



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
07.09.2016 Bulletin 2016/36

(51) Int Cl.:
A47K 10/24 (2006.01)

(21) Application number: **15157198.1**

(22) Date of filing: **02.03.2015**

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

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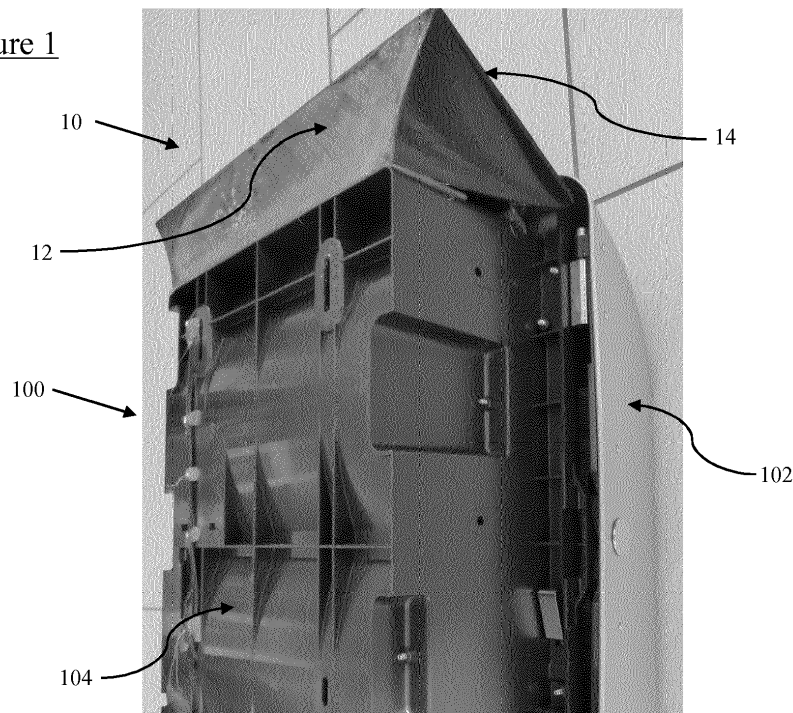
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(54) **A kit for converting a battery-powered automatic towel dispenser to solar power**

(57) A kit 10 for converting a battery-powered automatic towel dispenser of the type described into a solar-powered automatic towel dispenser 100 for use in an indoor lit area, the kit 10 comprising a battery pack 16 for fitting into a battery compartment 26 of the towel dispenser 100, the battery pack 16 including a rechargeable nickel-metal hydride (Ni-MH) low self-discharge (LSD) battery having positive and negative connection areas at

the respective ends for connection with connectors in the battery compartment; at least one tuned amorphous silicon solar panel or at least one dye-sensitised solar cell panel 14, the at least one panel 14 being mounted to a support structure 12; and cable connection means 22, 24 linking the tuned amorphous silicon solar panel or the dye-sensitised solar cell panel 14 to the Ni-MH LSD battery in the battery pack 16.

Figure 1



Description

[0001] The present invention relates to a kit for converting a battery-powered automatic towel dispenser into a solar-powered automatic towel dispenser for use in an indoor lit area.

BACKGROUND TO THE INVENTION

[0002] Automatic towel dispensers are sometimes provided in public washrooms. A dispenser typically includes a proximity sensor, and automatic means for dispensing a measured length of paper towel, which can be torn off or retrieved from the dispenser by a user. Typically, a motor arrangement is activated to dispense towel from its roll. US6412679 and WO2009/082294 both disclose towel dispensers of this type.

[0003] In relation to manually-operated towel dispensers, automatic towel dispensers are hygienic, since they can be operated without touching any part of the towel dispenser, such as a dispensing handle. They also serve to reduce wastage and reduce mess, since they should only dispense a limited length or number of towels sufficient to dry a person's hands. The dispenser may be used to dispense one type of towel in one installation, or another type of towel at another installation- for example, higher quality (thicker) paper towels may be best suited for use in hotels, or lower quality (thinner) towels for public washrooms. A fabric towel may be used instead.

[0004] The disadvantage of an automatic towel dispenser is that it requires electricity to work. Electricity may be supplied from the mains, but this increases the cost of installation significantly as safety regulations generally require a qualified electrician to undertake such work when in a washroom area. More commonly, battery-powered towel dispensers are provided, which are very easy to fit. Typically, a towel dispenser is provided in two parts - a back section which includes a battery holder and an automatic towel dispenser arrangement, and a front cover which fits over the back section, hiding the internal mechanism. To install the dispenser, the back section is screwed to the wall, or attached using any other suitable fixings, batteries and a series of towels are installed, and then the front cover is clipped over to complete the installation.

[0005] Battery-powered towel dispensers are cheap and easy to install. However, the batteries require periodic replacement. Typically, four dry 'C' or 'D' sized cells are used. The cells are to power the dispenser. The cells are replaced by opening or removing the front cover, removing the old cells and replacing with new ones. Depleted batteries should ideally be recycled to recover raw materials, but the cost and inconvenience of doing so often means that they are discarded with general waste, which damages the environment.

[0006] Another problem with battery-powered towel dispensers is that the cells will often deteriorate and leak, particularly since the towel dispensers are often located

in moist environments. Leaking cells can damage the towel dispenser. Having to remove the leaking cells and clean away the leaked electrolyte is an unpleasant and possibly time-consuming job, adding to the on-going running cost of a battery-powered towel dispenser. This problem can be reduced by providing some sort of sealing arrangement to protect the cells from moisture. However, any effective sealing arrangement will either significantly increase the time required to replace the cells, or will increase the cost of replacement cells if they need to be provided in specialist sealed units. The fact that ordinary, commonly available 'C' sized cells may be used in existing towel dispensers is important to some users, since they know that they can rely on a cheap future supply of replacement cells.

