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[Continued on next page]

(54) Title: THIN FILM BATTERY

(57) Abstract: In an electric or electronic device containing a battery for power supply the battery is a solid state battery based on thin film technology, the battery is at least partially responsible for the shape of the electric or electronic device.

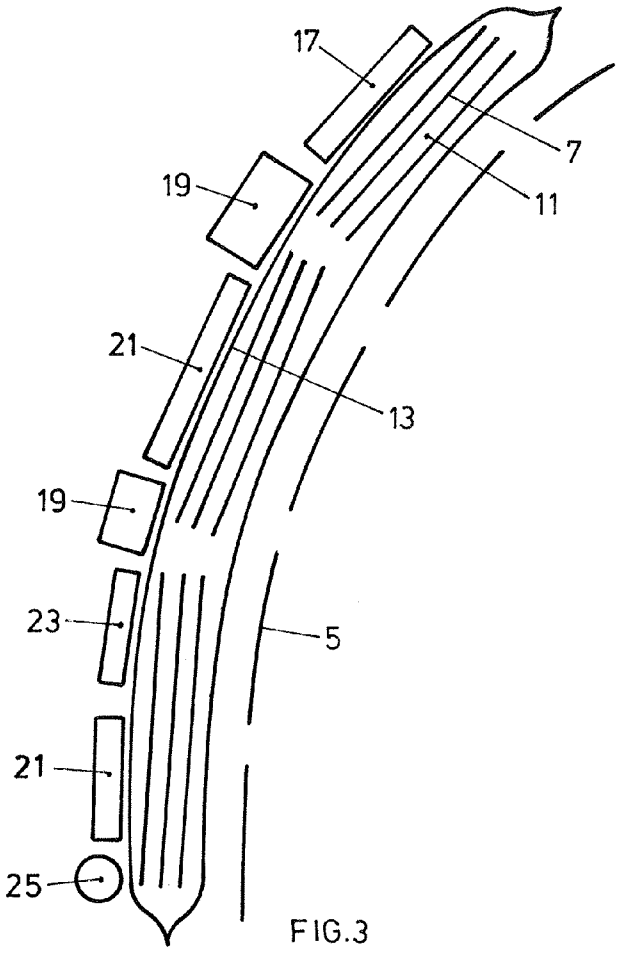

FIG.3

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THIN FILM BATTERY

The present invention refers to an electric or electronic device containing a battery supply according to the introduction of claim 1, in particular to a hearing device and a method for the production of an electric or electronic device.

Rechargeable standard cells or custom batteries are conventionally still separately packed and considered as separate components for safety reasons. The volume required for the battery package, the usually not optimum battery form and the reliable contacts or wiring between the battery and the electronic circuits limit the minimum HI volume and restrict the HI case design. Especially if one mechanical platform shall support different HI form factors, the degree of design freedom for the HI housing is very limited.

Various approaches are known to reduce the required volume for the arrangement of a battery at or in an electronic device, such as a hearing device.

Within the DE 100 23 907 it is proposed to arrange a plate like solid state accumulator battery within the housing of a hearing device. Furthermore, the WO 99/55131 proposes the arrangement of a foil battery, which is arranged on or

around a hollow cylinder to achieve high energy density to be used as energy storing unit for a hearing device.

The US 2009/0010462 proposes the use of a rechargeable thin film battery module for powering an external electric device.

It is an object of the present invention to integrate a battery with even more or maximal capacity within an available volume or which allows even to reduce the dimensions of the casing of an electric or electronic device as in particular a hearing instrument. The battery form should not restrict the casing of the electric or electronic case design for different power classes.

According to the present invention, an electric or electronic device is proposed according to the wording of claim 1. It is proposed that the device containing a battery for power supplies, the battery is a solid state battery based on thin film technology, the battery being at least partially responsible for the shape of the electric or electronic device.

One of the evolving rechargeable technologies is lithium based solid state batteries, based on thin film technology, comprising the deposit of the cathode, electrode and anode and the waver level packaging. This technology allows to neglect a specific battery packaging but to integrate the

battery directly into the mechanical and electronic design of a respective device, such as e.g. a hearing instrument.

Lots of patents cover rechargeable batteries in hearing aids based on solid state thin film or foil based batteries like the ones as mentioned above. Main focus is on form in order to fill up efficiently the case or recharging mechanism, folding, stacking, winding, but in general the battery is considered as a separate component of the electronic device.

