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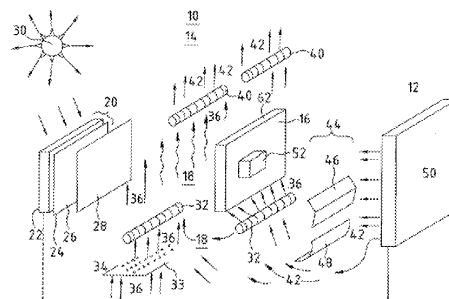
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Anw., 63450 Hanau****The following information is derived from the documents submitted by the applicant**(54) Title: **Display Unit**

(57) Main claim: A display unit (10, 66, 78), comprising a screen (14), such as a flatscreen with an LCD (16), arranged in a frame (12, 72, 86), and a non-glare protective glass (20) arranged by maintaining an air gap (18) in front of the LCD (16), characterized in that the LCD (16) is adapted as a trans-reflective LCD, in that the protective glass (20) has an infrared filter (26) to absorb incident thermal radiation, in that the air gap (18) between the LCD and the protective glass is adapted as a volumetric flow channel (18) for feeding a medium to evacuate heat generated by the LCD (16) and/or external irradiation, or to supply heat at low exterior temperature.



Description

[0001] The invention relates to a display unit according to the preamble of claim 1.

[0002] DE 297 00 485 U1 describes a flatscreen with an LCD matrix that is arranged between a glass plate and a flat illumination device, respectively by maintaining an air gap. The thickness of the glass plate in this case is a multiple of the air gap width, and the illumination device has a light-emitting surface adapted for a uniform light emission and is positioned immediately opposite the LCD matrix. The glass plate arranged in front of the LCD matrix enlarges the viewing angle within which the screen display can be viewed. The glass plate at the same time forms a mechanical protection for the LCD matrix. An air gap is formed between the glass plate and the LCD matrix, thus preventing the occurrence of interfering Newton rings. The glass plate is rendered nonreflective by preferably coating the latter with metal on both sides.

[0003] The LCD matrix described above is a transmissive LCD panel. These can be obtained as large format flat screens. However, these types of flatscreens have the disadvantage that they require a dedicated light source, whose light strength is limited, to render the information. The rendered information is only poorly readable or cannot be read at all in direct sun irradiation onto the flatscreen or in high ambient light.

[0004] A further, not thoroughly observed detail, of the display units, which are in particular used in exterior applications, is a reliable cooling or heating of the flatscreen. In particular on inadmissibly high ambient or operating temperatures, flatscreens react with undesirable effects, such as partial or total blackening of the rendering surface, up to and including complete destruction. The destruction of the panel (recrystallization of the liquid crystals) already occurs at temperatures below 0°C.

[0005] The previously known embodiments of display units therefore greatly restrict the range of applications.

[0006] Based on this prior art, the present invention has the task of refining a display unit of the type described above such that the ability to recognize the visual information is improved, in particular at bright ambient light or direct incident light over a large temperature range, both in interior and in exterior applications.

[0007] The task is without limitation solved by the invention in that the LCD is adapted as a trans-

reflective LCD, wherein the protective glass has an infrared filter to absorb incident thermal radiation, wherein the air gap between the LCD and the protective glass is adapted as a volumetric flow channel to supply a medium for evacuating heat generated by the LCD and/or external irradiation, or to supply heat at low exterior temperatures.

[0008] The inventive embodiment improves the ability to recognize the rendered visual information at high ambient light and in a large temperature range. Compared to previously used transmissive flatscreens, a trans-reflective flatscreen has the advantage that the latter is not mandatorily reliant on an internal illumination device to render the information because the LCD uses the incident ambient light to render the information. Using a reflector, the incident ambient light is used as backlighting for the liquid crystals. As a result, the flatscreen can be read in essentially all lighting conditions. Until now, trans-reflective flatscreens could only be manufactured in sizes up to approximately 19", and were therefore restricted for use in small mobile equipment or automotive displays. The new manufacturing technologies now permit sizes starting at 32".

[0009] The features cannot only improve visibility, but also reduce energy consumption and improve the efficiency of the LCD. We additionally note that the service life of the LCD is extended.

[0010] The nonglare protective glass can preferably be formed using Conturan® glass.

[0011] In order to cool the flatscreen, firstly an infrared filter is provided that absorbs incident thermal radiation, and secondly an air gap is proposed between the LCD and the protective glass to form a volumetric flow channel, over which heat generated on the surface of the LCD and/or by external irradiation can be transported away. At the same time, the volumetric flow channel also permits the option to supply heat at low exterior temperatures to protect the LCD.

[0012] The infrared filter is preferably applied on the rear face of the protective glass, for example by vapor deposition. The heating up of the display unit, in particular of the flatscreen, by external irradiation is as a result reduced.

[0013] A preferred embodiment specifies that the protective glass is adapted as safety glass. Safety glass consists of at least three layers, for example comprised of two glass layers with a film positioned in between them, wherein the layers are permanently bonded together as a unit. In this case, the infrared filter can be applied, for example by

vapor deposition, on any surface of the component of the safety glass facing the interior. The arrangement, number, and adaptation of the layers can be varied without modifying the inventive thought. If a UV filter is not – as is typically the case – applied on the flatscreen to protect the latter, said filter can be applied in addition to the infrared filter on any surface of the protective glass or the safety glass.

