(11) Application No. AU 2007222067 B2

(19) AUSTRALIAN PATENT OFFICE

(54) Title
Battery charger

(51)[6] International Patent Classification(s)
H02J 7/00 (2006.01) 20060101AFI2007112
H02J 7/00 2BHEP
PCT/US2007/004628

(21) Application No: 2007222067 (22) Application Date: 2007.02.20

(87) WIPO No: WO07/102997

(30) Priority Data

(31) Number	(32) Date	(33) Country
11/370,595	2006.03.08	US

(43) Publication Date : 2007.09.13

(71) Applicant(s)
Eveready Battery Company, Inc.

(72) Inventor(s)
Furth, David A.; Iswarienko, Mandy; Hoffman, Peter F.; Brandon, Michael J.; Barr, Jason M.; Devereaux, Rachel P.

(74) Agent/Attorney
Halfords IP, 1 Market Street, Sydney, NSW, 2000

(56) Related Art
GB2386006
US2004/0151979
US2005/0189921
US2004/0247996
US6350040

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
13 September 2007 (13.09.2007)

PCT

(10) International Publication Number
WO 2007/102997 A3

(51) International Patent Classification:
H02J 7/00 (2006.01)

(21) International Application Number:
PCT/US2007/004628

(22) International Filing Date:
20 February 2007 (20.02.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
11/370,595 8 March 2006 (08.03.2006) US

(71) Applicant (*for all designated States except US*): **EVEREADY BATTERY COMPANY, INC.** [US/US]; 533 Maryville University Drive, St. Louis, MO 63141 (US).

(72) Inventors; and
(75) Inventors/Applicants (*for US only*): **BRANDON, Michael, J.** [US/US]; 33993 Adams Avenue, North Ridgeville, OH 44039 (US). **BARR, Jason, M.** [US/US]; 1905 Bonnie Brook Lane, Wentzville, MO 63385 (US). **HOFFMAN, Peter, F.** [US/US]; 33120 Heartwood Avenue, Avon, OH 44011 (US). **FURTH, David, A.** [US/US]; 3148 Rickard Road, Skaneateles, NY 13152 (US). **DEVEREAUX, Rachel, P.** [US/US]; 1120 Foxworth Court, Ballwin, MO 63011 (US). **ISWARIENKO, Mandy** [DE/US]; 1606 Timberwood Estates Drive, Wildwood, MO 63011 (US).

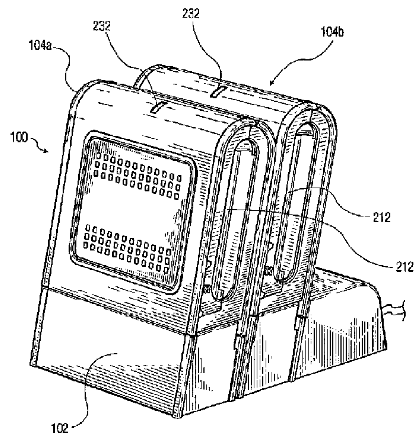
(74) Agents: **ADAMS, Gregory, J.** et al.; Eveready Battery Company, Inc., 25225 Detroit Road, Westlake, OH 44145 (US).

(81) **Designated States** (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT,

[Continued on next page]

(54) **Title:** BATTERY CHARGER



(57) **Abstract:** A battery charger (100) includes a base (102) which selectively receives first (104a) and second (104b) battery pods. The battery pods (104a, 104b), which are adapted to receive one or more batteries (212) for charging, have a form factor which facilitates the handling of the pods (104) and the batteries (212) received therein. Charging energy may be allocated between the pods (104) as a function of the temporal sequence in which the pods (104) are received by the base (102). Charging energy may also be allocated among the batteries (212) so that the batteries (212) are substantially charged at about the same time.

WO 2007/102997 A3

RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

(88) Date of publication of the international search report: 22 November 2007

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

BATTERY CHARGER

BACKGROUND

The present invention relates to battery chargers.

Recent years have seen a proliferation of battery powered electrical devices. Digital cameras, personal digital assistants (PDAs), hand held games, portable audio players, remote control devices, wireless computer keyboards and mice, and mobile telephones are but a few examples of this trend.

Rechargeable (secondary) batteries, such as nickel-metal hydride (NiMH), nickel-cadmium (NiCd), and lithium ion (LiIon) electrical cells, have likewise gained increasing acceptance as a renewable power source for these and other devices. Rechargeable batteries are typically well-suited for use in relatively high-drain devices, making them attractive in a wide variety of applications. As they can be recharged and reused, rechargeable batteries can also provide convenience and cost advantages relative to non-rechargeable (primary) batteries.

One factor which affects the utility of rechargeable batteries and the chargers needed to charge them is increasing mobility. As but one example, business travelers often require the use of a battery powered appliance while on a business trip. As another, a leisure traveler may likewise wish to use a digital camera while on a trip or outing. In either case, the user may wish to have a supply of replacement batteries ready to hand.

Functionality can also be a factor in less mobile situations. For example, a user may wish to charge a number of batteries, whether for immediate use or use at a later time. Once the batteries are removed from the charger, however, the batteries sometimes become misplaced or otherwise disorganized.

Factors such as size, ease of use, and charging time can also influence the decision to use to a particular charger. In situations where a user wishes to charge multiple batches of batteries, it is generally desirable that the batches are charged as quickly as possible, or otherwise in an easily understood and predictable way. It is also desirable that the available charging capacity be used relatively efficiently, and that the charging of the various batteries in a batch be completed at about the same time.

SUMMARY

Aspects of the present invention address these matters, and others.