[0007] A towel dispenser that comprises a back section and includes a proximity sensor, means for receiving and storing towels, an electrically-operated dispensing means to dispense towels when the proximity sensor is activated, and a battery compartment for receiving and connecting at least one battery to power the dispensing means, and which further comprises a front section for substantially covering the back section, is henceforth referred to as "a towel dispenser of the type described". A towel dispenser of the type described may have a front section which is broader and/or taller than the rear section.

[0008] It is an object of the invention to provide a towel dispenser which reduces or substantially obviates the problems mentioned above.

STATEMENT OF INVENTION

[0009] According to the present invention, there is provided a kit for converting a battery-powered automatic towel dispenser of the type described into a solar-powered automatic towel dispenser for use in an indoor lit area, the kit comprising

a battery pack for fitting into a battery compartment of the towel dispenser, the battery pack including a rechargeable nickel-metal hydride (Ni-MH) low self-discharge (LSD) battery having positive and negative connection areas at the respective ends for connection with connectors in the battery compartment; a support structure for attachment to an upper surface of the back section of the towel dispenser; at least one tuned amorphous silicon solar panel or at least one dye-sensitised solar cell panel, the at least one panel being mounted to the support structure; and cable connection means linking the tuned amorphous silicon solar panel or the dye-sensitised solar cell panel to the Ni-MH LSD battery in the battery pack.

[0010] The kit is highly advantageous because it enables existing towel dispensers to be quickly and easily

upgraded to use a more efficient battery and solar panel(s) in a matter of seconds. The front section of the towel dispenser is opened or removed and the existing cells are taken out of the battery compartment. The battery pack of the kit is then inserted into the battery compartment, the solar panels and support structure secured to the top of the rear section of the towel dispenser (which is attached to the wall), and the front section closed. This then allows the towel dispenser to operate for extended periods without battery maintenance. Locating the support structure and solar panels above the back section of the dispenser provides protection for the panels without increasing the footprint of the dispenser.

[0011] Significantly, the kit harvests light from artificial light sources, which is advantageous in washrooms that are not substantially internally lit by sunlight for much of the day (or at all). The rechargeable nickel-metal hydride (Ni-MH) low self-discharge (LSD) battery does not waste energy powering internal battery functions, further extending the operational lifetime of the dispenser during periods of intense use. Energy is drawn directly from the Ni-MH LSD battery pack on demand, and the user may pass their hand close to the proximity sensor to cause one or more towels to be dispensed for use.

[0012] Tuned amorphous silicon solar (TASS) panels and/or dye sensitised solar cell (DSSC) panels are particularly suitable for use in low-light conditions typically found in toilets and washrooms. They can be designed (i.e. tuned) specifically to operate at high efficiency in a particular spectrum, for example the spectrum emitted by typical fluorescent tubes. The energy absorption capability of TASS or DSSC panels is great enough to allow the appended solar panel(s) and support structure to fit substantially within the existing width and depth of the towel dispenser being upgraded - i.e. bulky protruding solar panel extensions are not required for sufficient power generation. The dispenser can operate indefinitely, without battery replacement, even in low-light conditions or where there is little or no natural light.

[0013] The support structure may have a sloped upper surface. The support structure may be attached behind the front section of the towel dispenser.

[0014] The support structure provides a stable platform for the solar panels, preventing their angle being inadvertently changed. The support structure may be wedge-shaped to achieve this, and its sloped surface angles the solar panels towards a light source to maximise energy harvesting. The support structure is manufactured to support the panels at a specific angle. Locating the support structure and solar panels behind the front section reduces the degree to which the panels protrude into the room, reducing the likelihood of a damaging collision as a person walks by.

[0015] The kit fits onto the back section without significantly protruding from the dispenser as the front section is broader and taller than the back section, as is often the case with towel dispensers of the type described. This provides a stepped area between the front section

and the mounting wall in which the support structure and panels are secured to the top of the back section. In other words, as viewed from the side, the front section is proud of the top of the back section, and the support structure is able to fit onto the back section within the stepped area such that it is not immediately apparent as an extension of the dispenser.

[0016] The total surface area of the solar panel(s) may be around 384 square centimetres. The at least one tuned amorphous silicon solar panel or the at least one dye sensitised solar cell may harvest energy at a rate of substantially 5 microwatts (μ W) per square centimetre under artificial light conditions of substantially 200 lux.

[0017] This is found to provide sufficient power to keep the battery pack charged in most scenarios, and solar panel(s) of this area can be accommodated without extending outside the existing width and depth of the towel dispenser. This means that a large area of light-absorbing surface is available to convert photons to electrical energy, overcoming the challenge of operating in low light conditions produced by ambient room lighting such as fluorescent tubing, for example.

[0018] The advantages of using at least one DSSC panel to charge the battery pack include the ability of DSSCs to function optimally in low-light conditions. They are also capable of efficiently harvesting light entering from a wide ranges of angles, and particularly acute angles, due to high light penetration into the titanium dioxide nanostructure within DSSCs. This makes DSSCs ideal for capturing the diffuse light available indoors. Additionally, as they utilise thin-film technology, they do not require a glass substrate and are consequently more robust and flexible.

[0019] The at least one TASS or DSSC panel and the support structure may be top-mounted on the towel dispenser, and the at least one panel may be disposed at an angle substantially between 60° and horizontal (0°) when the back section of the towel dispenser is mounted to a substantially vertical wall. Preferably, the panels are mounted at an angle of 30° from the horizontal, and more preferably around 20° from the horizontal. In many embodiments, the top surface of the back section is horizontal in use, therefore the panels may be provided at an angle substantially in the range 0-60° relative to the top surface.

