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NAGARE et al.(10) **Pub. No.: US 2012/0318462 A1**(43) **Pub. Date: Dec. 20, 2012**(54) **METHOD AND APPARATUS FOR
MANUFACTURING WOUND ELECTRODE
ASSEMBLY FOR BATTERY****Publication Classification**(51) **Int. Cl.**
H01M 4/04 (2006.01)(52) **U.S. Cl.** **156/443**(75) Inventors: **Tatsuya NAGARE**, Hyogo (JP);
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Souichirou UENO, Tokushima (JP)(73) Assignee: **SANYO Electric Co., Ltd.**, Osaka (JP)(21) Appl. No.: **13/599,547**(22) Filed: **Aug. 30, 2012****Related U.S. Application Data**(62) Division of application No. 12/710,408, filed on Feb.
23, 2010.(30) **Foreign Application Priority Data**

Feb. 23, 2009 (JP) 2009-039390

(57) **ABSTRACT**

The present invention aims to provide a method for bonding protective tapes to the cut edges of an electrode plate within a short period to prevent short circuit in an electrode assembly. An electrode plate cutting & tape bonding process includes (1) cutting an electrode plate into pieces **100a** and **100b**, (2) forming a gap **W** between edges **106** and **107** of the pieces **100a** and **100b**, (3) bonding protective tapes **51** and **52** to both sides of the pieces **100a** and **100b**, covering the edges and the gap, and (4) conveying the pieces **100a** and **100b** connected together. Next, the tapes **51** and **52** are cut into pieces **51a** & **52a** and **51b** & **52b**. Then, the electrode plate piece **100a** with the tape pieces **51a** & **52a** and **51b** & **52b** is wound together with a negative electrode plate, with a separator sandwiched therebetween.

