

AIRTIGHTNESS TEST SYSTEM OF BATTERY ASSEMBLY AND AIRTIGHTNESS
TEST METHOD OF BATTERY ASSEMBLY USING THE SAME

CROSS REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority to Korean Patent Application No. 10-2022-0135029, filed on 19 October 2022, the entire contents of which is incorporated herein for all purposes by this reference.

TECHNICAL FIELD

[0002] The present invention relates to a test system of a battery assembly, and more specifically, to an airtightness test system of a battery assembly.

BACKGROUND

[0003] Conventional vehicle batteries should secure thermal runaway performance within a predetermined range for fire safety. The thermal runaway performance is a time required from a time point at which initial spark is generated to a fire connection time point in which a fire spreads to nearby cells or nearby components of a battery assembly when the fire occurs in at least one of battery cells while a vehicle travels, and currently, general vehicle batteries should generally secure the thermal runaway performance of about 5 minutes. However, in reality, since it is difficult for a driver to conduct an immediate response with the thermal runaway performance of about 5 minutes, a

goal in the related technology fields may be increasing thermal runaway performance to about 30 minutes.

[0004] Therefore, in the related art, a venting valve has been applied to a battery assembly to increase a travelable time when thermal runaway occurs. Therefore, when a combustion reaction occurs in some cells, since a generated gas is not discharged from an inside of a battery housing, an increase in an internal pressure may be prevented, thereby increasing stability in the event of thermal runaway.

[0005] However, when the venting valve is applied to the battery assembly as described above, there is a problem in that it became difficult to test the airtightness of the battery assembly. More specifically, it is preferable to perform the test in a state immediately before all components (including the venting valve) constituting the battery assembly are assembled and shipped in order to test the assembling reliability between the components, and when the venting valve is coupled, an internal pressure of the battery assembly is not maintained, and thus it is difficult to perform a conventional pressure decay test.

Documents of Related Art

[0006] (Patent Document 1) Korean Patent No. 10-2326465 (entitled "SEALING TEST DEVICE AND METHOD OF BATTERY CASE", 9 November 2021)

SUMMARY OF THE INVENTION

[0007] The present invention has been made in efforts to solve the above problems and is directed to providing an airtightness test system of a battery assembly, which may include a sealing jig in which an accommodating space for accommodating a venting valve or a pressure modulator is formed and a pressure generating device for providing a

pressure to each of an inside of the sealing jig and an inside of a battery assembly and perform a pressure decay test even when the venting valve and the pressure modulator are coupled, and an airtightness test method of the battery assembly using the same.

[0008] In addition, the present invention is directed to providing an airtightness test system of a battery assembly, which may include an adapter made of a material having a low stiffness and test coupling performance without a load of a counterpart component to be coupled to a venting valve, and an airtightness test method of the battery assembly using the same.

[0009] In addition, the present invention is directed to providing an airtightness test system of a battery assembly, which may include an assembling jig of which an inner surface is formed to correspond to a venting valve and test the coupling performance of the venting valve, and an airtightness test method of the battery assembly using the same.

[0010] In order to solve the above problems, an airtightness test system of a battery assembly according to one embodiment of the present invention includes a sealing jig coupled above a venting valve or a pressure mediator included in the battery assembly and including a sealed first space in which the venting valve is accommodated therein, a first sensor configured to measure an internal pressure of the first space, a second sensor configured to measure a pressure of a second space, which is an internal space of the battery assembly, a first pressure generating device configured to press the first space, a second pressure generating device configured to press the second space, and a controller configured to receive each pressure value from the first sensor and the second sensor and control the first pressure generating device and the second pressure generating device.

[0011] In addition, the controller may pre-store a reference pressure range of the second space and a reference pressure range of the first space, and when the pressure values of the first sensor and the second sensor are out of the reference pressure range of each of the first space and the second space, control the first pressure generating device and the second pressure generating device so that the pressure values of the first sensor and the second sensor are within the reference pressure ranges.