According to the present invention the basic substrate of the electric or electronic device is mainly based upon solid state thin film batteries or foil based batteries and the electric or electronic components are arranged in connection to the battery elements. The use of the mentioned solid state thin film batteries or foil based batteries allows to adapt the shape of the battery to the form of the hearing device. In other words, the main shape of the hearing device is created by the arrangement of the batteries and the individual components, such as e.g. in case of a hearing instrument the chip, caps, antenna, cap switches, microphones etc. can be arranged in accordance with the shape as formed by the batteries. As a result, the battery or the batteries serve as the basic substrate for the electronic device, such as a hearing instrument.

The battery foils can either, at least partially, form the shell as such, or can be placed on the side of the shell, the top of the shell, the bottom of the shell or at any combination.

E.g. for BTE's the bottom face has always the same shape fitting behind a wearer's ear (see figure 1). Therefore, it is proposed to align the battery foil to the bottom face in order to use the same shape as a platform for all BTE designs. Different alignments to the bottom face are possible as shown e.g. in figure 2, which means either:

- according to figure 2a straight in one piece,
- according to figure 2b bended in one piece, and
- according to figure 2c straight or bended multiple pieces.

Multiple pieces may be arranged in multiple planes and in a certain angle. Where one foil does not provide sufficient capacity, multiple foils are stacked.

The invention is further described with reference to the attached figures, where examples of possible designs of inventive electronic devices are shown.

Figure 3 shows the possible arrangement of foil batteries, arranged in multiple planes to form the substrate of a hearing instrument,

figure 4 shows a further embodiment of the present invention, showing a hearing instrument complete in the canal,

figure 5 shows again a further possible embodiment of the present invention of a in-the-ear hearing device, and

figure 6 shows schematically the principle for recharging batteries of an electronic device according to the present invention.

As already mentioned above, figure 1 shows the principal shape of a behind the ear hearing device, where it becomes obvious that by increasing the capacity e.g. of a normally used knob battery 3, 3', 3'' also the shape of the hearing device 1 increases. Accordingly and taking the various proposed shapes of figure 2 into consideration, a packaging of a multiple piece battery is shown in principal in figure 3. The packaging foil 11 for the battery, serves either directly as the substrate as such for the hearing instrument electronics, which is adapted to the shape 5 of an ear of a user person. The battery pieces 7, which are arranged as stacks 11 of solid state thin film batteries, are arranged within a battery cover foil 13 serving as a PCB (Printed circuit board). The hearing instrument electronics are contacted on the battery or battery pieces respectively as shown in Figure 3, or wires are contacted directly to the battery stack. These electronic components

can be e.g. microphones 19, chips 17 and 21, antennas 25, caps 23, etc. The PCB serves for the interconnection of the electronic components like the mentioned chips, cap, antenna, cap switch, microphones etc, and for the connection of the electronic components to the battery elements.

The proposed kind of packaging consists of a minimum of packaging levels and provides therefore an overall system with minimum dimensions. The package composition aligned to the bottom shape of the HI remains identical for all types of BTEs. Maybe different lengths are required for different HI power classes. This gives the most degrees of freedom for the HI housing design.

Splitting the battery into multiple pieces e.g. to adapt to the required form can also be utilized to reduce the influence of different parts to each other like analog, acoustic output and digital processing, NVM (none volatile memory) access, memory control, or to physically allocate battery capacity to functionalities/components with different priorities. A further purpose for splitting is to have different energy potentials for functionalities/components with different energy requirements such as e.g. microelectronics vs. electro-acoustic transducers.

A similar architecture can be chosen for the ITE/CIC (complete in the canal) products. Either the module consists of multiple subcomponents flexible in a row extending from a microphone 19 at the face plate 33 to the receiver 27, as shown in figure 4, or the battery has form optimized to the lateral cut of the ear canal, e.g. stacked displaced ellipses with same or different axes length and same or different axes orientation as shown in figure 5. On top 49 and on the bottom 51 of this battery module 47 the electronic components can be mounted. In case of big components, like receivers, spare volume in the battery component may be provided to fit the receiver into. Top and bottom layer PCB are connected in order to interconnect electronic components of the two layers.

The coupling component for contact-less recharging of the inventively proposed film or foil based batteries can be put to any face of the electronic device, such as of the hearing instrument. But when allocating it as a foil below the battery foil, as shown in figure 6, or around each layer of the battery, the coupling component gets a standard form for all electronic devices as e.g. behind the ear 1 designs. This standard form of solid state batteries 7,11 and battery cover foil 13 is ideal as a platform, provided on a charger module 61.

