Translation of Patent Application No. 1020020025330

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(54) Coin-Type Electric Double Layer Capacitor and Its Manufacturing Method

Abstract

The present invention relates to a coin-type electric double layer capacitor and its manufacturing method and particularly to the coin-type electric double layer capacitor in which components of a unit cell and unit cells are sturdily coupled and its manufacturing method. In the present invention the coin-type electric double layer capacitor is comprised by laminating 4 to 6 unit cells, each consisting of metal cases (20) (20') having plates (21) (21') and extended side walls (22) (22') therefrom, polarized electrodes (10) (10') that are fixed and completed inside the metal cases (20) (20'), a separator (30) laminated in-between the polarized electrodes (10) (10'), and a gasket (40), wherein the metal cases (20) (20') and polarized electrodes (10) (10') are welded by laser under the condition that their centers coincide with each other, and in-between the unit cells (50) a fixing member having a disc shaped substrate (61) and a cylindrical coupling part formed by extending therefrom is interposed and then welded by laser and coupled under the condition that centers of the metal cases (20) (22') and fixing member (60) coincide with each other, and its manufacturing method is provided. Accordingly, the present invention affords stable coupling physically as well as electrically without any eccentricity phenomenon or complicated processes so that it has excellent coupling capability and particularly exhibits superior electrical performance without damaging the polarized electrode.

Representative Diagram

Fig. 3

Keywords

coin, electric double layer, capacitor, unit cell, electrode, laser, welding

Specification

Brief Description of the Drawings

Fig. 1 is a partially exploded cross-sectional oblique diagram showing the unit cell of the conventional coin-type electric double layer capacitor.

Fig. 2a is an oblique diagram showing the configuration course for the unit cell of a coin-type electric double layer capacitor of the prior art.

Fig. 2b is an oblique diagram showing the configuration course for the unit cell of another coin-type electric double layer capacitor of the prior art.

Fig. 3 is a cross-sectional diagram of the coin-type electric double layer capacitor according to the present invention.

Fig. 4 is a cross-sectional diagram showing a preferred example of the polarized electrode applied to the present invention.

Fig. 5a to Fig. 5c are cross-sectional diagrams of the configuration intended to describe the manufacturing method of the coin-type electric double layer capacitor according to the present invention.

* Description of reference numbers for key pacts of the drawings *

10, 10: polarized electrode 12, 12': metal current collector

12a: recessed part 14, 14': powder activated carbon slurry

20, 20': metal case 20, 21': plate

22, 22': side wall 30: separator

40: gasket 50: unit cell

60: fixing member 61: substrate

62: coupling part 70, 70': terminal

80: cladding R: laser beam

Detailed Description of the Invention

Objective of the Invention

Technology to Which the Invention Belongs and Available Art of the Field

The present invention relates to a coin-type electric double layer capacitor and its manufacturing method and more specifically to the coin-type electric double layer capacitor in which a metal case and a polarized electrode are welded by laser under the condition that their centers coincide with each other to configure a unit cell, and a fixing member is interposed in-between such unit cells and welded by laser to afford excellent electrical performance and electrically stable coupling and its manufacturing method.

Recently, in addition to advancement of electronic devices, home appliances industrial devices and the like, development of high end, small-size and light-weight electronic parts are being promoted. Accordingly there is a demand for multi-functional parts as

a result of diversification of electronic parts. One such example is combination of the functions of a secondary battery and a capacitor, wherein use of the electric double layer capacitor utilizing the electrostatic charge phenomenon which occurs in the electric double layer formed at different interfaces is increasing day by day.

Because the electric double layer capacitor is not accompanied by any chemical reactions unlike batteries, its extent of deterioration caused by repeated charging and discharging operations is very small. Therefore, the electric double layer capacitor is a device not requiring maintenance and used for a wide range of applications including the backup power supply for memory devices in particular.

Such electric double layer capacitor is completed after 2 ~ 6 unit cells, each comprising two electrodes (polarized electrodes) of anode and cathode into which electrolyte in liquid state or solid state is impregnated, a separator made of a porous material which enables only ionic conduction between the two electrode and promotes insulation and short circuit prevention, a gasket which prevents leakage of an electrolyte and promotes insulation and short circuit prevention, and metal cases for anode and cathode which package them are laminated in series and then two terminals for anode and cathode are combined.

