



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
22.10.2008 Bulletin 2008/43

(51) Int Cl.:
E01F 9/012^(2006.01)

(21) Application number: **08007343.0**

(22) Date of filing: **15.04.2008**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT RO SE SI SK TR
Designated Extension States:
AL BA MK RS

(71) Applicant: **Kabushiki Kaisha Asco**
Osaka-shi, Osaka
533-0011 (JP)

(72) Inventor: **Yamaguchi, Hideo, K.K. ASCO,**
Osaka-shi, Osaka 533-0011 (JP)

(30) Priority: **20.04.2007 JP 2007111938**
03.08.2007 JP 2007203090

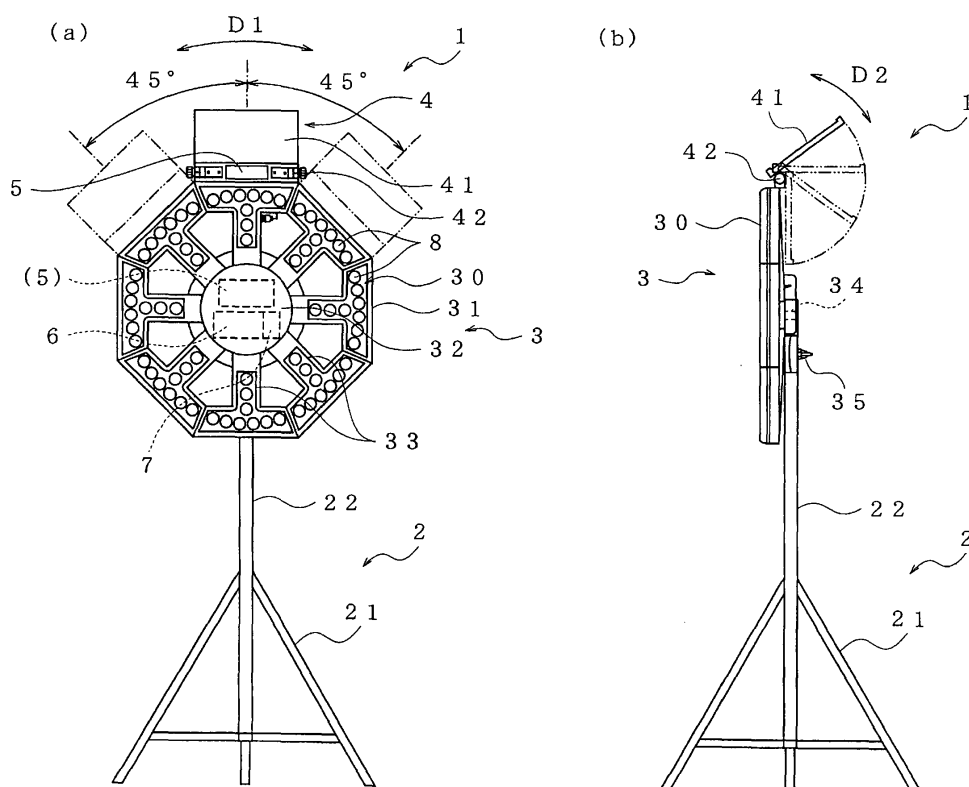
(74) Representative: **Knoblauch, Andreas**
Schlosserstrasse 23
60322 Frankfurt (DE)

(54) **Solar warning light**

(57) A solar warning light 1 includes a display panel 3 and a solar panel 4, which is supported tiltably on a horizontal axis by the top of the display panel 3. The display panel 3 includes an LED display 30, which includes a number of light emitters 8. The light emitters 8 increase front brightness and focus laterally radiated light

so as to improve their front views. The light emitters 8 are fitted on a banded outer frame 31 and a plurality of banded connecting frames 33. It is possible to make easily recognizable displays by controlling the manner in which and the timing at which the light emitters 8 flash, emit light, and scroll.

FIG. 1



Description

FIELD OF THE INVENTION

[0001] The present invention relates to a warning light including an LED display. In particular, the invention relates to a solar warning light fitted with a solar panel and a battery in it so as to be used outdoors with ease.

BACKGROUND OF THE INVENTION

[0002] An LED (light emitting diode) is a semiconductor device which is high in color purity because its spectral half-width is narrow. An LED is a light emitting device which is small in size and high in efficiency, and which emits light in brilliant colors. In recent years, blue LEDs have been put to practical use. This has made it possible to use LEDs of the three primary colors (red, green, and blue), thereby enabling full color displays.

[0003] LEDs consume small amounts of power, generate no heat, and have long lives. Therefore, LEDs are used for various displays, and suitably for traffic signs, guide signs in buildings, etc. A display including LEDs may indicate a specified phrase such as "UNDER CONSTRUCTION" or "ACCIDENT HAPPENING AHEAD OF HERE". The phrase is stored in the memory in the display.

[0004] It is also possible to provide an outdoor display by controlling the LEDs and emission order of light emitters arrayed simply in the form of an arrow, or arrayed inside the frame of a sign.

[0005] The outdoor display includes a memory, a display designating means, and a control. The memory stores display data in advance. The display designating means designates display data which should be displayed. The control retrieves the designated data from the memory and displays it on the display.

[0006] It is preferable that an outdoor indicating or warning light be fitted with a battery and/or a solar panel.

[0007] However, it is not sufficiently preferable that an outdoor indicating or warning light be fitted with a battery and/or a solar panel. It is preferable that an outdoor indicating or warning light should have a longer life and be able to generate power regardless of its orientation and the position of the sun.

[0008] It is important that it be easy to recognize the warning displayed by highly directive light emitters, which emit light in one direction.

[0009] For example, JP H9-203014 A discloses a warning light including light emitters and fitted with a solar panel on it and a battery in it. Each of the emitters emits light toward the center of an optically transparent columnar or cylindrical member, which refracts and scatters the light and radiates the refracted and scattered light from its substantially whole body.

[0010] The solar panel of this warning light is fitted in a fixed position on the frame of the light. Accordingly, depending on the place and direction in which the warning light is set, the solar panel may not efficiently generate

power. The mere refraction and scattering of the light from the light emitters are insufficient as display functions. Therefore, there is a demand for a solar warning light which maintains an efficiency of solar power generation wherever the light is set, and which enables more recognizable displays for a longer period of time.

SUMMARY OF THE INVENTION

[0011] The object of the present invention is provide a solar warning light which can maintain an efficiency of solar power generation, lengthens its battery life so as to enable long-time displays, and enables more easily recognizable displays.

[0012] A solar warning light according to the present invention includes a solar panel, a battery, and a display panel. The solar panel has a receiving surface. The display panel is supported by an upper portion of a stand. The display panel includes an LED display positioned on its front side. The LED display includes an array of light emitters. The display panel is fitted with a display control and a memory in it. The display control so controls the light emission from the light emitters as to display a specified emission pattern. The memory stores display patterns. The display panel is also fitted with a horizontal shaft fitted to its top in parallel to it. The solar panel is supported by the horizontal shaft tiltably around it.

