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(54) Title: QUICK CHANGE BATTERY SYSTEM				
(57) Abstract <p>An apparatus for facilitating battery exchange in a portable electronic device. A housing has an opening for containing the battery. The opening has first and second apertures for permitting the battery to be pushed directly into contact with a retainer. Access to the battery is unobstructed to expedite battery exchange and to permit movement of the battery in different directions through the housing opening. Multiple retaining arms can have arcuate surfaces for holding the battery. The housing can have multiple retaining arms having complex or complementary battery holding surfaces, and can have multiple housing sections attached to the multiple retaining arms. Visual contact with the battery permits continuous display of battery charge strips attached to the battery exterior case. The method of the invention permits quick exchange of batteries so that continuous operation of the electronic device is not encumbered. By sliding the battery against electrical contacts within the opening, the contacts are automatically cleaned during battery replacement.</p>				

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QUICK CHANGE BATTERY SYSTEM**BACKGROUND OF THE INVENTION**

The invention described herein relates to the field of battery operated devices such as electronic controllers. More particularly, the invention relates to an improved apparatus for permitting unobstructed access to batteries in electronic devices to facilitate the quick replacement of a discharged battery.

Small, portable batteries provide electric power to portable electronic and electrical devices such as radios, portable stereos, lap top computers, car alarms, garage door openers, smoke alarms, telephones, pagers, television and video controllers, handheld games, electronic game controllers, and other devices. Batteries are typically contained within a compartment or chamber covered by a moveable door or panel. Such doors prevent batteries from being displaced from electrical contacts and prevent dirt from entering the battery compartment.

Certain accessories such as game controllers, portable radios, music players, and other devices provide continuous play over long time periods. For electronic game controllers, players sometimes engage in games which extend beyond the useful life of a battery. To provide communication between a controller and receiver base unit, cumbersome power and control cables connect the game controller to the receiver base unit. Such cables limit player mobility and present hazards to children and other persons.

Portable controllers can be provided which communicate through infrared or radio signals between the controller and the receiver base unit, however the utility of such controllers is limited by available battery power. An electronic game player may be engrossed in a personal record high scoring game at the moment that

battery power is discharged, thereby disrupting the game at the crucial moment as the battery is replaced.

Conventional battery storage systems encumber a person's ability to exchange a discharged battery with a charged replacement battery. In most systems, a cover door or panel must be removed so that the batteries can be removed from the housing cavity. Such cover doors and panels often break and require replacement of the entire housing. Representative examples of battery storage compartments and covers are found in United States Patent No. 4,129,688 to Fisher (1978) and United States Patent No. 4,166,359 to Domokos (1977) which disclosed watch housing covers for creating a waterproof compartment. United States Patent No. 4,182,020 to Malloy (1980) also disclosed a waterproof cover for sealing a battery within a watch housing. United States Patent No. 5,010,532 to Perrot (1991) disclosed a watch opening and cover for closing a battery housing, and United States Patent No. 5,645,954 to Tamuru (1997) disclosed a moveable terminal connected to a battery compartment cover.

Although different techniques have been developed to remove discharged batteries from compartments, significant dexterity is often required to extricate such batteries. In one technique, flexible pull tabs or ribbons are positioned below the battery and one end of the ribbon is connected to the housing and the other ribbon end extends exterior of the battery. The free ribbon end is pulled to dislodge the battery, and insertion of the replacement battery pushes the ribbon back into the compartment. Flat bladed tools can be inserted between batteries and the case housing to pry the battery from the compartment. Another technique uses a special gripping tool to engage and to remove the battery. Representative examples are shown in United States Patent No. 4,138,531 to Thompson (1979) which disclosed a

technique for manually lifting a battery from a battery holder and in United States Patent No. 5,617,079 to Harrison (1997) which disclosed an elongated rod and carriage for inserting and removing a battery from a device.

When compartments doors are used, various systems have been developed
5 to latch the compartment door. United States Patent No. 4,371,594 to Ohara et al. (1983) disclosed a lock for a battery compartment door, United States Patent No. 5,337,215 to Sunderland et al. (1994) disclosed a pivoting battery compartment and door, and United States Patent No. 5,722,705 to Deguchi (1998) disclosed a lock structure for a battery compartment cover. United States Patent No. 4,904,549 to
10 Goodwin et al. (1990) disclosed a latch for releasing a battery from a locked position relative to a battery housing.

An improved battery compartment door system for a battery operated pager was disclosed in United States Patent No. 5,369,802 to Murray (1994). The discharged battery was changed by pushing a replacement battery against an
15 entrance door and into contact with the discharged battery. An exit battery door was opened for the discharged battery as the replacement battery opened the entrance door. Operation of the doors was automatic during battery insertion into the battery compartment.

In addition to battery compartments having moveable doors and covers,
20 removable, rechargeable battery packs and latching systems have been developed to facilitate battery replacement. United States Patent No. 4,191,917 to Brown et al. (1978) disclosed such a rechargeable battery pack. United States Patent No. 4,191,917 to Brown et al. (1980) also disclosed a replaceable battery pack. United States Patent No. 3,999,110 to Ramstrom et al. (1975), United States Patent No.
25 4,146,682 to Nakao (1979), United States Patent No. 5,213,913 to Anthony et al.

