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SECONDARY BATTERY MANUFACTURING DEVICE

Abstract

A secondary battery manufacturing device is provided that includes a case portion provided with a nozzle configured to face a base material being moved by a coating roll. A cavity portion is positioned inside the case portion, with the cavity portion forming a conduit for transferring a coating solution to the nozzle. A vent portion is provided that has a first side surrounding an inlet to the cavity portion and a second side extends to the outside of the case portion to form a path for discharging gas. A filtering portion is positioned between the cavity portion and the vent portion, with the filtering portion being configured to direct gas contained in the coating solution in a direction toward the vent portion and prevent liquid of the coating solution from being directed to the vent portion.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to and the benefit of Korean Patent Application No. 10-2024-0024832 filed on Feb. 21, 2024 in the Korean Intellectual Property Office, the contents of which in its entirety are herein incorporated by reference.

BACKGROUND

1. Field

[0002] The present disclosure relates to a secondary battery manufacturing device.

2. Description of the Related Art

[0003] A secondary battery is a battery which can be charged and discharged, unlike a primary battery which cannot be re-charged. Low-capacity secondary batteries are used in small portable electronic devices such as smartphones, feature phones, laptop computers, digital cameras, camcorders, and the like, and large-capacity secondary batteries are widely used as power sources for driving motors, a batteries for storing power, and the like in hybrid vehicles, electric vehicles, and the like. These secondary batteries include an electrode assembly composed of a positive electrode and a negative electrode, a case which accommodates the same, and a terminal connected to the electrode assembly.

[0004] In production of secondary batteries, a process of uniformly applying a slurry including an active material and the like on a thin base material is one of the important processes for ensuring stable performance and safety in secondary batteries.

[0005] The above-described information disclosed in the background technology of the present disclosure is only for improving understanding of the background of the present disclosure, and accordingly, may include information that does not constitute the related art.

SUMMARY

[0006] The present disclosure relates to a secondary battery manufacturing device capable of removing gas from a slurry to be applied on a base material.

[0007] However, the technical problems to be solved by the present disclosure are not limited to the above-described technical problem, and other technical problems which are not mentioned will be clearly understood by those skilled in the art from the following description.

[0008] An exemplary secondary battery manufacturing device according to one embodiment of the present disclosure for solving the above technical problem includes a case portion provided with a nozzle, the nozzle being configured to face a base material being moved by a coating roll, a cavity portion positioned inside the case portion, the cavity portion forming a conduit for transferring a coating solution to the nozzle, a vent portion having a first side surrounding an inlet to the cavity portion and a second side extending outward from the case portion to form a path for discharging gas, and a filtering portion positioned between the cavity portion and the vent portion, the filtering portion being configured to direct gas contained in the coating solution in a direction toward the vent portion and prevent liquid of the coating solution from being directed to the vent portion.

[0009] In some examples, the case portion may include a lower case surrounding a lower portion of the cavity portion and an upper case surrounding an upper side of the filtering portion, with the upper case being fixed to the lower case.

[0010] In some examples, the cavity portion may include an inner pipe forming a conduit for supplying the coating solution in a width direction of the case portion, with an upper side of the inner pipe being open and a supply pipe configured to supply the coating solution to the inner pipe,

the supply pipe having a first side connected to the inner pipe and a second side extending to outside of the case portion.
[0011] In some examples, the vent portion may include a vent cover covering an upper side of the filtering portion, the vent being configured to collect gas from the filtering portion, and a vent pipe extending from the vent cover to outside of the case portion, the vent pipe being configured to guide discharge of the gas.
[0012] In some examples, the filtering portion may include a filtering frame positioned between the vent portion and the cavity portion, with a plurality of holes being formed in the filtering frame in a vertical direction, and a filter member detachably installed inside the filtering frame and configured to allow the gas from the coating solution to pass therethrough and to prevent the liquid from the coating solution from passing therethrough.
[0013] In some examples, the filtering frame may include a first support member formed in a plate shape and covering an upper side of the cavity portion, with a first connection hole being formed in the first support member such that the gas can pass through the first support member, a second support member positioned above the first support member, with a second connection hole being formed in the second support member at a position facing the first connection hole and such that the gas can pass through the second support member, and a connection member connecting the first supporter and the second supporter.
[0014] In some examples, the filter member may be positioned between the first support member and the second support member.
[0015] In some examples, the first connection hole has an inner diameter that gradually narrows toward an upper side where the filter member is located.
[0016] In some examples, the second connection hole has inner diameter that gradually narrows toward a lower side where the filter member is located.
[0017] In some examples, the filtering portion may be attachable to and detachable from the case portion by a sliding operation.
[0018] An exemplary secondary battery manufacturing device according to one embodiment of the present disclosure for solving the above technical problem includes a case portion provided with a nozzle, the nozzle being configured to face a base material being moved by a coating roll, a cavity portion positioned inside the case portion, the cavity portion forming a conduit for transferring a coating solution to the nozzle, a vent portion having a first side surrounding an inlet to the cavity portion, and a second side extending to outside of the case portion to form a path for discharging gas, a filtering portion positioned between the cavity portion and the vent portion, the filtering portion being configured to direct gas contained in the coating solution in a direction toward the vent portion, and a guide portion fixed to the case portion, the guide portion being configured to guide sliding movement of the filtering portion.
[0019] In some examples, the guide portion may include guide bodies installed on opposite sides of the filtering portion in a width direction and extending along a direction that the filtering portion moves when being guided into the case portion, and guide grooves formed in a longitudinal direction of the guide bodies.
[0020] In some examples, the filtering portion may include a filtering frame positioned between the vent portion and the cavity portion, with a plurality of holes being formed in the filtering frame in a vertical direction, and the filter frame being configured such that sliding movement of the filtering frame is guidable by the guide portion, and a filter member detachably positioned inside the filtering frame, the filter member being configured to allow gas form the coating solution to pass therethrough and to prevent liquid from the coating solution from passing therethrough.
[0021] In some examples, the filtering frame may include a first support member formed in a plate shape and covering an upper side of the cavity portion, with a first connection hole being formed in the first support member such that through the gas may pass therethrough, a second support member positioned above the first supporter, with a second connection hole being formed in the