[0012] In addition, the airtightness test system of the battery assembly may further include a coupling unit configured to maintain coupling between the sealing jig and the battery assembly.

[0013] In addition, the coupling unit may include a magnet accommodated inside one end of the sealing jig.

[0014] In addition, the coupling unit may include a first extending member which extends vertically from one end surface of the sealing jig and of which one end is coupled to a side surface of the sealing jig, a first lever coupled to the one end of the first extending member and configured to move the first extending member in an extending direction, and a first pressing member coupled to the other end of the first extending member, and the first pressing member may be interlocked with the first lever to press the surface of the battery assembly.

[0015] In addition, the coupling unit may include a pressing jig including a hook fitted into an extrusion member of the battery assembly formed on one end thereof.

[0016] In addition, two or more pressing jigs may be installed, and the pressing jig may be provided at each of both sides of the sealing jig.

[0017] In addition, the coupling unit may include a second extending member which extends vertically from one end surface of the sealing jig and of which one end is coupled to the other end of the pressing jig, a second lever coupled to the second extending member and the coupling part of the pressing jig and configured to move the second extending member in an extending direction, and a second pressing member coupled to the other end of the second extending member, and the second pressing member may be interlocked with the second lever to press the other end surface of the sealing jig.

[0018] In addition, the pressing jig may include a groove or hole-shaped interlocking part formed in the other end thereof, and the coupling unit may further include at least one connecting bar of which both ends are coupled to the interlocking parts formed at both sides of the pressing jig.

[0019] In addition, the airtightness test system of the battery assembly may further include an adapter including a protruding part of which a side surface is formed identically to a valve hook of the venting valve, and a handle coupled to one surface of the protruding part and configured to adjust a phase of the protruding part.

[0020] In addition, the protruding part may be made of a material having a lower strength than the battery assembly or the valve hook of the venting valve.

[0021] In addition, the airtightness test method of the battery assembly may further include an assembling jig of which an inner surface of one end portion is formed with a fixing groove having the same shape as a shape of a side surface of the venting valve and including an accommodating part in which the venting valve is accommodated.

[0022] In addition, the assembling jig may have a side surface further formed with a phase check groove formed to connect one end and the other end thereof.

[0023] An airtightness test method of a battery assembly using an airtightness test system of the battery assembly according to one embodiment of the present invention includes (a) testing performance of a venting valve itself, (b) testing coupling performance of the battery assembly portion coupled to the venting valve, (c) assembling the venting valve to the battery assembly, (d) testing an assembled portion of the venting valve and the battery assembly, and (e) testing airtightness inside the battery assembly in a state in which the venting valve has been coupled.

[0024] In addition, the operation (d) may include (d1) positioning an assembling jig above the venting valve, (d2) checking a phase of the assembling jig at an assembling start point through a phase check groove, (d3) providing a torque to the assembling jig, (d4) checking a phase of the assembling jig at an assembling end point through the phase check groove, and (d5) comparing a change in an angle of the assembling jig and the torque provided to the assembling jig for assembling with reference values.

[0025] In addition, the operation (e) may include (e1) positioning a sealing jig above the venting valve, and (e2) coupling the sealing jig to a surface of the venting valve through a coupling unit, and further include (e3) pressing an inside of the sealing jig through a first pressure providing device, (e4) pressing an inside of the battery assembly through a second pressure providing device, (e5) sensing an internal pressure of the sealing jig and an internal pressure of the battery assembly in real time through a first sensor and a second sensor,

and (e6) controlling a first pressure generating device and a second pressure generating device so that pressure values of the first sensor and the second sensor are within reference pressure ranges, by a controller.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] FIG. 1 is a schematic diagram illustrating a coupling relationship between an airtightness test system of a battery assembly according to the present invention, the battery assembly, and a venting valve.

[0027] FIG. 2 is a block diagram illustrating a control method of a controller according to the present invention.

[0028] FIG. 3 is a perspective view illustrating a first embodiment of a coupling unit according to the present invention.

