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(54) **Integrated power supply capacitor for radio telephone**

(57) Capacitance C is structurally combined with a battery B eg. Ni - Cd and electrically coupled to the battery such that the capacitance substantially compensates for voltage variations at the terminals of the battery caused by the internal impedance of the battery at pulsed loads. The capacitance may be wound on or in a dielectric sheath D of the battery or the capacitance and the battery may be formed of strips which are superimposed and spirally wound together. Enables optimisation of the capacitance for the type of power supply and since the capacitance is not positioned in the circuitry reduction in size and weight of the electronic apparatus.

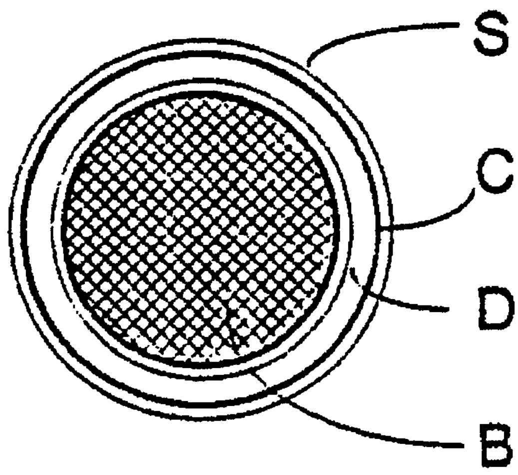

Fig. 2a

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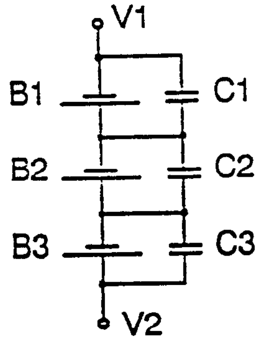

Fig. 1a

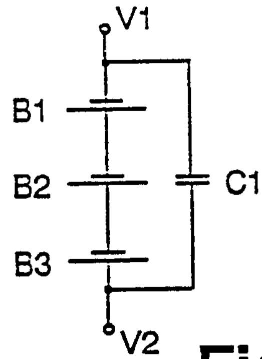

Fig. 1b

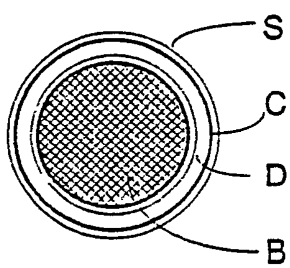

Fig. 2a

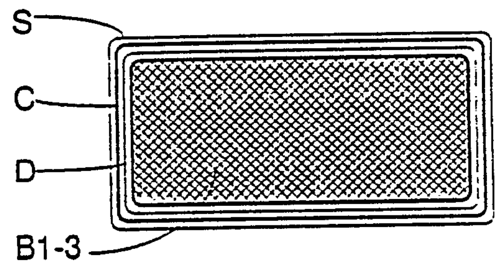

Fig. 2b

Integral power supply and capacitor

The present invention relates to power supplies and particularly to power supplies for a portable device, such as a radiotelephone or the like.

Typical power supplies for portable devices comprise batteries. An inherent characteristic of batteries is their internal impedance, which appears as variation of the terminal voltage when the battery is loaded. In TDMA (Time Division Multiple-Access) radiotelephones transmissions are time divided, which causes a pulsed current to be drawn from the battery. In other words, the battery is intermittently loaded. The voltage variation experienced at the battery terminals due to the intermittent loading will differ, depending on the respective system and the type of the battery. Such inconvenient voltage variation is conventionally compensated for by connecting a capacitor electrically in parallel with the battery, in mobile phones generally in connection with the electronics of the "telephone", because the battery is usually located in its own separate compartment.

The capacitor compensating for the battery voltage variation is selected according to the battery type, whereby its capacitance can vary in a rather large range, e.g. within the range 1 to 50 mF. However it is usually within 5 to 15 mF. Optimally we would select in each case the minimum capacitance, because a capacitor of this magnitude usually is round, and requires a large space. Usually the location of such a capacitor causes difficulties when designing the telephone.

The capacitance and other characteristics of the compensating capacitor must be dimensioned according to the highest requirements, because e.g. for a radiotelephone there are available different batteries with different capacities, and also different internal impedances due to the use of different technologies. Therefore the choice will generally not be optimal.

