

The invention relates to a plate electrode with a metal covering, intended for use in alkaline electrochemical cells, for example nickel/cadmium storage batteries.

Compared to plate electrodes for acidic electrochemical cells, e.g. lead-acid storage batteries, the coverings differ both as regards the material used and also, more importantly, as regards workability and form (metal fabric!).

In conventional pocket-type plates of this type the cover walls are usually made from perforated metal sheet, e.g. nickel-coated iron plate. The normally elongate pockets are manufactured individually from perforated strips of metal, and after being filled with the active mass and sealed they are assembled to make a pocket-type plate by joining their long edges together (e.g. by means of interlocking hem flanges). The pockets, which as a rule are arranged horizontally on top of one another, are joined at the side edges of the pocket-type plate by metal skirts, and a metal crosspiece with a diverting vane joins the lateral metal skirts at the top edge of the pocket-type plate.

The large number of operations involved makes the manufacture of such a pocket-type plate highly complex, both as regards the machinery required and as regards the scale of the work involved. However, as is known, pocket-type plates of this sort also have qualitative defects compared to other types of electrode such as sintered plates, e.g. poor utilisation of the mass, high internal resistance, high contact resistance between the active mass and the electrolyte, poor current conduction to the diverting vane and low power-to-weight ratio.

FR-A-2 140 150 discloses a plate electrode, more particularly one for lead-acid storage batteries, with a grid of synthetic material as a support for the active mass. The active mass forms a continuous covering on one or both sides of the grid of synthetic material and extends into the openings of the grid. A layer of fibre material is applied on the outside of this covering and contains electrically conductive material for carrying the current. In this embodiment the layer of fibre material is not joined to the grid of synthetic material. According to one alternative design, the layer of fibre material may be applied straight onto the grid of synthetic material and carry the active mass on its outer face. The mechanical stability of a plate electrode with this design relies on the active mass being dimensionally stable.

FR-A-2 347 790 describes an Fe/Ni storage battery in which the positive electrodes are plate electrodes, with the compressed pulverised active mass disposed between

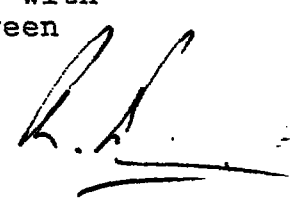


plate-sized pieces of metallic fabric. However, this patent contains no information about constructional details of the plate electrode in the region of the active portion. More particularly, it does not reveal how the pieces of metallic fabric are joined to the active mass consolidated at increased pressure and how the required contact pressure is maintained long term.

It is the object of the invention to create a plate electrode suitable for the stated purpose, which can be manufactured more simply and cheaply than conventional pocket-type plates and sintered plates and has improved quality characteristics compared to these, especially compared to pocket-type plates.

To attain this object the plate electrode according to the invention has the features specified in Claim 1.

The invention also relates to a method of manufacturing such a plate electrode. The steps of the method according to the invention are given in Claim 3.

The metal coating of the plate electrode of the invention acts as a pressure-resistant container wall for the necessary containment of the formless active mass and as a current diverter. The metallic fabric covering under FR-A-2 347 790 would also appear to do the same jobs. However, the plate electrode according to FR-A-2 140 150 does not require a container wall, since the active mass thereof obviously forms a dimensionally stable body when dry. In this case the role of current diverter is played by, say, a metallised layer of fibres, which may be disposed both on the outer face of the coating of active mass and inside the latter. Since it lacks sufficient mechanical stability, it would be impossible for this layer of fibres to act as a container wall within the meaning of the solution provided by the invention, and according to the content of FR-A-2 140 150 nor is it intended to do so. Accordingly, no recognisable purpose would be served by replacing the fibre layer, used solely to divert current and evidently chosen on account of its low weight, by a heavy covering of metallic fabric.

On the other hand, the grid of synthetic material according to FR-A-2 140 150 is used solely as a supporting scaffold for the active mass, said scaffold being needed to manufacture the plate. Arranging such a grid of synthetic material in the gap in the metallic fabric covering occupied by the active mass as in FR-A-2 347 790 would, without any other recognisable effect, merely produce a reduction in the volume of the active mass and possibly to a sub-division thereof into individual panels of the mass. Therefore even the use of

 3.

(19)

this combination evidently does not make for improved plate characteristics, of the type envisaged with the measures according to the invention.

By using metal cloth instead of perforated sheet metal for the cover walls, the size of the passage per unit of area can be roughly tripled or more. This enables better utilisation of the active mass and produces lower contact resistance between the active mass and the electrolyte. A higher discharge voltage is thus also achieved. The diversion of current to the diverting vane takes place directly along the wires of the metallic fabric pieces, regardless of the orientation of the mass panels, thereby dispensing with the contact resistances between the pockets and the metal skirts which are unavoidable in conventional pocket-type plates and which often vary with time. The result is a lower internal resistance, the magnitude of which moreover remains virtually constant. What is more, no metal skirts are required.

