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Patent Claims

1. Button cell containing, arranged one on top of
5 the other in a flat cylindrical gastight housing, at least one positive electrode and one negative electrode with a separator situated in between, and also an electrolyte, characterized in that the electrodes are of square or hexagonal shape.
- 10 2. Button cell according to Claim 1, characterized in that the electrodes are cut or punched out of a strip material.
3. Button cell according to Claim 2, characterized in that the strip material is formed by rolling together
15 a rolled strip composed of an active-mass powder compacted in a rolling mill and a metal-cloth strip or expanded-metal strip.
4. Button cell according to Claim 3, characterized in that the expanded metal is composed of nickel or
20 nickel-plated steel.
5. Button cell according to one of Claims 1 to 4, characterized in that it contains a positive nickel hydroxide electrode, a negative cadmium or hydrogen storage electrode and an alkaline electrolyte.
- 25 6. Button cell according to one of Claims 3 to 5, characterized in that the metal-cloth or expanded-metal layer of each electrode faces the housing lid or housing base.
7. Button cell according to one of Claims 3 to 6,
30 characterized in that the metal-cloth or expanded-metal strip is additionally coated with a mixture composed of active carbon, conducting soot and a hydrophobic binder.
8. Button cell according to one of Claims 1 to 7, characterized in that a predetermined breaking point in
35 the form of a groove-shaped weakening of the housing wall is provided on its housing.



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Button Cell

The invention relates to a button cell containing, arranged one on top of the other in a flat cylindrical gastight housing, at least one positive electrode and one negative electrode with a separator situated in between, and also an electrolyte.

Button cells comprise a housing cup and a lid which are both produced as punched and drawn parts from nickel-plated deep-drawing strip steel. Normally, the housing cup is positively polarized and the lid negatively polarized. With this construction, they may contain different electrochemical systems. Button cells of the rechargeable Ni/Cd system are very widespread. Recently, button cells containing metal oxide/metal hydride systems, in particular Ni/Nickel hydride cells, have been acquiring increasing importance.

At least the positive electrodes of many conventional button cells, and in the case of the alkaline Ni/Cd system also the negative electrodes, are mass electrodes in the form of pressed powder pellets enclosed in a fine-mesh pure-nickel wire cloth.

A fine-pore separator composed of plastic mat is arranged between the electrodes. A corrugated spring contact on the back of the negative electrode produces a defined compressive pressure on the plate group and consequently results in a uniform contact resistance between electrodes and housing.

The cells are closed by flanging the cup rim over the lid rim. In this arrangement, a plastics ring is used simultaneously as sealing ring and to insulate the cup from the lid.

The manufacture of pressed powder electrodes for button cells is laborious and, in addition, unsuitable for an efficient production cycle, which is largely determined by automatic operations. The mass powder has first to be dispensed and pressed into the pellet; the pellet is then placed in a small basket composed of a nickel wire cloth and covered with a small plate composed of the same cloth material, and the small basket is



closed by wrapping a rim projecting beyond the pellet over the small cover plate. The electrode is then subjected once again to the pressure of a pressure ram.

Because of the discontinuous sequence of operating steps, this method is not only time-consuming, but also expensive as a result of the expenditure on nickel wire cloth netting which substantially exceeds the amount necessary for electrode reinforcement and for current collection.

10 The object of the invention is therefore to make available for the assembly of button cells of the standard type electrodes which are not inferior in their electrical performance, for example, to the pressed powder pellets but can be produced in a more efficient
15 way, if possible in an automatable manner.

The object is achieved, according to the invention, by means of a button cell as defined in Claim 1.

According to this claim, the button cell is fitted with electrodes of square or hexagonal form
20 instead of round electrodes. A particular advantage of these new electrodes is that they can be cut out in the desired shape not in the manner which is standard for the round pressed powder pellets but much more simply from a rolled electrode strip which is in finished form per se.
25 However, even when compared with round electrodes, which can likewise be cut from an endless strip, the angular electrodes according to the invention have the advantage that their shape makes possible a utilization of the strip material, which is virtually free of any cutting
30 waste.

The continuous production of a rolled strip readily fits into the automatic manufacturing flow of the button-cell production.

The invention is explained in greater detail
35 below with reference to a few figures.

