Notice of References Cited	Application/Control No. 13/146,669	Applicant(s)/Patent Under Reexamination PYTLIK ET AL.	
	Examiner JULIAN ANTHONY	Art Unit 1726	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-4,224,387	09-1980	Nakayama, Yasuaki	429/133
*	B	US-7,566,515	07-2009	Suzuki et al.	429/162
*	C	US-6,443,999	09-2002	Cantave et al.	29/623.1
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Form PTO-1449 U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY. DOCKET NO. RUF-11-1270	SERIAL NO.
	APPLICANTS Eduard Pytlik et al.	
LIST OF PUBLICATIONS CITED BY APPLICANT *(Use several sheets if necessary)*	FILING DATE Herewith	GROUP

U.S. PATENT DOCUMENTS

EXAMINER INITIAL*		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
	AA	US 6,265,100 B1	07/24/2001	Elric W. Saaski et al.			
	AB						
	AC						
	AD						
	AE						
	AF						
	AG						
	AH						
	AI						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION YES	TRANSLATION NO
	AJ	1,088,271 A (DE '758)	10/25/1967	United Kingdom				
	AK	~~1 471 758 A1 (GB 1,088,271 A)~~	~~05/09/1969~~	~~Germany~~			X	
	AL	31 13 309 A1	10/21/1982	Germany			Abstract only	
	AM	36 38 793 A1	05/26/1988	Germany			Abstract only	
	AN	0 202 857 B1	07/31/1991	Europe				
	AO	196 47 593 A1	05/20/1998	Germany			Abstract only	
	AP	697 00 312 T2	02/24/2000	Germany			Abstract only	
	AQ	198 57 638 A1	06/15/2000	Germany			Abstract only	
	AR	10 2009 017 514 A1	10/07/2010	Germany			Abstract only	
	AS							
	AT							
	AU							

OTHER PUBLICATIONS (Including Author, Title, Date, Pertinent Pages, Etc.)

	AV	
	AW	
	AX	

EXAMINER /Julian Anthony/	DATE CONSIDERED 03/23/2014

*EXAMINER: Initial if publication considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to Applicant.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /J.A./

Search Notes

Application/Control No.	Applicant(s)/Patent under Reexamination
13/146,669	PYTLIK ET AL.
Examiner	**Art Unit**
JULIAN ANTHONY	1726

SEARCHED			
Class	Subclass	Date	Examiner
429	162	3/13/2014	JA
429	174	3/13/2014	JA
29	623.1	3/13/2014	JA
29	623.5	3/13/2014	JA

INTERFERENCE SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	DATE	EXMR
EAST limited class/keyword search	3/13/2014	JA

Form PTO-1449 US DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY. DOCKET NO. RUF-11-1270	SERIAL NO. 13/146,669
	APPLICANT Eduard Pytlik, et al.	
LIST OF PUBLICATIONS CITED BY APPLICANT *(Use several sheets if necessary)*	FILING DATE July 28, 2011	GROUP

US PATENT DOCUMENTS

EXAMINER INITIAL*		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
	AA	7,488,553 B2	02/10/09	Tsukamoto et al.			
	AB						
	AC						
	AD						
	AE						
	AF						
	AG						
	AH						
	AI						
	AJ						
	AK						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION YES	TRANSLATION NO
	AL	2008-262825	10/30/08	JP			x	
	AM	1 968 134 A1	09/10/08	EP				
	AN							
	AO							
	AP							

OTHER PUBLICATIONS (Including Author, Title, Date, Pertinent Pages, Etc.)

	AR	
	AS	
	AT	

EXAMINER /Julian Anthony/	DATE CONSIDERED 03/23/2014

*EXAMINER: Initial if publication considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to Applicant.

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /J.A./

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Art Unit	: 1726	**Customer No.: 035811**
Examiner	: Julian Anthony	
Serial No.	: 13/146,669	Docket No.: RUF-11-1270
Filed	: July 28, 2011	
Inventors	: Eduard Pytlik	
	: Jürgen Lindner	
	: Ulrich Barenthin	Confirmation No.: 6273
	: Winfried Gaugler	
Title	: BUTTON CELLS AND METHOD	
	: FOR PRODUCING SAME	
		Dated: May 2, 2014

RESPONSE

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In response to the Official Action dated March 27, 2014, the Applicants amend the application as follows:

In the Claims

1. (Currently Amended) A button cell comprising:

a housing cup and a housing top separated from one another by an electrically insulating seal and which form a housing with a flat bottom area and a flat top area parallel to it, and

an electrode-separator assembly within the housing comprising at least one positive and at least one negative electrode in the form of flat layers and connected to one another by at least one flat separator,

wherein the electrode layers are aligned essentially at right angles to the flat bottom and top areas and the button cell is closed without being beaded over, and the electrode-separator assembly is in the form of a spiral winding whose end faces face in a direction of the flat bottom area and the flat top area.

2. (Previously Presented) The button cell as claimed in claim 1, wherein the electrodes and/or the separator are/is in the form of strips or ribbons.

3. (Cancelled)

4. (Currently Amended) The button cell as claimed in claim [[3]] 1, wherein the winding has an axial cavity in its center, which axial cavity is at least partially filled by a winding core.

5. (Previously Presented) The button cell as claimed in claim 1, wherein the electrode-separator assembly has one of the following layer sequences:

negative electrode/separator/positive electrode/separator and

positive electrode/separator/negative electrode/separator.

6. (Previously Presented) The button cell as claimed in claim 1, wherein the positive electrode and/or the negative electrode are/is connected via an output conductor to the housing in an area of the flat bottom area and/or of the flat top area.

7. (Currently Amended) The button cell as claimed in claim [[3]] 1, further comprising at least one insulator which prevents direct mechanical and electrical contact between the end faces of the winding and the flat bottom and top areas.

8. (Previously Presented) The button cell as claimed in claim 7, wherein the at least one insulator is a flat layer composed of plastic arranged between the end faces of the winding and the flat bottom and top areas.

9. (Previously Presented) The button cell as claimed in claim 1, which is rechargeable.

10. (Previously Presented) The button cell as claimed in claim 1, having a height:diameter ratio of < 1.

11. (Previously Presented) A method for producing a button cell according to claim 1, comprising inserting an electrode-separator assembly with electrodes in the form of a flat layer into the housing such that the electrode layers are aligned essentially at right angles to the flat bottom and top areas, wherein the housing comprises a metallic cup part and a metallic top part.

12. (Previously Presented) The method as claimed in claim 11, wherein the electrode-separator assembly is inserted as a winding.

13. (Previously Presented) The method as claimed in claim 12, further comprising:

inserting the winding into the metallic top part, and

inserting the metallic top part with the winding into a metallic cup part.

14. (Previously Presented) The method as claimed in claim 12, wherein the winding is heat-treated on its end faces before being installed, with it being at least for a short time subjected to a temperature at which the separator is thermoplastically deformable.

Remarks

The Applicants have amended Claim 1 to include the subject matter of Claim 3.

Claim 3 has been cancelled in view of the inclusion of that subject matter into Claim 1.

Claim 4 has also been amended to depend from Claim 1 in view of the cancellation of Claim 3.

Finally, Claim 7 has similarly been amended in view of the cancellation of Claim 3.

Entry of the above amendments and cancellation into the official file and consideration on the merits is respectfully requested.

The Applicants enclose a new Fig. 4 and respectfully request that it be entered into the official file.

The drawings stand objected to with respect to the claimed insulator which prevents direct mechanical and electrical contacts between the end faces of the winding and the flat bottom of top areas must be shown. The Applicants note that original Claim 4 shows such an insulator with respect to reference numbers 411 and 412. However, the originally submitted Fig. 4 shows a button cell that is closed in a classical manner with an edge of the cell cup 401 being beaded inward over an edge of the cell top 402. New Fig. 4 has been modified such that the button cell 400 is closed without being beaded over in accordance with Claim 1 and, also, in accordance with the claimed feature wherein the insulator prevents direct and electrical contact between the end faces of the winding in the flat bottom and top areas. Withdrawal of the objections to the drawings is respectfully requested.

Claims 1, 2, 6, 10 and 11 stand rejected under 35 USC §102 as being anticipated by Nakayama. The Applicants respectfully submit that the rejection is moot in view of the addition

of the subject matter of Claim 3 into Claim 1. Withdrawal of the rejection is respectfully requested.

Claims 3-5, 9, 12 and 13 stand rejected under 35 USC §103 over the combination of Suzuki with Nakayama. The Applicants note that the rejection is technically moot with respect to cancelled Claim 3. Nonetheless, the Applicants will address the substance of that rejection as it could theoretically apply to Claims 1 and 11.

The rejection frankly acknowledges that Nakayama does not disclose a spiral winding. Hence, the rejection turns to Suzuki for such disclosure. However, the Applicants respectfully submit that importing the teachings of Suzuki into Nakayama would still result in a different button cell and a different method of producing a button cell as recited in Claims 1 and 11, respectively.

Suzuki indeed discloses a spiral winding (Fig. 2). However, the end faces of the winding in Fig. 2 of Suzuki do not face in the direction of the flat bottom area and the flat top area. This difference is important. The Applicants explain in para. [0020] of their specification that a right-angled alignment of electrode layers (to the flat bottom and top areas) is unexpectedly advantageous. Lithium electrodes have a volume expansion and shrink during charging and discharging. If a lithium electrode is in the form of a flat layer, in particular in the form of a flat layer being spirally winded, the expansion/shrink is directional. Mechanical forces resulting from the expansion/shrink do act in this case in a radial direction much stronger than in an axial direction.

This allows the use of a housing of a housing cup and a housing top which is closed without being beaded over. All mechanical forces resulting from the charging and discharging processes can be absorbed by the (radial) casing area and not by the flat bottom and top areas.

The Applicants respectfully submit that Suzuki (as well as Nakayama) fails to disclose, teach or suggest this unexpected advantage and inherently fails to disclose, teach or suggest the structure which results in this advantage. Hence, even if one skilled in the art were to import the teachings of Suzuki into Nakayama as set forth in the rejection, both the resulting button cells and the method of making such a button cell would be different from the subject matter of independent Claim 1. Withdrawal of the rejection is accordingly respectfully requested.

Claims 7, 8 and 14 stand rejected under 35 USC §103 over the further combination of Cantave with Suzuki and Nakayama. The Applicants respectfully submit that Cantave fails to cure the deficiencies set forth above with respect to the combination of Suzuki with Nakayama. Withdrawal of the rejection is respectfully requested.

In light of the foregoing, the Applicants respectfully submit that the entire application is now in condition for allowance, which is respectfully submitted.

Respectfully submitted,

T. Daniel Christenbury
Reg. No. 31,750

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(215) 656-3381

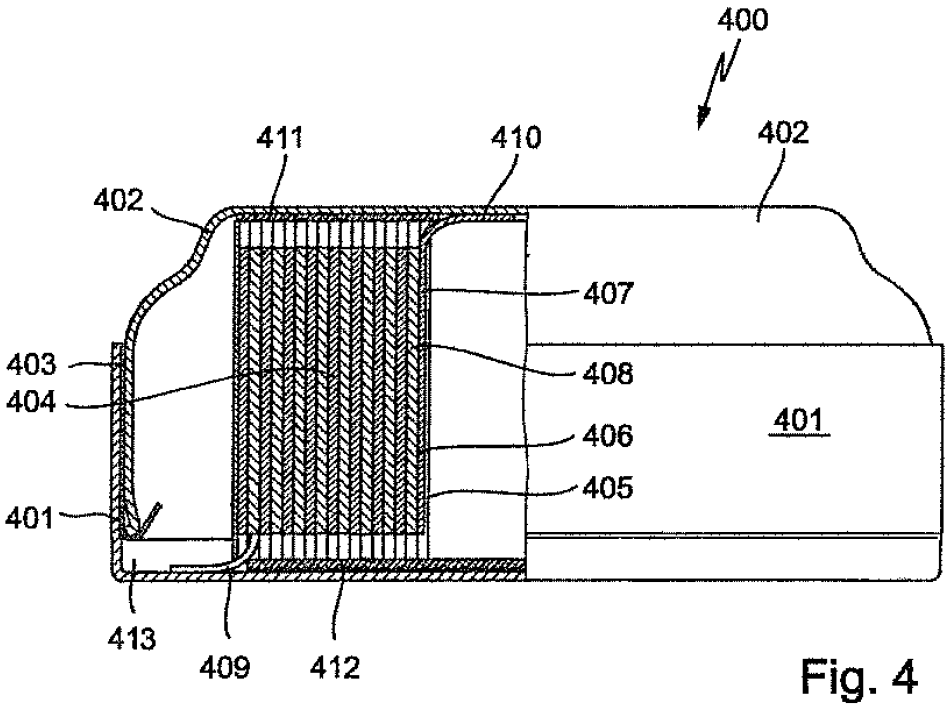

Fig. 4

Electronic Acknowledgement Receipt

EFS ID:	18926571
Application Number:	13146669
International Application Number:	
Confirmation Number:	6273
Title of Invention:	BUTTON CELLS AND METHOD FOR PRODUCING SAME
First Named Inventor/Applicant Name:	Eduard Pytlik
Customer Number:	35811
Filer:	Thomas Daniel Christenbury/Vivian Pena
Filer Authorized By:	Thomas Daniel Christenbury
Attorney Docket Number:	RUF-11-1270
Receipt Date:	02-MAY-2014
Filing Date:	07-SEP-2011
Time Stamp:	13:00:02
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Miscellaneous Incoming Letter	RUF-11-1270-ATL.pdf	195808 5899f0d3fead50d228f0f79821db6a8f077f181e	no	1
Warnings:					
Information:					

2		RUF-11-1270-Response.pdf	196002 f834b4b38803abb76f203474056b8db32f27003b	yes	8

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Claims	2	4
	Applicant Arguments/Remarks Made in an Amendment	5	8

Warnings:	
Information:	
Total Files Size (in bytes):	391810

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Attorney Docket No.: RUF-11-1270

In re Application of: Eduard Pytlik et al.
Serial No.: 13/146,669
Filed: July 28, 2011
For: BUTTON CELLS AND METHOD FOR PRODUCING SAME

Mail Stop Amendment
Commissioner for Patents
P.O. Box 14508
Alexandria, VA 22313-1450

Sir:

A response to the outstanding official action in the above-identified application is enclosed, along with a New Sheet of Fig. 4.

☐ Small entity status of this application under 37 CFR §1.9 and §1.27 has been established.

☐ This is a Petition for an Extension of Time for the period noted below, as well as for any additional period necessary to render this submission timely.

☒ No additional fee is required.

		SMALL ENTITY	OTHER THAN SMALL ENTITY
TIME EXTENSION PETITION FEE	No. of month(s): 0		$0.00
Subtract time extension fee previously paid	No. of month(s): 0		($0.00)
TOTAL EXTENSION FEE DUE			$0.00

CLAIM FEE	CLAIM(S) REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	EXTRA CLAIM(S) PRESENT	RATE	ADD'L CLAIM FEE	RATE	ADD'L CLAIM FEE
TOTAL	13	MINUS	20	= 0	x 40=	$	x 80=	$0.00
INDEPENDENT	1	MINUS	3	= 0	x 210=	$	x 420=	$0.00
☐	FIRST PRESENTATION OF MULTIPLE CLAIM(S)				+ 390=	$	+ 780=	$0.00
	TOTAL ADDITIONAL CLAIM FEE DUE					$		$0.00
							TOTAL FEE DUE:	**$0.00**

☐ Please charge Deposit Account No. 50-2719 in the amount of $ _____.

☒ The Commissioner is authorized to charge payment of the following fees associated with this communication or credit any overpayment to Deposit Account No. 50-2719.

☒ Any filing fees under 37 CFR §1.16 for the presentation of extra claims.

☒ Any patent application processing fees under 37 CFR §1.17.

Respectfully submitted,

T. Daniel Christenbury, Reg. No. 31,750

Date: May 2, 2014

TDC/vp
(215)656-3381

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PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 13/146,669	Filing Date 09/07/2011	☐ To be Mailed

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)		
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	05/02/2014	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 13	Minus	** 20	= 0	X $80 =	0
	Independent (37 CFR 1.16(h))	* 1	Minus	***3	= 0	X $420 =	0
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	0

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
/SUSAN FORD/

Form PTO-1449 US DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY. DOCKET NO. RUF-11-1270	SERIAL NO. 13/146,669
	APPLICANT Eduard Pytlik, et al.	
LIST OF PUBLICATIONS CITED BY APPLICANT *(Use several sheets if necessary)*	FILING DATE July 28, 2011	GROUP 1726

US PATENT DOCUMENTS

EXAMINER INITIAL*		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
	AA						
	AB						
	AC						
	AD						
	AE						
	AF						
	AG						
	AH						
	AI						
	AJ						
	AK						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION YES	TRANSLATION NO
	AL	2007-294111	11/08/07	JP			x	
	AM	2003-31266	01/31/03	JP			x	
	AN	2008-262826	10/30/08	JP			x	
	AO	1-307176	12/12/89	JP			Abstract	
	AP	7-153488	06/16/95	JP			x	

OTHER PUBLICATIONS (Including Author, Title, Date, Pertinent Pages, Etc.)

	AR	
	AS	
	AT	

EXAMINER	DATE CONSIDERED

*EXAMINER: Initial if publication considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to Applicant.

PATENT ABSTRACTS OF JAPAN

(11)Publication number : **2007-294111**
(43)Date of publication of application : **08.11.2007**

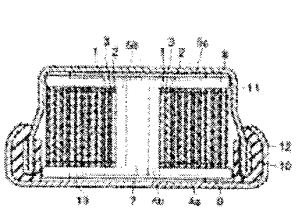
(51)Int.Cl. ***H01M 10/04 (2006.01)***
H01M 2/34 (2006.01)
H01M 2/02 (2006.01)

(21)Application number : **2006-116981**
(22)Date of filing : **20.04.2006**

(71)Applicant : **TOSHIBA BATTERY CO LTD**
(72)Inventor : **KOBAYASHI YOSHIKAZU**

(54) COMPACT BATTERY

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a compact battery capable of improving heavy load characteristics without damaging productivity.
SOLUTION: The compact battery is provided with a vessel, and a group of flat electrodes housed in the vessel and including a laminate containing a positive electrode 1 and negative electrode 2 winded in a spiral shape. The group of the flat electrodes is integrated with a winding shaft center 7 by winding the laminate in the spiral shape in a state that at least either one of the positive electrode 1 or negative electrode 2 is fixed on the winding shaft center 7.



CLAIMS

[Claim(s)]
[Claim 1]
Laminated material which is stored in a container and the aforementioned container and contains a positive electrode and an anode is a sized cell possessing a flat shape electrode group wound spirally, A sized cell, wherein the aforementioned flat shape electrode group is united with the aforementioned winding axis by winding the aforementioned laminated material spirally where at least one electrode is fixed to a winding axis among the aforementioned positive electrode and the aforementioned anode.

[Claim 2]
The sized cell according to claim 1 which is provided with the following and characterized by making obturation of the aforementioned container by caulking processing performed to the aforementioned positive electrode case or the aforementioned negative electrode case.
A positive electrode case in which the aforementioned container serves as a positive pole terminal.
A negative electrode case which serves as a negative pole terminal.
An insulating gasket which interposed between the aforementioned positive electrode case and the aforementioned negative electrode case.

[Claim 3]
A positive pole terminal part arranged between the aforementioned positive electrode case and one end face of the aforementioned electrode group,
A negative pole terminal part arranged between the aforementioned negative electrode case and an end face of another side of the aforementioned electrode group,
A positive electrode lead part for uniting with the aforementioned winding axis and securing conduction between the aforementioned positive pole terminal part and the aforementioned positive electrode,
A negative electrode lead part for uniting with the aforementioned winding axis and securing conduction between the aforementioned negative pole terminal part and the aforementioned anode
The sized cell according to claim 2 providing in a pan.
[Claim 4]
The sized cell according to claim 3 having arranged an insulating member between the aforementioned positive electrode case and one end faces of the aforementioned electrode group, between the aforementioned negative electrode cases and end faces of another side of the aforementioned electrode group, or to both.
[Claim 5]
A first insulating member fixed to an end of the aforementioned winding axis so that one end face of the aforementioned electrode group might be covered,
A second insulating member fixed to the other end of the aforementioned winding axis so that an end face of another side of the aforementioned electrode group might be covered,
A positive pole terminal part arranged between an inner surface of the aforementioned positive electrode case, and said first insulating member,
A negative pole terminal part arranged between an inner surface of the aforementioned negative electrode case, and said second insulating member,
A positive electrode lead part for uniting with the aforementioned winding axis and securing conduction between the aforementioned positive pole terminal part and the aforementioned positive electrode,
A negative electrode lead part for uniting with the aforementioned winding axis and securing conduction between the aforementioned negative pole terminal part and the aforementioned anode
The sized cell according to claim 2 providing in a pan.
[Claim 6]
A sized cell of a Claims 1-5 any 1 item description being a coin type or a button type battery.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[Field of the Invention]
[0001]
The present invention relates to the sized cell (for example, a button type battery, a coin type cell) provided with the winding electrode group.
[Background of the Invention]
[0002]
The spread of a portable electron and communication equipment, such as a small video camera, a cellular phone, PDA, and a notebook computer, was remarkable, rechargeable batteries, such as a rechargeable lithium-ion battery and a nickel hydrogen storage battery, were put in practical use as these power supplies, and development towards small weight saving and high capacity-ization has been performed briskly.
[0003]
In addition to the flow of the further miniaturization of a portable equipment, a rechargeable battery is required as a power supply of the apparatus made indispensable [a miniaturization called a wrist watch], Small rechargeable batteries, such as a button form and a coin form, have been put in practical use by uses, such as a power supply for backup of SRAM and RTC to which discharge is performed with the light load whose discharge current is a number - a tens of microA grade, and a main power supply of a changing-battery unnecessary wrist watch.
[0004]
As for the structure of small rechargeable batteries, such as these button type and a coin form, what is shown in Fig.10 is common. That is, that by which the positive electrode case 21 which serves as a positive pole terminal was caulked via the insulating gasket 23 as a well-closed container in the metal negative electrode cases 22 which serve as a negative pole terminal is used. Inside this well-closed container, one the positive electrode 24 and the anode 25 of the shape of a tablet whose diameter is smaller than the opening diameter of the insulating gasket 23 are stored at a time, respectively. Between the positive electrode 24 and the anode 25, the separator 26 which made the electrolysis solution impregnate interposes.
[0005]
Since small rechargeable batteries, such as such a button form and a coin form, are simple for structure, they are excellent in mass production nature, and have the characteristics that a miniaturization is possible.
[0006]
However, small rechargeable batteries, such as a button form of the structure shown above and a coin form, have the insufficient characteristic at the time of discharging in the high current demanded as a main power supply of a portable device, and are not suitable as a main power supply of a portable device.
[0007]
A miniaturization is indispensable about a rechargeable lithium-ion battery, a nickel hydrogen storage battery, etc. which have been used by the miniaturization of personal digital assistants, such as a small video camera, a cellular phone, PDA, and a notebook computer, as a main power supply on the other hand (for example, a Patent document 1, 2). The manufacturing method of a rechargeable lithium-ion battery or a nickel hydrogen storage battery is described simply. First, the charge collector consisting of a metallic foil or a metal net is applied or filled up with an active material layer, and an electrode is formed. An electrode group is produced by winding or laminating these electrodes after welding the tab terminal for current collection to the formed electrode. Bending was intricately performed to the tab terminal for current collection furthermore taken out from the electrode group, it welded to a safety element, an electrode pin, an electrode can, etc., and the cell was manufactured. This appearance takes a complicated manufacturing process to manufacture of these rechargeable batteries, and its work is complicated. It is necessary to provide space and parts in a cell for short prevention of a tab terminal, or to incorporate many parts, such as a safety element, in a cell. Therefore, in these rechargeable batteries, the miniaturization was dramatically difficult and had reached the limit substantially in the actual condition.
[Patent document 1] JP,H11-345626,A
[Patent document 2] JP,H11-354150,A

[Description of the Invention]
[Problem to be solved by the invention]
[0008]
It is the object of this invention to make the heavy loading characteristic of sized cells, such as a button form and a coin form, improve, without impairing productivity.
[Means for solving problem]
[0009]
The laminated material which the sized cell concerning the present invention is stored in a container and the aforementioned container, and contains a positive electrode and an anode is a sized cell possessing the flat shape electrode group wound spirally,
The aforementioned flat shape electrode group is united with the aforementioned winding axis by winding the aforementioned laminated material spirally, where at least one electrode is fixed to a winding axis among the aforementioned positive electrode and the aforementioned anode.
[0010]
Here, a flat shape electrode group means the electrode group which has the structure where the height of the winding axial direction of an electrode group is smaller than the size of a direction vertical to a winding axis.
[Effect of the Invention]
[0011]
According to the present invention, the sized cell which can improve a heavy loading characteristic can be provided, without impairing productivity.
[Best Mode of Carrying Out the Invention]
[0012]
The inventors found out the method of storing a wound type electrode group with safety and sufficient productivity in the case of sized cells, such as a button form and a coin form, as a result of repeating research about improvement in the heavy loading characteristic of a sized cell. Thereby, as compared with the conventional sized cell, the heavy loading characteristic improved by leaps and bounds.
[0013]
Namely, the metal negative electrode cases which serve as a negative pole terminal and the metal positive electrode cases which serve both as a positive pole terminal, Fitting is carried out via an insulating gasket and the aforementioned positive electrode case or a negative electrode case uses further the container which has caulking **** obturation structure by caulking process, It found out that the sized cell excellent in the heavy loading characteristic could be provided by storing the electrode group which wound spirally the laminated material containing a positive electrode and an anode in the container.
[0014]
In the rechargeable lithium-ion battery and nickel hydrogen storage battery which are used as a main power supply of a portable device, by winding a thin positive electrode and anode via a separator, it becomes possible to enlarge the counterelectrode area of an anode and a positive electrode, and a high current can be taken out. However, as mentioned above, the manufacturing process is complicated, and there are dramatically many parts in a cell because of securing safety etc. For this reason, it has been thought impossible to store that electrode group structure in sized cells, such as a button form and a coin form.
[0015]
Then, it is the inventors' aiming at conversion of the way of thinking from a prior art, and incorporating the contact button of an electric insulating plate, an electrode, and an external terminal into the structure of an electrode group a winding axis and if needed at least, It made it possible to store efficiently the electrode group which wound the positive electrode, the anode, and the separator (several layers - tens of layers) in the case of sized cells, such as a button form and a coin form, with the advantage maintained of it being safe and excelling in productivity.
[0016]
Hereafter, it is described how the inventors realized the present invention.
[0017]
First, when a positive electrode and an anode were spirally wound via a separator, the winding electrode group which can be stored in the case of sized cells, such as a button form and a coin form, was able to be manufactured by taking in in an electrode group, uniting a winding axis with an anode

and/or a positive electrode. As for this winding axis or some [that] bases, it is desirable to be formed from insulating materials, such as polyethylene, polypropylene resin, glass, and ceramics.

[0018]

Next, it describes about connection between an electrode group and the metal casing which serves both as an external terminal. In comparatively big rechargeable lithium-ion batteries, such as a cylindrical shape and a square shape, after welding a tab terminal to the central part and the winding component part of an electrode group and performing bending to it, the current is collected by welding to a safety element or an obturation pin. However, since the bending process is complicated, it is inferior to productivity. Then, structure was able to be simplified by installing a terminal in the winding axis made inherent in an electrode group for the purpose of connection between an electrode and the metal casing which serves both as an external terminal. The method of connecting an electrode to this terminal is not limited especially although there are adhesion by welding of sticking by pressure, resistance welding, ultrasonic welding, etc., electroconductive glue, etc., etc. It does not limit, especially although connection methods with the metal casing which serves both as this terminal and external terminal include contact of adhesion by welding of resistance welding, ultrasonic welding, etc., electroconductive glue, etc., a terminal, and a cell case, etc. However, in current collection by contact, it is desirable to improve current collection nature using a metal net, metal powder, a carbon filler, a conductive paint, etc.

[0019]

Next, it is desirable to install an insulating member for the purpose of preventing a short circuit between an electrode group and a cell case. If insulation is held as an insulating member, limitation in particular will not be carried out, but the electric insulating plate made of polyethylene or polypropylene resin, PET, the film made from polyimide, etc. can be used. An insulating member can be arranged between a positive electrode case and electrode groups, between a negative electrode case and electrode groups, or to both.

[0020]

This insulating member may be united with a winding axis. As for an insulating member and a winding axis, since the stability on structure improves as an electrode group by unifying an insulating member and a winding axis, unifying is desirable.

[0021]

Next, although how positive and negative poles fill up metallic bases, such as the conventional molding system and metal net of a granulation mixture, and foaming nickel, with a mixture about an electrode may be used, What applied the mixture of slurry form to the metallic foil, and was dried at the point referred to as being easy to perform production of a closing-in electrode is good, and can also use what rolled it further. As for the electrode used for the inside of an electrode group, when using the electrode which coated the binder layer which contains an active substance in the above metallic foils, it is preferable from volume efficiency to use the thing in which the active substance layer was formed to both sides of the metallic foil. In order to connect easily about the portion linked to the terminal of one side of an electrode group, it is preferable to expose especially a metallic foil among electrode configuration material. The electrode which restricted to this portion about this and formed the active substance layer only in one side may be used, and after forming an active substance layer in both sides, only one side may once remove an active substance layer.

[0022]

Next, it is not what this cell keeps a principal point in the structure of a cell including an electrode, and is limited for a positive electrode agent, MnO_2, V_2O_5, Nb_2O_5, $LiTi_2O_4$, $Li_4Ti_5O_{12}$, $LiFe_2O_4$, cobalt acid lithium, Nickel acid lithium, manganic acid lithium, nickel manganic acid lithium, All things, such as organic compounds, such as inorganic compounds, such as metallic oxides, such as nickel cobalt acid lithium, cobalt manganic acid lithium, and nickel cobalt manganic acid lithium, or graphite fluoride, and FeS_2, or poly aniline, and a poly acene structure, are applicable. In that action potential is high in this and it excels in a cycle characteristic, however, cobalt acid lithium, The lithium content oxide which replaced some of nickel acid lithium, manganic acid lithium, those mixtures, and those elements by other metallic elements is more preferable, Being used over a long period of time also has still more preferable cobalt acid lithium in a certain small rechargeable battery at the point [reactivity / with an electrolysis solution or moisture] in high capacity low and chemically of being stable.

[0023]

About the anode active substance of this cell, it is not limited and Next, metal lithium, Or Li-aluminum, Li-In, Li-Sn, Li-Si, Li-germanium, Organic compounds, such as lithium alloys, such as Li-Bi and Li-Pb, or a poly acene structure, Or all things, such as an oxide like carbonaceous material [occlusion and can emit lithium] or Nb_2O_5, $LiTi_2O_4$, and $Li_4Ti_5O_{12}$, or Li content silica oxide, and Li content nitride, are applicable. Excel in a cycle characteristic, action potential is low, and the carbonaceous material occlusion and can emit Li is preferable at the point that it is high capacity, The carbonaceous material in which black lead structures, such as natural graphite, an artificial graphite, expanded graphite, a mesophase pitch baking body, and a mesophase pitch fiber baking body, progressed at the point said that there is little deterioration of battery actuation voltage also especially in the discharge last stage is more preferable.

[0024]

[Example]

Hereafter, with reference to Drawings, it describes in detail about the working example of the present invention.

[0025]

(Working example 1)

The cross sectional view of the cell of the working example 1 is shown in Fig.1. Hereafter, the manufacturing method of the cell of the working example 1 is described.

[0026]

First, to $LiCoO_2$100 part by weight, 5 parts by weight of acetylene black and 5 parts by weight of graphite powder were added as a conducting agent, 5 parts by weight of polyvinylidene fluorides were added as a binding agent, it diluted and mixed by N-methyl pyrrolidone, and the positive electrode mixture of slurry form was obtained. Next, a coating and drying were performed on one side of aluminium foil with a thickness of 0.02 mm which is a positive pole collector about this positive electrode mixture with the doctor blade method, and the positive electrode agent contained layer was formed in the aluminium foil surface. Henceforth, a coating and drying were repeated until the coating film thickness of the positive electrode agent contained layer became 0.13 mm by both sides, and as shown in Fig.2, the positive electrode 1 in which the positive electrode agent contained layer 1b was laminated by both sides of the positive pole collector 1a was produced. Next, the positive electrode agent contained layer of a 2-mm portion was removed from the end of both sides of this positive electrode 1, and the aluminum layer was exposed, it was considered as the energized part 1c, and the positive electrode board cut out to 3.3 mm in width, 150 mm in length, and 0.13-mm-thick length was obtained.

[0027]

Next, as a binding agent, 2.5 parts by weight was added, respectively, it diluted with ion exchange water, styrene butadiene rubber (SBR) and carboxymethyl cellulose (CMC) were mixed with it to 100 parts by weight of graphitization mesophase pitch carbon fiber powder, and the negative electrode mixture of slurry form was obtained. As a coating and drying were repeated like the case of a positive electrode and it was shown in real almsgiving and Fig.3 so that the thickness of an anode active substance contained layer may become copper foil with a thickness of 0.02 mm which is a negative pole collector with 0.12 mm about the obtained negative electrode mixture, the anode 2 in which anode active substance contained layer 2b was laminated by both sides of the negative pole collector 2a was produced. Next, the anode active substance contained layer of a 2-mm portion was removed from the end of both sides of this anode 2, and the copper layer was exposed, it was considered as the energized part 2c, and the negative electrode plate cut out to 3.3 mm in width, 150 mm in length, and 0.12-mm-thick length was produced.

[0028]

Next, the positive-and-negative-poles terminal of the structure shown in Fig.4 and Fig.5 was prepared. (a) of Fig.4 is the side view which looked at the positive pole terminal from the slit side, and (b) of Fig.4 is a plan view of a positive pole terminal. The positive pole terminal 4 is provided with the following.

The disc-like positive pole terminal board 4a (positive pole terminal part).

The cylindrical terminal connection part 4b (positive electrode lead part) electrically connected to the positive pole terminal board 4a.

The slit 4c formed in the terminal connection part 4b.

This positive pole terminal 4 is formed from aluminum, for example. On the other hand, (a) of Fig.5 is a

plan view of a negative pole terminal, and (b) of Fig.5 is the side view which looked at the negative pole terminal from the slit side. The negative pole terminal 5 is provided with the following.
The disc-like negative terminal block 5a (negative pole terminal part).
The cylindrical terminal connection part 5b (negative electrode lead part) electrically connected to the negative terminal block 5a.
The slit 5c formed in the terminal connection part 5b.
This negative pole terminal 5 is formed from stainless steel, for example.
[0029]
As shown in Fig.6, after inserting the energized part 1c of the positive electrode 1 in the slit 4c of the terminal connection part 4b of the positive pole terminal 4, the pressure was put on the terminal connection part 4b from the outside, and the energized part 1c was made to stick to the terminal connection part 4b by pressure. After inserting the energized part 2c of the anode 2 in the slit 5c of the terminal connection part 5b of the negative pole terminal 5, the pressure was put on the terminal connection part 5b from the outside, and the energized part 2c was made to stick to the terminal connection part 5b by pressure.
[0030]
Next, the terminal which connected the electrode was united with the winding component shown in Fig.7. (a) of Fig.7 is the plan view which looked at the winding component 6 from the upper part, (b) is a side view of the winding component 6, and (c) is the plan view which looked at the winding component 6 from the lower part. The winding component 6 is provided with the following.
As shown in Fig.7, it is the winding axis 7.
The electric insulating plates 8 and 9 (1st [the], second insulating member) united with an upper end and a lower end of the winding axis 7.
The winding axis 7 has the notch 7a in which the terminal connection part 5b of the negative pole terminal 5 is inserted, as shown in (a) of Fig.7. The notch 7b by which the terminal connection part 4b of the positive pole terminal 4 is inserted in the winding axis 7 as shown in (c) of Fig.7 is provided by the position of the opposite side of the notch 7a. As shown in the electric insulating plate 9 as a first insulating member at (b) of Fig.7, and (c), the circular groove part 9a where the positive pole terminal board 4a is stored is formed. The slit 9b is also formed in the electric insulating plate 9 so that it may communicate with the notch 7b of the winding axis 7. On the other hand, as shown in the electric insulating plate 8 as a second insulating member at (a) of Fig.7, and (b), the circular groove part 8a where the negative terminal block 5a is stored is formed. The slit 8b is also formed in the electric insulating plate 8 so that it may communicate with the notch 7a of the winding axis 7.
[0031]
Subsequently, this winding component 6 and the positive-and-negative-poles terminals 4 and 5 are made to unify. That is, as shown in Fig.8, the terminal connection part 4b of the positive pole terminal 4 was inserted into the notch 7b of the winding axis 7, and the positive pole terminal board 4a has been arranged in the groove part 9a of the electric insulating plate 9. The terminal connection part 5b of the negative pole terminal 5 was inserted into the notch 7a of the winding axis 7, and the negative terminal block 5a has been arranged in the groove part 8a of the electric insulating plate 8. As a result of inserting the terminal connection parts 4b and 5b into the notch 7a of the winding axis 7, and 7b, the form of the winding axis 7 turned into cylindrical shape.
[0032]
The separator 3 which consists of a polyethylene microporous film (3.5 m in width, and 22 micrometers in thickness) Between the winding axis 7 and the positive electrodes 1, Between the winding axis 7 and the anode 2, it inserted one sheet into each at a time, and fixed to it, the positive electrode 1 and the anode 2 were spirally wound via this separator 3, and the flat shape electrode group whose height of the winding axial direction of an electrode group is smaller than the size of a direction vertical to a winding axis was manufactured. The cross sectional view of an electrode group is shown in Fig.9. The winding axis 7 with which the terminal connection part 4b (positive electrode lead part) of the positive pole terminal 4 and the terminal connection part 5b (negative electrode lead part) of the negative pole terminal 5 were united is placed at the central part of the winding electrode group which interposed the separator 3 and wound the positive electrode 1 and the anode 2 spirally as shown in Fig.9. The electric insulating plate 8 as a second insulating member is arranged at the upper surface of the winding electrode group. The negative terminal block 5a (negative pole terminal part) currently united with the terminal connection part 5b is arranged on the electric insulating plate 8. The electric

insulating plate 9 as a first insulating member is arranged on the lower surface of the winding electrode group. The positive pole terminal board 4a (positive pole terminal part) currently united with the terminal connection part 4b is laminated by the electric insulating plate 9.