(1993), United States Patent No. 5,401,592 to Gilpin et al. (1993), and United States Patent No. 4,871,629 to Bunyea (1989) disclosed latching systems for a battery pack. United States Patent No. 5,573,870 to Andrews (1996) disclosed a quick change battery pack assembly. United States Patent No. 5,637,417 to Engmark et al. (1997) disclosed a push button operated release for a spring loaded battery pack, and United States Patent No. 5,786,106 to Armani (1998) disclosed a battery replacement cartridge.

When a replacement battery is exchanged for a discharged battery, different systems have been developed to prevent loss of power to the attached electronic components. United States Patent No. 5,148,042 to Nakazoe (1992) disclosed an electronic device locking device for releasably locking batteries. United States Patent No. 5,712,553 to Hallberg (1998) disclosed a battery power supply transposition circuit. United States Patent No. 5,832,282 (1998) and 5,579,491 to Jeffries et al. (1994) disclosed systems for implementing battery hot swapping in portable computers, and United States Patents Nos. 5,028,806 to Stewart et al. (1989) and to Stewart et al. (1991) disclosed circuitry for switching between batteries in a portable computer. United States Patent No. 4,648,066 to Pitt (1987) disclosed a module and special battery connector permitting battery replacement without loss of stored data.

Although a significant amount of effort has been dedicated to improving techniques for storing and replacing batteries in portable electronic devices, such devices require manual door operation or cartridge latching systems which delay battery replacement operations and increase the expense of the electronic device. Complicated door mechanisms are subject to malfunction and breakage and are undesirable for continuous operation devices such as game controllers. Accordingly,

a need exists for an improved battery replacement and storage device which permits rapid battery replacement with minimal disruption to operation.

SUMMARY OF THE INVENTION

5 The invention provides a method and an apparatus for permitting replacement of a battery having positive and negative terminals. The apparatus comprises a housing, an opening in the housing having a first aperture and a second aperture, wherein the first and second apertures are sufficiently large to permit movement of the battery therethrough. A retainer means is engaged with the housing for holding
10 the battery in a selected position relative to the opening, and the battery is accessible through the opening for permitting displacement of the battery from the opening.

Preferably the retainer means is comprised of a retainer which includes an arcuate surface for holding the battery in a selected position relative to the opening
15 so that the battery is accessible through the opening for permitting displacement of the battery from the retainer.

In another embodiment of the invention, a portable apparatus having electronic components powered by a battery comprises a housing, an opening in the housing having a first aperture and a second aperture which are sufficiently large to
20 permit movement of the battery therethrough, and a plurality of retaining arms engaged with the housing. Each retaining arm includes an arcuate surface for holding the battery in a selected position relative to the opening so that the battery is accessible through the opening to permit displacement of the battery from the retaining arms.

In the different embodiments of the invention, the retaining means can comprise electrical contacts for engagement with the battery positive and negative terminals, and the battery can be completely contained within the housing opening. The electrical contacts can be engaged with electronic components, and a battery
5 can be placed within a cartridge for insertion into the housing opening.

The method of the invention is practiced by placing a battery proximate to a first aperture of a housing opening having first and second apertures sufficiently large to permit movement of the battery therethrough, of moving the battery into contact with retainer means engaged with said housing for holding the battery in a
10 selected position relative to the electrical contacts so that the positive and negative terminals of the battery are engaged with the electrical contacts and so that access to the battery through the first and second apertures is unobstructed, and of displacing the battery from the opening through the second aperture. In different embodiments of the method, the battery can be displaced from the opening by
15 moving a second battery through the opening, and the electrical contacts are cleaned by moving the battery through the opening.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates a portable controller having an opening for
20 containing a battery.

Figure 2 illustrates a side sectional view of a housing and opening.

Figures 3 and 4 illustrate a retainer mechanism for engaging and for permitting disengagement of a battery.

Figure 5 illustrates a slot for orienting a battery within a housing and
25 further illustrates a detent for activating a charge strip.

Figure 6 illustrates the displacement of a battery from the housing opening.

Figure 7 illustrates a second battery displacing a discharged battery.

Figure 8 illustrates a cartridge for insertion into the housing opening.

5 Figures 9 and 10 illustrate a sequence for replacing a battery in a housing having flexible retainer means for gripping the batteries.

Figure 11 illustrates an elevation view of a housing having multiple retaining arms within a retainer.

10 Figures 12 and 13 illustrate top and side views for multiple retaining arms forming complementary planar surfaces for contacting a battery.

Figure 14 illustrates an exploded elevation view of a housing having first and second sections attached to multiple retaining arms, and having a cap for guiding the battery into contact with the multiple retaining arms.

15 Figure 15 illustrates an exploded elevation view for one use of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The invention provides an improved apparatus and method for retaining batteries and for permitting the quick replacement of batteries in electronic devices
20 such as game controllers. Referring to Figure 1, portable device or controller 10 is formed with housing 12 having opening 14. Controller 10 can incorporate electrical or electronic components for performing selected functions. As shown in Figure 2, opening 14 has first aperture 16 and second aperture 18 which are sufficiently large to permit the entry of battery 20 into opening 14. Retainer means such as electrical
25 contacts 22 and 24 are attached to housing 12 within opening 14 for engaging and

for retaining battery 20 in a stationary position relative to housing 12. Such retaining means are not limited to electrical contacts and can comprise different structures and orientations as described below. Electrical contacts 22 and 24 can also provide the function of providing electrical engagement with positive and negative terminals of battery 20, however the primary function of electrical contacts 22 and 24 as a
5 retainer means is to provide engagement between battery 20 and housing 12. Such retainer means can comprise a clip, latch, flexible cord, clearance fit, or other structural or mechanical combination of elements sufficient to retain battery 20 stationary relative to housing 12. In other embodiments of the invention, the
10 electrical contacts and device for retaining battery 20 can be separate from a retainer means for gripping battery 20.