Figure 1 shows a diagrammatic representation of the method of manufacture of the electrodes according to the invention,

Figure 2 shows the capacity of the rolled strip to be



broken up into square-shaped or hexagon-shaped electrodes,

Figure 3 shows a button cell having square-shaped electrodes,

5 Figure 4 shows a button cell having hexagon-shaped electrodes.

According to Figure 1, mass powder is fed from a feedstock container 1 via the feeding hopper 2 onto the roller pair of a rolling mill or calender 3 and compacted
10 to form a rolled strip. Simultaneously, a nickel wire cloth strip 5 which is stored on the coil 4 and which may also be replaced by a nickel expanded metal or a nickel-clad iron expanded metal, is drawn in by the calender over guide rollers 6 and rolled together in the calender
15 with the mass powder.

The rolled strip 7, reinforced on one side, passes over further guide rollers 8 and runs between cutting rollers 9 which separate it into webs of the desired width. The webs are then cut into square or
20 hexagonal single electrodes in the punching device 10.

The possibility of dividing up a rolled strip 11 into square electrodes (for example of side length 5.8 mm and of area 33.6 mm^2) is shown in Figure 2a and the capability of being divided up into hexagonal electrodes
25 (for example of side length 4.1 mm and of area 43.6 mm^2) is shown in Figure 2b.

In the case of square division, the waste of processed strip is virtually zero. In the case of hexagonal division, a small cutting loss of 4.6 % due to
30 unusable edge regions has to be accepted.

Electrodes of the shape according to the invention which can be cut or punched from a rolled strip are consequently extremely advantageous in relation to a material saving.

35 The state of affairs is, on the other hand, disadvantageous if the rolled strip is to be divided up into round electrodes of similar size in accordance with the pattern of a hexagonally close packed arrangement as in Figure 2b. The cutting waste is in that case theoretic-



cally 11 %, but is in practice much higher for tool reasons.

Figure 3 shows a button cell 12 comprising square electrodes 13, 13' and Figure 4 shows a button cell 14 comprising hexagonal electrodes 15, 15', in each case in cross section and in a plan view of the housing cup from inside.

The electrodes are separated by a mat separator 19 and mounted in the housing formed from the housing cup 16 and lid 17 with the inclusion of the sealing ring 18 in such a way, usually, that the metal netting or expanded-metal overlays 20 point outwards, i.e. towards the housing parts. To produce the necessary compressive pressure, the negative electrode 13' additionally has a contact spring 21.

In the plan view of the base area of the housing cup, the positive electrode can in each case readily be recognised as a square or rectangle inscribed in the circular sealing ring.

Button cells according to the invention may preferably be based on the rechargeable Ni/Cd and Ni/metal hydride (Ni/MH) systems.

In that case, such cells are provided not only with an alkaline electrolyte but with a positive nickel hydroxide electrode and a negative cadmium electrode or a negative electrode composed of an alloy metal capable of storing hydrogen.

The voids between the round cell seal and the angular electrodes have proved to be a very effective remedy for the problem of so-called squeezing (pressing out of excess electrolyte when pressure is exerted on the electrode assembly when Ni/MH button cells are closed, which may result in leakages) since they provide free spaces for the electrolyte squeezed out. If round electrodes are used, this possibility could be provided only by means of an expanded-metal inlay underneath the positive electrode.

The novel electrodes also behave with mechanical stability towards the effects encountered in a treatment



with alkaline solution preceding the assembly. The treatment with alkaline solution is a standard practical step which comprises decarbonatizing a negative cadmium mass, first precipitated as cadmium carbonate for reasons of better filterability, with hot alkaline solution, i.e. reprecipitating it to form $\text{Cd}(\text{OH})_2$. It has been found that the calendered electrodes do not break off at the edges during the decarbonatizing.

To improve the gas take-up, the negative rolled-strip electrode according to the invention may advantageously be brought into contact with a material which catalyses the oxygen reduction. Such a material is, for example, a mixture of active carbon, conducting soot and a hydrophobic binder. During the electrode production process, this mixture can either be rolled into the metal cloth or expanded metal provided as carrier strip before it enters the calender together with the mass powder or it may be later rolled onto the electrode rolled strip which is in finished form per se. As a result of the direct electron-conducting contact with the main electrode, this layer functions as auxiliary electrode whose virtually polarization-free surface is the preferred oxygen take-up point.