second connection member at a position facing the first connection hole, with the filter member being positioned between the first connection hole and the second connection hole, a connection member connecting the first support member and the second support member, and a wing member extending in a lateral direction of the connection member and including a guide protrusion positioned in the guide groove.
[0022] In some examples, the filter member may include a membrane filter.
[0023] In some examples, the secondary battery manufacturing device may further include an airtight plate supporting a lower side of the filtering portion, positioned along an outer periphery of the cavity portion, and configured to guide movement of the coating solution from the cavity portion to the nozzle.

Description

BRIEF DESCRIPTION OF DRAWINGS
[0024] Since the following drawings appended in the present specification exemplify preferred embodiments of the present disclosure, and serve to help further understanding of the technical spirit of the present disclosure together with the following detailed description of the present disclosure, the present disclosure should not be understood as being limited to the items disclosed in the drawings:
[0025] FIG. **1** is a side view illustrating an exemplary secondary battery manufacturing device according to the present disclosure;
[0026] FIG. **2** is an exploded perspective view illustrating the exemplary secondary battery manufacturing device according to the present disclosure;
[0027] FIG. **3** is a perspective view illustrating the exemplary secondary battery manufacturing device according to the present disclosure;
[0028] FIG. **4** is a side cross-sectional view illustrating the exemplary secondary battery manufacturing device according to the present disclosure;
[0029] FIG. **5** is a front view illustrating a state in which an exemplary filtering frame according to the present disclosure is connected to a guide portion;
[0030] FIG. **6** is a side cross-sectional view illustrating an installation state of an exemplary locking portion according to the present disclosure;
[0031] FIG. **7** is a cross-sectional view illustrating an exemplary filtering portion according to the present disclosure;
[0032] FIG. **8** is a bottom view illustrating an exemplary first supporter according to the present disclosure; and
[0033] FIGS. **9** and **10** are graphs illustrating a liquid entry pressure (LEP) according to a pore diameter of an exemplary filter member according to the present disclosure.
DETAILED DESCRIPTION
[0034] Hereinafter, preferred embodiments of the present disclosure will be described in detail with reference to the accompanying drawings. Prior to this, the terms and words used in the present specification and claims should not be construed as being limited to their usual or dictionary meanings and should be interpreted as meanings and concepts consistent with the proposed technical spirit of the present disclosure based on the principle that the inventor may appropriately define the concept of terms to describe his/her invention in the best way. Accordingly, since the embodiments disclosed in the present specification and configurations shown in the drawings are only some of the most preferred embodiments of the present disclosure and do not represent the entire technical spirit of the present disclosure, it should be understood that there are various equivalents and modifications which may replace them at the time of filing the present application.
[0035] Further, when used in the present specification, “comprise or include” and/or “comprising

or including" specify the presence of mentioned shapes, numbers, steps, operations, members, and/or groups thereof and do not exclude the presence or addition of one or more other shapes, numbers, steps, operations, members, and/or groups thereof.

[0036] Further, in order to help understanding of the invention, the accompanying drawings are not drawn to actual scale and the sizes of some components may be exaggerated. In addition, the same reference numerals may be given to the same components in different embodiments.

[0037] Stating that two objects for comparison are 'the same' means that that the two objects are 'substantially the same.' Accordingly, 'substantially the same' may include a deviation considered to be a low level in the art, for example, a deviation within 5%. Further, uniformity of a parameter in a certain area may mean uniformity from an average perspective.

[0038] Although first, second, and the like are used to describe various components, these components are not limited by these terms. These terms are only used to distinguish one component from another component, and a first component may also be a second component unless otherwise stated.

[0039] Throughout the specification, unless otherwise stated, each component may be singular or plural.

[0040] Disposition of an arbitrary component at "an upper portion (or a lower portion)" of a component or "on (or under)" the component means that the arbitrary component may be disposed in contact with an upper surface (or a lower surface) of the component or another component may be interposed between the component and the arbitrary component disposed on (or under) the component.