[0020] A top-mounted solar panel is advantageous for absorbing light from ceiling-mounted lights, whilst still absorbing an appreciable amount of sunlight from any windows. The top-mounted panel is preferably mounted at an angle to face into the room, towards any ceiling-mounted lights, plus any light reflected from walls and mirrors. Providing the panel at an angle of around 20° is found to be particularly advantageous, bearing in mind that the towel dispenser is likely to be mounted to a wall which is at the edge of a room. Also, if multiple solar panels are used, these can provide some redundancy - the unit will continue functioning even if one of the solar panels develops a defect or is blocked from light.

[0021] A water-resistant barrier may be provided to protect the battery pack from moisture. In one embodiment, a shrink wrap cover is provided to protect the cells of the battery pack, although other types of water-resistant or water-tight barrier may be provided, either integrally or as an additional component which is fitted over the battery compartment once the battery pack has been installed. As the battery pack is constantly recharged and has a long service life, for example around 10 years, the ease of changing the battery is a minimal consideration compared to the disposable dry cells which were used in the original battery-powered towel dispenser. The batteries can therefore be sealed more securely, to prevent moisture from affecting their operation or causing degradation. This protects the battery pack from short-circuits, corrosion and leakage which can all be problems with conventional battery-powered towel dispensers.

[0022] In particular, the battery pack may comprise at least one set of two Ni-MH cells, connected in series. Preferably, two sets of two cells are provided. In one embodiment, a shrink-wrap cover is provided over each set of two cells. The positive cable from the solar panel may be connected to one of the sets of cells and the negative cable from the solar panel may be connected to the other set of cells, so that the cells do not form a circuit with the solar panel when they are disconnected from each other. However, when the cells are inserted into a battery enclosure usually designed for 4 cells, the existing connections are used to form a charging circuit between the solar panels and the cells, and to connect the cells to the towel dispenser to provide it with power.

[0023] One or more Schottky blocking diodes may be provided between the solar panel and the cells. This prevents discharge of the cells through the solar panels in low-light conditions. Schottky blocking diodes are found to be preferable to providing a charge controller in this application, since they are small, simple and cheap. The Schottky blocking diodes use very little energy, enabling close to 100% efficiency in this part of the energy transfer. A conventional charge controller would typically have an efficiency of 80% or lower. This is significant as the amount of energy generated by the solar panel(s) is relatively low, and space is at a premium on the top of the towel dispenser. Using blocking diodes instead of an electronic charge controller allows a towel dispenser to be modified without adding particularly bulky extensions.

[0024] A towel dispenser being retro-fitted with the kit described above may include means for receiving and storing towels, a towel dispensing mechanism powered by the battery pack, at least one indicator lamp that illuminates to convey information, and a sensor to control activation of the dispensing mechanism. Preferably, the sensor is a proximity or motion sensor.

[0025] This combination of features allows the dispenser to dispense towels on demand for use in drying the hands of the requesting person. The proximity or motion sensor detects movement of a hand or arm in the region in front of the dispenser, and activates accordingly,

conserving energy by remaining inactive when no activity is detected.

[0026] The towel dispensing mechanism may be activated when the sensor is triggered, dispensing a fixed length of towel per trigger event.

[0027] The on-demand nature of the towel dispensing, and the limited length of towel dispensed, conserves energy and paper towels, maximising the length of time the dispenser can operate between services.

[0028] The towel dispensing mechanism may include at least one motorised reel to expel towel and a serrated portion to facilitate the disengagement of towel from the dispenser.

[0029] The towel can be dispensed from a reel of towel by rotating the reel, or alternatively from another arrangement of towels using a suitable mechanism. The serrated edge allows non-perforated towels to be used as well as towels with periodic perforations as 'tear lines', without leading to additional towel waste. The serrated edge is fixed near the towel dispensing portion of the dispenser, allowing users to manually tear the dispensed portion of towel away.

[0030] The at least one TASS or DSSC panel may be disposed substantially above or behind the sensor, so that the panel(s) will not be showered with droplets of water as users take towels. In most designs of towel dispenser of the type described, towels are dispensed from the bottom of the dispenser in any case.

[0031] The at least one indicator lamp may indicate the energy level remaining in the battery pack or the length of towel remaining, indicating whether there are few or no towels remaining, or whether the battery is approaching depletion.

[0032] The cable connection means between the externally-mounted solar panel(s) and the internally mounted battery pack will preferably fit through existing apertures in the body of the dispenser, so that the operation and maintenance of the towel dispenser (i.e. refilling with towels) is substantially unaffected by conversion to solar operation. However, in some cases the towel dispenser may need to be disassembled or have additional apertures created to facilitate use of the conversion kit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033] For a better understanding of the present invention, and to show more clearly how it may be carried into effect, reference will now be made by way of example only to the accompanying drawings, in which:

Figure 1 shows a rear perspective view of a first embodiment of a kit according to the invention, fitted to a battery-powered automatic towel dispenser of the type described;

Figure 2 shows a side perspective view of the kit and towel dispenser of Figure 1;

Figure 3 shows a front perspective view of the kit and towel dispenser of Figure 1;

Figure 4 shows a base perspective view of the kit and towel dispenser of Figure 1;

Figure 5 shows a perspective view of a battery arrangement, part of the kit of Figure 1; and

Figure 6 shows a plan view of an empty battery compartment from the towel dispenser of Figure 1.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0034] Referring firstly to Figures 1 to 3, a first embodiment of a kit for converting a battery-powered automatic towel dispenser into a solar-powered automatic towel dispenser is indicated generally at 10. The kit 10 has been fitted to a towel dispenser 100. The kit 10 includes a support structure 12 on which top-mounted solar panels 14 are provided (where solar panel may refer to a tuned amorphous silicon solar (TASS) panel in one embodiment, or to a dye-sensitised solar cell (DSSC) panel in another embodiment, or a combination of the two). The support structure is approximately wedge-shaped. The solar panels 14 are disposed at an angle of around 30° at the top of the dispenser 100. The solar panels 14 are rigidly secured to the support structure 12. The solar panels 14 are connected to a battery pack via cable connection means as discussed later with reference to Figures 5 and 6.