According to a first aspect of the invention, a battery charger includes a first battery pod and a first charging bay. The first battery pod includes a first battery receiving region adapted to receive a first plurality of generally cylindrical batteries for charging and a first cover. The first cover is moveable to an open position which allows a human user to remove selected ones of the first plurality of batteries from the first battery receiving region for use in a battery powered appliance and a closed position which facilitates handling of the first battery pod. The first battery pod has a form factor which allows the first battery pod to be placed in a human clothes pocket. The first charging bay is adapted to selectively receive the first battery pod for charging the first plurality of batteries.

According to another aspect of the invention, a method is used with a battery charger including a first battery holder and a first charging bay. The first battery holder is adapted to receive a first plurality of batteries for charging and includes a first cover. The method includes inserting a first plurality of batteries in the first battery holder, closing the first cover, placing the first battery holder in the first charging bay, charging the first plurality of batteries, removing the first battery holder from the first charging bay, opening the first cover, and removing a battery from the battery receiving region. The first plurality of batteries includes at least one of AAA, AA, C, and D size batteries;

According to another aspect, a battery charger includes first and second battery holders, a base, and charging circuitry. The first battery holder is adapted to receive a first battery for charging and includes a first cover moveable to a first position which allows a user to remove the first battery from the first battery holder for use in a battery powered appliance and a second position which facilitates handling of the first battery holder. The second battery holder is adapted to receive a second battery for charging and includes a second cover moveable to a first position which allows a user to remove the second battery from the second battery holder and a second position which facilitates handling of the second battery holder. The base includes a first portion adapted to selectively receive the first battery holder and a second portion adapted to selectively receive the second battery holder. The charging circuitry is adapted to charge the first and second batteries when the first and second battery holders are received by the base.

Those skilled in the art will recognize still other aspects of the present invention upon reading and understanding the attached description.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example and not limitation in the figures of the accompanying drawings, in which like references indicate similar elements and in which:

Figure 1 is a perspective view of a battery charger.
Figure 2 is a perspective view of a battery pod.
Figure 3 is a perspective view of a base.
Figure 4 is a functional block diagram of a charging circuit.
Figure 5 depicts a method for charging batteries.
Figure 6 is a perspective view of a battery pod.

DETAILED DESCRIPTION

With reference to Figure 1, a battery charger 100 includes a base 102 and first 104a and second 104b battery holders or pods. The pods 104a, 104b are adapted to be selectively received by the base 102 and preferably have external dimensions which facilitate handling and/or transport by a typical consumer. As illustrated in Figures 1 and 2, for example, the pods 104a, 104b have a length of 77 millimeters (mm), a width of 71 mm, and a depth or thickness of 22 mm. At least a portion of the pods 104 is preferably visible during charging. As shown in Figure 1, and depending on a user's perspective, substantially all of the front surface of the first pod 104a, the tops and sides of first 104a and second 104b pods, and the rear surface of the second pod 104b can be seen.

Turning now to Figure 2, the pods 104 include a body 202 and a cover 204 which, in the illustrated embodiment, is hingedly attached to the body 202 for rotation about a hinge axis 206. The cover 204 is moveable in a generally clamshell fashion between an open position (as shown) which allows a user to selectively insert and/or remove batteries and a closed position which facilitates handling and/or transport of the pod 104 and any batteries inserted therein. The body 202 and cover 204 include corresponding latch or tab portions 208a, 208b which provide sufficient closing force to hold the cover 204 in the closed position during normal handling of the pod 104 but allow a user to easily open and/or close the cover 204 as desired.

As illustrated in Figure 2, the pod 104 includes a battery receiving region 210 adapted to receive one or more batteries 212a, 212b, 212c, 212d. First 214a and second 214b contact supports carry respective battery contacts 218a, 218b and 220a, 220b. The contact supports 214 are preferably mounted for pivotal motion with respect to the battery receiving region 210 so that the user may configure the pod 104 to accept batteries of different sizes. As illustrated, the first contact support 214a is disposed in a first position which accepts relatively shorter (e.g., AAA size) batteries; the second contact support 214b is disposed in a second position which accepts relatively longer (e.g., AA size) batteries. Tabs 222a, 222b are preferably provided to assist the user in pivoting the contact supports 214a, 214b to their desired positions. Spaced apart from the first set of battery contacts 218a, 218b, 220a, 220b is a corresponding second set of battery contacts 224a, 224b, 226a, 226b.

Electrical connections to the base 102 are provided through pod electrical contacts 228 located at a bottom portion of the pod. To facilitate handling of the pod 104 and to reduce the likelihood of damaging or shorting the pod electrical contacts 228, the contacts 228 may be slightly recessed in or substantially flush with the lower surface of the body 202. Electrical protection devices such as a positive temperature coefficient (PTC) resistive devices or diodes may also be provided to protect against short circuits or to allow charging but not discharging of the batteries 212 through the pod electrical contacts 228.

A light pipe 238 (shown in phantom) is disposed in the body 202. A first end 236 of the light pipe terminates at a rear portion of the lower surface of the body 202 so that the light pipe is in optical communication with the exterior of the body 202. The second end forms a human readable status indicator 232, which aligns with a corresponding opening 234 in the cover 204 so that the status indicator 234 is visible when the cover 204 is closed. To facilitate handling of the pod 104 and to reduce the likelihood of damaging the first end 236 of the light pipe 238, the first end 236 may be slightly recessed in or substantially flush with the lower surface of the body 202.

Vents 232, 234 located in the cover 204 and body 202, respectively, provide ventilation of the batteries 212 during charging. Additional vents are formed by cutouts 250a, 250b in the sides of the body 202 and cover 204, respectively.

