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NOTCHING APPARATUS FOR SECONDARY BATTERIES

Abstract

Proposed is a notching apparatus for secondary batteries including a notching processing part provided on a transport path of an electrode film to create an electrode tab on the electrode film, a first variable roller positioned in front of the notching processing part based on a proceeding direction of the electrode film and provided to be movable, a first fixed roller fixedly placed near the first variable roller, a second variable roller positioned at a rear of the notching processing part based on the proceeding direction of the electrode film and provided to be movable, and a second fixed roller fixedly placed near the second variable roller.

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Background/Summary

CROSS REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority to Korean Patent Application No. 10-2024-0157432, filed Nov. 7, 2024, which claims priority to Korean Patent Application No. 10-2024-0022758 filed Feb. 16, 2024, the entire contents of which is incorporated herein for all purposes by this reference.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The present disclosure relates to a notching apparatus for secondary batteries.

Description of the Related Art

[0003] In general, a notching system is a facility to create an electrode tab by shearing a film for a secondary battery electrode. The system may consist of an unwinder part for unwinding a film for an electrode (hereinafter referred to as “electrode film”) wound in a roll shape, a notching processing part for shearing the electrode film into the form of an electrode tab, a vision inspection part for checking whether the processed electrode tab is processed normally, and a rewinder part for rewinding the processed electrode film into a roll shape.

[0004] A typical notching system may perform the electrode notching process by arranging the unwinder part, notching processing part, vision inspection part, and rewinder part inline and transporting an electrode film at a certain pitch. At this time, the electrode film may be advanced at a predetermined transport speed by the rewinder part rewinding the electrode film.

[0005] Meanwhile, notching is usually performed by shearing one electrode tab at a time. This method requires that the transport of the electrode film be temporarily stopped while notching is performed in the notching processing part, which can make the notching process take a long time.

[0006] Accordingly, a notching device for secondary batteries is required that can improve the productivity of secondary batteries by ensuring that the entire electrode film is transported without stopping even during notching processing.

[0007] In addition, a notching device for secondary batteries capable of simultaneously creating multiple electrode tabs during notching processing is required.

Documents of Related Art

[0008] (Patent Document 0001) Korean Patent No. 10-1691937

SUMMARY OF THE INVENTION

[0009] According to an aspect of the present disclosure, provided is a notching apparatus for secondary batteries that can improve productivity by ensuring that the transport of an electrode film is not interrupted during the notching process of the electrode film.

[0010] In addition, provided is a notching apparatus for secondary batteries capable of simultaneously creating multiple electrode tabs during notching processing.

[0011] According to another aspect of the present disclosure, provided is a notching apparatus for secondary batteries that can be widely applied to green technology fields such as electric vehicles, battery charging stations, and solar and wind power generation using batteries.

[0012] A notching apparatus for secondary batteries according to an embodiment of the present disclosure may include: a notching processing part provided on a transport path of an electrode film to create an electrode tab on the electrode film; a first variable roller positioned in front of the notching processing part based on a proceeding direction of the electrode film and provided to be movable; a first fixed roller fixedly placed near the first variable roller; a second variable roller positioned at the rear of the notching processing part based on the proceeding direction of the electrode film and provided to be movable; and a second fixed roller fixedly placed near the second variable roller.

[0013] In this case, the notching processing part may include an upper mold and a lower mold