[0033]

With bottomed cylindrical shape, the open end prepared the metal vessel 11 (for example, formed from stainless steel, such as SUS304) which has the reverse part 10 turned up outside as a negative electrode case which serves as a negative pole terminal. The insulating gasket 12 of ring shape was fitted into the reverse part 10 of this negative electrode case 11. In this negative electrode case 11, the electrode group was inserted so that that negative terminal block 5a might touch the inner surface of the negative electrode case 11, and the negative terminal block 5a and the negative electrode case 11 were welded by resistance.

[0034]

The container made of aluminum 13 which carried out bottomed cylindrical shape was prepared as a positive electrode case which serves as a positive pole terminal. In this positive electrode case 13, the electrode group was inserted so that that positive pole terminal board 4a might touch the inner surface of the positive electrode case 13, and the positive pole terminal board 4a and the positive electrode case 13 were welded by resistance.

[0035]

After drying for 12 hours what welded this electrode group, the negative electrode case, and the positive electrode case at 85 degrees C, the nonaqueous electrolyte which dissolved $LiBF_4$ in the solvent which mixed ethylene carbonate and gamma-butyllactone at a ratio of the volume ratio 1:2 at a ratio of 1.5 mol/L as a supporting electrolyte was poured in. After fitting the positive electrode case 13 into the negative electrode case 11, the upper and lower sides were reversed, it sealed by carrying out ****** processing to the positive electrode case 13, and 5.3 mm in thickness and the button form small rechargeable battery of the diameter phi12mm working example 1 were manufactured.

[0036]

(Working example 2)

Manufacture of the electrode group was the same as that of the working example 1, and applied the conductive paint which made the portion which an electrode group contacts by the inner surface of a negative electrode case and a positive electrode case distribute graphite particles without carrying out welding of the negative pole terminal of an electrode group, welding of a negative electrode case, a positive pole terminal, and a positive electrode case.

[0037]

After drying 12h of produced electrode groups at 85 degrees C, the electrode group has been arranged so that the negative terminal block of an electrode group may touch the inner base where the conductive paint of the negative electrode case which unified the insulating gasket is applied. The nonaqueous electrolyte made to dissolve $LiBF_4$ in the solvent which mixed ethylene carbonate and gamma-butyllactone at a ratio of the volume ratio 1:2 at a ratio of 1.5 mol/L as a supporting electrolyte is poured in, The positive electrode case in which the conductive paint is applied was fitted into the inner base so that the positive pole terminal board of an electrode group might furthermore be touched, and it sealed by carrying out caulking process to a positive electrode case after flip vertical, and 5.3 mm in thickness and the button form small rechargeable battery of the diameter phi12mm working example 2 were manufactured.

[0038]

(Comparative example)

5 parts by weight of acetylene black and 5 parts by weight of graphite powder were added as a conducting agent to $LiCoO_2$100 part by weight, 5 parts by weight of ethylene tetrafluoride was added as a binding agent, after mixing, it ground and granular positive electrode mixture was obtained. Next, pressing was performed to 8 mm in diameter, and 2.1 mm in thickness, and this positive electrode granulation mixture was used as the positive electrode tablet.

[0039]

Next, styrene butadiene rubber (SBR) and carboxymethyl cellulose (CMC) were further ground after 2.5 part-by-weight addition, mixing, and drying as a binding agent, respectively to 100 parts by weight of graphitization mesophase pitch carbon fiber powder, and granular negative electrode mixture was obtained to it. Pressing was performed to 8 mm in diameter, and 2.1 mm in thickness, and the obtained

anode granulation mixture was used as the anode tablet.

[0040]

Next, after drying 12h of these positive-and-negative-poles tablets at 85 degrees C, it has arranged in order of a polypropylene nonwoven with a thickness of 0.2 mm which becomes the negative electrode case which unified the insulating gasket from an anode tablet and polypropylene, and a positive electrode tablet. The nonaqueous electrolyte made to dissolve $LiBF_4$ in the solvent which mixed ethylene carbonate and gamma-butyllactone at a ratio of the volume ratio 1:2 at a ratio of 1.5 mol/L as a supporting electrolyte is poured in, Furthermore the positive electrode case was fitted in, caulking process was carried out to the positive electrode case after flip vertical, and 5.3 mm in thickness and the button form small rechargeable battery of the diameter phi12mm comparative example were manufactured.

[0041]

About the cell of the working example and comparative example which were produced as above, a 48h initial charge was carried out with the constant current constant voltage of 4.2V and 1 mA. Then, it discharged to 3.0V by the constant current of 250microA, and service capacity was calculated. A result is shown in Table 1 as the service capacity 1. Let what discharged by 15-mA constant current similarly be the service capacity 2.

[Table 1]

表1

	電極種	放電容量 1 250μA 定電流 (mAh)	放電容量 2 15mA 定電流 (mAh)
実施例 1	塗工電極	16.7	16.5
実施例 2	塗工電極	16.7	16.4
比較例 1	タブレット電極	16.2	1.2

[0042]

In the case of the light load of 250microA, equivalent capacity is obtained compared with the cell of a comparative example using the electrode of the shape of a tablet which produced the cell of the working examples 1 and 2 with the conventional granulation mixture molding method although it was

clearer than Table 1, but in the discharge at the time of 15-mA load discharging, capacity is remarkably large. In the difference of the current collection method between an electrode group and the positive-and-negative-poles case which is external terminals, it was checked also the current collection by contact of the working example 2, or current collection by welding of the working example 1 that there is no inferiority in service capacity.

[0043]

Although the working example of the present invention was described using the nonaqueous solvent secondary battery which used the nonaqueous solvent for nonaqueous electrolyte, It is also possible to be able to apply naturally also to the polymer secondary battery using a polymer electrolyte or the solid electrolyte secondary cell using a solid electrolyte, and to use a polymer thin film and a solid-electrolyte membrane for a change of the separator made of resin. Although described based on the button form small rechargeable battery sealed by caulking process of a positive electrode case about cell form, it is also possible to replace a positive-and-negative-poles electrode and to seal by caulking process of a negative electrode case. It is not necessary to be a button form and can apply also in the small rechargeable battery of a coin form also to cell form. It is also possible to apply also in the rechargeable battery of a cylindrical shape and a square shape. Even if it applies the present invention to a primary battery, it is possible to acquire an equivalent effect.

[0044]

Maintaining the advantage of the battery size which a button form and a coin shaped battery have being small, and excelling in productivity according to the present invention as described above, the service capacity at the time of load discharging can be markedly alike to the conventional cell, and the outstanding big sized cell can be provided. Therefore, the industrial value is very big.

[0045]

The present invention is not limited to the above-mentioned embodiment as it is, and in an execution phase, in the range which does not deviate from the summary, a component is deformed and shape can be taken. Various invention can be formed with a proper combination of two or more components currently disclosed in the above-mentioned embodiment. For example, some components may be deleted from all the components shown in an embodiment. The component covering a different embodiment may be combined suitably.

[Brief Description of the Drawings]

[0046]

[Drawing 1]The cross sectional view showing typically the coin type nonaqueous electrolyte secondary battery concerning one embodiment of the present invention.

[Drawing 2]The perspective view showing typically the positive electrode used with the coin type nonaqueous electrolyte secondary battery of Fig.1.

[Drawing 3]The perspective view showing typically the anode used with the coin type nonaqueous electrolyte secondary battery of Fig.1.

[Drawing 4]The side view and plan view showing the positive pole terminal used with the coin type nonaqueous electrolyte secondary battery of Fig.1.

[Drawing 5]The side view and plan view showing the negative pole terminal used with the coin type nonaqueous electrolyte secondary battery of Fig.1.

[Drawing 6]The mimetic diagram for describing the process which makes an electrode and a terminal unify.

[Drawing 7]The side view and plan view showing the winding component used with the coin type nonaqueous electrolyte secondary battery of Fig.1.

[Drawing 8]The mimetic diagram for describing the process of inserting in the winding component of Fig.7 the terminal in which the electrode was unified.

[Drawing 9]The cross sectional view showing typically the electrode group used with the coin type nonaqueous electrolyte secondary battery of Fig.1.

[Drawing 10]The cross sectional view showing the conventional coin type cell.

[Explanations of letters or numerals]

[0047]

1 -- positive electrode, 1 a -- positive pole collector, 1 b -- positive electrode agent contained layer, 1 c -- energized part, 2 -- anode, 2 a -- a negative pole collector and 2b-- anode active substance contained layer, 2 c -- energized part, 3 and 26 -- a separator and 4 -- a positive pole terminal and 4a -- a positive pole terminal board and 4b -- a terminal connection part -- 4 c -- slit, 5 -- negative

pole terminal, 5 a -- negative terminal block, 5 b -- terminal connection part, 5 c -- slit, 6 -- winding component, 7 -- a winding axis and 7a, 7 b -- a notch and 8, 9 -- an electric insulating plate and 8a, 9 a -- groove part, 10 -- a reverse part and 11, 22 -- a negative electrode case and 12, 23 -- an insulating gasket and 13, 21 -- positive electrode case, 24 -- positive electrode tablet, 25 -- anode tablet.

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[0046]
[Drawing 1]The cross sectional view showing typically the coin type nonaqueous electrolyte secondary battery concerning one embodiment of the present invention.
[Drawing 2]The perspective view showing typically the positive electrode used with the coin type nonaqueous electrolyte secondary battery of Fig.1.
[Drawing 3]The perspective view showing typically the anode used with the coin type nonaqueous electrolyte secondary battery of Fig.1.
[Drawing 4]The side view and plan view showing the positive pole terminal used with the coin type nonaqueous electrolyte secondary battery of Fig.1.
[Drawing 5]The side view and plan view showing the negative pole terminal used with the coin type nonaqueous electrolyte secondary battery of Fig.1.
[Drawing 6]The mimetic diagram for describing the process which makes an electrode and a terminal unify.
[Drawing 7]The side view and plan view showing the winding component used with the coin type nonaqueous electrolyte secondary battery of Fig.1.
[Drawing 8]The mimetic diagram for describing the process of inserting in the winding component of Fig.7 the terminal in which the electrode was unified.
[Drawing 9]The cross sectional view showing typically the electrode group used with the coin type nonaqueous electrolyte secondary battery of Fig.1.
[Drawing 10]The cross sectional view showing the conventional coin type cell.

[Translation done.]

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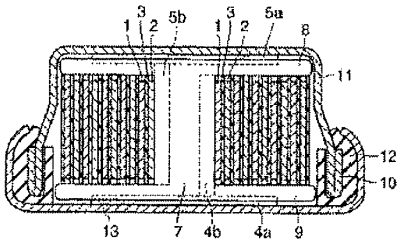
DRAWINGS

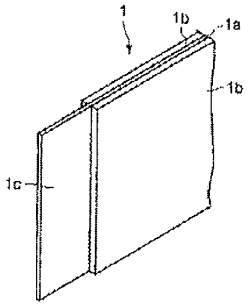
[Drawing 1]

図1



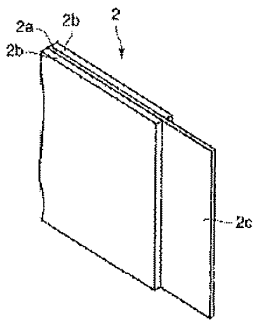
[Drawing 2]

図2



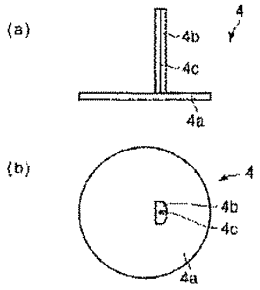
[Drawing 3]

図3



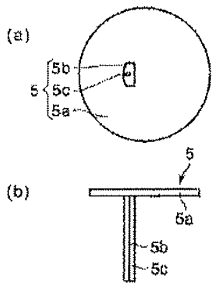
[Drawing 4]

図4



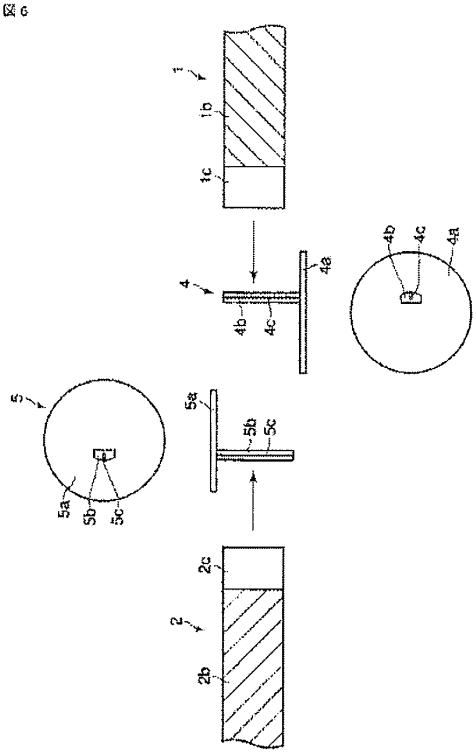
[Drawing 5]

図5



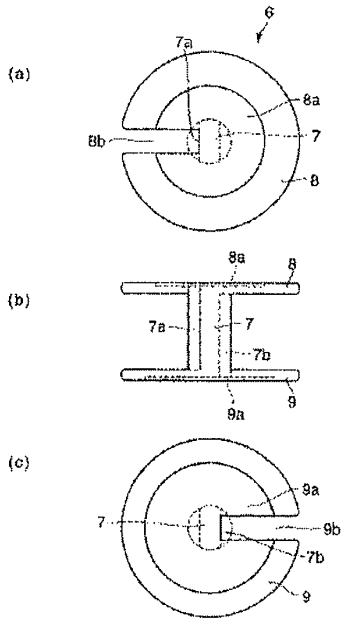
[Drawing 6]

図6



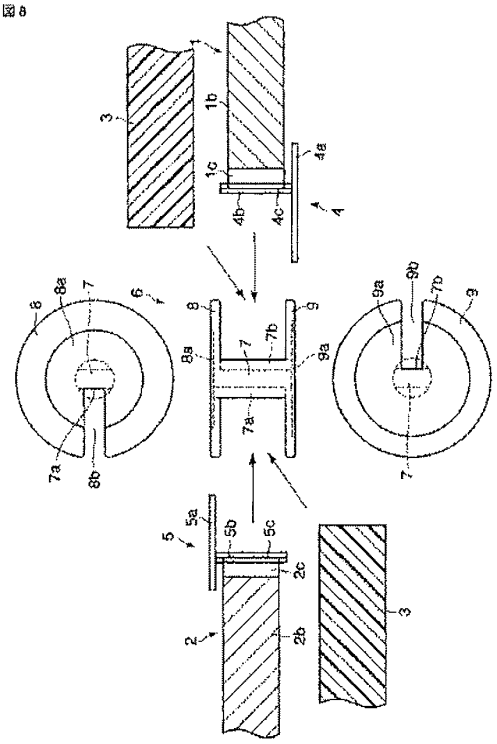
[Drawing 7]

図7



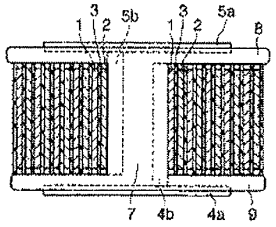
[Drawing 8]

図8



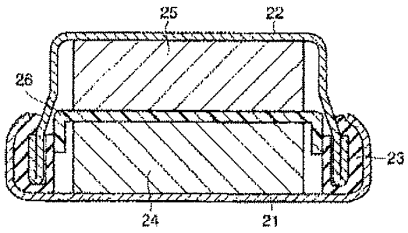
[Drawing 9]

図9



[Drawing 10]

図10



[Translation done.]

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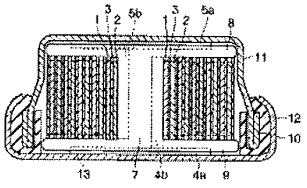
最終頁に続く

(54)【発明の名称】小型電池

(57)【要約】
【課題】生産性を損なうことなく、重負荷特性を改善することが可能な小型電池を提供する。
【解決手段】容器と、前記容器内に収納され、正極１及び負極２を含む積層物が渦巻き状に捲回された扁平型電極群とを具備する小型電池であって、前記扁平型電極群は、前記正極１及び前記負極２のうち少なくとも一方の電極を捲回軸芯７に固定した状態で前記積層物を渦巻き状に捲回することにより前記捲回軸芯７と一体となっていることを特徴とする小型電池。
【選択図】　図１

図1



【特許請求の範囲】
【請求項１】
容器と、前記容器内に収納され、正極及び負極を含む積層物が渦巻き状に捲回された扁平型電極群とを具備する小型電池であって、
前記扁平型電極群は、前記正極及び前記負極のうち少なくとも一方の電極を捲回軸芯に固定した状態で前記積層物を渦巻き状に捲回することにより前記捲回軸芯と一体となっていることを特徴とする小型電池。
【請求項２】
前記容器は、正極端子を兼ねる正極ケースと、負極端子を兼ねる負極ケースと、前記正極ケースと前記負極ケースの間に介在された絶縁ガスケットとを具備し、前記正極ケースまたは前記負極ケースに施されたカシメ加工により前記容器の封口がなされていることを特徴とする請求項１記載の小型電池。
【請求項３】
前記正極ケースと前記電極群の一方の端面との間に配置された正極端子部と、
前記負極ケースと前記電極群の他方の端面との間に配置された負極端子部と、
前記捲回軸芯に一体化されており、前記正極端子部と前記正極間の導通を確保するための正極リード部と、
前記捲回軸芯に一体化されており、前記負極端子部と前記負極間の導通を確保するための負極リード部と
をさらに具備することを特徴とする請求項２記載の小型電池。
【請求項４】
前記正極ケースと前記電極群の一方の端面との間か、前記負極ケースと前記電極群の他方の端面との間か、あるいは両方に絶縁部材を配置したことを特徴とする請求項３記載の小型電池。
【請求項５】
前記電極群の一方の端面を覆うように前記捲回軸芯の一端に固定された第１の絶縁部材と、
前記電極群の他方の端面を覆うように前記捲回軸芯の他端に固定された第２の絶縁部材と、
前記正極ケースの内面と前記第１の絶縁部材との間に配置された正極端子部と、
前記負極ケースの内面と前記第２の絶縁部材との間に配置された負極端子部と、
前記捲回軸芯に一体化されており、前記正極端子部と前記正極間の導通を確保するための正極リード部と、
前記捲回軸芯に一体化されており、前記負極端子部と前記負極間の導通を確保するための負極リード部と
をさらに具備することを特徴とする請求項２記載の小型電池。
【請求項６】
コイン型もしくはボタン型電池であることを特徴とする請求項１～５いずれか１項記載の小型電池。
【発明の詳細な説明】
【技術分野】
【０００１】
本発明は捲回電極群を備えた小型電池（例えば、ボタン型電池，コイン型電池）に関する。
【背景技術】
【０００２】
小型ビデオカメラ、携帯電話、ＰＤＡ、ノートパソコン等の携帯用電子・通信機器の普及はめざましく、これらの電源としてリチウムイオン二次電池、ニッケル水素蓄電池等の二次電池が実用化され、小型軽量化、高容量化へ向けた開発が盛んに行われてきた。
【０００３】

携帯用機器のさらなる小型化の流れに加え、腕時計といった小型化が必須とされる機器の電源として二次電池が要求され、放電電流が数～数十μＡ程度の軽負荷で放電が行われるSRAMやRTCのバックアップ用電源、電池交換不要腕時計の主電源といった用途に、ボタン形、コイン形等の小型二次電池が実用化されてきている。

【０００４】

これらボタン形、コイン形等の小型二次電池の構造は、図１０に示すものが一般的である。すなわち、密閉容器として、正極端子を兼ねる正極ケース２１に負極端子を兼ねる金属製の負極ケース２２が絶縁ガスケット２３を介してかしめ加工されたものが使用される。この密閉容器の内部に、絶縁ガスケット２３の開口径より直径が小さいタブレット状の正極２４及び負極２５がそれぞれ１枚ずつ収納されている。正極２４と負極２５の間には、電解液を含浸させたセパレータ２６が介在されている。

【０００５】

このようなボタン形、コイン形などの小型二次電池は構造が簡単であることから、量産性に優れ、小型化が可能という特徴を持っている。

【０００６】

しかしながら、上記に示した構造のボタン形、コイン形等の小型二次電池は小型携帯機器の主電源として要求される大電流にて放電した場合の特性が不十分であり、小型携帯機器の主電源としては適していない。

【０００７】

一方、小型ビデオカメラ、携帯電話、ＰＤＡ、ノートパソコン等の携帯端末の小型化により、主電源として使用されてきたリチウムイオン二次電池、ニッケル水素蓄電池等についても小型化が必須となっている（例えば特許文献１，２）。リチウムイオン二次電池やニッケル水素蓄電池の製造方法を簡単に説明する。まず、金属箔または金属ネットからなる集電体に活物質層を塗布または充填し、電極を形成する。形成した電極に集電用タブ端子を溶接後、これら電極を捲回または積層することにより電極群を作製する。さらに電極群から取り出した集電用タブ端子に複雑に曲げ加工を行い、安全素子や電極ピンや電極缶などに溶接し、電池を製作していた。これらの二次電池の製造はこの様に複雑な製造工程を要し、作業が複雑である。また、タブ端子のショート防止のために電池内に空間や部品を設けたり、安全素子など多数の部品を電池内に組み込む必要がある。よって、これら二次電池では、小型化が非常に困難で現状でほぼ限界に達していた。

【特許文献１】特開平１１－３４５６２６号公報

【特許文献２】特開平１１－３５４１５０号公報

【発明の開示】

【発明が解決しようとする課題】

【０００８】

ボタン形やコイン形などの小型電池の重負荷特性を、生産性を損なうことなく改善させることが本発明の目的である。

【課題を解決するための手段】

【０００９】

本発明に係る小型電池は、容器と、前記容器内に収納され、正極及び負極を含む積層物が渦巻き状に捲回された扁平型電極群とを具備する小型電池であって、

前記扁平型電極群は、前記正極及び前記負極のうち少なくとも一方の電極を捲回軸芯に固定した状態で前記積層物を渦巻き状に捲回することにより前記捲回軸芯と一体となっていることを特徴とする。

【００１０】

ここで、扁平型電極群とは、電極群の捲回軸方向の高さが捲回軸に垂直な方向の大きさよりも小さい構造を有する電極群を意味する。

【発明の効果】

【００１１】

本発明によれば、生産性を損なうことなく、重負荷特性を改善することが可能な小型電

池を提供することができる。

【発明を実施するための最良の形態】

【００１２】

本発明者らは小型電池の重負荷特性の向上に関して研究を重ねた結果、ボタン形、コイン形などの小型電池のケース内に捲回型電極群を安全かつ生産性よく収納する方法を見出した。これにより、従来の小型電池に比較して重負荷特性が飛躍的に向上した。

【００１３】

すなわち、負極端子を兼ねる金属製の負極ケースと、正極端子を兼ねる金属製の正極ケースが、絶縁ガスケットを介して嵌合され、さらに前記正極ケースまたは負極ケースが加締め加工により加締められた封口構造を有する容器を使用し、その容器内に、正極及び負極を含む積層物を渦巻き状に捲回した電極群を収納することにより、重負荷特性に優れた小型電池を提供することができることを見出した。

【００１４】

小型携帯機器の主電源として使用されているリチウムイオン二次電池やニッケル水素蓄電池では、セパレータを介して薄い正極と負極を捲回することで、負極と正極の対向電極面積を大きくすることが可能となり、大電流を取り出すことができる。しかし、前述したようにその製造工程は複雑であり、安全性を確保するなどのために電池内の部品数が非常に多い。このため、ボタン形やコイン形などの小型電池内にその電極群構造を収納することは不可能と考えられてきた。

【００１５】

そこで、本発明者らは従来技術からの発想の転換を図り、少なくとも捲回軸芯、必要に応じて絶縁板、電極と外部端子との接続端子を電極群の構造に取り込むことで、安全で生産性に優れているという利点を維持したまま、ボタン形、コイン形などの小型電池のケース内に正極、負極およびセパレータを数層～数十層捲回した電極群を効率よく収納することを可能とした。

【００１６】

以下、本発明者らが本発明をいかにして実現したかを説明する。

【００１７】

まず、正極および負極をセパレータを介して渦巻き状に捲回する場合に、捲回軸芯を負極及び／または正極と一体化したまま電極群内に取り入れることで、ボタン形やコイン形などの小型電池のケース内に収納可能な捲回電極群を製作することができた。この捲回軸芯またはその一部の基部はポリエチレンやポリプロピレン樹脂、ガラス、セラミックなどの絶縁性材料から形成されることが望ましい。

【００１８】

次に、電極群と外部端子を兼ねる金属ケースとの接続について説明する。円筒形や角形などの比較的大きなリチウムイオン二次電池では、電極群の中心部や捲回部材部にタブ端子を溶接し、それに曲げ加工を施した後、安全素子や封口ピンに溶接し、集電を行なっている。しかしながら、曲げ工程が複雑なため生産性に劣っている。そこで、電極群に内在させる捲回軸芯に、電極と外部端子を兼ねる金属ケースとの接続を目的に端子を設置することで構造を単純にすることができた。この端子に電極を接続する方法は圧着、抵抗溶接や超音波溶接などの溶接、導電性接着剤などによる接着などがあるが特に限定するものではない。さらに、この端子と外部端子を兼ねる金属ケースとの接続方法としては抵抗溶接や超音波溶接などの溶接、導電性接着剤などによる接着、端子と電池ケースの接触などがあるが特に限定するものではない。しかし、接触による集電の場合は金属ネット、金属粉末、炭素フィラー、導電性塗料などを使用して集電性を向上させることが望ましい。

【００１９】

次に、電極群と電池ケースの間にはショートを防止することを目的に絶縁部材を設置することが望ましい。絶縁部材としては絶縁性が保持されれば特に限定はしないが、ポリエチレンやポリプロピレン樹脂製の絶縁板、ＰＥＴやポリイミド製のフィルムなどが使用できる。絶縁部材は、正極ケースと電極群との間か、負極ケースと電極群との間か、あるい

は両方に配置することができる。

【００２０】

また、この絶縁部材を捲回軸芯に一体化してもよい。絶縁部材と捲回軸芯を一体化することにより電極群としては構造上の安定性が向上するため、絶縁部材と捲回軸芯は一体化することが望ましい。

【００２１】

次に、電極については正負極とも従来の顆粒合剤の成形方式や金属ネットや発泡ニッケルなどの金属基板に合剤を充填する方法を用いてもよいが、肉薄電極の作製が行ない易いと言う点で金属箔にスラリー状の合剤を塗布、乾燥したものがよく、さらにそれを圧延したものも用いることもできる。上記の様な金属箔に作用物質を含む合剤層を塗工した電極を用いる場合は、電極群の内部に用いる電極は金属箔の両面に作用物質層を形成したものを用いるのが、容積効率の上から好ましい。電極群の片側の端子に接続する部分については接続を容易にするために電極構成材の内、特に金属箔を露出させるのが好ましい。これに関してはこの部分に限り片面にのみ作用物質層を形成した電極を用いてもよいし、一旦、両面に作用物質層を形成した後、片面のみ作用物質層を除去してもよい。

【００２２】

次に、本電池は電極を含めた電池の構造に主点を置いたものであり、正極作用物質については限定されるものではなく、MnO_2、V_2O_5、Nb_2O_5、$LiTi_2O_4$、$Li_4Ti_5O_{12}$、$LiFe_2O_4$、コバルト酸リチウム、ニッケル酸リチウム、マンガン酸リチウム、ニッケルマンガン酸リチウム、ニッケルコバルト酸リチウム、コバルトマンガン酸リチウム、ニッケルコバルトマンガン酸リチウムなどの金属酸化物、あるいはフッ化黒鉛、FeS_2などの無機化合物、あるいはポリアニリンやポリアセン構造体などの有機化合物などあらゆる物が適用可能である。ただし、この中で作動電位が高く、サイクル特性に優れるという点でコバルト酸リチウム、ニッケル酸リチウム、マンガン酸リチウムやそれらの混合物やそれらの元素の一部を他の金属元素で置換したリチウム含有酸化物がより好ましく、長期間に渡り使用されることもある小型二次電池においては高容量で電解液や水分との反応性が低く化学的に安定であるという点でコバルト酸リチウムがさらに好ましい。

【００２３】

次に、本電池の負極作用物質については限定されるものではなく、金属リチウム、あるいはLi－Al、Li－In、Li－Sn、Li－Si、Li－Ge、Li－Bi、Li－Pbなどのリチウム合金、あるいはポリアセン構造体などの有機化合物、あるいはリチウムを吸蔵・放出可能な炭素質材料、あるいはNb_2O_5、$LiTi_2O_4$、$Li_4Ti_5O_{12}$やLi含有珪素酸化物の様な酸化物、Li含有窒化物などあらゆるものが適用可能である。サイクル特性に優れ、作動電位が低く、高容量であるという点でLiを吸蔵・放出可能な炭素質材料が好ましく、特に放電末期においても電池作動電圧の低下が少ないと言う点で天然黒鉛や人造黒鉛、膨張黒鉛、メソフェーズピッチ焼成体、メソフェーズピッチ繊維焼成体などの黒鉛構造が発達した炭素質材料がより好ましい。

【００２４】

[実施例]

以下、本発明の実施例について図面を参照して詳細に説明する。

【００２５】

（実施例１）

実施例１の電池の断面図を図１に示す。以下、実施例１の電池の製造方法を説明する。

【００２６】

まず、$LiCoO_2$ １００重量部に対し、導電剤としてアセチレンブラック５重量部と黒鉛粉末５重量部を加え、結着剤としてポリフッ化ビニリデンを５重量部加え、Ｎ－メチルピロリドンで希釈、混合し、スラリー状の正極合剤を得た。次に、この正極合剤を、正極集電体である厚さ０．０２ｍｍのアルミニウム箔の片面にドクターブレード法により塗工、乾燥を行い、アルミニウム箔表面に正極作用物質含有層を形成した。以後、正極作用物質含有層の塗膜厚さが両面で０．１３ｍｍとなるまで塗工、乾燥を繰り返し、図２に示

すように、正極集電体１ａの両面に正極作用物質含有層１ｂが積層された正極１を作製した。次に、この正極１の両面の端から２ｍｍ部分の正極作用物質含有層を除去し、アルミ層を剥き出しにして通電部１ｃとし、幅３．３ｍｍ、長さ１５０ｍｍ、厚さ０．１３ｍｍの長さに切り出した正極板を得た。

【００２７】

次に、黒鉛化メソフェーズピッチ炭素繊維粉末１００重量部に結着剤としてスチレンブタジエンゴム（ＳＢＲ）とカルボキシメチルセルロース（ＣＭＣ）をそれぞれ２．５重量部を添加し、イオン交換水で希釈、混合し、スラリー状の負極合剤を得た。得られた負極合剤を負極集電体である厚さ０．０２ｍｍの銅箔に負極作用物質含有層の厚さが０．１２ｍｍとなるように正極の場合と同様に塗工、乾燥を繰り返し実施し、図３に示すように、負極集電体２ａの両面に負極作用物質含有層２ｂが積層された負極２を作製した。次に、この負極２の両面の端から２ｍｍ部分の負極作用物質含有層を除去し、銅層を剥き出しにして通電部２ｃとし、幅３．３ｍｍ、長さ１５０ｍｍ、厚さ０．１２ｍｍの長さに切り出した負極板を作製した。

【００２８】

次に、図４及び図５に示す構造の正負極端子を用意した。図４の（ａ）は、正極端子をスリット側から見た側面図で、図４の（ｂ）は正極端子の平面図である。正極端子４は、円板状の正極端子板４ａ（正極端子部）と、正極端子板４ａに電気的に接続された棒状の端子接続部４ｂ（正極リード部）と、端子接続部４ｂに形成されたスリット４ｃとを有する。この正極端子４は、例えば、アルミニウムから形成される。一方、図５の（ａ）は、負極端子の平面図で、図５の（ｂ）は負極端子をスリット側から見た側面図である。負極端子５は、円板状の負極端子板５ａ（負極端子部）と、負極端子板５ａに電気的に接続された棒状の端子接続部５ｂ（負極リード部）と、端子接続部５ｂに形成されたスリット５ｃとを有する。この負極端子５は、例えば、ステンレスから形成されている。

【００２９】

図６に示すように、正極１の通電部１ｃを正極端子４の端子接続部４ｂのスリット４ｃに挿入した後、端子接続部４ｂに外側から圧力をかけ、端子接続部４ｂに通電部１ｃを圧着させた。また、負極２の通電部２ｃを負極端子５の端子接続部５ｂのスリット５ｃに挿入した後、端子接続部５ｂに外側から圧力をかけ、端子接続部５ｂに通電部２ｃを圧着させた。

【００３０】

次に、電極を接続した端子を図７に示す捲回部材と一体化した。図７の（ａ）は、捲回部材６を上方から見た平面図で、（ｂ）は捲回部材６の側面図で、（ｃ）は捲回部材６を下方から見た平面図である。捲回部材６は、図７に示すように、捲回軸芯７と、捲回軸芯７の上端及び下端に一体化された絶縁板８，９（第１，第２の絶縁部材）とを備える。捲回軸芯７は、図７の（ａ）に示すように、負極端子５の端子接続部５ｂが嵌め合わされる切欠部７ａを有する。また、捲回軸芯７には、図７の（ｃ）に示すように、正極端子４の端子接続部４ｂが嵌め合わされる切欠部７ｂが、切欠部７ａの反対側の位置に設けられている。第１の絶縁部材としての絶縁板９には、図７の（ｂ），（ｃ）に示すように、正極端子板４ａが収納される円形の溝部９ａが形成されている。また、絶縁板９には、捲回軸芯７の切欠部７ｂと連通するようにスリット９ｂも形成されている。一方、第２の絶縁部材としての絶縁板８には、図７の（ａ），（ｂ）に示すように、負極端子板５ａが収納される円形の溝部８ａが形成されている。また、絶縁板８には、捲回軸芯７の切欠部７ａと連通するようにスリット８ｂも形成されている。