[0013] Because the receiving surface of the solar panel tilts around the horizontal shaft, this surface can be shifted to any position around the shaft. This makes it possible to orient the receiving surface to the sun, thereby making it possible to maintain an efficiency of solar power generation. By controlling the light emission from the light emitters, it is possible to make easily recognizable displays.

[0014] The upper portion of the stand may be fitted with a horizontal pin, by which the center of the display panel may be supported rotatably so that the display panel can turn within a first angular range around the pin. In this case, not only does the solar panel tilt around the horizontal shaft, but the display panel also turns around the horizontal pin. This makes it possible to shift the receiving surface of the solar panel to any position around the horizontal shaft and pin. Accordingly, it is easier to orient the receiving surface to the sun, so that the efficiency of power generation is higher.

[0015] The display panel may further include a banded outer frame, a center frame, and a plurality of banded connecting frames, which connect the outer and center frames. The horizontal pin may be fitted to the center frame. The light emitters may be arrayed on the outer and connecting frames. It is possible to display various patterns by controlling the order in which and the timing at which the light emitters on the outer and connecting frames emit light.

[0016] The light emitters on the outer and connecting frames may be so controlled as to flash simultaneously or sequentially, or to emit light sequentially in a stream.

In this case, if the outer frame is polygonal, it is possible to display a variety of easily recognizable patterns by controlling the order in which and the timing at which the light emitters on the outer and connecting frames flash or emit light.

[0017] Each of the light emitters may include an LED, a convex lens, and a prism. The convex lens focuses the center light flux emitted by the LED within a second angular range from the light source of the LED. The prism defines the view angle of the light radiated by the LED laterally outside the second angular range. It is possible to increase the front brightness by improving the central clarity of vision through by means of the convex lens, which focuses the center light flux. Each of the light emitters emits light at a specified view angle by condensing the laterally radiated light through the associated prism, which defines the view angle of the light outside the second angular range.

[0018] The LED display may further include an optically transparent front panel. The convex lenses of the light emitters may be molded integrally on one or both sides of the front panel. In this case, the front panel functions as part of the display panel, and as lenses. This makes it possible to reduce the number of parts, so that the light emitters are compact.

[0019] The prism may be tubular and have a front end face, a first inner cylindrical surface, an inner conical surface, a second inner cylindrical surface, a first outer peripheral surface, a first outer conical surface, a second outer peripheral surface, and a second outer conical surface. The front end face may be in contact with the front panel. The first inner cylindrical surface may closely surround the LED. The second inner cylindrical surface may extend along the edge of the convex lens and is larger in diameter than the first inner cylindrical surface. The inner conical surface connects the two inner cylindrical surfaces. The first outer peripheral surface may surround the LED. The first outer conical surface diverges steeply from the first outer peripheral surface. The second outer peripheral surface diverges gently from the first outer conical surface. The second outer conical surface diverges from the second outer peripheral surface to the front end face. The prism may project the light incident into it to its front end face and the convex lens so as to define the view angle of the light emitted from the LED.

[0020] The center light flux within the angular range from the light source passes directly inside the tubular prism, so that the flux is emitted directly through the convex lens, without the inner prism surfaces interfering with the flux. The prism condenses the light outside the angular range through its first outer peripheral surface, first outer conical surface, and second outer peripheral surface, projects the condensed light toward the front panel, and radiates the light through its front end face in contact with the front panel. As a result, the light emitters are high in front brightness and can focus the laterally radiated light.

[0021] The battery may be fitted to the solar panel. This

makes the solar warning light small in size and neat in appearance.

[0022] Alternatively, the battery may be fitted to the center frame. The solar warning light may be larger in size with a larger battery fitted to the center frame.

[0023] The outer frame may be a regular octagon consisting of eight frame parts and having a horizontal top. The connecting frames may be eight in number. The battery, the display control, and the memory may be fitted to the center frame. The first angular range may be 90 degrees, 45 degrees on each of the right and left sides. The solar panel may be supported tiltably by the horizontal top frame part. The solar panel can be supported easily by the horizontal top frame part. It is possible to shift the solar panel for 45 degrees by turning the display panel for the angle equivalent to the length of each of the frame parts.

[0024] The center frame may be fitted an on-off switch, a lighting pattern change-over switch, and a lighting time zone change-over switch all on its back side. The on-off switch makes it possible to operate the solar warning light when necessary. The lighting pattern change-over switch makes it possible to switch what is displayed on the display panel. The lighting time zone change-over switch makes it possible to preset a display time zone such as daytime or nighttime.

[0025] The stand may include a foldable tripod and a vertically telescopic strut. The horizontal pin may be fitted to an upper portion of the strut. If the tripod is folded, and if the strut is shortened, the solar warning light is compact and easy to carry. The solar warning light is easy to set wherever the tripod can be put. The solar warning light can be set at a desired height.

[0026] The battery may be a nickel-hydrogen battery. Because the light emitters originally consume small amounts of power, the nickel-hydrogen battery, which is large in capacity, can supply the emitters with power for long-time displays. Because the nickel-hydrogen battery is large in capacity, it can be small in size and may be fitted to the solar panel. It is possible to further lengthen the life of the nickel-hydrogen battery by charging the battery with electricity from the solar panel.

[0027] As described already, the solar panel can tilt around the horizontal shaft so that the receiving surface of this panel can be oriented to the sun. This enables the solar warning light to maintain an efficiency of power generation. The light emitters of the LED display are fine in front view by increasing the front brightness and condensing the laterally radiated light. This enables the solar warning light to make easily recognizable displays by controlling the order in which and the timing at which the light emitters flash and emit light.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028]

FIGS. 1(a) and 1(b) are a front view and a side view

respectively of a solar warning light embodying the present invention.

FIGS. 2(a) and 2(b) are back views of part of the solar warning light, showing its switch unit in different positions.

FIG. 3 is a block diagram of a system for the solar warning light.

FIG. 4 is a block diagram of another system for the solar warning light.

FIGS. 5(a) and 5(b) are sectional views of a light emitter of the solar warning light. FIG. 5(b) shows optical paths.

FIG. 6 is a sectional view of the display of another solar warning light embodying the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0029] Preferred embodiments of the present invention will be described below in detail with reference to the accompanying drawings.

[0030] With reference to FIG. 1, a solar warning light 1 embodying the present invention includes a stand 2 and a display panel 3, which is supported by an upper portion of the stand 2. The display panel 3 includes an LED display 30 supported on its front side. The LED display 30 includes a number of light emitters 8. The display panel 3 is fitted with a display control 6 and a memory 7 in it. The display control 6 so controls the light emission from the light emitters 8 as to make a display on the LED display 30. The memory 7 stores display patterns. The display panel 3 supports a solar panel 4 on its top.

[0031] The display panel 3 includes a polygonal array of outer light emitters and radial arrays of inner light emitters. The display panel 3 also includes a banded outer frame 31, a center frame 32, and a number of banded connecting frames 33, which connect the frames 31 and 32. The light emitters 8 are mounted on the outer frame 31 and the connecting frames 33 so that the LED display 30 can be formed as desired on the front side of the display panel 3. Alternatively, the display panel 3 might be a disk or a polygonal plate. In this case, the inner and outer light emitters might be mounted on the front side of the display panel 3.