The various proposed examples of electronic devices using thin film or foil batteries, gives the advantage of more efficient packaging with solid state thin film rechargeable

batteries. It allows to decrease the required volume for electric and electronic devices as e.g. for BTEs as well as for ITE/CIC's.

The main purpose of the shown embodiments within figures 2 to 6 is for the better understanding of the present invention. The given examples are of course not at all limiting and it is possible to use the proposed arrangement of thin film battery to any kind of electronic and electric devices and even more gives the possibility to reduce the required volume, especially for arranging power supply units within such kind of devices. The main idea of the present invention is to use thin film or foil batteries to create at least partially the design or shape of the electric or electronic device, which means as a result the power supply elements are at least partially responsible for the shape of the substrate of the mentioned devices.

Claims

1. Electric or electronic device containing a battery for power supply, characterized in that the battery is a solid state battery based on thin film technology, the battery is at least partially responsible for the shape of the electric or electronic device.

2. Device according to claim 1, characterized in that the basic substrate of the device is mainly based upon solid state thin film batteries or foil based batteries and in that electric component are arranged in connection to the battery elements.

3. Device according to one of the claims 1 or 2, characterized in that the battery or batteries are splitted into multiple pieces to adapt at least to a great extend the required form of the device.

4. Device according to one of the claims 1 to 3, characterized in that coupling elements for contact less recharging of the batteries are arranged.

5. Device according to one of the claims 1 to 4, characterized in that lithium based solid state batteries are used based on thin film technology.

6. Device according to one of the claims 1 to 5, characterized in that the battery or batteries serve either directly as printed circuit board for the

electronics or electronic components or the printed circuit board of the device is contacted on the battery or battery pieces respectively, the printed circuit board serves for the interconnection of the electronic components like chips, caps, antennas, cap switches, microphones, etc. and for the connection of the electronic components to the battery elements.

7. Device according to one of the claims 1 to 6, characterized in that it is a hearing instrument, such as a behind the ear instrument, an in-the-ear instrument or a complete in-the-canal hearing instrument.

8. Method for the production of an electronic or electric device, characterized in that the casing and/or the substrate of the device is at least partially or to a great extend formed by the battery or by batteries.

9. Method according to claim 8, characterized in that the battery is splitted into multiple pieces to adapt the required form of the electric or electronic device.

10. Method for the production of a hearing instrument, characterized in that the substrate form or architecture of the instrument is at least to a great extend influenced by the arrangement of the battery or the batteries, based on thin film technology.

11. Method according to claim 10, characterized in that the battery or batteries are at least to a great extend arranged such as to influence the standard form of a BTE, an ITE or a CIC hearing instrument, the hearing instrument electronics are arranged directly on the battery or batteries.

12. Method according to one of the claims 9 to 11, characterized in that for physically allocate battery capacity to functionalities/components with different priorities the battery is splitted into multiple pieces.

13. Method according to one of the claims 9 to 12, characterized in that the battery is splitted into multiple pieces to adapt different energy potentials for functionalities/components with different energy requirements as e.g. microelectronics vs. electro-acoustic transducers.

14. Method according to one of the claims 8 to 13, characterized in that the battery is split into multiple pieces to power parts of the circuitry independently in order to reduce interference through power supply.

