

PATENT SPECIFICATION

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(54) TERMINAL ASSEMBLY FOR AN ELECTROCHEMICAL DEVICE

(71) We, UNION CARBIDE CORPORATION, a corporation organized and existing under the laws of the State of New York, United States of America of 270 Park Avenue, New York, State of New York 10017, United States of America, (assignee of THEODORE ROBERT BEATTY and HARRY VOURLIS), do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to sealed alkaline electrochemical devices in general, and more particularly to the provision of an improved terminal assembly in one wall of the sealed metallic container used for such devices.

Electrochemical devices, as the term is used herein and in the appended claims, means any electrochemical device employing electrodes in physical contact with an alkaline electrolyte, and includes such devices as electrochemical current-producing cells, electrolytic capacitors, coulometers and electrolysis cells.

Alkaline electrolytes are notoriously known for their ability to readily wet most metal and plastic surfaces and consequently it has been a difficult problem to liquid-tightly close the metallic containers of electrochemical devices using seals composed of metal or plastic parts. The alkaline electrolyte upon wetting these parts actually creeps past the seals and eventually leaks out from inside the metallic containers. It has been a particularly troublesome problem to provide terminal assemblies in the wall or walls of the metallic container which are liquid-tightly sealed against leakage of the alkaline electrolyte.

In our United States Patent No. 3,871,376 there is disclosed and claimed a flat electrochemical current-producing cell wherein an electrode assembly including flat electrode elements of opposite polarity having a porous separator containing an alkaline electrolyte interposed therebetween is enclosed within a sealed plastic film envelope and wherein a terminal connection is provided by placing

a current collector adjacent to one end of the electrode assembly which is exposed through an opening in the wall of the envelope. The current collector is tightly adhered and sealed to the wall of the envelope around the opening by a thin layer of an adhesive sealant which is non-wettable by the alkaline electrolyte. The adhesive sealant is preferably formulated from the class of compounds known as "fatty polyamides".

In our United States Patent No. 4,044,200 there is disclosed and claimed a flat electrochemical current-producing cell wherein the electrode assembly is again enclosed within a sealed plastic film envelope and wherein a terminal connection is provided using both internal and external current collectors which are also sealed to the wall of the envelope by thin layers of the same non-wetting adhesive sealant around the opening in the wall, the current collectors being electrically connected to one another through the opening by suitable means such as a spot weld.

The present invention relates to improvements in terminal assemblies in the metallic container of an electrochemical device employing an alkaline electrolyte.

By practice of the present invention there may be provided an improved terminal assembly in one wall of the metallic container used in an electrochemical device which is liquid-tightly sealed against leakage of the electrolyte.

According to the present invention there is provided a terminal assembly in combination with a metallic container of an electrochemical device having an alkaline electrolyte comprising an internal electrically conductive member disposed adjacent to the inner surface of one wall of said metallic container and overlying an opening in said wall, a first electrical insulator member having an opening therein interposed between said internal electrically conductive member and the inner surface of said wall with its opening coinciding with said opening in said wall, an external electrically conductive

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member representing the outer cell terminal connection disposed adjacent to the outer surface of said wall and overlying said opening therein, a second electrical insulator member having an opening therein interposed between said external electrically conductive member and the outer surface of said wall with its opening coinciding with said opening in said wall, a thin layer of an adhesive sealant, which is non-wettable by said alkaline electrolyte, interposed at each of the interfaces between said first and second electrical insulator members and said internal and external electrically conductive members and between said first and second electrical insulator members and the inner and outer surface of said wall, and wherein said internal and external electrically conductive members are spot welded to one another through said opening in said wall.

The electrical insulator members may, for example, be flat washers made from an organic plastics composition such as polypropylene. The internal and external electrically conductive members may be metal plates or foils and are maintained in electrical connection with one or a plurality of electrodes in the electrochemical device.

Preferably the adhesive sealant substantially covers each face of each of the electrical insulator members at each of the interfaces between the first and second electrical insulator members and the internal and external electrically conductive members and between the first and second electrical insulator members and the inner and outer surfaces of the wall of the metallic container.

The present invention will now be further described with reference to the accompanying drawing which is a sectional view of one embodiment of a terminal assembly in accordance with the present invention.

Referring to the drawing, the reference numeral 10 denotes one wall of the metallic container used in an electrochemical device employing an alkaline electrolyte, e.g. a nickel plated steel container used in a conventional nickel-cadmium cell. In the embodiment of the invention illustrated, the wall 10 is polarized, that is, the wall is maintained in electrical connection with one electrode or electrodes (not shown) of one polarity while the terminal assembly to be hereinafter described is maintained in electrical connection with one electrode or electrodes of opposite polarity.