[0032] It is possible to display various patterns (flashing and scrolling) by controlling the order in which, and the timing at which, the light emitters 8 on the outer frame 31 and the connecting frames 33 flash and emit light. This enables LED displays easy to recognize. In other words, the whole front side of the display panel 3 can be the LED display 30.

[0033] The outer frame 31 is polygonal but might alternatively be annular. It is essential that light emitters 8 be arrayed in series along the outer periphery of the display panel 3. With reference to FIGS. 2A and 2B, the polygonal frame 31 is preferable because it is easy to mount the solar panel 4, which is rectangular, on the horizontal top part 31A of this frame 31.

[0034] The solar panel 4 is mounted on the horizontal

top part 31A of the polygonal frame 31. The top part 31A is fitted with a horizontal shaft 42, which is parallel to its upper side. The solar panel 4 is supported by the horizontal shaft 42 tiltably in opposite directions D2 around this shaft. This makes it possible to incline the receiving surface 41 of the solar panel 4 to an arbitrary position around the horizontal shaft 42. As a result, the receiving surface 41 can be oriented to the sun so that the efficiency of power generation of the solar panel 4 can be maintained.

[0035] An upper portion of the stand 2 is fitted with a horizontal pin 34, on which the center of the display panel 3 is supported rotatably so as to turn in opposite directions D1 within a specified range around this pin 34. The directions D1 are perpendicular to the directions D2. This makes it possible to incline the receiving surface 41 of the solar panel 4 to an arbitrary position around the horizontal pin 34 as well as the horizontal shaft 42. As a result, it is yet easier to orient the receiving surface 41 to the sun.

[0036] As described above, the solar panel 4 is supported on the horizontal shaft 42, which is fitted to the top part of the display panel 3, and the receiving surface 41 of the solar panel 4 can incline around the horizontal shaft 42 perpendicularly to the directions in which the display panel 3 turns. The display panel 3 turns right and left, and the receiving surface 41 of the solar panel 4 can incline. This makes it possible to incline the receiving surface 41 to an arbitrary position around the horizontal shaft 42 and pin 34 so as to orient this surface 41 to the sun.

[0037] The solar panel 4 can tilt into contact with the back side of the display panel 3 (LED display 30) so that the solar warning light 1 can be stored compactly.

[0038] The outer frame 31 is a regular octagon. It is possible to shift the display panel 3 easily for an angle of 45 degrees by turning this panel for the angle equivalent to the length of one side of the outer frame 31. The stand 2 includes a strut 22. The horizontal pin 34 is fitted to the center of the display panel 3 and supported rotatably on an upper portion of the strut 22 so that this panel 3 can turn in the directions D1.

[0039] As described above, the display panel 3 is an equilateral polygon and turns right and left for the angle equivalent to the length of one side of this panel 3. This symmetrizes the layout of the LED display 30, thereby enabling LED display constant in layout.

[0040] The center frame 32 has a guide groove 36 formed on its back side, which limits the turning angle of the display panel 3. A set screw 35 engages with the guide groove 36 so as to fix the display panel 3. By loosening the set screw 35, it is possible to turn the display panel 3 within the range set by the guide groove 36. By tightening the set screw 35, it is possible to fix the display panel 3 in a position within this range. A butterfly nut engages with the set screw 35 and can be tightened and loosened manually. This makes it possible to turn the display panel 3 without using a special tool.

[0041] When one side of the display panel 3 is positioned horizontally at the top of this panel, the solar panel 4 is fitted on this side. By turning the display panel 3 right and left for the angle equivalent to the length of one side of this panel, it is possible to shift the solar panel 4 for 45 degrees on each side and 90 degrees on both sides. It is also possible to incline the solar panel 4. This enables the solar panel 4 to shift in a wide range and be oriented in a desired direction.

[0042] The stand 2, which supports the display panel 3, further includes a foldable tripod 21. The strut 22 of the stand 2 is vertically telescopic. The center frame 32 of the display panel 3 is supported rotatably by the upper portion of the strut 22. If the tripod 21 is folded, and if the strut 22 is contracted, the solar warning light 1 is compact and easy to carry. The tripod 21 makes it easy to set the solar warning light 1 in an arbitrary place. It is possible to position the display panel 3 at a desired height by extending or contracting the strut 22.

[0043] The display control 6 and memory 7 are fitted as devices for LED display to the center frame 32 of the display panel 3. The solar panel 4 is fitted with a small battery 5 in it. Alternatively, the center frame 32 might be fitted with a battery 5 in it. A larger battery might, in place of the battery 5, be fitted in an arbitrary position on the stand 2.

[0044] Because the small battery 5 is fitted in the solar panel 4, the solar warning light 1 is small in size and neat in appearance.

[0045] The power from the solar panel 4 is transmitted through a cord 43 and a plug 44 to the devices in the center frame 32 and can be used to activate the light emitters 8 and charge the battery 5. If the battery 5 is a nickel-hydrogen battery, it can be small in size and large in capacity.

[0046] Because the LED display 30 is low in power consumption, the battery 5 can be a nickel-hydrogen battery of such size that it can be fitted in the solar panel 4.

[0047] If the battery 5 is a nickel-hydrogen battery, as stated above, it can be small in size and large in capacity. This makes it easy to fit the battery 5 in the solar panel 4 or mount the battery on the center frame 32.

[0048] Because the light emitters 8 are low in power consumption, they can emit light for a long time if the battery 5 is a nickel-hydrogen battery large in capacity. For example, if the battery 5 is a nickel-hydrogen battery, and once it is charged fully, the light emitters 8 can keep emitting light for 15 days. As the need arises, the power from the solar panel 4 is used to charge the battery 5. This makes the life of the battery 5 longer.

[0049] As shown in FIG. 2(a), the center frame 32 is fitted with an on-off switch 51, a lighting pattern change-over switch 52 and a lighting time zone change-over switch 53 on its back side, which enable displays as the need arises. When the on-off switch 51 is turned on, the solar warning light 1 starts to operate. The lighting pattern change-over switch 52 makes it possible to switch what is displayed on the display panel 3. The lighting time zone

change-over switch 53 makes it possible to preset a display time zone such as daytime or nighttime.

[0050] Because the display panel 3 can rotate around the horizontal pin 34, as shown in FIG. 2(b), this panel 3 can turn right and left with the solar panel 4 supported by the top part 31A of the outer frame 31, without any load imposed on the devices in the center frame 32.

[0051] With reference to FIG. 3, a system for the solar warning light 1 will be described below.

[0052] The display control 6 controls the solar warning light 1 and can be supplied with power either directly from the solar panel 4 or from the (nickel-hydrogen) battery 5. The display control 6 controls a voltage detector 55 and a charging control 54. The voltage detector 55 checks the capacity of the battery 5 as required. The charging control 54 charges the battery 5 by supplying it with power from the solar panel 4. If the voltage across the battery 5 drops, the battery is charged by means of the voltage detector 55 and the charging control 54.

