A BATTERY DISPOSAL UNIT

The present invention concerns battery disposal. More particularly, but not exclusively, the invention concerns the provision of a battery disposal unit in which exhausted batteries may be stored. The battery disposal unit comprises a battery testing device and a battery storage container. The battery testing device is at least partially integrated with the battery storage container.
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Many modern devices are battery powered. While in some cases rechargeable batteries are used, single use batteries are still common. Careless disposal of batteries in general waste can cause environmental problems as the batteries can contaminate land-fill areas. Additionally, governments are increasingly introducing legislation concerning the disposal of waste, including disposal of batteries. For example, the European Batteries and Accumulators Directive 2006 will mean that retailers will have to provide battery recycling facilities if they sell over a certain amount of portable batteries. At present, there is no easy way for a consumer to check whether or not a battery is ready for disposal along with an easy disposal method for exhausted batteries. It is common for many consumers to have a number of batteries stored at home, some of which may be exhausted and some of which may still include a usable quantity of charge. As well as disposal of exhausted batteries it is desirable not to dispose of usable batteries.

The present invention seeks to mitigate the above-mentioned problems.
The present invention provides a battery disposal unit comprising: a battery testing device, and a battery storage container, wherein the battery testing device is at least partially integrated with the battery storage container.

Advantageously, a user may test a battery with the battery testing device, and if the battery is exhausted place it for disposal in the battery storage container. The battery disposal unit may be suitable for individual consumer use. For example, the battery disposal unit may be sized such that it may be stored in a consumer's home.

Alternatively, the battery disposal unit may be sized such that it is suitable for public use. For example, the battery disposal unit may be located at a public location such as a post office, supermarket, or council property. At least partially integrating the battery testing device with the battery storage container may increase the convenience and ease of use of the battery disposal device. The partial integration may be such that the external surface of the battery testing device sits approximately flush with the external surface of the battery storage container.

The battery testing device may be arranged such that it is possible to test batteries of a plurality of different sizes. The battery testing device may be arranged such that it is possible to test some or all of the following battery sizes, AA, AAA, AAAA, C, D, PP3 (9 Volt) and button/watch batteries. The battery testing device may be arranged such that it is possible to test batteries of a plurality of different chemistries. The battery testing device may be arranged such that it is possible to test some or all of the following battery chemistries, Alkaline, Nickel Cadmium, Nickel Metal Hydride and Lithium.
The battery testing device may be so shaped and arranged that a user is required to hold a battery up to the battery testing device in order that the battery is tested. Preferably, the battery testing device is shaped such that a user is required to actively secure the battery in the battery testing device. Advantageously, this may prevent batteries from becoming stuck in the battery testing device. Additionally, this may provide the advantage of preventing the battery testing device becoming overloaded by the accidental testing of more than one battery at a time.

Preferably, the battery testing device comprises a printed circuit board assembly. The battery testing device may comprise a battery condition indicator. The battery condition indicator may comprise at least three indicators including, "fully charged", "low charge", and "no charge". The battery condition indicator may include more than three indicators in order to increase the accuracy of the indication of the battery condition. Alternatively, a simplified version of the battery testing device may include only one or two condition indicators. The condition of the battery indicated may depend on the level of voltage measured by the battery testing device. Alternatively or additionally, the battery testing device may measure the impedance or resistance of a battery being tested. The battery condition indicator may indicate the condition of the battery in dependence on where in a range of predetermined values the measured values of voltage, impedance or resistance lie. Preferably, the battery condition indicator provides a visual or aural indication of the condition of the battery. The battery condition indicator may include three LEDs corresponding to at least
three battery conditions. The three LEDs may be red, amber and green. The battery condition indicator may comprise a speaker arranged to emit beeps in order to indicate the condition of a battery being tested.

The battery testing device may be powered at least partially by the battery under test. The battery testing device may be wholly powered by the battery under test. Advantageously, there is no need for such a battery testing device to include a power supply in addition to the battery being tested. Such a feature simplifies the battery testing device as there is no need to monitor the battery testing device and change the battery when it is low. Also, as one aim of the battery disposal unit is to promote safe disposal and recycling of batteries and to be environmentally friendly, it is preferred that it does not use an additional battery.

The battery storage container may include a lid. The lid may be screw fit, snap fit or push fit. Preferably, the lid is arranged to be removable to allow easy emptying of the battery storage container. The lid may include an aperture through which batteries may be passed. The lid may include a security seal to prevent tampering with the contents of the battery storage container.

The invention also provides a method of sorting batteries suitable for disposal using a battery disposal unit comprising a battery testing device arranged to receive a test battery, the battery testing device integrated with a battery storage container, the method comprising the following steps:

inserting a battery for test into the battery testing device, and
if the battery testing device indicates that the battery is suitable for disposal, placing the battery into the battery storage container.

It will of course be appreciated that features described in relation to one aspect of the present invention may be incorporated into other aspects of the present invention. For example, the method of the invention may incorporate any of the features described with reference to the apparatus of the invention and vice versa.