【００３１】

次いで、この捲回部材６と正負極端子４，５とを一体化させる。すなわち、図８に示すように、正極端子４の端子接続部４ｂを捲回軸芯７の切欠部７ｂ内に挿入すると共に、正極端子板４ａを絶縁板９の溝部９ａ内に配置した。また、負極端子５の端子接続部５ｂを捲回軸芯７の切欠部７ａ内に挿入すると共に、負極端子板５ａを絶縁板８の溝部８ａ内に配置した。捲回軸芯７の切欠部７ａ，７ｂ内に端子接続部４ｂ，５ｂが挿入された結果，

捲回軸芯７の形状が円柱形状となった。

【００３２】

幅３．５ｍｍ、厚さ２２μｍのポリエチレン微多孔膜からなるセパレータ３を捲回軸芯７と正極１の間、捲回軸芯７と負極２の間それぞれに１枚ずつはさんで固定し、正極１と負極２をこのセパレータ３を介して渦巻状に捲回し、電極群の捲回軸方向の高さが捲回軸に垂直な方向の大きさよりも小さい扁平型電極群を製作した。電極群の断面図を図９に示す。図９に示す通り、正極１と負極２をセパレータ３を介在させて渦巻き状に捲回した捲回電極群の中心部には、正極端子４の端子接続部４ｂ（正極リード部）と負極端子５の端子接続部５ｂ（負極リード部）が一体化された捲回軸芯７が位置する。捲回電極群の上面には、第２の絶縁部材としての絶縁板８が配置されている。端子接続部５ｂに一体化されている負極端子板５ａ（負極端子部）は、絶縁板８上に配置されている。また、捲回電極群の下面には、第１の絶縁部材としての絶縁板９が配置されている。端子接続部４ｂに一体化されている正極端子板４ａ（正極端子部）は、絶縁板９に積層されている。

【００３３】

有底円筒形状で、開口端が外側に折り返されたリバース部１０を有する金属製容器１１（例えば、ＳＵＳ３０４などのステンレスから形成される）を、負極端子を兼ねる負極ケースとして用意した。この負極ケース１１のリバース部１０にリング状の絶縁ガスケット１２を嵌合した。この負極ケース１１内に電極群をその負極端子板５ａが負極ケース１１の内面と接するように挿入し、負極端子板５ａと負極ケース１１を抵抗溶接した。

【００３４】

有底円筒形状をしたアルミニウム製容器１３を、正極端子を兼ねる正極ケースとして用意した。この正極ケース１３内に電極群をその正極端子板４ａが正極ケース１３の内面と接するように挿入し、正極端子板４ａと正極ケース１３を抵抗溶接した。

【００３５】

この電極群と負極ケースおよび正極ケースを溶接したものを８５℃で１２時間乾燥した後、エチレンカーボネイトとγ－ブチルラクトンを体積比１：２の割合で混合した溶媒に支持塩として$LiBF_4$を１．５ｍｏｌ／Ｌの割合で溶解した非水電解液を注液した。負極ケース１１に正極ケース１３を嵌合した後、上下を反転させ、正極ケース１３に加絞め加工を実施することによって封口し、厚さ５．３ｍｍ、直径φ１２ｍｍの実施例１のボタン形小型二次電池を製作した。

【００３６】

（実施例２）

電極群の製作までは実施例１と同様で、電極群の負極端子と負極ケースの溶接と正極端子と正極ケースの溶接を実施しないで、負極ケースと正極ケースの内面で電極群が接触する部分に黒鉛微粒子を分散させた導電性塗料を塗布した。

【００３７】

作製した電極群を８５℃で１２ｈ乾燥した後、絶縁ガスケットを一体化した負極ケースの導電性塗料が塗布してある内底面に電極群の負極端子板が接するように電極群を配置した。エチレンカーボネイトとγ－ブチルラクトンを体積比１：２の割合で混合した溶媒に支持塩として$LiBF_4$を１．５ｍｏｌ／Ｌの割合で溶解せしめた非水電解質を注液し、さらに電極群の正極端子板に接するように内底面に導電性塗料が塗布してある正極ケースを嵌合し、上下反転後、正極ケースに加締め加工を実施することにより封口し、厚さ５．３ｍｍ、直径φ１２ｍｍの実施例２のボタン形小型二次電池を製作した。

【００３８】

（比較例）

$LiCoO_2$１００重量部に対し導電剤としてアセチレンブラック５重量部と黒鉛粉末５重量部を加え、結着剤として４フッ化エチレンを５重量部加え、混合後、粉砕し、顆粒状の正極合剤を得た。次にこの正極顆粒合剤を、直径８ｍｍ、厚さ２．１ｍｍに加圧成形を行ない、正極タブレットとした。

【００３９】

次に、黒鉛化メソフェーズピッチ炭素繊維粉末１００重量部に結着剤としてスチレンブタジエンゴム（ＳＢＲ）とカルボキシメチルセルロース（ＣＭＣ）をそれぞれ２．５重量部添加、混合、乾燥後、さらに粉砕し顆粒状の負極合剤を得た。得られた負極顆粒合剤を、直径８ｍｍ、厚さ２．１ｍｍに加圧成形を行ない、負極タブレットとした。

【００４０】

次に、これらの正負極タブレットを８５℃で１２ｈ乾燥した後、絶縁ガスケットを一体化した負極ケースに負極タブレット、ポリプロピレンからなる厚さ０．２ｍｍのポリプロピレン不織布、正極タブレットの順に配置した。エチレンカーボネイトとγ－ブチルラクトンを体積比１：２の割合で混合した溶媒に支持塩として$LiBF_4$を１．５ｍｏｌ／Ｌの割合で溶解せしめた非水電解質を注液し、さらに正極ケースを嵌合し、上下反転後、正極ケースに加締め加工を実施し、厚さ５．３ｍｍ、直径φ１２ｍｍの比較例のボタン形小型二次電池を製作した。

【００４１】

以上の通り作製した実施例及び比較例の電池について、４．２Ｖ、１ｍＡの定電流定電圧で４８ｈ初充電を実施した。その後、２５０μＡの定電流で３．０Ｖまで放電を実施し放電容量を求めた。結果を表１に放電容量１として示す。同様に１５ｍＡの定電流で放電を実施したものを放電容量２とする。

【表１】

表1

	電極種	放電容量１ 250μA定電流 (mAh)	放電容量２ 15mA定電流 (mAh)
実施例１	塗工電極	16.7	16.5
実施例２	塗工電極	16.7	16.4
比較例１	タブレット電極	16.2	1.2

【００４２】

表１より明らかであるが、実施例１．２の電池は、従来の顆粒合剤成形法により作製したタブレット状の電極を用いた比較例の電池に比べ、２５０μＡの軽負荷の場合には同等の容量が得られるが、１５ｍＡ重負荷放電時の放電においては著しく容量が大きい。また

、電極群と外部端子である正負極ケースとの集電方法の違いにおいては、実施例２の接触による集電でも実施例１の溶接による集電でも放電容量には遜色がないことが確認された。

【００４３】

なお、本発明の実施例は、非水電解質に非水溶媒を用いた非水溶媒二次電池を用いて説明したが、ポリマー電解質を用いたポリマー二次電池や固体電解質を用いた固体電解質二次電池についても当然、適用可能であり、樹脂製セパレータの変わりにポリマー薄膜や固体電解質膜を用いることも可能である。また、電池形状については正極ケースの加締め加工により封口するボタン形小型二次電池をもとに説明したが、正負極電極を入れ替え、負極ケースの加締め加工により封口することも可能である。さらに、電池形状についてもボタン形である必要はなくコイン形の小型二次電池においても適用可能である。また、円筒形および角形の二次電池においても適用することも可能である。さらに、一次電池に対して本発明を適用しても同等の効果を得ることが可能である。

【００４４】

以上説明したとおり、本発明によればボタン形やコイン形電池の持つ電池サイズが小さく、かつ、生産性に優れるという利点を維持したまま、重負荷放電時の放電容量が従来の電池に対し格段に大きな優れた小型電池を提供することができる。よって、その工業的価値は非常に大きなものである。

【００４５】

なお、本発明は上記実施形態そのままに限定されるものではなく、実施段階ではその要旨を逸脱しない範囲で構成要素を変形して具体化できる。また、上記実施形態に開示されている複数の構成要素の適宜な組み合わせにより、種々の発明を形成できる。例えば、実施形態に示される全構成要素から幾つかの構成要素を削除してもよい。さらに、異なる実施形態にわたる構成要素を適宜組み合わせてもよい。

【図面の簡単な説明】

【００４６】

【図１】本発明の一実施形態に係るコイン型非水電解質二次電池を模式的に示した断面図。

【図２】図１のコイン型非水電解質二次電池で使用される正極を模式的に示した斜視図。

【図３】図１のコイン型非水電解質二次電池で使用される負極を模式的に示した斜視図。

【図４】図１のコイン型非水電解質二次電池で使用される正極端子を示す側面図と平面図。

【図５】図１のコイン型非水電解質二次電池で使用される負極端子を示す側面図と平面図。

【図６】電極と端子とを一体化させる工程を説明するための模式図。

【図７】図１のコイン型非水電解質二次電池で使用される捲回部材を示す側面図と平面図。

【図８】電極が一体化された端子を図７の捲回部材に挿入する工程を説明するための模式図。

【図９】図１のコイン型非水電解質二次電池で使用される電極群を模式的に示した断面図。

【図１０】従来のコイン型電池を示す断面図。

【符号の説明】

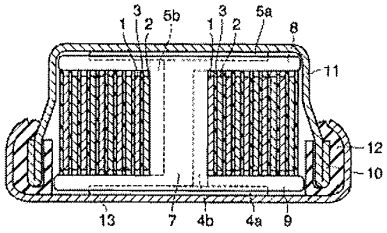
【００４７】

１…正極、１ａ…正極集電体，１ｂ…正極作用物質含有層、１ｃ…通電部，２…負極，２ａ…負極集電体、２ｂ…負極作用物質含有層、２ｃ…通電部、３，２６…セパレータ、４…正極端子、４ａ…正極端子板，４ｂ…端子接続部、４ｃ…スリット、５…負極端子、５ａ…負極端子板、５ｂ…端子接続部、５ｃ…スリット、６…捲回部材、７…捲回軸芯，７ａ，７ｂ…切欠部，８，９…絶縁板、８ａ，９ａ…溝部、１０…リベース部、１１，２２…負極ケース、１２，２３…絶縁ガスケット、１３，２１…正極ケース、２４…正極タ

ブレット、２５…負極タブレット。

【図１】

図1



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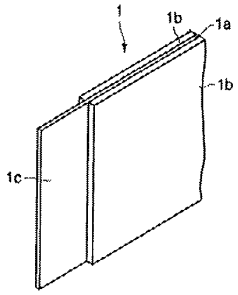

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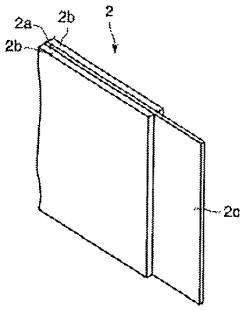

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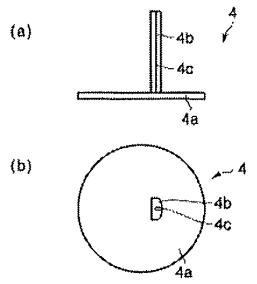
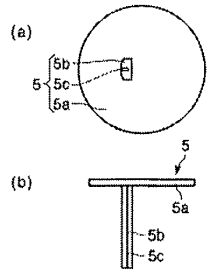


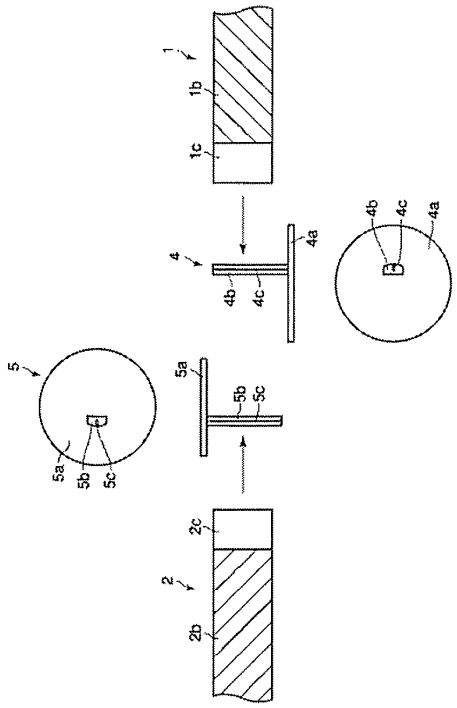
【図５】

図５



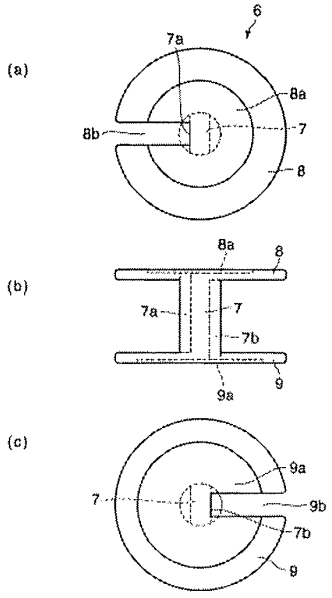
【図６】

図６



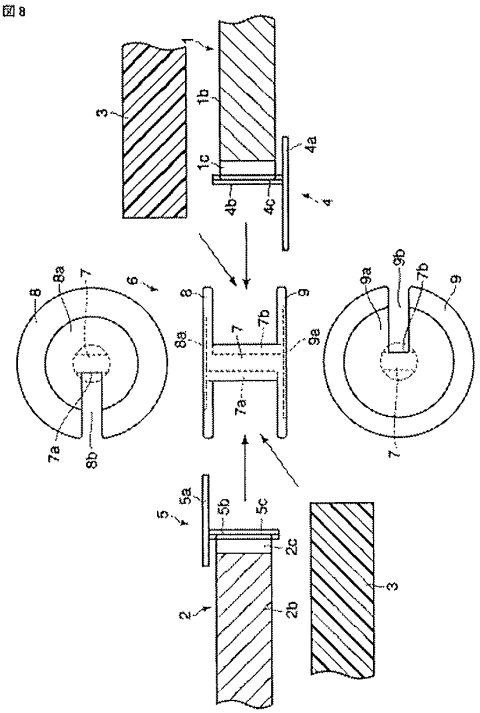
【図７】

図７



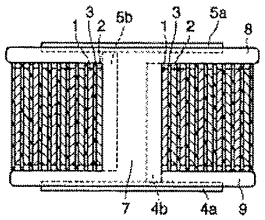
【図８】

図８



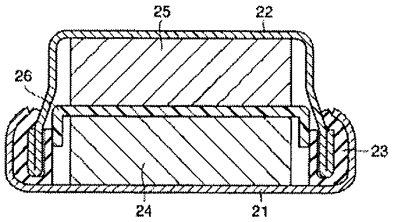
【図９】

図9



【図１０】

図10



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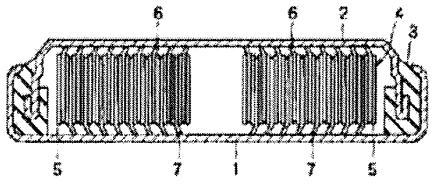
(54) FLAT NONAQUEOUS SECONDARY BATTERY

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a flat nonaqueous secondary battery improved in discharge capacity.
SOLUTION: This flat nonaqueous secondary battery is provided with a sealed container provided by crimping and fixing a positive electrode container 1 and a negative electrode container 2 through an insulation gasket 3, and an electrode group 4 housed in the sealed container and composed by rolling, in a spiral shape, a laminate provided with a positive electrode including a positive electrode collector and a negative electrode including a negative electrode collector. The battery is characterized in that an end part of the positive electrode collector or the negative electrode collector is projected on one rolling surface of the electrode group, and the projected end part is bent to bring it into contact with the inside surface of the container, out of the positive electrode container and the negative electrode container, having the same polarity as the projected end part.



* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1]A well-closed container obtained by fixing a positive electrode container and an anode container by caulking via an insulating gasket.
A positive electrode which is stored in the aforementioned well-closed container and contains a positive pole collector, and an anode containing a negative pole collector.
In a flat shape nonaqueous secondary battery possessing an electrode group which wound laminated material provided with the above spirally,

A flat shape nonaqueous secondary battery making a container internal surface of an end which made an end of the aforementioned positive pole collector or the aforementioned negative pole collector project to one winding surface of the aforementioned electrode group, bent an end which projected [aforementioned], and projected [aforementioned] among the aforementioned positive electrode container and the aforementioned anode container, and same polarity contact.

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]The present invention relates to a flat shape nonaqueous secondary battery.
[0002]
[Description of the Prior Art]The use of a small nonaqueous electrolyte battery like a coin type or a button type nonaqueous electrolyte battery had the main power supply of small equipment, and the main backup power supply of the recording element. All are aimed at the prolonged use with minute power consumption, and, as for the structure, the positive electrode of a pellet type is stored in metal positive electrode cases, and the anode of a pellet type is stored in metal negative electrode cases, and what interposed the separator between the positive electrode and the anode is known. According to such a structure, since the reaction surface product of a positive electrode and an anode is small, reactivity cannot be low, and it can discharge only with minute current.
[0003]Since the electrode group which interposed the separator and was spirally wound between the strip-like positive electrode and the anode is used for the cylindrical shape cell and square-shaped cell which are used for a cellular phone or an electronic device on the other hand, discharge with big current is possible for them. There is flexibility which can design the thickness and area of an electrode in accordance with the load and capacity of the electronic device needed.
[0004]By the way, also in the coin type or button type nonaqueous electrolyte battery, the necessity of sending big current has come out for diversification of the purpose of use. In order to send big current, it is necessary to enlarge the reaction surface product of an electrode and to make it winding structure like a cylindrical shape cell or a square-shaped cell. The method of storing what crushed the electrode of winding structure and was made into the thin square shape is in the container of the flat shape used for a coin type or a button type battery. If (for example, JP,2000-164259,A published unexamined application) stores a square-shaped electrode group in the container of a cylindrical shape, it will produce the problem that useless space increases.
[0005]In order to solve such a problem, in JP,H11-345626,A published unexamined application, making the height of the axis direction of winding into form smaller than the size of a direction vertical to a medial axis is proposed.
[0006]However, in the cell described in JP,H11-345626,A published unexamined application, since the electrical link is taken by contact with a tab and a container, high service capacity is not obtained.
[0007]
[Problem to be solved by the invention]An object of the present invention is to provide the flat shape nonaqueous secondary battery whose service capacity improved.

[0008]
[Means for solving problem]The well-closed container obtained when the flat shape nonaqueous secondary battery concerning the present invention fixes a positive electrode container and an anode container by caulking via an insulating gasket, It is a flat shape nonaqueous secondary battery possessing the electrode group which wound spirally laminated material provided with the positive electrode which is stored in the aforementioned well-closed container and contains a positive pole collector, and the anode containing a negative pole collector, The end of the aforementioned positive pole collector or the aforementioned negative pole collector is made to project to one winding surface of the aforementioned electrode group, and the container internal surface of the end which bent the end which projected [aforementioned] and projected [aforementioned] among the aforementioned positive electrode container and the aforementioned anode container, and same polarity is made to contact.
[0009]
[Mode for carrying out the invention]An example of the flat shape nonaqueous secondary battery concerning the present invention is described.
[0010]This flat shape nonaqueous secondary battery is stored in the well-closed container obtained by fixing a positive electrode container and an anode container by caulking via an insulating gasket, and the aforementioned well-closed container, and possesses the electrode group which wound spirally laminated material provided with the positive electrode containing a positive pole collector and the anode containing a negative pole collector. A separator can be arranged between a positive electrode and an anode.
[0011]In this flat shape nonaqueous secondary battery, it can have the structure described to the following (a) - (c).
[0012](a) Make the end of the aforementioned positive pole collector project to one winding surface of the aforementioned electrode group, bend the end which projected [aforementioned], and make the inner surface of the aforementioned positive electrode container contact.
[0013](b) Make the end of the aforementioned negative pole collector project to one winding surface of the aforementioned electrode group, bend the end which projected [aforementioned], and make the inner surface of the aforementioned anode container contact.
[0014](c) Make the end of the aforementioned positive pole collector project to one winding surface of the aforementioned electrode group, bend the end which projected [aforementioned], and make the inner surface of the aforementioned positive electrode container contact. The end of the aforementioned negative pole collector is made to project to the winding surface of another side of the aforementioned electrode group, the end which projected [aforementioned] is bent, and the inner surface of the aforementioned anode container is made to contact.
[0015]Here, a surface vertical to the winding axis of an electrode group is meant as a winding surface.
[0016](a) mentioned above Among - (c), according to the composition of (c), since service capacity can be improved substantially, it is desirable.
[0017](a) mentioned above In the composition of - (c), it is preferable that the end of a negative-electrode-active-material contained layer has projected from the end of a positive-active-material contained layer. This is because a lithium dendrite deposits easily at the end of a negative-electrode-active-material contained layer when the end of the negative-electrode-active-material contained layer is opposing with the positive-active-material contained layer.
[0018](a) mentioned above In the composition of - (c), the end projected from the winding surface is bendable to the periphery [of an electrode group], or inner circumference side. Since it is hard to produce an internal short circuit, the one straight to the inner circumference side is preferable.
[0019]In an electrode group, it is more preferable than the length of a winding axial direction to lengthen lay length orthogonal to a winding axis. By having such composition, it has a thin shape and the nonaqueous electrolyte battery of high energy density can be obtained.
[0020]Hereafter, it describes about a positive electrode, an anode, a separator, and nonaqueous electrolyte.
[0021]1) **** -- this positive electrode is formed from that with which the positive electrode layer containing an active material and a conductive material was supported by the charge collector.
[0022]as the aforementioned active material -- various oxides (for example, lithium manganese multiple oxides, such as $LiMn_2O_4$, --) Lithium nickel complex oxide, such as manganese dioxide, for

example, $LiNiO_2$ etc., For example, the amorphous vanadium pentoxide containing lithium cobalt multiple oxides, such as $LiCoO_2$, a lithium cobalt nickel composite oxide, and lithium, charcogen compounds (for example, titanium disulfide, molybdenum disulfide, etc.), etc. can be mentioned. Especially, it is preferable to use a lithium manganese multiple oxide, a lithium cobalt multiple oxide, and lithium nickel complex oxide.

[0023]As the aforementioned charge collector, the expanded metal made from aluminum, aluminium foil, the mesh made from aluminum, the punched metal made from aluminum, etc. can be used, for example.

[0024]As the aforementioned conductive material (electrically conductive filler), for example, carbon black (for example, acetylene black and furnace black --) Graphite and glassy carbon grinding things (for example, an artificial graphite, powdered black lead, powdered expanded graphite, etc.), such as Ketchen black, powdered or granular type corks, a carbon fiber grinding thing, a graphitized carbon fiber grinding thing, nickel powder, etc. can be mentioned. The aforementioned conductive material may be used alone, or 2 or more type may use it, mixing.

[0025]For example, a slurry is prepared by mulling positive active material, a conductive material, and a binding agent under existence of a solvent, the aforementioned positive electrode applies the aforementioned slurry to a charge collector, and after drying, it is produced by performing press forming.

[0026]As the aforementioned binding agent, polyvinylidene fluoride, a styrene butadiene copolymer, carboxymethyl cellulose, its derivative, etc. can be mentioned, for example.

[0027]2) **** -- this anode is formed from that with which the negative electrode layer containing an active material was supported by the charge collector.

[0028]As the aforementioned active material, the carbonaceous material which does occlusion and discharge of a lithium ion can be mentioned, for example. as this carbonaceous material -- an organic polymer compound (for example, phenol resin --) The carbonaceous material represented by what obtained by calcinating polyacrylonitrile, cellulose, etc., corks, what [is obtained by calcinating a mesophase pitch], artificial graphite, and natural graphite, etc. can be mentioned. Especially, it is preferable to use the carbonaceous material produced by calcinating the aforementioned mesophase pitch under ordinary pressure or decompression at the temperature of 500-3000 degrees C in inert gas atmospheres, such as argon gas and nitrogen gas.

[0029]As the aforementioned charge collector, copper expanded metals, copper foil, a copper mesh, a copper punched metal, etc. can be used, for example.

[0030]In the aforementioned anode, it permits that a conductive material (electrically conductive filler) is included. Having described with the positive electrode mentioned above as a conductive material (electrically conductive filler) and the same thing can be mentioned.

[0031]For example, a slurry is prepared by mulling negative electrode active material and a binding agent under existence of a solvent, the aforementioned anode applies the aforementioned slurry to a charge collector, and after drying, it is produced by performing press forming.

[0032]Having described with the positive electrode mentioned above as the aforementioned binding agent and the same thing can be mentioned.

[0033]3) Isolating a positive electrode and an anode, as long as movement of a lithium ion is possible, what kind of thing may be sufficient as a separator separator. As this separator, the microporous film and nonwoven fabric which carry out the main component of the polyolefin (for example, polyethylene, polypropylene) can be used, for example.

[0034]4) Nonaqueous electrolyte nonaqueous electrolyte is prepared by dissolving an electrolyte in a nonaqueous solvent, for example.

[0035]As the aforementioned nonaqueous solvent, for example Ethylene carbonate (EC), propylene carbonate (PC), Butylene carbonate (BC), dimethyl carbonate (DMC), Diethyl carbonate (DEC), ethyl methyl carbonate (EMC), Gamma-butyrolactone (gamma-BL), sulfolane, acetonitrile, 1,2-dimethoxyethane, 1,3-dimethoxypropane, wood ether, a tetrahydrofuran (THF), 2-methyltetrahydrofuran, etc. can be mentioned. The aforementioned nonaqueous solvent may be used alone, or 2 or more type may use it, mixing.

[0036]As the aforementioned electrolyte, for example Lithium perchlorate ($LiClO_4$), Lithium salt, such as lithium-hexafluorophosphate ($LiPF_6$), lithium-borofluoride ($LiBF_4$), and arsenic lithium hexafluoride

($LiAsF_6$), lithium, trifluoromethanesulfonate ($LiCF_3SO_3$), can be mentioned. The aforementioned electrolyte may be used alone, or 2 or more type may use it, mixing.

[0037]As for the dissolved amount to the aforementioned nonaqueous solvent of the aforementioned electrolyte, it is desirable to carry out within the limits of 0.2 mol/L - 2 mol/L.

[0038]An example of the flat shape nonaqueous secondary battery concerning the present invention is shown in Fig.1 - 5. Fig.1 is a cross sectional view showing an example (for example, coin type nonaqueous secondary battery) of the flat shape nonaqueous secondary battery concerning the present invention.

[0039]The electrode group 4 is stored in the well-closed container in which the anode container (cap) 2 of the bottomed cylindrical shape was fixed by caulking to the positive electrode container (outer can) 1 of a bottomed cylindrical shape via the insulating gasket 3. The electrode group 4 is produced by interposing the separator 5 and, for example, being spirally wound between a positive electrode and an anode. The negative pole collector 6 which the negative pole collector 6 has projected in one winding surface of the electrode group 4, and was projected was bent at the inner circumference side, and is in contact with the inner surface of the anode container 2. The positive pole collector 7 which the positive pole collector 7 has projected in the winding surface of another side of the electrode group 4, and was projected was bent at the inner circumference side, and is in contact with the inner surface of the positive electrode container 1. Nonaqueous electrolyte is impregnated by the electrode group 4.

[0040]The flat shape nonaqueous secondary battery concerning the present invention described above, It is stored in the well-closed container obtained by fixing a positive electrode container and an anode container by caulking via an insulating gasket, and the aforementioned well-closed container, and the electrode group which wound spirally laminated material provided with the positive electrode containing a positive pole collector and the anode containing a negative pole collector is provided. The end of the aforementioned positive pole collector or the aforementioned negative pole collector is made to project to one winding surface of the aforementioned electrode group, and the container internal surface of the end which bent the end which projected [aforementioned] and projected [aforementioned] among the aforementioned positive electrode container and the aforementioned anode container, and same polarity is made to contact.

[0041]If lay length orthogonal to a winding axis is made longer than the length of the winding axial direction of an electrode group in order to attain high-energy-density-ization of a flat type battery, weaving and decomposition which an electrode group deforms in the shape of a bamboo shoot by the handling at the time of manufacture, etc. will take place easily. According to the invention in this application, also when the length of the direction orthogonal to a winding axis is made longer than the length of the winding axial direction of an electrode group, it can stop by a bent part that the electrode and separator near a center of a winding surface tend to project outside, and weaving of the electrode group at the time of manufacture and decomposition can be reduced.

[0042]Since the end projected from the winding surface is bent in the state where a notch is not contained, it is easy to commit repulsive force which tries to return to the original form at a bent part, and it can improve the touch area of the end and container internal surface which were projected. As a result, since internal resistance of a cell can be made low, service capacity can be improved.

[0043]

[Working example]Hereafter, the working example of the present invention is described in detail with reference to Drawings.

[0044]Fig.2 is a plan view showing the positional relationship of the positive electrode of an electrode group and anode in the coin type nonaqueous secondary battery of Fig.1, and a separator,Fig.3 is a cross sectional view which is along the III-III line of Fig.2, Fig.4 is a mimetic diagram showing the winding object which wound the positive electrode, separator, and anode of Fig.2 spirally, and Fig.5 is a cross sectional view showing the state where the negative pole collector projected to one winding surface of the winding object of Fig.4 was bent to the inner circumference side.

[0045](Working example 1)

After dissolving 3 parts by mass of polyvinylidene fluorides (Kureha Chemical Industry trade name: #1100) in 25 parts by mass of <production of positive electrode> N-methyl pyrrolidone, 8 parts by mass of graphite (Lonza trade name: KS6) was added as positive active material as $LiCoO_2$89 parts by mass and a conductive material with a mean particle diameter of 3 micrometers, it stirred and mixed

using dissolver and a bead mill, and the positive electrode slurry was prepared. Have the structure shown in Fig.2 by using die coater for both sides of aluminium foil with a thickness [as a charge collector] of 15 micrometers for this slurry, opening and painting, making it dry, and pressing and carrying out the slit of the constant interval, and thickness at 200 micrometers, In the width of the positive-active-material contained layer 8, at 2 mm, the width of the positive-active-material contained layer non-holding area 7 (positive pole collector) obtained the 3.5-mm-wide reel-like positive electrode 9 by 1.5 mm.

[0046]As opposed to 100 parts by mass of <production of anode> mesophase pitch system carbon fiber powder (made by PETOKA), Add 10 parts by mass of graphite powder (Lonza trade name: KS15), mix, and further 4.2 parts by mass of styrene / butadiene latex (the trade name by Asahi Chemical Industry Co., Ltd.: solid content. L1571, 48 % by weight), As a thickening agent, 20 parts by mass of distilled water was added, it mixed with 130 parts by mass of aqueous solutions (1 % by weight of solid content) of carboxymethyl cellulose (the trade name made from the 1st industrial medicine manufacture: BSH12), and the slurry was prepared. Have the structure shown in Fig.2 by using die coater for both sides of 10-micrometer-thick copper foil for this slurry, opening and painting, drying, and pressing and carrying out the slit of the constant interval, and thickness at 200 micrometers, In the width of the negative-electrode-active-material contained layer 10, at 3 mm, the width of the negative-electrode-active-material contained layer non-holding area 6 (negative pole collector) obtained the 4.5-mm-wide reel-like anode 11 by 1.5 mm.

[0047]The strip-like porous membrane made from polyethylene whose <production of electrode group> width is 4 mm was prepared as the separator 5. After making the layer contains active material 8 of the positive electrode 9 oppose to the center portion of the layer contains active material 10 of the anode 11, It has arranged so that the end of the negative pole collector 6 may project the separator 5 from the one end part by the side of the long side of the separator 5 on the outside of between the positive electrode 9 and the anodes 11 and the positive electrode 9 and the end of the positive pole collector 7 may project it from the end of another side on it. The obtained laminated material was wound spirally, and as shown in Fig.4, the winding finish end of the acquired winding object 12 was fixed with the adhesive tape 13.

[0048]Subsequently, as shown in Fig.5, the negative pole collector 6 projected to one winding surface of the winding object 12 was moved to the inner circumference position at intervals of 90 degrees, and the whole was bent. The positive pole collector 7 projected to the winding surface of another side of the winding object 12 was moved to the inner circumference position at intervals of 90 degrees, the whole was bent, and the electrode group 4 20 mm in diameter and 4.5 mm in height was obtained.

[0049]Nonaqueous electrolyte was prepared by carrying out the 1.5 mol/L dissolution of $LiBF_4$ as an electrolyte to the mixed solvent obtained by mixing <preparation of nonaqueous electrolyte> ethylene carbonate (EC), and gamma-butyllactone (gamma-BL) by a volume ratio 1:3.

[0050]2450 sizes (at 24 mm, the height of a path is 5 mm) were used for the <assembly of cell> battery container. In the positive electrode container 1, the electrode group 4 was stored so that the bent part of the positive pole collector 7 might touch the bottom inner face of the positive electrode container 1, and reduced pressure drying was performed at 80 degrees C for 24 hours. Subsequently, after cooling to a room temperature, the aforementioned nonaqueous electrolyte 0.6g was injected. After attaching the annular insulating gasket 3 to the open end of the anode container 2, by fixing this anode container 2 by caulking to the positive electrode container 1, the bent part of the negative pole collector 6 was contacted to the inner surface of the anode container 2, and the coin type nonaqueous secondary battery which has the structure shown in Fig.1 was obtained.

[0051](Working example 2)

Thickness by using die coater for both sides of 10-micrometer-thick copper foil for the slurry same with having described in working example 1 of which the <production of anode> above-mentioned was done, opening and painting, drying, and pressing and carrying out the slit of the constant interval at 200 micrometers, At 3 mm, the width of the negative-electrode-active-material contained layer obtained the reel-like anode in which a negative-electrode-active-material contained layer non-holding area does not exist. After removing the negative-electrode-active-material contained layer of the end of the short side direction of this anode, the tab made from nickel was welded.

[0052]After making the layer contains active material of a positive electrode oppose to the center portion of the layer contains active material of a <production of electrode group> anode, the separator

same with having described in working example 1 mentioned above on the outside of the positive electrode between a positive electrode and anodes has been arranged so that the end of a positive pole collector may project from the one end part by the side of the long side of a separator. The winding finish end of the winding object acquired by winding the obtained laminated material spirally was fixed with adhesive tape.

[0053]Subsequently, the whole was bent by moving to the inner circumference position the positive pole collector projected to the winding surface of another side of a winding object at intervals of 90 degrees, and an electrode group 20 mm in diameter and 4.5 mm in height was obtained.

[0054]Having described in working example 1 mentioned above and the thing of the same size were used for the <assembly of cell> battery container. In the positive electrode container, the electrode group was stored so that the bent part and container base of a positive pole collector might touch, and reduced pressure drying was performed at 80 degrees C for 24 hours. Subsequently, after cooling to a room temperature, the nonaqueous electrolyte 0.6g same with having described in working example 1 mentioned above was injected. After attaching an annular insulating gasket to the open end of an anode container, by fixing this anode container by caulking to a positive electrode container, the negative electrode tab was contacted to the inner surface of the anode container, and the coin type nonaqueous secondary battery was obtained.

[0055](Comparative example 1) The electrode group was first produced by Fig.6 and the method shown in 7.

[0056]The <production of positive electrode> above-mentioned by using die coater for both sides of aluminium foil with a thickness [as a charge collector] of 15 micrometers for the slurry same with having described in working example 1 carried out, opening and painting, making it dry, and pressing and carrying out the slit of the constant interval, At 200 micrometers, the 0.5-mm-wide plain part was formed in the both sides of a positive-active-material contained layer for the width of the positive-active-material contained layer at 2.0 mm, and thickness obtained the 3.0-mm-wide reel-like positive electrode. After removing the positive-active-material contained layer of the end 13 of the short side direction of this positive electrode, the tab 14 made from aluminum was welded.

[0057]Thickness by using die coater for both sides of 10-micrometer-thick copper foil for the slurry same with having described in working example 1 of which the <production of anode> above-mentioned was done, opening and painting, drying, and pressing and carrying out the slit of the constant interval at 200 micrometers, At 3 mm, the width of the negative-electrode-active-material contained layer obtained the reel-like anode in which a negative-electrode-active-material contained layer non-holding area does not exist. After removing the negative-electrode-active-material contained layer of the end 15 of the short side direction of this anode, the tab 16 made from nickel was welded.