The term "opening" as used herein describes an open space serving as a passage for the movement of batteries. Opening 14 provides a passage for permitting the movement of battery 20 therethrough, and can be straight, curved, or
15 irregular in shape. Although opening 14 is illustrated in Figures 1 and 2 as a substantially straight passage within housing 12, opening 14 could bend at different angles so that second aperture 18 is not perpendicular, parallel, or aligned with first aperture 16 as shown in Figure 3.

Figure 3 illustrates one embodiment of the invention wherein retainer
20 means 26 holds battery 20 relative to housing 12. Retainer means 26 can comprise an electrical contact as shown in Figure 2 and can be formed with flexible tabs 28 each having one or more fins 30 as shown in Figure 4. Tabs 28 can be molded directly into different portions of housing 12, and one or more tabs 28 can retain battery 20 and ensure the proper orientation of battery 20 relative to housing 12 and
25 to electrical contacts 22 and 24.

Opening 14 permits battery 20 to be observed at all times during operation of controller 10. If battery 20 is formed with a strip indicating the charge status of the battery as shown in Figure 5, opening 14 permits visual contact with such charge strip indicator. Batteries having a charge strip typically require depression of such strip element to activate operation of the charge strip. To automatically accomplish this function, spring-loaded detent 31 can be integrated with housing 12 as shown in Figure 5.

Although opening 14 is not closed to dirt and other contaminants in the environment around controller 10, opening 14 can be formed in such a way that discontinuities for trapping dirt are not present. By molding housing 12 in two fitted components, housing 12 is easily manufactured and provides a smooth, continuous interior surface forming opening 14. This combination of second aperture 18 with first aperture 16 within opening 14 permits dirt and other contaminants to be flushed through opening 14 without accumulating within a recess or compartment, in contrast with conventional battery compartments requiring a contamination-proof door or cover.

Although battery 20 is illustrated in a preferred embodiment as being recessed completely within an exterior surface of housing 12, the retaining means could hold battery 20 partially or wholly outside of housing 12 exterior surface. The interior placement is preferred because battery 20 is protected from accidental contact and can be insulated from vibrations which might damage electrical contacts 22 or dislodge battery 20 from engagement with electrical contacts 22. A single battery 20 is illustrated in stationary contact relative to electrical contacts 22, however more than one battery 20 can be stacked in different orientations within opening 14.

As shown in Figures 1 and 5, opening 14 can be oriented with slot 32 to provide a polarized shape for battery 20. If the controller 10 requires one or more AA batteries having standard positive and negative terminals, slot 32 can be configured to permit the proper insertion of battery 20 through opening 14. This feature of the invention prevents battery 20 from being inserted backwards into opening 14, and prevents accidental, improper contact between the terminals of battery 20 and electrical contacts 22 and 24. Accordingly, slot 32 provides a safety feature for preventing accidental damage to electronic components within controller 10.

To remove battery 20 from opening 14, battery 20 is pushed through either first aperture 16 or through second aperture 18 as shown in Figure 6. During such movement, electrical contacts 22 and 24 are cleaned as the positive and negative terminals of battery 20 slide relative to electrical contacts 22 and 24. This movement automatically cleans electrical contacts 22 and 24 without requiring separate attention, and further permits electrical contacts 22 and 24 to be cleaned in a single direction across the entire face of electrical contacts 22 and 24. Any contact wear and cleaning efficiency is uniform because of the linear movement of the battery 20 terminals relative to electrical contacts 22 and 24.

Electrical contacts 22 and 24 can be elongated along the length of opening 14 between first aperture 16 and second aperture 18 to provide a make or break function. This feature permits a replacement battery such as battery 34 to engage electrical contacts 22 and 24 before discharged battery 20 is removed from housing 12. Suitable electronic components can be provided to regulate electrical current during the exchange of battery 20. For example, diodes can prevent

replacement battery from transmitting energy into discharged battery 20 in higher voltage batteries.

In one embodiment of the invention, a brief power interruption occurs and electronics within controller 10 bridge the split second power outage during battery exchange. This feature is desirable because controller 10 does not simultaneously engage two batteries (such as a nearly discharged battery and a fully charged battery) in parallel. The temporary condition of two batteries in parallel could cause leakage or explosion of the discharged battery unless electronics for addressing multiple battery contact was provided. In another embodiment of the invention, make before break electronics can be provided so that power interruption does not occur. In another embodiment of the invention, two pairs of electrical contacts 22 and 24 can be provided, and electronics within controller 10 can prevent cross contact between battery 20 and battery 34 during exchange procedures.

Figure 6 illustrates the displacement of battery 20 from engagement with retainer means such as electrical contacts 22. Battery 20 can be dislodged from such engagement with a person's finger or by the insertion of an object into contact with battery 20. Figure 7 illustrates another embodiment of the invention wherein a second, charged replacement battery 34 is moved into first aperture 16 and into contact with the original discharged battery 20 in contact with electrical contacts 22 and 24. As the replacement battery 34 is moved through opening 14, the discharged battery 20 is displaced from opening 14 and replacement battery 34 is moved into engagement with electrical contacts 22 and 24 and with tabs 28.