[0041] Further, when it is described that a certain component is "connected," "coupled," or "linked" to another component, it should be understood that the components may be directly connected or linked to each other, but still another component may be "interposed" between the components, or the components may be "connected," "coupled," or "linked" through still another component. In addition, a case in which a certain part is electrically connected to another part includes not only a case in which the parts are directly connected, but also a case in which the parts are connected with another element therebetween.

[0042] Throughout the specification, "A and/or B" refers to A, B, or A and B unless otherwise stated. That is, "and/or" includes all or any combination of a plurality of listed items. "C to D" means greater than or equal to C and less than or equal to D unless otherwise specified.

[0043] The terms used in the present specification are provided for describing the embodiments of the present disclosure, and are not intended to limit the present disclosure.

[0044] FIG. **1** is a side view illustrating an exemplary secondary battery manufacturing device **1** according to the present disclosure, FIG. **2** is an exploded perspective view illustrating the exemplary secondary battery manufacturing device **1** according to the present disclosure, and FIG. **4** is a side cross-sectional view illustrating the exemplary secondary battery manufacturing device **1** according to the present disclosure.

[0045] As shown in FIGS. **1**, **2**, and **4**, the exemplary secondary battery manufacturing device **1** according to the present disclosure includes a case portion **20**, a cavity portion **30**, a vent portion **40**, and a filtering portion **50**. In some examples, the exemplary secondary battery manufacturing device **1** may further include a guide portion **100**, an airtight plate **110**, and a locking portion **120**. In the present disclosure, the secondary battery manufacturing device **1** may be referred to as a slot die coater.

[0046] In the secondary battery manufacturing device **1**, a filter member **90** including a porous membrane may be installed on the cavity portion **30**, which supplies a liquid slurry, and the vent portion **40**. The filter member **90** may extend to the outside of the case portion **20** to suppress leakage of the slurry and allow for only air bubbles to be removed from the slurry. In the present disclosure, the air bubbles contained in the slurry may be referred to as gas.

[0047] Since only the air bubbles contained in the slurry may be exhausted to the outside of the

case portion **20**, slurry leakage may be suppressed and production costs may because there is less additional work required from workers. When only the vent portion **40** is installed without the filtering portion **50**, there may be a problem in that the slurry is discharged along with the gas to the outside of the case portion **20**. Further, when only the vent portion **40** is installed without the filtering portion **50**, work efficiency may deteriorate as only air bubbles at a specific portion where the vent portion **40** is installed are removed. However, when the filtering portion **50** using a porous membrane is installed along with the vent portion **40**, the air bubbles may be removed from an entire open area of the cavity portion **30**.

[0048] A base material **12**, which is an electrode plate for a secondary battery, is moved by a coating roll **10**. The secondary battery manufacturing device **1** is installed at a position facing the coating roll **10**. The secondary battery manufacturing device **1** may coat the outside of the base material **12** with an active material using a slot die coater. A coating solution, which is the liquid slurry, is discharged from the slot die coater and fixed to the outside of the base material **12**. The base material **12** may be used for a negative electrode or positive electrode.

[0049] Various alternatives are possible with respect to the technical idea of the case portion **20**, including the provision of a nozzle **26** at a position facing the base material **12** moving through the coating roll **10**. The case portion **20** according to one embodiment of the present disclosure includes an upper case **22** and a lower case **24**.

[0050] The lower case **24** is installed in a shape surrounding a lower portion of the cavity portion **30**. An upper side of the lower case **24** is open. The lower case **24** is formed in a concave shape toward the upper side and may have a length in a width direction (X) corresponding to a length in the width direction (X) of the base material **12**. The cavity portion **30** may be located inside the lower case **24**. The nozzle **26**, which is a hole for discharging the coating solution, may be provided in the lower case **24** facing the base material **12**. The nozzle **26** may include a groove extending from an upper end of the lower case **24** in the width direction (X) of the lower case **24**. The nozzle **26** forms a path for discharging the coating solution moving through the cavity portion **30** to the base material **12**.

[0051] The upper case **22** surrounds an upper side of the filtering portion **50** and is fixed to the lower case **24**. The upper case **22** may have a concave shape toward a lower side, and may be fixed to the lower case **24** while surrounding the filtering portion **50** and the vent portion **40**. The upper case **22** and the lower case **24** may be integrally formed, and various alternatives are possible, such as the cases being composed of three or more components or the like as necessary.

[0052] Various alternatives are possible with respect to the technical idea of the cavity portion **30** forming a conduit located inside the case portion **20** and provided to transfer the coating solution to the nozzle **26**. The cavity portion **30** according to one embodiment of the present disclosure includes an inner pipe **32** and a supply pipe **34**.

[0053] The inner pipe **32** forms a conduit for supplying the coating solution in the width direction (X) of the case portion **20** and an upper side of the inner pipe **32** is open. The inner pipe **32** extends in the width direction (X) of the case portion **20** and is in fluid communication with the nozzle **26** of the case portion **20**.