[0058]The strip-like porous membrane made from polyethylene whose <production of electrode group> width is 4 mm was prepared as the separator 17. After making the layer contains active material of a positive electrode oppose to the center portion of the layer contains active material of the anode same with having described in working example 2 mentioned above, the separator 17 same with having described in working example 1 mentioned above between the positive electrode and the anode has been arranged. It pulled, and it continued and the separator 17 has been further arranged to the positive electrode side of this laminated material. The winding finish end of the winding object acquired by winding the obtained laminated material spirally was fixed with the adhesive tape 18, and the electrode group 19 which the separator has projected to both winding surfaces was obtained.

[0059]Having described in working example 1 mentioned above and the thing of the same size were used for the <assembly of cell> battery container. In the positive electrode container, the electrode group was stored so that a container internal surface might touch a positive electrode tab, and reduced pressure drying was performed at 80 degrees C for 24 hours. Subsequently, after cooling to a room temperature, the nonaqueous electrolyte 0.6g same with having described in working example 1 mentioned above was injected. After attaching an annular insulating gasket to the open end of an anode container, by fixing this anode container by caulking to a positive electrode container, the negative electrode tab was contacted to the inner surface of the anode container, and the coin type nonaqueous secondary battery was obtained.

[0060](Comparative example 2)

The winding object was produced the same with having described in working example 1 of which the <production of electrode group> above-mentioned was done. After forming a notch parallel to a winding axis in the negative pole collector projected to one winding surface of the winding object at

equal intervals, the negative pole collector was bent to the inner circumference side. After forming a notch parallel to a winding axis in the positive pole collector projected to the winding surface of another side of a winding object at equal intervals, the positive pole collector was bent to the inner circumference side, and an electrode group 20 mm in diameter and 4.5 mm in height was obtained.
[0061]Having described in working example 1 mentioned above and the thing of the same size were used for the <assembly of cell> battery container. In the positive electrode container, the electrode group was stored so that the bent part of a positive pole collector might touch the bottom inner face of a positive electrode container, and reduced pressure drying was performed at 80 degrees C for 24 hours. Subsequently, after cooling to a room temperature, the nonaqueous electrolyte 0.6g same with having described in working example 1 mentioned above was injected. After attaching an annular insulating gasket to the open end of an anode container, by fixing this anode container by caulking to a positive electrode container, the bent part of the negative pole collector was contacted to the inner surface of the anode container, and the coin type nonaqueous secondary battery was obtained.
[0062]It aged at ordinary temperature for 24 hours after pouring in the rechargeable battery of the acquired working examples 1-2 and the comparative examples 1-2. Subsequently, after the constant current constant voltage control performed charge at 10 mA equivalent to 0.2C for 10 hours, the charging and discharging cycle discharged at 10 mA was given. The service capacity and internal resistance of 1 cycle eye, 50 cycle eye, and a 100 cycle eye are measured, and the result is shown in the following table 1.
[0063]About the rechargeable battery of the working examples 1-2 and the comparative examples 1-2, the number (inside of 100 electrode groups) which weaving produced in the electrode group by the method described below is measured, and the result is shown in the following table 1.
[0064]That is, the electrode group was dropped from 20 cm in height, and form was observed. Less than +0.5 mm (a maximum of 5.0 mm of total amounts) was used as the good article to the vertical direction (winding axial direction) of the electrode group, and the thing over +0.5 mm was made into weaving.
[0065]
[Table 1]

	1サイクル目		50サイクル目		100サイクル目		巻きずれ
	放電容量 (mAh)	内部抵抗 (mΩ)	放電容量 (mAh)	内部抵抗 (mΩ)	放電容量 (mAh)	内部抵抗 (mΩ)	(100 個中)
実施例1	51	420	45.2	450	42.2	470	0
実施例2	50	450	41.6	490	39.5	510	0
比較例1	43	550	30.7	600	26.0	620	8
比較例2	45	500	35.3	540	29.3	560	3

[0066]The rechargeable battery of the working examples 1-2 is understood that service capacity is high compared with the comparative examples 1 and 2, and internal resistance is low so that clearly from Table 1. According to the rechargeable battery of the working examples 1-2, it turns out that it is avoidable that the shape of a spiral type of an electrode group collapses due to the handling at the time of a manufacturing process.
[0067]On the other hand, that internal resistance increases according to the rechargeable battery of the comparative example 2, Since it has bent to the inner circumference side after putting a notch into the charge collector which made the winding surface of the electrode group project, it is easy to take lessons for a kink from the form of a bent part, the repulsive force of a bent part becomes weak, and it is thought that it originates in being easy to produce reliance unevenness. Since the part by which the notch is formed in the bent part, and the effect which fixes the position of positive and negative poles or a separator become weak, the form of an electrode group is conjectured to be easy to deform in the shape of a bamboo shoot.
[0068]
[Effect of the Invention]As explained in full detail above, according to the present invention, a flat shape nonaqueous secondary battery with high service capacity can be provided low [internal resistance].

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]The cross sectional view showing an example (for example, coin type nonaqueous secondary battery) of the flat shape nonaqueous secondary battery concerning the present invention.
[Drawing 2]The plan view showing the positional relationship of the positive electrode of an electrode group and anode in the coin type nonaqueous secondary battery of Fig.1, and a separator.
[Drawing 3]The cross sectional view which is along the III-III line of Fig.2.
[Drawing 4]The mimetic diagram showing the winding object which wound the positive electrode, separator, and anode of Fig.2 spirally.
[Drawing 5]The cross sectional view showing the state where the negative pole collector projected to one winding surface of the winding object of Fig.4 was bent to the inner circumference side.
[Drawing 6]The plan view showing the positional relationship of the positive electrode of an electrode group and anode in the coin type nonaqueous secondary battery of the comparative example 1, and a separator.
[Drawing 7]The mimetic diagram showing the electrode group in the coin type nonaqueous secondary battery of the comparative example 1.
[Explanations of letters or numerals]
1 -- Positive electrode container,
2 -- Anode container,
3 -- Insulating gasket
4 -- Electrode group,
5 -- Separator,
6 -- Negative-electrode-active-material contained layer non-holding area (negative pole collector),
7 -- Positive-active-material contained layer non-holding area (positive pole collector).

[Translation done.]

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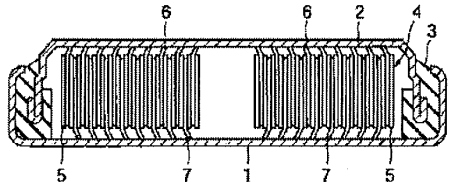
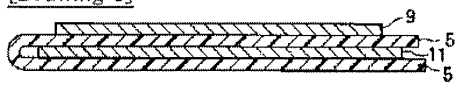
DRAWINGS

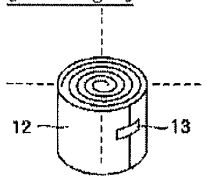
[Drawing 1]



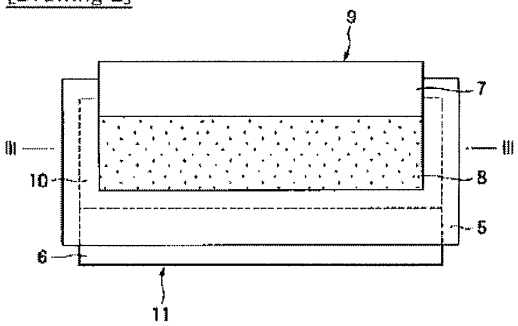
[Drawing 3]



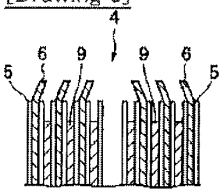
[Drawing 4]



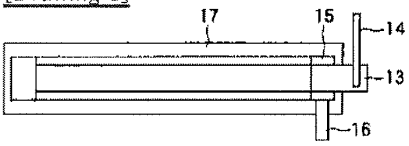
[Drawing 2]



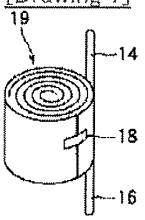
[Drawing 5]



[Drawing 6]



[Drawing 7]



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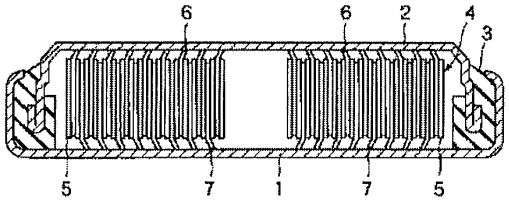
最終頁に続く

(54)【発明の名称】　扁平型非水二次電池

(57)【要約】
【課題】　放電容量が向上された扁平型非水二次電池を提供することを目的とする。
【解決手段】　正極容器１と負極容器２を絶縁ガスケット３を介してかしめ固定することにより得られる密閉容器と、前記密閉容器内に収納され、正極集電体を含む正極と負極集電体を含む負極とを備える積層物を渦巻き状に捲回した電極群４とを具備する扁平型非水二次電池であって、前記電極群の一方の捲回面に前記正極集電体または前記負極集電体の端部を突出させ、前記突出した端部を折り曲げて前記正極容器及び前記負極容器のうち前記突出した端部と同極の容器内面に接触させることを特徴とする。



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【特許請求の範囲】

【請求項１】　正極容器と負極容器を絶縁ガスケットを介してかしめ固定することにより得られる密閉容器と、前記密閉容器内に収納され、正極集電体を含む正極と負極集電体を含む負極とを備える積層物を渦巻き状に捲回した電極群とを具備する扁平型非水二次電池であって、前記電極群の一方の捲回面に前記正極集電体または前記負極集電体の端部を突出させ、前記突出した端部を折り曲げて前記正極容器及び前記負極容器のうち前記突出した端部と同極の容器内面に接触させることを特徴とする扁平型非水二次電池。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、扁平型非水二次電池に関するものである。

【０００２】

【従来の技術】コイン型またはボタン型非水電解質電池のような小型の非水電解質電池の用途は、小型機器の主電源や記録素子のバックアップ電源が主なものであった。いずれも消費電力は微小で長期間の使用を目的としており、その構造は、金属製正極ケース内にペレット状の正極が収納され、かつ金属製負極ケース内にペレット状の負極が収納され、正極と負極の間にセパレータを介在させたものが知られている。このような構造によると、正極と負極の反応面積が小さいために反応性が低く、微小な電流でしか放電することができない。

【０００３】一方、携帯電話や電子機器に使用される円筒形電池や角形電池は、帯状の正極と負極の間にセパレータを介在させて渦巻き状に捲回した電極群を用いるため、大きな電流での放電が可能である。また、必要とされる電子機器の負荷と容量に合わせて電極の厚さと面積を設計できる自由度がある。

【０００４】ところで、コイン型またはボタン型の非水電解質電池においても使用目的の多様化のため、大きな電流を流す必要性が出ている。大きな電流を流すためには、電極の反応面積を大きくする必要があり、円筒形電池や角形電池のように捲回構造にする必要がある。コイン型やボタン型電池に用いられる扁平型の容器内に、捲回構造の電極を押し潰して薄い角型にしたものを収納する方法がある（例えば、特開２０００－１６４２５９号公開公報）が、円筒形の容器内に角型の電極群を収納すると、無駄な空間が多くなるという問題点を生じる。

【０００５】このような問題を解決するため、特開平１１－３４５６２６号公開公報では、捲回の中心軸方向の高さを中心軸に垂直な方向の大きさよりも小さな形状にすることが提案されている。

【０００６】しかしながら、特開平１１－３４５６２６号公開公報に記載された電池では、タブと容器との接触により電気的接続が取られているため、高い放電容量が得られない。

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【０００７】

【発明が解決しようとする課題】本発明は、放電容量が向上された扁平型非水二次電池を提供することを目的とする。

【０００８】

【課題を解決するための手段】本発明に係る扁平型非水二次電池は、正極容器と負極容器を絶縁ガスケットを介してかしめ固定することにより得られる密閉容器と、前記密閉容器内に収納され、正極集電体を含む正極と負極集電体を含む負極とを備える積層物を渦巻き状に捲回した電極群とを具備する扁平型非水二次電池であって、前記電極群の一方の捲回面に前記正極集電体または前記負極集電体の端部を突出させ、前記突出した端部を折り曲げて前記正極容器及び前記負極容器のうち前記突出した端部と同極の容器内面に接触させることを特徴とするものである。

【０００９】

【発明の実施の形態】本発明に係る扁平型非水二次電池の一例を説明する。

【００１０】この扁平型非水二次電池は、正極容器と負極容器を絶縁ガスケットを介してかしめ固定することにより得られる密閉容器と、前記密閉容器内に収納され、正極集電体を含む正極と負極集電体を含む負極とを備える積層物を渦巻き状に捲回した電極群とを具備する。正極と負極の間には、セパレータを配置することができる。

【００１１】この扁平型非水二次電池では、以下の（ａ）～（ｃ）に説明する構造を有することができる。

【００１２】（ａ）前記電極群の一方の捲回面に前記正極集電体の端部を突出させ、前記突出した端部を折り曲げて前記正極容器の内面に接触させる。

【００１３】（ｂ）前記電極群の一方の捲回面に前記負極集電体の端部を突出させ、前記突出した端部を折り曲げて前記負極容器の内面に接触させる。

【００１４】（ｃ）前記電極群の一方の捲回面に前記正極集電体の端部を突出させ、前記突出した端部を折り曲げて前記正極容器の内面に接触させる。また、前記電極群の他方の捲回面に前記負極集電体の端部を突出させ、前記突出した端部を折り曲げて前記負極容器の内面に接触させる。

【００１５】ここで、捲回面とは、電極群の捲回軸と垂直な面を意味する。

【００１６】前述した（ａ）～（ｃ）のうち（ｃ）の構成によると、放電容量を大幅に向上させることができるため、望ましい。

【００１７】前述した（ａ）～（ｃ）の構成において、負極活物質含有層の端部が正極活物質含有層の端部より突出していることが好ましい。これは、負極活物質含有層の端部が正極活物質含有層と対向していると、負極活物質含有層の端部にリチウムデンドライトが析出しやす

くなるからである。

【００１８】前述した（ａ）～（ｃ）の構成において、捲回面から突出した端部は、電極群の外周側もしくは内周側に折り曲げることができる。内周側に折り曲げる方が、内部短絡が生じ難いため、好ましい。

【００１９】電極群では、捲回軸方向の長さよりも捲回軸と直交する方向の長さを長くすることが好ましい。このような構成にすることによって、薄型で、かつ高エネルギー密度の非水電解質電池を得ることができる。

【００２０】以下、正極、負極、セパレータ及び非水電解液について説明する。

【００２１】１）正極

この正極は、活物質及び導電性材料を含む正極層が集電体に担持されたものから形成される。

【００２２】前記活物質としては、種々の酸化物（例えば、$LiMn_2O_4$ などのリチウムマンガン複合酸化物、二酸化マンガン、例えば、$LiNiO_2$ などのリチウムニッケル複合酸化物、例えば$LiCoO_2$ などのリチウムコバルト複合酸化物、リチウムコバルトニッケル複合酸化物、リチウムを含む非晶質五酸化バナジウムなど）や、カルコゲン化合物（例えば、二硫化チタン、二硫化モリブデンなど）等を挙げることができる。中でも、リチウムマンガン複合酸化物、リチウムコバルト複合酸化物、リチウムニッケル複合酸化物を用いるのが好ましい。

【００２３】前記集電体としては、例えば、アルミニウム製エキスパンドメタル、アルミニウム箔、アルミニウム製メッシュ、アルミニウム製パンチドメタル等を用いることができる。

【００２４】前記導電性材料（導電性フィラー）としては、例えば、カーボンブラック（例えばアセチレンブラック、ファーネスブラック、ケッチェンブラックなど）、グラファイト類（例えば、人造黒鉛、粉末状黒鉛、粉末状膨張黒鉛など）、グラッシーカーボン粉砕物、粉末状あるいは破砕状コークス類、炭素繊維粉砕物、黒鉛化炭素繊維粉砕物、ニッケル粉末等を挙げることができる。前記導電性材料は、単独で使用しても、あるいは２種以上混合して使用しても良い。

【００２５】前記正極は、例えば、正極活物質、導電性材料及び結着剤を溶媒の存在下で混練することによりスラリーを調製し、前記スラリーを集電体に塗布し、乾燥した後、プレス成形を施すことにより作製される。

【００２６】前記結着剤としては、例えば、ポリビニリデンフルオライド、スチレン・ブタジエン共重合体、カルボキシメチルセルロース及びその誘導体等を挙げることができる。

【００２７】２）負極

この負極は、活物質を含む負極層が集電体に担持されたものから形成される。

【００２８】前記活物質としては、例えば、リチウムイオンを吸蔵・放出する炭素質材料を挙げることができる。かかる炭素質材料としては、例えば、有機高分子化合物（例えば、フェノール樹脂、ポリアクリロニトリル、セルロース等）を焼成することにより得られるもの、コークスや、メソフェーズピッチを焼成することにより得られるもの、人造グラファイト、天然グラファイト等に代表される炭素質材料を挙げることができる。中でも、アルゴンガス、窒素ガス等の不活性ガス雰囲気中において、５００～３０００℃の温度で、常圧または減圧下にて前記メソフェーズピッチを焼成して得られる炭素質材料を用いるのが好ましい。

【００２９】前記集電体としては、例えば、銅製エキスパンドメタル、銅箔、銅製メッシュ、銅製パンチドメタル等を用いることができる。

【００３０】前記負極には、導電性材料（導電性フィラー）を含むことを許容する。導電性材料（導電性フィラー）としては、前述した正極で説明したのと同様なものを挙げることができる。

【００３１】前記負極は、例えば、負極活物質及び結着剤を溶媒の存在下で混練することによりスラリーを調製し、前記スラリーを集電体に塗布し、乾燥した後、プレス成形を施すことにより作製される。

【００３２】前記結着剤としては、前述した正極で説明したのと同様なものを挙げることができる。

【００３３】３）セパレータ

セパレータは、正極と負極を隔離しつつ、リチウムイオンの移動が可能なものであればどのようなものでも良い。かかるセパレータとしては、例えば、ポリオレフィン（例えば、ポリエチレン、ポリプロピレン）を主成分とする微多孔膜、不織布を用いることができる。

【００３４】４）非水電解液

非水電解液は、例えば、非水溶媒に電解質を溶解させることにより調製される。

【００３５】前記非水溶媒としては、例えば、エチレンカーボネート（ＥＣ）、プロピレンカーボネート（ＰＣ）、ブチレンカーボネート（ＢＣ）、ジメチルカーボネート（ＤＭＣ）、ジエチルカーボネート（ＤＥＣ）、エチルメチルカーボネート（ＥＭＣ）、γ－ブチロラクトン（γ－ＢＬ）、スルホラン、アセトニトリル、１，２－ジメトキシエタン、１，３－ジメトキシプロパン、ジメチルエーテル、テトラヒドロフラン（ＴＨＦ）、２－メチルテトラヒドロフラン等を挙げることができる。前記非水溶媒は、単独で使用しても、２種以上混合して使用してもよい。

【００３６】前記電解質としては、例えば、過塩素酸リチウム（$LiClO_4$）、六フッ化リン酸リチウム（$LiPF_6$）、ホウフッ化リチウム（$LiBF_4$）、六フッ化砒素リチウム（$LiAsF_6$）、トリフルオロメタンスルホン酸リチウム（$LiCF_3SO_3$）等のリチウム塩を挙げることができる。前記電解質は、単独で使用

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しても、２種以上混合して使用してもよい。

【００３７】前記電解質の前記非水溶媒に対する溶解量は、０．２ｍｏｌ／Ｌ～２ｍｏｌ／Ｌの範囲内にすることが望ましい。

【００３８】本発明に係る扁平型非水二次電池の一例を図１～５に示す。図１は、本発明に係る扁平型非水二次電池の一例（例えば、コイン型非水二次電池）を示す断面図である。

【００３９】有底円筒形の正極容器（アウター缶）１に有底円筒形の負極容器（キャップ）２が絶縁ガスケット３を介してかしめ固定された密閉容器内には、電極群４が収納されている。電極群４は、例えば、正極と負極の間にセパレータ５を介在させて渦巻き状に捲回されることにより作製される。電極群４の一方の捲回面には負極集電体６が突出しており、突出した負極集電体６は内周側に折り曲げられて負極容器２の内面と接している。また、電極群４の他方の捲回面には正極集電体７が突出しており、突出した正極集電体７は内周側に折り曲げられて正極容器１の内面と接している。非水電解液は、電極群４に含浸されている。

【００４０】以上説明した本発明に係る扁平型非水二次電池は、正極容器と負極容器を絶縁ガスケットを介してかしめ固定することにより得られる密閉容器と、前記密閉容器内に収納され、正極集電体を含む正極と負極集電体を含む負極とを備える積層物を渦巻き状に捲回した電極群とを具備する。前記電極群の一方の捲回面に前記正極集電体または前記負極集電体の端部を突出させ、前記突出した端部を折り曲げて前記正極容器及び前記負極容器のうち前記突出した端部と同極の容器内面に接触させる。

【００４１】扁平型電池の高エネルギー密度化を図るために電極群の捲回軸方向の長さよりも捲回軸と直交する方向の長さを長くすると、製造時のハンドリング等によって電極群が箱状に変形する巻きずれや分解が起こり易くなる。本願発明によれば、電極群の捲回軸方向の長さよりも捲回軸と直交する方向の長さを長くした際にも、捲回面の中心付近の電極やセパレータが外側に突出しようとするのを折り曲げ部で抑えることができ、製造時の電極群の巻きずれや分解を低減することができる。

【００４２】また、捲回面から突出した端部は切り込みの入っていない状態で折り曲げられているため、折り曲げ部に元の形状に戻ろうとするような反発力が働きやすく、突出した端部と容器内面との接触面積を向上することができる。その結果、電池の内部抵抗を低くすることができるため、放電容量を向上することができる。

【００４３】

【実施例】以下、本発明の実施例を図面を参照して詳細に説明する。

【００４４】図２は、図１のコイン型非水二次電池における電極群の正極と負極とセパレータの位置関係を示す

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平面図で、図３は図２のIII－III線に沿う断面図で、図４は図２の正極とセパレータと負極とを渦巻き状に捲回した捲回体を示す模式図で、図５は、図４の捲回体の一方の捲回面に突出した負極集電体を内周側に折り曲げた状態を示す断面図である。

【００４５】（実施例１）

＜正極の作製＞Ｎ－メチルピロリドン２５質量部にポリフッ化ビニリデン（呉羽化学工業製商品名：＃１１００）３質量部を溶解させた後、正極活物質として平均粒径３μｍの$LiCoO_2$８９質量部と導電性材料としてグラファイト（ロンザ社製商品名：ＫＳ６）８質量部とを添加し、ディゾルバー及びビーズミルを用いて撹拌混合し、正極スラリーを調製した。このスラリーを集電体としての厚さ１５μｍのアルミニウム箔の両面にダイスコータを用いて一定間隔を開けて塗付し、乾燥させ、プレスし、スリットすることにより、図２に示す構造を有し、厚さが２００μｍで、正極活物質含有層８の幅が２ｍｍで、正極活物質含有層非保持領域７（正極集電体）の幅が１．５ｍｍで、幅が３．５ｍｍのリール状正極９を得た。

【００４６】＜負極の作製＞メソフェーズピッチ系炭素繊維粉末（ペトカ社製）１００質量部に対して、グラファイト粉末（ロンザ社製商品名：ＫＳ１５）を１０質量部添加して混合し、さらにスチレン／ブタジエンラテックス（旭化成工業社製商品名：Ｌ１５７１，固形分が４８重量%）４．２質量部と、増粘剤としてカルボキシメチルセルロース（第１工業製薬製商品名：ＢＳＨ１２）の水溶液（固形分１重量%）１３０質量部と、蒸留水２０質量部とを加えて混合し、スラリーを調製した。このスラリーを厚さ１０μｍの銅箔の両面にダイスコータを用いて一定間隔を開けて塗付し、乾燥し、プレスし、スリットすることにより、図２に示す構造を有し、厚さが２００μｍで、負極活物質含有層１０の幅が３ｍｍで、負極活物質含有層非保持領域６（負極集電体）の幅が１．５ｍｍで、幅が４．５ｍｍのリール状負極１１を得た。

【００４７】＜電極群の作製＞幅が４ｍｍの帯状のポリエチレン製多孔膜をセパレータ５として用意した。負極１１の活物質含有層１０の中央部分に正極９の活物質含有層８を対向させた後、正極９及び負極１１の間と正極９の外側にセパレータ５を、セパレータ５の長辺側の一端部から負極集電体６の端部が突出し、かつ他方の端部から正極集電体７の端部が突出するように配置した。得られた積層物を渦巻き状に捲回し、図４に示すように、得られた捲回体１２の巻き終わり端部を粘着テープ１３で固定した。

【００４８】次いで、図５に示すように、捲回体１２の一方の捲回面に突出した負極集電体６を９０°おきに内周側に倒して全体を折り曲げた。また、捲回体１２の他方の捲回面に突出した正極集電体７を９０°おきに内周

側に倒して全体を折り曲げ、直径２０ｍｍ、高さ４．５ｍｍの電極群４を得た。

【００４９】＜非水電解液の調製＞エチレンカーボネート（ＥＣ）とγ－ブチルラクトン（γ－ＢＬ）を体積比で１：３で混合し、得られた混合溶媒に電解質としてＬｉＢＦ４を１．５ｍｏｌ／Ｌ溶解させることにより非水電解液を調製した。

【００５０】＜電池の組立て＞電池容器には２４５０サイズ（径が２４ｍｍで、高さが５ｍｍ）を使用した。正極容器１内に電極群４を正極集電体７の折り曲げ部が正極容器１の底部内面と接するように収納し、８０℃で２４時間減圧乾燥を施した。次いで、室温まで冷却した後、前記非水電解液０．６ｇを注入した。負極容器２の開口端に環状の絶縁ガスケット３を取りつけた後、この負極容器２を正極容器１にかしめ固定することにより、負極容器２の内面に負極集電体６の折り曲げ部を接触させ、図１に示す構造を有するコイン型非水二次電池を得た。

【００５１】（実施例２）

＜負極の作製＞前述した実施例１で説明したのと同様なスラリーを厚さ１０μｍの銅箔の両面にダイスコータを用いて一定間隔を開けて塗付し、乾燥し、プレスし、スリットすることにより、厚さが２００μｍで、負極活物質含有層の幅が３ｍｍで、負極活物質含有層非保持領域の存在しないリール状負極を得た。この負極の短辺方向の端部の負極活物質含有層を除去した後、ニッケル製のタブを溶接した。

【００５２】＜電極群の作製＞負極の活物質含有層の中央部分に正極の活物質含有層を対向させた後、正極及び負極の間と正極の外側に前述した実施例１で説明したのと同様なセパレータを、セパレータの長辺側の一端部から正極集電体の端部が突出するように配置した。得られた積層物を渦巻き状に捲回し、得られた捲回体の巻き終わり端部を粘着テープで固定した。

【００５３】次いで、捲回体の他方の捲回面に突出した正極集電体を９０°おきに内周側に倒すことで全体を折り曲げ、直径２０ｍｍ、高さ４．５ｍｍの電極群を得た。

【００５４】＜電池の組立て＞電池容器には前述した実施例１で説明したのと同様なサイズのものを使用した。正極容器内に電極群を正極集電体の折り曲げ部と容器底面が接するように収納し、８０℃で２４時間減圧乾燥を施した。次いで、室温まで冷却した後、前述した実施例１で説明したのと同様な非水電解液０．６ｇを注入した。負極容器の開口端に環状の絶縁ガスケットを取りつけた後、この負極容器を正極容器にかしめ固定することにより、負極容器の内面に負極タブを接触させ、コイン型非水二次電池を得た。

【００５５】（比較例１）まず、図６、７に示す方法で電極群を作製した。

【００５６】＜正極の作製＞前述した実施例１で説明したのと同様なスラリーを集電体としての厚さ１５μｍのアルミニウム箔の両面にダイスコータを用いて一定間隔を開けて塗付し、乾燥させ、プレスし、スリットすることにより、厚さが２００μｍで、正極活物質含有層の幅が２．０ｍｍで、正極活物質含有層の両側に幅０．５ｍｍの無地部が形成され、幅が３．０ｍｍのリール状正極を得た。この正極の短辺方向の端部１３の正極活物質含有層を除去した後、アルミニウム製のタブ１４を溶接した。

【００５７】＜負極の作製＞前述した実施例１で説明したのと同様なスラリーを厚さ１０μｍの銅箔の両面にダイスコータを用いて一定間隔を開けて塗付し、乾燥し、プレスし、スリットすることにより、厚さが２００μｍで、負極活物質含有層の幅が３ｍｍで、負極活物質含有層非保持領域の存在しないリール状負極を得た。この負極の短辺方向の端部１５の負極活物質含有層を除去した後、ニッケル製のタブ１６を溶接した。

【００５８】＜電極群の作製＞幅が４ｍｍの帯状のポリエチレン製多孔膜をセパレータ１７として用意した。前述した実施例２で説明したのと同様な負極の活物質含有層の中央部分に正極の活物質含有層を対向させた後、正極と負極の間に前述した実施例１で説明したのと同様なセパレータ１７を配置した。ひきつづき、この積層物の正極側にセパレータ１７をさらに配置した。得られた積層物を渦巻き状に捲回し、得られた捲回体の巻き終わり端部を粘着テープ１８で固定し、両方の捲回面にセパレータが突出している電極群１９を得た。

【００５９】＜電池の組立て＞電池容器には前述した実施例１で説明したのと同様なサイズのものを使用した。正極容器内に電極群を正極タブと容器内面が接するように収納し、８０℃で２４時間減圧乾燥を施した。次いで、室温まで冷却した後、前述した実施例１で説明したのと同様な非水電解液０．６ｇを注入した。負極容器の開口端に環状の絶縁ガスケットを取りつけた後、この負極容器を正極容器にかしめ固定することにより、負極容器の内面に負極タブを接触させ、コイン型非水二次電池を得た。

【００６０】（比較例２）

＜電極群の作製＞前述した実施例１で説明したのと同様にして捲回体を作製した。捲回体の一方の捲回面に突出している負極集電体に捲回軸と平行な切り込みを等間隔で形成した後、負極集電体を内周側に折り曲げた。また、捲回体の他方の捲回面に突出している正極集電体に捲回軸と平行な切り込みを等間隔で形成した後、正極集電体を内周側に折り曲げ、直径２０ｍｍ、高さ４．５ｍｍの電極群を得た。

【００６１】＜電池の組立て＞電池容器には前述した実施例１で説明したのと同様なサイズのものを使用した。正極容器内に電極群を正極集電体の折り曲げ部が正極容

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器の底部内面と接するように収納し、８０℃で２４時間減圧乾燥を施した。次いで、室温まで冷却した後、前述した実施例１で説明したのと同様な非水電解液０．６ｇを注入した。負極容器の開口端に環状の絶縁ガスケットを取りつけた後、この負極容器を正極容器にかしめ固定することにより、負極容器の内面に負極集電体の折り曲げ部を接触させ、コイン型非水二次電池を得た。

【００６２】得られた実施例１～２及び比較例１～２の二次電池を注液後、２４時間常温でエージングを施した。次いで、０．２Ｃ相当の１０ｍＡで定電流定電圧方式で１０時間充電を行った後、１０ｍＡで放電する充放電サイクルを施した。１サイクル目と５０サイクル目と＊

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＊１００サイクル目の放電容量及び内部抵抗を測定し、その結果を下記表１に示す。

【００６３】また、実施例１～２及び比較例１～２の二次電池について、以下に説明する方法で電極群に巻きずれの生じた個数（電極群１００個中）を測定し、その結果を下記表１に示す。

【００６４】すなわち、高さ２０ｃｍから電極群を落下させて形状の観察を行った。電極群の垂直方向（捲回軸方向）に＋０．５ｍｍ（総高最大５．０ｍｍ）以内を良品とし、＋０．５ｍｍを超えるものを巻きずれとした。

【００６５】

【表１】

	1サイクル目		50サイクル目		100サイクル目		巻きずれ
	放電容量 (mAh)	内部抵抗 (mΩ)	放電容量 (mAh)	内部抵抗 (mΩ)	放電容量 (mAh)	内部抵抗 (mΩ)	(100個中)
実施例1	51	420	45．2	450	42．2	470	0
実施例2	50	450	41．6	490	39．5	510	0
比較例1	43	550	30．7	600	26．0	620	8
比較例2	45	500	35．3	540	29．3	560	3

【００６６】表１から明らかなように、実施例１～２の二次電池は、比較例１，２に比べて放電容量が高く、かつ内部抵抗が低いことがわかる。また、実施例１～２の二次電池によると、製造工程時のハンドリングで電極群の渦巻形状が崩れるのを回避できることがわかる。

【００６７】一方、比較例２の二次電池によると内部抵抗が増大するのは、電極群の捲回面に突出させた集電体に切り込みを入れた後、内周側に折り曲げているため、折り曲げ部の形状にくせがつきやすく、折り曲げ部の反発力が弱くなり、当てむらが生じやすいことに起因すると考えられる。また、折り曲げ部に切り込みが形成されている分、正負極やセパレータの位置を固定する効果が弱くなるため、電極群の形状が筒状に変形しやすいものと推測される。

【００６８】

【発明の効果】以上詳述したように本発明によれば、内部抵抗が低く、かつ放電容量が高い扁平型非水二次電池を提供することができる。

【図面の簡単な説明】

【図１】本発明に係る扁平型非水二次電池の一例（例えば、コイン型非水二次電池）を示す断面図。

【図２】図１のコイン型非水二次電池における電極群の正極と負極とセパレータの位置関係を示す平面図。

【図３】図２のIII－III線に沿う断面図。

【図４】図２の正極とセパレータと負極とを渦巻き状に捲回した捲回体を示す模式図。

【図５】図４の捲回体の一方の捲回面に突出した負極集電体を内周側に折り曲げた状態を示す断面図。

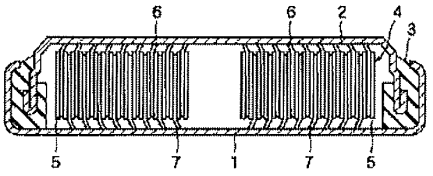
【図６】比較例１のコイン型非水二次電池における電極群の正極と負極とセパレータの位置関係を示す平面図。

【図７】比較例１のコイン型非水二次電池における電極群を示す模式図。

【符号の説明】

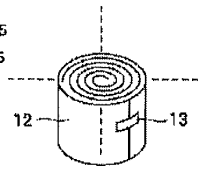
１…正極容器、
２…負極容器、
３…絶縁ガスケット、
４…電極群、
５…セパレータ、
６…負極活物質含有層非保持領域（負極集電体）、
７…正極活物質含有層非保持領域（正極集電体）。

【図１】

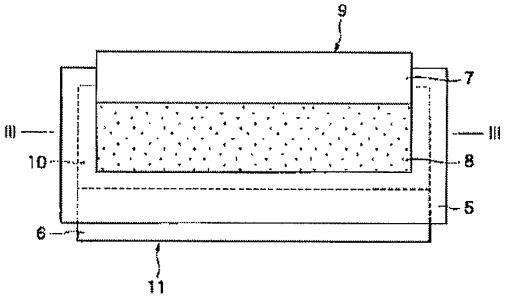


【図３】

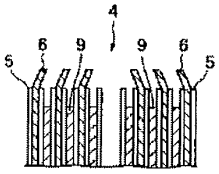
【図４】



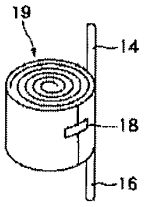
【図２】



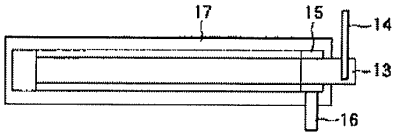
【図５】



【図７】



【図６】



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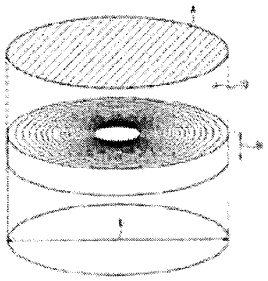
(54) COIN-SHAPED NONAQUEOUS ELECTROLYTIC SOLUTION SECONDARY BATTERY

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a coin-shaped nonaqueous electrolytic solution secondary battery high in discharge load characteristics and free of deformation of the battery accompanied with charge and discharge.
SOLUTION: As for the coin-shaped nonaqueous electrolytic solution secondary battery, a cylindrical wound body 10 is constituted by means that a belt form positive electrode 1 and a belt form negative electrode 2 are wound via a belt form separator 3, the wound-around shaft direction of the wound body 10 is the same as the height direction of a battery can 13, the ratio D/H between the outer diameter D (mm) of the wound body 10 and the height H (mm) of the wound-around shaft direction of the wound body 10 is 1-25, the positive electrode 1 is equipped wit a positive electrode current collector and at least one piece of a positive electrode lead, and when the cross-sectional area of the positive electrode lead is C (mm2), the number of the positive leads is n, and the cross-sectional area of the positive electrode current collector is S (mm2), these ratio (C × n)/S is 1 or more.



* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1]
It is a coin form nonaqueous electrolyte secondary battery containing a strip-like positive electrode, a strip-like anode, a strip-like separator, and a battery can of a coin form,
The aforementioned positive electrode and the aforementioned anode are wound via the

aforementioned separator, and constitute a cylindrical winding object,
A winding axial direction of the aforementioned winding object is the same as a height direction of the aforementioned battery can,
a ratio with outer diameter [of the aforementioned winding object] D (mm), and height [of a winding axial direction of the aforementioned winding object] H (mm) -- D/H is 1-25
The aforementioned positive electrode is provided with a positive pole collector and at least one positive electrode leads,
if a cross-sectional area of n and the aforementioned positive pole collector is set [a cross-sectional area of the aforementioned positive electrode leads] to S (mm^2) for the number of C (mm^2) and the aforementioned positive electrode leads -- these ratios (Cxn) -- a coin form nonaqueous electrolyte secondary battery, wherein /S is one or more.
[Claim 2]
The coin form nonaqueous electrolyte secondary battery according to claim 1 whose aforementioned ratio D/H is 1.5-23.
[Claim 3]
The coin form nonaqueous electrolyte secondary battery according to claim 1 whose volume of the aforementioned coin form nonaqueous electrolyte secondary battery of more than 1 cm^3 is below 7 cm^3.
[Claim 4]
The coin form nonaqueous electrolyte secondary battery according to claim 1 whose outer diameter of the aforementioned battery can is not less than 20 mm 50 mm or less.
[Claim 5]
The coin form nonaqueous electrolyte secondary battery [the aforementioned positive electrode and the aforementioned anode] according to claim 1 occlusion and can emit a lithium ion.

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[Field of the Invention]
[0001]
The present invention relates to a coin form nonaqueous electrolyte secondary battery with a high discharging load characteristic.
[Background of the Invention]
[0002]
The coin form nonaqueous electrolyte secondary battery represented by the coin form rechargeable lithium-ion battery, It is also called a button form or a flat form nonaqueous electrolyte secondary battery, and is observed as a sized cell corresponding to heavy loading which persons, such as a headphone set, clock type communication equipment, and body clamping-die medical equipment, use for what is called a wearable appliance etc. that are used attaching to the body.
[0003]
There is a thing using the electrode body which laminated at a time the positive electrode circularly pierced as a conventional coin form rechargeable lithium-ion battery, for example and one anode via

the separator. However, in this type of cell, since an electrode becomes thick, the diffused resistor of a lithium ion to the thickness direction of an electrode increases, there is a fault in which a discharging load characteristic is deteriorated, and there is a problem that it can be used only for the use of low-power output.

[0004]

In order to solve the above-mentioned problem, the method of making an electrode thin is proposed by using the electrode body which wound the strip-like positive electrode and the strip-like anode via the strip-like separator (for example, a Patent document 1, a Patent document 2, a Patent document 3, see Patent Document 4.).

[Patent document 1] JP,2003-77543,A

[Patent document 2] JP,2005-310578,A

[Patent document 3] JP,H11-345626,A

[Patent document 4] JP,H11-354150,A

[Description of the Invention]

[Problem to be solved by the invention]

[0005]

In the cell proposed by the Patent document 1 and the Patent document 2, The electrode body is inserted in a battery can after winding a strip-like positive electrode and a strip-like anode via a strip-like separator, forming an electrode body, and molding the electrode body into flat shape, and the winding axial direction of an electrode body and the height direction (thickness direction) of a battery can have intersected perpendicularly. In this case, since the electrode body in a battery can is seen from the height direction of a cell and formed in the shape of a rectangular head, there is a problem which a gap produces between an electrode body and a battery can, and capacity loss produces. In this electrode structure, in order that expansion and the contracting direction of the electrode accompanying the charge and discharge of a cell may correspond with the height direction of a battery can, when charge and discharge are repeated, a possibility of deforming into a height direction also has a cell.

[0006]

On the other hand by the cell proposed by the Patent document 3 and the Patent document 4, In order that a gap may not arise between an electrode body and a battery can since the winding axial direction of an electrode body and the height direction of a battery can are the same, and expansion and the contracting direction of the electrode accompanying the charge and discharge of a cell may correspond with the radial direction of a battery can, even if it repeats charge and discharge, there is also no possibility that a cell may deform.

[0007]

However, in the Patent document 3 and the Patent document 4, it is [that electrode structure is only disclosed and] and no specific constitution for improvement in a heavy loading characteristic is disclosed. Of course, no specific constitution for improvement in a heavy loading characteristic is disclosed also in the Patent document 1 and the Patent document 2.

[0008]

The present invention is what solved the above-mentioned problem, and provides a coin form nonaqueous electrolyte secondary battery with a high discharging load characteristic.

[Means for solving problem]

[0009]

A positive electrode with a strip-like coin form nonaqueous electrolyte secondary battery of the present invention, and a strip-like anode, Are a strip-like separator and the battery can of a coin form an included coin form nonaqueous electrolyte secondary battery, and the aforementioned positive electrode and the aforementioned anode, It is wound via the aforementioned separator, constitute a cylindrical winding object, and the winding axial direction of the aforementioned winding object is the same as the height direction of the aforementioned battery can, and Outer diameter [of the aforementioned winding object] D (mm), a ratio with height [of the winding axial direction of the aforementioned winding object] H (mm) -- D/H being 1-25 and the aforementioned positive electrode, if it has a positive pole collector and at least one positive electrode leads and the cross-sectional area of n and the aforementioned positive pole collector is set [the cross-sectional area of the aforementioned positive electrode leads] to S (mm^2) for the number of C (mm^2) and the aforementioned positive electrode leads -- these ratios (Cxn) -- /S is characterized by being one or

more.
[Effect of the Invention]
[0010]
According to the present invention, a discharging load characteristic is high and a coin form nonaqueous electrolyte secondary battery also without deformation of the cell accompanying charge and discharge can be provided.
[Best Mode of Carrying Out the Invention]
[0011]
Hereafter, the embodiment of the coin form nonaqueous electrolyte secondary battery of the present invention is described.
[0012]
It has a strip-like positive electrode, a strip-like anode, a strip-like separator, and a battery can of a coin form, a positive electrode and an anode are wound via a separator, and the coin form nonaqueous electrolyte secondary battery of the present invention constitutes the cylindrical winding object. By this structure, an electrode can be made thin and a discharging load characteristic can be improved to some extent.
[0013]
The winding axial direction of the above-mentioned winding object is made the same as that of the height direction of a battery can. Deformation of a cell can be prevented, even if expansion and the contracting direction of an electrode, and the radial direction of a battery can firm in strength correspond and it repeats charge and discharge by this structure.
[0014]
a ratio with outer diameter [of the above-mentioned winding object] D (mm), and height [of the winding axial direction of a winding object] H (mm) -- D/H (flakiness) is set as 1-25. By less than one, D/H cannot say it as a coin shaped battery, and is not suitable for the coin form nonaqueous electrolyte secondary battery for wearable appliances as which high capacity is required by thin small size.
[0015]
If D/H exceeds 25, it will deviate from the tolerance level of the usual cell design. That is, since about 2 mm is required for the electrode width which can bear the manufacturing process which winds an electrode at the lowest, the minimum of height H of the winding axial direction of a winding object is 2 mm. The maximum of the outer diameter D of a winding object is considered to be 50 mm from the size of the apparatus which mounts a cell. For this reason, the maximum of D/H is set to 25. As for D/H, when cell capacity required for the apparatus which mounts a cell is taken into consideration, 1.5-23 are more preferable.
[0016]
The above-mentioned positive electrode is provided with a positive pole collector and at least one positive electrode leads, and if the cross-sectional area of n and a positive pole collector is set to S (mm^2) for the number of C (mm^2) and positive electrode leads, the cross-sectional area of positive electrode leads, these ratios (Cxn) -- /S is set or more to one and is more preferably set or more to two. Thereby, a discharging load characteristic can be improved further and it becomes the optimal as a cell for various equipment by which a heavy loading characteristic is demanded. This is because the increase in the electrical resistance in a positive electrode lead part can be inhibited by enlarging the gross area (Cxn) of positive electrode leads from the cross-sectional area (S) of a positive pole collector.
[0017]
a ratio (Cxn) -- although the maximum in particular of /S is not limited -- a ratio (Cxn) -- when /S exceeded 10 and the winding object with it in which the thickness of positive electrode leads becomes thicker than the thickness of a positive pole collector too much is formed, positive electrode leads stop meeting the outside of a winding object, and there is a possibility that a cylindrical winding object may deform. [cylindrical] Thereby, problems, such as reduction in service capacity, an increase in electrical resistance, and a deposit of a lithium metal, may arise. for this reason, a ratio (Cxn) -- as for /S, it is preferable that it is ten or less.
[0018]
What is necessary is in the case of n= 1 (i.e., when the number of positive electrode leads is one), to be set to C/S>=1 and just to make thickness of positive electrode leads more than the thickness of a

positive pole collector, since it is above passage (Cxn) /S>=1. Although the width in particular of positive electrode leads is not limited, when the rationality of manufacture of positive electrode leads is taken into consideration, not less than 3 mm is preferable.

[0019]

As for the volume of the coin form nonaqueous electrolyte secondary battery of the present invention, it is preferable that more than 1 cm^3 is below 7 cm^3. If it is this within the limits, it will become the optimal as a coin form nonaqueous electrolyte secondary battery for wearable appliances with which high capacity is demanded by thin small size.

[0020]

As for the coin form nonaqueous electrolyte secondary battery of the present invention, it is preferable that the outer diameter of a battery can is not less than 20 mm 50 mm or less. If it is this within the limits, it will become the optimal as a coin form nonaqueous electrolyte secondary battery for wearable appliances with which high capacity is demanded by thin small size like the above.

[0021]

Next, an example of the coin form nonaqueous electrolyte secondary battery of the present invention is described based on Drawings. However, in Fig.1 – Fig.10, the same code may be given to identical parts and the duplicate description may be omitted.

[0022]

Fig.1 is a perspective view of the winding object used for the present invention. In Fig.1, the winding object 10 winds a strip-like positive electrode and a strip-like anode via a strip-like separator, and is produced.

[0023]

The above-mentioned positive electrode adds a solvent to the mixture containing positive active material, the electric conduction auxiliary agent for positive electrodes, the binder for positive electrodes, etc., and after applying to both sides of a positive pole collector the positive electrode mixture paste obtained by mulling sufficiently and drying, it can form it by controlling the positive electrode mixture layer to predetermined thickness and predetermined electrode density.

[0024]

As the above-mentioned positive active material, although lithium nickel oxides, such as lithium manganese oxidation things, such as lithium cobalt oxides, such as $LiCoO_2$, and $LiMn_2O_4$, and $LiNiO_2$, etc. can be used, if occlusion and discharge of a lithium ion are possible, limitation will not be carried out to these, for example.

[0025]

It will not be limited especially if it is a stable electronic conductor chemically substantially in the constituted cell as the above-mentioned positive pole collector. As a positive pole collector, aluminium foil etc. are used, for example.

[0026]

The charge collector exposed part which has not applied positive electrode mixture paste to the one end part of a positive pole collector is provided, and the positive electrode leads 11 are formed by turning up a charge collector exposed part. A charge collector exposed part may be provided to the both ends of a charge collector, and may also provide positive electrode leads to the both ends of a charge collector. It is good also as positive electrode leads to replace with the above-mentioned positive electrode leads which turn up and form a charge collector exposed part, and weld the tab as a separate part to the one end part or both ends of a positive pole collector.

[0027]

The above-mentioned anode adds a solvent to the mixture containing negative electrode active material, the electric conduction auxiliary agent for anodes, the binder for anodes, etc., and after applying to both sides of a negative pole collector the negative electrode mixture paste obtained by mulling sufficiently and drying, it can form it by controlling the negative electrode mixture layer to predetermined thickness and predetermined electrode density.

[0028]

As the above-mentioned negative electrode active material, although carbon materials, such as artificial graphites, such as natural graphite or massive black lead, scaly graphite, and earthy graphite, are used, if occlusion and discharge of a lithium ion are possible, limitation will not be carried out to these, for example.

[0029]
It will not be limited especially if it is a stable electronic conductor chemically substantially in the constituted cell as the above-mentioned negative pole collector. As a negative pole collector, copper foil etc. are used, for example.
[0030]
The charge collector exposed part which has not applied the negative electrode mixture paste to the one end part of a negative pole collector is provided, and the negative electrode leads 12 are formed by turning up a charge collector exposed part. A charge collector exposed part may be provided to the both ends of a charge collector, and may also provide negative electrode leads to the both ends of a charge collector. It is good also as negative electrode leads to replace with the above-mentioned negative electrode leads which turn up and form a charge collector exposed part, and weld the tab as a separate part to the one end part or both ends of a negative pole collector.
[0031]
Although the positive electrode leads 11 were provided to the periphery side of the winding object 10 and the negative electrode leads 12 were provided to the inner circumference side of the winding object 10 in Fig.1, The positive electrode leads 11 may be provided to the inner circumference side of the winding object 10, and the negative electrode leads 12 may be provided to the periphery side of the winding object 10, and both the positive electrode leads 11 and the negative electrode leads 12 may be provided to the periphery side of the winding object 10.
[0032]
The insulating fine porous thin film which has the big degree of ion permeation and predetermined mechanical strength as the above-mentioned separator is used. What has a function which blockades a fine hole above constant temperature (100-140 degrees C), and raises resistance is preferable from a point of the improvement in safety of a cell. The sheet, the nonwoven fabric and textile fabrics which consist of olefin system polymer or glass fibers which have organic solvent-proof nature and hydrophobicity, such as polypropylene and polyethylene, as the above-mentioned separator specifically, or the porous body layer which fixed the particles of the olefin system with adhesives is used.
[0033]
Fig.2 is a perspective view showing the process which is inserting the winding object 10 in the cylindrical battery can 13. The winding object 10 is inserted in the battery can 13 so that the winding axial direction N may become the same as that of height direction M of the battery can 13. As for the construction material of the battery can 13, aluminum etc. are used. The lower electric insulating plate (not shown) is arranged at the bottom part of the battery can 13. The construction material in particular of a lower electric insulating plate is not limited, but can use polymer materials, such as a polyphenylene sulfide (PPS).
[0034]
Fig.3 is a perspective view showing the process which arranges the upper electric insulating plate 14 on the winding object 10, after inserting the winding object 10 in the battery can 13. The same construction material as the above-mentioned lower electric insulating plate can be used for the construction material of the upper electric insulating plate 14.
[0035]
Fig.4 is a perspective view in the state where the reverse part and the negative electrode leads 12 of the negative pole terminal 16 which placed the upper electric insulating plate 14 on the winding object 10, and are arranged in the central part of the lid 15 were welded. The lid 15 and the negative pole terminal 16 are insulated with the insulating packing 17. As for the construction material of the lid 15, aluminum etc. are used like the battery can 13. As for the construction material of the negative pole terminal 16, nickel etc. are used. Polymer materials, such as polypropylene (PP), can be used for the construction material of the insulating packing 17.
[0036]
Fig.5 A is a perspective view in the state where the battery can 13 and the lid 15 were joined by laser welding etc. Fig.5 B is a cross sectional view of the B-B line of Fig.5 A. In Fig.5 B, the winding object 10 is stored in the well-closed container formed with the lid 15 and the battery can 13, and the lower electric insulating plate 19 is arranged at the bottom part of the battery can 13. However, in Fig.5 B, the portion by the side of the inner circumference of the winding object 10 is not made into the section. The winding object 10 has the structure which wound spirally the strip-like positive electrode

1 and the strip-like anode 2 via the strip-like separator 3 as above-mentioned. The positive electrode leads 11 are joined in the state where it was inserted between the battery can 13 and the lid 15. Thereby, the battery can 13 and the lid 15 function as a positive pole terminal. However, depending on the construction material of the battery can 13, the battery can 13 and the lid 15 may serve as an anode. If an electrolysis solution is poured in and the pouring-in mouth 18 is finally sealed with an obturation object (not shown) from the pouring-in mouth 18, a coin form nonaqueous electrolyte secondary battery will be completed.

[0037]

The above-mentioned electrolysis solution, for example Vinylene carbonate (VC), propylene carbonate (PC), Ethylene carbonate (EC), butylene carbonate (BC), dimethyl carbonate (DMC), Diethyl carbonate (DEC), methylethyl carbonate (MEC), Organic solvents, such as gamma-butyrolactone, to one kind or the solvent mixed two or more kinds, For example, what is necessary is just to use the electrolysis solution in which at least one kind of lithium salt chosen from $LiClO_4$, $LiPF_6$, $LiBF_4$, $LiAsF_6$, $LiSbF_6$, $LiCF_3SO_3$, etc. was dissolved. What is necessary is just to make concentration of the Li ion in this electrolysis solution into 0.5 - 1.5 mol/L.

[0038]

Fig.6 is a mimetic diagram of the winding object 10. In Fig.6, the graphic display of positive electrode leads and negative electrode leads is omitted. a ratio with outer diameter [of the winding object 10] D (mm), and height [of the winding axial direction of the winding object 10] H (mm) -- D/H is set as 1-25. a ratio with the reaction usable area R (mm^2) to which the area A (mm^2), positive electrode, and anode of the upper face part of the winding object 10 are opposing -- as for R/A, it is preferable to set it as 9-25.

[0039]

Fig.7 is a mimetic diagram of the positive electrode for describing the parameter of the present invention. In Fig.7, the 1st positive active material layer 22 and the 2nd positive active material layer 23 formed shorter than the 1st positive active material layer 22 are formed in both sides of the strip-like positive pole collector 21 of the positive electrode 20. The end of the positive pole collector 21 in which the positive active material layer is not formed is bent, and forms the positive electrode leads 24. Here, in the length of the 1st positive active material layer 22, if width of J (mm) and the positive pole collector 21 is set to W (mm), the reaction usable area R (mm^2) will be set [length / of L (mm) and the 2nd positive active material layer 23] to R=(L+J) xW.

[0040]

It is preferable that L/(Bxn) of these ratios will set the cross-sectional area of the positive electrode 20 including the positive pole collector 21, the 1st positive active material layer 22, and the 2nd positive active material layer 23 as 2000-8000 if the number of B (mm^2) and positive electrode leads is set to n.

[0041]

Fig.8 is a cross sectional view of the I-I line of Fig.7.Fig.9 is a cross sectional view of the II-II line of Fig.7.if the cross-sectional area of n and the positive pole collector 21 is set [the cross-sectional area of the positive electrode leads 24] to S (mm^2) for the number of C (mm^2) and positive electrode leads here -- these ratios (Cxn) -- /S is set or more to one.

[0042]

Fig.10 is a perspective view showing other forms of the positive electrode leads of Fig.7.In Fig.10, the positive electrode leads 25 are formed by welding a tab to the end of the positive pole collector 21. ratio L/(Bxn) described above even if it was a form of Fig.10, and a ratio (Cxn) -- the optimum range of /S is the same.

[Working example]

[0043]

Hereafter, although the present invention is described based on an working example, the present invention is not limited to the following working examples.

[0044]

(Working example 1)

<Production of a positive electrode>

$LiCoO_2$:80 part by weight which is positive active material, and acetylene black which is electric

conduction auxiliary agents : 10 parts by weight, Polyvinylidene fluoride (PVDF) which is a binder: To 5 parts by weight, N-methyl-2-pyrrolidone (NMP) was mixed so that it might become uniform as a solvent, and the positive electrode mixture content paste was prepared to them. This positive electrode mixture content paste was applied so that the active material application length of the surface side might become both sides of aluminium foil with a thickness [used as a positive pole collector] of 20 micrometers and the active material application length of the 1221-mm and back surface side might be set to 1155 mm, and it dried. Then, the calendar process was performed, the thickness of the electrode was adjusted so that overall thickness might be set to 134 micrometers, it cut so that it might be set to 3.0 mm in width, and the strip-like positive electrode was produced. The active material uncoated portion is formed in the both ends of the produced strip-like positive electrode.

[0045]

Here, the periphery side at the time of forming a winding object is said, the back surface side means the inner circumference side at the time of forming a winding object, and the same of the surface side of the above-mentioned positive pole collector may be said of the case of the negative pole collector mentioned later.

[0046]

<Production of an anode>

Black-lead:90 part by weight which is negative electrode active material, and PVDF which is binders: To 5 parts by weight, NMP was mixed so that it might become uniform as a solvent, and the negative electrode mixture content paste was prepared to them. This negative electrode mixture content paste was applied so that the active material application length of the surface side might become both sides of copper foil with a thickness [used as a negative pole collector] of 12 micrometers and the active material application length of the 1207-mm and back surface side might be set to 1207 mm, and it dried. Then, the calendar process was performed, the thickness of the electrode was adjusted so that overall thickness might be set to 142 micrometers, it cut so that it might be set to 3.5 mm in width, and the strip-like anode was produced. The active material uncoated portion is formed in the both ends of the produced strip-like anode.

[0047]

<Production of a winding object>

Between the strip-like positive electrode and anode which were produced as mentioned above, the separator which consists of a fine porous film made from polyethylene 20 micrometers in thickness and 4.3 mm in width was arranged and wound, and the winding object was produced. The winding object was formed so that all of the positive-active-material application part of both sides of a positive electrode might oppose with a negative-electrode-active-material application part. Next, the aluminium foil of the active material uncoated portion of a positive electrode was turned up and taken out from the end by the side of the outer peripheral part of a winding object, and one positive electrode leads were formed. Copper foil of the active material uncoated portion of an anode was turned up and taken out from the end by the side of the inner periphery of a winding object (center side), and one negative electrode leads were formed.

[0048]

the outer diameter D of the produced winding object -- height H of 23.5 mm and a winding object -- 3.7 mm and these ratios -- D/H was 6.4. the cross-sectional area C of positive electrode leads -- several n of 0.06mm^2 and positive electrode leads -- the cross-sectional area S of 1 and a positive pole collector -- 0.06mm^2 and these ratios (Cxn) -- /S was 1.0.

[0049]

<Preparation of an electrolysis solution>

The electrolysis solution which did 1.2 mol / L dissolution of $LiPF_6$ was prepared in the mixed solvent (the mixture of EC:DEC a product ratio 1:2) of ethylene carbonate (EC) and diethyl carbonate (DEC).

[0050]

<Production of a cell>

The battery can made from aluminum (the outer diameter of 24 mm, 5.0 mm in height, side surface 0.25 mm in thickness, and bottom surface 0.3 mm in thickness) and the lid made from aluminum (24 mm in diameter and 0.4 mm in thickness) were prepared. Fitting of the negative pole terminal made from nickel 6 mm in diameter is carried out in the center of a lid via the packing made from

polypropylene. Next, after having arranged the 0.05-mm-thick lower electric insulating plate made from PPS at the bottom part of the above-mentioned battery can, the above-mentioned winding object was inserted into the battery can so that the winding axial direction of a winding object might become the same as that of the height direction of a battery can. Next, after having arranged the 0.05-mm-thick upper electric insulating plate made from PPS in the upper part of a winding object, negative electrode leads were welded to the back side of the negative pole terminal. Then, the battery can and the lid were joined by laser welding, inserting positive electrode leads between a battery can and a lid.

[0051]

After pouring in the above-mentioned electrolysis solution from the pouring-in mouth with a diameter of 1.5 mm provided by the lid finally and making an electrolysis solution permeate an electrode body sufficiently, it sealed by inserting a sealing pin in a pouring-in mouth and carrying out laser welding, and the battery body product produced the coin form rechargeable lithium-ion battery of 2.3 cm^3.

[0052]

(Working example 2)

The aluminium foil of the active material uncoated portion of a positive electrode was turned up, respectively, and was taken out from the end by the side of the outer peripheral part of a winding object, and the end by the side of an inner periphery, and the battery body product produced the coin form nonaqueous electrolyte secondary battery of 2.3 cm^3 like the working example 1 except having formed two positive electrode leads.

[0053]

the outer diameter D of the winding object of this example -- height H of 23.5 mm and a winding object -- 3.7 mm and these ratios -- D/H was 6.4. the cross-sectional area C of positive electrode leads -- several n of 0.06mm^2 and positive electrode leads -- the cross-sectional area S of 2 and a positive pole collector -- 0.06mm^2 and these ratios (Cxn) -- /S was 2.0.

[0054]

(Working example 3)

At the end of the aluminium foil of the active material uncoated portion of a positive electrode, 0.02 mm in thickness. The tab made from aluminum 5 mm in width and 8 mm in length was joined by ultrasonic welding, it took out from the outer peripheral part side of a winding object, and the battery body product produced the coin form nonaqueous electrolyte secondary battery of 2.3 cm^3 like the working example 1 except having formed one positive electrode leads.

[0055]

the outer diameter D of the winding object of this example -- height H of 23.5 mm and a winding object -- 3.7 mm and these ratios -- D/H was 6.4. the cross-sectional area C of positive electrode leads -- several n of 0.10mm^2 and positive electrode leads -- the cross-sectional area S of 1 and a positive pole collector -- 0.06mm^2 and these ratios (Cxn) -- /S was 1.7.

[0056]

(Comparative example 1)

At the end of the aluminium foil of the active material uncoated portion of a positive electrode, 0.02 mm in thickness. The tab made from aluminum 2.5 mm in width and 8 mm in length was joined by ultrasonic welding, it took out from the outer peripheral part side of a winding object, and the battery body product produced the coin form nonaqueous electrolyte secondary battery of 2.3 cm^3 like the working example 1 except having formed one positive electrode leads.

[0057]

the outer diameter D of the winding object of this comparative example -- height H of 23.5 mm and a winding object -- 3.7 mm and these ratios -- D/H was 6.4. the cross-sectional area C of positive electrode leads -- several n of 0.05mm^2 and positive electrode leads -- the cross-sectional area S of 1 and a positive pole collector -- 0.06mm^2 and these ratios (Cxn) -- /S was 0.8.

[0058]

Each dimension of the positive electrode of the working examples 1-3 and the comparative example 1 and an anode is summarized in Table 1 and 2, and is shown.

[0059]

[Table 1]

	正極寸法（mm）			
	幅	活物質塗布長（表面側／裏面側）	電極厚さ	集電体厚さ
実施例１	３．０	１２２１／１１５５	０．１３４	０．０２
実施例２	３．０	１２２１／１１５５	０．１３４	０．０２
実施例３	３．０	１２２１／１１５５	０．１３４	０．０２
比較例１	３．０	１２２１／１１５５	０．１３４	０．０２

[0060]
[Table 2]

	負極寸法（mm）			
	幅	活物質塗布長（表面側／裏面側）	電極厚さ	集電体厚さ
実施例１	３．５	１２０７／１２０７	０．１４２	０．０１２
実施例２	３．５	１２０７／１２０７	０．１４２	０．０１２
実施例３	３．５	１２０７／１２０７	０．１４２	０．０１２
比較例１	３．５	１２０７／１２０７	０．１４２	０．０１２

[0061]
The cell parameter and electrode parameter of the working examples 1-3 and the comparative example 1 are shown in Table 3 and 4.
[0062]
[Table 3]

	電池パラメータ					
	電池外径（mm）	電池高さ（mm）	電池体積（cm^3）	捲回体外径D（mm）	捲回体高さH（mm）	D／H
実施例１	２４	５．０	２．３	２３．５	３．７	６．４
実施例２	２４	５．０	２．３	２３．５	３．７	６．４
実施例３	２４	５．０	２．３	２３．５	３．７	６．４
比較例１	２４	５．０	２．３	２３．５	３．７	６．４

[0063]
[Table 4]

	正極リード	電極パラメータ			
		正極リード断面積C（mm^2）	正極集電体断面積S（mm^2）	正極リード数n（本）	（C×n）／S
実施例１	Ａｌ箔	０．０６	０．０６	１	１．０
実施例２	Ａｌ箔	０．０６	０．０６	２	２．０
実施例３	Ａｌタブ	０．１０	０．０６	１	１．７
比較例１	Ａｌタブ	０．０５	０．０６	１	０．８

[0064]
<Evaluation of a battery characteristic>
Constant potential charge was performed until it performed constant current charge to 4.3V by 0.2C and the current value was set to 0.02C after that about each cell of the working examples 1-3 and the

comparative example 1. Next, constant current discharge was performed to 3.0V by 0.2C, and initial capacity (a) was calculated. "C" means the current value in the case of discharging the design capacity of a cell in 1 hour.

[0065]

Then, constant potential charge was performed until it performed constant current charge to 4.3V by 0.2C and the current value was set to 0.02C after that in each cell. Next, constant current discharge was performed to 3.0V by 2C, and heavy-loading capacity (b) was calculated.

[0066]

The above-mentioned result to the capacity maintenance rate Z (%) was searched for from the following formula, and it evaluated as a discharging load characteristic.

[0067]

Z=(b/a) x100

[0068]

The above-mentioned battery characteristic is shown in Table 5 with parameter D/H, and a parameter (Cxn)/S.

[0069]

<Evaluation of a cycle characteristic>

The charge-and-discharge cycle test was done like next. Charge performed constant potential charge until it performed constant current charge to 4.3V by 0.5C and the current value was set to 0.02C after that about each cell. Discharge performed constant current discharge to 3.0V by 1C. It repeated up to 200 cycles by making this charge and discharge into one cycle. Next, the appearance of the cell was observed by viewing and the existence of deformation of a cell was checked. The result is shown in Table 5.

[0070]

[Table 5]

	パラメータ		電池特性		サイクル特性
	D／H	(C×n)／S	初期容量 (mAh)	容量維持率Z (%)	電池変形の有無
実施例1	6．4	1．0	220	90	無し
実施例2	6．4	2．0	210	93	無し
実施例3	6．4	1．7	220	92	無し
比較例1	6．4	0．8	220	78	無し

[0071]

From Table 5, the working examples 1-3 which have a parameter (Cxn)/S in one or more ranges are understood that the capacity maintenance rate Z (heavy loading characteristic) is high compared with the comparative example 1 out of the range. By each cell of the working examples 1-3 and the comparative example 1, even if it repeated charge and discharge 200 times, no deformation of a cell was accepted.

[Industrial applicability]

[0072]

As described above, the discharging load characteristic of the present invention is high, and a coin form nonaqueous electrolyte secondary battery also without deformation of the cell accompanying charge and discharge can be provided. This coin form nonaqueous electrolyte secondary battery can be widely used as a power supply of not only the power supply for wearable appliances but various apparatus.

[Brief Description of the Drawings]

[0073]

[Drawing 1]It is a perspective view of the winding object used for the present invention.

[Drawing 2]It is a perspective view showing the process which is inserting the winding object in a cylindrical battery can.

[Drawing 3]After inserting a winding object in a battery can, it is a perspective view showing the process which arranges the upper electric insulating plate on a winding object.

[Drawing 4]It is a perspective view in the state where the reverse part and negative electrode leads of the negative pole terminal which placed the upper electric insulating plate on the winding object, and are arranged in the central part of the lid were welded.
[Drawing 5]Fig.5 A is a perspective view in the state where a battery can and a lid were joined by laser welding etc.
Fig.5 B is a cross sectional view of a B-B line of Fig.5 A.

[Drawing 6]It is a mimetic diagram of a winding object.
[Drawing 7]It is a mimetic diagram of the positive electrode for describing the parameter of the present invention.
[Drawing 8]It is a cross sectional view of the I-I line of Fig.7.
[Drawing 9]It is a cross sectional view of the II-II line of Fig.7.
[Drawing 10]It is a perspective view showing other forms of the positive electrode leads of Fig.7.
[Explanations of letters or numerals]
[0074]
1 Positive electrode
2 Anode
3 Separator
10 Winding object
11 Positive electrode leads
12 Negative electrode leads
13 Battery can
14 An upper electric insulating plate
15 Lid
16 Negative pole terminal
17 Insulating packing
18 Pouring-in mouth
19 Lower electric insulating plate
20 Positive electrode
21 Positive pole collector
22 The 1st positive active material layer
23 The 2nd positive active material layer
24 Positive electrode leads
25 Positive electrode leads

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

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[Translation done.]