[0014] According to a further preferred embodiment, the display unit has climate control devices that supply the volumetric flow channel with a cooling or heating medium.

[0015] In a preferred embodiment, in particular for interior applications, the climate control devices are adapted as fans, such as radial or axial fans that are arranged in the region of a perimeter opening of the volumetric flow channel.

[0016] The climate control devices are preferably adapted as one or several fans, such as radial or axial fans, to generate a volumetric media flow in the volumetric flow channel. The fans can be arranged in the region of perimeter openings of the volumetric flow channel, wherein first fans introduce ambient air through ventilation slots, and second fans collect ambient air from the volumetric flow channel, and then evacuate ambient air to the environment through ventilation slots. This embodiment corresponds to a simple embodiment for climate control for applications for which temperatures below the operating or ambient temperature specified for the flatscreen of the display unit are not expected. This would for example be the case when the display unit is used in interior applications, such as display windows.

[0017] The air gap between the LCD and the protective glass forms a volumetric flow channel that facilitates a volumetric airflow along the surface of the LCD such that a best-possible uniform temperature distribution is achieved over the flatscreen surface. In particular in the upper region of the display unit, the interior air temperature can increase to operating temperatures inadmissible for the flatscreen if the latter heats up. This is solved in that the volumetric flow channel or volumetric flow channels are physically created between the protective glass and the flatscreen, in which the heat generated by the operation of the flatscreen and by external irradiation can be evacuated with a suitable medium.

[0018] If the ambient or operating temperature is too low for the flatscreen of the display unit, a medium to heat the flatscreen of the display unit can also be supplied in the volumetric flow channel. The medium to evacuate the generated heat or to supply heat is preferably air, but can also be any other suitable medium, and is determined depending on the particular application and/or ambient conditions of the display unit. Without impacting the spirit of the invention, the description below continues to make reference to air as the medium for transporting heat for better comprehension.

[0019] The interior temperature is monitored by at least one temperature sensor that is advantageously arranged in the upper region of the display unit. The number of the temperature sensors and their physical location within the display unit can vary without modifying the spirit of the invention. Said sensors can also be used to regulate the cooling or heating.

[0020] If ambient temperatures are expected for which the airflow in the volumetric flow channel does not provide adequate cooling or heating, the climate control device can be adapted as an air-conditioning system. The latter is coupled to the volumetric flow channel to form a cooling/heating circuit. The cooling/heating circuit preferably includes the volumetric flow channel and preferably includes a space extending between the rear face of the LCD and the housing rear wall.

[0021] The information to be displayed by the display are provided by an internal or external memory unit attached onto, or separate from, the display. The memory unit can for example be a PC, a multimedia unit, or also control electronics for converting external analog or digital video signals. The memory unit obtains its information and control commands to be reproduced over wireline or wireless programming, such as WLAN, GPRS, ULRs etc. For mobile display units, the information to be provided by the memory unit can be rendered dependent on a localizing device, such as GPS and/or GSM/UMTS broadcast stations. Optionally, the viewer can in this manner also interactively communicate with the LCD by touch, cell phone, or other future communications technologies.

[0022] Depending on the design implementation of the display unit, the climate control circuit of the flatscreen can be provided as climate control for the memory unit, or a dedicated climate control circuit can be provided without modifying the spirit of the invention.

[0023] The LCD can preferably have a TFT matrix and be adapted as an active matrix display.

[0024] We note that the aforementioned exemplary embodiments are not to be regarded as limiting the inventive thought, but that modifications are easily implemented without departing from the core thought and scope of the invention.

[0025] Further details, advantages, and features of the invention are not only derived from the claims, and from the features derived from these – either by themselves and/or in combination – but also from the preferred exemplary embodiments derived from the descriptions of the drawing to follow.

[0026] The drawing shows in:

[0027] [Fig. 1](#) a schematic construction of a display unit,

[0028] [Fig. 2](#) a schematic construction of a protective class,

[0029] [Fig. 3a\)–g\)](#) a perspective view of a housing of a first embodiment of the display unit,

[0030] [Fig. 3a\)–f\)](#) perspective views of a rear wall of the housing of the display unit in accordance with [Fig. 3](#),

[0031] [Fig. 4](#) a perspective view of a second embodiment of a display unit, and in

[0032] [Fig. 5](#) a perspective view of a third embodiment of a display unit.

[0033] [Fig. 1](#) shows a strictly schematic rendering of a first embodiment of a display unit **10**, consisting of a flatscreen **14** arranged in a frame or housing **12**. The flatscreen **14** comprises a trans-reflective liquid crystal screen, hereinafter called LCD **16**, and a nonglare protective glass **20** arranged in front of the LCD **16** by maintaining an air gap **18**. The protective glass **20** lies in a plane extending parallel to the surface of the LCD **16**. The air gap **18** formed between the protective glass **20** and the LCD **16** is adapted as a volumetric flow channel **18** to introduce a cooling or heating medium.