[0054] Because one side of the supply pipe **34** is connected to the inner pipe **32** and the other side of the supply pipe **34** extends to outside of the case portion **20**, the supply pipe **34** forms a conduit for supplying the coating solution to the inner pipe **32**. In the present disclosure, the coating solution may be referred to a slurry, as described throughout the disclosure.

[0055] Various alternatives are possible with respect to the technical idea of one side of the vent portion **40** being installed in a shape surrounding an inlet of the cavity portion **30** and the other side of the vent portion **40** extending to the outside of the case portion **20** to form a path that discharges gas. The vent portion **40** according to one embodiment of the present disclosure includes a vent cover **42** and a vent pipe **44**.

[0056] Various alternatives are possible with respect to the technical idea of the vent cover **42**

covering an upper side of the filtering portion **50** and collecting gas moving from the upper side of the filtering portion **50**. A lower side of the vent cover **42** according to one embodiment of the present disclosure is open toward the filtering portion **50** and the vent cover **42** guides gas that has passed through the filtering portion **50**. The vent cover **42** may have a shape that gradually narrows from the lower side to the upper side.

[0057] The vent pipe **44** is connected to the upper side of the vent cover **42** to serve as a gas discharge path. Various alternatives are possible with respect to the technical idea of the vent pipe **44** extending from the vent cover **42** to the outside of the case portion **20** to guide discharge of gas. The vent pipe **44** according to one embodiment of the present disclosure may have a pipe shape extending upward from the upper side of the vent cover **42** and protrude to the outside of the case portion **20**. The gas discharged to the upper side of the filtering portion **50** is guided by the vent cover **42** to the vent pipe **44** and is exhausted to the outside of the case portion **20** through the vent pipe **44**.

[0058] Various alternatives are possible with respect to the technical idea of the filtering portion **50** being located between the cavity portion **30** and the vent portion **40** and allowing only the gas contained in the coating solution to move in a direction toward the vent portion **40**. The filtering portion **50** may be attached to and detached from the case portion **20** by a sliding operation. A space for mounting the filtering portion **50** is provided inside the case portion **20**, and a filter of the filtering portion **50** operated in a sliding manner may be easily replaced.

[0059] The filtering portion **50** is installed on the inner pipe **32** provided in the cavity portion **30** and the vent portion **40** is installed on the filtering portion **50**. Accordingly, the gas contained in the coating solution moving to the nozzle **26** through the inner pipe **32** passes through the filtering portion **50** and then is discharged to the outside of the case portion **20** through the vent portion **40**. Further, the liquid coating solution may not pass through the filtering portion **50**, and, thus, the liquid coating solution is discharged only through the nozzle **26**.

[0060] The filtering portion **50** according to one embodiment of the present disclosure may include a filtering frame **60** and the filter member **90**. Since the filtering portion **50** is detachably installed on the case portion **20** in a sliding manner, a process of replacing the filtering frame **60** and the filter member **90** may be performed without disassembling the case portion **20**. The filter member **90** may include a porous membrane.

[0061] Various alternatives are possible with respect to the technical idea of the filtering frame **60** being located between the vent portion **40** and the cavity portion **30**, being formed with a plurality of holes in the vertical direction (Z), and supporting the filter member **90**. The sliding movement of the filtering frame **60** is guided by the guide portion **100**. In the present disclosure, the filter member **90** may include or be referred to as a porous membrane or membrane.

[0062] The filtering frame **60**, which supports the filter member **90**, may include a plurality of connection holes to facilitate the collection of air bubbles. Since the filtering frame **60** forms a groove having a shape concave toward the filter member **90**, the air bubbles contained in the coating solution gather in the concave-shaped groove provided in the filtering frame **60**, and, thus, the air bubbles may be relatively easily and rapidly collected.

[0063] Because pores of the filter member **90** may be blocked by slurry particles as the working time increases, the filter member **90** including a porous membrane may be periodically replaced.

[0064] FIG. **7** is a cross-sectional view illustrating the exemplary filtering portion **50** according to the present disclosure and FIG. **8** is a bottom view illustrating an exemplary first support member **62** according to the present disclosure. As shown in FIGS. **2**, **7**, and **8**, the filtering frame **60** according to one embodiment of the present disclosure may include the first support member **62**, a second support **66**, and a connection member **70**. In some examples, the filtering frame **60** may further include a wing member **80**.

[0065] Various alternatives are possible with respect to the technical idea of the first support member **62** being formed in a plate shape that covers an upper side of the cavity portion **30** and

including a first connection hole **64** through which gas passes. The first connection hole **64** may have an inner diameter that gradually narrows toward an upper side where the filter member **90** is located. A diameter of the first connection hole **64** may be 100 μm or more, which is larger than a pore diameter (1 μm or less) of the porous membrane of the filter member **90**.

