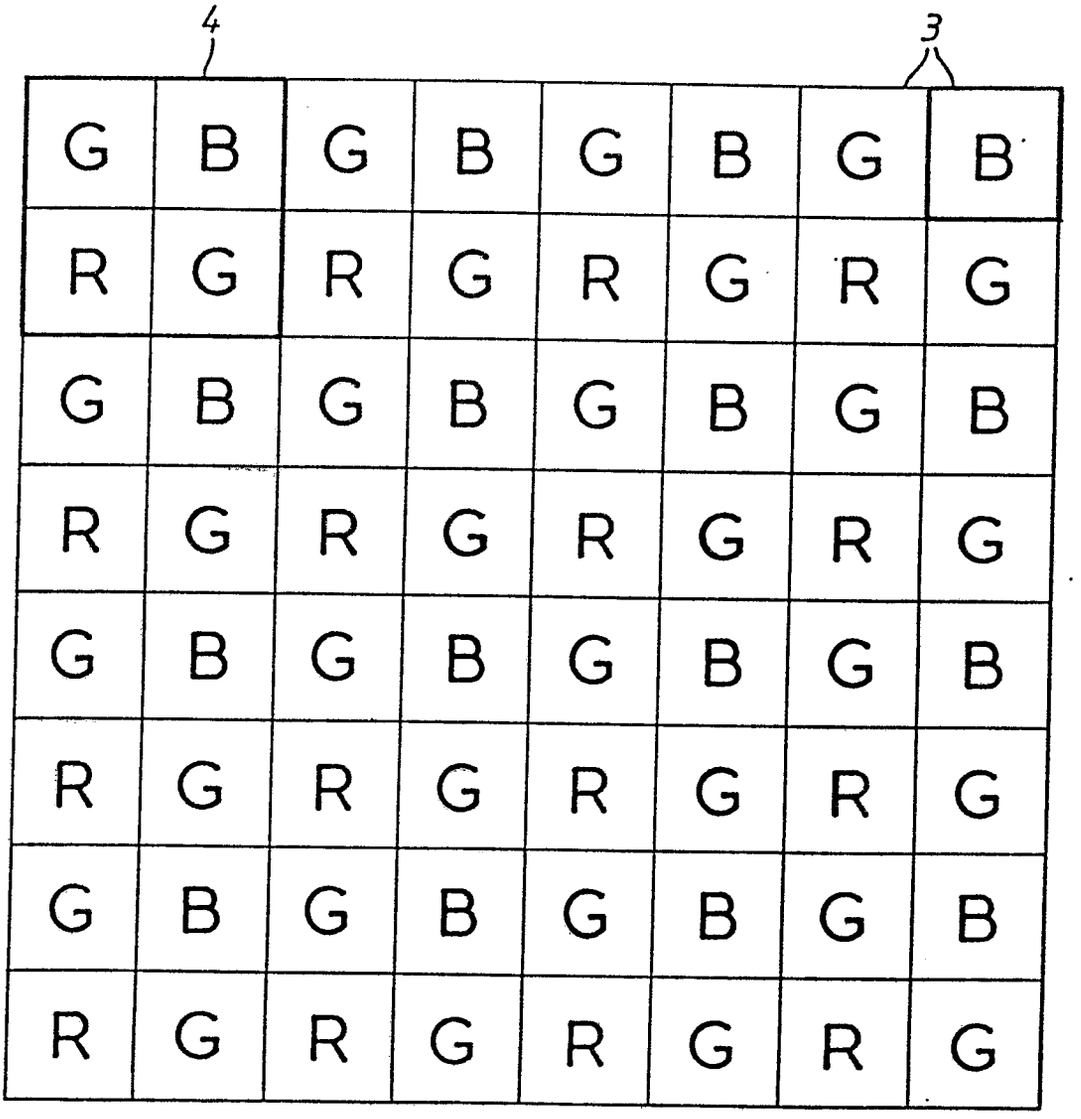


FIG. 1.


