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(54) CUTTING DEVICE FOR CUTTING A COATED ELECTRODE STRIP

(57) The cutting device (10) comprises a first cutting tool (14) having a first blade (18) with a first cutting edge (20) and a second cutting tool (16) having a second blade (22) with a second cutting edge (24), the first blade (18) being movable relating to the second blade (22) so that the first cutting edge (20) and the second cutting edge (24) are intended to cooperate on at least one movable

cutting point (26), with a cutting angle (α) defined between the first (20) and second (24) cutting edges at the cutting point (26). The cutting device (10) comprises means (30) for varying the cutting angle (α) at the cutting point (26) while the first (14) and second (16) cutting tools move relating to each other.

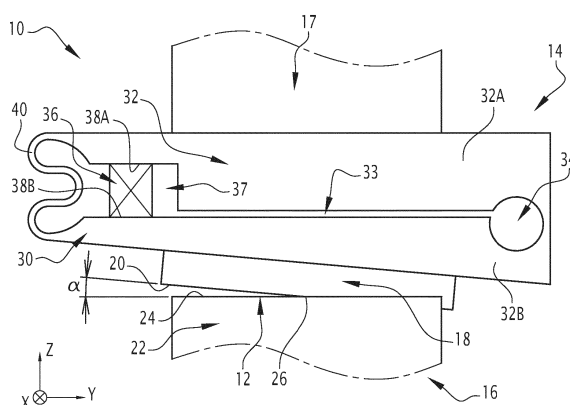


FIG.1

Description

[0001] The present invention relates to a cutting device for cutting a coated electrode strip. Cutting a coated electrode strip takes place in a manufacturing process of a battery.

[0002] A cutting device for cutting a coated electrode strip is already known from prior art. Such a cutting device usually comprises a stationary lower blade (also called "die") and a vertically moving upper blade (also called "punch"), the blades having cutting edges crossing each other with a specific shear angle. The lower and upper blades usually each have specific rake angle, independently from each other.

[0003] The electrode strip is usually cut transversally, from a first lateral edge to a second opposite lateral edge.

[0004] It should be noticed that making a clean-cut edge at the coated electrode strip is quite challenging as it is quite thin, and a sharp square corner with a burr tends to arise more frequently at the second edge side rather than at the first edge.

[0005] However, in case the electrode does not have a clean-cut edge, it may cause a mild short-circuit between a cathode and an anode through a separator due to cutting burrs, which may lead to faster self-discharge of the battery cell, and which is a painful failure of the battery cell incurs high costs to correct.

[0006] The invention is intended to solve this problem, by providing a cutting device enhancing the quality of the cut edge.

[0007] To this end, the invention relates to a cutting device for cutting a coated electrode strip, comprising a first cutting tool having a first blade with a first cutting edge and a second cutting tool having a second blade with a second cutting edge, the first blade being movable relating to the second blade so that the first cutting edge and the second cutting edge are intended to cooperate on at least one movable cutting point, with a cutting angle defined between the first and second cutting edges at the cutting point, characterized in that the cutting device comprises means for varying the cutting angle at the cutting point while the first and second cutting tools move relating to each other.

[0008] The means for varying the cutting angle allow a better quality of the cut edge than in case of a cut with a fixed cutting angle.

[0009] Several means for varying the cutting angle will be disclosed in the disclosure. More particularly, a cutting device according to the invention may comprise any of the following features, taken alone or in any possible combination.

- The means for varying the angle comprise the first blade shaped so that the first cutting edge is curved.
- The first cutting edge has a concave shape, preferentially a shape that is symmetrical relating to a central transverse plane, for example an elliptic shape.