[0066] The first support member **62** may be formed in a plate shape and the filter member **90** is mounted on the first support member **62**. The first support member **62** may be installed to contact the coating solution inside the cavity portion **30**. Hydrophobic treatment may be performed on the first connection hole **64** so that only the air bubbles contained in the coating solution move to the filter member **90** through the first connection hole **64**, and, thus, the coating solution may not move through the first connection hole **64** to the filter member **90**. The hydrophobic coating or application may be performed on an inner side surface of the first support member **62** facing the first connection hole **64**. A plurality of first connection holes **64** are provided in the first support **62** and extend in a vertical direction. A path of the first connection hole **64** gradually narrows from a lower side to an upper side. Accordingly, only air bubbles of the coating solution located under the first connection holes **64** may be collected through the first connection holes **64** and move to the filter member **90** at an upper side. Thus, the liquid coating solution may not move upward through the first connection holes **64** on which hydrophobic treatment has been performed.

[0067] The first support member **62** may be formed in a flat plate shape and hydrophilic treatment may be performed on a lower side surface of the first support member **62** facing the cavity portion **30**. Because the hydrophilic coating or application is performed on the lower side surface of the first support member **62**, the liquid coating solution is present on the lower side surface of the first support member **62** and only air bubbles may move to the first connection holes **64**, which have a concave groove shape.

[0068] When a hydrophobic surface and a hydrophilic surface are adjacent to each other, the air bubbles are more attracted to the hydrophobic surface side, and, thus, the air bubbles may be induced to the hydrophobic surface. Since surface free energy is less in the concave portion where the first connection holes **64** are formed in the lower side surface of the first support member **62**, the air bubbles may be collected more easily than on a flat surface.

[0069] As the air bubbles induced to the hydrophobic surface of the first connection holes **64** pass through small pores of the hydrophobically treated filter member **90**, only air bubbles may be discharged to the upper side of the filter member **90** without leakage of the coating solution. In an operation of discharging only gas to the upper side of the filtering frame **60**, a capillary phenomenon is used and only gas may be removed from the system without leakage of the liquid within a certain pressure range.

[0070] When a membrane is used as the filter member **90**, a liquid entry pressure (LEP) at which the liquid starts to leak through pores of the membrane may be given by the following Young-Laplace equation:

[00001]LEP = $P_1 - P_0 = -\frac{4 \cos(\ )}{d}$ [0071] wherein P.sub.1 is a pressure inside a system and a pressure at a lower side of the filter member **90**, P.sub.0 is a pressure outside the system and a pressure at an upper side of the filter member **90**, γ is the surface tension of the liquid coating solution, α is a contact angle between the liquid coating solution and the filter member **90**, and d is a diameter of the pore provided in the filter member **90**. When a pressure difference between the inside and outside increases, α also increases, and when α exceeds a certain value, the liquid leaks through the pores to outside of the system. The contact angle α is sensitively affected by the surface treatment state.

[0072] In order to suppress the leakage of the coating solution through the filter member **90**, it is preferable that an LEP value is as high as possible, the contact angle is large, and a pore size of the membrane is small. When a porous membrane is used as the filter member **90**, more effective air bubble removal may be performed.

[0073] Various alternatives are possible with respect to the technical idea of the second support

member **66** being located on the first support **62** and including a second connection hole **68** at a position facing the first connection hole **64** with the filter member **90** therebetween. A plurality of second connection holes **68** may be provided to extend in the vertical direction. The second connection holes **68** have inner diameters that gradually narrow toward a lower side where the filter member **90** is located. The second support member **66** has a plate shape and is spaced apart from the first support member **62**. A filter mounting groove **72** for mounting the filter member **90** is provided between the first support member **62** and the second support member **66**.

[0074] Because the first connection holes **64** and the second connection holes **68** are installed at positions facing each other with the filter member **90** therebetween, gas may be more smoothly exhausted. Hydrophobic surface treatment may also be performed on inner side surfaces of the second support member **66** facing the second connection holes **68**. Diameters of the first connection holes **64** may be 200±50 μm and a distance between adjacent first connection holes **64** may be 500±100 μm. Diameters of the second connection holes **68** may be 200±50 μm and a distance between adjacent second connection holes **68** may be 500±100 μm.

[0075] A hydrophobic material is coated on inner side surfaces of the first connection holes **64**, and a hydrophobic material may also be coated on inner side surfaces of the second connection holes **68**. When the coating solution is a negative electrode slurry, the coating solution includes distilled water or water and, thus, has hydrophilic characteristics. Accordingly, the coating solution is induced to the lower side surface of the first support member **62** on which a hydrophilic coating is formed and is prevented from moving to the first connection hole **64** on which a hydrophobic coating is formed. However, the air bubbles contained in the coating solution are not affected by the hydrophobic coating and are collected in the first connection hole **64** forming a concave groove shape, and the air bubbles move to the vent portion **40** through the filter member **90** and the second connection holes **68**.

[0076] The hydrophobic material contained in the hydrophobic coating should include stable characteristics such that the coating will not participate in an electrochemical reaction in the secondary battery. The hydrophobic coating used in the present disclosure may include at least one of nanosilica, fluorinated nanosilica, polyurethane, non-acetic acid type silicon, and a fluorocarbon compound (fluorocarbon).

The fluorocarbon compound is a compound composed of carbon and fluorine atoms and has unique chemical and physical properties. A fluorocarbon molecule has a structure in which one or more carbon atoms are replaced with one or more fluorine atoms.