4
3
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R G R G R G R G
G B G B G B G B
R G R G R G R G
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FIG. 2.

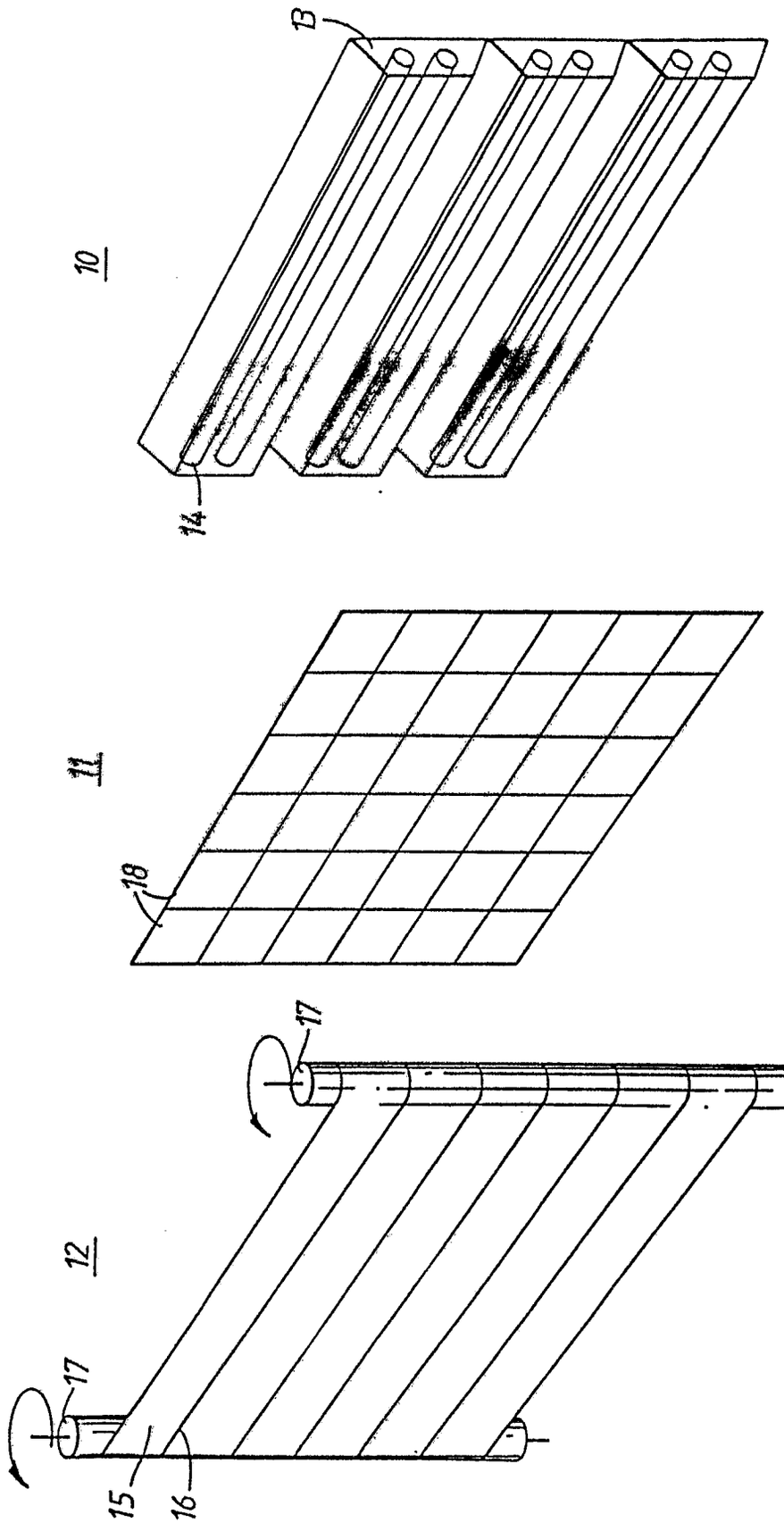

FIG. 3.