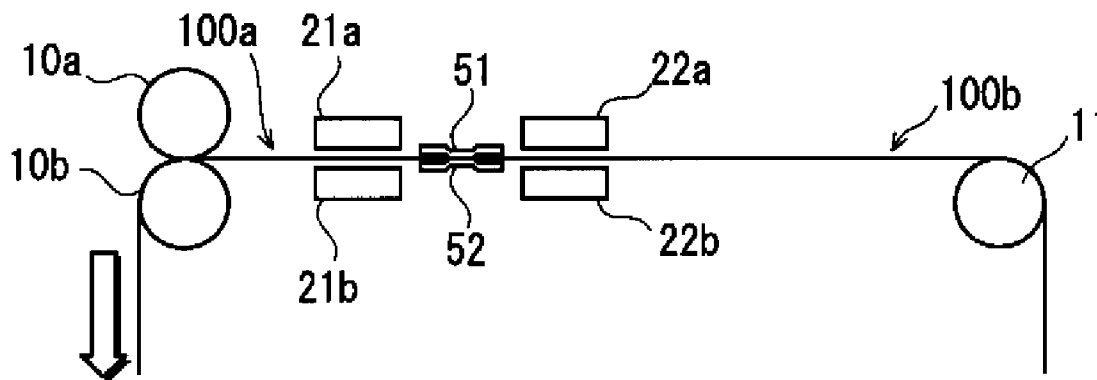
Electrode plate conveying

FIG. 1

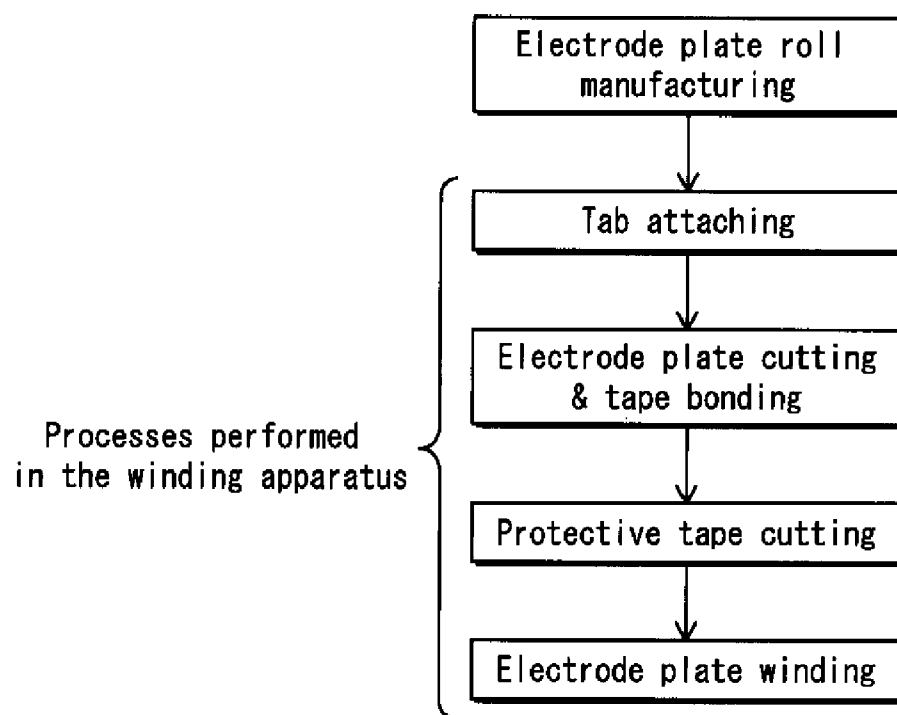


FIG. 2

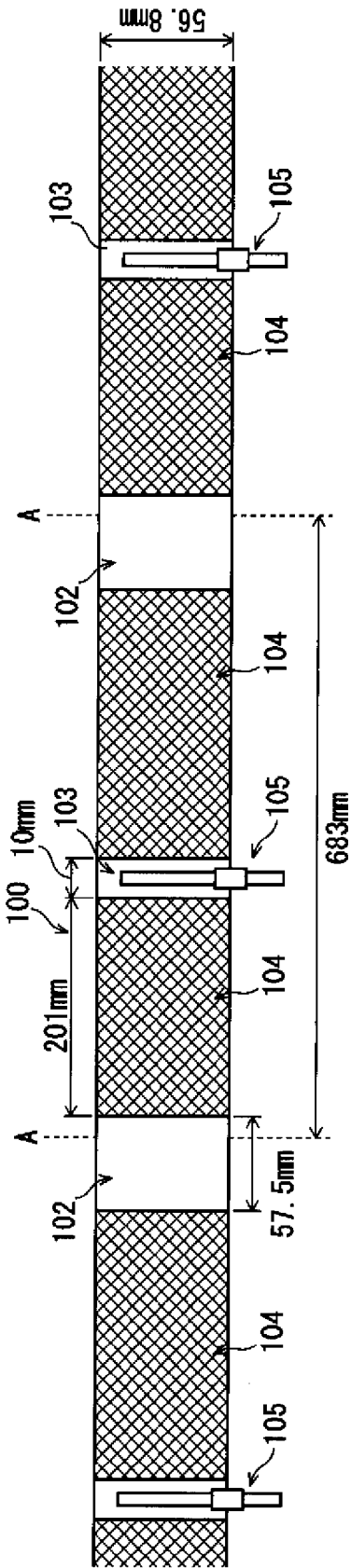


FIG. 3A

Electrode plate cutting

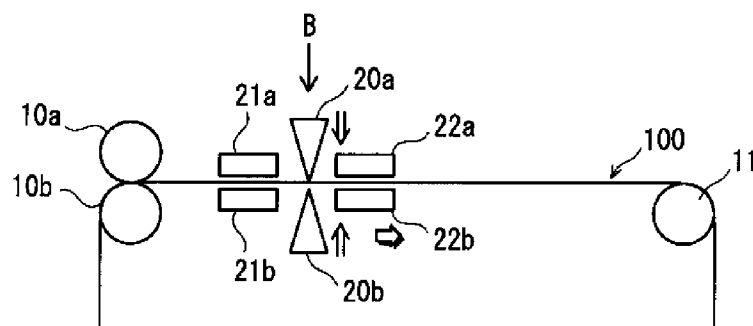


FIG. 3B

Pitch widening

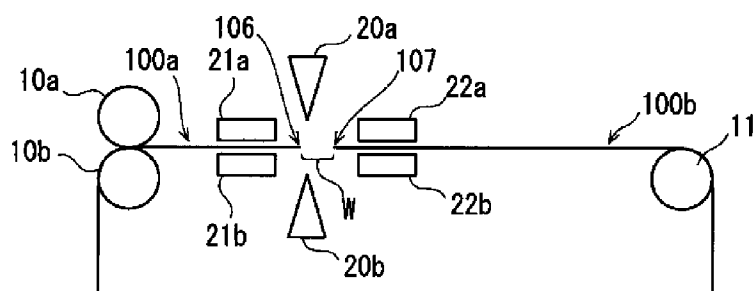


FIG. 3C

Tape bonding

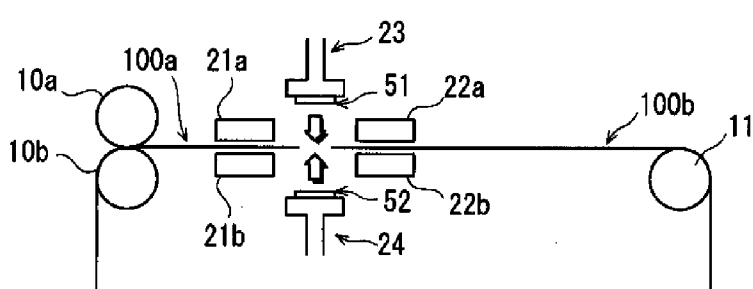


FIG. 3D

Electrode plate conveying

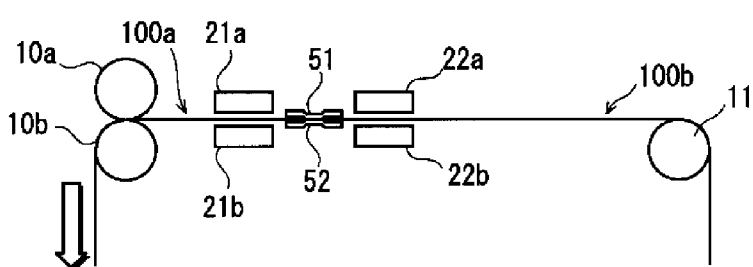


FIG. 4

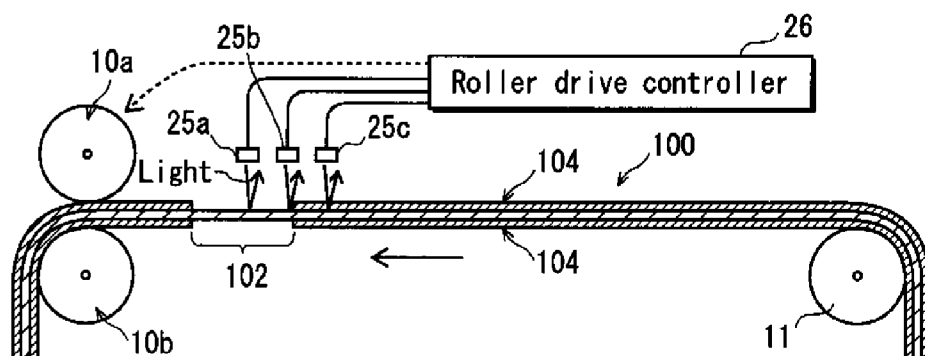


FIG. 5A

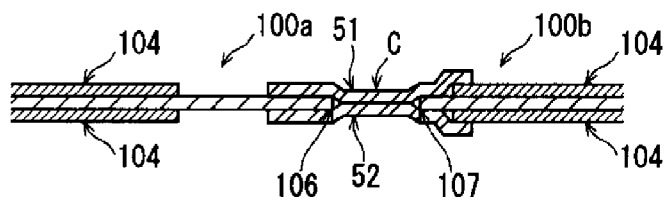


FIG. 5B

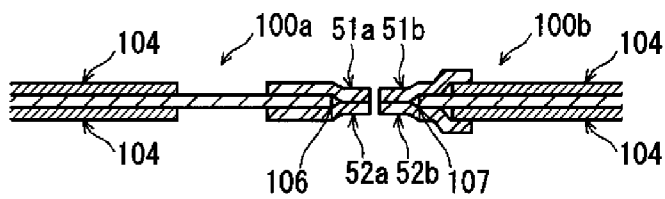


FIG. 6A

Protective tape cutting

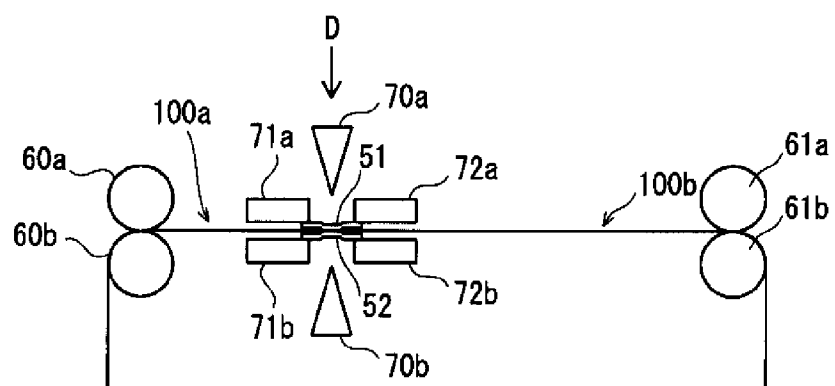


FIG. 6B

Electrode plate conveying

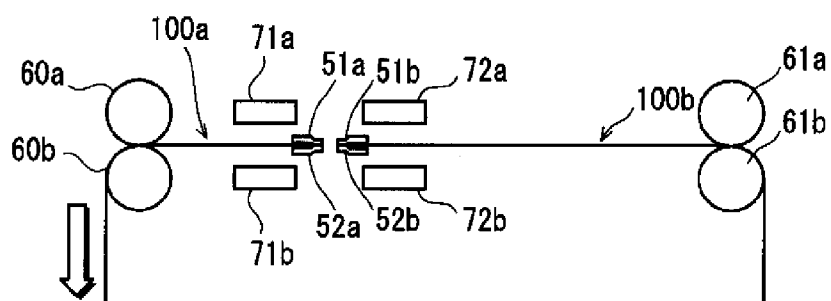


FIG. 7

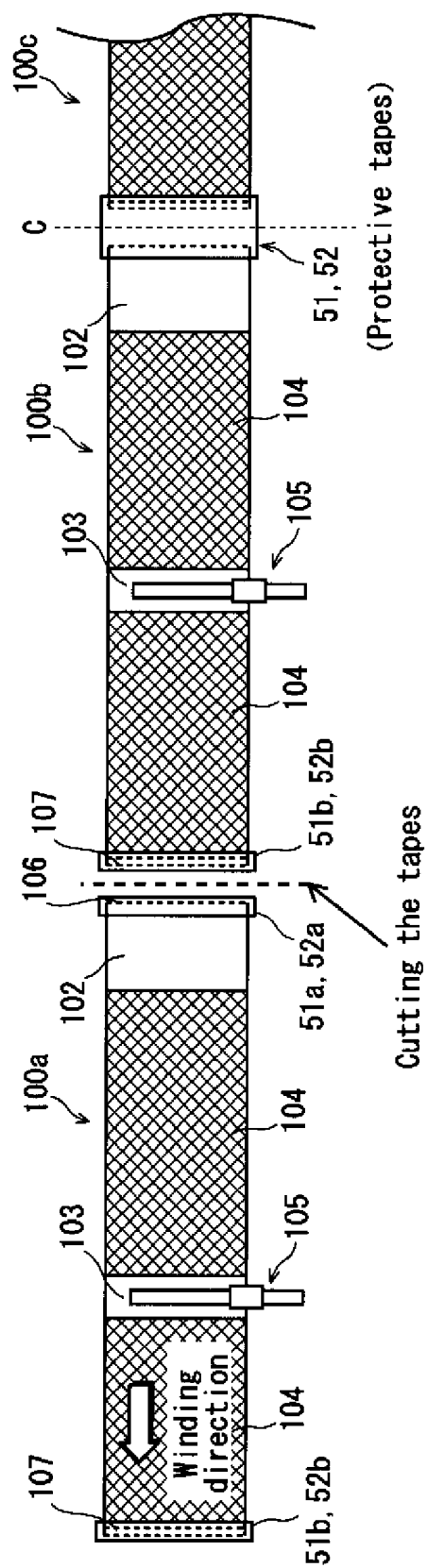


FIG. 8

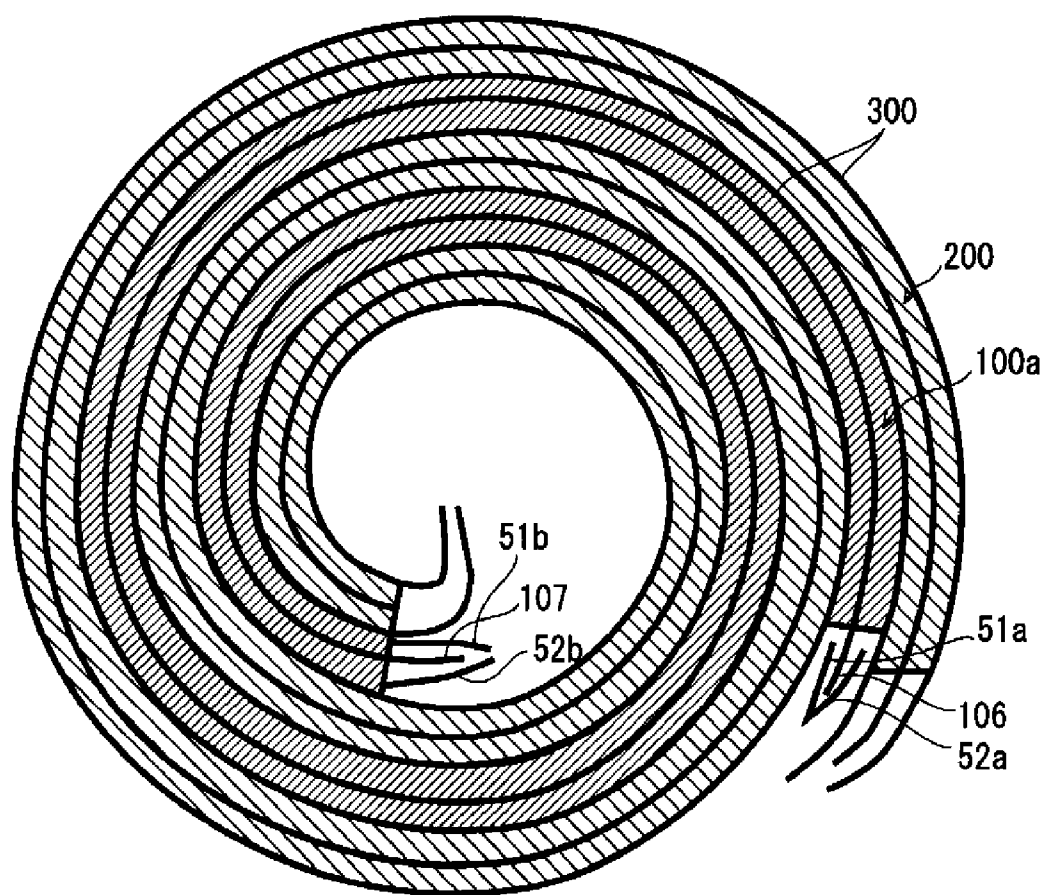


FIG. 9A

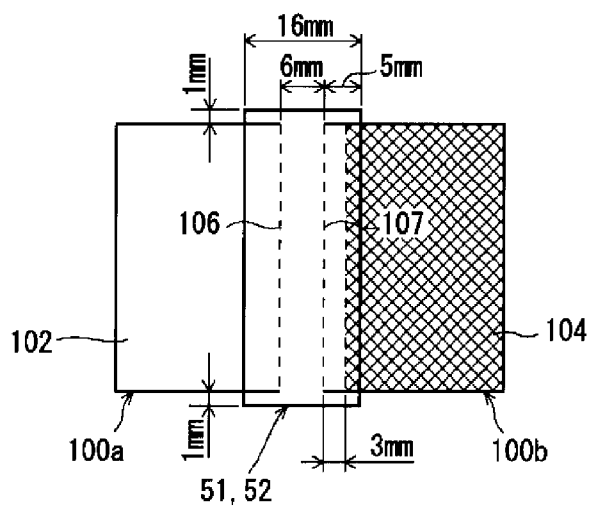


FIG. 9B

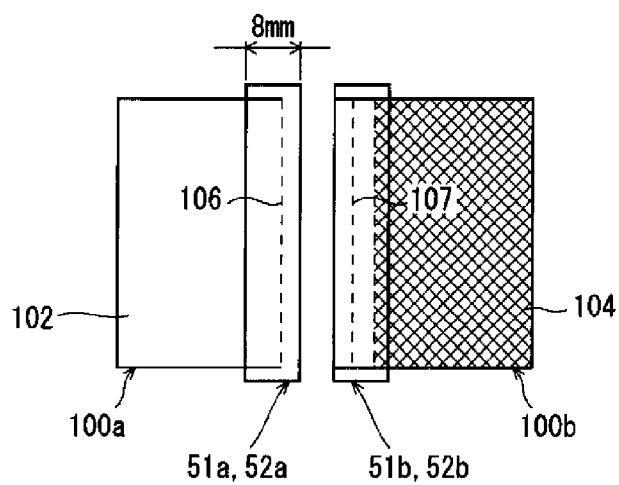
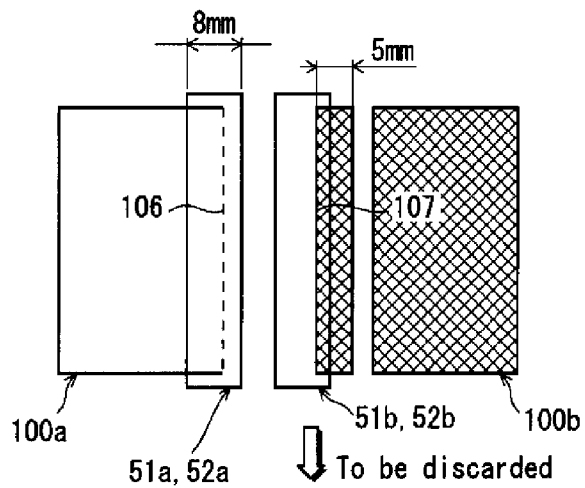


FIG. 9C



METHOD AND APPARATUS FOR MANUFACTURING WOUND ELECTRODE ASSEMBLY FOR BATTERY

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a divisional application of U.S. Ser. No. 12/710,408, filed Feb. 23, 2010, and is based upon and claims the benefit of priority from the prior Japanese Patent Application No. 2009-039390, filed on Feb. 23, 2009, the entire contents of which are incorporated by reference.

BACKGROUND OF THE INVENTION

[0002] (1) Field of the Invention