Battery 20 is insertable into opening 14 through either first aperture 16 or through second aperture 18. This feature of the invention provides unique flexibility in the construction and use of housing 12 by permitting operation and

battery 20 exchange from more than one side of housing 14. This design also provides unique flexibility in the design and construction of housing 12. Housing 12 can be molded in a single piece or in two or more pieces connectable with snap fittings or other conventional fastening systems. This design flexibility significantly
5 simplifies manufacture, assembly, and repair of controller 10.

Access to battery 20 is unobstructed through first aperture 16 or second aperture 18. This feature of the invention permits battery 20 to be displaced from opening 14 in either direction through first aperture 16 or through second aperture 18. Additionally, this feature of the invention permits battery 20 to be displaced from
10 opening 14 in many different ways. Battery 20 can be displaced from opening 14 with a person's finger, with contact from another battery 20 moving through opening, or with another object urged against battery 20. In other embodiments of the invention, battery 20 can be carried by a case such as cartridge 36 insertable through opening 14 as shown in Figure 8. Cartridge 36 can carry one or more
15 batteries, and can be integrated within battery 20. Cartridge 36 can be configured to enter first aperture 16 and to exit second aperture 18, or vice versa. Cartridge 36 can have slot 38 engageable with key 40 for aligning the electrodes of battery 20 with electrical contacts 22 and 24. Ribs 42 engageable with recesses 44 can temporarily retain cartridge 36 within opening 14.

20 Figures 9 and 10 show a sequence of battery 34 displacing battery 20 in contact with fins 30 and flexible tabs 28. Fins 30 directly contact battery 20 for retaining battery 20 in the proper place as shown in Figure 9. The natural molded-in position of tabs 28 provides a spring-loaded feature for retaining battery 20. As battery 34 is moved into contact with battery 20, tabs 28 move outwardly as shown in
25 Figure 10. When battery 34 is retained by tabs 28 and fins 30, tabs 28 provide a

restoring force for gripping battery 34. By rounding the bases for tabs 28, additional flexure is provided to provide a gripping force against battery 20 or replacement battery 34. The material used for tabs 28 can comprise ABS or PVC plastic or a composite, metallic, or other suitable material. The material used will affect the tab
5 base curve radius, tab thickness, and height of fins 30. Although Figures 9 and 10 illustrate one technique for using tabs 28 and fins 30 as retainer means, many other forms and combinations of components can accomplish the inventive function of temporarily retaining a battery stationary to housing 12.

Figure 11 illustrates housing 46 having opening 48 and retainer 50 for holding
10 battery 20. Retainer 50 has a plurality of retaining arms 52 each having an arcuate surface 54 for contacting battery 20. As battery 20 is inserted within opening 48, retaining arms 52 and the associated arcuate surfaces 54 are displaceable from an initial position or orientation to provide a restoring force for holding battery 20. Arcuate surfaces 54 also facilitate the retention of battery 20. Arcuate surfaces 54
15 can be formed in different orientations and shapes to accomplish different objectives. For example, each arcuate surface 54 can have a rounded entry edge 56 for facilitating movement of battery 20 relative to the respective retaining arm 52. Each arcuate surface 54 can form a planar segment for contacting and holding battery 20.

20 The shapes of arcuate surfaces 54 for adjacent retaining arms 52 can be complementary to form a cooperative combination of planar segments. The orientation and different shaped arcuate surfaces 54 can be configured as shown in Figure 12 and in Figure 13. In such embodiment, housing 46 is formed with two sections 58 and 60 which are connectable as illustrated in Figure 14. Cap 62
25 completes housing 46 to retain housing sections 58 and 60, and to provide a guide

for entry of battery 20 into opening 48. This embodiment facilitates construction of housing 46 by significantly reducing the complexity of each retaining arm 52. A single curve is permitted for arcuate surfaces 54, and the combination of adjacent retaining arms 54 cooperates to form a plurality of planar segments cooperating to hold battery 20 within housing 46. When battery 20 is removed from contact with retaining arms 54, retaining arms 54 can elastically return to the initial position.

Further, retaining arms 52 and 54 can be interleaved or not in different embodiments of the invention. The offsetting and interleaving of the retaining arms 52 and 54 permits the length of either or both of the retaining arms 52 and 54 to be increased. An increase in the length of the retaining arms 52 and 54 may enhance the invention by decreasing the force required to bend the retaining arms 52 and 54, by decreasing the deflection angle of the retaining arms 52 and 54 and by thus decreasing the stresses experienced by the retaining arms 52 and 54. This in turn potentially enables the retaining arms 52 and 54 to be constructed from materials commonly used for electronics enclosures (such as ABS), with the result that the retaining arms 52 and 54 can possibly be molded as part of the housing 46 and not as separate parts.

Figure 15 illustrates one embodiment of the invention in the form of a portable game controller 60. Lower housing 62 has retaining arms 64 which interleave with retaining arms 66 attached to upper housing 68. Battery electrical contacts 70, circuit board 72, and various keys 74 are integrated within controller 60. Figure 15 shows how a retaining means such as the combination of retaining arms 64 and 66 can be integrated within an apparatus such as controller 60 without requiring additional numbers of component parts. This design flexibility significantly reduces manufacturing and assembly cost, and facilitates the reliability of the apparatus.