[0034] In the shown embodiment, the protective glass **20** is adapted as a safety glass with at least three layers, wherein a first outer layer **22** preferably consists of Conturan® glass as a nonglare glass layer, a second middle layer as a film **24** with a vapor-deposited infrared filter **26** or only vapor-deposited IR/UV filters, and a third inner layer as a glass layer **28**, for example made of ESG safety glass.

[0035] A detailed rendering of the protective glass **20** is shown in [Fig. 2](#). The individual layers, consisting of nonglare Conturan® glass, film with vapor-deposited IR protection, and ESG safety glass **28** can be bonded, for example laminated, to each other. In order to evacuate heat generated between the protective glass **20** and the surface **62** of the LCD **16**, climate control devices **32** are provided in the form of fans **32** that are arranged in the region of a bottom ventilation slot **34** of the volumetric flow channel **18**. The fans **40** introduce an airflow **36** into the volumetric flow channel **18** that is evacuated as exhaust air **42** by fans **40** arranged in the region of an upper ventilation slot **38**.

[0036] Guide brackets **46**, **48** can be arranged that guide the airflow **42** in a region **44** between a rear face of the LCD and a rear wall of the frame **12**. An air-conditioning system **50** can be integrated in the rear wall of the frame **12** to heat/cool the air flow.

[0037] The airflow **42** is selected such that the temperature distribution achieved over the flat screen surface **62** is as uniform as possible. In particular in the upper region of the display unit **10**, the interior air temperature can increase to operating temperatures inadmissible for the flatscreen if the latter heats up. This is solved in that the volumetric flow channel **18** is physically created between the protective glass **20** and the flatscreen **16**, in which the heat generated by the operation of the flatscreen **16** and by external irradiation **30** is evacuated with a suitable medium, such as air.

[0038] If the ambient or operating temperature is too low for the flatscreen **16**, the volumetric flow channel **18** can also transport a medium to heat the flatscreen.. The medium to transport the generated heat or to supply heat is preferably air, but can also be any other suitable medium, and is determined depending on the particular application and/or ambient conditions of the display unit. The exemplary embodiment for the climate control shown in [Fig. 1](#) is for applications for which temperatures below the operating or ambient temperature specified for the flatscreen of the display unit are not expected. This would for example be the case when the display unit is used in interior applications, such as display windows. The airflow **36** to cool or heat the display **16** is generated by one or several radial or axial fan types **32**, **40** and can be introduced into the volumetric flow channel over filters **33**.

[0039] The information to be displayed by the display 16 is provided by an internal or external memory unit 52 attached onto, or separate from, the display. The memory unit can for example consist of a PC or other multimedia unit, or also of control electronics for converting external analog or digital video signals. The memory unit 52 obtains the information to be displayed by the latter and its control commands over wireline or wireless programming, such as WLAN, GPRS, UMTS. For mobile display units, the information to be provided, or that of the memory unit, can be made dependent on a localizing device, such as GPS and/or GSM/UMTS broadcast stations.

[0040] Fig. 3 shows a possible embodiment of a housing 54 for the display unit, consisting of a frame 56 and a rear element 58. The frame 56 encloses the LCD 16 along its perimeter together with the safety glass 20 arranged at a distance from the LCD 16. In the shown exemplary embodiment, the ventilation devices, such as radial fans 32.1, 32.2 and 32.3 are arranged in a region behind the display 16, preferably in the region of ventilation slots 60 integrated into a bottom perimeter 58 of the rear wall. Alternatively, a ventilation unit, such as a radial fan, can also be arranged parallel to a side perimeter of the frame 56. Air is for example sucked in by the radial fans 32.1, 32.2, 32.3 through the ventilation slots 60 and then evacuated through ventilation slots 64 arranged in the upper region of the frame. The filters 33 can be arranged between ventilation ducts 60 and the volumetric flow channel.

[0041] Fig. 4a)–f) shows the rear wall element 58 in various views.

[0042] Fig. 5 shows a perspective view of a further embodiment of a display unit 66 that can preferably be used in exterior applications, such as advertising in pedestrian zones, but also in interior applications, such as display window advertising and entrance foyers, wherein – as is the case in exterior applications – direct sun irradiation, or at least strong ambient light, must likewise be expected, depending on the location of the display window. The display unit can optionally be equipped with a display either on the front, or with one display each on the front and back. Further displays can be arranged above one another or next to each other. The protective glass 22 – behind which the at least one LCD 16 and the fan units 32, 40 and/or further climate control devices are arranged at a distance – is visible from the outside. Ventilation perforations 70 are integrated along an upper side 68 of the display device. A housing 72 of the display unit is 66 is shaped as a column, wherein the flatscreen 14 is arranged in a front side or front and rear side 72 of

the column. Operating elements, such as power supply, control units, PCs, etc. can be arranged in a base 76 of the column.