Turning now to Figure 3, the base 102 includes first 302a and second 302b bays which are adapted to receive the pods 104a, 104b for charging the batteries disposed therein. The first bay 302a includes bay electrical contacts 304 which correspond to the pod electrical contacts 228. The first bay 302a also includes a multicolor red/green/amber light emitting diode (LED) 308 in optical communication with the end 236 of the light pipe. Mechanical protrusions or keys 310, which correspond to recesses in the rear bottom surface of the body 202, prevent the pod 104 from being inserted in the bay 302a in the incorrect orientation. The construction of the second bay 302b is substantially the same as that of the first bay 302a so that the pods 104a, 104b may be placed interchangeably in either bay 302a, 302b.

The housing 102 also houses battery charging circuitry which supplies electrical energy to the bays 302a, 302b and thus the batteries 212 received in the respective pods 104. The battery charging circuitry, which advantageously receives power from a wall cube connected to the alternating current (AC) power mains, is electrically connected to the electrical contacts 304 and to the LEDs 308 of the bays 302a, 302b.

With references to Figures 1, 2 and 3, the bays 302 and pods 104 are advantageously configured so that the pods 104 are received in and removed from the bays 302 in a direction which is substantially collinear with the longitudinal axes of the batteries 212. Also illustrated, the cover 204 is arranged so that the batteries 212 are inserted in and removed from the pods 104 in a direction which is substantially perpendicular to the longitudinal axes of the batteries 212. Moreover, the bays 302 are arranged so that the rear surface of the first pod 104a and the front surface of the second pod 104b are disposed parallel substantially adjacent to one other. Although other physical arrangements are contemplated, one advantage of such an arrangement is that the physical footprint of the base 102 may be reduced, while also allowing easy access to the pods 104 and the batteries 212 received therein.

As will be appreciated by those skilled in the art, various battery charger circuit topologies are well known and are ordinarily selected based on the chemistry or other characteristics of the batteries being charged, economic factors, and the like. As one example, NiMH or NiCD batteries are sometimes charged at a relatively constant charging current which is established as a function of the energy capacity of the batteries to be charged. Charging is often controlled based on the rate of change of the battery voltage or using a timer based circuit, either alone or in combination. As another, LiIon batteries are sometimes charged at a relatively high, substantially constant current level when relatively discharged, with the current generally decreasing as the battery becomes more fully charged.

Nonetheless, and as illustrated in Figure 4, it remains desirable to allocate the available charging energy among the bays 302a, 302b and the batteries 212 being charged. As can be seen, the charging circuitry includes first 402a and second 402b battery charging channels and bay select circuitry 402. The bay select circuitry 404 applies the electrical energy from the charging channels 402a, 402b to the charging bays 302a, 302b on a first in, first out (FIFO) basis as a function of the temporal sequence in which the pods 104 are inserted in the bays 302a, 302b.

Accordingly, the first bay 302 to receive a pod 104 is designated as the primary bay; the second bay 302 to receive a pod 104 is designated as the secondary bay. Charging energy is preferentially applied to the primary bay 302. This may be accomplished, for example, by applying all or substantially all of the charging energy to the primary bay 302 until charging of the pod 104 placed therein has been substantially completed. When the pod 104 placed in the primary bay 302 is substantially charged or is otherwise removed from the bay 302, the secondary bay 302 becomes the primary bay 302, and all or substantially all of the charging energy is applied thereto. If, while charging a first pod, a second pod 104 is inserted in an unoccupied bay, the unoccupied bay is treated as the secondary bay. If a pod 104 is inserted in the unoccupied bay after charging of the first pod 104 has been substantially completed, the previously unoccupied bay is treated as the primary bay.

Thus, charging energy is preferentially applied to the first pod 104 to be inserted in one of the bays 302a, 302b. If a second pod 104 is subsequently installed in the unoccupied bay 302a, 302b, the second pod 104 is placed in the queue for charging. Once the first pod 104 has been charged, the charging energy is applied to the second pod 104. Removing and then reinserting the first pod 104, for example following the installation of different batteries 212, would cause the first pod 104 to be placed in the queue for charging. In either case, a substantially charged pod 104 may also be trickle charged, even during charging of another pod 104.

In addition, the charging circuitry preferably applies the charging energy to batteries installed in a pod 104 through two more charging channels or circuits 402a, 402b. In the embodiment illustrated in Figure 2, a first channel 402a is used to charge the first 212a and second 212b batteries; a second channel is used to charge the third 212c and fourth 212d batteries. The first and second charging channels 402a, 402b apply charging energy at charging rates which are selected so that the charging of the batteries 212 installed in a given pod 104 can be expected to be completed at approximately the same time.

Thus, the charging energy may be applied as a function of the energy storage capacity of the batteries 212 connected to the channels 402a, 402b. As illustrated in Figure 2, the first 212a and second 212b batteries are AAA size batteries, whereas the third 212c and fourth 212d batteries are AA size batteries. Conventional AA and AAA-size NiMH rechargeable batteries typically have an energy storage capacity of about 2650 milliampere hours (mAH) and 1000 mAH, respectively. In the illustrated situation, the first charging channel 402a would apply charging energy to the first 212a and second 212b batteries at a first rate; the second channel 402b would apply charging energy to the third 212c and fourth 212d batteries at a second, relatively higher rate. Where the objective is to ensure that substantially discharged batteries would be charged in approximately three (3) hours, for example, the first charging channel 402a would supply each battery 212a, 212b with a charging current of approximately 400 milliamperes (mA), whereas the second charging channel 402b would supply each battery 212c, 212d with a charging current of approximately 1.08 amperes (A). As will be appreciated, such an arrangement can in many cases be expected to improve both the utility of the charger and the efficiency of the charging process.