[0053] This safely keeps the battery 5 from being overcharged. In addition, this makes it possible to effectively utilize the power generated by the solar panel 4. A voltage monitor lamp 56 indicates the voltage across the battery 5 so that the power remaining in the battery can be checked at all times.

[0054] The switches 51 - 53 are fitted on the back side of the center frame 32. The on-off switch 51 is a power switch. The lighting pattern change-over switch 52 makes it possible to switch what is displayed on the display panel 3. The lighting time zone change-over switch 53 makes it possible to select a display time zone from among daytime, nighttime, and day and night.

[0055] All the operating conditions set by means of the switches 51 - 53 are transmitted to the display control 6, which includes the memory 7. Then, the display control 6 generates control commands, in accordance with which the solar warning light 1 makes a display on the LED display 30.

[0056] Various display patterns may be displayed on the LED display 30. The light emitters 8 on the outer frame 31 may flash sequentially or simultaneously, or emit light in clockwise or counterclockwise order (scrolling). The light emitters 8 on the radial connecting frames 33 may flash or emit light (scrolling) in inward order.

[0057] The solar warning light 1 may have a brightness control function for daytime and nighttime displays. The warning light 1 may also have an anti-overheating function for monitoring the heat generated by the devices in the display panel 3 and/or an overcurrent protection function. The anti-overheating function and overcurrent protection function make it possible to automatically switch off the warning light 1 if the light detects abnormality.

[0058] Preset display patterns can be stored in the memory 7 and displayed to indicate a construction site, a blind alley, an accident, etc.

[0059] Of course, it is possible to arbitrarily set the speed at which the light emitters 8 flash in order and the time for which they light up. It is also possible to arbitrary

set the speed at which the display on the display panel 3 scrolls.

[0060] FIG. 4 shows a system in which a solar panel 4 and a battery 5 are provided as one unit.

[0061] With reference to FIG. 4, the solar panel 4 charges the battery 5, which supplies power for LED displays. If the voltage across the battery 5 drops, the solar panel 4 supplies the battery 5 with power so as to charge it through a charging control 54 and a voltage detector 55. Otherwise, the system is identical in structure with that shown in FIG. 3.

[0062] The light emitters 8 will be described below with reference to FIGS. 5(a), 5(b), and 6.

[0063] With reference to FIG. 5(a), the LED display 30 includes an optically transparent front panel 80 and a board 85. Each light emitter 8 includes an LED 81, a convex lens 82, and a prism 83. The LED 81 is fitted to the board 85. The convex lens 82 is formed as part of the front panel 80 and focuses the center light flux emitted from the LED 81 within a specified angular range from the light source of the LED. The light radiated laterally outside the angular range by the LED 81 is projected toward the front panel 80 by the prism 83. This widens the view angle of the light from the LED 81, which is small in diameter.

[0064] The prism 83 is tubular and has inner peripheral surfaces 84, outer peripheral surfaces, and a front end face 83h, which is in contact with the front panel 80. The inner peripheral surfaces 84 are a first inner cylindrical surface 83a, an inner conical surface 83b, and a second inner cylindrical surface 83c. The first inner cylindrical surface 83a is smaller in diameter than the second inner cylindrical surface 83c and closely surrounds the LED 81. The inner conical surface 83b connects the inner cylindrical surfaces 83a and 83c. The second inner cylindrical surface 83c extends along the edge of the convex lens 82. The outer peripheral surfaces are a first outer peripheral surface 83d, a first outer conical surface 83e, a second outer peripheral surface 83f, and a second outer conical surface 83g. The first outer peripheral surface 83d surrounds the LED 81. The first outer conical surface 83e diverges steeply from the first outer peripheral surface 83d. The second outer peripheral surface 83f diverges gently from the first outer conical surface 83e. The second outer conical surface 83g diverges from the second outer peripheral surface 83f and adjoins the front end face 83h.

[0065] The front panel 80 has annular guides 86 molded integrally on its back side. Each annular guide 86 surrounds and positions the front end of the prism 83 of one of the light emitters 8. It is preferable that each annular guide 86 be a ridge which is large enough in diameter to surround the associated end face 83h, and which has a conical guide surface for slidable contact with this face 83h.

[0066] The convex lens 82 is molded integrally on the back side of the front panel 80 but might be molded on the front side or both sides of this panel. The formation

of the convex lens 82 on the back side of the front panel 80 makes the front side of this panel a smooth display surface, which enables good displays, and which is not liable to be dirty and is easy to clean.

[0067] It is preferable that the inner diameter of the front end face 83h of each prism 83 be nearly equal to the diameter of each convex lens 82. The front end of each prism 83 is held fixedly between the edge of the associated lens 82 and the associated guide 86.

[0068] This positions the LED 81, prism 83 and convex lens 82 of each light emitter 8 correctly as desired. The center light flux emitted from the LED 81 within the specified angular range from the light source 81 a of the LED passes inside the prism 83 and is projected directly to the convex lens 82. The light radiated from the LED 81 laterally outside the angular range is incident into the prism 83 and reflected in it. The reflected light is projected toward the front panel 80 and radiated through the lens and the front end face 83h of the prism.

[0069] As stated above, the light radiated laterally outside the specified angular range is focused and radiated through the front end face 83h of the prism 83. The light emitted from the LED 81 is radiated in the size of the front end face 83h. This makes it possible to define the view angle for emission displays, with emission brightness maintained.

[0070] FIG. 5(b) schematically shows optical paths. The light passing inside the prism 83 is projected directly to the lens 82 and focused into beams 800. The light incident into the prism 83 is reflected in it and radiated as beams 810 and 820 through the lens 82 and prism face 83h respectively.

[0071] As stated above, the light projected from the light source 81a is focused in a central emission zone A1 and an annular emission zone A2, which surrounds the zone A1. The emission zones A1 and A2 cover the convex lens 82 and prism face 83h respectively. In other words, the light from the light source 81a increases the front brightness through the convex lens 82 and widens the view angle through the prism 83.

[0072] Accordingly, by arranging the light emitters 8 at intervals, it is possible to form a display which is high in front brightness and easily visible.

[0073] FIG. 6 shows the display of another solar warning light embodying the present invention. This display includes a vertical array of light emitters 8A, 8B, 8C, 8D, and 8E, which are fitted to a board 85. The board 85 is supported by supports 87, which extend from a frame 88. Control signals can be transmitted to the light emitters 8A - 8E through a cable CA, through which they can be supplied with power. The cable CA is connected to a control by a connecting plug 89 and a main body control cable CB.

[0074] A control (not shown) makes it possible to set and control the emission timing, emission time, and emission order of the light emitters 8A - 8E. This makes it possible to light up the light emitters 8A - 8E simultaneously, flash them on and off, and light them up in order

(scrolling).

[0075] The light emitters 8A - 8E include LEDs 81 A - 81E, convex lenses 82A - 82E, and prisms 83A - 83E, respectively.