It is also within the scope of the invention for the button cell to have a safety valve in the form of a weak point which is introduced into the housing wall and which serves as predetermined breaking point which bursts at extremely high internal pressure and thus prevents the cell from bulging. Such weak points are preferably groove-shaped recesses in the base of the housing cup and take the form of polarity symbols (+ sign) or company symbols.

The electrodes according to the invention have made button cells available which are at least equal to known button cells of identical shape and size but fitted with conventional electrodes in expensive cloth-basket enclosures in terms of capacity. As a result of the better material utilization in relation to the consumption of metal-cloth netting, however, a cost saving of up

to 50 % is achieved with the novel electrodes.

Experiments have furthermore shown that specified capacities laid down for button cells comprising round .
rolled-strip electrodes are also fulfilled with the
5 square or hexagonal electrodes according to the
invention.

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Fig. 1

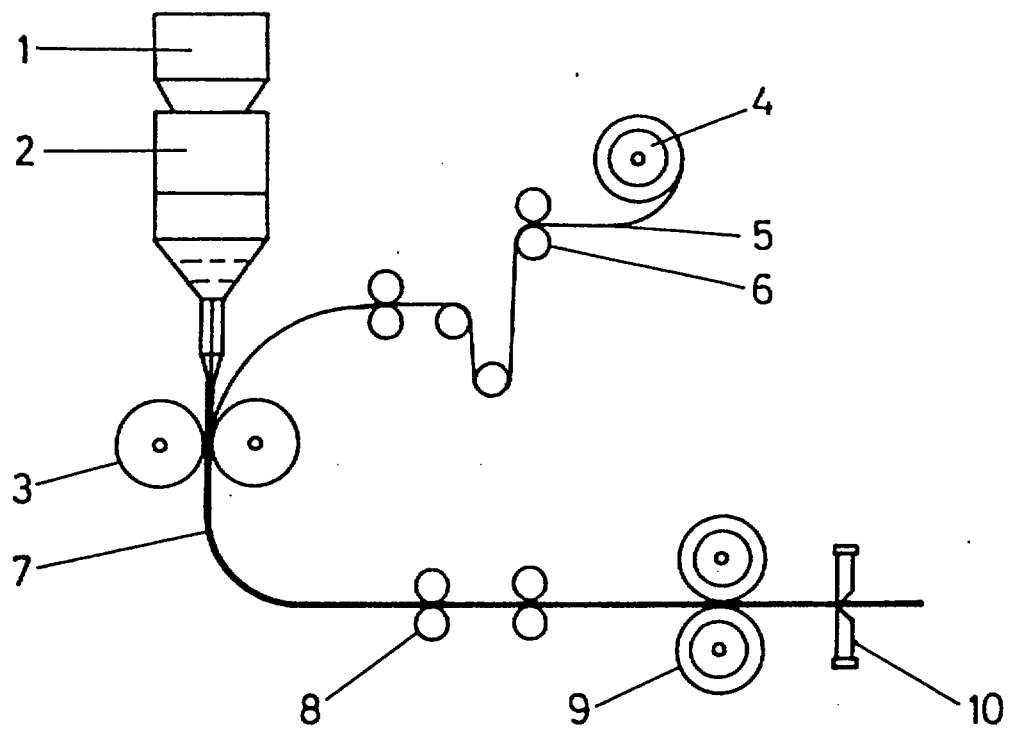


Fig. 2a

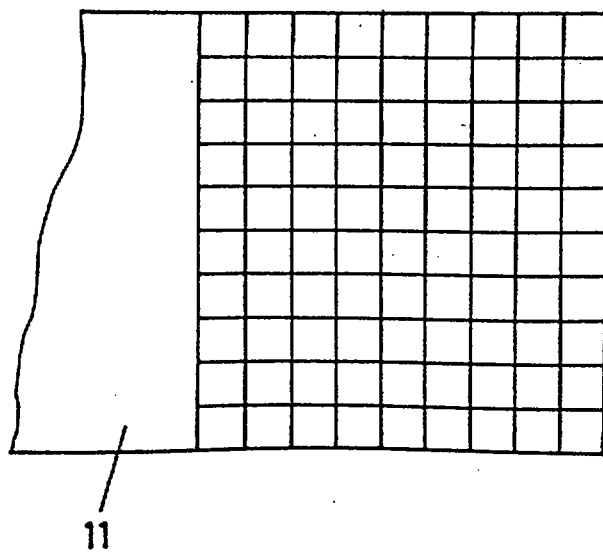


Fig. 2b

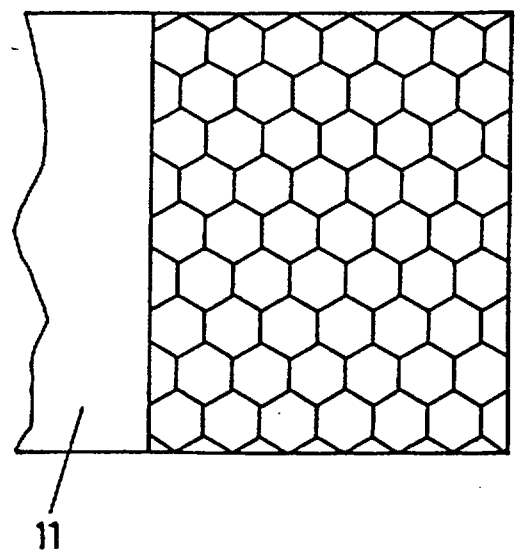


Fig. 3

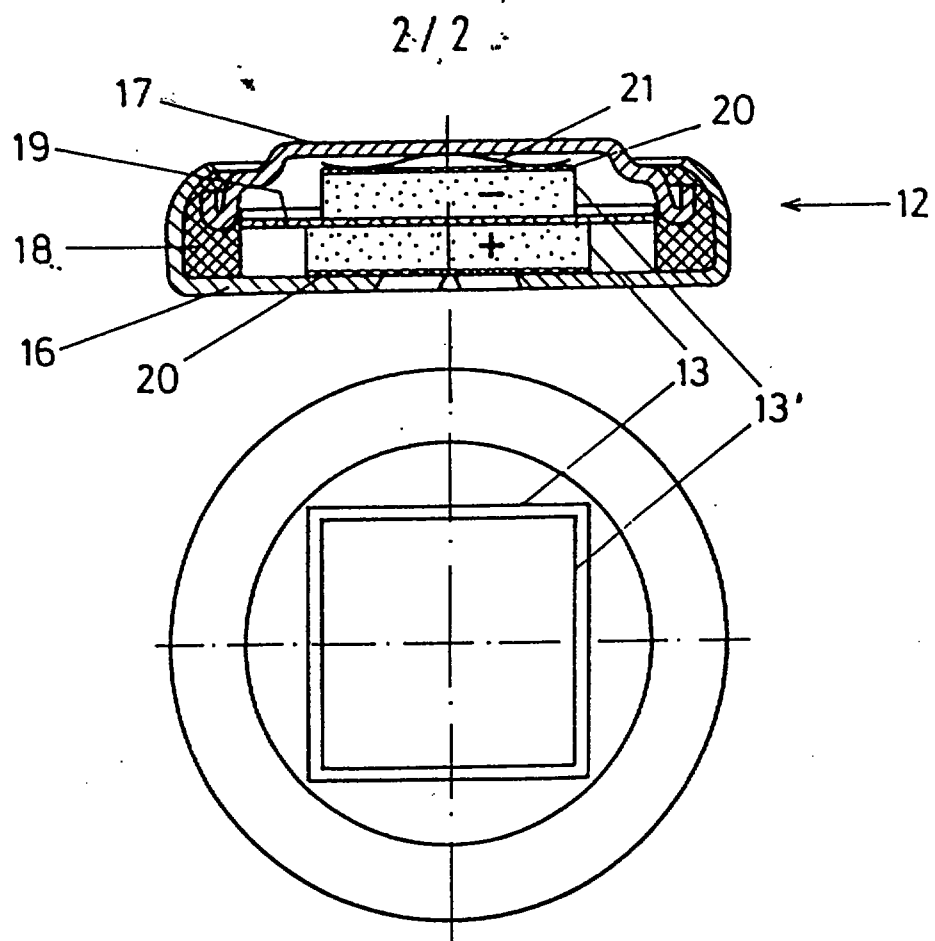
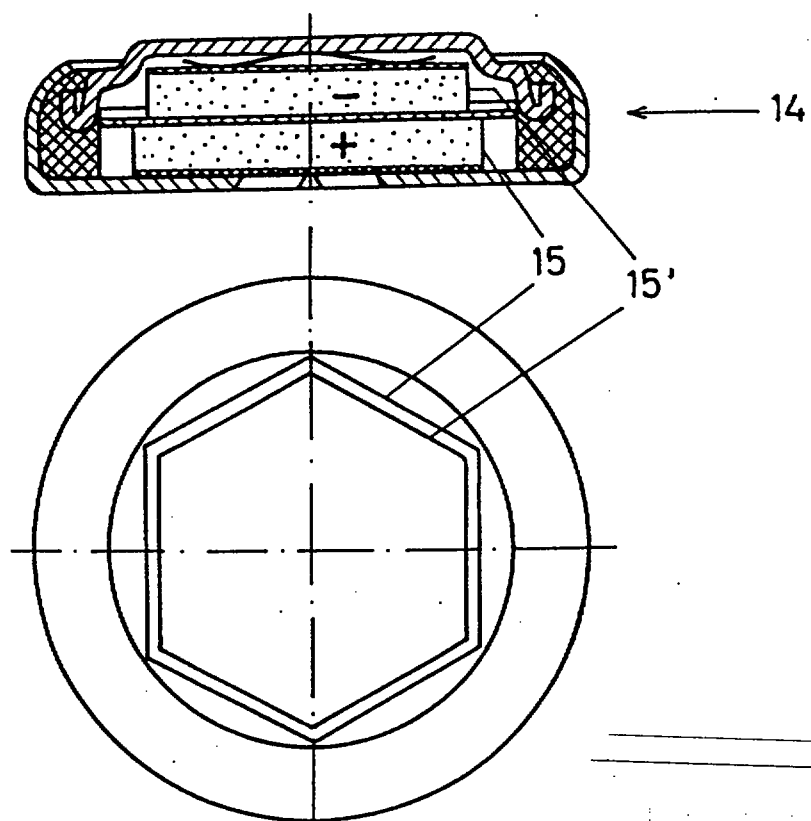