[0029] FIG. 4 is a plan view illustrating the coupling between a second embodiment of the coupling unit according to the present invention and the battery assembly.

[0030] FIG. 5 is a perspective view illustrating the second embodiment of the coupling unit according to the present invention.

[0031] FIG. 6 is an exploded perspective view illustrating an adapter according to the present invention.

[0032] FIG. 7 is a cross-sectional view illustrating the adapter according to the present invention.

[0033] FIG. 8 is a perspective view illustrating an assembling jig according to the present invention.

[0034] FIG. 9 is a flowchart illustrating an airtightness test method of the battery assembly according to the present invention.

[0035] FIG. 10 is a flowchart illustrating detailed operations of an operation of testing an assembled portion of the venting valve according to the present invention.

[0036] FIG. 11 is a schematic diagram illustrating the operation of testing the assembled portion of the venting valve according to the present invention.

[0037] FIG. 12 is a flowchart illustrating detailed operations of an operation of testing the airtightness of the battery assembly according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0038] Hereinafter, the technical spirit of the present invention will be described in more detail with reference to the accompanying drawings. Prior to the description, the terms or words used in the specification and claims should not be construed as being limited to their usual or dictionary meanings and should be construed as meaning and concept consistent with the technical spirit of the present invention according to a principle in which the inventors can appropriately define the concept of the terms in order to describe their inventions in the best method.

[0039] Hereinafter, a basic configuration and operation of an airtightness test system 1000 of a battery assembly according to the present invention will be described with reference to FIGS. 1 and 2.

[0040] As illustrated in FIG. 1, the airtightness test system 1000 of the battery assembly according to the present invention may include a sealing jig 100 and a coupling unit 200 coupling the sealing jig 100 to a surface of a battery assembly BA. The sealing jig 100 may be coupled above a venting valve VV or a pressure modulator included in

the battery assembly BA and may include a first space 110, which is a sealed space in which the venting valve VV is accommodated, therein. More specifically, the venting valve VV may be installed in a venting hole of the battery assembly BA and opened and closed depending on a pressure difference between an internal pressure and an external pressure of the battery assembly BA. In addition, the pressure modulator may allow air inside and outside the battery assembly BA to communicate with each other by covering the venting hole with a ventilated member (e.g., a Gore-Tex) and may be connected to a second pressure generating device 420 to be described below so that the air is injected into the battery assembly BA.

[0041] In the airtightness test system 1000 of the battery assembly according to the present invention, by installing the sealing jig 100 capable of accommodating the venting valve VV or the pressure modulator outside the battery assembly BA, it is possible to block air from being vented to the outside of the battery assembly BA during a pressure decay test, thereby maintaining the internal pressure of the battery assembly BA, and by adjusting the pressure difference between the external pressure and the internal pressure of the venting valve VV, it is possible to minimize a load applied to the venting valve VV or the pressure modulator.

[0042] Therefore, as illustrated in FIG. 2, the airtightness test system 1000 of the battery assembly according to the present invention may include a first sensor 310 for measuring an internal pressure of the first space 110 and a second sensor 320 for measuring a pressure of a second space 120, which is an internal space of the battery assembly BA. In addition, the airtightness test system 1000 of the battery assembly may include a first pressure generating device 410 for

pressing the first space 110 and a second pressure generating device 420 for pressing the second space 120. In addition, the airtightness test system 1000 of the battery assembly according to the present invention may include a controller 500 for receiving a pressure value from each of the first sensor 310 and the second sensor 320 and controlling the first pressure generating device 410 and the second pressure generating device 420.

[0043] In this case, the controller 500 may pre-store a reference pressure range of the second space 120 and a reference pressure range of the first space 110, and when the pressure values of the first sensor 310 and the second sensor 320 are out of each reference pressure range, control the first pressure generating device 410 and the second pressure generating device 420 so that the pressure values of the first sensor 310 and the second sensor 320 are within the reference pressure ranges. In this case, it is preferable that the reference pressure range of the first space 110 is in a range of 0.04 to 0.1 bar, and it is preferable that the reference pressure range of the second space 120 is around 0.02 bar.