placed facing each other above and below the electrode film with the electrode film in between.
[0014] In addition, the notching processing part may simultaneously create multiple electrode tabs on the electrode film with a single shearing process.
[0015] In addition, the first variable roller and the second variable roller may be provided to be able to move both in a forward direction same as the proceeding direction of the electrode film and in a reverse direction opposite to the proceeding direction.
[0016] In addition, the first variable roller and the second variable roller may be provided to move the same distance in the same direction.
[0017] In addition, the movement distance of the first variable roller and the second variable roller may be set so that a portion where a next electrode tab is to be processed on the electrode film reaches a notching position in the notching processing part.
[0018] In addition, the first variable roller and the second variable roller may participate in a transport of the electrode film, and the electrode film may be provided to be wound around at least a portion of an outer periphery of the first variable roller and around at least a portion of an outer periphery of the second variable roller.
[0019] In this case, the first fixed roller may be placed ahead of the first variable roller based on the proceeding direction of the electrode film.
[0020] In addition, the second fixed roller may be placed behind the second variable roller based on the proceeding direction of the electrode film.
[0021] In this case, the first variable roller and the second variable roller may be independently moved by separately provided respective moving parts.
[0022] Each of the moving parts may include: a shaft part on which the first variable roller or the second variable roller is rotatably installed; a moving body connected to the shaft part and provided so that the first variable roller or the second variable roller may move; a power generation part provided to supply external force to the moving body; and a power transmission part provided to transmit external force of the power generation part to the moving body.
[0023] In addition, the power transmission part may include: a rotating body configured to rotate forward and reversely by the power generation part and have screw threads formed on an outer periphery thereof; and a conversion part configured to extend from the moving body toward the rotating body and be helically connected to the rotating body to convert a rotational motion of the rotating body into a reciprocating linear motion.
[0024] The features and advantages of the present disclosure will become more apparent from the following detailed description based on the accompanying drawings.
[0025] Prior to this, terms or words used in this specification and claims should not be construed in their usual, dictionary meaning, and must be interpreted with meaning and concept consistent with the technical idea of the present disclosure on the basis of the principle that the inventor can define terminology appropriately to explain his or her invention in the best way possible.
[0026] According to an embodiment of the present disclosure, even when notching an electrode film, the transport can be continued without interruption by means of a surplus electrode film, and thus the productivity of secondary batteries can be improved.
[0027] Furthermore, since multiple electrode tabs can be processed simultaneously during notching processing, the notching processing time can be shortened.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0028] FIG. **1** is a side view schematically showing the configuration of a notching apparatus for secondary batteries according to an embodiment of the present disclosure.
[0029] FIG. **2** is an operational state view showing the state of notching processing by a notching

processing part.
[0030] FIG. **3** is an operational state view showing a state in which electrode tabs are formed on an electrode film after notching processing.
[0031] FIG. **4** is an operational state view showing a state in which the electrode film is moved in the forward direction by a first variable roller and a second variable roller in the state of FIG. **3**.
[0032] FIG. **5** is an operational state view showing a state in which a surplus electrode film is created as the first variable roller and the second variable roller return to their original positions in the state of FIG. **4**.
[0033] FIG. **6** is a cross-sectional view schematically showing the mechanism of a moving part that moves the first variable roller or the second variable roller.

DETAILED DESCRIPTION OF THE INVENTION

[0034] Terms used to describe an embodiment of the present disclosure are not intended to limit the disclosure. It should be noted that singular expressions include plural expressions unless the context clearly dictates otherwise.
[0035] It should be noted that, in assigning reference numerals to components in the drawings, identical components are assigned the same reference numerals as much as possible even if they are shown in different drawings, and similar reference numbers are assigned to similar components.
[0036] The drawings may be schematic or exaggerated for the purpose of illustrating the embodiments.
[0037] In this document, expressions such as “have”, “may have”, “include”, or “may include” refer to the presence of the corresponding feature (e.g., a numerical value, function, operation, or component such as a part), and do not exclude the presence of additional features.
[0038] Terms such as “one”, “other”, “another”, “first”, “second”, etc., used to distinguish one component from another component, and the components are not limited by the terms.
[0039] Hereinafter, an embodiment of the present disclosure will be described in detail with reference to the attached drawings.
[0040] FIG. **1** is a side view schematically showing the configuration of a notching apparatus for secondary batteries according to an embodiment of the present disclosure; FIG. **2** is an operational state view showing the state of notching processing by a notching processing part; FIG. **3** is an operational state view showing a state in which electrode tabs are formed on an electrode film after notching processing; FIG. **4** is an operational state view showing a state in which the electrode film is moved in the forward direction by a first variable roller and a second variable roller in the state of FIG. **3**; FIG. **5** is an operational state view showing a state in which a surplus electrode film is created as the first variable roller and the second variable roller return to their original positions in the state of FIG. **4**; and FIG. **6** is a cross-sectional view schematically showing the mechanism of a moving part that moves the first variable roller or the second variable roller.
[0041] As shown in FIG. **1**, a notching apparatus for secondary batteries according to an embodiment of the present disclosure may include: a notching processing part **100** provided on the transport path of an electrode film **10** to create an electrode tab **11** on the electrode film **10**; a first variable roller **200** positioned in front of the notching processing part **100** based on the proceeding direction of the electrode film **10** and provided to be movable; a first fixed roller **300** fixedly placed near the first variable roller **200**; a second variable roller **400** positioned at the rear of the notching processing part **100** based on the proceeding direction of the electrode film **10** and provided to be movable; and a second fixed roller **500** fixedly placed near the second variable roller **400**.
[0042] The notching processing part **100** may be provided on the transport path of the electrode film **10** that proceeds along a preset path. At this time, the notching processing part **100** may shear a specific portion (e.g., a non-coated portion) of the electrode film **10** to create the electrode tab **11** on the electrode film **10**.
[0043] In this case, the notching processing part **100** may include an upper mold **110** and a lower mold **120** placed facing each other above and below the electrode film **10** with the electrode film