It may also be desirable to adjust the charging rate as a function of the measured charge state of the battery or batteries connected to a given channel 402a, 402b. In one implementation, a channel containing a battery or batteries which are relatively more discharged would be charged at a relatively higher rate. In an exemplary situation in which the first 402a and second 402b channels are each connected to a respective battery having the same or similar energy storage capacities, the channel 402 connected to the relatively more discharged battery would be charged at a relatively faster rate. Such an arrangement can further facilitate the selection of charging rates which cause the charging of batteries 212 installed in a given pod 104 to be completed at about the same time.

Moreover, the charging energy may be allocated among the various pods 104 as a function of the battery or batteries received therein so as to more fully utilize the available charging capacity of the charger. By way of example in relation to the pods 104 of Figure 2, a first pod 104a containing four (4) AAA cells may be received in the primary bay 302, and a second pod 104b containing AA cells may be received in the secondary bay 304. In such a case, excess capacity which is not supplied to the first pod 104a may be used to charge the second pod 104b, albeit at a reduced rate, during the charging of the primary bay. Once the primary bay is substantially charged, the secondary bay becomes the primary bay as described above. In charger topologies where the energy supplied to the primary bay is reduced as the batteries being charged thereby become increasingly charged, the excess capacity may also be provided to the secondary bay during charging of the primary bay.

In operation, and with reference to Figure 5, the user opens the cover 204 and inserts the desired battery or batteries 212 in a first pod 104a at step 502. In the embodiment of Figure 2, for example, the user may insert up to four (4) AA or AAA size batteries. As shown, the battery sizes may selected in groups of (2), depending on the positions of the contact supports 214a, 214b.

At step 504, the user closes the cover 202 and inserts the first pod 104a in an unoccupied bay 302. As the pods 104 and bays 302 are preferably interchangeable, and assuming that both bays 302a, 302b are unoccupied, the first pod 104a may be inserted in either bay 302.

At step 506, the charging circuitry detects the presence of the first pod 104a in the selected bay, determines the type or types of batteries 212 installed therein, and begins the charging process. As described above, for example, the charging circuitry provides charging current at a rate which would be expected to charge the batteries in about three (3) hours.

The charging status of the first pod 104a is displayed on its human readable indicator 232 at step 508. More particularly, optical energy from the LED 308 is received by the light pipe and transmitted to the status indicator 232. Where the first pod 104a is the first pod to be inserted in the base 102, the status indicator 232 would ordinarily display as solid red to indicate that the batteries 212 are being charged, with the color changing to green when charging is complete. An error condition would be displayed as a blinking red signal.

At step 510, the user opens the cover 204 and inserts the desired battery or batteries in a second pod 104b.

At step 512, the user inserts the second pod 104b in an unoccupied bay 302.

At step 514, the charge control circuitry detects the presence of the second pod 104a in the selected bay 302 and determines the charging status of the first pod 104a.

At step 516, the charging circuitry charges the second pod 104b as a function of the first pod 104a charging status. Where the second pod 104b is inserted shortly after the first pod 104a, the first pod 104a would ordinarily be expected to be being charged. Accordingly, the second pod 104b would be placed in the queue for charging. If the first pod 104a is in error condition, or if charging of the first pod 104a has been or subsequently completed, the charging circuitry determines the type or types of batteries 212 installed in the second pod 104b and begins the charging process.

At step 518, the charging status of the second pod 104a is displayed on its human readable status indicator. When the second pod 104b is in the queue for charging, its status indicator 232 would ordinarily display as solid yellow, with the color changing to red to indicate that its batteries 212 are being charged, and to green when charging is complete.

At step 520, the user removes the desired pod 104 from its respective bay. In such a case, the charging circuitry notes the absence of the pod and adjusts the charging status of the remaining pod as appropriate. Thus, for example, if the removed pod was in the process of being charged and the remaining pod was in the queue for charging, the remaining pod is changed to the charging state. In any case, the user may then handle and/or transport the pod as desired. In the embodiment illustrated in Figure 2, the form factor of the pod 104 facilitates transport by the user of the pod 104 and any batteries 212 installed therein, for example in a shirt or other pocket, in a briefcase, book bag, camera bag, fanny pack, or the like. The pod 104 and its batteries 212 may also be placed in a drawer or other desired location for use at a later time.

At step 522, the user opens the cover 204 and removes one or more of the desired battery or batteries 212 from the pod 104, for example to place them in a desired battery powered appliance. Again, the form factor and operation of the cover 204 is preferably established so as to facilitate the ready removal of the desired batteries 212.

At step 524, the process is repeated as desired for additional batteries 212 and/or pods 104. For example, the user may elect to insert additional batteries in the previously removed pod as described above at step 510. As another, the user may elect to remove the remaining pod from the charger as described above at 520.

Other variations are possible. For example, the base 102 may include only a single bay 302, in which case the bay select circuitry 404 may be omitted. The base may also include three or more bays, in which case the additional bays may advantageously be treated as tertiary bays. To further reduce the size of the base 102, one or more the bays 302 may configured so to telescope, flip closed, or otherwise collapse when not in use. The base 102 may also be configured to be suspended from a horizontal surface, mounted on a wall, or placed in another desired position or location. The base 102 may also be provided with human readable indicators such as one or more LEDs, an alphanumeric liquid crystal display (LCD), or the like which provides additional information as to the operation and status of the charger 100 and/or the pods 104. The base 102 may also be provided with an operator input such as keys or switches which allow the user to further control the operation of the device.