While the unit cell of the electric double layer capacitor has various shapes, as shown in Fig. 1, the anode and cathode polarized electrodes (5) (5') are fixed and completed to inner faces of the anode and cathode metal cases (4) (4') having disc-shaped plates (2) (2') and cylindrical side walls (3) (3') formed by being extended therefrom, that is, inner faces of the plates (2) (2'), a separator (6) is interposed between the two electrodes (5) (5') for ionic conduction and insulation, and a gasket (7) is provided for insulation and short circuit prevention between the anode and cathode components and for preventing leakage of an electrolyte impregnated into the electrodes (5) (5') and pressurization is carried out as the above components are built in to form a coin-shaped unit cell (1). After 2 to 6 such unit cells (1) are laminated and anode and cathode terminals are fastened, coating is carried out with an insulating cladding to complete the coin-type electric double layer capacitor.

After the polarized electrodes (5) (5') are coupled inside the metal cases (4) (4') as in the above, electrical energy delivered outside of the unit cell (1) to the metal cases (4) (4') is delivered to the polarized electrodes (5) (5'). Accordingly, electrical conductivity must be excellent between the two components and they must be completely coupled. If complete coupling is not achieved, such electrical performance as electrostatic capacity, internal resistance and leakage current tends to deteriorate. Furthermore, the center of the metal cases (4) (4') must coincide with the center of the polarized electrodes (5) (5'). If the centers do not coincide with each other, electrical performance of the electric double layer capacitor deteriorates.

In the past in configuring the all (1) of such coin-type electric double layer capacitor, the polarized electrodes (5) (5') that were coupled to the metal cases (4) (4') were prepared with a powder activated carbon material on a sheet of solid state, prepared by fixing powder activated carbon slurry on a metal current collector or prepared as an activated carbon sheet of fibers, and fixing and coupling was carried out by such method that an adhesive or welding was used inside the metal cases (4) (4').

For example, as shown in Fig. 2a, an active electrode material prepared by mixing powder activated carbon, binder and conductive additive was prepared on a sheet of a solid state, the polarized electrode (5) (5') which was cut from the sheet into a disc shape, and a liquid conductive adhesive (8) such as carbon paste or conductive polymer was applied inside the metal case, that is, inside the plate (2) (2') before adhesion under pressure was carried out for fixing and coupling. However, such coupling method in which an adhesive (8) is used has the shortcoming of low productivity and complicated processes due to addition of a drying process. In particular, the problem of coupling failure occurred in which the adhered polarized electrode (5) (5') was easily separated from the metal case (4) (4') by quenching following high temperature drying or external shock. In addition, as the outer diameter of the polarized electrode (5) (5') is generally formed to be smaller than the inner diameter of the metal case (4) (4'), the phenomenon in which the polarized electrode (5) (5') drifts to one direction by surface tension of the adhesive (8), that is, the phenomenon of eccentricity is likely to take place so that the center of the metal case (4) (4') does not coincide with the polarized electrode (5) (5'), which results in the problem of deteriorating electrical performance.

In addition, to describe another configuration of the prior art referring to Fig. 2b, in configuring the polarized electrode (5) (5'), powder activated carbon slurry (5b) was coated on a metal current collector (5a) in the form of aluminum foil and then drying and rolling pressurization processes were performed to prepare the polarized electrode (5) (5'), or the metal (5a) such as aluminum (Al), nickel (Ni) or titanium (Ti) was plasma-sprayed on the surface of the fiber activated carbon sheet (5b) for preparation. In Fig. 2b the metal current collector and metal which were welded and coupled to the metal case (4) (4') were identically indicated with the reference numeral 5a, and the powder activated carbon slurry and fiber activated carbon sheet fixed on their surfaces were indicated with the reference numeral 5b. In the past the polarized electrode (5) (5') thus prepared was cut into a disc shape and coupled to the metal case (4) (4') by spot welding using the (+) welding terminal (9a) and (-) welding terminal (9b). However, because the spot welding is based on the mode in which resistance heat generated by applying mechanical pressure and current is used to fuse a pressurized area, it has such problems that the electrode (5) (5') is easily damaged by resulting shock and its electrical performance is deteriorated. That is, because spot welding, as shown in Fig. 1b, requires the welding terminals to be grounded to the metal case (4) (4') and polarized electrode (5) (5'), the electrode (5) (5') is changed by shock from the welding terminal (9a) grounded to the polarized electrode (5) (5').

Moreover, the polarized electrode (5) (5') of the fiber activated carbon sheet also has problems in that its material is expensive and that the method of spraying a metal for adhesion requires addition of a process for spraying a metallic material, which results in a complicated overall process. Expensive equipment required for spraying a metallic material also presents a problem.

In addition, when 2 ~ 6 of the coin-type unit cells (1) configured as above were laminated to carry out coupling in-between the

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