[0043] Lastly, Fig. 6 shows a perspective view of a further embodiment of a display unit 78, which is intended for open-air use, for example independently of a mains power supply. Power is supplied by a power source that is preferably supplied by regenerative energy sources. In the described example, a solar panel 80 is provided that is connected to a drive 82 and is controlled to track the sun. The energy generated by the solar panel 80 is stored in a rechargeable battery 84, which is available to supply energy to the display unit, for example during nighttime. The flatscreen 88 is arranged in an approximately column-shaped housing 86, together with the climate control device required for operation, such as fans and/or air-conditioning system. An intake opening 89 of the air-conditioning system is arranged on a rear side of the housing 86. Furthermore, the location can be embodied in various geometric structures, such as a cube, pyramid, cylinder, ..., in particular when TFT films or the like are used. A perforated cover bracket 90 is provided as an air outlet in the upper region of the housing 86. A condensate container 92 for the air-conditioning system integrated in the housing can for example be arranged in the bottom region of the housing. Additionally, a heater (not shown) can also be integrated in the housing 86, depending on the deployment location.

[0044] For communication of the display unit 78 with a control center, the display unit 78 can have a transmitter/receiver unit 83 that communicates with a control center over wireless data communication to display data on the flatscreen 88.

[0045] In summary, the invention provides a daylight-compatible LCD that is capable of displaying contrast-rich images (static or dynamic, color or black & white) in direct sunlight. The display is operable in environments with high temperature fluctuations in the range from -40° to +60°, and can be embodied in all protection rating classes. Applications for example include bright foyers or display window applications, or integrated in an exterior location.

[0046] The flatscreen is based on a trans-reflective LCD. This involves additionally using the sunlight as backlight, e.g. the sunlight passes through the LCD from the vantage point of the viewer and is reflected back by a rear mirror, and is used as an additional light source to pass light through the liquid crystals. Depending on the image content and the incident sunlight, the backlight is modulated bright or dark. Overdrive algorithms can for

example be used to accelerate the switching times of the transistors of the TFT matrix of the LCD.

[0047] However, suitable filtration measures must be implemented to expose the LCD to direct sunlight over an extended time frame. The sunlight, specifically the IR and UV radiation, blacken - and destroy - the display. Such forms of destruction are avoided by inventively integrated IR and/or UV filters. The display is also protected against overheating. As a result, the flatscreen can be exposed to direct sunlight in continuous use, wherein the sunlight strength can be in the range of 150,000 LUX. In order to obtain a still recognizable image under these conditions, the flatscreen should achieve a minimum light density of approximately 1,400 cd/m².

[0048] The invention is based on the thought to combine daylight visibility of the LCD display with a combination of nonglare IR and/or UV filter safety front glass with corresponding heat evacuation and cooling of the LCD. A ventilation circuit for heat evacuation in front of the trans-reflective panel, including cooling of the electronics, is proposed for this purpose.

[0049] The glass is nonglare glass, and is equipped with an absorption layer of the harmful radiation. The resulting heat is evacuated by suitable cooling and/or ventilation technology. For this purpose, cylindrical or radial fans are positioned on the bottom side between the safety glass and LCD, and also on the upper side for circulation and heat evacuation. Suitable cooling measures for the electronics are positioned on the rear side of the LCD. An IR/UV filter that allows 2% of the wavelengths from 1-400 nm to pass through - i.e., 98% of the UV radiation is blocked - is vapor-deposited on the protective glass.

Claims

1. A display unit (10, 66, 78), comprising a screen (14), such as a flatscreen with an LCD (16), arranged in a frame (12, 72, 86), and a non-glare protective glass (20) arranged by maintaining an air gap (18) in front of the LCD (16), **characterized in that** the LCD (16) is adapted as a trans-reflective LCD, in that the protective glass (20) has an infrared filter (26) to absorb incident thermal radiation, in that the air gap (18) between the LCD and the protective glass is adapted as a volumetric flow channel (18) for feeding a medium to evacuate heat generated by the LCD (16) and/or external irradiation, or to supply heat at low exterior temperature.

2. The display unit according to claim 1, characterized in that the infrared filter (26) is applied on a rear side of the protective glass (20), for example by vapor deposition.

3. The display unit according to claim 1 or 2, characterized in that the protective glass (20) is adapted as safety glass, consisting of at least three layers (22, 24, 28), an outer and an inner glass layer (22, 28), with a film (24) arranged between these, wherein the infrared filter (26) is vapor-deposited on any surface of an element of the safety class facing the inner side, and in that the layers are bonded, for example laminated, into a unit.

4. The display unit according to any of the above claims, characterized in that the protective glass (20) additionally comprises a UV filter.

5. The display unit according to any of the above claims, characterized in that the UV filter is applied in addition to the infrared filter (26) on any surface of protective glass or the safety glass.

6. The display unit according to any of the above claims, characterized in that the display unit has climate control devices (32, 40) that introduce a cooling/heating medium (36) into the volumetric flow channel (18).

7. The display unit according to any of the above claims, characterized in that the cooling/heating medium is air (36).

8. The display unit according to any of the above claims, characterized in that the climate control device is connected to a temperature sensor that records the interior temperature, preferably in the upper region of the display unit, and controls the climate control device.

9. The display unit according to any of the above claims, characterized in that the climate control devices are adapted as one or several fans (32, 40), such as radial or axial fans, to generate an airflow (36) in the volumetric flow channel (18), wherein the fans are arranged in the region of perimeter openings (34) of volumetric flow channel.

10. The display unit according to any of the above claims, characterized in that at least one fan (62), such as a radial fan, is arranged on a side perimeter of the LCD.

