

DISPLAY ASSEMBLY FOR AN ELECTRONIC DEVICE

Field of the Invention

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This invention relates to display assemblies for portable electronic devices. In particular, this invention relates to, but is not necessarily limited to, frontlighting of display assemblies for portable electronic devices.

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Background of the Invention

Portable electronic devices with display assemblies for providing information are known. These display assemblies provide the information using displays such as, for example, liquid crystal displays (LCDs). Various techniques are used to illuminate these displays. One common technique to illuminate an LCD of a display assembly is by backlighting. The light for backlighting is typically provided by an internal light source placed behind the LCD. Alternatively, the LCD can be illuminated by ambient light from outside the display assembly. For backlighting as such, a translector is placed at the rear of the LCD to not only reflect ambient light but also to allow light from the internal light source to pass through.

Conventionally, backlighting requires both ambient light and an internal light source to illuminate an LCD. However, ambient light alone is often insufficient and this requires the internal light source to remain active most of the time. To alleviate dependence on the internal light source, some LCD devices adopt frontlighting instead of backlighting. For frontlighting, a reflector is placed at the back of an LCD or within the LCD to reflect incident ambient light or incident light from an internal light source placed in front of the LCD.

As is known in the art, a substantial amount of light from the internal light source is lost due to scattering before reaching the reflector of an LCD. Consequently, light is not efficiently channeled from the light source to the LCD. In conventional frontlighting or backlighting, inefficient use of light when illuminating an LCD results in power wastage. Such power wastage adversely shortens battery life of limited energy content batteries which typically powers portable electronic devices.

Summary of the Invention

It is an object of this invention to overcome or at least alleviate inefficient use of light and power in display assemblies for portable
5 electronic devices.

According to one aspect of the invention, there is provided a display assembly for an electronic device, said display assembly comprising:

10 a display having elements to provide indicia;

at least one light source to provide light to illuminate said display; and

15 at least one diffracting layer coupled to said display and said light source,

wherein said diffracting layer is adapted to diffract said light, received within a range of predetermined incident angles, towards said display and thereby enable said indicia to be illuminated for viewing within
20 predetermined viewing angles.

Preferably, said diffracting layer can be a light recordable film.

25 Suitably, said light recordable film can be a holographic film.

Preferably, said diffracting layer can be adapted to provide said predetermined viewing angles of at least twenty degrees in a latitudinal axis, said latitudinal axis being relative to a horizontal plane of said display.

30 Suitably, said diffracting layer can be adapted to provide said predetermined viewing angles of at least fifty degrees in a longitudinal axis, said longitudinal axis being relative to a horizontal plane of said display.

35 Preferably, said diffracting layer can be transparent to said light reflected from said display.

Suitably, said display can be a liquid crystal display having a reflector, said reflector being coupled to a rear side of or within said liquid crystal display.

5 Preferably, said display assembly can further comprise a transparent cover, coupled to said light source and said diffracting layer, said transparent cover being mountable to a housing for said electronic device.

10 Suitably, said transparent cover can be adapted to receive said light from said light source and to channel at least some of said light to said diffracting layer.

15 Preferably, said transparent cover can comprise a touch screen panel for a user of said electronic device to provide information.

 Suitably, said light source can comprise one or more light emitting diodes.

20 Preferably, said light source can comprise one or more incandescent lamps.

 Suitably, said electronic device can be a portable communication device.

25 According to another aspect of the invention, there is provided a display assembly for an electronic device, said display assembly comprising:

30 a transparent cover mountable to a housing for said electronic device;

 a display having elements to provide indicia; and

 at least one diffracting layer, coupled to said transparent cover and said display;

35 wherein said diffracting layer is adapted to diffract light, received within a range of predetermined incident angles, towards said display and thereby

enable said indicia to be illuminated for viewing within predetermined viewing angles.

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Preferably, said diffracting layer can be a light recordable film.

Suitably, said light recordable film can be a holographic film.

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Preferably, said diffracting layer can be adapted to provide said predetermined viewing angles of at least twenty degrees in a latitudinal axis, said latitudinal axis being relative to a horizontal plane of said display.

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Suitably, said diffracting layer can be adapted to provide said predetermined viewing angles of at least fifty degrees in a longitudinal axis, said longitudinal axis being relative to a horizontal plane of said display.

Preferably, said diffracting layer can be transparent to said light reflected from said display.

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Suitably, said display assembly can further comprise at least one light source to provide said light, said light source being coupled to said diffracting layer.

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Preferably, said transparent cover can be adapted to receive at least some of said light from said light source and to channel said some of said light to said diffracting layer.

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Preferably, said light source can comprise one or more incandescent lamps.

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Suitably, said transparent cover can comprise a touch screen panel for a user of said electronic device to provide information.

Preferably, said electronic device can be a portable communication device.