[0044] Therefore, the airtightness test system 1000 of the battery assembly according to the present invention may maintain the pressure difference between the external pressure and the internal pressure of the venting valve VV below a predetermined value and block the air inside the battery assembly BA from being vented to the outside so that the pressure decay test may be easily performed even in a state in which the venting valve VV has been coupled to the battery assembly BA. In addition, additionally, the durability of the venting valve VV may be tested by setting a value of the reference pressure range of the

second space 120 to be larger than a value of the reference pressure range of the first space 110.

[0045] Hereinafter, a first embodiment of a coupling unit 200 according to the present invention will be described with reference to FIG. 3.

[0046] As described above, the airtightness test system 1000 of the battery assembly according to the present invention may further include the coupling unit 200 for maintaining the coupling between the sealing jig 100 and the surface of the battery assembly BA. More specifically, as illustrated in FIG. 3A, the coupling unit 200 may include a magnet 210 accommodated inside one end of the sealing jig 100. As the magnet 210 is accommodated in the one end, the one end of the sealing jig 100 and the surface of the battery assembly BA may be magnetically coupled.

[0047] In addition, in the first embodiment of the coupling unit 200, the coupling unit 200 may include a first extending member 221 which extends vertically from one end surface of the sealing jig 100 and of which one end is coupled to a side surface of the sealing jig 100, a first lever 222 coupled to the one end of the first extending member 221 and for moving the first extending member 221 in the extending direction, and a first pressing member 223 coupled to the other end of the first extending member 221. In this case, it is preferable that the first pressing member 223 is interlocked with the first lever 222 to press the surface of the battery assembly BA.

[0048] Therefore, as illustrated in FIG. 3B, when it is difficult to separate the sealing jig 100 due to a high coupling strength between the sealing jig 100 and the battery assembly BA, by allowing the first pressing member 223 to press the surface of the battery assembly BA using the first lever 222 to generate a clearance between the sealing

jig 100 and the battery assembly BA, the sealing jig 100 may be easily separated.

[0049] As the first embodiment of the coupling unit 200 is applied, when the surface of the battery assembly BA in which the sealing jig 100 is positioned is made of a steel material that may be coupled to the magnet 210, it is possible to maintain the coupling between the sealing jig 100 and the surface of the battery assembly BA with a simpler structure.

[0050] Hereinafter, a second embodiment of the coupling unit 200 according to the present invention will be described with reference to FIGS. 4 and 5.

[0051] In the second embodiment of the coupling unit 200, it is preferable that the coupling unit 200 includes a pressing jig 230 of which one end includes a hook 231 fitted into an extrusion member of the battery assembly BA. As illustrated in FIG. 4, the hook 231 may be fixedly fitted into a component of the battery assembly BA.

[0052] In this case, one end surface of the sealing jig 100 may be coupled in contact with the surface of the battery assembly BA, and the other end surface of the battery assembly BA may be formed to be flat with a predetermined area. In addition, as illustrated in FIG. 5A, the coupling unit 200 may include a second extending member 241 which extends vertically from one end surface of the sealing jig 100 and of which one end is coupled to the other end of the pressing jig 230, a second lever 242 coupled to the second extending member 241 and the coupling unit 200 of the pressing jig 230 and for moving the second extending member 241 in an extending direction, and a second pressing member 243 coupled to the other end of the second extending member 241. It is preferable that the second pressing member 243 is interlocked

with the second lever 242 to press the other end surface of the sealing jig 100.