The invention is particularly suitable for retaining a battery in a portable apparatus having electronic components powered by the battery. Although Figures 11-15 illustrate retainer 50 having multiple retaining arms 54 on opposite sides of battery 20, retainer 50 could hold battery 20 from a single side with a flat or shaped housing surface on the other side of battery 20. Retainer 50 can comprise a single element suitable for holding battery 20 within opening 48, and can operate with a single retaining arm 50 instead of multiple retaining arms 54. Retainer 50 can be spring loaded, can provide the retaining force by the elasticity of the retainer 50 material, or can be activated in other mechanical ways.

Movement of battery 20 through opening 14 cleans electrical contacts 22 each time that battery 20 is exchanged with a new replacement battery 34. Instead of using compartment doors or panels to prevent dirt and other contaminants from entering the battery compartment, the invention provides an unobstructed opening 14 for permitting passage of dirt completely through housing 12. Any dirt contamination of electrical contacts 22 is contact wiped clean during battery 20 replacement, thereby providing a self cleaning function for the invention. This wiping function removes contaminants and oxidation from contact points, and potentially creates a molecular bond between metals resistant to contamination and oxidation.

The invention significantly decreases the time necessary to exchange batteries 20, thereby providing substantial improvement over the prior art in the operator time taken away from operation of controller 10. This feature of the invention is particularly useful in game controllers wherein split second operation substantially affects the game performance. Opening 14 provides unobstructed exchange operation, and eliminates covers and moving doors subject to breakage and jamming in the excitement of game operation.

Although the invention has been described in terms of certain preferred embodiments, it will be apparent to those of ordinary skill in the art that modifications and improvements can be made to the inventive concepts herein without departing from the scope of the invention. The embodiments shown herein are merely
5 illustrative of the inventive concepts and should not be interpreted as limiting the scope of the invention.

WHAT IS CLAIMED IS:

1. An apparatus for permitting replacement of a battery having positive and negative terminals, comprising:

5 a housing;

an opening in said housing having a first aperture and a second aperture, wherein said first and second apertures are sufficiently large to permit movement of the battery therethrough; and

10 a retainer means engaged with said housing for holding the battery in a selected position relative to said opening, wherein the battery is accessible through said opening for permitting displacement of the battery from said opening.

2. An apparatus as recited in Claim 1, wherein the battery is insertable through said first aperture into engagement with said retaining means, and wherein
15 said battery is displaceable through said second aperture.

3. An apparatus as recited in Claim 1, wherein said battery is moveable into said opening through said first aperture or through said second aperture.

20 4. An apparatus as recited in Claim 1, wherein the battery is displaceable from said retainer means by contact with another battery moving through said opening.

5. An apparatus as recited in Claim 1, wherein said retainer means
25 comprises electrical contacts for engagement with the battery positive and negative

terminals.

6. An apparatus as recited in Claim 5, wherein said electrical contacts are engaged with the positive and negative terminals of the battery as the battery is moved through said opening.

7. An apparatus as recited in Claim 1, further comprising a release for disengaging the battery from said retainer means.

8. An apparatus as recited in Claim 1, wherein the battery is completely contained within said opening and does not extend outside of said housing when said retainer means holds said battery.

9. An apparatus as recited in Claim 1, wherein the battery has a charge indicator strip, further comprising means engaged with said housing for activating the charge indicator strip.

10. A portable apparatus having electronic components powered by a battery, comprising:

a housing;

an opening in said housing having a first aperture and a second aperture, wherein said first and second apertures are sufficiently large to permit movement of the battery therethrough;

battery contacts within said cavity for engaging the battery; and

retainer means for restraining the battery in engagement with said

battery contacts and for releasably permitting the battery to be displaced from said opening.

11. An apparatus as recited in Claim 10, wherein said retainer means is
5 attached to said housing.

12. An apparatus as recited in Claim 10, wherein said retainer means
comprises a cartridge for carrying the battery which is insertable into said opening.

10 13. An apparatus as recited in Claim 10, wherein said electrical contacts
are engaged with the positive and negative terminals of the battery as the battery is
moved through said opening.

14. An apparatus as recited in Claim 13, wherein the battery is
15 displaceable from said opening by another battery moving through said opening.

15. An apparatus as recited in Claim 14, further comprising means for
regulating electricity from the batteries when both batteries are engaged with said
battery contacts.

20 16. A method for permitting replacement of a battery having positive and
negative terminals for powering electrical contacts connected to an electronic
component, comprising the steps of:

placing a battery proximate to a first aperture of a housing opening,
25 wherein said opening has first aperture and second apertures sufficiently large to

permit movement of the battery therethrough;

moving the battery into contact with retaining means engaged with said housing for holding the battery in a selected position relative to the electrical contacts so that the positive and negative terminals of the battery are engaged with the electrical contacts and so that access to the battery through said first and second apertures is unobstructed; and

displacing the battery from said opening through said second aperture.

17. A method as recited in Claim 16, further comprising the step of operating the electronic component.

18. A method as recited in Claim 16, further comprising the step of displacing the battery from said opening by moving a second battery through said opening until the second battery contacts the first battery to displace the first battery from the opening.

19. A method as recited in Claim 18, further comprising the step of engaging the second battery with said retainer means for holding the second battery in a selected position within said opening.

20. A method as recited in Claim 16, further comprising the step of cleaning said electrical contacts by moving the battery through said opening.

21. An apparatus for permitting replacement of a battery having positive and negative terminals, comprising:

a housing;

an opening in said housing having a first aperture and a second aperture, wherein said first and second apertures are sufficiently large to permit movement of the battery therethrough; and

5 a retainer engaged with said housing, wherein said retainer includes an arcuate surface for holding the battery in a selected position relative to said opening so that the battery is accessible through said opening for permitting displacement of the battery from said retainer.