10 in between.
[0044] Referring to FIG. **1**, the upper mold **110** may be placed above the electrode film **10**, and the lower mold **120** may be placed below the electrode film **10**. Thus, the upper mold **110** and the lower mold **120** may be placed to face each other with the electrode film **10** interposed therebetween. In this case, a punch may be mounted on the upper mold **110**, and a die may be mounted on the lower mold **120**.
[0045] As shown in FIG. **2**, to form the electrode tab **11** on the electrode film **10**, at least one of the upper mold **110** and the lower mold **120** may be moved in the direction of shearing the electrode film **10**.
[0046] Accordingly, the upper mold **110** may be lowered toward the lower mold **120**, the lower mold **120** may be raised toward the upper mold **110**, and it is also possible for both the upper mold **110** and the lower mold **120** to be lowered and raised. As the upper mold **110** and the lower mold **120** come into contact with each other, the electrode tab **11** may be formed on the electrode film **10** located between the upper mold **110** and the lower mold **120**.
[0047] At this time, the notching processing part **100** may simultaneously form multiple electrode tabs **11** on the electrode film **10** with a single shearing process.
[0048] The notching processing part **100** according to the present disclosure may be configured so that multiple, i.e., two or more electrode tabs **11** are simultaneously formed on the electrode film **10** through a single shearing process.
[0049] That is, since a large number of electrode tabs **11** may be processed at one time through multi-notching, the time required for notching processing may be shortened. The attached drawing shows that the notching processing part **100** is able to notch two electrode tabs **11** at one time, but this is only an example, and it is also possible to configure the notching processing part **100** to process two or more electrode tabs **11** at the same time as needed.
[0050] Thus, as shown in FIG. **3**, when at least one of the upper mold **110** and the lower mold **120** returns to the original position thereof so that the upper mold **110** and the lower mold **120** are spaced apart from each other with the electrode film **10** in between, the electrode tab **11** that has been sheared by the notching processing part **100** may be formed in a specific portion of the electrode film **10**. One or more electrode tabs **11** may be created on the electrode film **10** in one shearing process depending on the type of notching processing part **100**.
[0051] Meanwhile, the first variable roller **200** may be positioned in front of the notching processing part **100** based on the proceeding direction of the electrode film **10**. Referring to FIG. **1**, since the electrode film **10** proceeds from the left to the right in the drawing, the right side may be defined as the front and the left side may be defined as the rear based on the notching processing part **100**.
[0052] The first variable roller **200** positioned in front of the notching processing part **100** may be rotated by the electrode film **10** that is being moved. In addition, the first variable roller **200** is not fixed in place, but may be provided to be movable within a preset section. The first variable roller **200** will be described again later.
[0053] The first fixed roller **300** is positioned in the proximity of the first variable roller **200**, and may be rotated by the electrode film **10** that proceeds. In this case, unlike the first variable roller **200**, the first fixed roller **300** may be fixed in place without moving.
[0054] The first fixed roller **300** may be placed at an appropriate position on the transport path of the electrode film **10** to transport the electrode film **10** along a preset path and to help the electrode film **10** advance smoothly.
[0055] The second variable roller **400** may be positioned at the rear of the notching processing part **100**. The second variable roller **400** positioned at the rear of the notching processing part **100** may be rotated by the electrode film **10** that proceeds.
[0056] In addition, like the first variable roller **200**, the second variable roller **400** is not fixed in place but may be provided to be movable within a preset range. The second variable roller **400** will