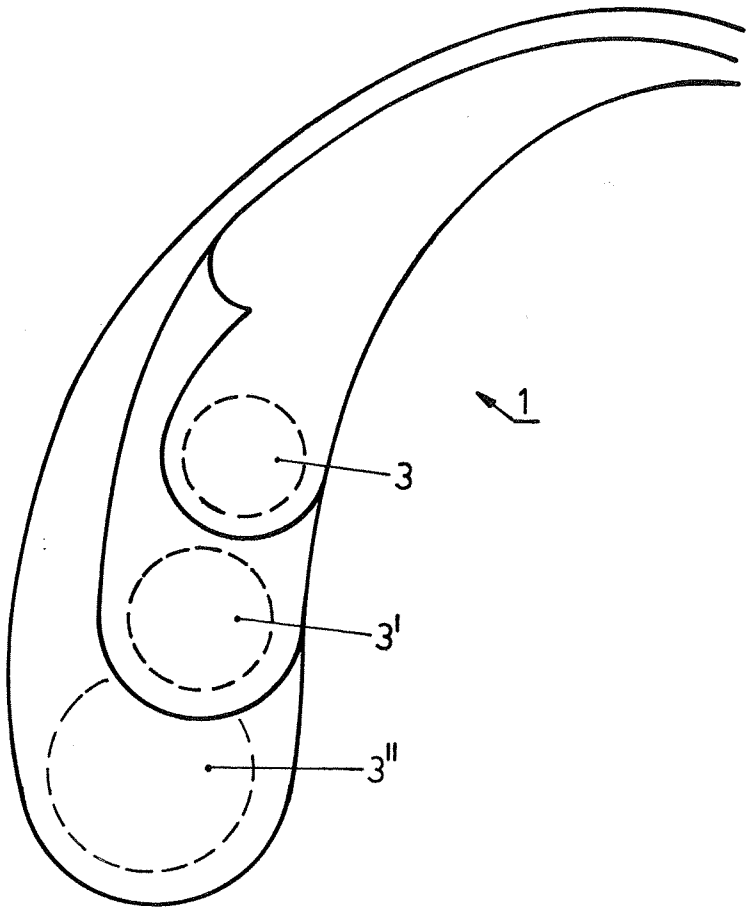

FIG. 1

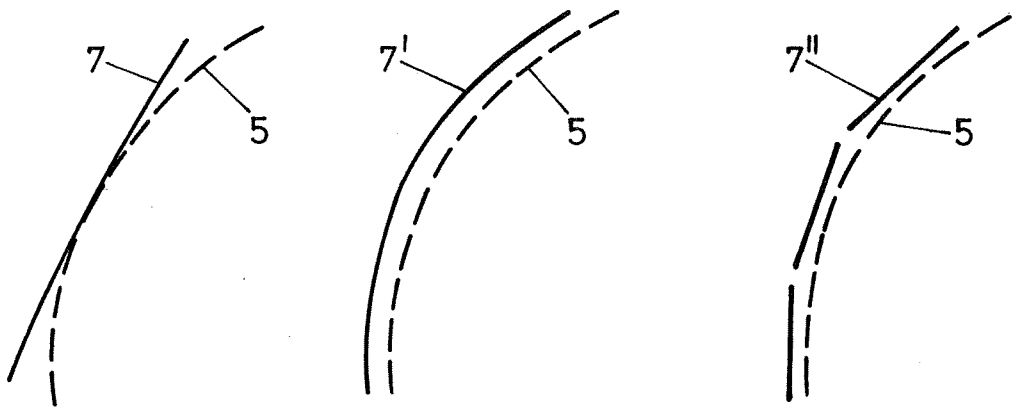

FIG. 2

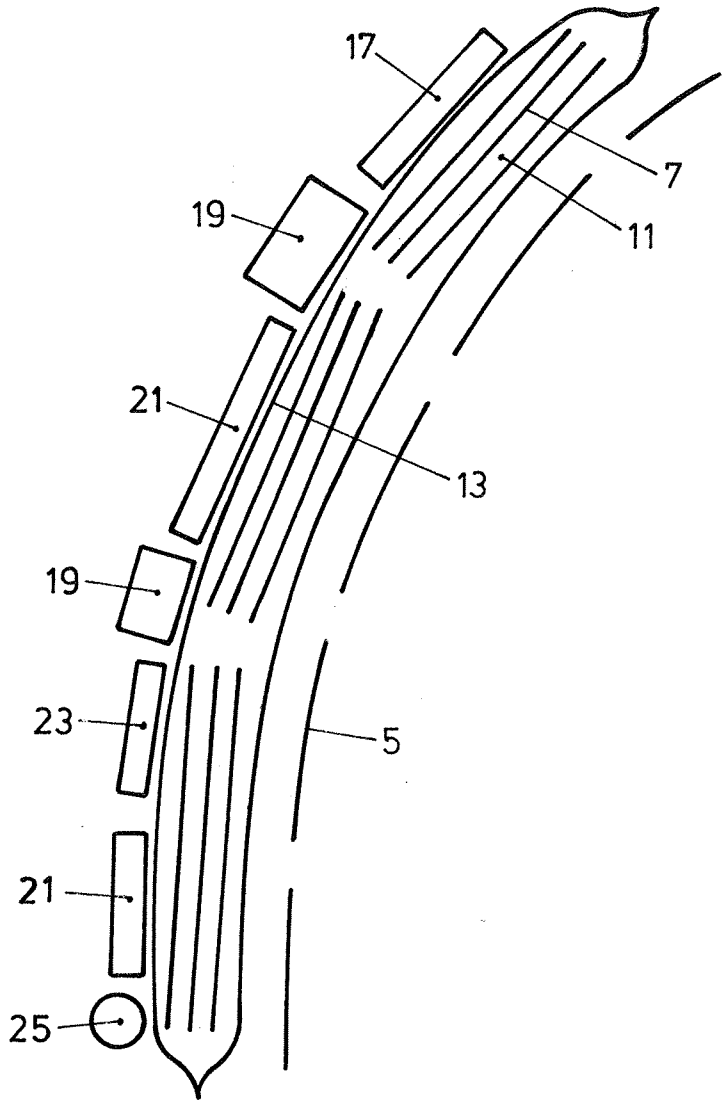

FIG.3