The pods 104 may likewise receive batteries having different or additional sizes. Thus, the pods 104 may be configured to accept AAA, AA, C, and D size batteries, a desired subset of these sizes (e.g., both C and D size batteries, AA, AAA, and C size batteries, or the like), or batteries of only a single size(e.g., AAA, AA, C, or D size batteries). The first pod 104a may also be configured to accept batteries of a first size or sizes, whereas the second pod 104b may be configured to accept batteries of a second size or sizes. Again, however, the pods 104 are advantageously configured to be received in either of the bays 302. In one example, the first pod 104a would be configured to accept AA and AAA size batteries, while the second pod 104b would be configured to accept C size batteries. One advantage of such an arrangement is that the user may be provided with or otherwise obtain pods 104 which meet the user's existing or evolving needs.

Various mechanical and electrical connection arrangements may be implemented depending on the size or sizes of the batteries to be received in a pod 104. As shown in the non-limiting example of Figure 2, batteries 212 having more than one size may be selectively received in the same space, and may share a common set of battery electrical contacts. Where batteries 212 of various sizes share a common set of contacts, the battery size may be determined using a switch actuated by the pivot members 218 and read by the charging circuitry. The battery size may also be determined through a user operated switch disposed on the pod 104 or base 102. In another implementation, batteries of different sizes may be received in different physical spaces, or separate battery electrical contacts may otherwise be provided for the different size batteries. In such a case, the energy supplied by the charging electronics may be established as a function of the contacts to which a particular charging channel is connected, or otherwise by detecting the presence of the various batteries. In still another implementation, the charging electronics may determine the battery energy storage capacity or other characteristics of the batteries by measuring one or more pertinent electrical characteristics of the battery. Of course, still other variations are possible.

The pods may also be configured to receive non-cylindrical batteries, for example prismatic batteries, battery packs, or the like. The charger 100 may also be configured so that each pod 104 contains only a single charging channel 304. As yet another alternative, a separate charging channel 304 may be provided for each battery 212 received in a pod 104.

For example, Figure 6 illustrates a charger 100 in which the base 102 includes only a single bay 302a. Also as illustrated in Figure 6, the pod 104 accepts four (4) batteries of a single size, and the cover 204 slidingly engages the body 202.

Where the base includes more than one bay 302, the pods 104 may be charged in other than a FIFO basis. Accordingly, the available charging energy may be allocated among two or more pods 104, for example so that the charging of the various pods 104 would ordinarily be expected to be completed in a similar time frame. The charging priority of the various bays 302 and pods 104 may also be user selectable, for example through a user operated switch located on the base 102.

In still another implementation, the pods 104 may include an electrically powered appliance such as a flashlight having an LED or other light source and a corresponding user operable switch. In such a case, the electrically powered appliance is advantageously powered by a LiIon coin cell or other power source separate from the batteries 212 so that the appliance remains functional when the batteries 212 are removed from the pod 104 for use in an external device.

As yet another implementation, the energy transfer between the base 102 and pods 104 may be accomplished through inductive or capacitive coupling. Such an arrangement avoids the necessity for physical electrical contacts. The charger 100 or the pods 104 may also be powered by a source other than the AC power mains, for example through a USB port, other batteries, a mechanical energy source, or solar cells.

Where the pod 104 is provided with a USB or other suitable connector, either the pod 104 or a remote charging device may include suitable battery charging circuitry so that the batteries 212 may be charged from the USB port of an external device or other external source when the pod 104 is remote from the base 102. The pod 104 may also be used to provide electrical energy for charging still other rechargeable batteries disposed in an external battery powered appliance.

Figure 6 illustrates a charger 100 in which the base 102 includes only a single bay 302a. Also as illustrated in Figure 6, the pod 104 accepts four (4) batteries of a single size, and the cover 204 slidingly engages the body 202.

The invention has been described with reference to the preferred embodiments. Of course, modifications and alterations will occur to others upon reading and understanding the preceding description. It is intended that the invention be construed as including all such modifications and alterations insofar as they come within the scope of the appended claims.

CLAIMS

1. A battery charger comprising:

a first battery pod including

a first battery receiving region adapted to receive a first plurality of generally cylindrical batteries for charging;

a first cover moveable to an open position which allows a human user to remove selected ones of the first plurality of batteries from the first battery receiving region for use in a battery powered appliance and a closed position which facilitates handling of the first battery pod, wherein the first battery pod has a form factor which allows the first battery pod to be placed in a human clothes pocket;

a first charging bay adapted to selectively receive the first battery pod for charging the first plurality of batteries.

2. The battery charger of claim 1 including:

a second battery pod including

a second battery receiving region adapted to receive a second plurality of generally cylindrical batteries for charging;

a second cover moveable to an open position which allows a human user to remove selected ones of the second plurality of batteries from the second battery receiving region for use in a battery powered appliance and a closed position which facilitates handling of the second battery pod, wherein the second battery pod has a form factor which allows the second battery pod to be placed in a human clothes pocket.

a second charging bay adapted to selectively receive the second battery pod for charging the second plurality of batteries.

3. The battery charger of claim 2 wherein the first and second charging bays are adapted to receive either of the first and second battery pods.

4. The battery charger of claim 3 electrical charging energy is supplied to the first and second charging bays on a FIFO basis.

5. The battery charger of claim 4 wherein the battery charger has a charging capacity, wherein the battery charger is adapted to provide the first and second charging bays with an electrical charging energy based on an energy storage capacity of the batteries received in the first and second battery pods, wherein the battery charger preferentially applies the

charging capacity to a primary charging bay, and wherein the battery charger applies an excess charging capacity to a secondary charging bay.

6. The battery charger of claim 1 wherein the battery charger includes a first charging channel which charges at least a first battery at a first selectable charging rate and a second charging channel which charge at least a second battery at a second selectable charging rate, and wherein the first and second charging rates are selected so that charging of the first and second batteries is completed at approximately the same time.

7. The battery charger of claim 6 wherein the first charging rate is selected as a function of the energy storage capacity of the first battery and the second charging rate is selected as a function of the energy storage capacity of the second battery.