10 22. An apparatus as recited in Claim 21, wherein the battery is insertable through said first aperture into engagement with said retainer, and wherein said battery is displaceable through said second aperture.

23. An apparatus as recited in Claim 21, wherein said battery is moveable
15 into said opening through said first aperture or through said second aperture.

24. An apparatus as recited in Claim 21, wherein the battery is displaceable from said retainer by contact with another battery moving through said opening.
20

25. An apparatus as recited in Claim 21, wherein said retainer includes electrical contacts for engagement with the battery positive and negative terminals.

26. An apparatus as recited in Claim 21, wherein said arcuate surface is
25 displaceable from an initial position to hold the battery.

27. An apparatus as recited in Claim 21, wherein said retainer comprises a plurality of retaining arms each having an arcuate surface for contacting the battery.

5 28. An apparatus as recited in Claim 27, wherein each retaining arm has a rounded entry edge for facilitating movement of the battery relative to each retaining arm before the battery contacts the arcuate surface of said retaining arm.

29. An apparatus as recited in Claim 27, wherein certain of said retaining
10 arms are attached to said housing in an orientation opposite other retaining arms.

30. An apparatus as recited in Claim 29, wherein the arcuate surfaces of opposing retaining arms form complementary planar segments for holding the battery.

15 31. An apparatus as recited in Claim 27, wherein the arcuate surfaces of different retaining arms form complementary planar segments for holding the battery.

32. An apparatus as recited in Claim 27, wherein at least two of said
20 retaining arms are elastically displaceable from an initial position to hold the battery.

33. An apparatus as recited in Claim 21, wherein said housing comprises two sections each attached to a portion of said retainer, and wherein said retainer includes a plurality of retaining arms each having an arcuate surface for contacting
25 the battery.

34. An apparatus as recited in Claim 33, wherein said housing sections are attached to retainer arms configured in an interleaved configuration.

5 35. A portable apparatus having electronic components powered by a battery, comprising:

a housing;

an opening in said housing having a first aperture and a second aperture, wherein said first and second apertures are sufficiently large to permit

10 movement of the battery therethrough; and

a plurality of retaining arms engaged with said housing, wherein each retaining arm includes an arcuate surface for holding the battery in a selected position relative to said opening so that the battery is accessible through said opening for permitting displacement of the battery from said retaining arms.

15 36. An apparatus as recited in Claim 35, wherein said housing comprises two sections each attached to retaining arms each having an arcuate surface for contacting the battery.

20 37. An apparatus as recited in Claim 36, wherein said housing sections are attachably connectable to position the respective retaining arms in a position forming complementary planar segments for holding the battery.

38. An apparatus as recited in Claim 36, wherein said housing sections are
25 connectable to place corresponding retaining arms in an alternating pattern.

39. An apparatus as recited in Claim 35, wherein the arcuate surfaces of each retaining arm form complementary planar segments for holding the battery.

5 40. An apparatus as recited in Claim 35, wherein each retaining arm has a rounded entry edge for facilitating movement of the battery relative to each retaining arm before the battery contacts the arcuate surface of said retaining arm.