Fig. 4



Abstract.

Button Cell

Instead of the conventional round pressed powder electrodes with nickel wire cloth enclosure, a button
5 cell (12) contains, in a flat cylindrical housing, square
or hexagonal electrodes (13, 13') which can be cut out of
a continuously manufactured rolled strip with a metal-
netting overlay without appreciable material waste. The
netting overlays (20) face the housing cup (16) or the
10 lid (17) when the electrodes are fitted. The free space
left between the electrode edges and the round internal
cell boundary is available as electrolyte collecting
space and is advantageous for the gas take-up.

Published with Figure 3

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BUTTON CELL

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18 JUL 1997

The invention relates to a button cell which contains arranged one above the other in a gas-tight housing of ~~flat cylindrical~~ shape at least one positive and one negative electrode having an interposed separator and an electrolyte.

Button cells comprise a housing cup and a cover, both made of nickel-plated deep-drawing strip iron as punched drawn parts. The housing cup is conventionally the positive pole and the cover the negative. They may then contain various electrochemical systems. Button cells of the recharging Ni/Cd system are in very widespread use. Button cells having metal oxide/metal hydride systems, in particular Ni/nickel hydride cells, have recently become increasingly important.

At least the positive electrodes of many conventional button cells, and the negative electrodes in the case of the alkaline Ni/Cd system, are mass electrodes in the form of pressed powder tablets which are enclosed in a fine-meshed pure nickel gauze.

There is arranged between the electrodes a fine-pored separator of nonwoven plastics. A corrugated contact spring on the rear side of the negative electrode brings a defined pressing power to act on the plate group, thus giving rise to a steady contact resistance between the electrodes and the housing.

The cells are closed by flanging the cup rim over the cover rim. A plastics ring here assumes the dual role of a sealing ring and insulation between the cup and the cover.