[0053] In the second embodiment of the coupling unit 200, a sealing member may be coupled to the battery assembly BA by the other end surface pressed by the second pressing member 243, and a position of the second pressing member 243 may be fixed by the second extending member 241 and the hook 231 of the pressing jig 230. Therefore, the pressing jig 230 and the second pressing member 243 may be positioned at both sides of the sealing member to apply a uniform pressure to the sealing member. Therefore, in the second embodiment of the coupling unit 200, when the sealing jig 100 is pressed through the second lever 242, the sealing jig 100 may be coupled to the surface of the battery assembly BA, and when the sealing jig 100 is not pressed through the second lever 242, the sealing jig 100 and the battery assembly BA may be separated.

[0054] Furthermore, when the sealing jig 100 is sufficiently long, that is, when the sealing jig 100 is formed to extend lengthily in one side direction as it accommodates two or more venting valves VV or pressure modulators therein, the pressing jig 230 is provided on each of both ends in the extending direction, and it is possible to increase stability by connecting the pressing jigs 230. This is illustrated in FIG. 5B. More specifically, each of the pressing jigs may include an interlocking part 232, which is a coupling hole or groove, formed in the other end thereof, and the coupling unit 200 may further include at least one connecting bar 233 of which both ends are coupled to the interlocking parts 232 positioned at both sides of the pressing jig. Therefore, a uniform pressure may be applied to both sides of the sealing jig 100 so that the pressure decay test may be stably performed.

[0055] As the second embodiment of the coupling unit 200 is applied, when the surface of the battery assembly BA on which the sealing jig 100 is positioned is made of a material (e.g., aluminum) that may not be coupled to the magnet 210, it is possible to maintain the coupling between the sealing jig 100 and the surface of the battery assembly BA with a simpler structure.

[0056] Hereinafter, an adapter 600 according to the present invention will be described in more detail with reference to FIGS. 6 and 7.

[0057] As illustrated in FIG. 6, it is preferable that the airtightness test system 1000 of the battery assembly according to the present invention further includes the adapter 600 including a protruding part 610 of which a side surface is formed identically to the valve hook of the venting valve VV and a handle 620 coupled to one surface of the protruding part 610 and for adjusting a phase of the protruding part 610. It is preferable that the protruding part 610 and the handle 620 may be detached from each other, and a predetermined space is formed inside the handle 620. As described above, since the protruding part 610 and the handle 620 are formed separately, the adapter 600 may be easily separated and replaced.

[0058] As illustrated in FIG. 7, the protruding part 610 may be coupled to a counterpart of the venting valve VV, that is, a component of the battery assembly BA, which is coupled to the venting valve VV, and thus whether a dimension of the counterpart is accurate may be tested. In this case, the protruding part 610 may be made of a material having a lower strength than the battery assembly BA or the valve hook of the venting valve VV, thereby preventing dents or wear of the counterpart. To this end, for example, the protruding part 610 may be manufactured using acetal as a main raw material.

[0059] Hereinafter, an assembling jig 700 according to the present invention will be described in more detail with reference to FIG. 8.

[0060] As illustrated in FIG. 8A, the airtightness test system 1000 of the battery assembly according to the present invention may further include the assembling jig 700 formed with a fixing groove 711 of which an inner surface of one end portion has the same shape as a shape of the side surface of the venting valve VV and including an accommodating part 710 in which the venting valve VV is accommodated. The assembling jig 700 may be made of plastic for mechanical machining. The assembling jig 700 may further have a phase check groove 720 formed in a side surface to connect one end to the other end thereof. By forming the phase check groove 720, it is possible to check an angle at which the venting valve VV is rotated by the coupling. The assembling jig 700 includes the fixing groove 711 so that the venting valve VV and the assembling jig 700 may move in one phase, and as the assembling jig 700 rotates, the venting valve VV may be easily coupled to the battery assembly BA.

[0061] In addition, as illustrated in FIG. 8B, the assembling jig 700 may have a plurality of grooves or protrusions into which a rotating jig may be inserted formed on the other end thereof. It is preferable that the grooves or protrusions formed on the other end of the assembling jig 700 are designed to be universally coupled to a plurality of conventionally used rotating jigs.