FIGURE 1

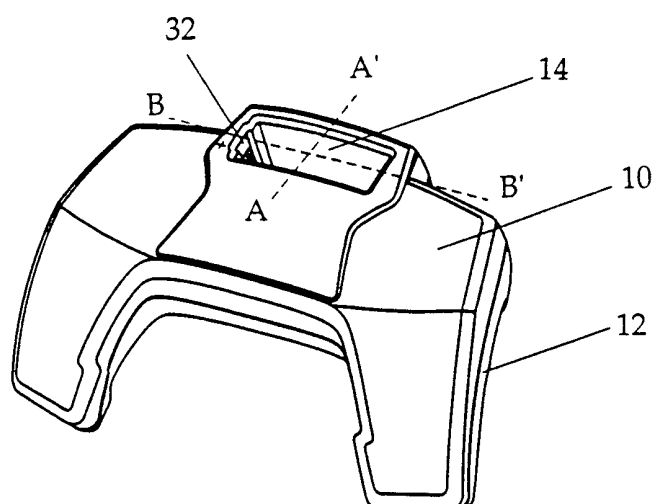


FIGURE 2

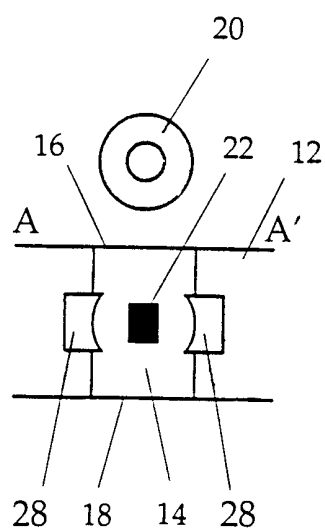


FIGURE 3

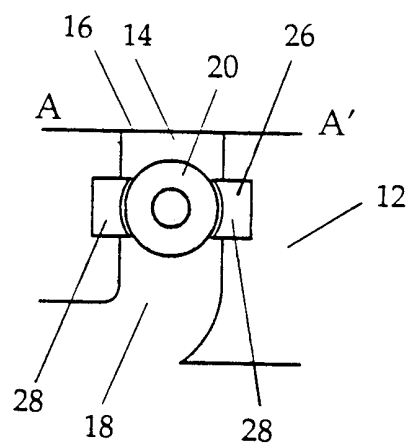


FIGURE 4

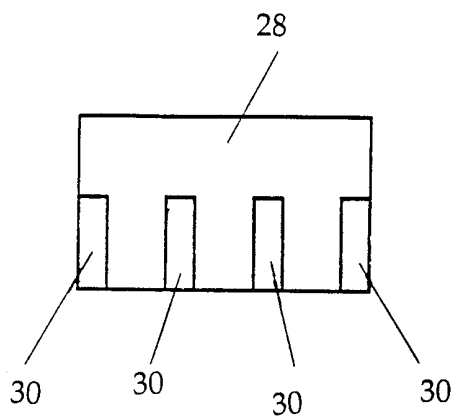


FIGURE 5

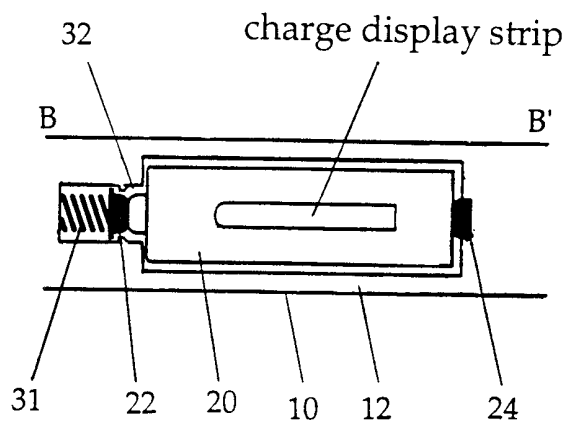


FIGURE 6

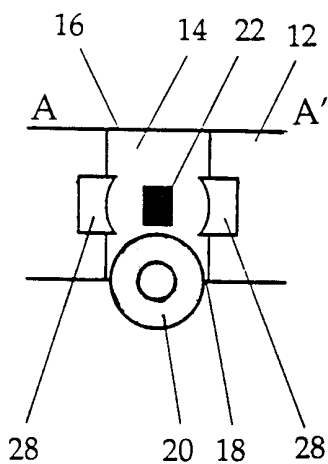


FIGURE 7

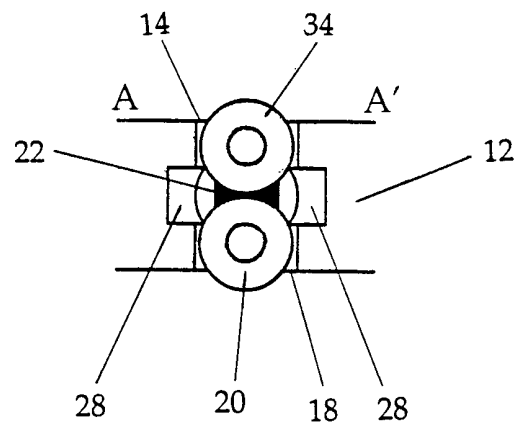


FIGURE 8