Producing powder pressed electrodes for button cells is awkward and is moreover unsuitable for a continuous production sequence which is largely determined by automatic operating cycles. The mass powder must first be apportioned and pressed into a tablet; the tablet is then placed in a nickel gauze basket and is covered with a lamina of the same woven material, and the basket is closed by folding in over the covering plate a rim which protrudes beyond the tablet. The electrode is then again

18 JUL 1997

subjected to pressure by a pressure ram.

Because the successive working steps are discontinuous, this process is not only time-consuming but is also costly because substantially more nickel gauze net is required than is necessary for reinforcing electrodes and for current dissipation.

Patent documents JP-A 57-128 459 and EP-A 0 123 900 disclose button cells in which the negative electrode is produced from a metal in strip form or an alloy, in particular of lithium or a lithium alloy.

The object of the invention is to provide electrodes bound to the support for equipping button cells.

The object is achieved according to the invention by means of a button cell such as is defined in Claim 1.

According to Claim 1, the button cell is equipped with electrodes which are square or hexagonal rather than round. A particular advantage of these novel electrodes is that they can be stamped out, not as conventionally in the case of round pressed powder tablets, but very much more simply from an electrode rolled strip which is per se complete and corresponds to the desired form. But the angular electrodes according to the invention also have the a priori advantage over round electrodes, which can likewise be cut out from a continuous strip, of being able by virtue of their shape to utilise the strip material fully, virtually eliminating off-cuts.

The continuous production of a rolled strip is a straightforward addition to the automatic process flow of button cell manufacture.

The invention is explained below in greater detail with the aid of diagrams where:

18 JUL 1997

- Fig. 1 shows in schematic form the method of manufacturing electrodes according to the invention;
- Fig. 2 shows the divisibility of the rolled strip into electrodes of square or hexagonal form;
- Fig. 3 shows a button cell having electrodes of square form;
- Fig. 4 shows a button cell having electrodes of hexagonal form.

According to Fig. 1, mass powder is delivered from a supply container 1 by way of the feeding hopper 2 on to the pair of rolls of a roller mill or a calender 3 and is compressed to a rolled strip. A nickel wire [**] which is supplied on the coil 4 [***] iron expanded metal may also replace is drawn in simultaneously by the calender by way of guiding rollers 6 and is there rolled together with the mass powder.

The rolled strip 7, reinforced on one side, passes through further guiding rollers 8 and runs through cutting rollers 9 which divide it into webs of the desired width. The webs are then dissected in the punching device 10 into square or hexagonal single electrodes.

Fig. 2a illustrates the possibility of dividing a length 11 of rolled strip into square electrodes (for example of a 5.8 mm edge length and a 33.6 mm² surface area) and Fig. 2b the possibility of dividing it into hexagonal electrodes (for example of a 4.1 mm edge length and a 43.6 mm² surface area).

Square division results in virtually zero processed strip waste. In the case of hexagonal division the percentage off-cut inevitably occasioned by the unusable portions at the edge is only 4.6%.

Electrodes of a form according to the invention, which can be removed or punched out from a rolled strip, consequently afford extremely favourable material savings.

18 JUL 1987

On the other hand, the economics are less favourable if the length of rolled strip is to be divided into round electrodes of the same size in accordance with the tessellating hexagonal pattern as shown in Fig. 2b. The cutting waste in this case is theoretically 11%; however, in practice it is far greater for technical reasons related to the machinery.

Fig. 3 illustrates a button cell 12 having square electrodes 13, 13' and Fig. 4 a button cell 14 having hexagonal electrodes 15, 15', with each shown both in cross-section and in an internal plan view of the housing cup.

In the housing formed by the housing cup 16 and the cover 17 including the sealing ring 18, the electrodes are separated by a nonwoven separator 19 and are normally mounted such that the metal net or expanded metal supports 20 face outward, that is to say toward the parts of the housing. In order to create the requisite pressing power, there is additionally allocated to the negative electrode 13' a contact spring 21.

The plan view of the floor surface of the housing cup shows clearly the positive electrode as a square or hexagon, respectively, inscribed in the circular sealing ring.

Button cells according to the invention can preferably be based on the rechargeable Ni/Cd and Ni/metal hydride (Ni/MH) systems.

Such cells then contain, in addition to an alkaline electrolyte, a positive nickel hydroxide electrode and a negative cadmium electrode or a negative electrode of an alloying metal enabled to store hydrogen.