[0003] The present invention relates to a method for manufacturing electrode assemblies for batteries and an apparatus for manufacturing wound electrodes, and in particular to a method for manufacturing wound electrode assemblies by cutting and winding pieces of an electrode plate pulled out from an electrode plate roll.

[0004] (2) Description of the Related Art

[0005] As a method for manufacturing wound electrode assemblies for batteries, it is common to pull out an electrode plate bit by bit from an electrode plate roll, cut off one-cell-long pieces from the electrode plate with a cutter, and wind the electrode plate pieces.

[0006] Here, degradation of the cutter increases the occurrence of burrs at the cut edges, and increases burrs in size as well. Such burrs can be a cause of short circuit in a wound electrode assembly (Japanese Patent Application Publication No. 10-241737).

[0007] In view of this, a conventional method to control burrs is required to beforehand determine an acceptable level of burrs, regularly check the burrs by sampling, and change the cutter with a new one when the acceptable level is reached.

[0008] Also, as disclosed in Japanese Patent Application Publication No. 2001-85066, there is a well-known technique to prevent short circuit in an electrode assembly even if burrs occur at the cut edge. According to this method, protective tapes are bonded to the cut edges so as to sandwich them and cover the both sides of the electrode plate pieces.

SUMMARY OF THE INVENTION

[0009] However, since each one-cell-long electrode plate piece has two cut edges namely the downstream-side edge and the upstream-side edge, two processing steps are required to bond protective tapes to the downstream-side and upstream-side edges. This takes a considerable time. As the time required for these tape bonding steps increases, the takt time (i.e. the time interval between winding up of a one-cell-long piece and winding up of the next one-cell-long piece) of the winding process increases as well. This can be a cause of degradation of the productive efficiency.

[0010] Here, it is possible to bond protective tapes to a position to be cut, before cutting an electrode plate, and cut the protective tapes and the electrode plate together. This requires only a single step to bond the protective tapes per one-cell-long electrode plate piece, and reduces the time for bonding the tapes. However, if a burr that is larger than the thickness of the protective tapes occurs in the cutting of the electrode plate, the protective tapes can not cover the whole

burr. In such cases, the protective tapes do not have a sufficient effect of preventing the occurrence of short circuit in the electrode assembly.

[0011] The present invention is made in view of the above problem. An object of the present invention is to provide a method for achieving a sufficient effect of preventing the occurrence of short circuit in an electrode assembly by bonding protective tapes to cut edges of an electrode plate, without taking a considerable time for the bonding the protective tapes.