* NOTICES *

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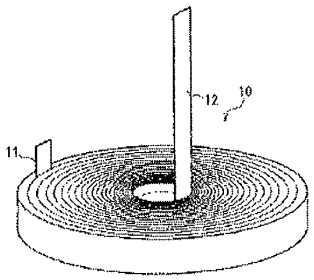
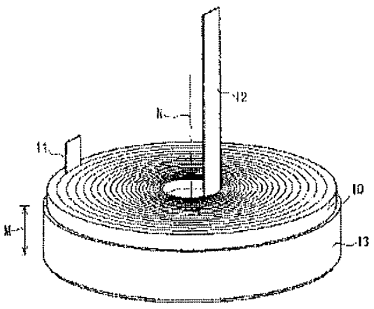
DRAWINGS

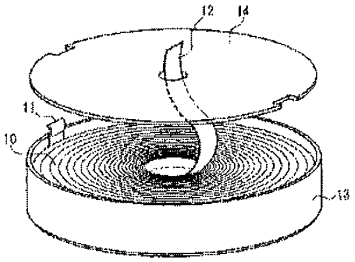
[Drawing 1]



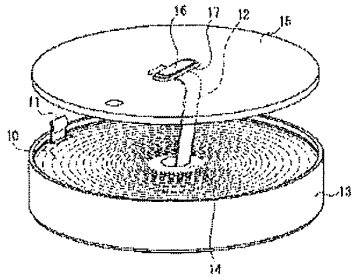
[Drawing 2]



[Drawing 3]

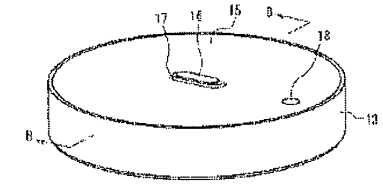


[Drawing 4]



[Drawing 5]

A



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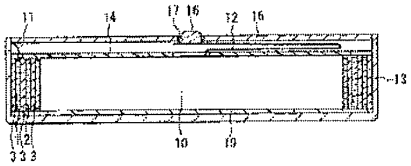
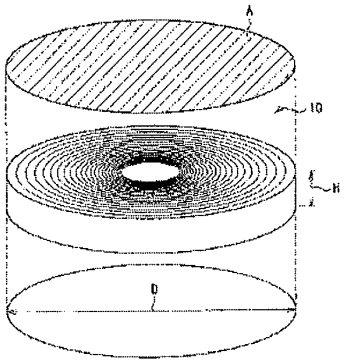
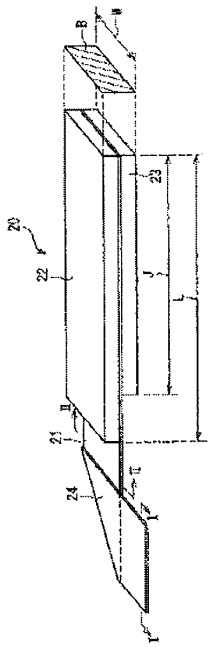


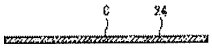
[Drawing 6]



[Drawing 7]

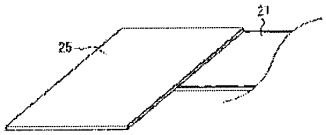


[Drawing 8]



[Drawing 9]

[Drawing 10]



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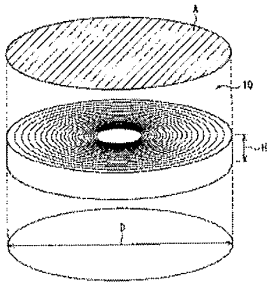
最終頁に続く

(54)【発明の名称】コイン形非水電解液二次電池

(57)【要約】
【課題】放電負荷特性が高く、充放電に伴う電池の変形もないコイン形非水電解液二次電池を提供する。
【解決手段】本発明のコイン形非水電解液二次電池は、帯状の正極１と帯状の負極２とが、帯状のセパレータ３を介して捲回されて円筒状の捲回体１０を構成し、捲回体１０の捲回軸方向は、電池缶１３の高さ方向と同一であり、捲回体１０の外径Ｄ（ｍｍ）と、捲回体１０の捲回軸方向の高さＨ（ｍｍ）との比Ｄ／Ｈは、１～２５であり、正極１は、正極集電体と、少なくとも１本の正極リードとを備え、正極リードの断面積をＣ（mm^2）、正極リードの数をｎ、正極集電体の断面積をＳ（mm^2）とすると、これらの比（Ｃ×ｎ）／Ｓは１以上であることを特徴とする。
【選択図】図６



【特許請求の範囲】
【請求項１】
帯状の正極と、帯状の負極と、帯状のセパレータと、コイン形の電池缶とを含むコイン形非水電解液二次電池であって、
前記正極と前記負極とは、前記セパレータを介して捲回されて円筒状の捲回体を構成し、
前記捲回体の捲回軸方向が、前記電池缶の高さ方向と同一であり、
前記捲回体の外径Ｄ（ｍｍ）と、前記捲回体の捲回軸方向の高さＨ（ｍｍ）との比Ｄ／Ｈが、１～２５であり、
前記正極は、正極集電体と、少なくとも１本の正極リードとを備え、
前記正極リードの断面積をＣ（$ｍｍ^2$）、前記正極リードの数をｎ、前記正極集電体の断面積をＳ（$ｍｍ^2$）とすると、これらの比（Ｃ×ｎ）／Ｓは１以上であることを特徴とするコイン形非水電解液二次電池。
【請求項２】
前記比Ｄ／Ｈが、１．５～２３である請求項１に記載のコイン形非水電解液二次電池。
【請求項３】
前記コイン形非水電解液二次電池の体積が、１$ｃｍ^3$以上７$ｃｍ^3$以下である請求項１に記載のコイン形非水電解液二次電池。
【請求項４】
前記電池缶の外径が、２０ｍｍ以上５０ｍｍ以下である請求項１に記載のコイン形非水電解液二次電池。
【請求項５】
前記正極及び前記負極は、リチウムイオンを吸蔵・放出可能である請求項１に記載のコイン形非水電解液二次電池。
【発明の詳細な説明】
【技術分野】
【０００１】
本発明は、放電負荷特性が高いコイン形非水電解液二次電池に関する。
【背景技術】
【０００２】
コイン形リチウムイオン二次電池に代表されるコイン形非水電解液二次電池は、ボタン形又は扁平形非水電解液二次電池とも呼ばれ、ヘッドホンセット、時計型通信機器、身体取付型医療機器等の人が身につけて使用するいわゆるウェアラブル機器等に用いる重負荷対応の小型電池として注目されている。
【０００３】
従来のコイン形リチウムイオン二次電池としては、例えば、円形に打ち抜いた正極と負極とを１枚づつセパレータを介して積層した電極体を用いたものがある。しかし、このタイプの電池では、電極が厚くなるため、電極の厚さ方向に対するリチウムイオンの拡散抵抗が増加して、放電負荷特性が低下する欠点があり、低出力の用途にしか使用できないという問題がある。
【０００４】
上記問題を解決するために、帯状の正極と、帯状の負極とを、帯状のセパレータを介して捲回した電極体を用いることにより、電極を薄くする方法が提案されている（例えば、特許文献１、特許文献２、特許文献３、特許文献４参照。）。
【特許文献１】特開２００３－７７５４３号公報
【特許文献２】特開２００５－３１０５７８号公報
【特許文献３】特開平１１－３４５６２６号公報
【特許文献４】特開平１１－３５４１５０号公報
【発明の開示】
【発明が解決しようとする課題】

【０００５】
特許文献１及び特許文献２に提案されている電池では、帯状の正極と、帯状の負極とを、帯状のセパレータを介して捲回して電極体を形成し、その電極体を扁平状に成形した後、電極体の捲回軸方向と電池缶の高さ方向（厚さ方向）とが直交した状態で、電極体を電池缶に挿入している。この場合、電池缶内の電極体は、電池の高さ方向から見て四角状に形成されているため、電極体と電池缶との間に隙間が生じ、容積ロスが生じる問題がある。また、この電極構造では、電池の充放電に伴う電極の膨張・収縮方向が電池缶の高さ方向と一致するため、充放電を繰り返すと電池が高さ方向に変形するおそれもある。
【０００６】
一方、特許文献３及び特許文献４に提案されている電池では、電極体の捲回軸方向と、電池缶の高さ方向とが同一であるため、電極体と電池缶との間に隙間が生ぜず、また、電池の充放電に伴う電極の膨張・収縮方向が電池缶の径方向と一致するため、充放電を繰り返しても電池が変形するおそれもない。
【０００７】
しかし、特許文献３及び特許文献４では、単に電極構造が開示されているのみであり、重負荷特性の向上のための具体的構成が一切開示されていない。もちろん、特許文献１及び特許文献２にも重負荷特性の向上のための具体的構成は一切開示されていない。
【０００８】
本発明は上記問題を解決したもので、放電負荷特性が高いコイン形非水電解液二次電池を提供するものである。
【課題を解決するための手段】
【０００９】
本発明のコイン形非水電解液二次電池は、帯状の正極と、帯状の負極と、帯状のセパレータと、コイン形の電池缶とを含むコイン形非水電解液二次電池であって、前記正極と前記負極とは、前記セパレータを介して捲回されて円筒状の捲回体を構成し、前記捲回体の捲回軸方向が、前記電池缶の高さ方向と同一であり、前記捲回体の外径Ｄ（ｍｍ）と、前記捲回体の捲回軸方向の高さＨ（ｍｍ）との比Ｄ／Ｈが、１～２５であり、前記正極は、正極集電体と、少なくとも１本の正極リードとを備え、前記正極リードの断面積をＣ（ｍｍ^2）、前記正極リードの数をｎ、前記正極集電体の断面積をＳ（ｍｍ^2）とすると、これらの比（Ｃ×ｎ）／Ｓは１以上であることを特徴とする。
【発明の効果】
【００１０】
本発明によると、放電負荷特性が高く、充放電に伴う電池の変形もないコイン形非水電解液二次電池を提供できる。
【発明を実施するための最良の形態】
【００１１】
以下、本発明のコイン形非水電解液二次電池の実施形態を説明する。
【００１２】
本発明のコイン形非水電解液二次電池は、帯状の正極と、帯状の負極と、帯状のセパレータと、コイン形の電池缶とを備え、正極と負極とは、セパレータを介して捲回されて円筒状の捲回体を構成している。この構造により、電極を薄くでき、放電負荷特性をある程度向上できる。
【００１３】
また、上記捲回体の捲回軸方向は、電池缶の高さ方向と同一とされている。この構造により、電極の膨張・収縮方向と、強度的に強固な電池缶の径方向とが一致し、充放電を繰り返しても電池の変形を防止できる。
【００１４】
また、上記捲回体の外径Ｄ（ｍｍ）と、捲回体の捲回軸方向の高さＨ（ｍｍ）との比Ｄ／Ｈ（扁平度）は、１～２５に設定されている。Ｄ／Ｈが１未満では、コイン形電池とはいえず、薄型小型で高容量が要求されるウェアラブル機器用のコイン形非水電解液二次電

池には適さない。

【００１５】

また、Ｄ／Ｈが２５を超えると、通常の電池設計の許容範囲を逸脱する。即ち、電極を捲回する製造工程に耐え得る電極幅は最低でも約２ｍｍは必要であるため、捲回体の捲回軸方向の高さＨの最小値は２ｍｍである。また、電池を搭載する機器の大きさから、捲回体の外径Ｄの最大値は５０ｍｍと考えられる。このため、Ｄ／Ｈの最大値は２５となる。さらに、電池を搭載する機器に必要な電池容量を考慮するとＤ／Ｈは１．５～２３がより好ましい。

【００１６】

また、上記正極は、正極集電体と、少なくとも１本の正極リードとを備え、正極リードの断面積をＣ（mm^2）、正極リードの数をｎ、正極集電体の断面積をＳ（mm^2）とすると、これらの比（Ｃ×ｎ）／Ｓは１以上に設定され、より好ましくは２以上に設定される。これにより、放電負荷特性をさらに向上でき、重負荷特性が要求される各種機器用の電池として最適となる。これは、正極リードの総断面積（Ｃ×ｎ）を正極集電体の断面積（Ｓ）より大きくすることにより、正極リード部での電気抵抗の増加を抑制できるからである。

【００１７】

また、比（Ｃ×ｎ）／Ｓの上限は特に限定されないが、比（Ｃ×ｎ）／Ｓが１０を超えると、正極リードの厚さが正極集電体の厚さより厚くなりすぎ、円筒状の捲回体を形成した場合に、正極リードが捲回体の外形に沿わなくなり、円筒状の捲回体が変形するおそれがある。これにより、放電容量の減少、電気抵抗の増加、リチウム金属の析出等の問題が生じる場合がある。このため、比（Ｃ×ｎ）／Ｓは、１０以下であることが好ましい。

【００１８】

上記のとおり（Ｃ×ｎ）／Ｓ≧１であるから、ｎ＝１の場合、即ち正極リードが１本の場合には、Ｃ／Ｓ≧１となり、正極リードの厚さを正極集電体の厚さ以上とすればよい。また、正極リードの幅は特に限定されないが、正極リードの製造の合理性を考慮すると３ｍｍ以上が好ましい。

【００１９】

また、本発明のコイン形非水電解液二次電池の体積は、１cm^3以上７cm^3以下であることが好ましい。この範囲内であれば、薄型小型で高容量が要求されるウェアラブル機器用のコイン形非水電解液二次電池として最適となる。

【００２０】

さらに、本発明のコイン形非水電解液二次電池は、電池缶の外径が、２０ｍｍ以上５０ｍｍ以下であることが好ましい。この範囲内であれば、上記と同様に薄型小型で高容量が要求されるウェアラブル機器用のコイン形非水電解液二次電池として最適となる。

【００２１】

次に、本発明のコイン形非水電解液二次電池の一例を図面に基づき説明する。但し、図１～図１０では、同一部分には同一の符号を付し、重複した説明は省略する場合がある。

【００２２】

図１は、本発明に用いる捲回体の斜視図である。図１において、捲回体１０は、帯状の正極と帯状の負極とを、帯状のセパレータを介して捲回して作製されている。

【００２３】

上記正極は、正極活物質、正極用導電助剤、正極用バインダ等を含む混合物に、溶剤を加えて十分に混練して得た正極合剤ペーストを、正極集電体の両面に塗布して乾燥した後に、その正極合剤層を所定の厚さ及び所定の電極密度に制御することにより形成できる。

【００２４】

上記正極活物質としては、例えば、$LiCoO_2$等のリチウムコバルト酸化物、$LiMn_2O_4$等のリチウムマンガン酸化物、$LiNiO_2$等のリチウムニッケル酸化物等が使用できるが、リチウムイオンを吸蔵・放出可能であればこれらに限定はされない。

【００２５】

上記正極集電体としては、構成された電池において実質的に化学的に安定な電子伝導体であれば特に限定されない。正極集電体としては、例えば、アルミニウム箔等が用いられる。

【００２６】

正極集電体の一端部には正極合剤ペーストを塗布していない集電体露出部が設けられ、集電体露出部を折り返すことにより、正極リード１１が形成されている。また、集電体露出部は、集電体の両端部に設けてもよく、正極リードも集電体の両端部に設けてもよい。さらに、集電体露出部を折り返して形成する上記正極リードに代えて、正極集電体の一端部又は両端部に別部品としてのタブを溶接して正極リードとしてもよい。

【００２７】

上記負極は、負極活物質、負極用導電助剤、負極用バインダ等を含む混合物に、溶剤を加えて十分に混練して得た負極合剤ペーストを、負極集電体の両面に塗布して乾燥した後に、その負極合剤層を所定の厚さ及び所定の電極密度に制御することにより形成できる。

【００２８】

上記負極活物質としては、例えば、天然黒鉛又は塊状黒鉛、鱗片状黒鉛、土状黒鉛等の人造黒鉛等の炭素材料が用いられるが、リチウムイオンを吸蔵・放出可能であればこれらに限定はされない。

【００２９】

上記負極集電体としては、構成された電池において実質的に化学的に安定な電子伝導体であれば特に限定されない。負極集電体としては、例えば、銅箔等が用いられる。

【００３０】

負極集電体の一端部には負極合剤ペーストを塗布していない集電体露出部が設けられ、集電体露出部を折り返すことにより、負極リード１２が形成されている。また、集電体露出部は、集電体の両端部に設けてもよく、負極リードも集電体の両端部に設けてもよい。さらに、集電体露出部を折り返して形成する上記負極リードに代えて、負極集電体の一端部又は両端部に別部品としてのタブを溶接して負極リードとしてもよい。

【００３１】

図１では、正極リード１１を捲回体１０の外周側に設け、負極リード１２を捲回体１０の内周側に設けたが、正極リード１１を捲回体１０の内周側に設け、負極リード１２を捲回体１０の外周側に設けてもよく、また、正極リード１１及び負極リード１２をともに捲回体１０の外周側に設けてもよい。

【００３２】

上記セパレータとしては、大きなイオン透過度及び所定の機械的強度を有する絶縁性の微多孔性薄膜が用いられる。また、一定温度以上（１００～１４０℃）で微孔を閉塞し、抵抗を上げる機能を有するものが、電池の安全性向上の点から好ましい。具体的には、上記セパレータとしては、耐有機溶剤性及び疎水性を有するポリプロピレン、ポリエチレン等のオレフィン系ポリマー又はガラス繊維からなるシート、不織布、織布、又はオレフィン系の粒子を接着剤で固着した多孔質体層等が用いられる。

【００３３】

図２は、捲回体１０を円筒状の電池缶１３に挿入している工程を示す斜視図である。捲回体１０は、その捲回軸方向Ｎが電池缶１３の高さ方向Ｍと同一となるように、電池缶１３に挿入される。電池缶１３の材質は、アルミニウム等が用いられる。また、電池缶１３の底部には、下部絶縁板（図示せず。）が配置されている。下部絶縁板の材質は特に限定されず、ポリフェニレンサルファイド（ＰＰＳ）等の高分子材料を用いることができる。

【００３４】

図３は、捲回体１０を電池缶１３に挿入した後に、捲回体１０の上に上部絶縁板１４を配置している工程を示す斜視図である。上部絶縁板１４の材質は、上記下部絶縁板と同様の材質が使用できる。

【００３５】

図４は、上部絶縁板１４を捲回体１０の上に載置し、蓋１５の中央部に配置された負極

端子１６の裏部と負極リード１２とを溶接した状態の斜視図である。蓋１５と負極端子１６とは、絶縁パッキング１７によって絶縁されている。蓋１５の材質は、電池缶１３と同様にアルミニウム等が用いられる。負極端子１６の材質は、ニッケル等が用いられる。絶縁パッキング１７の材質は、ポリプロピレン（ＰＰ）等の高分子材料を用いることができる。

【００３６】

図５Ａは、電池缶１３と蓋１５とをレーザー溶接等により接合した状態の斜視図である。図５Ｂは、図５ＡのＢ－Ｂ線の断面図である。図５Ｂにおいて、蓋１５と電池缶１３とで形成された密閉容器内に捲回体１０が収納され、電池缶１３の底部には下部絶縁板１９が配置されている。但し、図５Ｂでは、捲回体１０の内周側の部分は断面にしていない。捲回体１０は、前述のとおり、帯状の正極１と帯状の負極２とを、帯状のセパレータ３を介して渦巻状に捲回した構造を有している。また、正極リード１１は、電池缶１３と蓋１５との間に挟まれた状態で接合されている。これにより、電池缶１３及び蓋１５が正極端子として機能する。但し、電池缶１３の材質によっては、電池缶１３及び蓋１５が負極となる場合もある。最後に、注液口１８から、電解液を注液し、注液口１８を封口体（図示せず。）によって封口すればコイン形非水電解液二次電池が完成する。

【００３７】

上記電解液は、例えば、ビニレンカーボネート（ＶＣ）、プロピレンカーボネート（ＰＣ）、エチレンカーボネート（ＥＣ）、ブチレンカーボネート（ＢＣ）、ジメチルカーボネート（ＤＭＣ）、ジエチルカーボネート（ＤＥＣ）、メチルエチルカーボネート（ＭＥＣ）、γ－ブチロラクトン等の有機溶媒を１種類又は２種類以上混合した溶媒に、例えば、$LiClO_4$、$LiPF_6$、$LiBF_4$、$LiAsF_6$、$LiSbF_6$、$LiCF_3SO_3$等から選ばれる少なくとも１種類のリチウム塩を溶解させた電解液を用いればよい。この電解液中のＬｉイオンの濃度は、０．５～１．５ｍｏｌ／Ｌとすればよい。

【００３８】

図６は、捲回体１０の模式図である。図６では、正極リード及び負極リードの図示を省略している。捲回体１０の外径Ｄ（ｍｍ）と、捲回体１０の捲回軸方向の高さＨ（ｍｍ）との比Ｄ／Ｈは、１～２５に設定されている。また、捲回体１０の上面部の面積Ａ（mm^2）と、正極と負極とが対向している反応有効面積Ｒ（mm^2）との比Ｒ／Ａは、９～２５に設定することが好ましい。

【００３９】

図７は、本発明のパラメータを説明するための正極の模式図である。図７において、帯状の正極２０の正極集電体２１の両面には、第１正極活物質層２２と、第１正極活物質層２２より短く形成された第２正極活物質層２３とが形成されている。正極活物質層が形成されていない正極集電体２１の端部は折り曲げられて正極リード２４を形成している。ここで、第１正極活物質層２２の長さをＬ（ｍｍ）、第２正極活物質層２３の長さをＪ（ｍｍ）、正極集電体２１の幅をＷ（ｍｍ）とすると、反応有効面積Ｒ（mm^2）は、Ｒ＝（Ｌ＋Ｊ）×Ｗとなる。

【００４０】

また、正極集電体２１、第１正極活物質層２２、第２正極活物質層２３を含む正極２０の断面積をＢ（mm^2）、正極リードの数をｎとすると、これらの比Ｌ／（Ｂ×ｎ）は２０００～８０００に設定することが好ましい。

【００４１】

図８は、図７のＩ－Ｉ線の断面図である。また、図９は、図７のＩＩ－ＩＩ線の断面図である。ここで、正極リード２４の断面積をＣ（mm^2）、正極リードの数をｎ、正極集電体２１の断面積をＳ（mm^2）とすると、これらの比（Ｃ×ｎ）／Ｓは１以上に設定される。

【００４２】

図１０は、図７の正極リードの他の形態を示す斜視図である。図１０では、正極集電体２１の端部にタブを溶接することにより正極リード２５を形成している。図１０の形態で

あっても、上記した比Ｌ／（Ｂ×ｎ）、比（Ｃ×ｎ）／Ｓの好適範囲は同様である。

【実施例】

【００４３】

以下、実施例に基づき本発明を説明するが、本発明は以下の実施例に限定されるものではない。

【００４４】

（実施例１）

＜正極の作製＞

正極活物質である$LiCoO_2$：８０重量部と、導電助剤であるアセチレンブラック：１０重量部と、バインダであるポリフッ化ビニリデン（ＰＶＤＦ）：５重量部とに、Ｎ－メチル－２－ピロリドン（ＮＭＰ）を溶剤として加えて、均一になるように混合して正極合剤含有ペーストを調製した。この正極合剤含有ペーストを、正極集電体となる厚さ２０μｍのアルミニウム箔の両面に、表面側の活物質塗布長が１２２１ｍｍ、裏面側の活物質塗布長が１１５５ｍｍになるように塗布し、乾燥した。その後、カレンダー処理を行って、全厚が１３４μｍになるように電極の厚さを調整し、幅３．０ｍｍになるように切断して、帯状の正極を作製した。作製した帯状の正極の両端部には、活物質未塗布部が形成されている。

【００４５】

ここで、上記正極集電体の表面側とは、捲回体を形成した場合の外周側をいい、その裏面側とは、捲回体を形成した場合の内周側をいい、後述する負極集電体の場合も同様である。

【００４６】

＜負極の作製＞

負極活物質である黒鉛：９０重量部と、バインダであるＰＶＤＦ：５重量部とに、ＮＭＰを溶剤として加えて、均一になるように混合して負極合剤含有ペーストを調製した。この負極合剤含有ペーストを、負極集電体となる厚さ１２μｍの銅箔の両面に、表面側の活物質塗布長が１２０７ｍｍ、裏面側の活物質塗布長が１２０７ｍｍになるように塗布し、乾燥した。その後、カレンダー処理を行って、全厚が１４２μｍになるように電極の厚さを調整し、幅３．５ｍｍになるように切断して、帯状の負極を作製した。作製した帯状の負極の両端部には、活物質未塗布部が形成されている。

【００４７】

＜捲回体の作製＞

上記のように作製した帯状の正極と負極との間に、厚さ２０μｍ、幅４．３ｍｍのポリエチレン製の微多孔性フィルムよりなるセパレータを配置して捲回して、捲回体を作製した。捲回体は、正極の両面の正極活物質塗布部が全て負極活物質塗布部と対向するように形成した。次に、正極の活物質未塗布部のアルミニウム箔を、捲回体の外周部側の端部より折り返して取り出し、正極リードを１本形成した。また、負極の活物質未塗布部の銅箔を、捲回体の内周部側（中心側）の端部より折り返して取り出し、負極リードを１本形成した。

【００４８】

作製した捲回体の外径Ｄは、２３．５ｍｍ、捲回体の高さＨは３．７ｍｍ、これらの比Ｄ／Ｈは６．４であった。また、正極リードの断面積Ｃは０．０６ｍｍ^2、正極リードの数ｎは１、正極集電体の断面積Ｓは０．０６ｍｍ^2、これらの比（Ｃ×ｎ）／Ｓは１．０であった。

【００４９】

＜電解液の調製＞

エチレンカーボネート（ＥＣ）とジエチルカーボネート（ＤＥＣ）との混合溶媒（ＥＣ：ＤＥＣの混合体積比は１：２）中に$LiPF_6$を１．２ｍｏｌ／Ｌ溶解させた電解液を調製した。

【００５０】

＜電池の作製＞

外径２４ｍｍ，高さ５．０ｍｍ、側面厚さ０．２５ｍｍ、底面厚さ０．３ｍｍのアルミニウム製の電池缶と，直径２４ｍｍ，厚さ０．４ｍｍのアルミニウム製の蓋を準備した。蓋の中央には、直径６ｍｍのニッケル製の負極端子がポリプロピレン製のパッキングを介して嵌合されている。次に、上記電池缶の底部に、厚さ０．０５ｍｍのＰＰＳ製の下部絶縁板を配置した後、捲回体の捲回軸方向が電池缶の高さ方向と同一となるように、上記捲回体を電池缶内に挿入した。次に、捲回体の上部に厚さ０．０５ｍｍのＰＰＳ製の上部絶縁板を配置した後、負極リードを負極端子の裏側に溶接した。その後、正極リードを電池缶と蓋との間に挟んだまま電池缶と蓋とをレーザー溶接により接合した。

【００５１】

最後に、蓋に設けられた直径１．５ｍｍの注液口から上記電解液を注液し、電極体に電解液を十分に浸透させた後、封止ピンを注液口に挿入してレーザー溶接することにより封口して、電池体積が２．３ｃｍ^{3}のコイン形リチウムイオン二次電池を作製した。

【００５２】

（実施例２）

正極の活物質未塗布部のアルミニウム箔を、捲回体の外周部側の端部と内周部側の端部よりそれぞれ折り返して取り出し、正極リードを２本形成した以外は、実施例１と同様にして、電池体積が２．３ｃｍ^{3}のコイン形非水電解液二次電池を作製した。

【００５３】

本実施例の捲回体の外径Ｄは、２３．５ｍｍ、捲回体の高さＨは３．７ｍｍ、これらの比Ｄ／Ｈは６．４であった。また、正極リードの断面積Ｃは０．０６ｍｍ^2、正極リードの数ｎは２、正極集電体の断面積Ｓは０．０６ｍｍ^2、これらの比（Ｃ×ｎ）／Ｓは２．０であった。

【００５４】

（実施例３）

正極の活物質未塗布部のアルミニウム箔の端部に、厚さ０．０２ｍｍ、幅５ｍｍ、長さ８ｍｍのアルミニウム製のタブを超音波溶接により接合し、捲回体の外周部側より取り出し、正極リードを１本形成した以外は、実施例１と同様にして、電池体積が２．３ｃｍ^{3}のコイン形非水電解液二次電池を作製した。

【００５５】

本実施例の捲回体の外径Ｄは、２３．５ｍｍ、捲回体の高さＨは３．７ｍｍ、これらの比Ｄ／Ｈは６．４であった。また、正極リードの断面積Ｃは０．１０ｍｍ^2、正極リードの数ｎは１、正極集電体の断面積Ｓは０．０６ｍｍ^2、これらの比（Ｃ×ｎ）／Ｓは１．７であった。

【００５６】

（比較例１）

正極の活物質未塗布部のアルミニウム箔の端部に，厚さ０．０２ｍｍ、幅２．５ｍｍ、長さ８ｍｍのアルミニウム製のタブを超音波溶接により接合し、捲回体の外周部側より取り出し、正極リードを１本形成した以外は、実施例１と同様にして、電池体積が２．３ｃｍ^{3}のコイン形非水電解液二次電池を作製した。

【００５７】

本比較例の捲回体の外径Ｄは、２３．５ｍｍ、捲回体の高さＨは３．７ｍｍ、これらの比Ｄ／Ｈは６．４であった。また、正極リードの断面積Ｃは０．０５ｍｍ^2、正極リードの数ｎは１、正極集電体の断面積Ｓは０．０６ｍｍ^2、これらの比（Ｃ×ｎ）／Ｓは０．８であった。

【００５８】

実施例１～３及び比較例１の正極及び負極の各寸法を表１及び表２にまとめて示す。

【００５９】

【表１】

	正極寸法（mm）			
	幅	活物質塗布長（表面側／裏面側）	電極厚さ	集電体厚さ
実施例１	３．０	１２２１／１１５５	０．１３４	０．０２
実施例２	３．０	１２２１／１１５５	０．１３４	０．０２
実施例３	３．０	１２２１／１１５５	０．１３４	０．０２
比較例１	３．０	１２２１／１１５５	０．１３４	０．０２

【００６０】

【表２】

	負極寸法（mm）			
	幅	活物質塗布長（表面側／裏面側）	電極厚さ	集電体厚さ
実施例１	３．５	１２０７／１２０７	０．１４２	０．０１２
実施例２	３．５	１２０７／１２０７	０．１４２	０．０１２
実施例３	３．５	１２０７／１２０７	０．１４２	０．０１２
比較例１	３．５	１２０７／１２０７	０．１４２	０．０１２

【００６１】

また、実施例１～３及び比較例１の電池パラメータ及び電極パラメータを表３及び表４に示す。

【００６２】

【表３】

	電池パラメータ					
	電池外径（mm）	電池高さ（mm）	電池体積（cm^3）	捲回体外径D（mm）	捲回体高さH（mm）	D／H
実施例１	２４	５．０	２．３	２３．５	３．７	６．４
実施例２	２４	５．０	２．３	２３．５	３．７	６．４
実施例３	２４	５．０	２．３	２３．５	３．７	６．４
比較例１	２４	５．０	２．３	２３．５	３．７	６．４

【００６３】

【表４】

	正極リード	電極パラメータ			
		正極リード断面積C（mm^2）	正極集電体断面積S（mm^2）	正極リード数n（本）	（C×n）／S
実施例１	Ａｌ箔	０．０６	０．０６	１	１．０
実施例２	Ａｌ箔	０．０６	０．０６	２	２．０
実施例３	Ａｌタブ	０．１０	０．０６	１	１．７
比較例１	Ａｌタブ	０．０５	０．０６	１	０．８

【００６４】

＜電池特性の評価＞

実施例１～３及び比較例１の各電池について、０．２Ｃで４．３Ｖまで定電流充電を行い、その後、電流値が０．０２Ｃとなるまで定電圧充電を行った。次に、０．２Ｃで３．０Ｖまで定電流放電を行って初期容量（ａ）を求めた。なお、「Ｃ」とは、電池の設計容量を１時間で放電する場合の電流値を意味する。

【００６５】

続いて、各電池を０．２Ｃで４．３Ｖまで定電流充電を行い、その後、電流値が０．０

２Ｃとなるまで定電圧充電を行った。次に、２Ｃで３．０Ｖまで定電流放電を行って重負荷容量（ｂ）を求めた。

【００６６】

上記結果から容量維持率Ｚ（％）を下記式から求め、放電負荷特性として評価した。

【００６７】

Ｚ＝（ｂ／ａ）×１００

【００６８】

上記電池特性を、パラメータＤ／Ｈ及びパラメータ（Ｃ×ｎ）／Ｓとともに表５に示す。

【００６９】

＜サイクル特性の評価＞

充放電サイクル試験を次にように行った。充電は各電池について、０．５Ｃで４．３Ｖまで定電流充電を行い、その後、電流値が０．０２Ｃとなるまで定電圧充電を行った。放電は、１Ｃで３．０Ｖまで定電流放電を行った。この充放電を１サイクルとして２００サイクルまで繰り返した。次に、電池の外観を目視により観察し、電池の変形の有無を確認した。その結果を表５に示す。

【００７０】

【表５】

	パラメータ		電池特性		サイクル特性
	Ｄ／Ｈ	（Ｃ×ｎ）／Ｓ	初期容量（ｍＡｈ）	容量維持率Ｚ（％）	電池変形の有無
実施例１	６．４	１．０	２２０	９０	無し
実施例２	６．４	２．０	２１０	９３	無し
実施例３	６．４	１．７	２２０	９２	無し
比較例１	６．４	０．８	２２０	７８	無し

【００７１】

表５から、パラメータ（Ｃ×ｎ）／Ｓが１以上の範囲にある実施例１～３は、その範囲外にある比較例１に比べて容量維持率Ｚ（重負荷特性）が高いことが分かる。また、実施例１～３及び比較例１の各電池では充放電を２００回繰り返しても電池の変形は一切認められなかった。

【産業上の利用可能性】

【００７２】

以上説明したように、本発明は、放電負荷特性が高く、充放電に伴う電池の変形もないコイン形非水電解液二次電池を提供できる。このコイン形非水電解液二次電池は、ウェアラブル機器用の電源だけでなく、様々な機器の電源として広く利用できる。

【図面の簡単な説明】

【００７３】

【図１】本発明に用いる捲回体の斜視図である。

【図２】捲回体を円筒状の電池缶に挿入している工程を示す斜視図である。

【図３】捲回体を電池缶に挿入した後に、捲回体の上に上部絶縁板を配置している工程を示す斜視図である。

【図４】上部絶縁板を捲回体の上に載置し、蓋の中央部に配置された負極端子の裏部と負極リードとを溶接した状態の斜視図である。

【図５】図５Ａは、電池缶と蓋とをレーザー溶接等により接合した状態の斜視図であり、図５Ｂは、図５ＡのＢ－Ｂ線の断面図である。

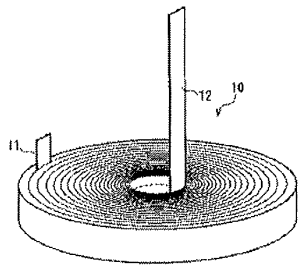
【図６】捲回体の模式図である。

【図７】本発明のパラメータを説明するための正極の模式図である。

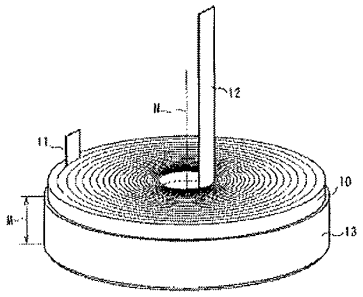
【図８】図７のＩ－Ｉ線の断面図である。

【図９】図７のＩＩ－ＩＩ線の断面図である。
【図１０】図７の正極リードの他の形態を示す斜視図である。
【符号の説明】
【００７４】
１　正極
２　負極
３　セパレータ
１０　捲回体
１１　正極リード
１２　負極リード
１３　電池缶
１４　上部絶縁板
１５　蓋
１６　負極端子
１７　絶縁パッキング
１８　注液口
１９　下部絶縁板
２０　正極
２１　正極集電体
２２　第１正極活物質層
２３　第２正極活物質層
２４　正極リード
２５　正極リード

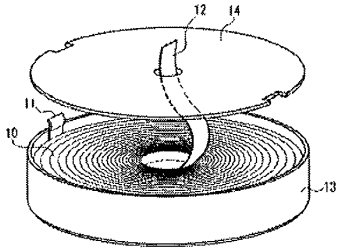
【図１】



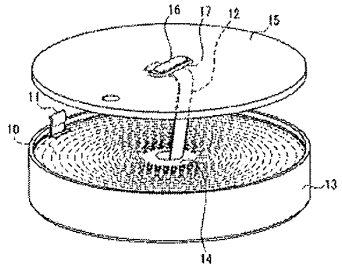
【図２】



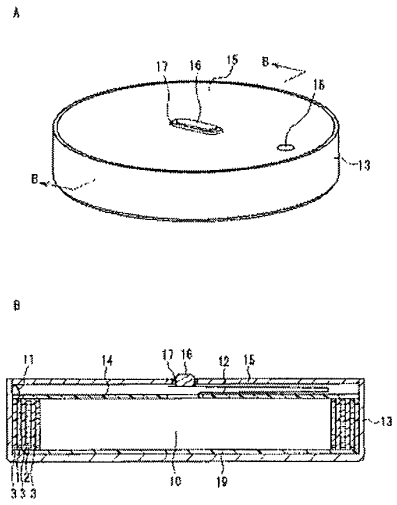
【図３】



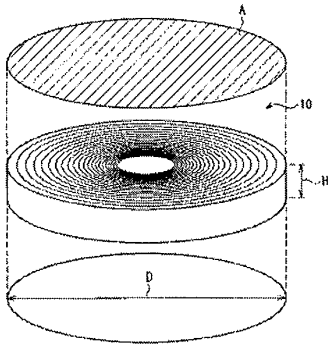
【図４】



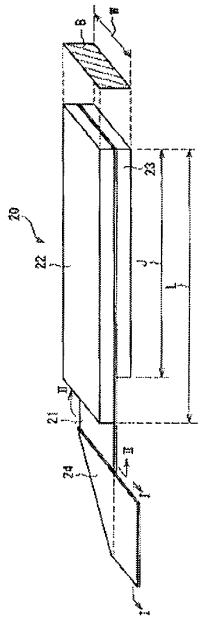
【図５】



【図６】



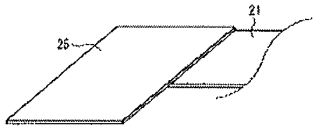
【図７】



【図８】

【図９】

【図１０】



フロントページの続き

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PATENT ABSTRACTS OF JAPAN

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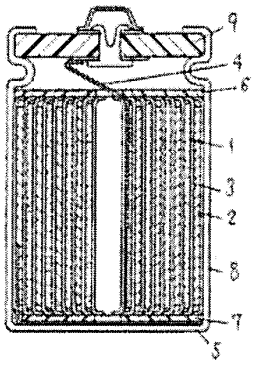
(54) CYLINDRICAL LITHIUM SECONDARY BATTERY

(57)Abstract:
PURPOSE: To suppress internal shortcircuiting due to generation of dendrite of negative electrode lithium and prevent the charging/discharging characteristics from dropping by folding end faces of a separator protruding in the upper and lower parts of an electrode in the direction of a core by means of hot wind heating, and thereby wrapping a positive and a negative electrode plate.
CONSTITUTION: An electrode body is made by the use of a separator 3 consisting of a fine porous film in three dimensional void structure, and this separator 3 extruding over and under the electrode body is folded in the direction of a core by means of hot wind heating so as to wrap a positive and a negative electrode plate 1, 2. This reduces dispersion of the charging/discharging characteristics because the permeation of the electrolyte is uniform and the liquid retaining property is excellent, and internal shortcircuiting due to void penetration can be prevented even when the dendrite has grown.