[0062] By including the assembling jig 700, the venting valve VV may be automatically coupled to the battery assembly BA, a torque for coupling the venting valve VV may be restricted to a reference range, and a rotating angle when the venting valve VV is coupled may be checked

through the phase check groove 720. In this case, it is preferable that the reference range of the torque is 10 NM.

[0063] Hereinafter, an airtightness test method of the battery assembly according to the present invention will be described with reference to FIGS. 9 and 12.

[0064] As illustrated in FIG. 9, it is preferable that the airtightness test method of the battery assembly BA using the airtightness test system 1000 of the battery assembly according to the present invention includes (a) testing performance of the venting valve VV itself, (b) testing coupling performance of the battery assembly BA part coupled to the venting valve VV, (c) assembling the venting valve VV to the battery assembly BA, (d) testing an assembled portion of the venting valve VV and the battery assembly BA, and (e) testing airtightness inside the battery assembly BA in a state in which the venting valve VV has been coupled.

[0065] More specifically, the operation (b) may be performed by the adapter 600, and a value may be checked by fitting the protruding part 610 of the adapter 600 into the counterpart of the battery assembly BA before the venting valve VV is coupled. In this case, the protruding part 610 may be made of a material having a lower strength than the battery assembly BA or the valve hook of the venting valve VV, thereby preventing dents or wear of the counterpart. To this end, for example, the protruding part 610 may be manufactured using acetal as a main raw material.

[0066] In addition, the operation (c) may be performed by the assembling jig 700, the venting valve VV may be automatically coupled to the battery assembly BA by the assembling jig 700 connected to the rotating jig, and the torque for coupling the venting valve VV may be

restricted. In this case, the torque may be controlled to 10 NM or less.

[0067] Then, as illustrated in FIG. 10, the operation (d) may include (d1) positioning the assembling jig 700 above the venting valve VV, (d2) checking a phase of the assembling jig 700 at an assembling start point through the phase check groove 720, (d3) providing a torque to the assembling jig 700, (d4) checking a phase of the assembling jig 700 at an assembling end point through the phase check groove 720, and (d5) comparing a change in an angle of the assembling jig 700 and the torque provided to the assembling jig 700 for assembling with reference values.

[0068] More specifically, in the operation (d1), as illustrated in FIG. 11A, the assembling jig 700 may be positioned above the venting valve VV, and in this case, the operation (b2) may also be performed together to check initial phases of the assembling jig 700 and the venting valve VV. In the operation (d3) performed subsequently, as illustrated in FIG. 11B, the rotating jig may be connected to the assembling jig 700 to provide the torque. Finally, in the operation (d4), a final phase of the assembling jig 700 may be checked through the phase check groove 720, and in the operation (d5), the provided torque and the rotating angle of the assembling jig 700 may be calculated and compared with the reference values.

[0069] The operation (d) may be performed simultaneously with the operation (c), and after the operation (d) is performed, the airtightness test method of the battery assembly may further include visually testing whether the venting valve VV and the battery assembly BA have been coupled correctly.

[0070] In addition, as illustrated in FIG. 12, the operation (e) may include (e1) positioning the sealing jig 100 above the venting valve

VV, and (e2) coupling the sealing jig 100 to the surface of the battery assembly BA through the coupling unit 200. In this case, the type of the coupling unit 200 or the sealing jig 100 may be adopted differently from each other depending on the material of the battery assembly BA. More specifically, when the material of the battery assembly BA to which the sealing jig 100 is coupled is a steel material, magnetic coupling is possible, and thus by applying the first embodiment of the coupling unit 200, the sealing jig 100 may be magnetically coupled to the battery assembly BA. Alternatively, when the material of the battery assembly BA to which the sealing jig 100 is coupled is a material in which the magnetic coupling is not possible, such as aluminum, by applying the second embodiment of the coupling unit 200, the sealing jig 100 may be coupled to the battery assembly BA in a pressing manner.