8. The battery charger of claim 6 wherein the first charging rate is selected as a function of the charge state of the first battery.

9. The battery charger of claim 1 wherein the first pod includes a human readable charging status indictor.

10. The battery charger of claim 9 wherein the charging status indicator is in optical communication with a light pipe, and wherein the light pipe is adapted to receive an optical signal from a light source external to the pod.

11. The battery charger of claim 1 wherein the first battery holder is adapted to receive a charging energy from a USB port.

12. The battery charger of claim 1 wherein the battery pod includes a first major surface and wherein the first major surface is substantially visible while the first plurality of batteries are being charged.

13. A method for use with a battery charger including a first battery holder and a first charging bay, wherein the first battery holder is adapted to receive a first plurality of batteries for charging and includes a first cover, wherein the method comprises:

inserting a first plurality of batteries in the first battery holder, wherein the first plurality of batteries includes at least one of AAA, AA, C, and D size batteries;

closing the first cover;

placing the first battery holder in the first charging bay;

charging the first plurality of batteries;

removing the first battery holder from the first charging bay;

opening the first cover;

removing a battery from the battery receiving region, wherein the first battery holder has a form factor, which facilitates transport of the first battery holder and any batteries installed therein in a shirt or other pocket, in a briefcase, book bag, camera bag, fanny pack, or the like.

14. The method of claim 13 wherein the battery charger includes a second battery holder and a second charging bay, wherein the second battery holder is adapted to receive a second plurality of batteries for charging and includes a second cover, wherein the method comprises:

inserting a second plurality of batteries in the second battery holder;
closing the second cover;
placing the second battery holder in the second charging bay;
charging the second plurality of batteries;
removing the second battery holder from the second charging bay;
opening the second cover;
removing a battery from the battery receiving region.

15. The method of claim 14 wherein placing the second battery holder includes placing the second battery holder in the second charging bay while the first plurality of batteries is being charged and wherein the method includes substantially charging the first plurality of batteries prior to charging the second plurality of batteries.

16. The method of claim 13 including adjusting the battery holder to receive a first battery of a first size and a second battery of a second size.

17. The method of claim 16 wherein charging the first plurality of batteries includes charging a first battery at a first rate and a second battery at a second rate, wherein the first rate is a function of the size of the first battery and the second rate is a function of the size of the second battery.

18. The method of claim 17 wherein the first rate is a function of the charge state of the second battery.

19. The method of claim 13 including placing the first battery holder in a clothes pocket.

20. The method of claim 13 including placing the first battery holder in a briefcase.

21. The method of claim 13 including determining an energy storage capacity of a battery installed in the first battery holder and wherein the step of charging the first plurality of batteries includes supplying a charging energy which is a function of the energy storage capacity.

22. A battery charger comprising:

a first battery holder adapted to receive a first battery for charging and including a first cover moveable to a first position which allows a user to remove the first battery from the first battery holder for use in a battery powered appliance and a second position which facilitates handling of the first battery holder;

a second battery holder adapted to receive a second battery for charging and including a second cover moveable to a first position which allows a user to remove the second battery from the second battery holder and a second position which facilitates handling of the second battery holder;

a base including a first portion adapted to selectively receive the first battery holder and a second portion adapted to selectively receive the second battery holder.

charging circuitry adapted to charge the first and second batteries when the first and second battery holders are received by the base.

23. The apparatus of claim 22 wherein the first and second batteries are charged at the same time.

24. The apparatus of claim 22 wherein charging energy is preferentially supplied to the first and second batteries in the temporal sequence in which the first and second battery holders are received in the base.

25. The apparatus of claim 22 wherein the first and second batteries are charged on a FIFO basis.

26. The apparatus of claim 22 including means for receiving a human input indicative of a priority with which charging energy should be applied to the first and second base portions.

27. The apparatus of claim 22 wherein the first battery holder includes an air vent.

28. The apparatus of claim 22 wherein the battery holder includes a human readable charge status indicator.

29. The apparatus of claim 28 wherein the charge status indicated by the charge status indicator is a function of optical energy received from a light source disposed in the base.

30. The apparatus of claim 22 wherein the first battery holder includes a battery powered appliance, and wherein the first battery powered appliance is powered by a third battery.

31. The apparatus of claim 22 wherein the battery powered appliance is a flashlight.

32. The apparatus of claim 22 wherein the first battery is generally cylindrical, the first portion of the base is adapted to receive the first battery holder in a direction which is substantially collinear to the longitudinal axis of the first battery, and wherein the first and second portions of the base are adapted to receive the first and second battery holders so that a major surface of the first battery holder is substantially adjacent a major surface of the second battery holder.

33. The apparatus of claim 22 wherein the first and second battery holders have exterior dimensions of approximately 77mm x 71mm x 22mm.

34. A battery charger comprising:

a first battery pod adapted to receive at least first and second batteries for charging and to allow the first and second batteries to be readily removed from the first battery pod for use in a battery powered device;

a first charging bay adapted to selectively receive the first battery pod for charging the first and second batteries;

means for charging the first battery at a first selectable charging rate and the second battery at a second selectable charging rate, wherein the first charging rate is selected as a function of the energy storage capacity of the first battery and the second charging rate is selected as a function of the energy storage capacity of the second battery;

a second battery pod adapted to receive at least third and fourth batteries for charging and to allow the third and fourth batteries to be readily removed from the second battery pod for use in a battery powered device;

a second charging bay adapted to selectively receive the second battery pod; and

means for supplying charging energy to the first and second charging bays on a FIFO basis.

35. The apparatus of claim 34 wherein the means for supplying applies an excess charging capacity to a secondary charging bay.