[0076] The convex lenses 82A - 82E are molded integrally on the back side of an optically transparent front panel 80 but might be molded on the front side or both sides of this panel. The front panel 80 has annular guides 86 molded integrally on its back side. Each annular guide 86 surrounds the front end of one of the prisms 83A - 83E so that the light emitters 8A - 8E can be positioned as desired. This makes the LED display compact and low-cost.

[0077] As described above, each of the light emitters includes an LED, a convex lens, and a prism. The convex lens focuses the center light flux emitted from the light source of the LED within the specified angular range. The prism projects toward the front panel the light radiated from the light source laterally outside the angular range. This makes it possible to increase the front brightness and condense the laterally radiated light, so that the LED display is fine in front view. The light emitters are arrayed. The convex lenses of the emitters and annular guides are molded integrally with the front panel, so that the LED display can make easily recognizable displays.

[0078] The receiving surface of the solar panel can incline around the horizontal shaft. The solar panel is supported by the display panel, which can turn around the horizontal pin. The pin is perpendicular to the shaft. This makes it easy to orient the receiving surface toward the sun, so that the efficiency of power generation of the solar panel can be maintained. Accordingly, it is possible to fix the receiving surface in the direction optimum for the place and direction in which the solar warning light is set. This makes it possible to set the solar warning light in any place. It is possible to make easily recognizable displays by controlling the manner in which and the timing at which the light emitters flash, emit light, and scroll.

[0079] The nickel-hydrogen battery is so large in capacity that the solar warning light enables long-time displays. The solar panel can either supply power directly to the display panel or charge the battery. This enables displays for a longer time.

[0080] Therefore, the solar warning light may be used anytime and anywhere as a marker light and can be applied suitably as a traffic or safety sign.

[0081] As stated above, the solar warning light can maintain an efficiency of solar power generation, enables long-time displays by lengthening the life of the battery, and also enables more easily recognizable displays.

FIG. 3

SOLAR WARNING LIGHT SYSTEM BLOCK DIAGRAM
1

[0082]

4: SOLAR PANEL

5: (NICKEL-HYDROGEN) BATTERY

6: DISPLAY CONTROL

7: MEMORY

30: LED DISPLAY

51: ON-OFF SWITCH

52: LIGHTING PATTERN CHANGE-OVER SWITCH

53: LIGHTING TIME ZONE CHANGE-OVER SWITCH

54: CHARGING CONTROL

55: VOLTAGE DETECTOR

56: POWER SUPPLY MONITOR LAMP

FIG. 4

SOLAR WARNING LIGHT SYSTEM BLOCK DIAGRAM
2

[0083]

4: SOLAR PANEL

5: (NICKEL-HYDROGEN) BATTERY

6: DISPLAY CONTROL

7: MEMORY

30: LED DISPLAY

51: ON-OFF SWITCH

52: LIGHTING PATTERN CHANGE-OVER SWITCH

53: LIGHTING TIME ZONE CHANGE-OVER SWITCH

54: CHARGING CONTROL

55: POWER SUPPLY DETECTOR

56: POWER SUPPLY MONITOR LAMP

Claims

1. A solar warning light comprising:

- a stand;
- a display panel supported by an upper portion of the stand;
- the display panel including an LED display positioned on the front side thereof, the LED display including an array of light emitters;
- a display control fitted in the display panel for so controlling the light emission from the light emitters as to display a specified emission pattern;
- a memory fitted in the display panel for storing display patterns;
- a horizontal shaft fitted to the top of the display panel;
- the horizontal shaft extending in parallel to the display panel;
- a solar panel supported by the horizontal shaft tiltably therearound;
- the solar panel having a receiving surface; and

- a battery.
2. A solar warning light as claimed in claim 1, further comprising:
- a horizontal pin fitted to the upper portion of the stand;
- wherein the center of the display panel is supported rotatably by the horizontal pin so that the display panel can turn within a first angular range around the pin.
3. A solar warning light as claimed in claim 2, wherein the display panel further includes:
- a banded outer frame;
- a center frame; and
- a plurality of banded connecting frames connecting the outer and center frames;
- the horizontal pin being fitted to the center frame;
- the light emitters being arrayed on the outer and connecting frames.
4. A solar warning light as claimed in claim 3, wherein the light emitters are so controlled as to flash simultaneously or sequentially, or to emit light sequentially in a stream.
5. A solar warning light as claimed in claim 4, wherein each of the light emitters includes:
- an LED having a light source;
- a convex lens for focusing the center light flux emitted by the LED within a second angular range from the light source; and
- a prism for defining the view angle of the light emitted by the LED outside the second angular range.
6. A solar warning light as claimed in claim 5, wherein the LED display further includes an optically transparent front panel, and wherein the convex lens is molded integrally on at least one side of the front panel.
7. A solar warning light as claimed in claim 5 or 6, wherein the prism is tubular and has:
- a front end face in contact with the front panel;
- a first inner cylindrical surface closely surrounding the LED;
- a second inner cylindrical surface extending along the edge of the convex lens;
- the second inner cylindrical surface being larger in diameter than the first inner cylindrical surface;
- an inner conical surface connecting the two inner cylindrical surfaces;
- a first outer peripheral surface surrounding the LED;
- a first outer conical surface diverging steeply from the outer peripheral surface;
- a second outer peripheral surface diverging gently from the first outer conical surface; and
- a second outer conical surface diverging from the second outer peripheral surface to the front end face; and
- wherein the prism projects the light incident thereinto to the front end face thereof and the convex lens so as to define the view angle of the light emitted from the LED.
8. A solar warning light as claimed in any one of claims 1 - 7, wherein the battery is fitted to the solar panel.
9. A solar warning light as claimed in claim 3 or 4, wherein the battery is fitted to the center frame.
10. A solar warning light as claimed in any one of claims 3 - 9, wherein the outer frame is a regular octagon consisting of eight frame parts and having a horizontal top, and wherein the connecting frames are eight in number;
- the display control and the memory being fitted to the center frame;
- the first angular range being 90 degrees, 45 degrees on each of the right and left sides;
- the solar panel being supported tiltably by the horizontal top frame part.
11. A solar warning light as claimed in any one of claims 3 - 10, further comprising an on-off switch, a lighting pattern change-over switch, and a lighting time zone change-over switch all fitted on the back side of the center frame.
12. A solar warning light as claimed in any one of claims 3 - 11, wherein the stand includes a foldable tripod and a vertically telescopic strut, and wherein the horizontal pin is fitted to an upper portion of the strut.
13. A solar warning light as claimed in any one of claims 1 - 12, wherein the battery is a nickel-hydrogen battery.