The interstices between the round cell seal and the angular electrodes have proved to be a most effective remedy for the problem known as squeezing (excess electrolyte being expressed as pressure is exerted on the electrode assembly during closing of Ni/MH button cells, which may result in incomplete sealing),

18 JUL 1997

in that they afford free spaces for the squeezed-out electrolyte. If round electrodes were utilised, this opportunity could be created only by means of an expanded metal insert beneath the positive electrode.

Where an alkali treatment precedes installation, the behaviour of the novel electrodes vis-à-vis the influences is also mechanically stable. The alkali treatment step is normal practice, with a negative cadmium mass which for reasons of improved filtrability is first precipitated as cadmium carbonate being decarbonised, that is to say reprecipitated to $\text{Cd}(\text{OH})_2$, with hot alkali. It has emerged that the calendered electrodes do not crumble away at the edges during decarbonisation.

In order to improve gas consumption the negative rolled strip electrode according to the invention can advantageously be combined with a material which catalyses oxygen reduction. An example of such a material is a mixture of activated carbon, conductive carbon black and a hydrophobic binder. During the electrode manufacturing process, this mixture may be either rolled into the woven or expanded metal provided as the support strip before the latter runs into the calender together with the mass powder, or rolled subsequently on to the electrode rolled strip which is per se complete. As a result of the direct electron-conducting contact with the main electrode, this layer acts as an auxiliary electrode whereof the virtually polarisation-free surface is the preferred site of oxygen consumption.

The scope of the invention also includes the availability to the button cell of a safety valve taking the form of a weakness which is incorporated in the housing wall and, as a predetermined break point, bursts open when the internal pressure is extremely high, thus preventing bulging of the cell. Such weaknesses are preferably groove-shaped recesses in the base of the housing cup and are formed as a polarity sign (+ sign) or as a company logo.

18 JUL 1997

The electrodes according to the invention afford ~~button cells~~ which, in terms of capacity performance, rank at least equal with known button cells which are of the same form and size but are equipped with conventional electrodes in wasteful woven basket enclosures. The better utilisation of material in terms of metal gauze net consumption, however, achieves cost savings of up to 50% in the case of the novel electrodes.

Tests have further shown that rated capacities which are prescribed for button cells having round rolled strip electrodes can also be met with the square or hexagonal electrodes according to the invention.



18 JUL 1997

Claims

1. Button cell which contains arranged one above the other in a gas-tight housing of flat cylindrical shape at least one positive and one negative electrode having an interposed separator and an electrolyte, with the anode being cut or punched in polygonal form from a strip material, characterised in that the anode and the cathode are manufactured from strip material which are [*] formed by rolling together a rolled strip of active mass powders compressed in a roller mill and a strip of woven or expanded metal, with the anode and the cathode being of square or hexagonal form.
2. Button cell according to Claim 1, characterised in that the expanded metal comprises nickel or nickel-plated steel.
3. Button cell according to Claim(s) 1 and/or 2, characterised in that it contains a positive nickel hydroxide electrode, a negative cadmium or hydrogen storage electrode and an alkaline electrolyte.
4. Button cell according to one or more of Claims 1 to 3, characterised in that the layer of woven or expanded metal of each electrode faces the cover or base of the housing.
5. Button cell according to one or more of Claims 1 to 4, characterised in that the strip of woven or expanded metal is additionally coated with a mixture of activated carbon, conductive carbon black and a hydrophobic binder.
6. Button cell according to one or more of Claims 1 to 5, characterised in that there is provided on the housing thereof a predetermined break point in the form of a groove-shaped weakness in the wall of the housing.

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REPLACEMENT SHEET

31 OCT 1998

Abstract.

Button Cell

Instead of the conventional round ~~pressed powder~~ electrodes with nickel wire cloth enclosure, a button cell (12) contains, in a flat cylindrical housing, square or hexagonal electrodes (13, 13') which can be cut out of a continuously manufactured rolled strip with a metal-netting overlay without appreciable material waste. The netting overlays (20) face the housing cup (16) or the lid (17) when the electrodes are fitted. The free space left between the electrode edges and the round internal cell boundary is available as electrolyte collecting space and is advantageous for the gas take-up.

Published with Figure 3