- The means for varying the angle comprise a support for the first blade that is able to tilt the first blade.
- The support comprises a first part and a second part, the second part holding the first blade, the first and second parts being connected by means of a hinge part.
- The support comprises an actuator arranged between the first part and the second part, intended to drive the second part in rotation around the hinge part.
- The actuator is conformed to drive the second part in an oscillating movement around the hinge part.
- The actuator is a piezoelectric element.
- The cutting device comprises at least one spring bridge extending between the first and second parts

[0010] Several aspects and advantages of the invention will be enlightened in the following disclosure, only given as a non limitative example and made in reference to attached drawings in which:

- Figure 1 is a front view of a cutting device according to a first embodiment of the invention;
- Figure 2 is a front view of a cutting device according to a second embodiment of the invention;
- Figure 3 is a perspective view of a cutting device according to a third embodiment of the invention.

[0011] Figure 1 shows a cutting device 10 according to a first embodiment of the invention. The cutting device 10 is intended to cut a coated electrode strip 12 in view of a manufacturing process of a battery.

[0012] The cutting device 10 comprise a first cutting tool 14 and a second cutting tool 16.

[0013] The second cutting tool 16 is fixed, forming a die, and the first cutting tool 14 forms a punch at least partially movable in a vertical direction Z towards the second cutting tool 16. To this end, the first cutting tool 14 comprises a classical displacement mean 17 for displacing the first cutting tool 14 in the vertical direction Z.

[0014] The first cutting tool 14 comprises a first blade 18 having a first cutting edge 20. In the first embodiment, the first cutting edge 20 forms a straight line.

[0015] The second cutting tool 16 comprises a second blade 22 having a second cutting edge 24. In the first embodiment, the second cutting edge 24 forms a straight line.

[0016] The first cutting edge 20 and the second cutting edge 24 are intended to cooperate on at least one movable cutting point 26, that is the point where the coated electrode strip 12 is cut. The cutting point 26 is an abstract point, that moves transversally along the coated electrode strip 12 in a transversal direction Y perpendicular to the vertical direction, while the first blade 18 moves towards the second blade 22 in the vertical direction Z.

[0017] The cutting point 26 is formed because the first cutting edge 20 is tilted by respect to the second cutting edge 24, with an angle α .

[0018] We define a cutting angle that is the angle between the first cutting edge 20 and the second cutting edge 24 at the cutting point 26. Because the first cutting edge 20 and the second cutting edge 24 are straight lines, the cutting angle is the same as the angle α .

[0019] It appears that a cut is cleaner when the cutting angle varies during the cut. Thus, the invention provides a cutting device comprising means 30 for varying the cutting angle at the cutting point 26 while the first 14 and second 16 cutting tools move relating to each other.

[0020] In conformity with the first embodiment, the means 30 for varying the angle comprise a support 32 for the first blade 18 that is partially tiltable.

[0021] The support 32 comprises a first part 32A and a second part 32B, the first 32A and second 32B parts being connected by means of a hinge part 34, with a space 33 between the first 32A and second 32B parts.

[0022] The hinge part 34 is for example formed by a through hole in the longitudinal direction X perpendicular to the vertical direction Z and to the transversal direction Y.

[0023] The first part 32A is connected to the displacement mean 17, and the second part 32B holds the first blade 18.

[0024] The support 32 also comprises an actuator 36 between the first part 32A and the second part 32B, intended to drive the first 32A and second 32B parts in rotation around the hinge part 34. The actuator 36 is arranged in a housing 37 between the first 32A and second 32B parts.

[0025] Preferentially, the actuator 36 is conformed to drive the first 32A and second 32B parts in an oscillating movement around the hinge part 34.

[0026] The actuator 36 is, for example, a piezoelectric element. The actuator 36 extends vertically in the housing 37 between a first actuation point 38A of the first part 32A, and a second actuation point 38B of the second part 32B.

[0027] The actuator 36 is driven by a power amplifier with alternating voltage at frequency, consequently, changing the distance between the actuation points 38A, 38B.

[0028] The distance changes convert the second part 32B in a rotational motion with the hinge part 34 as the centre of rotation.

[0029] Preferentially, the support 32 comprises spring bridges 40 between the first 32A and second 32B parts. The spring bridges 40 are arranged at a first end of the support 32 in the transversal direction Y, and the hinge part 34 is arranged at a second opposite end of the support 32 in the transversal direction Y. The spring bridges 40 are closing the housing 37 in the transversal direction Y.