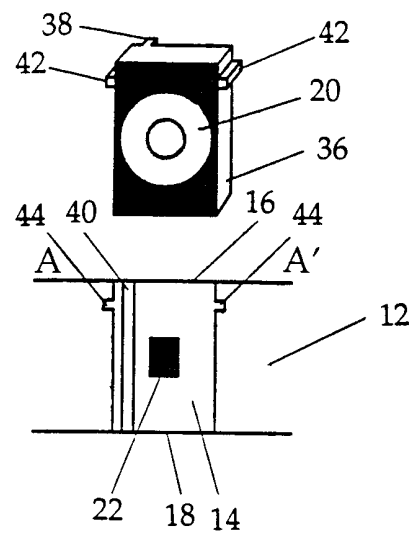


FIGURE 9

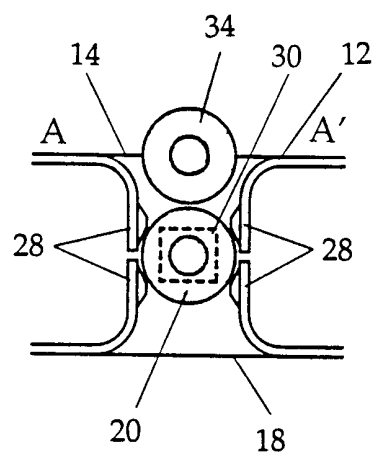


FIGURE 10

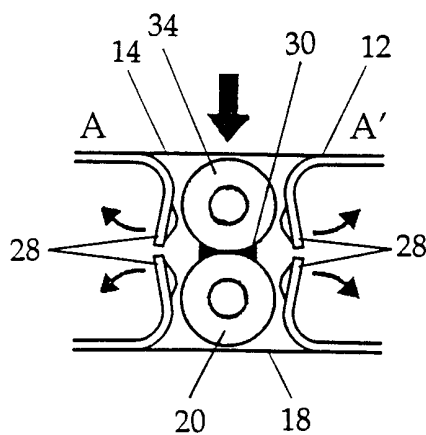


FIGURE 11

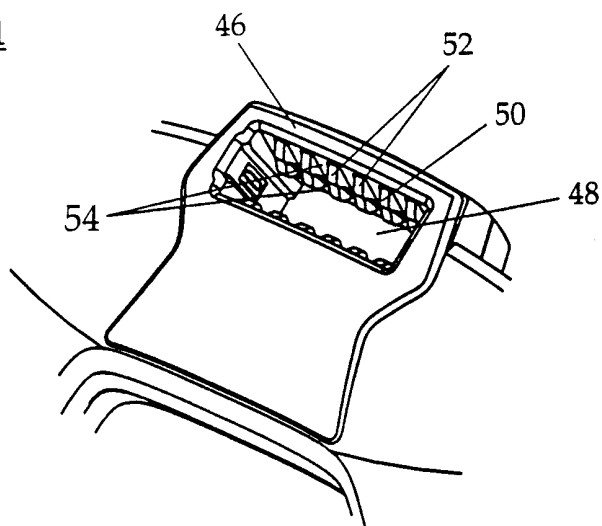


FIGURE 12

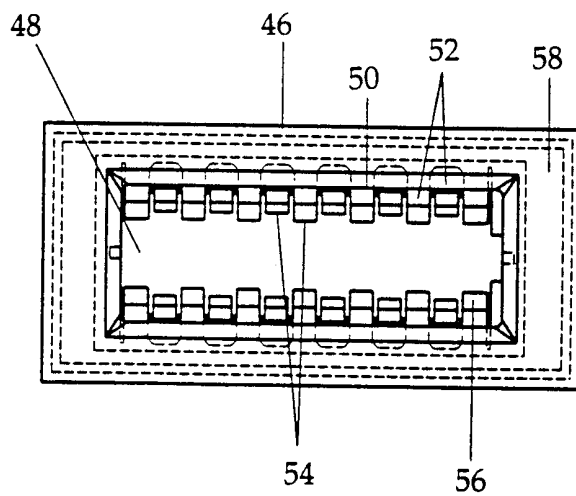


FIGURE 13

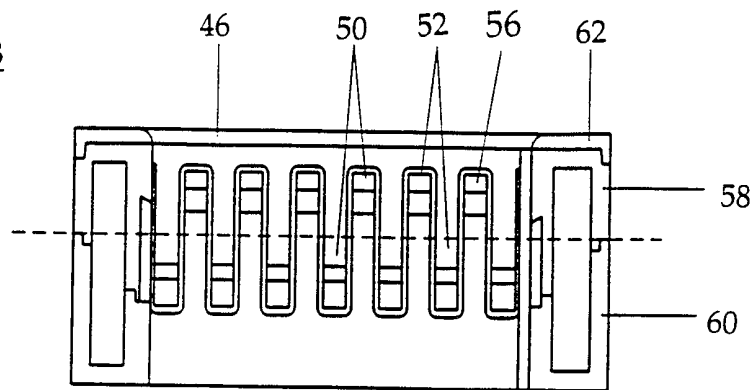


FIGURE 14

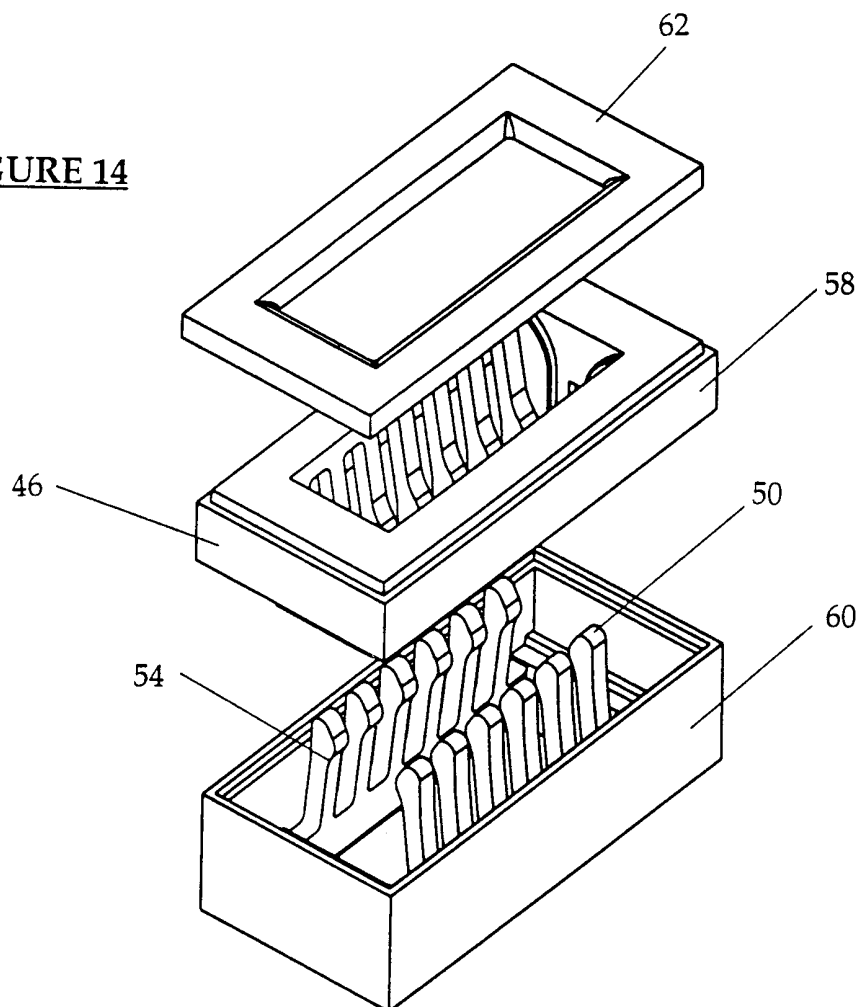


FIGURE 15