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審査請求　未請求　請求項の数 1　（全5頁）

㊹発明の名称　円筒形リチウム二次電池

㉑特　願　昭63－136383
㉒出　願　昭63(1988)6月2日

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明　細　書

1、発明の名称

円筒形リチウム二次電池

2、特許請求の範囲

正極と負極と、これら両極板よりも幅の広い帯状で三次元的空孔構造を有するポリオレフィン系の微孔性フィルムからなるセパレータを極板間に介在させて全体を渦巻状に巻回して構成した電極体を備え、かつこの電極体の上下部に突出しているセパレータの各端面を熱風加熱によって巻芯方向に折曲せしめて前記正，負極板を包被したことを特徴とする円筒形リチウム二次電池。

3、発明の詳細な説明

産業上の利用分野

本発明は金属リチウムを活物質とする負極板と、正極板とを、この両極間にセパレータを介在させて渦巻状に構成した電極体を有する円筒形リチウム二次電池に関するものである。

従来の技術

一般に有機電解液リチウム電池は、高エネルギー密度で長期信頼性に優れ、しかも作動温度範囲が広いなどの特長がある。

近年、このような長所を生かしつつ再充電可能ないわゆるリチウム二次電池の開発が活発化してきている。一般的には、金属リチウムを主活物質とする負極と、二硫化チタン（TiS_2）をはじめとする各種の層間化合物などを正極活物質として用い、炭酸プロピレンなどの有機溶媒に過塩素酸リチウムなどを溶解した有機電解液が用いられる。しかし、負極の充放動サイクルの寿命が短いことなどで、現在まだ実用化には至っていない。負極活物質としてのリチウムは、充放電サイクルとともに変形して樹枝状析出（デンドライト）を生じ。それが内部短絡ブリッジを形成するなど困難な問題を含んでいる。特にデンドライトは、電流密度の高い所に集中して発生し、リチウム負極面から垂直に成長する性質のもので、充放電サイクルが進むにつれてデンドライトによる表面の不均一化は促進され、最終的には脱落してしまう。このようにして負極から脱落したリチウムのデンドライ

トは、電解液中を浮遊するので、正極と電気的接触を持っている電池のケースやリード部分に接触する危険性があり、もし接触すれば、いわゆる内部短絡を起こしてしまい、電池としての機能は失われてしまう。また、デンドライトが脱落しないまでも、その成長が進みセパレータの空孔部を貫通して内部短絡を起こす危険性は高い。

このような負極の欠点を改良するため、サイクル寿命という観点から、電解液にデンドライトの発生を抑制する添加剤を加える方法、あるいはリチウムとの合金を用いる方法などの検討がなされているものの、さらに信頼性の向上、特に安全性という観点からの検討は遅れているといえる。

すなわち、デンドライトが発生した場合、これをセパレータ空孔部に貫通および電解液に浮遊させないことが重要である。そのためには、高信頼性でかつエネルギー密度を極力低下させないようなセパレータの最適構成化を図らなければならない。

しかしながら、従来のこの種電極体のセパレータは、断面形状が第4図のような不織布または第5図のような二次元的空孔構造の微孔性フィルムが用いられる。そしてこれらの構成方法は次の2通りあり、各電極体の構成断面図は第6図および第7図に示すように、既存のリチウム一次電池の構成方法をそのまま採用したものである。第1の方法は、第6図に示すごとくエキスパンデッドメタルやネットなどの芯材に二硫化チタンなどを活物質とする合剤を充填、乾燥してなる正極板1と金属リチウムを活物質とする負極板2との間に帯状セパレータ3を介在させて全体を渦巻状に構成する方法である。

第2の方法は、第7図の如く正負極板1，2それぞれをセパレータ3で包被して渦巻状に構成したものである。

発明が解決しようとする課題

従来の構成ではセパレータの形状および構成方法の両面で、以下の課題を有していた。

まず、セパレータの形状は次の4つの特性が要求される。

(1) 均一な充放電反応を進行させるために、セパレータの表面形状が平滑であること。

(2) デンドライトの成長によってセパレータの空孔を貫通しない空孔構造を有すること。

(3) 電池の短絡などの異常が生じた際、電極反応を瞬時に遮断し得ることのできるセパレータの高温閉孔性を有すること。

(4) 電解液の保液性に優れていること。

以上の特性に対して不織布の場合は、繊維状の樹脂が不規則に形成されているので表面形状が粗くしかも空孔も大きくて不均一なため、上記4の特性を除いていずれも充足できない課題がある。

また、二次元的空孔構造の微孔性フィルムの場合は、上記1と3の特性は備えているが、空孔の構造から保液性に乏しく、デンドライトが成長した際に空孔を貫通して内部短絡を起こし易いという課題がある。

次に、セパレータの構成面では以下の2つの条件が重要である。

(1) デンドライトの浮遊を防止する構成であること。

(2) エネルギー密度を低下させない構成であること。

しかし従来の構成では、まず第1の方法の場合、セパレータ3の上下部が開口しているため、デンドライトの浮遊やブリッジによって内部短絡を起こす危険性が極めて大である。このため、電極体の上下に絶縁板を装着する必要がある。しかしながら、電極体の上下に絶縁板を圧接した際、電極体の上下から突出しているセパレータが不均一に折れ曲がる。さらに折れ曲がったセパレータの反発作用で絶縁板が押し上げられるため、電極体への絶縁板の密着性が不均一かつ不十分で、デンドライトによる内部短絡の防止は困難であった。また電極体と絶縁板の密着性を高めるために絶縁板をより強固に圧接した場合は、極板の脱落が起こり電池性能が低下するばかりでなく内部短絡の防止ができないという課題があった。

また第2の方法で構成した場合は、渦巻状に巻回する際に第8図の斜線部Aにセパレータのシワ

が発生する。このため電極体の外径が大きくなり、ケースへの挿入が困難となる。

したがって、極板寸法を薄くあるいは短くして対処しなければならず、放電容量を低下させるという問題が生じる。また電解液が前記シワの部分に均一に浸透しにくいため、充放電特性のバラツキを増大させるという課題も有していた。

本発明はこのような課題を解決するもので、安全性および充放電特性の向上を目的とするものである。

課題を解決するための手段

これらの課題を解決するために本発明は、三次元的空孔構造を有する微孔性フィルムからなるセパレータを用いて前記第1の方法により電極体を構成し、さらに電極体の上下からはみ出ているセパレータを熱風加熱によって巻芯方向に折曲し正、負、両極板を被覆したものである。

作　用

この構成により、電解液の浸透が均一で保液性に優れていることから充放電特性のバラツキが低減できる。しかもデンドライトが成長した場合にも空孔貫通による内部短絡が防止できる。さらに微孔性フィルムであるため、電池の短絡など異常時の発熱でフィルムが溶けて空孔を閉塞し、電極反応を瞬時に遮断して安全性を確保することができる。

また、電極体の上下部を均一に被覆することができるのでデンドライトが脱落しにくく、しかもデンドライトの脱落がおこった場合にも電解液中への浮遊が阻止できることとなる。

実　施　例

第1図は本発明の一実施例による円筒形リチウム二次電池の断面図であり、以下これについて詳述する。

1図において、正極板1は五二酸化クロム(Cr_2O_5)を主活物質とする正極合剤をチタニウム製のエキスパンデッドメタルからなる芯材に充填し、乾燥したものである。4は芯材と同材質からなる正極リード板で芯材にスポット溶接したものである。負極板2は金属リチウムからなり、その一側面に負極リード板5が圧着されている。

3は三次元的空孔構造（海綿状）第2図参照を有するポリオレフィン系、例えばポリプロピレン、ポリエチレンまたはそれらの共重合体の微孔性フィルム（充放電特性や安全性の点で孔径は0.01～0.8μが好ましい）からなるセパレータで、正負極板1，2よりも幅の広い帯状に裁断したものである。本実施例ではポリプロピレン製の微孔性フィルムを使用した。第3図は第2図の3a部の拡大模式図であり、大きな連通空孔があいている。

次に、これらの正負極1，2間にセパレータ3を介在して全体を渦巻状に巻回して電極体を構成する。

そして電極体を回転させながら電極体の上下部端面、すなわち正負極1，2から突出したセパレータに熱風を電極体の巻芯方向にやや斜め上から送風して、前記セパレータの突出部を巻芯方向に収縮させながら折曲させて電極体を被覆し電極体の構成を完了する。（尚、加熱温度はセパレータの材質によって異なるが、本実施例の場合は140～160℃で行った。また折曲させた部分に平板を適度に押し当てて密着性をより高めてもよい。）

次に、ケース8上部に段部を形成させた後、電解液（本実施例では炭酸プロピレンと1，2－ジメトキシエタンの混合溶媒に溶質として過塩素酸リチウムを溶解させたものを用いた。）を注入する。注液する際、減圧下で操作すると短時間に均一な含浸状態が得られる。

そして封口板9を装着した後、ケース8開口端をカシメ封口することにより電池の組立てを完了する。

表1は本発明品と従来品各100個の充放電試験中における内部短絡による電圧不良数および50サイクル目の放電容量の最大値，最小値および平均値をまとめたものである。この場合の試験条件は、20℃において50mA の定電流で正極の充填容量の約80%にあたる600mAhの深さで充放電を繰り返したものである。

表　1

区	セパレータ		電圧不良	放電容量(mAh)		
	形状	構成	発生数(個)	最大	最小	平均
1	本発明品	本発明品	0／100	600	555	575
2	不織布	従来例1	100／100	600	550	570
3		〃 2	87／100	425	275	340
4	二次元的空孔構造微孔性フィルム	従来例1	75／100	585	550	565
5		〃 2	61／100	425	275	340

第9図は本発明品と従来品を前記同一条件で充放電試験したときの200サイクル目の放電特性の一例を示したものである。

これらの結果からも明らかなように、本発明品はセパレータの表面形状が平滑なため均一な充放電反応の進行が可能であり、デンドライトの成長が抑制できる。そして三次元的空孔構造を有しているため、電解液の浸透が均一で保液性にも優れることから充放電特性のバラツキが低減できる。しかもデンドライトが成長した場合にも空孔貫通による内部短絡が防止できる。さらに微孔性フィルムであるため、電池の短絡など異常時の発熱でフィルムが溶けて空孔を閉塞し、電極反応を瞬時に遮断して安全性を確保することができる。

また、セパレータ構成においては従来のように極板をあらかじめ袋状セパレータで包被して渦巻状電極体を構成した場合のセパレータのシワの発生がないために、電極体外径が大きくなりケースへの挿入が困難となることがない。さらに電極体上下に突き出ているセパレータの上下端面部を熱風加熱することによって、電極体上下の凹凸に添ってよく馴じむと同時に巻芯方向に折曲して電極体の上下部を均一に被覆することができるのでデンドライトが脱落しにくく、しかもデンドライトの脱落がおこった場合にも電解液中への浮遊が阻止することができるもので、内部短絡の防止および充放電特性の点で優れていることがわかる。

発明の効果

以上のように本発明によれば、負極リチウムのデンドライトの発生に伴う内部短絡の抑制および充放電特性の低下やバラツキが極めて小さいという効果が得られる。

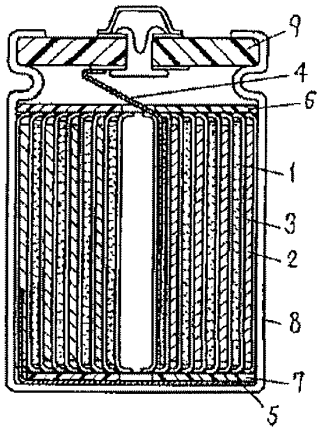
4．図面の簡単な説明

第1図は本発明の一実施例による円筒形リチウム二次電池の断面図、第2図は本発明の一実施例によるセパレータの断面図、第3図は第2図における3a部分拡大図、第4図および第5図は従来のセパレータの断面形状を示す図。第6図および第7図は従来の渦巻状電極体の構成を示す断面図、第8図は従来のセパレータ包被極板を巻回した場合のシワ発生部分を示す図である。第9図は充放電試験における200サイクル目の放電特性を示す図である。

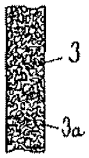
1……正極、2……負極、3……セパレータ。

代理人の氏名　弁理士　中　尾　敏　男　ほか1名

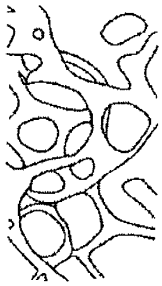
第　1　図



第 2 図



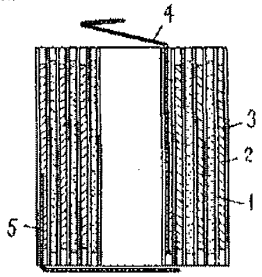
第 3 図



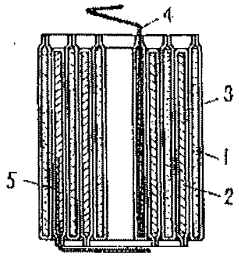
第 4 図

第 5 図

第 6 図

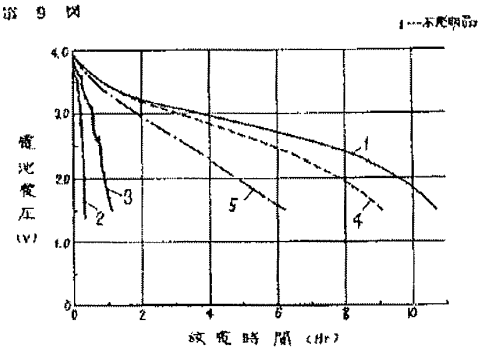


第 7 図



第 8 図

第 9 図



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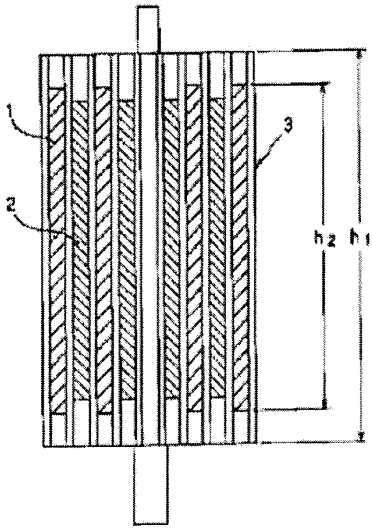
(71)Applicant : **SONY CORP**
(72)Inventor : **KAGEYAMA MASAYUKI**

(54) MANUFACTURE OF CYLINDRICAL NONAQUEOUS ELECTROLYTE BATTERY

(57)Abstract:
PURPOSE: To manufacture a large-capacity cylindrical nonaqueous electrolyte battery with high productivity by preventing a band-like positive electrode and a band-like negative electrode from being protruded over a separator and contacting with each other, and increasing the actual filled electrodes.
CONSTITUTION: A separator 3 having the width larger than that of a band-like positive electrode 2 or a band-like negative electrode 1 is used for manufacturing a wound electrode body so that part of the separator 3 is protruded over the upper and section and the lower end section of the band-like positive electrode 2 and the band-like negative electrode 1 when a layered product is wound, and part of the separator 3 protruded over the band-like positive electrode 2 and the band-like negative electrode 1 is folded to the inside or the outside by heat-molding.



CLAIMS

[Claim(s)]
[Claim 1]Laminate a strip positive electrode and a strip negative electrode via a separator in between, wind this laminated body spirally, and it faces producing a wound electrode body, Width uses a so-called size rather than a strip positive electrode and a strip negative electrode as a separator, A manufacturing method of a cylindrical nonaqueous electrolyte battery making it a part of separator protrude up and down from a strip positive electrode and a strip negative electrode where a laminated body is wound, and bending a part of this separator from which it protruded on the inside or the

outside by heating molding.

[Translation done.]

* NOTICES *

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]The present invention relates to the manufacturing method of the cylindrical nonaqueous electrolyte battery which stores a wound electrode body in a cylindrical battery can.
[0002]
[Description of the Prior Art]Remarkable progress of electronic technology in recent years is realizing the small size and one weight saving of an electronic device after another. In connection with it, the thing of small size, a light weight, and high energy density is increasingly called for also from the cell as a power supply for movement.
[0003]Conventionally, as a rechargeable battery of a general use, aqueous solution system cells, such as a lead battery and a nickel-cadmium battery, were in use. However, these aqueous solution system cell cannot be said to be what it can be satisfied with a cycle characteristic of enough in respect of the battery weight of what [excellent], or an energy density.
[0004]Then, the substance in which the dope and a dedope of a lithium ion like lithium, a lithium alloy, or a carbon material are possible is used for an anode, and research and development of the nonaqueous electrolyte secondary battery which uses lithium composite oxides, such as a lithium cobalt multiple oxide, for a positive electrode are performed these days. This cell has high cell voltage and has a high energy density.
[0005]By the way, as a use of these nonaqueous electrolyte secondary batteries, the supplied power source of portable electronic devices with the comparatively big consumed electric current, such as a video camera and a laptop computer, is assumed taking advantage of the feature that high energy density is obtained.
[0006]When using a cell as a supplied power source of an electronic device with the comparatively big consumed electric current, it is desirable to take wound electrode body form as an electrode form. A wound electrode body laminates a strip positive electrode and a strip negative electrode via a separator in between, and is produced by winding this laminated body spirally.
A wide electrode area can be taken and it can be equal to load discharging-proof.

[0007]Here, in such a wound electrode body, when the width of the strip positive electrode and the strip negative electrode was completely equalized and a strip positive electrode and a strip negative electrode deviate from a separator to a height direction in production processes, there is a possibility that some of strip positive electrodes and strip negative electrodes may protrude, it may contact mutually, and an internal short circuit may be induced from a separator.
[0008]For this reason, even if it is made for a part of separator to protrude up and down from a strip positive electrode and a strip negative electrode after width has wound the laminated body rather than the strip positive electrode and the strip negative electrode, using a so-called size as a separator and a strip negative electrode and a strip positive electrode deviate to the grade upper and lower sides for a while, Usually it is considered as the design with a margin which has not been referred to as

contacting exceeding a separator.
[0009]
[Problem to be solved by the invention]However, if it is made a design from which a part of separator protrudes up and down from a strip positive electrode and a strip negative electrode in this way, it is necessary also for a battery can to secure the excessive volume which is naturally equivalent to a part for the flash of the separator.
[0010]Since it is necessary to secure the excessive space which does not participate in this cell capacity in the nonaqueous electrolyte secondary battery using a wound electrode body, increase of the substantial fill volume of an electrode is restricted by the actual condition, and it cannot raise energy per volume sufficiently.
[0011]Then, the present invention is proposed in view of such the conventional actual condition, and is a thing.
A strip positive electrode and a strip negative electrode can protrude from the purpose more, and it has not been said to induce an internal short circuit, and can increase substantial fill volume of an electrode, and a cell of high capacity is providing a manufacturing method of a cylindrical nonaqueous electrolyte battery which can be manufactured with sufficient productivity.

[0012]
[Means for solving problem]In order to attain the above-mentioned purpose, the manufacturing method of the cylindrical nonaqueous electrolyte battery of the present invention, Laminate a strip positive electrode and a strip negative electrode via a separator in between, wind this laminated body spirally, and it faces producing a wound electrode body, It is made for a part of separator to protrude up and down from a strip positive electrode and a strip negative electrode, after width has wound the laminated body rather than the strip positive electrode and the strip negative electrode, using a so-called size as a separator, and a part of this separator from which it protruded is bent on the inside or the outside by heating molding.
[0013]In the manufacturing process of a cylindrical nonaqueous electrolyte battery, a wound electrode body laminates a strip positive electrode and a strip negative electrode via a separator in between, and is produced by winding this laminated body spirally.
[0014]It does in this way, faces producing a wound electrode body, and is made for a part of separator 3 to protrude up and down from the strip positive electrode 2 and the strip negative electrode 1 in the present invention, after width has wound the laminated body rather than the strip positive electrode 2 and the strip negative electrode 1, using a so-called size as the separator 3 as shown in Fig.1. And as shown in Fig.2, suppose that a part of this separator 3 from which it protruded is bent on the inside or the outside by heating molding.
[0015]Thus, if a part of separator 3 from which it protruded from the strip positive electrode 2 and the strip negative electrode 1 where a laminated body is wound is bent on the inside or the outside by heating molding, So to speak, space 4 where the strip positive electrode 2 or the strip negative electrode 1 between the separator 3 and the separator 3 is arranged will be covered by the bending part of a separator. Therefore, even if the strip negative electrode 1 and the strip positive electrode 2 deviate up and down by a certain cause, it has not said that it contacts mutually exceeding a separator, and the internal short circuit by contact of strip positive electrode 2 and strip negative electrode 1 comrades is prevented.
[0016]By the wound electrode body which the separator 3 from which it protruded up and down bends, height is low stopped compared with the wound electrode body to which the amount of flash of the separator 3 has extended in the height direction as it is from the strip positive electrode 2 and the strip negative electrode 1 in this way. Therefore, battery can volume can be reduced and the cylindrical nonaqueous electrolyte secondary battery whose substantial electrode pack density is capacity largely and which becomes in size will be obtained.
[0017]In order to prevent the internal short circuit of a cell reliably, the balance of the height of the whole wound electrode body and the height of the strip negative electrode 1 and the strip positive electrode 2 is important.
[0018]Namely, the height of the electrode 1 with longer length is made into h_2 for the height of the separator 3 in the state where heating molding is not carried out as shown in Fig.1, among h_1 and an electrode, When the height of the electrode 1 with longer length is made into H_2 among H_1 and an

electrode, the height of the whole wound electrode body in the state where heating molding was carried out as shown in Fig.2, h_1 and h_2 fulfill the conditions which $0.9h_1<=h_2<=0.98h_1$ Become more preferable than $0.8h_1<=h_2<=h_1$, H_1 and H_2 -- $0.94H_1<=H_2<=H_1$ -- preferable -- $0.95H_1<=H_2<=0.99H_1$ -- it is desirable to fulfill conditions.

[0019]When the height of the band electrodes 1 and 2 exceeds a mentioned range, Since there is no margin between the bending part of the separator 3 which serves as a lid in the electrode disposition space 4 in the state where heating molding was carried out, and the band electrode 1 and two ends, the band electrode 1 and two ends are exposed from the slight gap between this bending part, it, and the separator 3 that is adjacent to, and this causes an internal short circuit.

[0020]On the contrary, when the height of the band electrodes 1 and 2 is less than a mentioned range, it means that the separator 3 use area per wound electrode body increases, and is not preferable from the surface of material cost.

[0021]As the above-mentioned separator 3, each thing used in the nonaqueous electrolyte battery is usually usable, The fine porous film consisting of polyolefin system resin, such as polypropylene, polyethylene, and polybutylene, nylon, cellulose acetate, a nitrocellulose, polysulfone, polyacrylonitrile, polyvinylidene fluoride, etc. is used.

[0022]Although the method in particular of carrying out heating molding of these separators 3 is not limited, the hot wind blow system molded by spraying a hot wind to the separator 3, the heat pressing system molded by applying a pressure from the upper and lower sides by a heating jig, etc. are employable.

[0023]However, as for the cooking temperature in the case of heating molding, setting to less than the melting point is [beyond the temperature to which melting of the separator 3 is not softened and carried out, i.e., the softening temperature of the separator 3,] desirable. When cooking temperature is set up more than the melting point of the separator 3, it becomes a situation where the separator 3 carries out melting and a part of hole is buried and where nonaqueous electrolyte does not shift to the electrode disposition space 4 easily due to the separator 3 which carried out melting, and the separator 3 which adjoins it carrying out weld unification etc. Thereby, the amounts of electrolysis solution impregnation of the electrodes 1 and 2 run short, and it leads to deterioration of service capacity.

[0024]On the other hand, the strip negative electrode 1 and the strip positive electrode 2 are produced by applying the electrode compound containing an electrode active material to a strip-like electrode collector.

[0025]As negative electrode active material, carbon materials, such as conductive polymers, such as lithium, a lithium alloy, and polyacethylene, and corks, etc. can be used.

[0026]As positive active material, a transition metal compound like manganese dioxide and vanadium pentoxide, transition metal charcogen compounds, such as an iron sulfide, and also the conjugated compound of these and lithium can be used.

[0027]As an electrolysis solution, lithium salt is used as an electrolyte, for example, and the electrolysis solution which dissolved this in the organic solvent is used. Especially as an organic solvent, although not limited, for example Propylene carbonate, Ethylene carbonate, diethyl carbonate, 1, 2-dimethoxyethane, 1,2-diethoxyethane, r-butyrolactone, a tetrahydrofuran, 1,3-dioxolane, 4-methyl-1,3-JIEKISORAN, diethylether, sulfolane, methyl sulfolane, acetonitrile, propionitrile, etc. can be independent, or two or more kinds of mixed solvents can be used. Each what are more publicly known than before can use it also for an electrolyte, and there are $LiClO_4$, $LiAsF_6$, $LiPF_6$, $LiBF_4$, $LiB(C_6H_5)_4$, LiCl, LiBr, CH_3SO_3Li, CF_3SO_3Li, etc. in it.

[0028]

[Function]In the manufacturing process of a cylindrical nonaqueous electrolyte secondary battery, a wound electrode body laminates a strip positive electrode and a strip negative electrode via a separator in between, and it is produced by winding this laminated body spirally.

[0029]Thus, face producing a wound electrode body and width uses a so-called size rather than a strip positive electrode and a strip negative electrode as a separator, If it is made for a part of separator to protrude up and down from a strip positive electrode and a strip negative electrode where a laminated body is wound and a part of this separator from which it protruded is bent on the inside or the outside by heating molding, the cylindrical nonaqueous electrolyte secondary battery which is capacity and which becomes in size will be produced without causing an internal short circuit.

[0030]Namely, if a part of separator from which it protruded from the strip positive electrode and the strip negative electrode where a laminated body is wound is bent on the inside or the outside by heating molding, So to speak, space where the strip positive electrode or strip negative electrode between separators is arranged will be covered by the bending part of a separator. Therefore, even if a strip negative electrode and a strip positive electrode deviate up and down by a certain cause, it has not said that it contacts mutually exceeding a separator, and the internal short circuit by contact of a strip positive electrode and strip negative electrodes is prevented.
[0031]By the wound electrode body which the separator from which it protruded up and down bends, height is low stopped compared with the wound electrode body to which the amount of flash of the separator has extended in the height direction as it is from a strip positive electrode and a strip negative electrode in this way. Therefore, battery can volume can be reduced and the cylindrical nonaqueous electrolyte secondary battery whose substantial electrode pack density is capacity largely and which becomes in size is gained.
[0032]
[Working example]Based on an experimental result, it describes about the preferable working example of the present invention.
[0033]Drawing of longitudinal section of the cylindrical nonaqueous electrolyte battery produced by working-example 1 this example is shown in Fig.3. The cylindrical nonaqueous electrolyte battery of such composition was produced as follows.
[0034]First, the strip negative electrode 21 was produced as follows.
[0035]After carrying out weight introduction (what is called oxygen cross-bridging) of the functional group which contains oxygen in this 10 to 20%, using a petroleum pitch as a starting material, it calcinated at the temperature of 1000 degrees C among the inactive gas air current, and the carbonaceous material with the property near glassy carbon was obtained. As a result of performing X-ray diffraction measurement about this carbonaceous material, the spacing of the surface (002) was 3.76A. When true specific gravity was measured by the pyknometer method, it was 1.58g/cm^3. This carbonaceous material was ground and it was considered as carbonaceous material powder with a mean particle diameter of 10 micrometers. Thus, the obtained carbonaceous material powder was made into the negative-electrode-active-material carrier, 10 parts by weight of poly fluoridation kinky thread NIDEN (PVDF) used as 90 parts by weight of this carbonaceous material powder and a binding material was mixed, and negative electrode mixture was prepared. N-methyl pyrrolidone which is a solvent was distributed and this negative electrode mixture was made into the anode slurry (paste state).
[0036]After using 10-micrometer-thick strip-like copper foil as the negative pole collector 29 and making both sides of this negative pole collector apply and dry the above-mentioned negative electrode mixture slurry, compression molding was carried out and the strip negative electrode 1 was produced. The dimension of the electrode of this strip negative electrode 21 was 43.4 mm in width, and 700 mm in length, and both sides made mixture thickness after molding the same at 80 micrometers.
[0037]Next, the strip positive electrode 22 was produced as follows.
[0038]1 mol of cobalt carbonate was mixed with 0.5 mol of lithium carbonate, among the air, it calcinated at the temperature of 900 degrees C for 5 hours, and $LiCoO_2$ was obtained. $LiCoO_2$ was used as positive active material, 3 parts by weight of poly fluoridation kinky thread NIDEN used as 6 parts by weight of graphite used as 91 parts by weight of this and a conducting agent and a binding agent was mixed, and positive electrode mixture was prepared. N-methyl pro RIDON was made to distribute this positive electrode mixture, and it was considered as the positive electrode slurry (paste state).
[0039]After using 20-micrometer-thick strip-like aluminium foil as the positive pole collector 30 and making both sides of this positive pole collector 30 apply and dry the above-mentioned positive electrode mixture slurry uniformly, compression molding was carried out and the strip positive electrode 22 was produced. The dimension of the electrode of this strip positive electrode 22 was 41.4 mm in width, and 650 mm in length, and both sides made mixture thickness after molding the same at 80 micrometers.
[0040]The strip negative electrode 21 43.4 mm in width, and 700 mm in length produced as mentioned above, A fine porosity polypropylene film 25 micrometers in thickness and 45.9 mm in width is made into the separator 23 for the strip positive electrode 22 41.4 mm in width, and 650 mm in length, It

laminated in order of the strip negative electrode 21, the separator 23, the strip positive electrode 22, and the separator 23, and this laminated body was wound by direction that the cross direction turns into a height direction of a winding body many times. And a wound electrode body 19.6 mm in diameter and 45.9 mm in height was produced by fixing the separator final end part which is placed at an outermost periphery on a 40-mm-wide tape. The separator 23 is protruding from this winding body up and down from the strip negative electrode 21 and the strip positive electrode 22.
The percentage of height of the strip negative electrode 21 over overall height of a winding body was 94.6%.

[0041]Next, the flash portion of the separator protruded to the upper and lower sides of this winding body was bent inside, and was pressurized for about 5 seconds by pressure 3.8 kg/cm^2 using the fixture made from aluminum heated in temperature of 150 degrees C in this state. As a result, the wound electrode body whose percentage of the height of the strip negative electrode 21 of as opposed to 44.0 mm and overall height in height is 98.6% was obtained.
[0042]Thus, to the iron battery cans 25 which performed nickel plating for the produced wound electrode body, the insulator plate 24 was arranged and stored to wound electrode body up-and-down both sides. And the positive electrode leads 32 made from aluminum were drawn from the positive pole collector, the negative electrode leads 31 made from nickel were drawn from the negative pole collector to the battery lid 27, and it welded to the battery can 25.
[0043]Into this battery can 25, the electrolysis solution which dissolved $LiPF_6$ at a ratio of 1 mol/liter into the amount mixed solvent of isochore of propylene carbonate and diethyl carbonate was injected. By and the thing which you fix the safe valve gear 8 and the battery lid 27 which have an electric current breaker style by caulking the battery can 25 via the insulating sealed gasket 26 which applied the surface with asphalt, and is made to hold the airtightness in a cell, A cylindrical nonaqueous electrolyte battery 20 mm in diameter and 50 mm in height was produced.
[0044]A fine porosity polypropylene film with a width [used as working-example 2 separator] of 48.4 mm, The strip negative electrode 43.4 mm in width and 700 mm in length produced like the working example 1 and a strip positive electrode 41.4 mm in width and 650 mm in length were laminated in order of the strip negative electrode, the separator, the strip positive electrode, and the separator, it whirled and this laminated body was wound around the mold many times. And the separator end of the outermost periphery was fixed on the 40-mm-wide tape, and a winding body 19.6 mm in diameter and 48.4 mm in height was produced. A separator is protruding from this winding body up and down from a strip negative electrode and a strip positive electrode.
The percentage of height of a strip negative electrode over overall height of a winding body was 89.7%.

[0045]Next, the flash portion of the separator protruded to these upper and lower sides was bent inside, and application-of-pressure molding was carried out on the same conditions as the working example 1. As a result, the wound electrode body whose percentage of the height of a strip negative electrode of as opposed to 44.0 mm and overall height in height is 98.6% was obtained.
[0046]This wound electrode body was stored in the same battery can as the working example 1, and a cylindrical nonaqueous electrolyte battery 20 mm in diameter and 50 mm in height was produced by performing welding of a lead, injection of an electrolysis solution, and fixing of a battery lid.
[0047]A fine porosity polypropylene film with a width [used as working-example 3 separator] of 44.4 mm, The strip negative electrode 43.4 mm in width and 700 mm in length produced like the working example 1 and a strip positive electrode 41.4 mm in width and 650 mm in length were laminated in order of the strip negative electrode, the separator, the strip positive electrode, and the separator, it whirled and this laminated body was wound around the mold many times. And the separator end of the outermost periphery was fixed on the 40-mm-wide tape, and a winding body 19.6 mm in diameter and 44.4 mm in height was produced. A separator is protruding from this winding body up and down from a strip negative electrode and a strip positive electrode.
The percentage of height of a strip negative electrode over overall height of a winding body was 97.7%.

[0048]Next, the flash portion of the separator protruded to these upper and lower sides was bent inside, and application-of-pressure molding was carried out on the same conditions as the working example 1. As a result, the wound electrode body whose percentage of the height of a strip negative

electrode of as opposed to 44.0 mm and overall height in height is 98.6% was obtained.
[0049]This wound electrode body was stored in the same battery can as the working example 1, and a cylindrical nonaqueous electrolyte battery 20 mm in diameter and 50 mm in height was produced by performing welding of a lead, injection of an electrolysis solution, and fixing of a battery lid.
[0050]A fine porosity polypropylene film with a width [used as working-example 4 separator] of 44.4 mm, The strip negative electrode 43.4 mm in width and 700 mm in length produced like the working example 1 and a strip positive electrode 41.4 mm in width and 650 mm in length were laminated in order of the strip negative electrode, the separator, the strip positive electrode, and the separator, it whirled and this laminated body was wound around the mold many times. And the separator end of the outermost periphery was fixed on the 40-mm-wide tape, and a winding body 19.6 mm in diameter and 44.4 mm in height was produced. A separator is protruding from this winding body up and down from a strip negative electrode and a strip positive electrode.
The percentage of height of a strip negative electrode over overall height of a winding body was 98.6%.

[0051]Next, application-of-pressure molding of this wound electrode body was carried out on the same conditions as the working example 1. As a result, the wound electrode body whose percentage of the height of a strip negative electrode of as opposed to 44.0 mm and overall height in height is 98.6% was obtained.
[0052]This wound electrode body was stored in the same battery can as the working example 1, and a cylindrical nonaqueous electrolyte battery 20 mm in diameter and 50 mm in height was produced by performing welding of a lead, injection of an electrolysis solution, and fixing of a battery lid.
[0053]A fine porosity polypropylene film with a width [used as comparative example 1 separator] of 44.4 mm, Except setting electrode width as 41.5 mm and 39.5 mm, respectively, the strip negative electrode and strip positive electrode which were produced like the working example 1 were laminated in order of the strip negative electrode, the separator, the strip positive electrode, and the separator, it whirled and this laminated body was wound around the mold many times. And the separator end of the outermost periphery was fixed on the 40-mm-wide tape, and a winding body 19.6 mm in diameter and 44.4 mm in height was produced. A separator is protruding from this winding body up and down from a strip negative electrode and a strip positive electrode.
The percentage of height of a strip negative electrode over overall height of a winding body was 94.3%.