[0030] For example, the support 32 comprises two parallel spring bridges 40.

[0031] Each spring bridge 40 is for example bent three times, forming a W shape.

[0032] The actuator 36 with the spring bridges 40 drive

an oscillation movement of the second part 32B around the hinge part 34, thus an oscillation movement of the blade 18, modifying the cutting angle α at any time.

[0033] In the cutting device of the first embodiment, the first blade 18 works in a superposed motion of a constant speed linear vertical motion (driven by the displacement mean 17) with an oscillating micro-motion (driven by the support 32) at significantly high speed. This is advantageous for producing clean-cut edges. In other words, the blades 18, 22 work like micro-scissors working with micro-strokes at significantly high-speed.

[0034] A cutting device 10 according to a second embodiment is disclosed in reference to figure 2. On this figure, the elements analogous to the first embodiment are designed with the same reference numbers.

[0035] In this second embodiment, the first blade 18 is directly held by the displacement mean 17.

[0036] The means 30 for varying the angle comprise the first blade 18, with the first cutting edge 20 being curved.

[0037] Because of the curved shape, the cutting angle, defined between a tangent to the curved first cutting edge 20 and the second cutting edge 24, varies when the first blade 18 is vertically displaced.

[0038] Preferentially, the first cutting edge 20 has a concave shape, wherein the first cutting edge 20 is symmetrical relating to a central transverse plane. For example, the concave shape is elliptic.

[0039] Such a concave shape crosses the second cutting edge 24 on two cutting points 26, 26'. We thus define two cutting angles α , α' that are opposite.

[0040] This concave shape provide a cutting sequence in such a way that the cutting starts at both lateral edges of the coated strip 12 almost simultaneously and the cutting ends in the middle of the coated strip 12. In other words, the two cutting points 26, 26' approach each other while cutting, to finally meet at a point (in the middle of the strip), ending the cutting.

[0041] With this arrangement, the cutting device 10 works with progressively varying cutting angles, starting with bigger angles and ending with a 0-degree cutting angle. The cutting quality at the lateral edges of the strip 12 is almost identical for both edges, which is different from the prior art.

[0042] A cutting device 10 according to a third embodiment is disclosed in reference to figure 3. On this figure, the elements analogous to the first embodiment are designed with the same reference numbers.

[0043] The cutting device 10 according to the third embodiment combines the advantages of the first and second embodiments. In other words, the means 30 for varying the angle comprises the support 32 holding the first blade 18 and the curved first cutting edge 20.

[0044] The advantages are the same as in the first and second embodiments, so they will not be disclosed again.

Claims

1. A cutting device (10) for cutting a coated electrode strip (12), comprising a first cutting tool (14) having a first blade (18) with a first cutting edge (20) and a second cutting tool (16) having a second blade (22) with a second cutting edge (24), the first blade (18) being movable relating to the second blade (22) so that the first cutting edge (20) and the second cutting edge (24) are intended to cooperate on at least one movable cutting point (26), with a cutting angle (α) defined between the first (20) and second (24) cutting edges at the cutting point (26), **characterized in that** the cutting device (10) comprises means (30) for varying the cutting angle (α) at the cutting point (26) while the first (14) and second (16) cutting tools move relating to each other.

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2. The cutting device (10) according to claim 1, wherein the means (30) for varying the angle comprise the first blade (18) shaped so that the first cutting edge (20) is curved.

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3. The cutting device (10) according to claim 2, wherein the first cutting edge (20) has a concave shape, preferentially a shape that is symmetrical relating to a central transverse plane, for example an elliptic shape.

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4. The cutting device (10) according to any of preceding claims, wherein the means (30) for varying the angle comprise a support (32) for the first blade (18) that is able to tilt the first blade (18).