The present invention provides a power supply for portable electronic apparatus, said power supply including a housing comprising capacitative means integral with the housing and wherein the capacitative means are conformable with the housing. This has the advantage that the capacitative means can be optimised for the type of power supply of which it forms part. Furthermore, the overall size and weight of the power supply can be reduced, and the apparatus for which it is intended can be reduced in size and weight since it no longer requires such a capacitative means as part of its circuitry. Thus voltage variations of the terminals of a power supply can be compensated for using optimised capacitative means.

Suitably, the power supply comprises at least one electric cell having said housing.

This has the advantage that each cell of the power supply can have its own capacitative means which is optimised to yield the best performance possible from respective cells.

Alternatively, the power supply comprises a plurality of electric cells enclosed by said housing which is a convenient way of providing capacitative means optimised for a plurality of cells.

In a preferred embodiment the capacitative means are structurally integral with the housing. This has the advantage that the cost of the power supply is reduced since less materials are needed because the capacitative means can provide at least some of the structural functions which previously used dedicated materials. For instance, an electrode of the capacitative means could form an electrode, or part thereof, of an electrode of the power supply or cells.

Typically, the capacitative means comprises at least two electrically conductive members separable by a dielectric medium and arranged to have a substantially spiral cross-section, which is a particulary suitable arrangement for power supplies or cells having substantially rectangular, substantially circular or the like cross-sections.
Alternatively, the capacitative means comprises at least two substantially planar electrically conductive members separable by a dielectric medium which is particularly suitable for power supplies or cells comprising a planar structure.

The capacitative means and the power supply can be formed by strip-like elements, superimposed and spirally wound together for forming an integrated power supply and capacitor which is a particularly compact arrangement.

Embodiments of the invention are described in more detail below, by way of example only, and with reference to the enclosed drawings, in which:

figure 1 shows the basic circuit diagram of the integrated battery-capacitor of the invention, the battery package comprising three cells. In the embodiment example of figure 1a there is a capacitance in parallel with each cell. In the case of figure 1b a common capacitance is connected in parallel with the battery package; and

figure 2 in a simplified way shows embodiment examples of the battery-capacitor structure, whereby figure 2a is a capacitor connected to the sheath of a battery cell, and figure 2b is a capacitor connected to the sheath of a battery package.

The battery cells used in mobile phones and other small and light-weight equipment are of the nickel-cadmium (NiCd), metal hybrid, lithium, etc. type. Generally the battery is formed by series connected cells, e.g. 3 to 8 cells in series, whereby the battery package at its terminals generates a voltage, which is correspondingly e.g. 3,6 to 9,6 V. The battery cells are generally rods with a prismatic or circular cross section. Of course it is possible to apply the invention to batteries of different sizes and forms, as well as to a battery package, in which the battery forms a part of a power supply of the switched-mode type.

Figure 1a shows three battery cells B1 - B3 connected in series, forming a battery package with terminals marked as V1 and V2. An integrated capacitance C1, C2, C3 is arranged in parallel with each cell. Figure 1b shows a common capacitance C1 connected between the terminals V1 - V2 in parallel with the battery package. A person skilled in the art will realize that the principles of figures 1a and 1b can also be applied in other combinations. Thus the number of cells in the battery can be 1 to 8, and also larger. On the other hand, with the aid of battery packages, e.g. according to figure 1b, it is possible to form batteries consisting of several units, whereby each unit alternatively can have another number of cells B. Whether the capacitors are connected in parallel with single cells or in parallel with the battery package, or in some other combination referred to above, depends on the desired total capacitance, and of course on the structural aspects of the respective application. The dimensioning of different parallel/serial connections as such is well known to a person skilled in the art.

Figure 2a outlines how the invention is put into practice. The battery cell B can be some battery cell known as such, e.g. a rod-like Ni-Cd battery with a circular cross section, from which unnecessary paper, plastic or other wrapping layers are removed as required. A suitable dielectric sheath D is arranged around the cell B. In this schematic illustration a capacitor C is wound around the cell B, whereby in practice the capacitor could contain the required number of electrode film layers (not shown) isolated by dielectric film, and wound e.g. helically. The capacitor is protected by a sheath S in some way known as such.

Figure 2a does not show how the capacitor C is connected the the terminals V (figure 1) of the battery cell, but a person skilled in the art will realize that the connections at one end or at both ends of the battery between the films of the capacitor C and the battery terminals can be formed by means known as such, e.g. by conductors. It is also conceivable that the capacitor films are formed into integral extension strips, which extend outside the protecting sheath D and which are connected to the terminals of the battery cell.