The terminal assembly includes both internal and external current collectors 26, 28, respectively, which may be metal foils, for example nickel foils. The internal collector 26 is disposed adjacent to the inner surface of the wall 10 overlying the opening 14 but is separated therefrom by a first polypropylene washer 30 whose opening 32

coincides with the opening 14. The external collector 28 is disposed adjacent to the outer surface of the wall 10 overlying the opening 14 but is separated therefrom by a second polypropylene washer 34 whose opening 36 also coincides with the opening 14. A thin layer 38 of adhesive sealant which is non-wettable by the alkaline electrolyte, i.e., a fatty polyamide sealant, is interposed at the interface between the first polypropylene washer 30 and the internal collector 26 while another thin layer 40 of the same adhesive sealant is interposed at the interface between the first polypropylene washer 30 and the inner surface of the wall 10. In basically the same manner, the external collector 28 is tightly adhered and sealed to the outer surface of the wall 10 by a thin layer 42 of the adhesive sealant interposed at the interface between the second polypropylene washer 34 and the external collector 28 and by a thin layer 44 of the adhesive sealant interposed at the interface between the second polypropylene washer 34 and the outer surface of the wall 10. Collectors 26, 28 are both dimpled at the centermost portion thereof and are electrically connected to one another by suitable means such as the spot weld 46.

The electrical insulator members used in the terminal assembly of the invention may be made from a polypropylene film or sheet. In addition to polypropylene, the insulator members may be composed of one of the following materials: vinyl polymers and copolymers, polyvinylidene chloride, polyethylene, nylon, polysulfone, polystyrene, and fluorocarbon polymers. For use with the fatty polyamide adhesive, films or sheets made of polyethylene, polypropylene, and vinyl polymers and copolymers are preferred.

Suitable fatty polyamide sealants are disclosed in United States Patent No. 3,922,178. As disclosed in United States Patent No. 3,922,178, fatty polyamides are produced by reacting a polybasic acid with a polyfunctional amine. Generally, the fatty polyamides used in the practice of the invention are those having an amine number of above about 9. The amine number is the number of milligrams of KOH equivalent to one gram of fatty polyamide and is determined by procedures well known in the art. The fatty polyamide sealants can be mixed with extenders and modifiers in order to modify the physical properties of the fatty polyamide. The fatty polyamide sealant can be applied as a hot-melt or from solution in a solvent such as an alcohol/aromatic hydrocarbon mixture. Among the specific commercially available fatty polyamides that are particularly useful in the practice of the present invention are those produced under the tradename of Swift's Z-610, Swift and Company, and the Registered Trade

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It has been found that the adhesive sealants, i.e., fatty polyamides, do not readily wet some types of organic plastics and accordingly a liquid-tight seal between the plastic insulator and the metal parts of the terminal assembly is sometimes difficult to attain. This difficulty may be overcome and the bond between the plastic insulator and metal parts substantially improved if the plastic film or sheet from which the insulator is made, is first subjected to successive heat and corona discharge treatments. The process for treating the plastic film or sheet is disclosed and claimed in our United States Patent No. 3,914,521. In this process, the plastic film or sheet is heated to an elevated temperature, about 120°C in the case of a polypropylene, for a period of about one half minute, optionally cooling the plastic film or sheet to ambient temperature and then subjecting the film or sheet to a high intensity corona discharge in the area where the metal parts are to be adhered.

WHAT WE CLAIM IS:—

1. A terminal assembly in combination with a metallic container of an electrochemical device having an alkaline electrolyte comprising an internal electrically conductive member disposed adjacent to the inner surface of one wall of said metallic container and overlying an opening in said wall, a first electrical insulator member having an opening therein interposed between said internal electrically conductive member and the inner surface of said wall with its opening coinciding with said opening in said wall, an external electrically conductive member representing the outer cell terminal

connection disposed adjacent to the outer surface of said wall and overlying said opening therein, a second electrical insulator member having an opening therein interposed between said external electrically conductive member and the outer surface of said wall with its opening coinciding with said opening in said wall, a thin layer of an adhesive sealant, which is non-wettable by said alkaline electrolyte, interposed at each of the interfaces between said first and second electrical insulator members and said internal and external electrically conductive members and between said first and second electrical insulator members and the inner and outer surface of said wall, and wherein said internal and external electrically conductive members are spot welded to one another through said opening in said wall.

2. A terminal assembly as claimed in claim 1 wherein said adhesive sealant comprises a fatty polyamide.

3. A terminal assembly as claimed in claim 1 or claim 2 wherein said adhesive sealant substantially covers each face of each of said electrical insulator members at each of said interfaces, respectively.

4. A terminal assembly as claimed in any one of claims 1 to 3 wherein said internal and external electrically conductive members are composed of metal foil.

5. A terminal assembly as claimed in claim 1 and substantially as hereinbefore described with reference to the accompanying drawing.

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