FIG.1

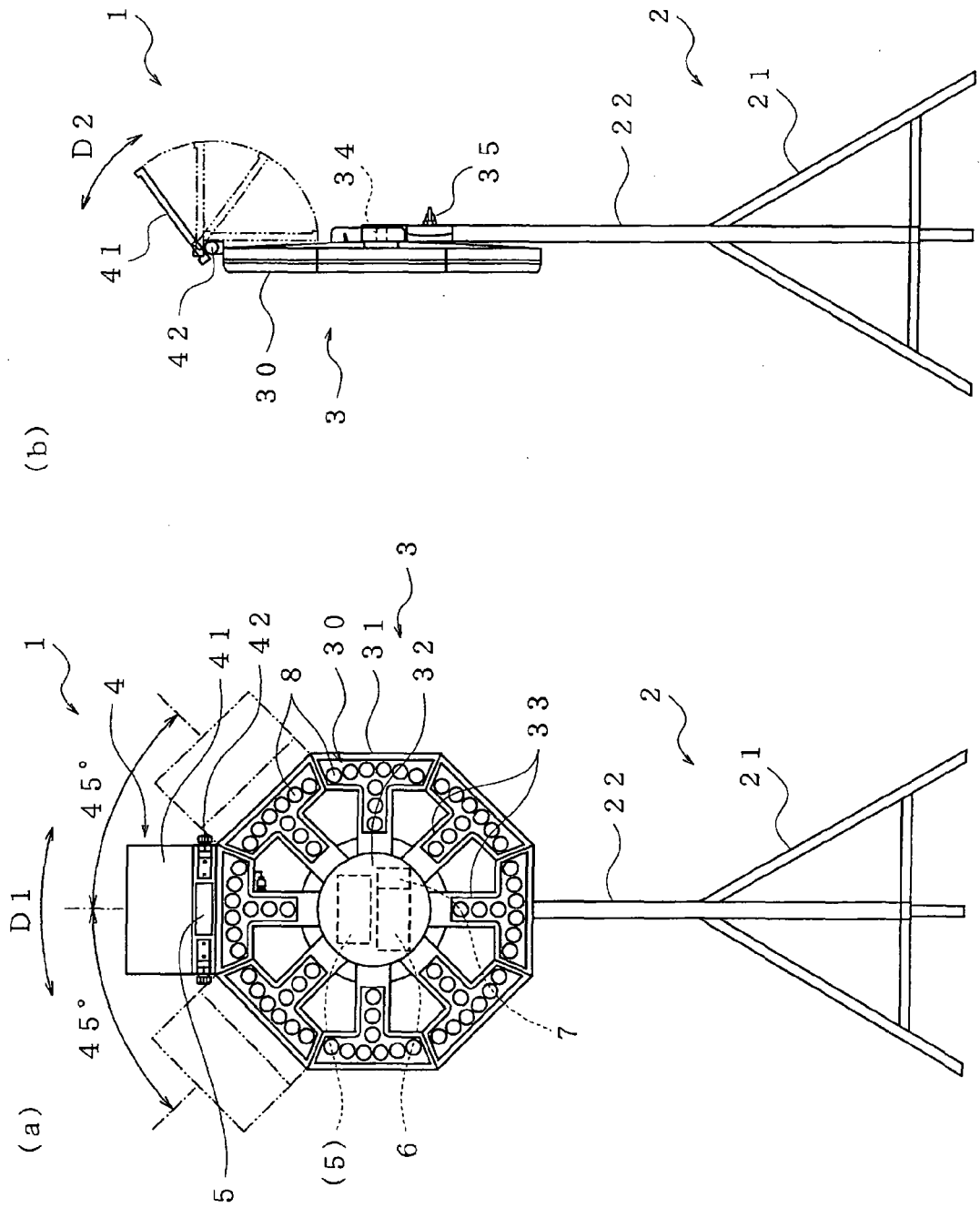


FIG. 2

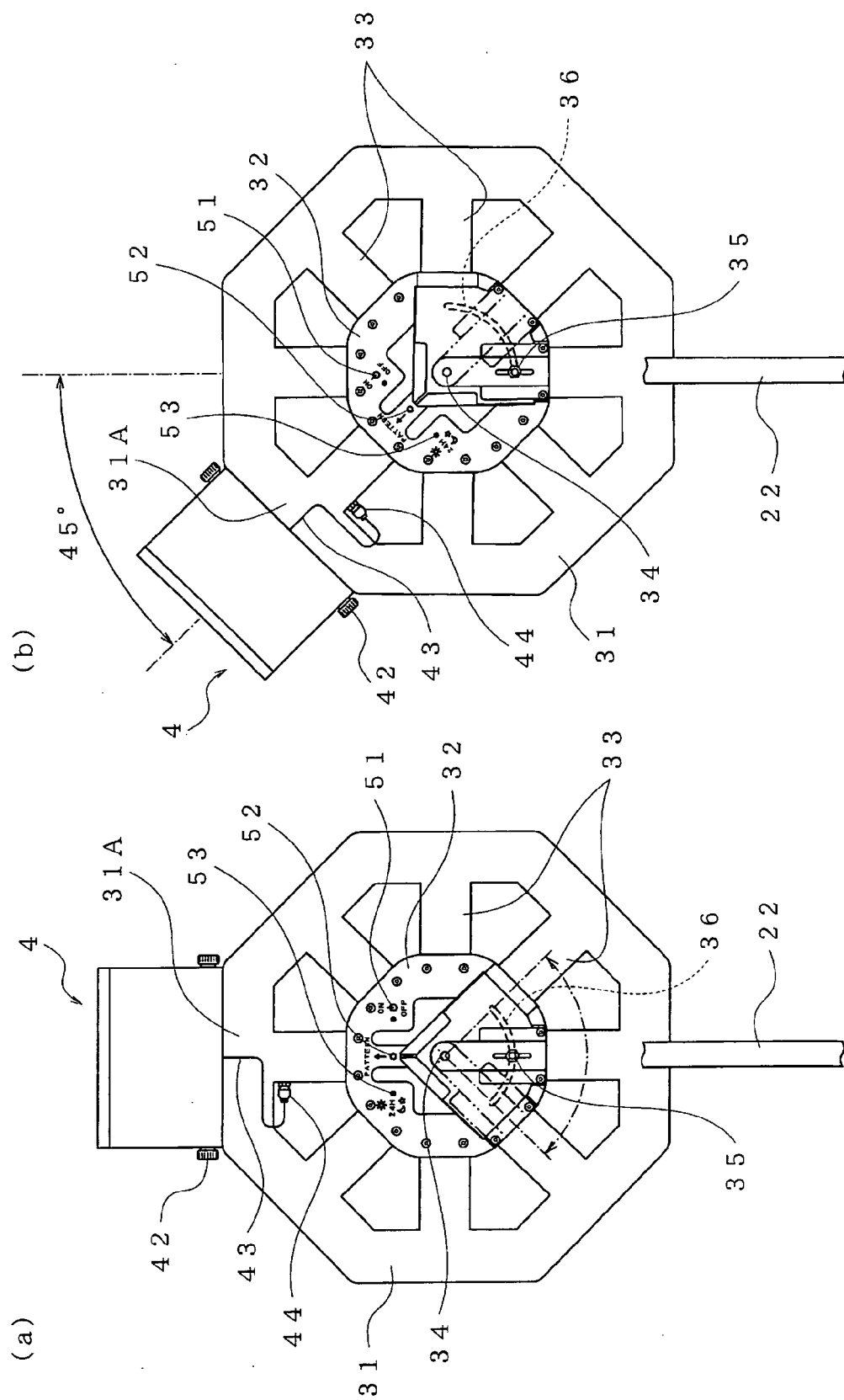


FIG. 3
SOLAR WARNING LIGHT SYSTEM BLOCK DIAGRAM1