be described again later.
[0057] The second fixed roller **500** is positioned in the proximity of the second variable roller **400**, and may be rotated by the electrode film **10** that proceeds. In this case, unlike the second variable roller **400**, the second fixed roller **500** may be fixed in place without moving. Like the first fixed roller **300**, the second fixed roller **500** may be placed at an appropriate position on the transport path of the electrode film **10** to transport the electrode film **10** along a preset path and to help the electrode film **10** advance smoothly.
[0058] In this case, the first variable roller **200** and the second variable roller **400** may be provided so as to be able to move both in the forward direction same as the proceeding direction of the electrode film **10** and in the reverse direction opposite to the proceeding direction.
[0059] As shown in FIG. **4**, once the electrode tab **11** is processed on the electrode film **10**, the first variable roller **200** may be moved in the forward direction same as the proceeding direction of the electrode film **10**, that is, in the right direction in the drawing, by a preset distance L.
[0060] At the same time as the movement of the first variable roller **200**, the second variable roller **400** may also move in the forward direction same as the proceeding direction of the electrode film **10**, that is, in the right direction in the drawing, by the same distance (preset distance L) as the first variable roller **200**.
[0061] That is, the first variable roller **200**, the second variable roller **400** may be provided to move the same distance in the same direction.
[0062] Accordingly, the electrode film **10** with the electrode tab **11** processed may be moved in the same direction as the proceeding direction of the electrode film **10** by the forward movement of the first variable roller **200** and the second variable roller **400**.
[0063] At this time, the movement distance of the first variable roller **200** and the second variable roller **400** may be set so that the portion where the next electrode tab **11** is to be processed on the electrode film **10** reaches the notching position in the notching processing part **100**.
[0064] That is, as shown in FIG. **4**, after the electrode tab **11** is formed on the electrode film **10**, the electrode film **10** moves in the forward direction by the forward movement of the first variable roller **200** and the second variable roller **400**, and a predetermined portion where the next electrode tab **11** is to be processed on the electrode film **10** may reach the notching position in the notching processing part **100**. As a result, the electrode film **10** waits for the next order of notching processing with the portion where the next electrode tab **11** is to be formed reaching the correct position for notching in the notching processing part **100**, and through this series of processes, electrode tabs **11** having a constant pitch may be continuously processed on the electrode film **10**.
[0065] Meanwhile, as shown in FIG. **5**, when the notching processing part **100** punches the electrode film **10** to perform the next notching processing, the first variable roller **200** and the second variable roller **400** may move in the opposite direction to the proceeding direction of the electrode film **10**, that is, in the left direction in the drawing, by a preset distance L. At this time, the distance (preset distance L) by which the first variable roller **200** and the second variable roller **400** move in the reverse direction may be the same as the distance by which the first variable roller **200** and the second variable roller **400** move in the forward direction.
[0066] However, as shown in FIG. **5**, the first variable roller **200** and the second variable roller **400** move in the opposite direction to the proceeding direction of the electrode film **10** while both the upper mold **110** and the lower mold **120** are pressing the electrode film **10**.
[0067] Thus, as the first variable roller **200** moves in the reverse direction a preset distance, based on the first variable roller **200**, an extra electrode film (hereinafter referred to as “surplus electrode film **12**”) is produced in front of the first variable roller **200** due to the reverse movement of the first variable roller **200**. The total length of the surplus electrode film **12** may be a length **2**L that is twice the movement distance L of the first variable roller **200**.
[0068] For reference, the surplus electrode film **12** may be transported through the first fixed roller **300** toward a rewinder part **20** where the electrode film **10** is rewound, and although the electrode

film **10** temporarily stops moving at the moment the notching processing part **100** notches the electrode film **10**, as the surplus electrode film **12** may continue to be transported toward the rewinder part **20**, the overall transport of the electrode film **10** may be considered to continue without stopping.

[0069] In addition, when the second variable roller **400** moves in the reverse direction by the preset distance L like the first variable roller **200**, since the electrode film **10** in front of the second variable roller **400** is pressed by the upper mold **110** and the lower mold **120** and is thus stationary and unable to move, the electrode film **10** supplied from an unwinder part (not shown) may be additionally supplied with a length **2**L corresponding to twice the reverse movement distance L of the second variable roller **400**.

[0070] In this case, the first variable roller **200** and the second variable roller **400** participate in the transport of the electrode film **10**, and the electrode film **10** may be provided to be wound around at least a portion of the outer periphery of the first variable roller **200** and around at least a portion of the outer periphery of the second variable roller **400**.