[0012] To fulfill this object, the present invention provides a method for manufacturing a wound electrode assembly, comprising: an electrode plate cutting step of cutting off an electrode plate piece having a length of one cell from a strip of electrode plate; a gap forming step of forming a gap between cut edges of the electrode plate piece and the electrode plate; a tape bonding step of bonding protective tapes to both sides of the electrode plate piece and the electrode plate to cover the gap and the cut edges; a tape cutting step of cutting the protective tapes at a position within the gap; and a winding step of winding the electrode plate piece having the cut protective tapes bonded thereto. Here, the "protective tape" means a tape for covering the surface of the electrode plate.

[0013] With the stated method for manufacturing a wound electrode assembly pertaining to the present invention, a strip of electrode plate is cut in the electrode plate cutting step, into electrode plate pieces each having a length of one cell.

[0014] Then, in the gap forming step and the tape bonding step, the cut edges of each electrode plate piece are covered with protective tapes, which are bonded to both sides of the electrode plate piece, and thus adjacent electrode plate pieces are connected together by protective tapes. Also, as protective tapes are bonded to the cut edges after the cutting of the electrode plate, the cut edges are covered with protective tapes in a favorable manner.

[0015] After that, the protective tapes are cut in the tape cutting step, at a position within the gap between the adjacent electrode plate pieces, and the electrode plate pieces are separated. Even after the separation, the cut edges are covered with the protective tapes bonded to both sides of the electrode plate pieces. Each of the electrode plate pieces with the protective tapes is wound up in the winding step, and thus a wound electrode assembly is manufactured. In an electrode assembly thus manufactured, the edges of the electrode plate piece are covered with the protective tapes which sandwich the edges. The tapes therefore have an effect of preventing the occurrence of short circuit in an electrode assembly even if burrs that are larger than the thickness of the protective tapes have occurred at the cut edges.

[0016] Also, according to the stated method for manufacturing a wound electrode assembly, protective tapes are bonded in the tape bonding step to both sides of the electrode plate piece and the electrode plate, to cover the gap and the cut edges. Thus, protective tapes are bonded to both cut edges by a single operation. That is, only a single operation is required to bond protective tapes to a one-cell-long electrode plate piece, which reduces the time for bonding the tapes.

[0017] As a result, the method pertaining to the present invention prevents the increase in takt time in the winding process which might be caused due to the time required for the bonding of the protective tapes.

[0018] Another aspect of the present invention is a wound electrode assembly manufacturing apparatus for manufacturing a wound electrode assembly by pulling out a strip of

electrode plate bit by bit, cutting off an electrode plate piece having a length of one cell from the electrode plate, and winding the electrode plate piece, the apparatus comprising: an electrode plate cutter operable to cut off the electrode plate piece;

[0019] a gap forming unit operable to form a gap between cut edges of the electrode plate piece and the electrode plate; a tape bonding unit operable to bond protective tapes to both sides of the electrode plate piece and the electrode plate to cover the gap and the cut edges; a tape cutter operable to cut the protective tapes at a position within the gap; and a winding unit operable to wind the electrode plate piece having the cut protective tapes bonded thereto. This apparatus for manufacturing wound electrode assembly achieves the same effect as the manufacturing method described above.

[0020] As explained above, the method and the apparatus pertaining to the present invention realize manufacturing of a wound electrode assembly that does not easily cause short circuit, without degrading the productive efficiency.

[0021] In the above-described method and apparatus for manufacturing the wound electrode assembly, the electrode plate may be pulled out bit by bit to a first stage in which the electrode plate cutting step, the gap forming step and the tape bonding step are performed, and the electrode plate piece with the protective tapes may be conveyed from the first stage to a second stage in which the tape cutting step is performed. With this structure, the processes can be performed in parallel in the first stage and the second stage.

[0022] This structure further reduces the total time required for the electrode plate cutting, the gap forming, the tape bonding and the tape cutting, and more efficiently prevents the increase in takt time in the winding process.

[0023] Moreover, the second stage immediately before the electrode plate winding process includes only the protective tape cutting, and it is unnecessary to perform the electrode plate cutting in this stage. This prevents powder dust and small fragments, generated in the electrode plate cutting, from being mixed into the electrode assembly in the electrode plate winding process.

[0024] The present invention realizes the manufacture of a wound electrode assembly that does not easily cause short circuit, without degrading the productive efficiency. Thus, the present invention is suitable for the manufacture of wound electrode assemblies for various kinds of batteries such as nonaqueous electrolyte batteries.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] These and the other objects, advantages and features of the invention will become apparent from the following description thereof taken in conjunction with the accompanying drawings which illustrate a specific embodiment of the invention.

[0026] In the drawings:

[0027] FIG. 1 is a process chart showing manufacturing processes for an electrode assembly pertaining to an embodiment;

[0028] FIG. 2 shows the structure of an electrode plate 100 with tabs;

[0029] FIGS. 3A to 3D illustrate an electrode plate cutting & tape bonding process;

[0030] FIG. 4 illustrates a control mechanism for stopping cutting line A at a cutting position B;

[0031] FIGS. 5A and 5B each show a cross section of a part of an electrode plate piece to which protective tapes are bonded;

[0032] FIGS. 6A and 6B illustrate a process for cutting protective tapes;

[0033] FIG. 7 shows that protective tapes are cut and an electrode plate piece 100a and an electrode plate piece 100b are separated from each other;

[0034] FIG. 8 shows a wound electrode assembly manufactured by an electrode plate winding process; and

[0035] FIGS. 9A to 9C show example sizes of a part of an electrode plate piece to which protective tapes are bonded.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0036] FIG. 1 is a process chart showing manufacturing processes for an electrode assembly pertaining to an embodiment of the present invention.

[0037] As FIG. 1 shows, the manufacturing processes for an electrode assembly include an electrode plate roll manufacturing process, a tab attaching process, an electrode plate cutting & tape bonding process, a protective tape cutting process, and an electrode plate winding process.

[0038] An electrode plate roll manufactured through the electrode plate roll manufacturing process is set up in an electrode assembly winding apparatus.

[0039] The electrode assembly winding apparatus includes a stage for the tab attaching process, a stage for the electrode plate cutting & tape bonding process, a stage for the protective tape cutting process, and a stage for the electrode plate winding process.