[0035] The solar panels 14 are tuned amorphous silicon solar panels, of a type designed to work at high efficiency specifically with artificial light sources. The towel dispenser 100 has a very low quiescent power consumption, and draws energy mainly upon actuation, i.e. every time the towel dispenser 100 is triggered to dispense towels. The battery is charged from the solar panels 14 continually, when the local area is sufficiently illuminated. Equally, the solar panels 14 could be dye-sensitised solar cell (DSSC) panels, which, although more expensive, are also efficient at harvesting electrical energy from artificial light, and flexible enough to fit to a range of surface contours. Schottky diodes (not shown) are provided to prevent current from flowing back from the rechargeable cell to the solar panels 14 in dark conditions.

[0036] The dispenser 100 has a front section 102 and a back section 104, the back section 104 being mounted to a wall when the dispenser 100 is installed. The support structure 12 is fixed to an upper surface of the back section 104. The front section 102 is a door covering the back section 104, and is hinged to the back at one side. In use, the front face of the front section 102 faces away from the wall. When secured to the upper surface of the back section 104, the support structure 12 and panels 14 are inherently set back from the front section 102. The recessed nature of the back section 104 relative to the front is clear in Figures 1 to 3. In particular, the back

section 104 is not visible in Figure 3 due to the perspective and the solar panels 14 appear to emerge upwardly and rearwardly from the front section 102, which is an aesthetically pleasing arrangement, and also prevents the panels from protruding excessively, which might increase the likelihood of damage.

[0037] A towel exit 106 is disposed along the lowermost front edge of the dispenser 100. Above the towel exit 106 is a window 108 in the front section 102. The window 108 is approximately semi-circular in shape. The window has symbols on its surface to represent the battery level and length of towel remaining. Indicator lamps 110 are provided behind these symbols to illuminate them when threshold values for battery level or length of towel remaining are reached. A proximity sensor (not shown) is also provided behind the same window 108. As the window 108 is transparent or translucent, the sensor is able to detect nearby motion of a user, and provides input to an electronic controller (not shown) within the dispenser 100 when an object is detected in proximity.

[0038] The lamps 110 indicate the battery level of the dispenser 100, and the length of towel remaining in the device. This may be a simple 'low level' indicator, or may be a more sophisticated numerical indication. Another lamp may indicate that a towel is being dispensed, or that an error has occurred internally, perhaps due to a towel becoming jammed or the device running out of towels.

[0039] As seen in Figure 4, the towel exit 106 has a raised outer lip 112, and a serrated edge 114a of a paper towel 114 is visible inside the exit 106. The edge 114a as viewed has been pulled down to lie slightly over a metal serrated edge (not directly visible) that lies along the line indicated by 116, i.e. lying behind the paper towel 114. The metal edge allows a user cut the towel free by pulling a dispensed length of towel across the edge at an angle.

[0040] Contained within the front section 102, and not shown in the Figures, are a controller and a motorised towel dispensing mechanism. The controller is adapted to activate the dispensing mechanism on demand when triggered by the sensor, i.e. when a user waves their hand in front of the device. When the dispenser is installed, towels are mounted within the body of the dispenser 100, and positioned so that the towels may be mechanically dispensed out of the towel exit 106. The body of the dispenser 100 also includes a rechargeable cell (not shown), which powers the dispenser 100 and is charged by the solar panels 14.

[0041] The kit is advantageous because it is quick and easy to install, and reduces the maintenance requirements for a towel dispenser. Existing towel dispensers can be retro-fitted with the kit, avoiding the need to manufacture and install new towel dispensers to replace otherwise functional dispensers, preventing unnecessary waste. It also makes the operation of the towel dispenser more environmentally friendly by allowing it to run solely using solar power, and the panels are positioned atop the device to maximise exposure to ceiling lights in a

washroom. Placing the panels high on the device also protects them from unintentional damage.

[0042] The converted towel dispenser is advantageous because it needs very infrequent maintenance. Typically, the rechargeable cell will not need changing for five to ten years. It is estimated that, over twenty years, the solar panel will lose less than 20% efficiency. The position and type of the solar panels 14 ensure that maximum energy is harvested, even from low-level artificial light.

[0043] Figure 5 shows a battery pack, indicated generally at 16, which forms part of the kit. The battery pack 16 includes two sets of two 'D' sized rechargeable cells 18, 20. Each set of cells is shrink-wrapped to protect them from moisture, and to hold the two cells of the set together to form one 'long cell'. The cells in the set are attached to each other in series, i.e. the negative terminal of one cell is connected to the positive terminal of the other cell.

[0044] A first cable 22 is attached to the negative end of the first cell set 18, and another cable 24 is attached to the positive end of the second cell set 20. These cables then connect to the solar panels 14 (not visible in Figure 5). Figure 6 shows a battery compartment 26 which is part of the towel dispenser and used to house the battery pack 16 of Figure 5. It is designed for four 'D' cells, but the two 'long cells' of the kit 10 also fit. It will be appreciated that battery compartments of alternative shapes and sizes may be present in different towel dispensers, and that the battery pack may vary in shape and size to fit within a different such battery compartment of complementary shape and size.