The pieces of metallic fabric preferably consist of uniform, uncoated wire material, e.g. nickel wire. This avoids contaminating the active mass with iron, as happens with the conventional pocket-type plates with cover walls made from nickel-coated sheet iron, and as a result the lifetime of the cycles is increased.

Since metal fabric is lighter than perforated sheet metal, the plate electrode according to the invention also allows a weight saving to be achieved and thus a higher power-to-weight ratio of the electrochemical cells equipped with it.

The plate electrode according to the invention is far simpler to manufacture and requires less complex means for doing so, since there is no prefabrication or assembly of individual pockets. It can be manufactured virtually in one operation. In addition it is possible to manufacture plate electrodes continuously from two webs of metallic fabric and one web of plastic grid and separate them from one another in the pressed and fused state, thereby considerably reducing manufacturing costs.

The drawing depicts one embodiment of the plate electrode according to the invention. To better illustrate its construction, the layers of material lying over one another have been partly stripped away in the figure.

In the case of this plate electrode the cover walls are constituted by two plate-sized pieces of metal cloth 1 and 2. Arranged between them is a grid 3 of thermoplastic synthetic material, the grid openings of which form panels 7 delimited by beams 4 and crosspieces 5, in which panels the active mass 6 is situated. The metal cloth pieces 1 and 2 are melted (not shown) into

R. D. 4.

the synthetic material grid 3, thereby occluding the panels 7 of the mass on all sides. The diverting vane 8 is formed by extensions of the metal cloth pieces 1 and 2, which may be welded directly to one another or with an intermediate part of a diverter. The metal cloth pieces 1 and 2 and the grid 3 of synthetic material have identical external dimensions, apart from the diverting vane 8, which contains no plastic. The number, shape, size and orientation of the mass panels 7, and hence the arrangement of the beams 4 and the optional central crosspieces 5 of the synthetic material grid 3, depend principally on the size and format of the plate electrode. The panels of the mass may be round instead of angular, thereby allowing the use of round tablets of mass produced in conventional manner.

The synthetic material grid 3 for example consists of polyethylene, polypropylene, polyvinyl chloride or polystyrene, and is either punched from sheets of material or manufactured by injection-moulding.

The active mass may be in powder form, paste or tablet form. Most suitable in terms of uniform metering and density of the mass are tablets, which are also the most convenient to handle when the plate electrode is manufactured.

The manufacture of the foregoing plate electrode involves first placing the synthetic material grid 3 onto a piece of metallic fabric 1 and then applying the active mass 6 into the grid openings or panels 7. A second piece of metallic fabric 2 is laid over this. The entire plate sandwich is then compressed over its whole area under the action of heat, causing the metallic fabric pieces 1 and 2 to be fused into the plastic grid 3. At the same time the active mass 6 is compressed (even more so in the case of tablets). The necessary heat can for example be produced by ultrasonic waves. The pressing power must be great enough both for the pieces of metallic fabric to be joined together correctly and for the active mass to be sufficiently compressed.

Plate electrodes with a very small thickness (1 mm and less) can be manufactured in the foregoing manner. A further advantage of the plate electrode according to the invention is that recycling can be carried out with far less effort than in the case of conventional pocket-type plates.

[Handwritten signature]
5.



24

Claims

1. Plate electrode with metal coating for alkaline electrochemical cells, the cover walls being comprised of two metallic fabric pieces (1, 2) having the size of a plate, characterised in that between the cover walls there is disposed a thermoplastic synthetic material grid (3), the openings (7) of which contain active mass (6), and that the metallic fabric pieces (1, 2) are melted in the plastic grid (3) so that the grid openings (7) are occluded on all sides and the cover walls (1, 2) exert permanent pressure on the active mass (6).
2. Plate electrode according to claim 1, characterised in that the metallic fabric pieces (1, 2) are made from uniform, uncoated wire material, for example nickel.
3. Method for manufacturing a plate electrode according to claim 1, characterised in that the plastic grid (3) is placed on a metallic fabric piece (1), active mass (6) is applied in the grid openings (7) and thereafter a second metallic fabric piece (2) placed thereon, and that the entire plate assembly is then pressed throughout its surface by thermal operation so that the metallic fabric pieces (1, 2) are melted in the plastic grid (3) and at the same time the active mass (6) is compressed.
4. Method according to claim 3, characterised in that the metallic fabric pieces (1, 2) employed are made from uniform, uncoated wire material, for example nickel.
5. Method according to claim 3, characterised by manufacturing plate electrodes from two webs of metal sheet and a web of plastic grid in a continuous process and separating them from one another in the compressed and fused state.



R. L. -6.