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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
5 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
10 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
15 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
20 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
25 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
30 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
35 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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