[0071] That is, the electrode film **10** may proceed in a zigzag manner along a transport path while wrapping at least a portion of the outer periphery of the first variable roller **200** and passing through the first fixed roller **300**. In addition, the electrode film **10** may proceed in a zigzag manner along a transport path while passing through the second fixed roller **500** and wrapping at least a portion of the outer periphery of the second variable roller **400**.

[0072] At this time, the first fixed roller **300** may be placed ahead of the first variable roller **200** based on the proceeding direction of the electrode film.

[0073] That is, the first fixed roller **300** should be positioned so as to contact the electrode film located ahead of the first variable roller **200** with respect to the proceeding direction of the electrode film **10**, so that the surplus electrode film **12** may be produced due to the positional movement of the first variable roller **200**.

[0074] In addition, the second fixed roller **500** may be placed behind the second variable roller **400** based on the proceeding direction of the electrode film.

[0075] The second fixed roller **500** should be positioned so as to contact the electrode film located behind the second variable roller **400** with respect to the proceeding direction of the electrode film **10**, so that the electrode film **10** may be additionally supplied due to the positional movement of the second variable roller **400**.

[0076] In this way, as the first variable roller **200** and the second variable roller **400** move in the forward direction and then move in the reverse direction, the electrode film **10** between the front of the first variable roller **200** and the first fixed roller **300** may become the surplus electrode film **12**. In addition, by the movement of the second variable roller **400**, the electrode film **10** may be pulled to a length corresponding to the length of the surplus electrode film **12** and additionally supplied. Accordingly, even though the proceeding of the electrode film **10** is temporarily stopped at the notching processing part **100** during shear processing, the overall transport of the electrode film **10** may be considered to continue without stopping.

[0077] Therefore, the rewinder part **20** may continuously rewind the electrode film **10** even when the notching processing part **100** processes the electrode tab **11**, so that the overall productivity of the electrode film **10** may be improved.

[0078] Meanwhile, the first variable roller **200** and the second variable roller **400**, which are provided to be movable in the forward and reverse directions, may be independently moved by separately provided respective moving parts **600**.

[0079] As shown in FIG. **6**, the moving part **600** may be provided separately for each of the first variable roller **200** and the second variable roller **400**. The moving part **600** provided for the first variable roller **200** and the moving part **600** provided for the second variable roller **400** have the same configuration, structure, and operating mechanism, and thus both moving parts **600** are described using the same reference numerals.

[0080] To be specific, the moving part **600** may include: a shaft part **610** on which the first variable roller **200** or the second variable roller **400** is rotatably installed; a moving body **620** connected to the shaft part **610** and provided so that the first variable roller **200** or the second variable roller **400** may move; a power generation part **630** provided to supply external force to the moving body **620**; and a power transmission part **640** provided to transmit external force of the power generation part **630** to the moving body **620**.

[0081] The shaft part **610** is configured to be the center of rotation of the first variable roller **200** or the second variable roller **400**, and the first variable roller **200** or the second variable roller **400** may be installed on the shaft part **610** so as to be rotatable.

[0082] The moving body **620** is connected to the shaft part **610**, and may enable the first variable roller **200** or the second variable roller **400** installed on the shaft part **610** to move in the forward and reverse directions. At this time, the moving body **620** may be installed in a housing part **625** that guides the movement of the moving body **620** and sets a movement section so that the moving body **620** moves within a preset distance.

[0083] A predetermined receiving space may be formed inside the housing part **625**, and the first variable roller **200**, the shaft part **610**, and the moving body **620** may be positioned so as to be exposed on the outside of the housing part **625**. A slot part **626** that guides the movement of the moving body **620** and limits the movement section may be formed in the housing part **625**.

[0084] The power generation part **630** is configured to supply external force to the moving body **620**, and may be installed in the receiving space of the housing part **625**. The power generation part **630** is not particularly limited in type as long as the power generation part **630** can generate power and supply the power to the moving body **620**. The power generation part **630** may be a motor capable of both forward and reverse rotation, a servo motor, etc., and other power sources may also be used.

[0085] The power transmission part **640** may be configured to transmit external force of the power generation part **630** to the moving body **620**. The power transmission part **640** may transmit external force provided from the power generation part **630** to the moving body **620** so that the moving body **620** may move in the forward and reverse directions. The power transmission part **640** may be configured to convert the rotational force provided from the power generation part **630** into a reciprocating linear motion and provide the converted force to the moving body **620**.