[0045] The towel dispenser is typically attached to a wall in a washroom and located to optimise the current generated by incident light on the solar panel (although the wall chosen for mounting the device will have some bearing on the available luminous flux density). The unit is then relatively autonomous, with towel being dispensed on demand, and maintenance only needed to replenish the supply of towels.

[0046] To upgrade the towel dispenser using the kit, the front section 102 is opened by unlocking and swinging it away from the back section 104 of the dispenser 100. If towels are currently installed, they may need to be temporarily removed to access to the battery compartment 26. Then, the battery pack 16 is installed in the battery compartment 26 by installing each 'long cell' 18, 20 into a respective side of the battery compartment.

[0047] The internal connections in the battery compartment 26 join the two 'long cells' together in series, and connect the positive and negative terminals of the four-cell battery to the towel dispenser 100, for powering the proximity sensor, dispensing means (not shown), and any other electrically-powered features. The cable connection means 22, 24 which lead to the solar panels are guided into the body of the dispenser 100, and aligned to avoid damage when the front section 102 is re-attached. The towels can then be re-installed, and the door closed. The converted towel dispenser 100 is then ready

for use. The whole process can be completed in a matter of seconds, streamlining the upgrade process and enabling the towel dispenser 100 to function more effectively.

[0048] In typical light conditions found in washrooms, the towel dispenser may be expected to operate for around 10 years without requiring any battery maintenance. Conversion of an existing battery-operated towel dispenser may be carried out in-situ, with minimal effort. The converted towel dispenser is more reliable, because the batteries are unlikely to fail. The risk of battery leakage is also significantly reduced, since each 'long cell' is substantially sealed in shrink wrap. As access to the battery compartment is generally not required once the towel dispenser has been converted, extra seals may be included over the battery compartment as part of the conversion process, further reducing the possibility that moisture will damage the batteries.

[0049] It will be appreciated that kits according to the invention can be made which are suitable for different models of towel dispensers of the type described. The type of towel dispensing means and towel storage means may be different in different devices. However, a wide range of towel dispensers are available which comprise a back section including a proximity sensor, means for receiving towels, electrically-operated dispensing means to expel towels when the proximity sensor is activated, and a battery compartment for receiving and connecting at least one cell to power the dispensing means, and which further comprise a front section for substantially covering the back section. Many different towel dispensers of this type may be upgraded with a suitable kit according to the invention.

[0050] The embodiments described above are provided by way of example only, and various changes and modifications will be apparent to persons skilled in the art without departing from the scope of the present invention as defined by the appended claims.

40 Claims

1. A kit for converting a battery-powered automatic towel dispenser of the type described into a solar-powered automatic towel dispenser for use in an indoor lit area, the kit comprising
 - a battery pack for fitting into a battery compartment of the towel dispenser, the battery pack including a rechargeable nickel-metal hydride (Ni-MH) low self-discharge (LSD) battery having positive and negative connection areas at the respective ends for connection with connectors in the battery compartment;
 - a support structure for attachment to an upper surface of the back section of the towel dispenser, at least one tuned amorphous silicon solar panel or at least one dye-sensitised solar cell panel, the at least one panel being mounted to the support structure; and
 - a cable connection means linking the at least one

tuned amorphous silicon solar panel or the at least one dye-sensitised solar cell panel to the Ni-MH LSD battery in the battery pack.

2. A kit as claimed in claim 1, in which the support structure has a sloped upper surface. 5
3. A kit as claimed in claim 1 or 2, in which the support structure is attached behind the front section of the towel dispenser. 10
4. A kit as claimed in any of claims 1 to 3, in which the total surface area of the at least one tuned amorphous silicon solar panel or the at least one dye sensitised solar cell panel is substantially 384 square centimetres. 15
5. A kit as claimed in any of claims 1 to 4, in which the at least one tuned amorphous silicon solar panel or the at least one dye sensitised solar cell panel harvests energy at a rate of substantially $5\mu\text{ W}$ per square centimetre under artificial light conditions of substantially 200 Lux. 20
6. A kit as claimed in any of claims 1 to 5, in which the at least one panel and the support structure are top-mounted, the at least one panel being disposed at an angle substantially between 60° and horizontal when the back section of the towel dispenser is mounted to a substantially vertical wall. 25
30
7. A kit as claimed in any preceding claim, in which a watertight seal protects the battery pack from moisture. 35
8. A kit as claimed in any preceding claim fitted to a battery-powered towel dispenser, in which the towel dispenser includes means for receiving and storing towels, a towel dispensing mechanism powered by the battery pack, at least one indicator lamp that illuminates to convey information, and a sensor to control activation of the dispensing mechanism. 40
9. A kit as claimed in claim 8, in which the sensor is a proximity or motion sensor. 45
10. A kit as claimed in claim 8 or 9, in which the towel dispensing mechanism is activated when the sensor is triggered, dispensing a fixed length of towel per trigger event. 50
11. A kit as claimed in any of claims 8 to 10, in which the towel dispensing mechanism includes at least one motorised reel to expel towel and a serrated portion to facilitate the disengagement of towel from the dispenser. 55
12. A kit as claimed in any of claims 8 to 11, in which the

at least one panel is disposed substantially above or behind the sensor.

13. A kit as claimed in any of claims 8 to 12, in which the at least one indicator lamp indicates the energy level remaining in the battery pack or the length of towel remaining.
14. A kit substantially as described herein, with reference to and as illustrated in Figures 1 to 6 of the accompanying drawings.