Figure 2b shows a capacitor C formed in the sheath of the battery package. In this case the battery package contains the series connection of cells B1 - B3 shown in figure 1b. In other respects the structure is the same as in figure 2a. In this case the capacitor C (C1 in figure 1b) is connected directly to the battery package terminals V1, V2 by some of the above outlined means.

The capacitor wound in the sheath of the battery cell or the battery package is an advantageous embodiment, because the capacitance of the capacitor is directly proportional to the area of the electrodes. The electrodes can be made of some suitable film, and isolated by a suitable dielectric film, whereby the films, superimposed and joined together, are wound as a strip to form the sheath of the battery. Then we do not experience the problem occurring in common wound capacitors, where the first turns must be wound with a small radius.

Instead of a wound capacitor film strip it is of course possible to contemplate the use of layered film packages, whereby the packages could be located in a certain place of the battery cell, or several parallel connected film packages could be located in several places. In such an alternative the capacitor could be a package formed as the extension of the battery rod at the bottom or at the top, around which the extended sheath of the battery is wound, having substantially the same diameter as the protecting sheath of the battery cell.

In principle the above described structures of the integrated battery-capacitor can be simply realized, e.g. so that we take battery cells on the market which we connect in the desired way to form a battery package. Around these battery cells or around the finished battery package we can wind a suitably
made strip containing the capacitor electrodes and the di-electrics, after which we connect the electrodes to the battery terminals and encase them by a protecting sheath.

Of course it is also possible to make the integrated battery-capacitor in accordance with the invention in connection with the battery manufacture as a continuous series of steps. Then it would be possible to join the capacitor strip on a film strip forming e.g. a lithium battery cell, and to wind these strips together to form a helical wrapping which is provided with a suitable sheath and suitable terminals, to which the capacitor terminals are connected. The sheath can be made in a simpler way in the integrated manufacture.

In the design of a capacitor integrated with the battery it is of course necessary to observe that a low internal impedance is required of the capacitor. Further the materials of the capacitor must be selected so that they suitably withstand the temperature created by charging/loading the battery. However, these practical design factors are not dealt with in greater detail here, because their solutions are known as such to a person skilled in the art.

In view of the foregoing description it will be evident to a person skilled in the art that various modifications may be made within the scope of the invention.

The scope of the present disclosure includes any novel feature or combination of features disclosed therein either explicitly or implicitly or any generalisation thereof irrespective of whether or not it relates to the claimed invention or mitigates any or all of the problems addressed by the present invention. The applicant hereby gives notice that new claims may be formulated to such features during prosecution of this application or of any such further application derived therefrom.

Claims

1. A power supply for electronic apparatus, said power supply including a housing comprising capacitative means integral with the housing and wherein the capacitative means are conformable with the housing.

2. A power supply according to claim 1, wherein the power supply comprises at least one electric cell having said housing.

3. A power supply according to claim 1, wherein the power supply comprises a plurality of electric cells enclosed by said housing.

4. A power supply according to any preceding claim, wherein the capacitative means are structurally integral with the housing.

5. A power supply according to any preceding claim, wherein the capacitative means comprises at least two electrically conductive members separable by a dielectric medium and arranged to have a substantially spiral cross-section.

6. A power supply according to any of claims 1 to 5, wherein the capacitative means comprises at least two substantially planar electrically conductive members separable by a

dielectric medium.

7. A power supply according to any of claims 1 to 5, wherein the capacitative means and the power supply are formed by strip-like elements, superimposed and spirally wound together for forming an integrated power supply and capacitor.

8. A power supply according to any of claims 2 to 7, wherein the electric cells comprise NiCd, metal hybrid, lithium or other corresponding cells.

9. A power supply according to any preceding claim, wherein the capacitative means has a magnitude of 1 to 50 mF.

10. A power supply according to any preceding claim, wherein the capacitative means is electrically coupled in parallel across output terminals of the power supply.

11. A radio telephone comprising a power supply according to any preceding claim.

12. A power supply substantially as hereinbefore described and with reference to the drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 -11-
(The Search report)

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elevant Technical Fields

(i) UK Cl (Ed.L) H1B; H1M; H2H

(ii) Int Cl (Ed.5) H01M

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE DATABASES: WPI

Search Examiner
M J INSLEY

Date of completion of Search
14 DECEMBER 1993

Documents considered relevant following a search in respect of Claims :-
1-12

Categories of documents

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Category	Identity of document and relevant passages	Relevant to claim(s)
A	GB 0418629 (ELEKTRIZITAT) see whole document	

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