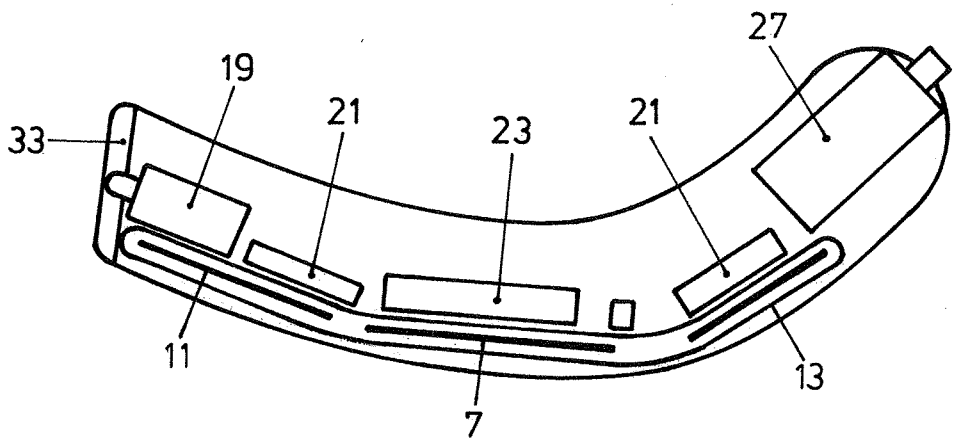

FIG.4

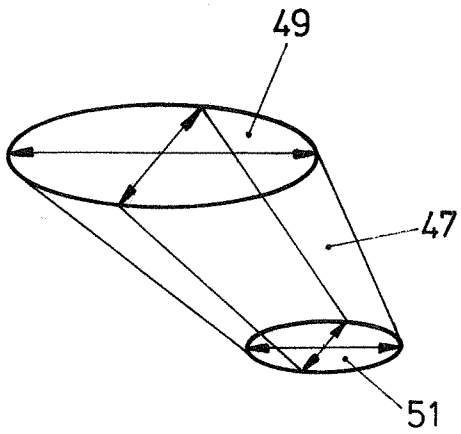

FIG.5

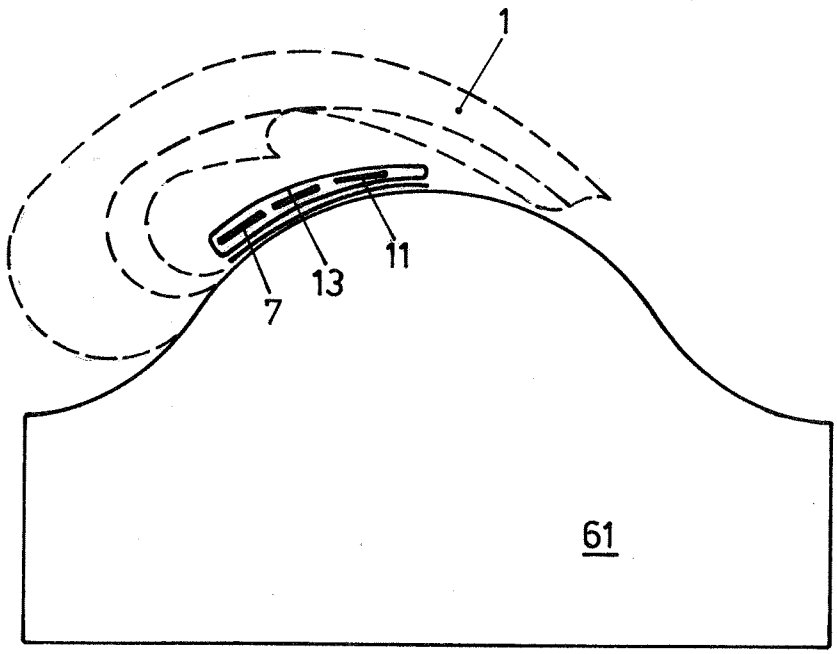

FIG.6