[0086] To be specific, the power transmission part **640** may include: a rotating body **641** that rotates forward and reversely by the power generation part **630** and has screw threads formed on the outer periphery thereof; and a conversion part **642** that extends from the moving body **620** toward the rotating body **641** and is helically connected to the rotating body **641** to convert the rotational motion of the rotating body **641** into a reciprocating linear motion.

[0087] The rotating body **641** may be a rotary shaft of the power generation part **630**, and may rotate in the same direction when the power generation part **630** rotates forward or backward. Screw threads may be formed on the outer periphery of the rotating body **641**.

[0088] The conversion part **642** is configured to be connected to the moving body **620** and to extend from the moving body **620** toward the rotating body **641**. One end of the conversion part **642** is connected to the moving body **620**, and the other end of the conversion part **642** may be coupled to the rotating body **641**.

[0089] The other end of the conversion part **642** is helically connected to the rotating body **641** and may move linearly along the longitudinal direction of the rotating body **641** when the rotating body **641** rotates. The conversion part **642** may change the direction of linear motion depending on the rotational direction of the rotating body **641** and may move reciprocally linearly. As the conversion part **642** moves in a reciprocating linear motion, the moving body **620** connected to the conversion part **642** may also move in a reciprocating linear motion in the same direction, and accordingly, the first variable roller **200** or the second variable roller **400** may also move in a reciprocating linear motion in the same direction. In this case, the spiral coupling and movement structure of the

rotating body **641** and the conversion part **642** may be similar to, for example, a linear motion (LM) guide, and an LM guide may be used as needed.

[0090] Above, the present disclosure has been described in detail through specific embodiments. The embodiments are for specifically explaining the present disclosure, and the present disclosure is not limited thereto. It is obvious to those skilled in the art that various changes and modifications to the embodiments are possible within the scope and spirit of the present disclosure, and it is also obvious that such changes and modifications fall within the scope of the appended patent claims.

Claims

1. A notching apparatus for secondary batteries, the apparatus comprising: a notching processing part provided on a transport path of an electrode film to create an electrode tab on the electrode film; a first variable roller positioned in front of the notching processing part based on a proceeding direction of the electrode film and provided to be movable; a first fixed roller fixedly placed near the first variable roller; a second variable roller positioned at a rear of the notching processing part based on the proceeding direction of the electrode film and provided to be movable; and a second fixed roller fixedly placed near the second variable roller.

2. The apparatus of claim 1, wherein the notching processing part comprises an upper mold and a lower mold placed facing each other above and below the electrode film with the electrode film in between.

3. The apparatus of claim 1, wherein the notching processing part simultaneously creates multiple electrode tabs on the electrode film with a single shearing process.

4. The apparatus of claim 1, wherein the first variable roller and the second variable roller are provided to be able to move both in a forward direction same as the proceeding direction of the electrode film and in a reverse direction opposite to the proceeding direction.

5. The apparatus of claim 4, wherein the first variable roller and the second variable roller are provided to move a same distance in a same direction.

6. The apparatus of claim 5, wherein a movement distance of the first variable roller and the second variable roller is set so that a portion where a next electrode tab is to be processed on the electrode film reaches a notching position in the notching processing part.

7. The apparatus of claim 1, wherein the first variable roller and the second variable roller participate in a transport of the electrode film, and the electrode film is provided to be wound around at least a portion of an outer periphery of the first variable roller and around at least a portion of an outer periphery of the second variable roller.

8. The apparatus of claim 1, wherein the first fixed roller is placed ahead of the first variable roller based on the proceeding direction of the electrode film.

9. The apparatus of claim 1, wherein the second fixed roller is placed behind the second variable roller based on the proceeding direction of the electrode film.

10. The apparatus of claim 1, wherein the first variable roller and the second variable roller are independently moved by separately provided respective moving parts.

11. The apparatus of claim 10, wherein each of the moving parts comprises: a shaft part on which the first variable roller or the second variable roller is rotatably installed; a moving body connected to the shaft part and provided so that the first variable roller or the second variable roller may move; a power generation part provided to supply external force to the moving body; and a power transmission part provided to transmit external force of the power generation part to the moving body.

12. The apparatus of claim 11, wherein the power transmission part comprises: a rotating body configured to rotate forward and reversely by the power generation part and have screw threads formed on an outer periphery thereof; and a conversion part configured to extend from the moving

body toward the rotating body and be helically connected to the rotating body to convert a rotational motion of the rotating body into a reciprocating linear motion.