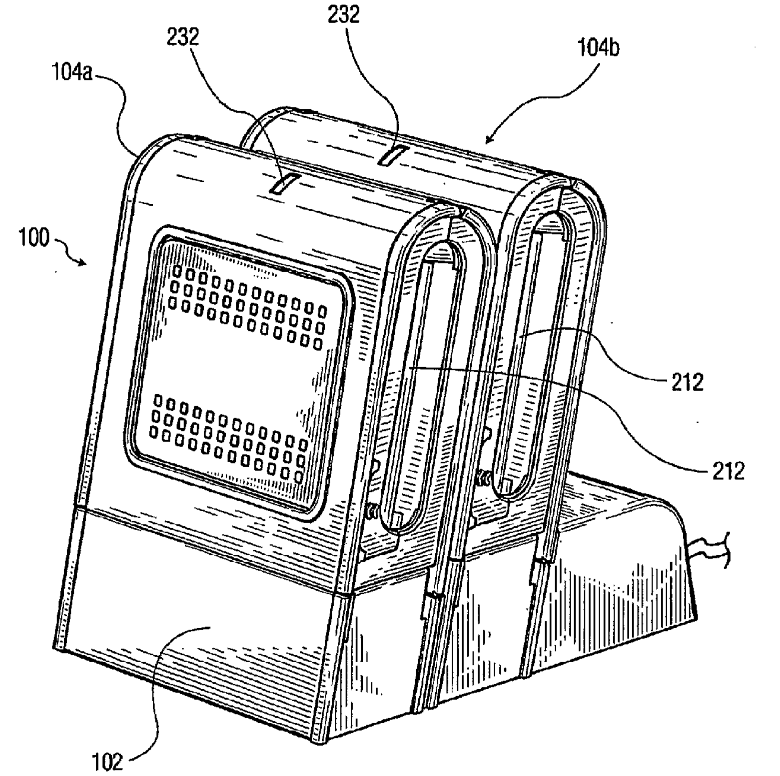


FIG. 1

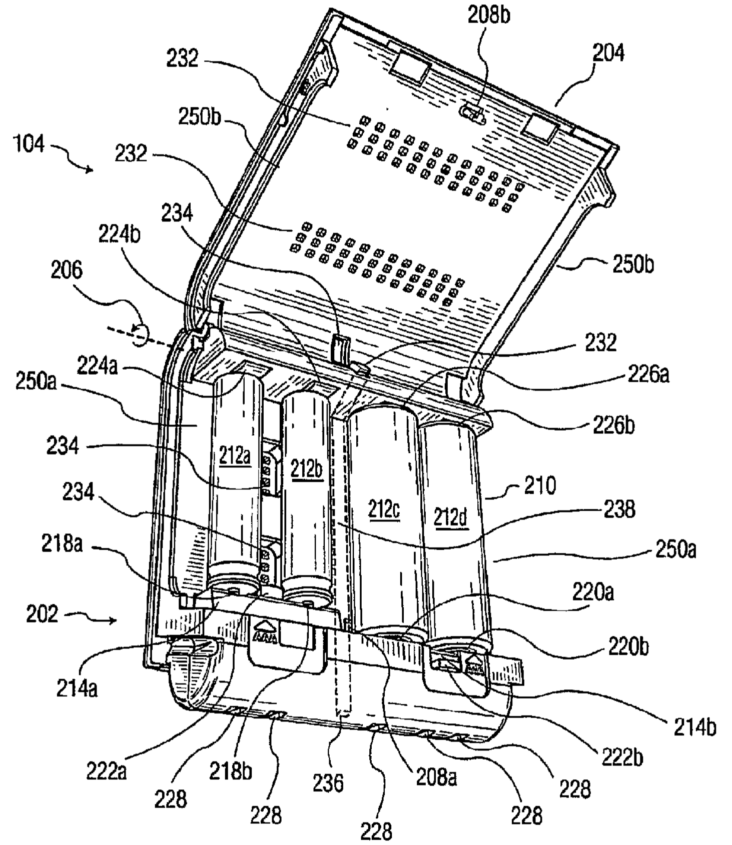

208b
204
232
250b
104
232
234
224b
250b
206
232
226a
224a
250a
226b
234
212a
212b
212c
212d
210
234
238
218a
250a
220a
202
220b
214a
214b
222b
222a
228
218b
236
208a
228
228
228
228
228