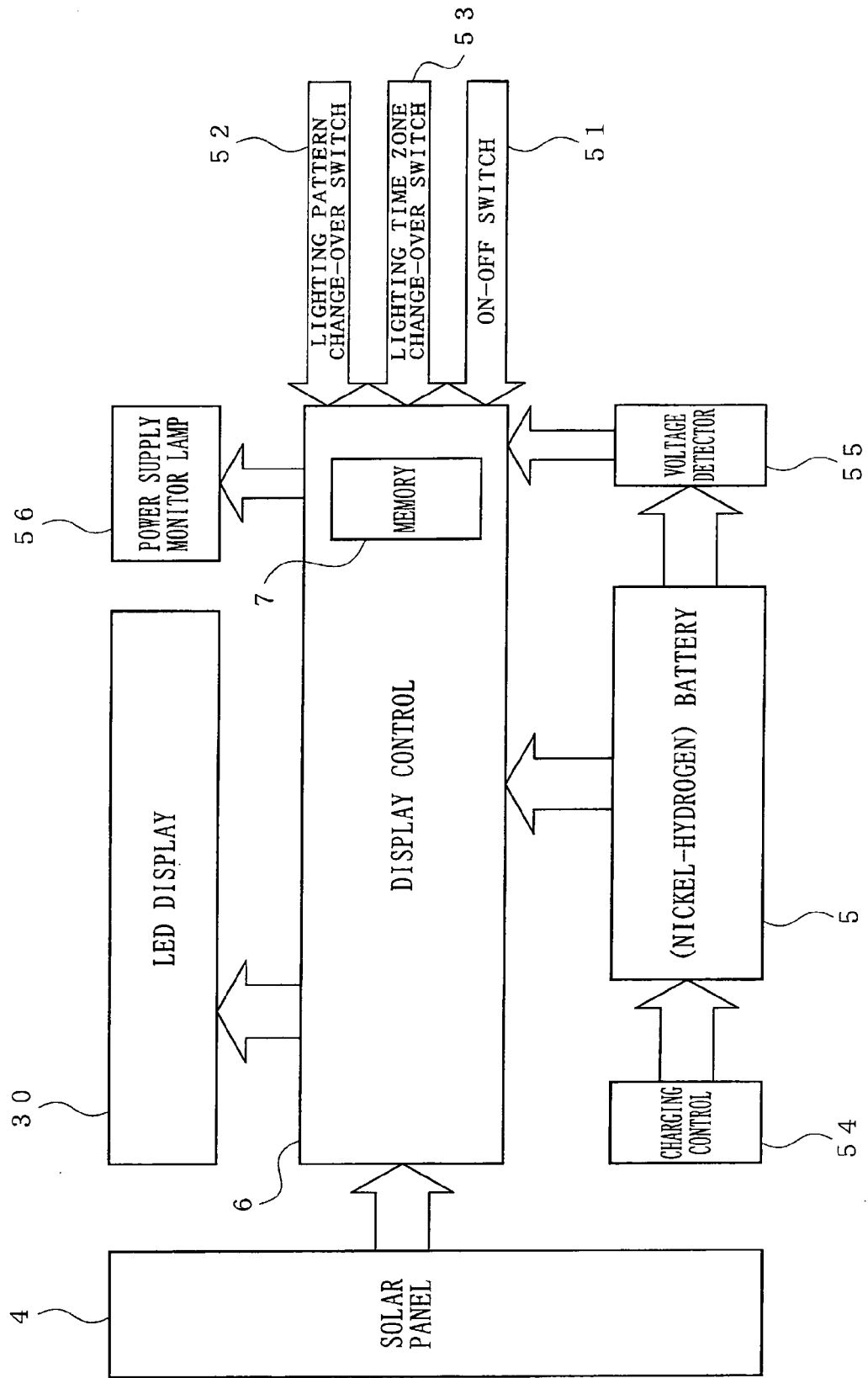


FIG. 4 SOLAR WARNING LIGHT SYSTEM BLOCK DIAGRAM2

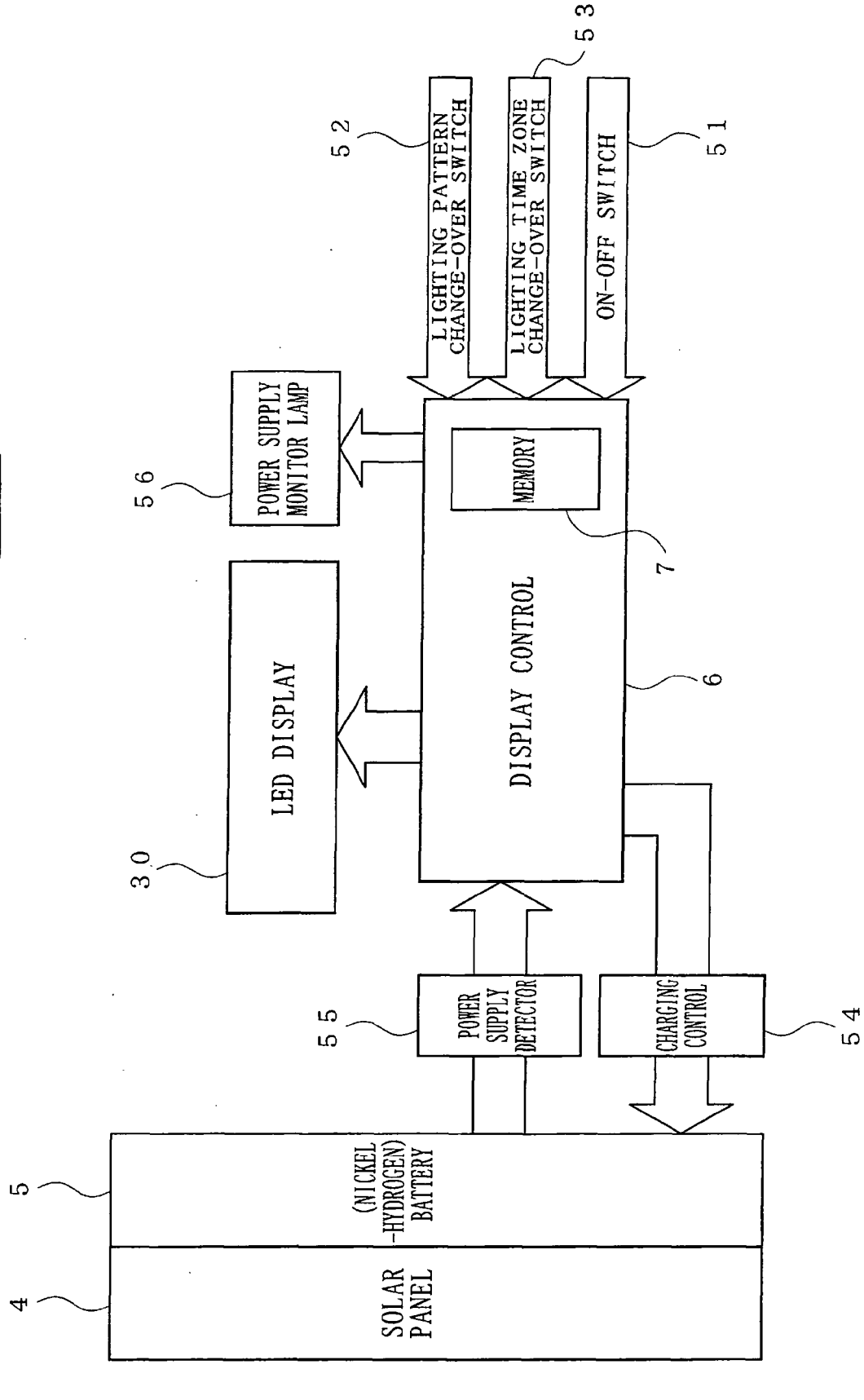
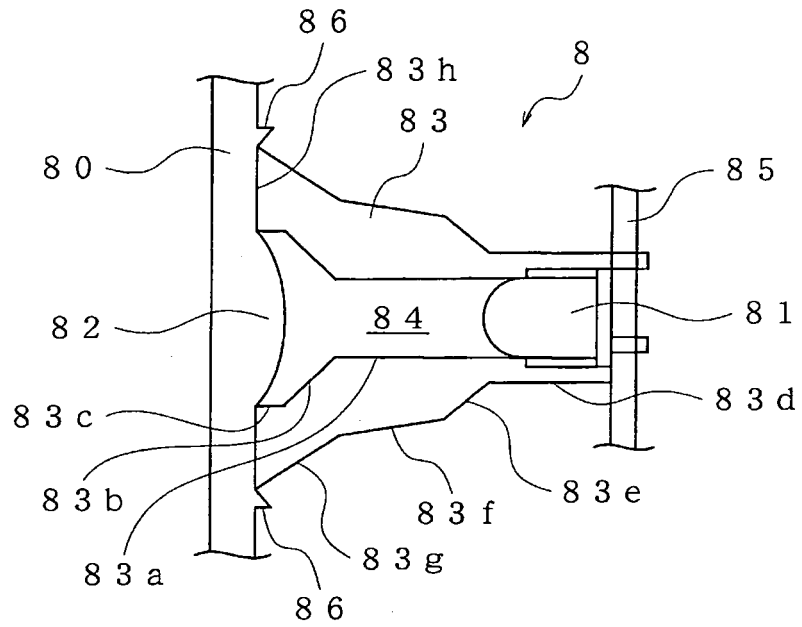