[0077] Various alternatives are possible with respect to the technical idea of the connection member **70** connecting the first support member **62** and the second support member **66**. The connection member **70** according to one embodiment of the present disclosure is installed on both sides of the first support member **62** and the second support member **66** in the width direction (X) and extends in the vertical direction (Z) to connect the first support member **62** and the second support member **66**. A length of the connection member **70** in the vertical direction (Z) may correspond to a thickness of the filter member **90** in the vertical direction (Z).

[0078] The filtering portion **50** may be detachably installed in the case portion **20**. The filtering portion **50** may be mounted in the case portion **20** by sliding movement in the horizontal direction. In addition, the filtering portion **50** may be attached to or detached from the case portion **20** in various ways.

[0079] FIG. **3** is a perspective view illustrating the exemplary secondary battery manufacturing device **1** according to the present disclosure and FIG. **5** is a front view illustrating a state in which the exemplary filtering frame **60** according to the present disclosure is connected to the guide portion **100**. As shown in FIGS. **3** and **5**, since the wing member **80** provided with the filtering portion **50** moves along the guide portion **100** mounted in the case portion **20**, the filtering portion **50** may be attached to and detached from the case portion.

[0080] Various alternatives are possible with respect to the technical idea of the wing member **80**

extending in a lateral direction of the connection member **70** and including a guide protrusion **82** associated with a guide groove **104**. The wing member **80** is installed on both sides of the filtering frame **60** in the width direction (X). The wing member **80** may be integrally formed with the connection member **70** or may be manufactured separately and coupled to the connection member **70**. The guide protrusion **82** protruding upward from the wing member **80** is inserted and associated with the guide groove **104** of the guide portion **100** fixed to the case portion **20**, and, thus, guides the sliding movement of the filtering frame **60**.

[0081] Various alternatives are possible with respect to the technical idea of the guide portion **100** being fixed to the case portion **20** and guiding the sliding movement of the filtering portion **50**. The guide portion **100** according to one embodiment of the present disclosure may include a guide body **102** and a guide groove **104**.

[0082] Various alternatives are possible with respect to the technical idea of the guide body **102** being installed on both sides of the filtering portion **50** in the width direction (X) and extending along the moving direction of the filtering portion **50**. The guide body **102** is formed in a quadrangular rod shape and may be fixed to the upper case **22**.

[0083] Various alternatives are possible with respect to the technical idea of the guide groove **104** forming a groove in the longitudinal direction (Y) of the guide body **102**. The guide groove **104** according to one embodiment of the present disclosure may form a “T”-shaped groove and the guide protrusion **82** may form a “T”-shaped protrusion. The horizontal movement of the filtering frame **60** may be guided in a state in which the guide protrusion **82** is positioned in the guide groove **104**.

[0084] FIG. **6** is a side cross-sectional view illustrating a state of the exemplary locking portion **120** according to the present disclosure. Various alternatives are possible with respect to the technical idea of the locking portion **120** providing a locking structure to prevent separation of the filtering portion **50** to outside of the case portion **20**. Unintentional separation of the filtering portion **50** mounted in case portion **20** to outside of the case portion **20** may be prevented by installing the locking portion **120**. The locking portion **120** according to one embodiment of the present disclosure is located outside the case portion **20**, and is fixed while surrounding the lower case **24**, with the guide portion **100** protruding to the outer side of the case portion **20**. The locking portion **120** according to one embodiment of the present disclosure includes a locking body **122** and locking protrusions **124**. The locking body **122** has a rod shape extending in the vertical direction (Z) and the locking protrusions **124** extend in a direction toward the case portion **20** from upper and lower sides of the locking body **122**. The locking protrusion **124** at the upper side are positioned to an upper side of the guide portion **100** and the locking protrusion **124** at the lower side are positioned to the lower case **24** and, thus, movement of the locking protrusion is restricted. The filtering portion **50** and the airtight plate **110** (to be described below) are located in a lateral direction of the locking body **122**. Since the locking portion **120** is fixed to the guide portion **100** and the lower case **24** in a forcibly fitting manner, the filtering portion **50** is restricted by the locking body **122** and, thus, lateral movement of the locking protrusion **124** is restricted.

[0085] As shown in FIG. **2**, the airtight plate **110** supports the lower side of the filtering portion **50** and is installed along an outer periphery of the cavity portion **30**. Various alternatives are possible with respect to the technical idea of the airtight plate **110** guiding the movement of the coating solution from the cavity portion **30** to the nozzle **26**. The filtering portion **50** and the guide portion **100** may be located on the airtight plate **110** so that a flow of the coating solution moving from the cavity portion **30** to the nozzle **26** is not affected. Due to installation of the airtight plate **110**, the filtering portion **50** may stay spaced apart from the cavity portion **30** at a set distance and not contact the cavity portion **30**. Since the airtight plate **110** is installed along an upper open inlet of the inner pipe **32** provided in the cavity portion **30**, movement of the coating solution discharged from the inner pipe **32** in directions except for a direction toward the nozzle **26** is blocked. Further, a flow path suitable for coating conditions may be formed by merely replacing the airtight plate