FIG. 2

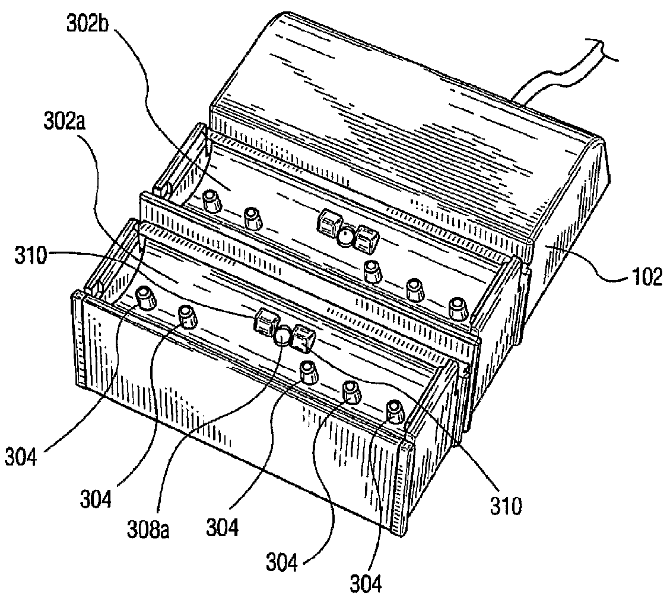


FIG. 3

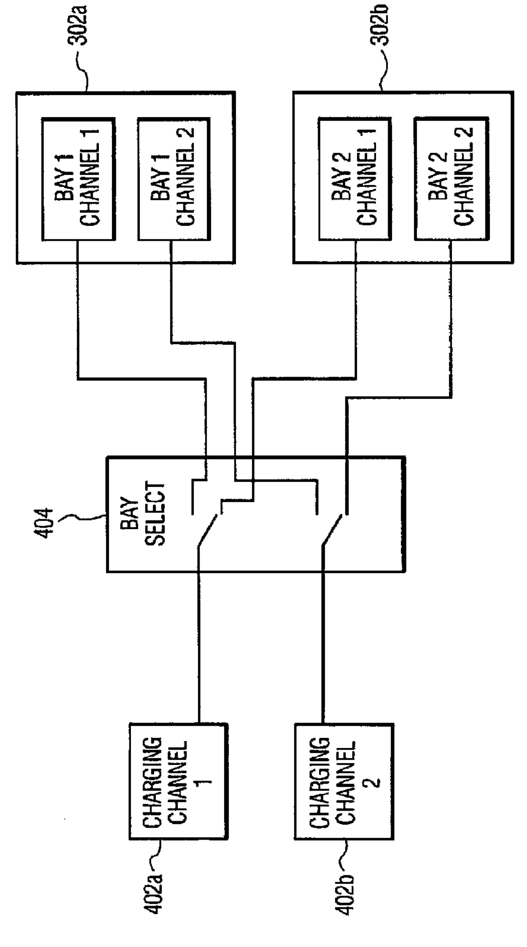

302a
BAY 1 CHANNEL 1
BAY 1 CHANNEL 2
302b
BAY 2 CHANNEL 1
BAY 2 CHANNEL 2
404
BAY SELECT
CHARGING CHANNEL 1
CHARGING CHANNEL 2
402a
402b

FIG. 4

5/6

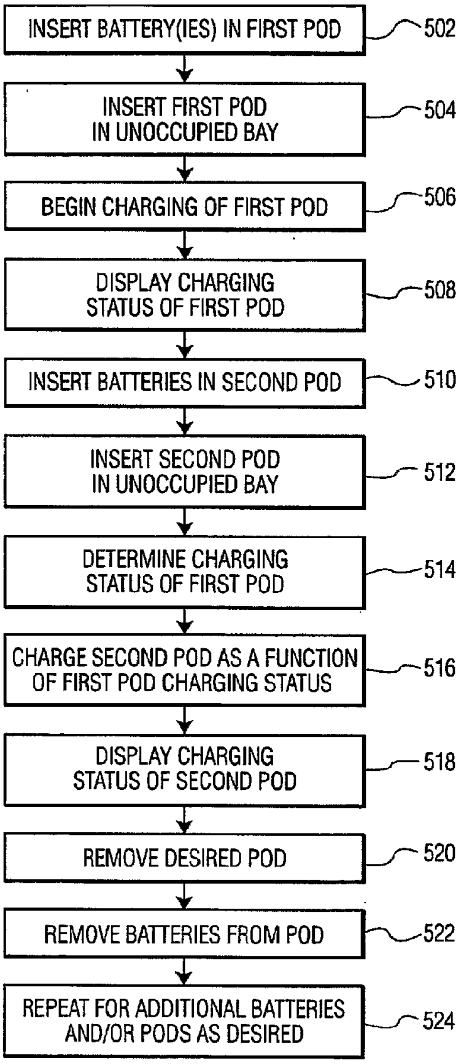

INSERT BATTERY(IES) IN FIRST POD
502
INSERT FIRST POD IN UNOCCUPIED BAY
504
BEGIN CHARGING OF FIRST POD
506
DISPLAY CHARGING STATUS OF FIRST POD
508
INSERT BATTERIES IN SECOND POD
510
INSERT SECOND POD IN UNOCCUPIED BAY
512
DETERMINE CHARGING STATUS OF FIRST POD
514
CHARGE SECOND POD AS A FUNCTION OF FIRST POD CHARGING STATUS
516
DISPLAY CHARGING STATUS OF SECOND POD
518
REMOVE DESIRED POD
520
REMOVE BATTERIES FROM POD
522
REPEAT FOR ADDITIONAL BATTERIES AND/OR PODS AS DESIRED
524

FIG. 5

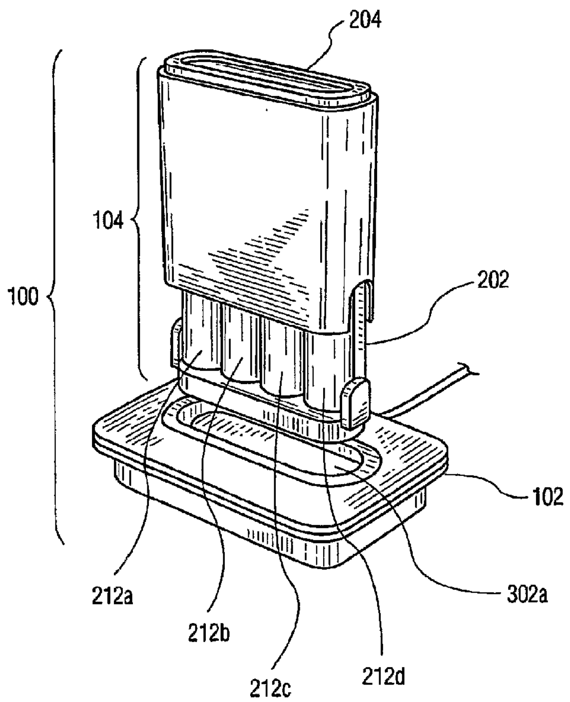


FIG. 6