FIG. 5

(a)



(b)

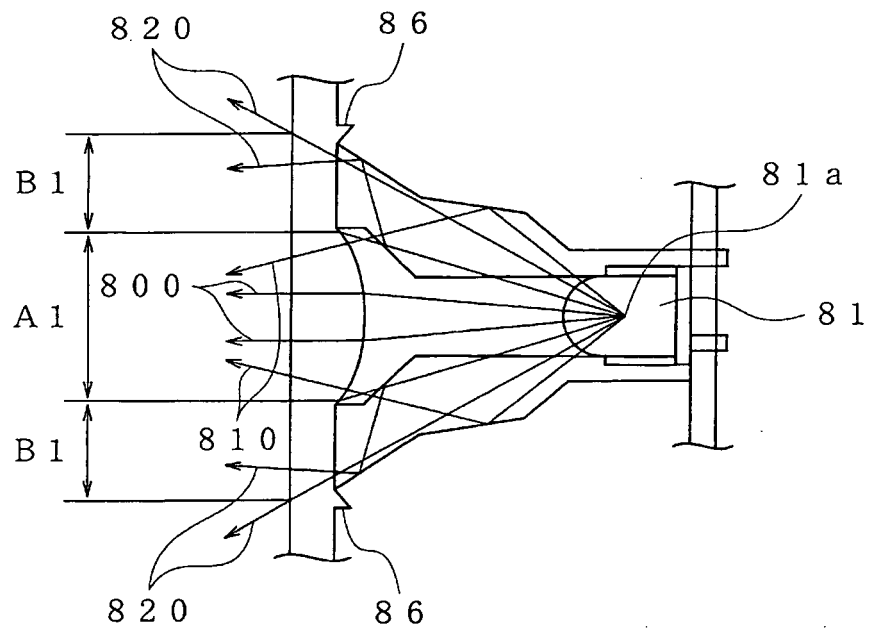
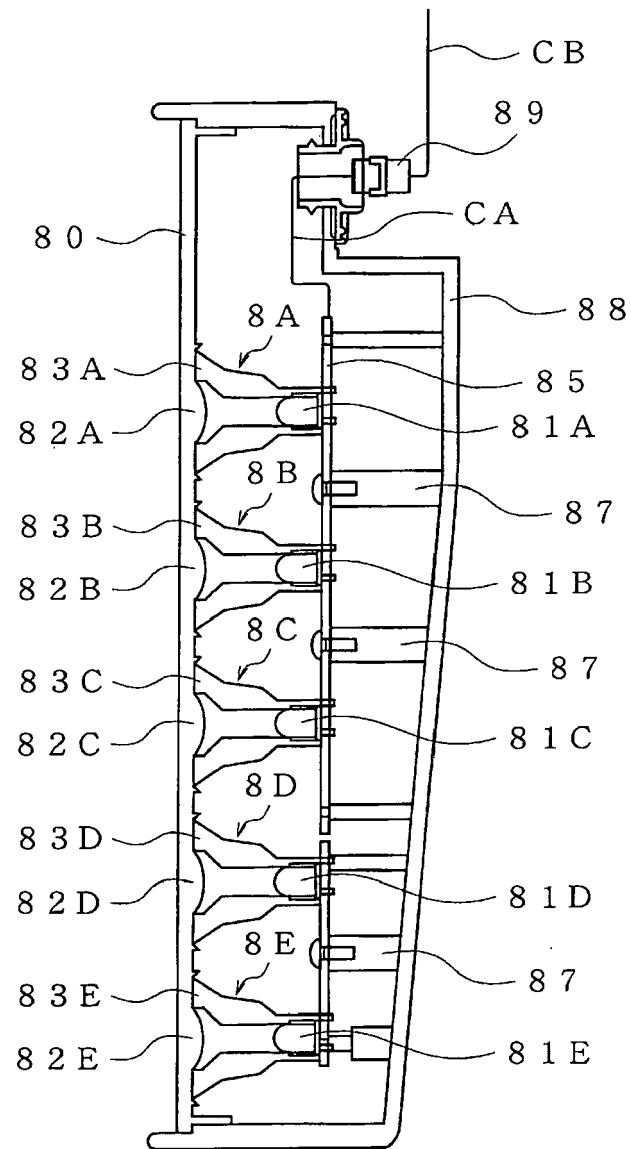


FIG. 6



REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP H9203014 A [0009]