Figure 1

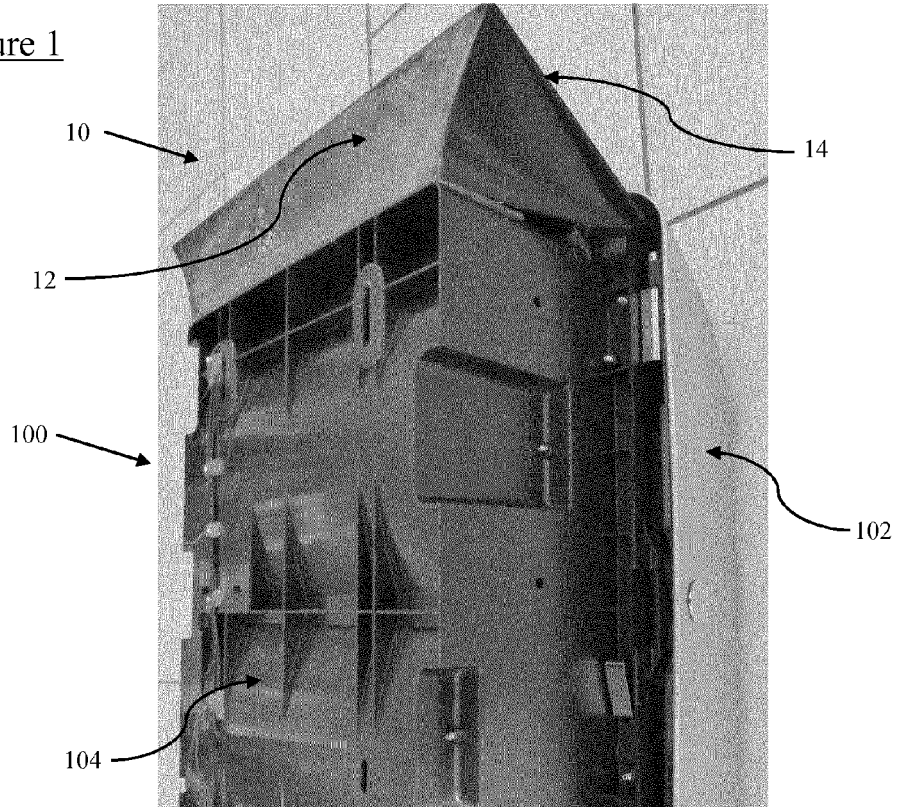


Figure 2

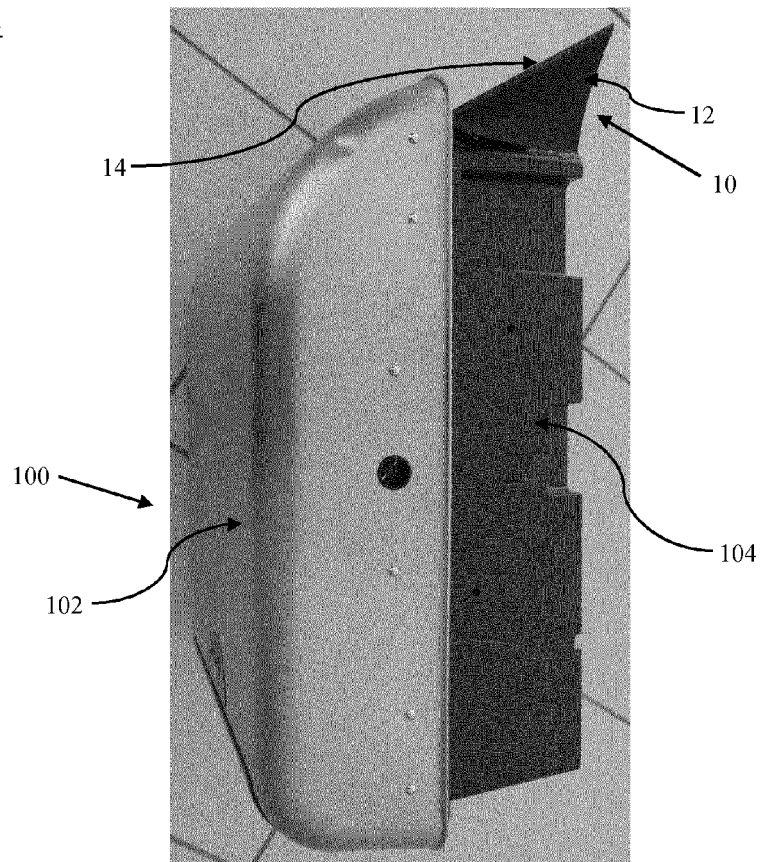


Figure 3

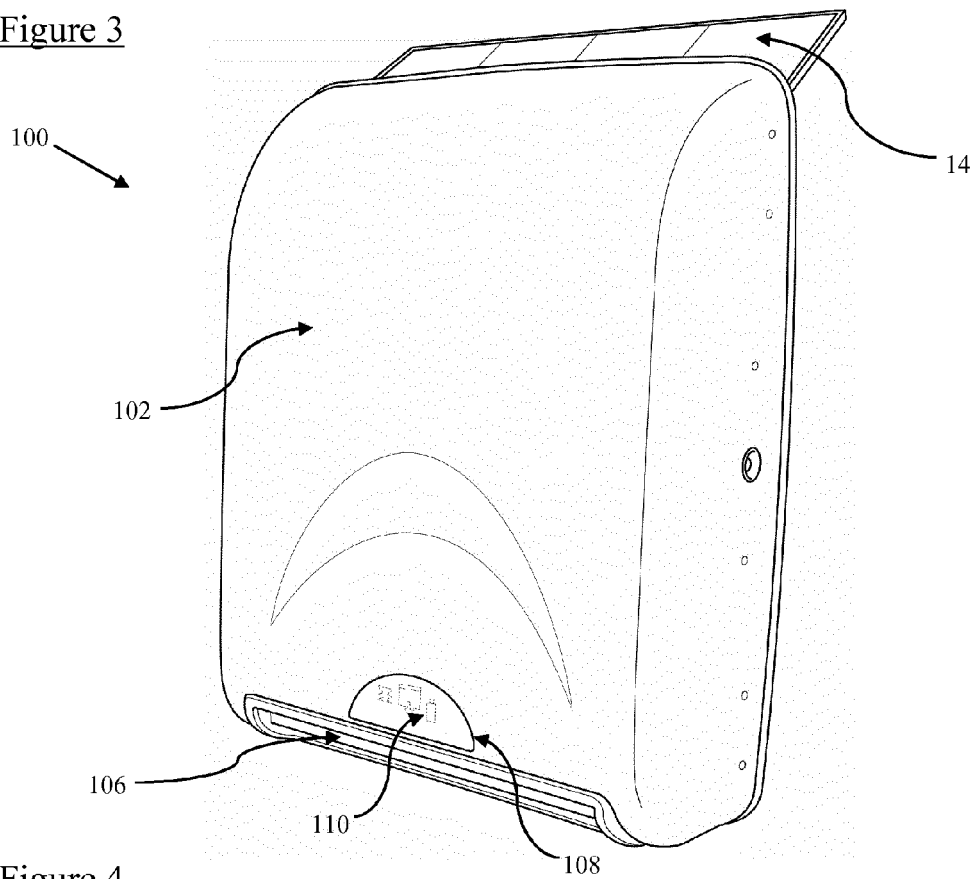


Figure 4

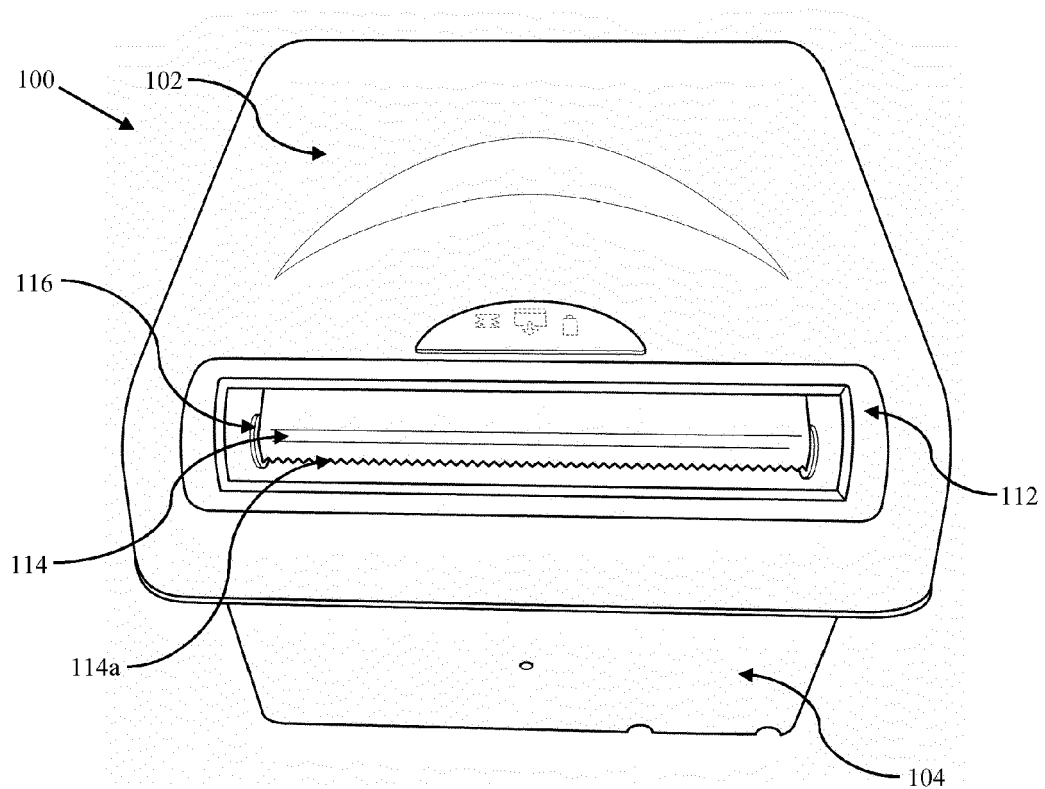


Figure 5

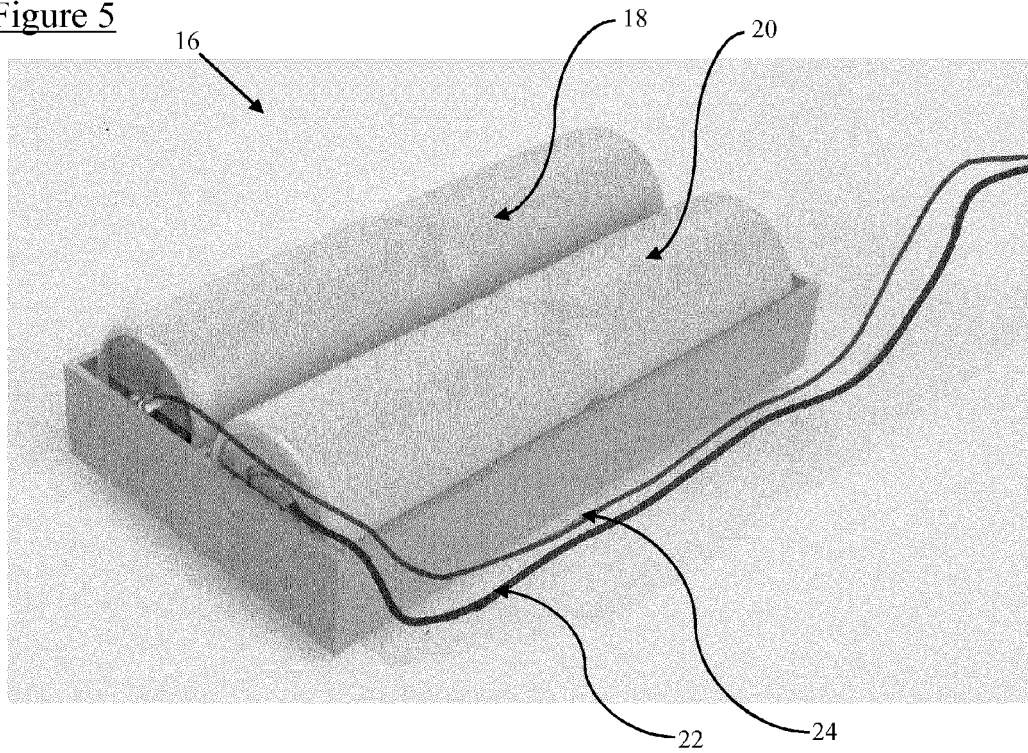
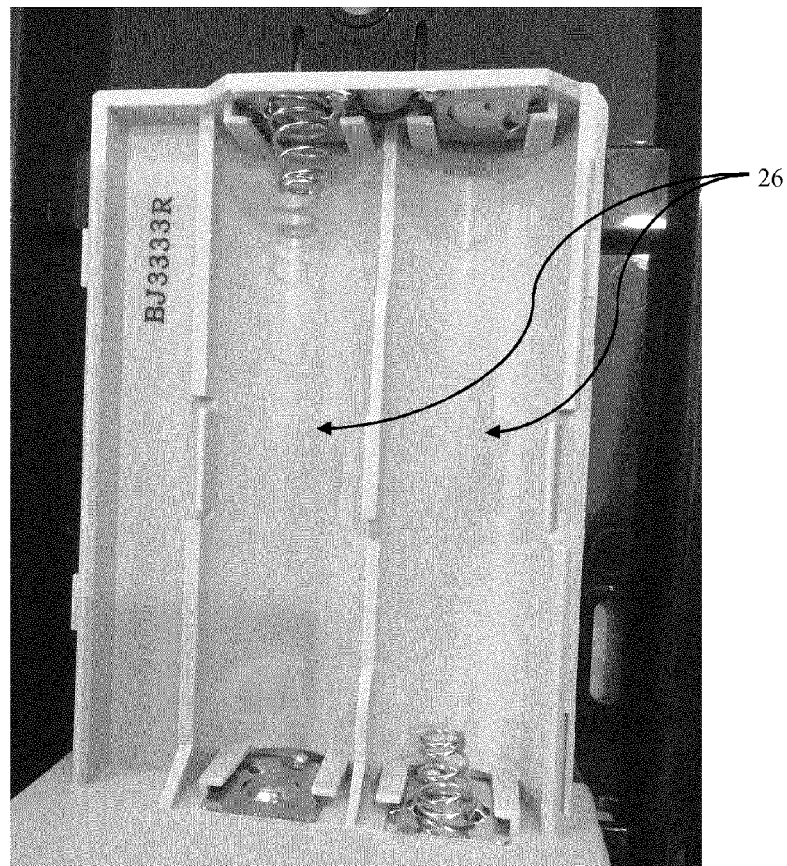


Figure 6





EUROPEAN SEARCH REPORT

Application Number
EP 15 15 7198

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	WO 97/29671 A1 (MOSINEE PAPER CORP [US]) 21 August 1997 (1997-08-21) * page 6, line 17 - page 11, line 11; figures 1-4 *	1-14	INV. A47K10/24