[0040] The electrode plate pulled out from the electrode plate roll passes through the stages (i.e. stations) in the electrode assembly winding apparatus one by one, and each of the processes are performed in the corresponding stage. Specifically, while a portion of the electrode plate pulled out beforehand in the electrode assembly winding apparatus is going through the electrode plate winding process, the subsequent portion of the electrode plate piece goes through the protective tape cutting process, and another portion of the electrode plate, following the subsequent electrode plate, goes through the electrode plate cutting & tape bonding process and the tab attaching process, respectively in the corresponding stages.

[0041] The following explains each of the processes, based on an example case of manufacturing an electrode assembly for a nonaqueous electrolyte battery and bonding protective tapes to the positive electrode plate of the electrode assembly.

1. Electrode Plate Roll Manufacturing Process

[0042] A positive-mixture slurry is firstly manufactured by mixing lithium cobalt oxide as a positive-electrode active material, a carbon powder as an electrical conducting material, polyvinylidene fluoride as a binding agent, and N-methylpyrrolidone.

[0043] The slurry is applied on both sides of an aluminum foil (having the thickness of 15 μm , for example) pulled out from an aluminum foil roll. Here, the slurry is not applied on cutting areas 102 near cutting lines A, and tab areas 103 to each of which a collector tab is to be attached (See FIG. 2).

[0044] The applied slurry is dried with a dryer and pressed with a roller, and thus a positive-mixture layer 104 is formed.

These steps produce a positive electrode plate, which is an aluminum foil as a core material, having the positive-mixture layer **104** formed thereon.

[0045] The electrode plate thus manufactured is cut with a slitter into strips each having a predetermined width. Also, each of the strips is wound up to be in the form of a roll. Thus, an electrode roll in the roll shape is manufactured.

2. Tab Attaching Process

[0046] The electrode roll is set up in the electrode assembly winding apparatus, and a tab **105** is welded to each of the tab areas **103** of the electrode plate pulled out from the electrode roll.

[0047] FIG. 2 shows an electrode plate **100** pulled out from the electrode roll, to which tabs **105** have been attached.

[0048] The electrode plate **100** is conveyed to the subsequent stage for the electrode plate cutting & tape bonding process.

3. Electrode Plate Cutting & Tape Bonding Process

[0049] FIGS. 3A to 3D illustrate the electrode plate cutting & tape bonding process. As shown in this drawing, the electrode plate cutting & tape bonding process includes the steps of electrode plate cutting (FIG. 3A), pitch widening (FIG. 3B), tape bonding (FIG. 3C) and electrode plate conveying (FIG. 3D), which are to be performed in the stated order.

[0050] For performing these steps, a pair of rollers **10a** & **10b** and a roller **11**, which are for conveying the electrode plate **100**, are provided downstream (i.e. the left side on FIGS. 3A to 3D) and upstream (i.e. the right side on FIGS. 3A to 3D), respectively.

[0051] The electrode assembly winding apparatus is also provided with a pair of cutters **20a** & **20b** for cutting the electrode plate **100**, two pairs of chucks **21a** & **21b** and **22a** & **22b** for grasping the electrode plate **100**, and a pair of tape bonding jigs **23** & **24** for bonding protective tapes to the electrode plate **100**.

[0052] The cutters **20a** & **20b** are arranged at a cutting position B between the roller **11** and the rollers **10a** & **10b**. The positions of the tape bonding jigs **23** & **24** are also adjusted according to the cutting position B.

[0053] The chucks **21a** & **21b** and **22a** & **22b** are provided downstream and upstream from the cutting position B, respectively. Note that the chucks **22a** & **22b** are configured to be able to move upstream while grasping the electrode plate **100**.

[0054] The tape bonding jigs **23** & **24** are jigs each for sucking protective tapes one by one and bonding each tape to the surface of the electrode plate by pressing it against the plate. Specifically, a vacuum suction pad may be used for this purpose.

[0055] The following explains the steps one by one.

(1) Electrode Plate Cutting (FIG. 3A)

[0056] The electrode plate **100** is conveyed by operation of the rollers **10a** & **10b**, and is stopped when a cutting line A reaches the cutting position B.

[0057] Then, the electrode plate is grasped with the chucks **21a** & **21b** and the chucks **22a** and **22b**, and is cut off with the cutters **20a** & **20b**. Thus the electrode plate **100** is cut along the cutting line A into a preceding electrode plate piece **100a**

and a succeeding electrode plate piece **100b**. The electrode plate piece **100a** has the length required for manufacturing a single cell.

[0058] FIG. 4 illustrates a control mechanism for stopping the cutting line A at the cutting position B.

[0059] A plurality of reflectance sensors **25a** to **25c** are arranged near the cutting position B along the conveyance direction. Each of the reflectance sensors **25a** to **25c** irradiates the part of the electrode plate **100** that passes immediately below the sensor with light, and receives the reflected light to sequentially obtain the reflectances. The reflectances are input to a roller drive controller **26**.

[0060] The reflectance of the surface of the electrode plate **100** is large on the cutting area **102** to which the positive mixture is not applied, whereas it is small on the positive-mixture layer **104**. That is, the reflectance to be measured by the reflectance sensors **25a** to **25c** greatly changes at the border (i.e. edge) between the cutting area **102** and the positive-mixture layer **104**. Thus, the roller drive controller **26** is capable of predicting when the edge passes immediately below the reflectance sensors **25a** to **25c**, based on the reflectances sequentially received from the reflectance sensors **25a** to **25c**. The roller drive controller **26** predicts when the cutting line A reaches the cutting position B, and stops the rollers **10a** & **10b** according to the obtained timing. Here, note that the present embodiment is provided with the cutting areas **102** and the tab areas **103**, to which the positive mixture is not applied. Alternatively, the cutting areas **102** may be configured to be longer than the tab areas **103**, and the distance between the reflectance sensor **25a** and the reflectance sensor **25c** may be configured to be longer than the tab areas **103** (e.g. no less than 10 mm) so that the cutting areas **102** can be detected. Another method to stop the cutting lines A at the cutting position B is detecting the tabs **105** attached to the electrode plate **100**.

[0061] (2) Pitch Widening (FIG. 3B)

[0062] The chucks **22a** & **22b** are moved upstream under the condition that the electrode plate pieces **100a** and **100b** are both grasped with the chucks **21a** & **21b** and the chucks **22a** & **22b** respectively, so that a gap W having a constant length is formed between the upstream-side edge **106** of the electrode plate piece **100a** and the downstream-side edge **107** of the electrode plate piece **100b**.