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5. The cutting device (10) according to claim 4, wherein the support (32) comprises a first part (32A) and a second part (32B), the second part (32B) holding the first blade (18), the first (32A) and second (32B) parts being connected by means of a hinge part (34).

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6. The cutting device (10) according to claim 5, wherein the support (32) comprises an actuator (36) arranged between the first part (32A) and the second part (32B), intended to drive the second part (32B) in rotation around the hinge part (34).

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7. The cutting device (10) according to claim 6, wherein the actuator (36) is conformed to drive the second part (32B) in an oscillating movement around the hinge part (34).

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8. The cutting device (10) according to claim 7, wherein the actuator (36) is a piezoelectric element.
9. The cutting device (10) according to any of claims 5 to 8, comprising at least one spring bridge (40) extending between the first (32A) and second (32B) parts

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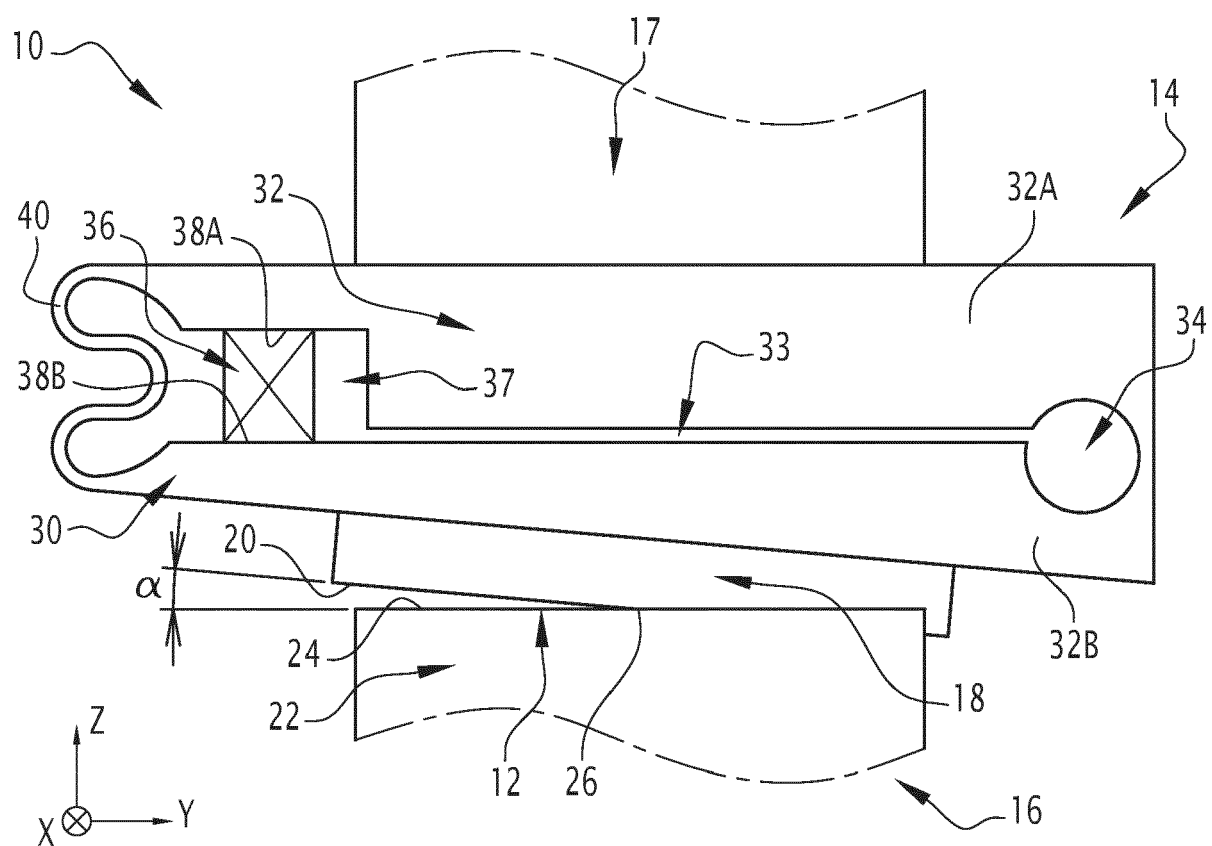