E	WO 2015/028816 A1 (BLICK VIVIAN [GB]) 5 March 2015 (2015-03-05) * page 2, line 17 - page 12, line 4; figures *	1-14	
			TECHNICAL FIELDS SEARCHED (IPC)
			A47K B65D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 21 August 2015	Examiner van de Beek-Duijker
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 15 15 7198

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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21-08-2015

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9729671 A1	21-08-1997	AU 720835 B2	15-06-2000
		AU 2273897 A	02-09-1997
		CA 2246357 A1	21-08-1997
		DE 69731188 D1	18-11-2004
		DE 69731188 T2	24-11-2005
		DE 69733851 D1	01-09-2005
		DE 69733851 T2	20-04-2006
		DE 69733977 D1	15-09-2005
		DE 69733977 T2	01-06-2006
		EP 0880331 A1	02-12-1998
		EP 1386572 A2	04-02-2004
		EP 1405590 A1	07-04-2004
		ID 15943 A	21-08-1997
		NZ 331912 A	28-01-2000
		US 5772291 A	30-06-1998
		US 6105898 A	22-08-2000
		US 2009026305 A1	29-01-2009
		US 2009272836 A1	05-11-2009
		WO 9729671 A1	21-08-1997
WO 2015028816 A1	05-03-2015	GB 2515354 A	24-12-2014
		GB 2517821 A	04-03-2015
		WO 2015028816 A1	05-03-2015

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 6412679 B [0002]
- WO 2009082294 A [0002]