Brief Description of the Drawings

5 In order to describe the invention and to put it into practical effect, reference will now be made to embodiments as illustrated with reference to the accompanying drawings in which:

10 FIG. 1 is a cross-section of a display assembly in accordance with a preferred embodiment of the invention;

FIG. 2 is a cross-section of a display assembly in accordance with an alternate embodiment of the invention;

15 FIG. 3 shows passage of light through a portion of a transparent cover and a diffracting layer of a section of the display assembly of FIG. 1; and

FIGs. 4a and 4b show predetermined viewing angles for viewing indicia displayed on the display assemblies of FIGs. 1 and 2.
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Detailed Description of the Invention

25 In accordance with a preferred embodiment of the invention, FIG. 1 is a cross-section of a display assembly 10 comprising at least one light source 12,14, a display 16, at least one diffracting layer 18 and a transparent cover 20.

For this preferred embodiment, light source 12,14 can be, for example, light emitting diodes (LEDs), incandescent lamps or cold cathode
30 fluorescent lamps (CCFL) or electro-luminance (EL) lamp. Light source 12,14 is coupled to transparent cover 20. Diffracting layer 18 can be a light recordable film such as, for example, a holographic film. Transparent cover 20 is mounted to a housing 22 (partly shown) for an electronic device (not shown) such as, for example, a portable communication device that requires
35 display assembly 10. Display 16 can be, for example, a liquid crystal display (LCD). A reflector 24 is coupled to a rear side of or within display 16 to reflect light incident on display 16. Incident light on display 16 can be from

either light source 12,14 or ambient light. Diffracting layer 18 is made with a transparent material, such as a polymer, and has diffracting characteristics that will be described below. Diffracting layer 18 is attached to a rear side of transparent cover 20. In the art, transparent cover 20 serves as a lens for
 5 viewing indicia provided with elements or pixels of display 16.

FIG. 1 also shows supports 26,28 to couple diffracting layer 18 to display 16. Display 16 and reflector 24 are mounted onto a substrate 30 disposed within housing 22.

10 In accordance with an alternate embodiment of the invention, FIG. 2 is a cross-section of a display assembly 40 comprising at least one light source 42,44, a display 46, a diffracting layer 48 and a transparent cover 50.

For display assembly 40, diffracting layer 48 can be a light recordable film such as a holographic film. Transparent cover 50 comprises a touch
 15 screen panel 52 for a user of the electronic device to provide information. Sensing elements 54 of touch screen panel 52 are also indicated in FIG. 2. Diffracting layer 48 is made with a transparent material and attached to a rear side of touch screen panel 52.

FIG. 2 also shows supports 56,58 to couple diffracting layer 48 to
 20 display 46. Display 46 and a reflector 60 are mounted onto a substrate 62 disposed within housing 64. Reflector 60 is coupled to a rear side of or within display 46 to reflect light incident on display 46. Incident light on display 46 can be from either light source 42,44 or ambient light.

25 FIG. 3 shows passage of light through a portion of transparent cover 20 and diffracting layer 18 of a section 32 of display assembly 10. Light from light source 12 that passes through transparent cover 20 towards diffracting layer 18 is diffracted towards display 16. Light rays 70,72,74 illustrate the path through transparent cover 20 and diffracting layer 18. Also shown in
 30 FIG. 3 is two light rays 76,78 reflected from display 16.

A viewing cone is desired for viewing indicia shown on display 16,46. To effectively channel light to illuminate the indicia within this viewing cone, diffracting layer 18,48 is adapted to diffract light, received within a range of
 35 predetermined incident angles, towards display 16,46. Thus, this invention advantageously enables the indicia to be illuminated for viewing within

predetermined viewing angles. Such predetermined viewing angles define the viewing cone.

With the above viewing cone, displays 16,46 are effectively illuminated so that indicia displayed can be clearly viewed. However, it is important to
 5 note that in the presence of sufficient ambient light, light source 12,14,42,44 need not be turned on. As diffracting layer 18,48 is transparent, such ambient light can provide effective illumination for displays 16,46.

FIGs. 4a and 4b show predetermined viewing angles for viewing
 10 indicia displayed on displays 16,46.

In FIG. 4a, displays 16,46 are horizontally represented by a horizontal plane 80 having a latitudinal axis 82 in which the predetermined viewing angles lie along a vertical plane 84 normal to horizontal plane 80. The predetermined viewing angles have a latitudinal range 86 of at least twenty
 15 degrees towards a user viewing displays 16,46. However, latitudinal range 86 can also be equally divided to either side of a vertical axis 88. This flexibility is possible because the viewing cone is predetermined based upon the design of diffracting layer 18,48. Hence, latitudinal range 86 can be larger or smaller than twenty degrees and can also be unequally divided
 20 relative to either side of vertical axis 88.