[0063] (3) Tape Bonding (FIG. 3C)

[0064] Then, protective tapes **51** and **52** are attached to the electrode plate pieces **100a** and **100b** with the tape bonding jigs **23** & **24** so as to cover the gap W kept between the upstream-side edge **106** and the downstream-side edge **107**. Specifically, the protective tapes are attached such that the electrode plate pieces **100a** and **100b** are sandwiched between the protective tapes **51** and **52**, and the upstream-side edge **106**, the downstream-side edge **107** and the gap W therebetween are covered with the protective tapes **51** and **52**.

[0065] Here, it is preferable that the protective tapes **51** and **52** are adhesive insulating tapes. Usable base material of the tapes is, for example, resin of polyolefin such as polyethylene and polypropylene, polyester, polyimide, polyamide, polyphenylene sulfide, or the like. Glass cloth tapes are also usable. A preferable thickness of the base material of the protective tapes **51** and **52** is 10 to 100 μ m.

[0066] As FIG. 5A shows, the upstream-side edge **106** of the preceding electrode plate piece **100a** and the downstream-side edge **107** of the succeeding electrode plate piece **100b** are connected by the bonded protective tapes **51** and **52**, and the

upstream-side edge **106** and the downstream-side edge **107** are covered with the protective tapes **51** and **52**.

[0067] Even if large burrs occur at the edges **106** and **107** in the electrode plate cutting process described above, the burrs are pressed with the tape bonding jigs **23** & **24** and are reduced in size in this tape bonding process.

(4) Electrode Plate Conveying (FIG. 3D)

[0068] The chucks **21a** & **21b** and the chucks **22a** & **22b** are released and the rollers **10a** & **10b** are driven, so that the connected electrode plate pieces **100a** and **100b** are conveyed to the next stage for the protective tape cutting process.

4. Protective Tape Cutting Process

[0069] FIGS. 6A and 6B illustrate the process for cutting the protective tapes.

[0070] The protective tape cutting process includes the steps of protective tape cutting (FIG. 6A) and electrode plate conveying (FIG. 6B), which are to be performed in the stated order.

[0071] In the stage for the protective tape cutting process, two pairs of rollers **60a** & **60b** and **61a** & **61b** for conveying the electrode plate **100** are provided downstream and upstream respectively, in the similar manner as in the stage for the electrode plate cutting & tape bonding process described above. The stage is also provided with a pair of cutters **70a** & **70b** for cutting the protective tapes and two pairs of chucks **71a** & **71b** and **72a** & **72b** for grasping the protective tapes.

[0072] The cutters **70a** & **70b** are provided at the cutting position D between the pair of rollers **60a** & **60b** and the pair of rollers **61a** & **61b**. The pair of chucks **71a** & **71b** and the pair of **72a** & **72b** are provided downstream and upstream from the cutting position D, respectively.

(1) Protective Tape Cutting (FIG. 6A)

[0073] The rollers **60a** & **60b** are driven so as to convey the connected electrode plate pieces **100a** and **100b**. The electrode plate pieces **100a** and **100b** are stopped when the cutting line C (See FIG. 5A and FIG. 7) of the protective tapes **51** and **52** reach the cutting position D. The mechanism for stopping the cutting line C at the cutting position D is the same as explained above for the electrode plate cutting process. The cutting line C positioned within the gap between the upstream-side edge **106** and the downstream-side edge **107** (e.g. in the middle of the gap), namely in an area where only the protective tapes **51** and **52** exist and the electrode plate does not.

[0074] Then, the protective tapes **51** and **52** are grasped with the chucks **71a** & **71b** and the chucks **72a** and **72b**, and are cut off with the cutters **70a** & **70b**.

[0075] As FIG. 5B shows, the protective tapes **51** and **52** are cut along the cutting line C and divided into protective tape pieces **51a** and **52a** and protective tape pieces **51b** and **52b**, respectively. The electrode plate pieces **100a** and **100b** are separated, but the upstream-side edge **106** of the electrode plate piece **100a** and the downstream-side edge **107** of the electrode plate piece **100b** are kept covered with the protective tape pieces **51a** and **52a** and the protective tape pieces **51b** and **52b**, respectively.

[0076] FIG. 7 shows that the protective tapes are cut and the electrode plate pieces **100a** and **100b** that have been connected are separated from each other. The electrode plate

piece **100b** and the electrode plate piece **100c** following it are connected by the protective tapes **51** and **52**.

(2) Electrode Plate Conveying (FIG. 6B)

[0077] The chucks **71a** & **71b** and the chucks **72a** & **72b** are released and the rollers **60a** & **60b** are driven, so that the electrode plate piece **100a** that has been separated is conveyed to the next stage for the electrode plate winding process.

5. Electrode Plate Winding Process

[0078] This stage is for manufacturing a wound electrode assembly as shown in FIG. 8 by winding, from the downstream-side edge **107**, the electrode plate **100a** conveyed from the previous stage, to which the pairs of protective tape pieces **51a** & **52a** and **51b** & **52b** had been bonded, together with an negative electrode plate **200** manufactured separately, such that a separator **300** is sandwiched therebetween.

[0079] The negative electrode plate **200** is manufactured in the following manner. A negative-mixture slurry is firstly manufactured by mixing graphite as a negative-electrode active material and carboxymethyl cellulose and styrene-butadiene rubber as a binding agent with water. Then, this slurry is applied to a copper foil (having the thickness of 8 μ m, for example).

[0080] The applied slurry is dried and thus a negative-mixture layer is formed. Finally, the foil is cut into pieces each having a predetermine size. As the separator, a microporous polyethylene film may be used, for example.

[0081] In the wound electrode assembly thus manufactured, the downstream-side edge **107** (i.e. the starting position of the winding) of the positive electrode plate piece **100a** is kept covered with the protective tape pieces **51b** and **52b**, and the ending position of the winding (i.e. the upstream-side edge **106**) is kept covered with the protective tape pieces **51a** and **52a**. Hence, even if burrs occur at the downstream-side edge **107** and the upstream-side edge **106**, short circuit to the negative electrode plate **200** is prevented.

Advantageous Effects of the Manufacturing Method Pertaining to the Embodiment

[0082] According to the wound electrode assembly manufacturing method pertaining to the embodiment described above, the protective tapes are attached to the cut edges of the electrode plate after the electrode plate is cut into pieces. Thus, the cut edges are covered with protective tapes in a preferable manner. As a result, even if burrs occur at the cut edges, the protective tapes achieve a sufficient effect of preventing the occurrence of short circuit in the electrode assembly.