11. The display unit according to any of the above claims, characterized in that the housing and/or the frame of the display unit has ventilation slots (**64**, **60**) at least in the lower and upper perimeter region.

12. The display unit according to any of the above claims, characterized in that the climate control device is an air-conditioning system that is coupled to the volumetric flow channel (**18**) to form a cooling/heating circuit.

13. The display unit according to any of the above claims, characterized in that the cooling/heating circuit comprises the volumetric flow channel (**18**) and preferably a space (**44**) extending between the rear side of the LCD and the housing wall.

14. The display unit according to any of the above claims, characterized in that electronic units (**52**) are arranged in the cooling/heating circuit, preferably on a rear side of the LCD (**16**), to control the display unit.

15. The display unit according to any of the above claims, characterized in that the LCD (**16**) has a TFT matrix.

6 sheets of drawings to follow

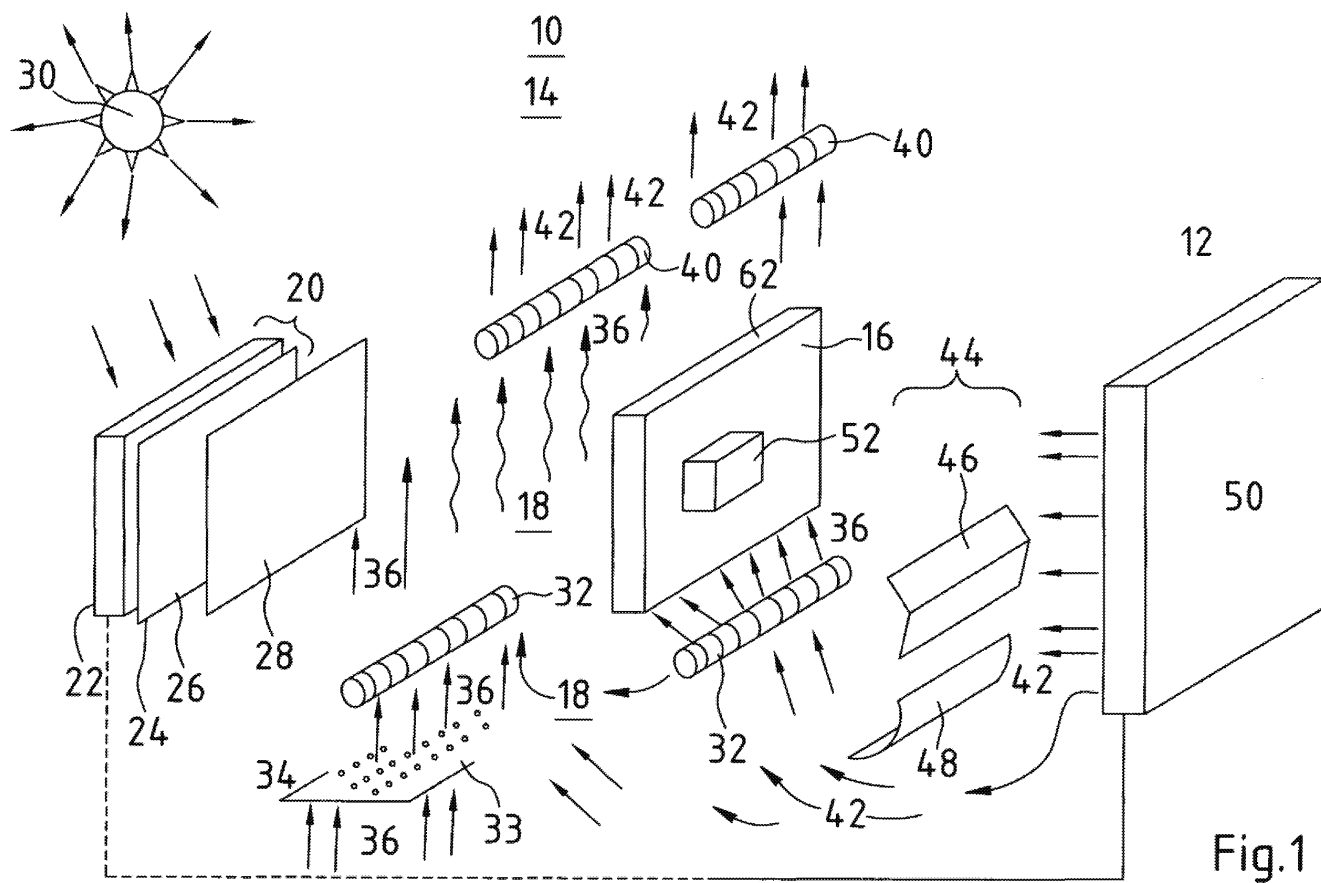
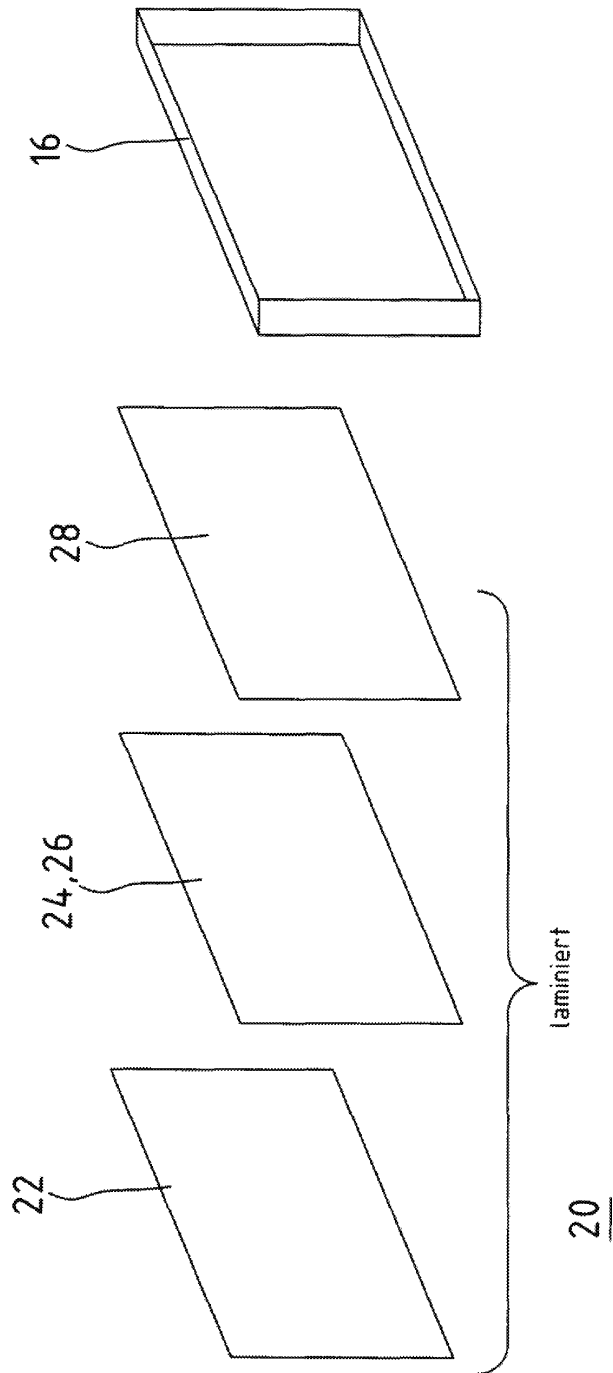
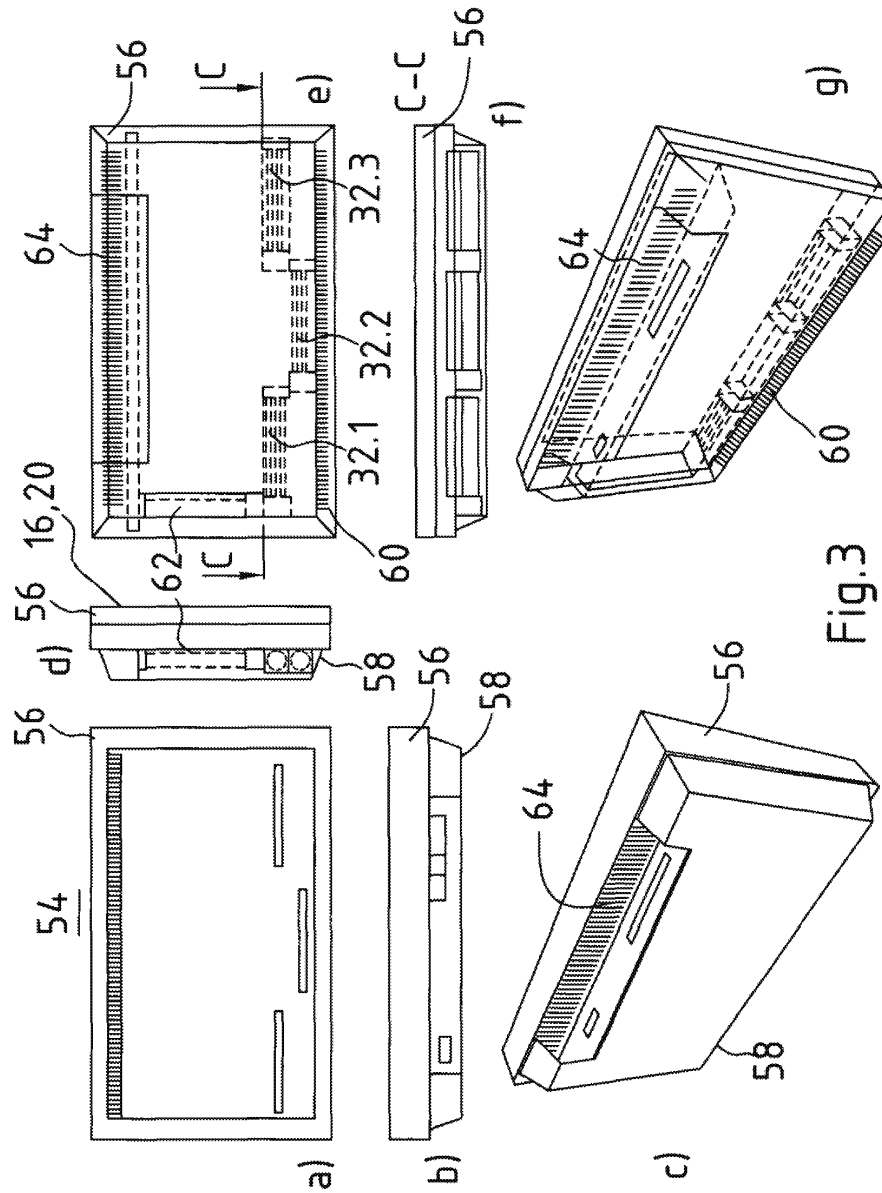