110.
[0086] The airtight plate **110** according to one embodiment of the present disclosure may include a first airtight member **112** having a shape surrounding a rear of the inner pipe **32** and second airtight members **114** connected to both sides of the first airtight member **112** in a width direction. The wing member **80** may be located on the first airtight member **112**. The second airtight members **114** are located on both sides of the inner pipe **32** in the width direction and guide the movement of the coating solution moving to an upper side of the inner pipe **32** in a forward direction toward the nozzle **26**.
[0087] Various alternatives are possible with respect to the technical idea of the filter member **90** being detachably installed inside the filtering frame and allowing only gas from the coating solution to pass therethrough. The filter member **90** may be installed between the first support member **62** and the second support member **66**. In some examples, the filter member **90** may include a membrane filter.
[0088] A porous membrane, which is the filter member **90**, may include at least one of polytetrafluoroethylene (PTFE), polyvinylidene fluoride (PVDF), polypropylene (PP), perfluoroalkoxy (PFA), and ethylene tetrafluoroethylene (ETFE).
[0089] Since a porous membrane is used as the filter member **90**, as the liquid coating solution may not pass through the filter member **90**, and as only gas passes through the filter member **90**, gas may be removed from the coating solution. Pressure in the secondary battery manufacturing device **1** may intermittently rise due to operation of a pump which supplies the slurry (the coating solution), and even in such a case, leakage of the liquid coating solution through the filter member **90** may be prevented. To this end, it is preferable that the LEP value, which may be calculated using the above-described Young-Laplace equation, is high. In order to acquire a high LEP value, a contact angle of the membrane should be large and a pore diameter of the membrane should be small.
[0090] Because a minimum pressure for discharging the slurry through the nozzle **26** does not exceed 10 bar under general coating conditions, when the LEP is greater than 10 bar, the leakage of the slurry may not occur and air bubbles may be stably removed. Among a plurality of possible membranes, PVDF has the largest contact angle and its LEP value is also high; when a pore size of the membrane manufactured of PVDF is 0.2 μm or less, the LEP is 10 or more, which is satisfactory for the purposes of the present disclosure.
[0091] FIG. **9** is a graph illustrating the liquid entry pressure (LEP) according to the pore diameter of the exemplary filter member **90** according to the present disclosure. In particular, FIG. **9** is a graph of the results of calculating the LEP value according to pore sizes of membranes made of hydrophobic materials such as PVDF, PFA, PTFE, and ETFE
[0092] in the graph shown in FIG. **9**, the contact angle of PTFE is 110°, the contact angle of PFA is 115°, the contact angle of ETFE is 96°, and the contact angle of PVDF is 140°.
[0093] Given that the surface tension of water, which was applied as a solvent for a negative electrode slurry, is 0.072 N/m, it can be seen in FIG. **9** that PVDF having a large contact angle may withstand the highest pressure range, and the LEP value significantly increases as the pore diameter decreases.
[0094] Meanwhile, as the surface tension γ decreases, the LEP also decreases in proportion to the surface tension γ. The surface tension of N-methyl-2-pyrrolidone (NMP), which is generally applied as a solvent for a positive electrode slurry, is roughly 0.040 N/m lower than that of water. And the negative electrode slurry may also have a lower value than the surface tension of the water, which is a solvent, depending on a composition thereof. Accordingly, a range of physical properties or the like in which the present disclosure may be effective may be acquired by calculating the LEP value at a low surface tension value.
[0095] FIG. **10** is a graph illustrating the liquid entry pressure (LEP) according to the pore diameter of the exemplary filter member **90** according to the present disclosure. FIG. **10** shows an LEP

calculation result at 0.024 N/m, which is ⅓ the surface tension value of the water, as a graph. The result values in FIG. **10** include a range of physical properties of a general slurry, as it is assumed that the surface tension of the slurry is very low. A pressure applied inside the cavity portion **30** is several tens of kPa and it may be assumed that the leakage of the slurry does not occur when the LEP is 1 bar or more. However, since pulsation or the like may occur when an actual pump is driven, setting an LEP of 3 bar or more as a safety margin is more stable and the hydrophobic physical properties and the pore diameter of the membrane, which is the filter member **90**, may be limited based on these values.

[0096] In the filter member **90** according to one embodiment of the present disclosure, the membrane be formed of PVDF, which is a material having a contact angle of 140° or more, which is a value representing hydrophobic physical properties. It is preferable that the pore diameter is small, and for a material having a large contact angle, such as PVDF, even when a membrane having a pore diameter of 0.2 μm is applied, gas air bubbles may be removed from the coating solution while suppressing the leakage of the slurry.

[0097] According to the present disclosure, because air bubbles introduced into a slurry are separated from the slurry, a defect rate of secondary batteries can be decreased.

[0098] Further, according to the present disclosure, because only the air bubbles introduced into the slurry are exhausted to external air and discharging of the slurry is prevented, additional work for collecting the slurry is omitted, and thus production costs can be reduced.

[0099] However, effects which can be acquired through the present disclosure are not limited to the above-described effects, and other technical effects which are not mentioned will be clearly understood by those skilled in the art from the following description.