[0083] According to the wound electrode assembly manufacturing method pertaining to the embodiment described above, in the tape bonding process, the protective tapes **51** and **52** are integrally bonded to so as to cover the upstream-side edge **106** of the electrode plate piece **100a** and the downstream-side edge **107** of the electrode plate piece **100b**. Thus, only a single taping operation is required to bond the protective tapes **51** and **52** to both the upstream-side edge **106** and the downstream-side edge **107**. In other words, only a single taping operation is required to manufacture the electrode plate piece for each single cell. Thus, the method pertaining to the embodiment does not require a long time for the bonding of the protective tapes.

[0084] Accordingly, the time required for the electrode plate cutting & tape bonding process and the protective tape cutting process is reduced, which prevents the increase in takt time in the winding process.

[0085] Moreover, according to the wound electrode assembly manufacturing method pertaining to the embodiment described above, the electrode plate cutting & tape bonding process and the protective tape cutting process are performed in different stages. Thus, the method allows the processes to be performed in parallel. This further reduces the time required for the electrode plate cutting & tape bonding process and the protective tape cutting process.

[0086] Furthermore, the stage immediately before the stage for the electrode plate winding process includes only cutting of the protective tapes is, and does not include cutting of the electrode plate. This prevents powder dust and small fragments, generated in the electrode plate cutting, from being mixed into the electrode assembly in the electrode plate winding process.

[0087] As described above, the wound electrode assembly manufacturing method pertaining to the embodiment reduces the time required for the electrode plate cutting & tape bonding process and the protective tape cutting process. Thus, it is easy to complete these processes in a shorter period than the winding of a one-cell-long electrode plate. This prevents an undesired increase in takt time of the winding process.

EXAMPLES

[0088] The following shows example sizes of electrode plates to be manufactured according to the embodiment above, protective tapes to be bonded to the electrode plates, and so on.

[0089] In FIG. 2, example sizes of the electrode plate 100 are depicted.

[0090] The width of the electrode plate 100 is 56.8 mm, and the length corresponding to one cell is 683 mm. The width of each cutting area 102 is 57.5 mm. The width of each tab area 103 is 10 mm. The length between the cutting area 102 and the tab area 103 is 201 mm.

[0091] In FIGS. 9A to 9C, examples sizes of the part of the protective tapes 51 and 52 where is bonded to the electrode plate are depicted.

[0092] In the example depicted in FIG. 9A, the width of each of the protective tapes 51 and 52 is 16 mm. The length of the gap W between the upstream-side edge 106 and the downstream-side edge 107 is 6 mm. The margin for bonding of each electrode plate is 5 mm.

[0093] On the side of the upstream-side edge 106, the protective tapes 51 and 52 are bonded to the cutting area 102 to which the positive mixture is not applied. However, on the side of the downstream-side edge 107, the width of the cutting area 102 to which the positive mixture is not applied is only 3 mm, and thus the upstream edges of the protective tapes 51 and 52 are bonded to the positive-mixture layer 104.

[0094] Part of the protective tapes 51 and 52 lies off the electrode plate for 1 mm from each side of the electrode plate.

[0095] In the example depicted in FIG. 9B, the protective tapes 51 and 52 mentioned above are cut in the middle. The widths of the protective tape pieces 51a and 51b and the protective tape pieces 51b and 52b are each 8 mm.

[0096] FIG. 9C shows an example case of discarding the protective tape pieces 51b and 52b, and a part of the electrode

plate piece 100b after completing the protective tape cutting process. The length of the part from the downstream-side edge 107 is 5 mm.

[0097] In such a case, the electrode plate winding process is performed on the electrode plate 100a with a protective tape piece attached only to the downstream-side edge.

Modifications

[0098] According to the embodiment described above, the protective tapes are bonded only to the positive electrode plate. However, it is possible to bond the protective tapes to the negative electrode plate in a similar manner. The protective tapes may be bonded only to the negative electrode plate, or to both the positive electrode plate and the negative electrode plate.

[0099] According to the embodiment described above, the electrode plate winding process is performed on the electrode plate 100a without removing the protective tape pieces 51a and 52a bonded to the upstream-side edge 106 and the protective tape pieces 51b and 52b bonded to the downstream-side edge 107. However, in the cases where the protective tape at the starting part of the winding of the electrode plate piece 100a, the protective tape pieces 51ab and 52b and a downstream-side part (i.e. the vicinity of the downstream-side edge 107) may be cut off after the completion of the protective tape cutting process, and then the winding process may be performed (See FIG. 9C).

[0100] Although the embodiment above is explained based on an example case of manufacturing an electrode assembly for a nonaqueous electrolyte battery, the present invention has no limitation on battery type. The present invention is applicable to manufacturing of any type of wound electrode assembly.

[0101] Although the present invention has been fully described byway of examples with reference to the accompanying drawings, it is to be noted that various changes and modifications will be apparent to those skilled in the art. Therefore, unless such changes and modifications depart from the scope of the present invention, they should be construed as being included therein.

What is claimed is:

1. A wound electrode assembly manufacturing apparatus for manufacturing a wound electrode assembly by pulling out a strip of electrode plate bit by bit, cutting off an electrode plate piece having a length of one cell from the electrode plate, and winding the electrode plate piece, the apparatus comprising:

- an electrode plate cutter operable to cut off the electrode plate piece;
- a gap forming unit operable to form a gap between cut edges of the electrode plate piece and the electrode plate;
- a tape bonding unit operable to bond protective tapes to both sides of the electrode plate piece and the electrode plate to cover the gap and the cut edges;
- a tape cutter operable to cut the protective tapes at a position within the gap; and
- a winding unit operable to wind the electrode plate piece having the cut protective tapes bonded thereto.

2. The apparatus of claim 1, wherein the electrode plate cutter, the gap forming unit and the tape bonding unit are provided in a first stage, and the tape cutter is provided in a second stage following the first stage.

3. The apparatus of claim 1, wherein the gap forming unit forms the gap by pulling the electrode plate piece and the electrode plate away from each other.

4. The apparatus of claim 3, wherein the electrode plate cutter, the gap forming unit and the tape bonding unit are provided in a first stage, and the tape cutter is provided in a second stage following the first stage.

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