Fig. 1





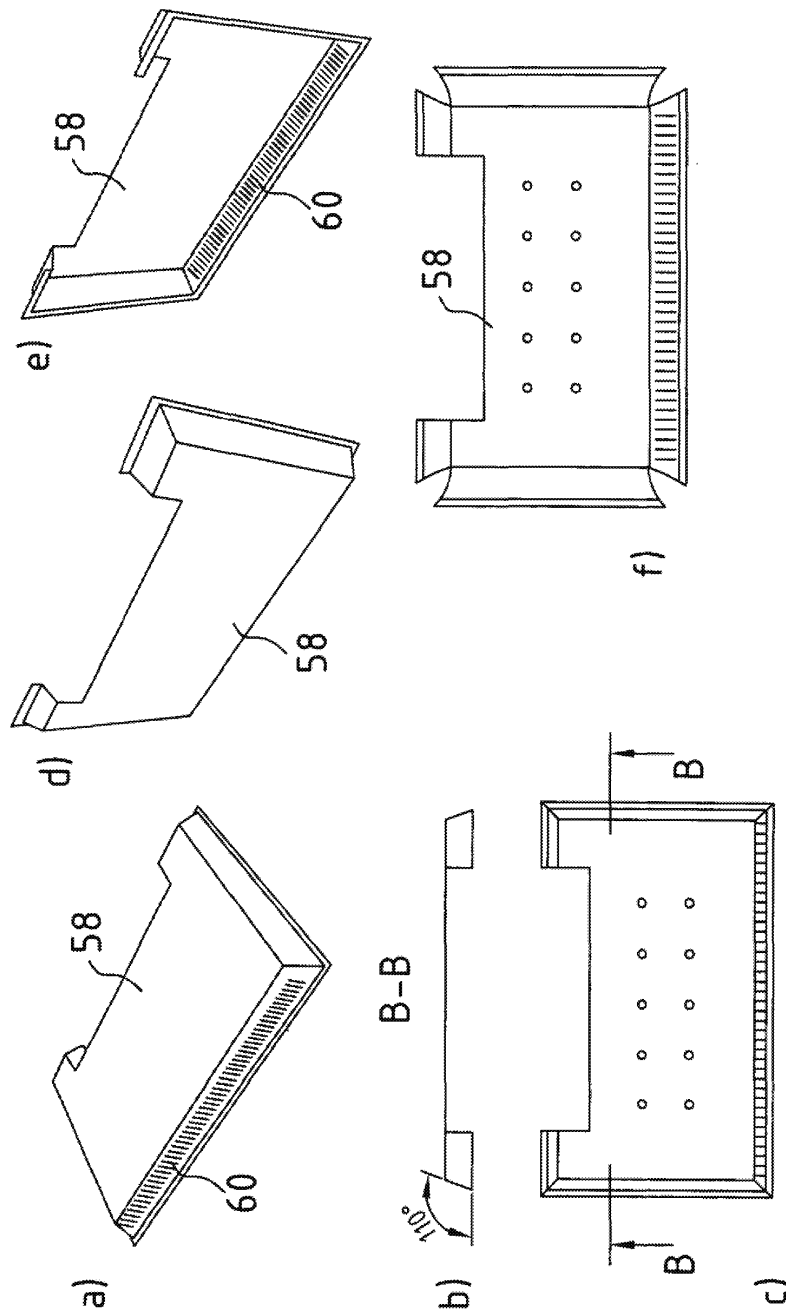


Fig.4

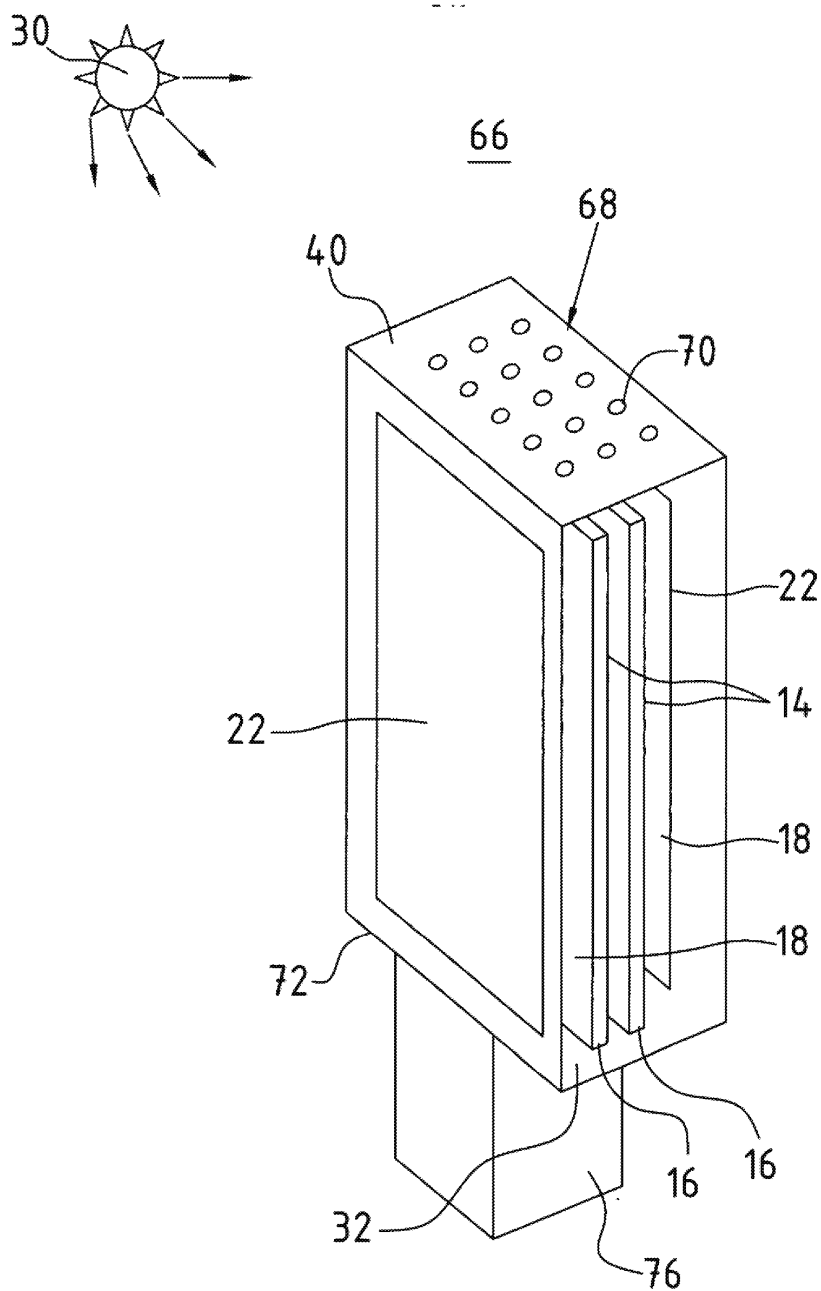


Fig.5

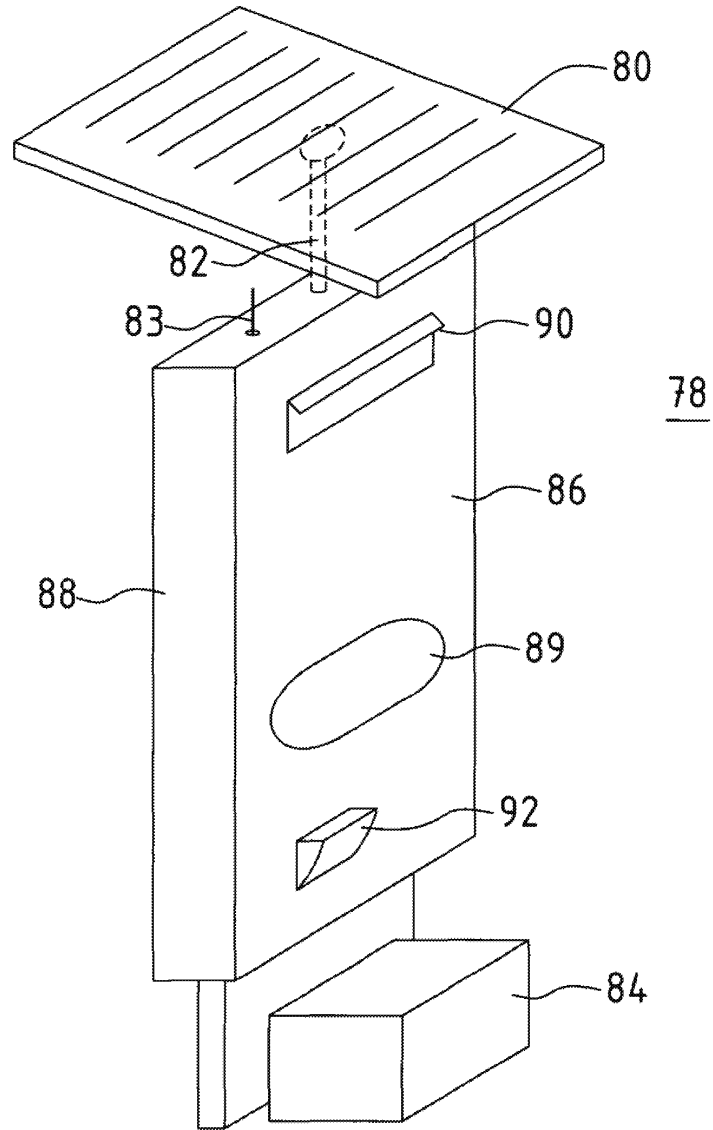
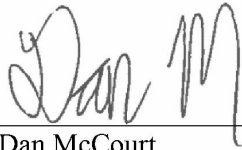


Fig.6



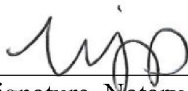
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