[0071] Then, the operation (e) may further include (e3) pressing an inside of the sealing jig 100 through a first pressure providing device, (e4) pressing an inside of the battery assembly BA through a second pressure providing device, (e5) sensing an internal pressure of the sealing jig 100 and an internal pressure of the battery assembly BA in real time through the first sensor 310 and the second sensor 320, and (e6) controlling the first pressure generating device 410 and the second pressure generating device 420 so that the pressure values of the first sensor 310 and the second sensor 320 are within the reference pressure ranges, by the controller 500.

[0072] Therefore, it is possible to maintain the pressure difference between the external pressure and the internal pressure of the venting valve VV below the predetermined value and block the air inside the battery assembly BA from being vented to the outside so that the

pressure decay test may be easily performed even in a state in which the venting valve VV has been coupled to the battery assembly BA. In addition, additionally, the durability of the venting valve VV may be tested by setting a value of the reference pressure range of the second space 120 to be larger than a value of the reference pressure range of the first space 110.

[0073] Through the above configuration, according to the airtightness test system of the battery assembly and the airtightness test method of the battery assembly using the same according to the present invention, by including the sealing jig in which the accommodating space for accommodating the venting valve or the pressure modulator is formed and the pressure generating device for providing the pressure to each of the inside of the sealing jig and the inside of the battery assembly it is possible to perform the pressure decay test even when the venting valve and the pressure modulator are coupled.

[0074] In addition, by including the adapter made of the material having the low stiffness, it is possible to test coupling performance without the load of the counterpart component to be coupled to the venting valve.

[0075] In addition, by including the assembling jig of which the inner surface is formed to correspond to the venting valve, it is possible to test the coupling performance of the venting valve.

[0076] The technical spirit of the present invention should not be construed as limited to the above-described embodiments. Not only the scope of applications is diverse, but also various modifications may be made by those skilled in the art without departing from the gist of the present invention as claimed in the claims. Therefore, these

improvements and changes fall within the scope of the present invention as long as they are obvious to those skilled in the art.

DESCRIPTION OF REFERENCE NUMERALS

1000: airtightness test system of battery assembly	
100: sealing jig	110: first space
120: second space	200: coupling unit
210: magnet	221: first extending member
222: first lever	223: first pressing member
230: pressing jig	231: hook
232: interlocking part	233: connecting bar
241: second extending member	
242: second lever	243: second pressing member
310: first sensor	320: second sensor
410: first pressure generating device	
420: second pressing generating device	
500: controller	600: adapter
610: protruding part	620: handle
700: assembling jig	710: accommodating part
711: fixing groove	720: phase check groove
BA: battery assembly	VV: venting valve

WHAT IS CLAIMED IS:

1. An airtightness test system of a battery assembly, comprising:
a sealing jig coupled above a venting valve or a pressure mediator included in the battery assembly and including a sealed first space in which the venting valve is accommodated therein;

a first sensor configured to measure an internal pressure of the first space;

a second sensor configured to measure a pressure of a second space, which is an internal space of the battery assembly;

a first pressure generating device configured to press the first space;

a second pressure generating device configured to press the second space; and

a controller configured to receive a pressure value from each of the first sensor and the second sensor and control the first pressure generating device and the second pressure generating device.

2. The airtightness test system of the battery assembly according to claim 1, wherein the controller is configured to:

pre-store a reference pressure range of the second space and a reference pressure range of the first space; and

when the pressure values of the first sensor and the second sensor are out of the reference pressure range of each of the first space and the second space,

control the first pressure generating device and the second pressure generating device so that the pressure values of the first sensor and the second sensor are within the reference pressure ranges.

3. The airtightness test system of the battery assembly according to claim 1 or claim 2, further comprising a coupling unit configured to maintain coupling between the sealing jig and the battery assembly.

4. The airtightness test system of the battery assembly according to claim 3, wherein the coupling unit includes a magnet accommodated inside one end of the sealing jig.