[0100] Although the present disclosure was described above with limited examples and drawings, the present disclosure is not limited thereto, and various modifications and variations may be made by those skilled in the art within the technical spirit of the present disclosure and the equivalent scope of the claims to be described below.

Claims

1. A secondary battery manufacturing device comprising: a case portion provided with a nozzle, the nozzle being configured to face a base material being moved by a coating roll; a cavity portion positioned inside the case portion, the cavity portion forming a conduit for transferring a coating solution to the nozzle; a vent portion having a first side surrounding an inlet to the cavity portion and a second side extending outward from the case portion to form a pathway for discharging gas; and a filtering portion positioned between the cavity portion and the vent portion, the filtering portion being configured to direct gas contained in the coating solution toward the vent portion and prevent liquid of the coating solution from being directed to the vent portion.

2. The secondary battery manufacturing device of claim 1, wherein the case portion includes a lower case surrounds a lower portion of the cavity portion and an upper case surrounding an upper side of the filtering portion, with the upper case being fixed to the lower case.

3. The secondary battery manufacturing device of claim 1, wherein the cavity portion includes: an inner pipe forming a conduit for supplying the coating solution in a width direction of the case portion, with an upper side of the inner pipe being open; and a supply pipe configured to supply the coating solution to the inner pipe, the supply pipe having a first side connected to the inner pipe and a second side extending to outside of the case portion.

4. The secondary battery manufacturing device of claim 1, wherein the vent portion includes: a vent cover covering an upper side of the filtering portion, the vent cover being configured to collect gas from the filtering portion; and a vent pipe extending from the vent cover to outside of the case portion, the vent pipe being configured to guide discharge of the gas.

5. The secondary battery manufacturing device of claim 1, wherein the filtering portion includes: a

filtering frame positioned between the vent portion and the cavity portion, with a plurality of holes being formed in the filtering frame in a vertical direction; and a filter member detachably installed inside the filtering frame and configured to allow the gas from the coating solution to pass therethrough and to prevent the liquid of the coating solution from passing therethrough.

6. The secondary battery manufacturing device of claim 5, wherein the filtering frame includes: a first support member formed in a plate shape and covering an upper side of the cavity portion, with a first connection hole being formed in the first support member such that the gas can pass through the first support member; a second support member positioned above the first support member, with a second connection hole being formed in the second support member at a position facing the first connection hole and such that the gas can pass through the second support member; a connection member connecting the first support member and the second support member; and the filter member positioned between the first support member and the second support member.

7. The secondary battery manufacturing device of claim 6, wherein the first connection hole has an inner diameter that gradually narrows toward an upper side where the filter member is located.

8. The secondary battery manufacturing device of claim 6, wherein the second connection hole has an inner diameter that gradually narrows toward a lower side where the filter member is located.

9. The secondary battery manufacturing device of claim 1, wherein the filtering portion is attachable to and detachable from the case portion by a sliding operation.

10. A secondary battery manufacturing device comprising: a case portion provided with a nozzle, the nozzle being configured to face a base material being moved by a coating roll; a cavity portion positioned inside the case portion, the cavity portion forming a conduit for transferring a coating solution to the nozzle; a vent portion having a first side surrounding an inlet to the cavity portion, and a second side extending to outside of the case portion to form a path for discharging gas; a filtering portion positioned between the cavity portion and the vent portion, the filtering portion being configured to direct gas contained in the coating solution in a direction toward the vent portion; and a guide portion fixed to the case portion, the guide portion being configured to guide sliding movement of the filtering portion.

11. The secondary battery manufacturing device of claim 10, wherein the guide portion includes: guide bodies installed on opposite sides of the filtering portion in a width direction and extending along a direction that the filtering portion moves when being guided into the case portion; and guide grooves formed in a longitudinal direction of the guide bodies.

12. The secondary battery manufacturing device of claim 11, wherein the filtering portion includes: a filtering frame positioned between the vent portion and the cavity portion, with a plurality of holes being formed in the filtering frame in a vertical direction, and the filtering frame being configured such that sliding movement of the filtering frame is guidable by the guide portion; and a filter member detachably positioned inside the filtering frame, the filter member being configured to allow gas from the coating solution to pass therethrough and to prevent liquid from the coating solution from pass therethrough.

13. The secondary battery manufacturing device of claim 12, wherein the filtering frame includes: a first support member formed in a plate shape and covering an upper side of the cavity portion, with a first connection hole being formed in the first support member such that the gas may pass therethrough; a second support member positioned above the first support member, with a second connection hole being formed in the second support member at a position facing the first connection hole, with the filter member be positioned between the first connection hole and the second connection hole; a connection member connecting the first support member and the second support member; and a wing member extending in a lateral direction of the connection member and including a guide protrusion positioned in the guide groove.

14. The secondary battery manufacturing device of claim 12, wherein the filter member includes a membrane filter.

15. The secondary battery manufacturing device of claim 10, further comprising an airtight plate

supporting a lower side of the filtering portion, positioned along an outer periphery of the cavity portion, and configured to guide movement of the coating solution from the cavity portion to the nozzle.