Description of the Drawings

Embodiments of the present invention will now be described by way of example only with reference to the accompanying schematic drawings of which:

Figure 1 shows a perspective view of a battery disposal unit according to a first embodiment of the invention;

Figure 2 shows a front view of a battery disposal unit according to the first embodiment of the invention;

Figure 3 shows a side view of the battery disposal unit according to the first embodiment of the invention; and

Figure 4 shows a circuit diagram of an example battery testing device which may form part of the first embodiment of the invention.

Detailed Description
Figures 1 to 3 show alternative views of a battery disposal unit 2 according to a first embodiment of the invention. The battery disposal unit 2 comprises a cylindrical battery storage container 4 and a battery testing unit 6 that is integrated into part of the sidewall of the battery storage container 4. The battery storage container 4 includes a screw-on lid 8. The battery storage container 4 is made from a blow-moulded plastics material and the screw-on lid 8 is made from an injection-moulded plastics material. The screw-on lid 8 includes a central aperture 10 through which batteries may be placed in the battery storage container 4. The battery testing device 6 comprises a moulded section including a number of recesses 12. The battery testing device 6 is bonded to the battery storage container by adhesive. In alternative embodiments of the invention, the battery testing device 6 may be associated with the battery storage container 4 by a snap/click fix or mechanically attached using clips or screws. Each of the recesses 12 is shaped such that it can receive a particular sized battery, for example, AAA, AA, C, D, or PP3 (9 Volt). Additionally, the recesses 12 are shaped such that when a battery is placed in a suitable recess, there are two contacts (not shown) that connect the battery under test to a testing circuit (see figure 4). In this embodiment of the invention, the recesses 12 are arranged to engage with an inserted battery such that in order to the battery to remain in place, the battery requires holding by a user testing the battery. In order to make it easy for a user to hold a battery in a recess 12, there are removed sections 14 located adjacent to the recesses 12. The battery testing device 6 also includes a
battery condition indicator 16 which is activated when a user holds a battery in a recess 12. Depending on the condition of the battery, the battery condition indicator lights a green LED when a battery is fully charged, an amber LED when a battery is low charge, and red when a battery is no charge. The condition of the battery is judged on the voltage measured by the testing circuit.

If a user tests a battery and the red LED is activated, the user may drop the exhausted battery through the aperture 10 into the battery storage container 6. Once the battery storage container 6 is full, it may be collected or taken to the relevant dropping-off spot to be sent to a battery disposal and/or recycling plant. Alternatively, the batteries in the battery storage container may be emptied into a separate storage container prior to being transported to the chosen disposal and/or recycling plant. If a user tests a battery and the amber or green LEDs are activated, the user does not drop the battery into the storage container 6 and may go on to use the battery until the battery is exhausted.

In an alternative embodiment of the invention, the battery testing circuit may be arranged such that a fully charged battery lights the red, amber; and green LEDs; a battery with a useful amount of charge remaining lights the red and the amber LEDs; and a battery with an exhausted charge lights only the red LED.

In this particular embodiment, the battery disposal unit is sized for individual or small office use. The battery disposal unit will conveniently sit on a desk or shelf. In alternative embodiments, the battery disposal unit may be sized for public use, such as in a supermarket.
or post office. Such a battery disposal unit may be considerably larger in order to reduce the frequency at which the unit must be emptied.

Figure 4 shows a circuit diagram of a battery testing device suitable for use as the battery testing device 6 as described for figures 1 to 3. Figure 4 shows a battery testing circuit 100 which is mounted on a printed circuit board (PCB). The circuit 100 includes 10 comparators, 102, 104, 106, 108, 110, 112, 114, 116, 118, and 120. The circuit 100 also includes a reference voltage source 122 connected to the positive input of each comparator. The reference voltage source 122 may be a battery of the same or similar type to the battery under test. A plurality of resistors 124, 126, 128, 130, 132, 134, 136, 138, 140, 142, are arranged in series such that they act as a voltage divider, reducing the voltage applied to the positive inputs of successive comparators. The battery under test is arranged such that the positive terminal of the battery under test is connected to the circuit 100 at point 144 (SIG IN). It will be appreciated that there may be a plurality of connection points (not shown) arranged such that a plurality of different types of battery may be tested by the circuit 100. The voltage of the battery is applied to the negative inputs of each of the comparators, via a resistor 146 and a buffer 148. Each comparator is arranged to provide an output to an LED, 150, 152, 154, 156, 158, 160, 162, 164, 166, 168, connected to that comparator. The LEDs act as the battery condition indicator 16 as described above. In this case, the LEDs are all the same colour and act as a bar display of charge. In alternative embodiments, the LEDs may be different colours, such as red, amber, and
green, and/or arranged such that only a single LED is activated in dependence on the charge remaining in the battery under test. If the voltage applied to the negative input of a comparator is greater than the voltage applied to the positive input of that comparator, the comparator is arranged to provide an output to the associated LED, thus lighting that LED. If the voltage applied to the negative input of a comparator is less than the voltage applied to the positive input of that comparator, the comparator is arranged such that it does not provide an output to the associated LED, and that LED remains unlit.