5. The airtightness test system of the battery assembly according to claim 3 or claim 4, wherein the coupling unit includes:

a first extending member which extends vertically from one end surface of the sealing jig and of which one end is coupled to a side surface of the sealing jig;

a first lever coupled to the one end of the first extending member and configured to move the first extending member in an extending direction; and

a first pressing member coupled to the other end of the first extending member, and

the first pressing member is interlocked with the first lever to press the surface of the battery assembly.

6. The airtightness test system of the battery assembly according to claim 3 or claim 4, wherein the coupling unit includes a pressing jig including a hook fitted into an extrusion member of the battery assembly formed on one end thereof.

7. The airtightness test system of the battery assembly according to claim 6, wherein two or more pressing jigs are installed, and

the pressing jig is provided at each of both sides of the sealing jig.

8. The airtightness test system of the battery assembly according to claim 6 or claim 7, wherein the coupling unit includes:

a second extending member which extends vertically from one end surface of the sealing jig and of which one end is coupled to the other end of the pressing jig;

a second lever coupled to the second extending member and the coupling unit of the pressing jig and configured to move the second extending member in an extending direction; and

a second pressing member coupled to the other end of the second extending member, and

the second pressing member is interlocked with the second lever to press the other end surface of the sealing jig.

9. The airtightness test system of the battery assembly according to any one of claims 6 to 8, wherein the pressing jig includes a groove or hole-shaped interlocking part formed in the other end thereof, and

the coupling unit further includes at least one connecting bar of which both ends are coupled to the interlocking parts formed at both sides of the pressing jig.

10. The airtightness test system of the battery assembly according to any one of claims 1 to 9, further comprising an adapter including a protruding part of which a side surface is formed identically to a valve hook of the venting valve, and

a handle coupled to one surface of the protruding part and configured to adjust a phase of the protruding part.

11. The airtightness test system of the battery assembly according to claim 10, wherein the protruding part is made of a material having a lower strength than the battery assembly or the valve hook of the venting valve.

12. The airtightness test system of the battery assembly according to any one of claims 1 to 11, further comprising an assembling jig of which an inner surface of one end portion is formed with a fixing groove having the same shape as a shape of a side surface of the venting valve and including an accommodating part in which the venting valve is accommodated.

13. The airtightness test system of the battery assembly according to claim 12, wherein the assembling jig has a side surface further formed with a phase check groove formed to connect one end and the other end thereof.

14. An airtightness test method of a battery assembly using an airtightness test system of the battery assembly, comprising:

- (a) testing performance of a venting valve itself;
- (b) testing coupling performance of the battery assembly part coupled to the venting valve;
- (c) assembling the venting valve to the battery assembly;
- (d) testing an assembled portion of the venting valve and the battery assembly; and

(e) testing airtightness inside the battery assembly in a state in which the venting valve has been coupled.

15. The airtightness test method of the battery assembly according to claim 14, wherein the operation (d) includes:

- (d1) positioning an assembling jig above the venting valve;
- (d2) checking a phase of the assembling jig at an assembling start point through a phase check groove;
- (d3) providing a torque to the assembling jig;
- (d4) checking a phase of the assembling jig at an assembling end point through the phase check groove; and
- (d5) comparing a change in an angle of the assembling jig and the torque provided to the assembling jig for assembling with reference values.

16. The airtightness test method of the battery assembly according to claim 14 or claim 15, wherein the operation (e) includes:

- (e1) positioning a sealing jig above the venting valve; and
 - (e2) coupling the sealing jig to a surface of the venting valve through a coupling unit, and
- further includes:
- (e3) pressing an inside of the sealing jig through a first pressure providing device;
 - (e4) pressing an inside of the battery assembly through a second pressure providing device;
 - (e5) sensing an internal pressure of the sealing jig and an internal pressure of the battery assembly in real time through a first sensor and a second sensor; and

(e6) controlling a first pressure generating device and a second pressure generating device so that pressure values of the first sensor and the second sensor are within reference pressure ranges, by a controller.