FIG.1

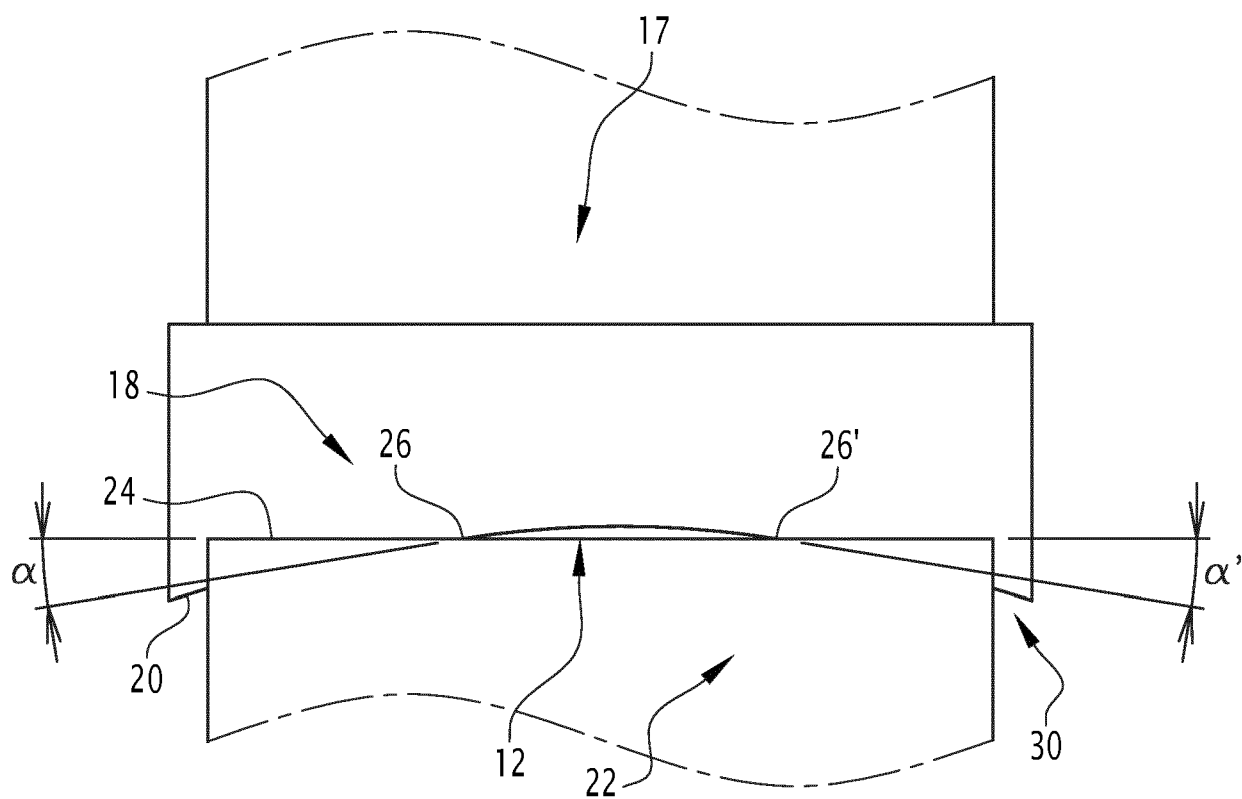


FIG.2

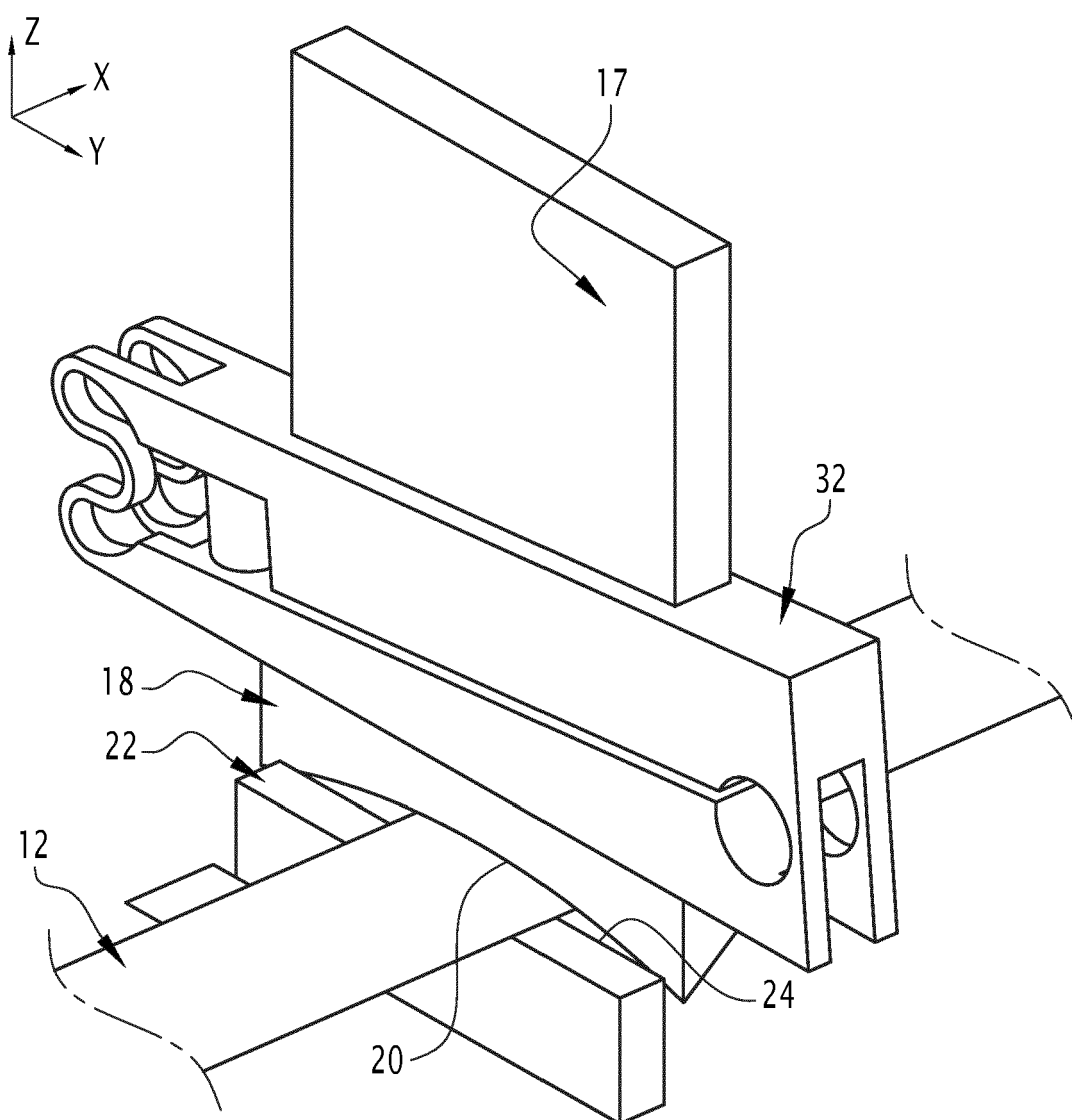


FIG.3



EUROPEAN SEARCH REPORT

Application Number

EP 23 30 7358

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2008/314217 A1 (MARCON LIONEL [FR]) 25 December 2008 (2008-12-25)	1,2	INV. B26D1/00
A	* paragraph [0038] - paragraph [0059]; figures 1-6 *	3-9	B26D1/04 B26B13/00 B26D1/30
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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 6 June 2024	Examiner Maier, Michael
CATEGORY OF CITED DOCUMENTS			
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EP 23 30 7358

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