In such a way, the circuit can be used to indicate the charge levels remaining in the battery under test. If a battery under test is at full charge, the voltage applied to the negative inputs of each of the comparators is greater than the reference voltage applied to the positive inputs of each of the comparators. Therefore, all of the LEDs will be powered and it will be clear to a user that the battery under test has full charge.

If a battery under test is partially depleted, the voltage applied to, for example, negative inputs of comparators 114, 116, 118, and 120, is greater than the voltage applied to the positive inputs of those comparators. Therefore, LEDs 162, 164, 166, and 168, will be powered. The voltage at the negative inputs of the remaining comparators is not greater than the reference voltage applied to those comparators, and so the remaining LEDs are not powered. Thus it will be clear to a user that the battery under test is partially depleted, though still contains a useful quantity of charge.
If a battery under test is completely depleted, the reference voltage is greater at each of the comparators and none of the LEDs will be powered. This indicates to a user that the battery under test is completely depleted and they can place it in the associated battery storage container for disposal.

The circuit 100 includes a mode select amplifier 170 via which may be used to control the mode of operation of the circuit 100. For example, the LEDs may be lit in series as a bar display (as described above) or a single LED may be lit to indicate the level of charge of a battery under test.

In the circuit 100 as described above, there are 10 LEDs which provides an accurate measure of charge available in a battery under test. The circuit is arranged such that each LED indicates approximately 10% of the charge available in a fully charged battery. Therefore, when 10 LEDs are lit, there is 100% charge in the battery under test. When 5 LEDs are lit, there is 50% charge available in the battery under test and so on. It may not be necessary to have such sensitive readings and alternative embodiments of the invention may include only 3 comparators and associated LEDs. In certain embodiments, there may be only one or two comparators arranged to simply show a user whether or not a battery contains any useful level of charge or if it should be disposed of in the battery storage container.

The person of ordinary skill in the art will appreciate that the above battery testing circuit is given by way of example only. There are many circuits that could be suitable for testing a battery and the invention is not limited to a battery testing circuit as described above.
Additionally, whilst the present invention has been described and illustrated with reference to particular embodiments, it will be appreciated by those of ordinary skill in the art that the invention lends itself to many different variations not specifically illustrated herein. By way of example only, certain possible variations will now be described.

For example, the battery condition indicator could be a speaker arranged to emit a number of noises depending on the condition of a battery. Alternatively, the battery condition indicator could be a single light source that is lit when the battery contains a useable amount of charge. The battery disposal unit may be cuboid rather than cylindrical depending on where the battery disposal unit is going to be located. The lid of the battery storage container may be push or snap fit. Alternatively, the lid of the battery storage container may be fastened to the storage container by mechanical attachments such as clips or screws. The battery testing device may be integrated into the battery storage container by a snap fit connection or mechanical attachment such as screws.

Where in the foregoing description, integers or elements are mentioned which have known, obvious or foreseeable equivalents, then such equivalents are herein incorporated as if individually set forth. Reference should be made to the claims for determining the true scope of the present invention, which should be construed so as to encompass any such equivalents. It will also be appreciated by the reader that integers or features of the invention that are described as preferable, advantageous, convenient or the like are optional and do not limit the scope of the
independent claims. Moreover, it is to be understood that such optional integers or features, whilst of possible benefit in some embodiments of the invention, may not be desirable, and may therefore be absent, in other embodiments.
Claims

1. A battery disposal unit comprising:
   a battery testing device, and
   a battery storage container, wherein the battery testing device is at least partially integrated with the battery storage container.

2. A battery disposal unit as claimed in claim 1, wherein the battery testing device is arranged to test batteries of a plurality of different sizes.

3. A battery disposal unit as claimed in claim 1 or claim 2, wherein the battery testing device is arranged to test batteries of a plurality of different chemistries.

4. A battery disposal unit as claimed in any of claims 1 to 3, wherein the battery testing device is so shaped that a user is required to hold a battery up to the battery testing device in order that the battery is tested.

5. A battery disposal unit as claimed in any preceding claim, wherein the battery testing device comprises a battery condition indicator.

6. A battery disposal unit as claimed in claim 5, wherein the battery condition indicator comprises at least three indicators including representations of "fully charged", "low charge", and "no charge".
7. A battery disposal unit as claimed in any preceding claim, wherein the battery testing device is powered at least partially by the battery under test.

8. A battery disposal unit as claimed in any preceding claim, wherein the battery testing device is wholly powered by the battery under test.

9. A battery disposal unit as claimed in any preceding claim, wherein the battery storage container includes a lid.

10. A battery disposal unit as claimed in claim 9, wherein the lid includes an aperture shaped to allow batteries to pass through.

11. A battery disposal unit substantially as herein described with reference to any of Figs. 1, 2, 3 and 4 of the accompanying drawings.

12. A method of sorting batteries suitable for disposal using a battery disposal unit comprising a battery testing device arranged to receive a test battery, the battery testing device integrated with a battery storage container, the method comprising the following steps:

   inserting a battery for test into the battery testing device, and

   if the battery testing device indicates that the battery is suitable for disposal, placing the battery into the battery storage container.