FIG. 4b shows a longitudinal axis 90 in which the predetermined viewing angles lie along a vertical plane 92 normal to horizontal plane 80. The predetermined viewing angles along vertical plane 92 have a longitudinal range 94 of at least fifty degrees. Longitudinal range 94 can be
 25 equally divided to either side of vertical axis 88. Like latitudinal range 86, longitudinal range 94 can be larger or smaller than fifty degrees and can also be unequally divided relative to either side of vertical axis 88 depending on how diffracting layer 18,48 is designed.

30 Conventionally, holographic films are used for imaging or scattering and, therefore, are not designed with a range of diffracting angles to direct or channel light. In the novel application of a holographic film or any light recordable material in display assemblies 10,40 of this invention, light is effectively channeled to illuminate displays 16,46. Consequently, display
 35 assemblies 10, 40 are more effectively frontlighted than conventional display assemblies. Hence, this invention advantageously overcome or at

least alleviates inefficient use of light and power in conventional display assemblies.

We claim:



Claims

1. A display assembly for an electronic device, said display assembly comprising:

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a display having elements to provide indicia;

at least one light source to provide light to illuminate said display; and

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at least one diffracting layer, coupled to said display and said light source,

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wherein said diffracting layer is adapted to diffract said light, received within a range of predetermined incident angles, towards said display and thereby enable said indicia to be illuminated for viewing within predetermined viewing angles.

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2. The display assembly as claimed in Claim 1 wherein said diffracting layer is a light recordable film.

3. The display assembly as claimed in Claim 2 wherein said light recordable film is a holographic film.

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4. The display assembly as claimed in Claim 1 wherein said diffracting layer is adapted to provide said predetermined viewing angles of at least twenty degrees in a latitudinal axis, said latitudinal being relative to a horizontal plane of said display.

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5. The display assembly as claimed in Claim 1 wherein said diffracting layer is adapted to provide said predetermined viewing angles of at least fifty degrees in a longitudinal axis, said longitudinal axis being relative to a horizontal plane of said display.

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6. The display assembly as claimed in Claim 1 wherein said diffracting layer is transparent to said light reflected from said display.



7. The display assembly as claimed in Claim 1 wherein said display is a liquid crystal display having a reflector, said reflector being coupled to a rear side of or within said liquid crystal display.

5 8. The display assembly as claimed in Claim 1 and further comprising a transparent cover, coupled to said light source and said diffracting layer, said transparent cover being mountable to a housing for said electronic device.

10 9. The display assembly as claimed in Claim 1 wherein said transparent cover is adapted to receive said light from said light source and to channel at least some of said light to said diffracting layer.

15 10. The display assembly as claimed in Claim 1 wherein said transparent cover comprises a touch screen panel for a user of said electronic device to provide information.

20 11. The display assembly as claimed in Claim 1 wherein said light source comprises one or more light emitting diodes.

 12. The display assembly as claimed in Claim 1 wherein said light source comprises one or more incandescent lamps.

25 13. The display assembly as claimed in Claim 1 wherein said electronic device is a portable communication device.

 14. A display assembly for an electronic device, said display assembly comprising:

30 a transparent cover mountable to a housing for said electronic device;

 a display having elements to provide indicia; and

35 at least one diffracting layer, coupled to said transparent cover and said display;



wherein said diffracting layer is adapted to diffract light, received within a range of predetermined incident angles, towards said display and thereby enable said indicia to be illuminated for viewing within predetermined viewing angles.

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15. The display assembly as claimed in Claim 13 wherein said diffracting layer is a light recordable film.

10 16. The display assembly as claimed in Claim 14 wherein said light recordable film is a holographic film.

15 17. The display assembly as claimed in Claim 14 wherein said diffracting layer is adapted to provide said predetermined viewing angles of at least twenty degrees in a latitudinal axis, said latitudinal being relative to a horizontal plane of said display.

20 18. The display assembly as claimed in Claim 14 wherein said diffracting layer is adapted to provide said predetermined viewing angles of at least fifty degrees in a longitudinal axis, said longitudinal axis being relative to a horizontal plane of said display.

19. The display assembly as claimed in Claim 14 wherein said diffracting layer is transparent to said light reflected from said display.

25 20. The display assembly as claimed in Claim 14 wherein said display assembly further comprises at least one light source to provide said light, said light source being coupled to said diffracting layer.

30 21. The display assembly as claimed in Claim 20 wherein said transparent cover is adapted to receive at least some of said light from said light source and to channel said some of said light to said diffracting layer.

22. The display assembly as claimed in Claim 20 wherein said light source comprises one or more light emitting diodes.

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23. The display assembly as claimed in Claim 20 wherein said light source comprises one or more incandescent lamps.



24. The display assembly as claimed in Claim 14 wherein said transparent cover comprises a touch screen panel for a user of said electronic device to provide information.

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25. The display assembly as claimed in Claim 14 wherein said electronic device is a portable communication device.

10 26. A display assembly for an electronic device comprising a display, a transparent cover, at least one light source and at least one diffracting layer substantially as described herein with reference to and as illustrated by the accompanying drawings.