[0054]Without carrying out heating molding of this winding body, it stored in the same battery can as the working example 1, and a cylindrical nonaqueous electrolyte battery 20 mm in diameter and 50 mm in height was produced by performing welding of a lead, injection of an electrolysis solution, and fixing of a battery lid.
[0055]As mentioned above, a total of 100 cells were respectively produced by the method according to the working example 1 - the working example 4, and the comparative example 1, and on the upper limit voltage 4.2V and the conditions of 300 mA of current, constant current charge was performed for 8 hours, and was saved for one month under the temperature condition of 23 degrees C about each with this charging state. And after performing constant current charge for 2.5 hours on condition of the upper limit voltage 4.2V and the current 1A, the charging and discharging cycle of discharging on condition of 400 mA of current and the final voltage 2.75V was repeated twice, and the service capacity of this two-cycle eye was measured.
[0056]The service capacity of the height of an electrode to the overall height of the wound electrode body before and behind heating molding which is an electrode flash defective number and a two-cycle eye comparatively is shown in Table 1 about each cell.
[0057]
[Table 1]

	巻回電極体の全高さに対する帯状負極の高さの割合（%）		電極はみだし不良数（本）		放電容量（mAh）
	加熱成型前	加熱成型後	加熱成型前	加熱成型後	
実施例1	94.6	98.6	0	0	1100
実施例2	89.7	98.6	0	0	1100
実施例3	97.7	98.6	2	3	1100
実施例4	98.6	98.6	38	40	1100
比較例1	94.3	—	0	0	1050

[0058]As shown in Table 1, the cell of the working example 1 which carried out heating molding of the separator and made the height of the wound electrode body low – the working example 4 can design highly the electrode pack density which stores a separator in a battery can as compared with the cell of the comparative example 1 which has not carried out heating molding, and high service capacity is obtained reflecting this.
[0059]When aiming at increase of the service capacity per volume of a cell, it turns out that it is effective to carry out heating molding of the separator and to make the height of the whole wound electrode body low from this.
[0060]About the cell of the working example 1 which carried out heating molding of the separator – the working example 4, when an electrode flash defective number is compared, it turns out that it is participating in the ratio of the height of an electrode over the overall height of a winding body in the state where heating molding of the electrode flash defective number is not carried out, largely.
[0061]When the ratio of electrode height over the overall height in the winding body in the state where heating molding is not carried out is small, That is, when the flash length of the separator from which it protrudes from an electrode is small (for example, the working example 3, the working example 4), where heating molding is carried out, the end of an electrode is exposed from the slight gap of a separator bending part and the separator which adjoins it, this results, and internal short circuits occur frequently.
[0062]Like the working example 1 and the working example 2, such a poor flash of an electrode comes to be reliably suppressed, so that the amount of flashes of the separator from an electrode becomes largely.
[0063]That is, the ratio of the height of the whole winding body in the state where heating molding is not carried out, and the height of an electrode is preferably [less than 90 to 98% of] suitable less than 80 to 100%, and less than 94 to 99% of range is suitable for the ratio of the height of the whole wound electrode body in the state where heating molding was carried out, and the height of an electrode.
[0064]However, although each has set the heating molding temperature of a separator as 150 degrees C in the above example, if this cooking temperature is set as 175 degrees C and a cell is produced like the working example 1, only a cell with small 780mAh and service capacity will be obtained. This is because heating molding temperature is too high, so it will be in the state which a separator and an adjacent separator weld and unify of a part of hole of a separator being buried and being hard to impregnate an electrolysis solution to an electrode. Therefore, as for the heating molding temperature of a separator, setting to less than the melting point is [beyond the temperature to which melting of the separator is not softened and carried out, i.e., the softening temperature of a separator,] desirable.

[0065]
[Effect of the Invention]So that clearly also from the above description the manufacturing method of the cylindrical nonaqueous electrolyte battery of the present invention, Face producing a wound electrode body and width uses a so-called size rather than a strip positive electrode and a strip negative electrode as a separator, Since a part of separator from which a part of separator protruded from the upper end part of a strip positive electrode and a strip negative electrode and the lower end part where a laminated body is wound, and it protruded from this strip positive electrode and strip

negative electrode is bent on the inside or the outside by heating molding, A strip positive electrode and a strip negative electrode protrude from a separator, it has not said that it contacts mutually, and the substantial fill volume of an electrode can be increased, and it is possible to manufacture the cylindrical nonaqueous electrolyte battery which is capacity and as for which size becomes with high productivity.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a mimetic diagram showing the wound electrode body in the state where heating molding is not carried out.
[Drawing 2]It is a mimetic diagram showing the wound electrode body in the state where heating molding was carried out.
[Drawing 3]It is outline drawing of longitudinal section showing the cylindrical nonaqueous electrolyte battery manufactured with the manufacturing method of the present invention.
[Explanations of letters or numerals]
1 ... Strip negative electrode
2 ... Strip positive electrode
3 ... Separator

[Translation done.]

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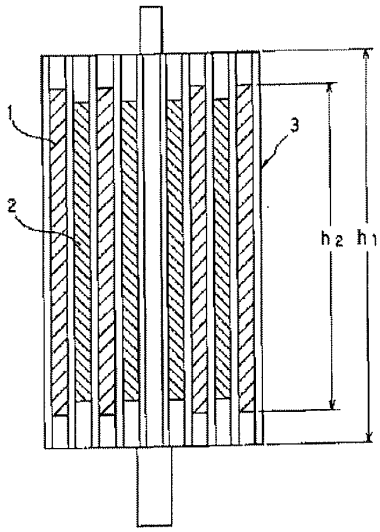
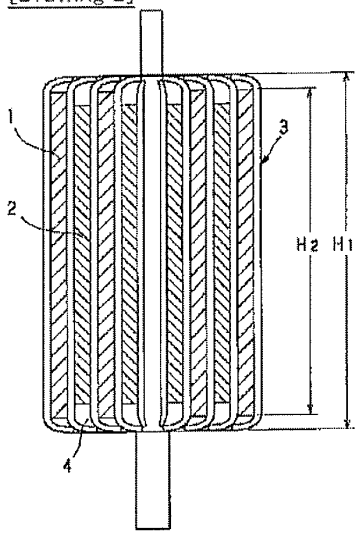
DRAWINGS

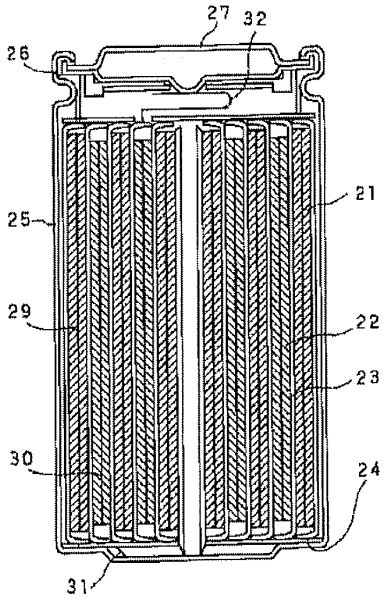
[Drawing 1]



[Drawing 2]



[Drawing 3]



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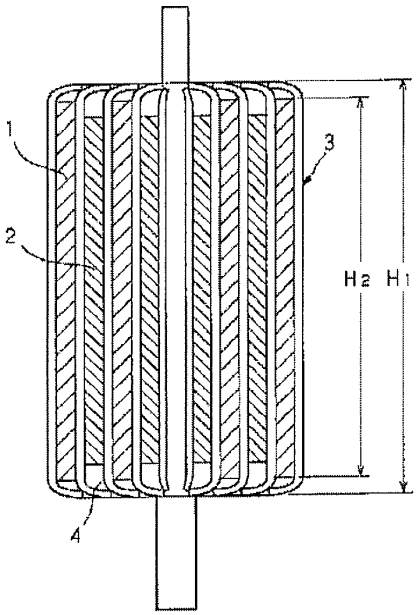
(54)【発明の名称】　円筒型非水電解質電池の製造方法

(57)【要約】

【構成】　巻回電極体を作製するに際して、セパレータ３として帯状正極２，帯状負極１よりも幅が大なるものを用い、積層体を巻回した状態で帯状正極２と帯状負極１の上端部，下端部からセパレータ３の一部がはみ出すようにし、この帯状正極２と帯状負極１からはみ出したセパレータ３の一部を加熱成型によって内側または外側に曲折する。

【効果】　セパレータ３から帯状正極２、帯状負極１とがはみ出して互いに接触するといったことがなく、且つ、電極の実質的な充填量を増大することができ、容量の大なる円筒型非水電解質電池を高い生産性をもって製造することが可能となる。



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【特許請求の範囲】

【請求項１】　帯状正極と帯状負極とを間にセパレータを介して積層し、この積層体を渦巻き状に巻回して巻回電極体を作製するに際して、

セパレータとして帯状正極，帯状負極よりも幅が大なるものを用いて、積層体を巻回した状態で帯状正極，帯状負極よりセパレータの一部が上下にはみ出すようにし、このはみ出したセパレータの一部を加熱成型によって内側または外側に曲折することを特徴とする円筒型非水電解質電池の製造方法。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、円筒型の電池缶内に巻回電極体を収納してなる，円筒型非水電解質電池の製造方法に関する。

【０００２】

【従来の技術】近年の電子技術のめざましい進歩は、電子機器の小型・軽量化を次々と実現させている。それに伴い移動用電源としての電池に対しても益々小型・軽量かつ高エネルギー密度のものが求められている。

【０００３】従来、一般用途の二次電池としては鉛電池、ニッケル・カドミウム電池等の水溶液系電池が主流であった。しかし、これら水溶液系電池は、サイクル特性には優れるものの電池重量やエネルギー密度の点で十分満足できるものとは言えない。

【０００４】そこで、最近，リチウムやリチウム合金もしくは炭素材料のような，リチウムイオンのドープ・脱ドープが可能な物質を負極に用い、リチウムコバルト複合酸化物等のリチウム複合酸化物を正極に使用する非水電解液二次電池の研究・開発が行われている。この電池は電池電圧が高く、高いエネルギー密度を有している。

【０００５】ところで、これら非水電解液二次電池の用途としては、高エネルギー密度が得られるという特長を活かして、ビデオ・カメラやラップ・トップ・パソコン等の比較的消費電流の大きな携帯用電子機器の供給電源が想定されている。

【０００６】電池を比較的消費電流の大きな電子機器の供給電源として用いる場合には、電極形式として巻回電極体形式を採ることが望ましい。巻回電極体は、帯状正極と帯状負極とを間にセパレータを介して積層し、この積層体を渦巻状に巻回することで作製されるものであり、電極面積が広くとれ、耐重負荷放電に耐え得るものである。

【０００７】ここで、このような巻回電極体では、セパレータと、帯状正極，帯状負極の幅を全く同一にすると、作製過程で帯状正極，帯状負極とが高さ方向にずれたときに、セパレータより帯状正極，帯状負極の一部がはみ出して、互いに接触して内部短絡が誘発される虞れがある。

【０００８】このため、セパレータとして帯状正極，帯

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状負極よりも幅が大なるものを用いて、積層体を巻回した状態でセパレータの一部が帯状正極，帯状負極より上下にはみ出すようにし、帯状負極，帯状正極が少し位上下にずれても、セパレータを越えて接触するといったことのないような、余裕を持った設計とされるのが通常である。

【０００９】

【発明が解決しようとする課題】しかしながら、このようにセパレータの一部が帯状正極，帯状負極より上下にはみ出すような設計にすると、電池缶にも、当然そのセパレータのはみ出し分に相当する余分な容積を確保することが必要になってくる。

【００１０】巻回電極体を用いる非水電解液二次電池では、この電池容量に関与しない余分なスペースを確保する必要があることから、電極の実質的な充填量の増大が制限され、体積当たりのエネルギーを十分に高めることができないのが実情である。

【００１１】そこで、本発明は、このような従来の実情に鑑みて提案されたものであり，セパレータより帯状正極，帯状負極とがはみ出して内部短絡が誘発されるといったことがなく、且つ、電極の実質的な充填量を増大させることができ、高容量の電池が生産性良く製造できる円筒型非水電解質電池の製造方法を提供することを目的とする。

【００１２】

【課題を解決するための手段】上述の目的を達成するために、本発明の円筒型非水電解質電池の製造方法は、帯状正極と帯状負極とを間にセパレータを介して積層し、この積層体を渦巻き状に巻回して巻回電極体を作製するに際して、セパレータとして帯状正極，帯状負極よりも幅が大なるものを用いて、積層体を巻回した状態で帯状正極，帯状負極よりセパレータの一部が上下にはみ出すようにし、このはみ出したセパレータの一部を加熱成型によって内側または外側に曲折するものである。

【００１３】円筒型非水電解質電池の製造工程において、巻回電極体は、帯状正極と帯状負極とを間にセパレータを介して積層し、この積層体を渦巻き状に巻回することで作製される。

【００１４】本発明では、このようにして巻回電極体を作製するに際して、図１に示すように、セパレータ３として帯状正極２，帯状負極１よりも幅が大なるものを用いて、積層体を巻回した状態で帯状正極２，帯状負極１よりセパレータ３の一部が上下にはみ出すようにする。そして、図２に示すように、このはみ出したセパレータ３の一部を加熱成型によって内側または外側に曲折することとする。

【００１５】このように積層体を巻回した状態で帯状正極２，帯状負極１よりはみ出したセパレータ３の一部を加熱成型によって内側または外側に曲折するようにすると、セパレータ３とセパレータ３の間の帯状正極２ある

いは帯状負極１が配置されているスペース４が、セパレータの曲折部によっていわば蓋をされた状態になる。したがって、帯状負極１，帯状正極２とが何らかの原因で上下にずれたとしても、セパレータを越えて互いに接触するといったことはなく、帯状正極２，帯状負極１同士の接触による内部短絡が防止される。

【００１６】また、このように帯状正極２，帯状負極１より上下にはみ出したセパレータ３が曲折されている巻回電極体では、セパレータ３のはみ出し分がそのまま高さ方向に延在されている巻回電極体に比べて高さが低く抑えられる。したがって、電池缶容積を低減でき、実質的な電極充填密度が大きく、容量の大なる円筒型非水電解質二次電池が得られることになる。

【００１７】なお、電池の内部短絡を確実に防止するためには、巻回電極体全体の高さと帯状負極１，帯状正極２の高さのバランスが重要である。

【００１８】すなわち、図１に示すように加熱成型していない状態のセパレータ３の高さをh_1，電極のうち長さの長い方の電極１の高さをh_2とし、図２に示すように加熱成型した状態の巻回電極体全体の高さをH_1，電極のうち長さの長い方の電極１の高さをH_2としたときに、h_1とh_2が$0.8h_1 \leqq h_2 \leqq h_1$より好ましくは$0.9h_1 \leqq h_2 \leqq 0.98h_1$なる条件を満たし、$H_1$と$H_2$が$0.94H_1 \leqq H_2 \leqq H_1$より好ましくは、$0.95H_1 \leqq H_2 \leqq 0.99H_1$なる条件を満たすことが望ましい。

【００１９】帯状電極１，２の高さが上記範囲を超える場合には、加熱成型した状態の電極配置スペース４において蓋となるセパレータ３の曲折部と帯状電極１，２端部の間に余裕がないために、該曲折部とそれと隣り合うセパレータ３の間の僅かな隙間から帯状電極１，２端部が露出し、これが内部短絡の原因になる。

【００２０】逆に、帯状電極１，２の高さが上記範囲を下回る場合には、巻回電極体当たりのセパレータ３使用面積が増大することを意味し、材料コストの面から好ましくない。

【００２１】上記セパレータ３としては、通常、非水電解質電池において用いられているものがいずれも使用可能であり、ポリプロピレン，ポリエチレン，ポリブチレン等のポリオレフィン系樹脂、ナイロン、セルロースアセテート、ニトロセルロース、ポリスルホン、ポリアクリロニトリル、ポリフッ化ビニリデン等よりなる微多孔性フィルムが用いられる。

【００２２】これらセパレータ３を加熱成型する方法は特に限定されないが、セパレータ３に対して熱風を吹きつけることで成型する熱風ブロー方式、加熱治具により上下から圧力を印加することで成型する加熱加圧方式等が採用できる。

【００２３】但し、加熱成型の際の加熱温度は、セパレータ３を軟化させ且つ溶融させない温度，すなわちセパレータ３の軟化点以上、融点未満に設定することが望ましい。加熱温度をセパレータ３の融点以上に設定した場合には、セパレータ３が溶融して空孔の一部が埋まる，溶融したセパレータ３と、それと隣合うセパレータ３とが融着一体化する等により、電極配置スペース４に非水電解液が移行し難い状況になる。これにより、電極１，２の電解液含浸量が不足し、放電容量の低下につながる。

【００２４】一方、帯状負極１，帯状正極２は、帯状の電極集電体に、電極活物質を含有する電極合剤を塗布することで作製されるものである。

【００２５】負極活物質としては、リチウム，リチウム合金，ポリアセチレン等の導電性ポリマー，コークス等の炭素材料等を用いることができる。

【００２６】正極活物質としては、二酸化マンガン，五酸化バナジウムのような遷移金属化合物や、硫化鉄等の遷移金属カルコゲン化合物、さらにはこれらとリチウムとの複合化合物を用いることができる。

【００２７】また、電解液としては、例えばリチウム塩を電解質とし、これを有機溶媒に溶解した電解液が用いられる。有機溶媒としては、特に限定されるものではないが、例えばプロピレンカーボネート、エチレンカーボネート、ジエチルカーボネート、１，２－ジメトキシエタン、１，２－ジエトキシエタン、γ－ブチロラクトン、テトラヒドロフラン、１，３－ジオキソラン、４－メチル－１，３－ジエキソラン、ジエチルエーテル、スルホラン、メチルスルホラン、アセトニトリル，プロピオニトリル等の単独もしくは二種類以上の混合溶媒が使用できる。電解質にも、従来より公知のものがいずれも使用でき、$LiClO_4$，$LiAsF_6$，$LiPF_6$，$LiBF_4$，$LiB(C_6H_5)_4$，LiCl，LiBr，CH_3SO_3Li，CF_3SO_3Li等がある。

【００２８】

【作用】円筒型非水電解質二次電池の製造工程において、巻回電極体は帯状正極と帯状負極とを間にセパレータを介して積層し、この積層体を渦巻き状に巻回することで作製される。

【００２９】このようにして巻回電極体を作製するに際して、セパレータとして帯状正極，帯状負極よりも幅が大なるものを用いて、積層体を巻回した状態で帯状正極，帯状負極よりセパレータの一部が上下にはみ出すようにし、このはみ出したセパレータの一部を加熱成型によって内側または外側に曲折するようにすると、内部短絡を招くことなく容量の大なる円筒型非水電解質二次電池が作製される。

【００３０】すなわち、積層体を巻回した状態で帯状正極，帯状負極よりはみ出したセパレータの一部を加熱成型によって内側または外側に曲折するようにすると、セパレータとセパレータの間の帯状正極あるいは帯状負極が配置されたスペースが、セパレータの曲折部によって

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いわば蓋をされた状態になる。したがって，帯状負極，帯状正極とが何らかの原因で上下にずれたとしても、セパレータを越えて互いに接触するといったことはなく、帯状正極，帯状負極同士の接触による内部短絡が防止される。

【００３１】また、このように帯状正極，帯状負極より上下にはみ出したセパレータが曲折されている巻回電極体では、セパレータのはみ出し分がそのまま高さ方向に延在されている巻回電極体に比べて高さが低く抑えられる。したがって、電池缶容積を低減でき、実質的な電極充填密度が大きく、容量の大なる円筒型非水電解質二次電池が獲得される。

【００３２】

【実施例】本発明の好適な実施例について実験結果に基づいて説明する。

【００３３】実施例１

本実施例で作製する円筒型非水電解質電池の縦断面図を図３に示す。このような構成の円筒型非水電解質電池を以下のようにして作製した。

【００３４】まず、帯状負極２１を次のようにして作製した。

【００３５】出発原料として石油ピッチを用い、これに酸素を含む官能基を１０～２０％重量導入（いわゆる酸素架橋）した後、不活性ガス気流中，温度１０００℃で焼成して、ガラス状炭素に近い性質を持った炭素質材料を得た。この炭素質材料について、Ｘ線回折測定を行った結果、（００２）面の面間隔は３．７６Åであった。またピクノメータ法により真比重を測定したところ、１．５８ｇ／ｃｍ^3 であった。この炭素質材料を粉砕し、平均粒径１０μｍの炭素質材料粉末とした。このようにして得た炭素質材料粉末を負極活物質担持体とし、この炭素質材料粉末９０重量部、結着材となるポリフッ化ビリニデン（ＰＶＤＦ）１０重量部を混合し、負極合剤を調製した。この負極合剤を、溶剤であるＮ－メチルピロリドンに分散させて負極スラリー（ペースト状）とした。

【００３６】負極集電体２９として厚さ１０μｍの帯状の銅箔を用い、この負極集電体の両面に上記負極合剤スラリーを塗布、乾燥させた後、圧縮成型して帯状負極１を作製した。なお、この帯状負極２１の電極の寸法は、幅４３．４ｍｍ、長さ７００ｍｍとし、成型後の合剤厚さは両面共に８０μｍで同一とした。

【００３７】次に、帯状正極２２を以下のようにして作製した。

【００３８】炭酸リチウム０．５モルと炭酸コバルト１モルを混合し、空気中，温度９００℃で５時間焼成して$LiCoO_2$ を得た。$LiCoO_2$ を正極活物質とし、これの９１重量部、導電剤となるグラファイト６重量部及び結着剤となるポリフッ化ビリニデン３重量部を混合し、正極合剤を調製した。この正極合剤をＮ－メチルプロリドンに分散させて正極スラリー（ペースト状）とした。

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【００３９】正極集電体３０として厚さ２０μｍの帯状のアルミニウム箔を用い、この正極集電体３０の両面に均一に上記正極合剤スラリーを塗布、乾燥させた後、圧縮成型して帯状正極２２を作製した。なお、この帯状正極２２の電極の寸法は、幅４１．４ｍｍ、長さ６５０ｍｍとし、成型後の合剤厚さは両面共に８０μｍで同一とした。

【００４０】以上のようにして作製された幅４３．４ｍｍ，長さ７００ｍｍの帯状負極２１と、幅４１．４ｍｍ，長さ６５０ｍｍの帯状正極２２を、厚さ２５μｍ、幅４５．９ｍｍの微多孔性ポリプロピレンフィルムをセパレータ２３として、帯状負極２１、セパレータ２３、帯状正極２２、セパレータ２３の順に積層し、この積層体を幅方向が巻回体の高さ方向になるような向きで多数回巻回した。そして、最外周に位置するセパレータ最終端部を、幅４０ｍｍのテープで固定することで、直径１９．６ｍｍ，高さ４５．９ｍｍの巻回電極体を作製した。この巻回体は、帯状負極２１，帯状正極２２よりセパレータ２３が上下にはみ出しており、巻回体の全高さに対する帯状負極２１の高さの割合が９４．６％であった。

【００４１】次に、この巻回体の上下にはみ出した状態になっているセパレータのはみ出し部分を、内側に折り曲げ、この状態で温度１５０℃に加熱したアルミニウム製治具を用いて圧力３．８ｋｇ／ｃｍ^2 で約５秒間加圧した。その結果、高さが４４．０ｍｍ、全高さに対する帯状負極２１の高さの割合が９８．６％の巻回電極体が得られた。

【００４２】このようにして作製された巻回電極体をニッケルめっきを施した鉄製電池缶２５に、巻回電極体上下両面に絶縁体板２４を配置して収納した。そして、アルミニウム製正極リード３２を正極集電体から導出して電池蓋２７に、ニッケル製負極リード３１を負極集電体から導出して電池缶２５に溶接した。

【００４３】この電池缶２５の中に、プロピレンカーボネートとジエチルカーボネートとの等容量混合溶媒中に、$LiPF_6$ を１モル／リットルの割合で溶解した電解液を注入した。そして、アスファルトで表面を塗布した絶縁封口ガスケット２６を介して電池缶２５をかしめることにより、電流遮断機構を有する安全弁装置８並びに電池蓋２７を固定し、電池内の気密性を保持させることで、直径２０ｍｍ、高さ５０ｍｍの円筒型非水電解質電池を作製した。

【００４４】実施例２

セパレータとなる幅４８．４ｍｍの微多孔性ポリプロピレンフィルムと、実施例１と同様にして作製された幅４３．４ｍｍ，長さ７００ｍｍの帯状負極と、幅４１．４ｍｍ，長さ６５０ｍｍの帯状正極を、帯状負極，セパレ

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ータ，帯状正極，セパレータの順に積層し，この積層体を渦巻き型に多数回巻回した。そして、最外周のセパレータ端部を、幅４０ｍｍのテープで固定して直径１９．６ｍｍ，高さ４８．４ｍｍの巻回体を作製した。この巻回体は、帯状負極，帯状正極よりセパレータが上下にはみ出しており、巻回体の全高さに対する帯状負極の高さの割合は８９．７％であった。

【００４５】次に、この上下にはみ出した状態になっているセパレータのはみ出し部分を、内側に折り曲げ、実施例１と同様な条件にて加圧成型した。その結果、高さが４４．０ｍｍ、全高さに対する帯状負極の高さの割合が９８．６％の巻回電極体が得られた。

【００４６】この巻回電極体を実施例１と同様の電池缶内に収納し、リードの溶接，電解液の注入，電池蓋の固定を行うことで、直径２０ｍｍ、高さ５０ｍｍの円筒型非水電解質電池を作製した。

【００４７】実施例３

セパレータとなる幅４４．４ｍｍの微多孔性ポリプロピレンフィルムと、実施例１と同様にして作製された幅４３．４ｍｍ，長さ７００ｍｍの帯状負極と、幅４１．４ｍｍ，長さ６５０ｍｍの帯状正極を、帯状負極，セパレータ，帯状正極，セパレータの順に積層し，この積層体を渦巻き型に多数回巻回した。そして、最外周のセパレータ端部を、幅４０ｍｍのテープで固定して直径１９．６ｍｍ，高さ４４．４ｍｍの巻回体を作製した。この巻回体は、帯状負極，帯状正極よりセパレータが上下にはみ出しており、巻回体の全高さに対する帯状負極の高さの割合は９７．７％であった。

【００４８】次に、この上下にはみ出した状態になっているセパレータのはみ出し部分を、内側に折り曲げ、実施例１と同様な条件にて加圧成型した。その結果、高さが４４．０ｍｍ、全高さに対する帯状負極の高さの割合が９８．６％の巻回電極体が得られた。

【００４９】この巻回電極体を実施例１と同様の電池缶内に収納し、リードの溶接，電解液の注入，電池蓋の固定を行うことで、直径２０ｍｍ、高さ５０ｍｍの円筒型非水電解質電池を作製した。

【００５０】実施例４

セパレータとなる幅４４．４ｍｍの微多孔性ポリプロピレンフィルムと、実施例１と同様にして作製された幅４３．４ｍｍ，長さ７００ｍｍの帯状負極と、幅４１．４ｍｍ，長さ６５０ｍｍの帯状正極を、帯状負極，セパレータ，帯状正極，セパレータの順に積層し，この積層体を渦巻き型に多数回巻回した。そして、最外周のセパレータ端部を、幅４０ｍｍのテープで固定して直径１９．６ｍｍ，高さ４４．４ｍｍの巻回体を作製した。この巻回体は、帯状負極，帯状正極よりセパレータが上下にはみ出しており、巻回体の全高さに対する帯状負極の高さの割合は９８．６％であった。

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【００５１】次に、この巻回電極体を実施例１と同様な条件にて加圧成型した。その結果、高さが４４．０ｍｍ、全高さに対する帯状負極の高さの割合が９８．６％の巻回電極体が得られた。

【００５２】この巻回電極体を実施例１と同様の電池缶内に収納し、リードの溶接，電解液の注入，電池蓋の固定を行うことで、直径２０ｍｍ、高さ５０ｍｍの円筒型非水電解質電池を作製した。

【００５３】比較例１

セパレータとなる幅４４．４ｍｍの微多孔性ポリプロピレンフィルムと、電極幅をそれぞれ４１．５ｍｍ，３９．５ｍｍに設定すること以外は実施例１と同様にして作製された帯状負極，帯状正極を、帯状負極，セパレータ，帯状正極，セパレータの順に積層し，この積層体を渦巻き型に多数回巻回した。そして、最外周のセパレータ端部を、幅４０ｍｍのテープで固定して直径１９．６ｍｍ，高さ４４．４ｍｍの巻回体を作製した。この巻回体は、帯状負極，帯状正極より上下にセパレータがはみ出しており、巻回体の全高さに対する帯状負極の高さの割合は９４．３％であった。

【００５４】この巻回体を加熱成型せずに、実施例１と同様の電池缶内に収納し、リードの溶接，電解液の注入，電池蓋の固定を行うことで、直径２０ｍｍ、高さ５０ｍｍの円筒型非水電解質電池を作製した。

【００５５】以上、実施例１～実施例４及び比較例１に準じた方法で各々合計１００本の電池を作製し、それぞれについて上限電圧４．２Ｖ，電流３００ｍＡの条件で定電流充電を８時間行い、この充電状態のまま温度２３℃条件下、１ヵ月間保存した。そして、上限電圧４．２Ｖ，電流１Ａの条件で定電流充電を２．５時間行った後、電流４００ｍＡ，終止電圧２．７５Ｖの条件で放電を行うといった充放電サイクルを２回繰り返し、この２サイクル目の放電容量を測定した。

【００５６】表１に、各電池について、加熱成型前後における巻回電極体の全高さに対する電極の高さの割合，電極はみ出し不良数及び２サイクル目の放電容量を示す。

【００５７】

【表１】

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	巻回電極体の全高さに対する帯状負極の高さの割合（%）		電極はみだし不良数（本）		放電容量（mAh）
	加熱成型前	加熱成型後	加熱成型前	加熱成型後	
実施例１	94.6	98.6	0	0	1100
実施例２	89.7	98.6	0	0	1100
実施例３	97.7	98.6	2	3	1100
実施例４	98.6	98.6	38	40	1100
比較例１	94.8	－	0	0	1050

【００５８】表１からわかるように、セパレータを加熱成型して巻回電極体の高さを低くした実施例１～実施例４の電池は、セパレータを加熱成型していない比較例１の電池と比較して、電池缶内に収納する電極充填密度を高く設計でき、これを反映して高い放電容量が得られている。

【００５９】このことから、セパレータを加熱成型して巻回電極体全体の高さを低くすることは、電池の体積当たりの放電容量の増大を図る上で有効であることがわかる。

【００６０】なお、セパレータを加熱成型した実施例１～実施例４の電池について、電極はみ出し不良数を比較すると、電極はみ出し不良数は、加熱成型されていない状態での、巻回体の全高さに対する電極の高さの割合に大きく関与していることがわかる。

【００６１】加熱成型されていない状態の巻回体での、全高さに対する電極高さの割合が小さい場合、すなわち、電極よりはみ出すセパレータのはみ出し長さが小さい場合（例えば実施例３，実施例４）には、加熱成型した状態で電極の端部が、セパレータ曲折部と、それと隣合うセパレータの僅かな隙間から露出し、これが原因して内部短絡が多発する。

【００６２】このような電極のはみ出し不良は、実施例１，実施例２のように、電極からのセパレータのはみ出し量が大きくなる程、確実に抑えられるようになる。

【００６３】すなわち、加熱成型していない状態での巻回体全体の高さと電極の高さの割合は８０～１００%以内、好ましくは９０～９８%以内が適当であり、加熱成型した状態での、巻回電極体全体の高さと電極の高さの割合は９４～９９%以内の範囲が適当である。

【００６４】但し、以上の例ではいずれもセパレータの加熱成型温度を１５０℃に設定しているが、この加熱温度を１７５℃に設定して実施例１と同様に電池を作製すると、７８０ｍＡｈと放電容量が小さい電池しか得られない。これは加熱成型温度が高過ぎるために、セパレータと隣合うセパレータとが融着して一体化する，セパレータの空孔の一部が埋まり、電極に電解液が含浸し難い状態になるからである。したがって、セパレータの加熱成型温度は、セパレータを軟化させ且つ溶融させない温度，すなわちセパレータの軟化点以上，融点未満に設定することが望ましい。

【００６５】

【発明の効果】以上の説明からも明らかなように、本発明の円筒型非水電解質電池の製造方法は、巻回電極体を作製するに際して、セパレータとして帯状正極，帯状負極よりも幅が大なるものを用い、積層体を巻回した状態で帯状正極と帯状負極の上端部，下端部からセパレータの一部がはみ出すようにし、この帯状正極と帯状負極からはみ出したセパレータの一部を加熱成型によって内側または外側に曲折するので、セパレータから帯状正極，帯状負極とがはみ出して互いに接触するといったことがなく、且つ、電極の実質的な充填量を増大することができ、容量の大なる円筒型非水電解質電池を高い生産性をもって製造することが可能である。

【図面の簡単な説明】

【図１】加熱成型していない状態の巻回電極体を示す模式図である。

【図２】加熱成型した状態の巻回電極体を示す模式図である。

【図３】本発明の製造方法で製造された円筒型非水電解質電池を示す概略縦断面図である。

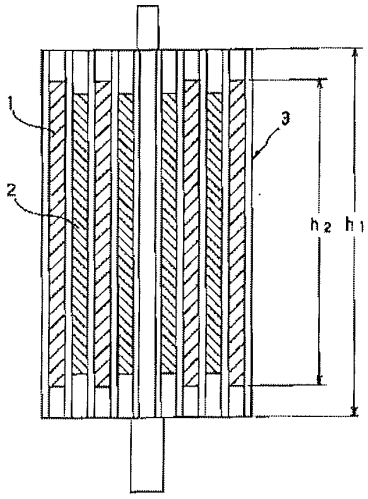
【符号の説明】

１・・・帯状負極

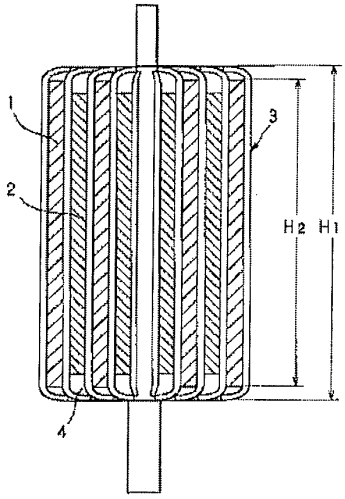
２・・・帯状正極

３・・・セパレータ

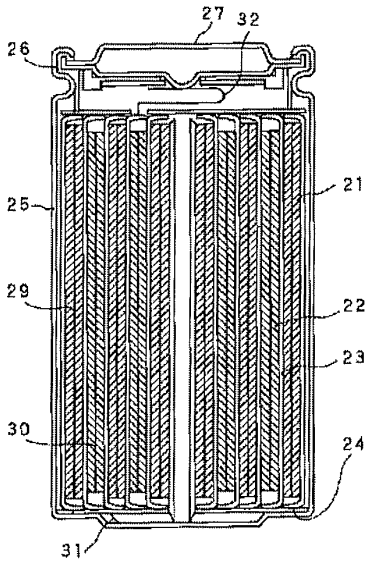
【図1】



【図2】



【図3】



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Warnings:					
Information:					
5	Foreign Reference	JP176.pdf	585042 db1ce40e19d94d16af0e3858291adb4e042e3188	no	6
Warnings:					
Information:					
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Serial No.	: 13/146,669	
Filed	: July 28, 2011	
Inventors	: Eduard Pytlik	Docket No.: RUF-11-1270
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	: Ulrich Barenthin	Confirmation No.: 6273
	: Winfried Gaugler	
Title	: BUTTON CELLS AND METHOD	
	: FOR PRODUCING SAME	Dated: May 8, 2014

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT

Commissioner for Patents
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Sir:

The Applicants enclose Form PTO-1449 together with a copy of each of the five (5) listed non-US publications. The publications are believed related in view of their mention in the corresponding Japanese Office Action dated March 18, 2014. The publications are submitted under 37 CFR §1.56 and are believed related to this application for the reasons stated.

Applicants certify that the items of information contained in the Supplemental Information Disclosure Statement was first cited in any communication from any foreign patent office in a counterpart foreign application not more than three months ago.

The Applicants respectfully request that this Supplemental Information Disclosure Statement be officially entered into the file and that appropriate notification be made that it was considered by the Examiner.

Respectfully submitted,

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pto.phil@dlapiper.com

Office Action Summary	Application No. 13/146,669	Applicant(s) PYTLIK ET AL.	
	Examiner JULIAN ANTHONY	Art Unit 1726	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *5-02-2014*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☒ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5)☒ Claim(s) *1,2 and 4-13* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1,2 and 4-13* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☒ The drawing(s) filed on *5-02-14* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date *5-08-14*.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

DETAILED ACTION

Remarks

This Office action is responsive to applicant's amendment filed on May 2, 2014.

Information Disclosure Statement

The IDS filed on May 8, 2014 has been considered by the examiner.

Drawings

The drawings were received on May 2, 2014. These drawings are acceptable. The objection to the drawings under 37 CFR 1.83(a) has been withdrawn.

Claim Rejections - 35 USC § 102

The rejection of claims 1, 2, 6, 10 and 11 under pre-AIA 35 U.S.C. 102(b) based on Nakayama (US 4,224,387) has been withdrawn.

Claim Rejections - 35 USC § 103

The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 2, 4-6 and 9-13 are rejected under pre-AIA 35 U.S.C. 102(b) as being anticipated by Nakayama (US 4,224,387) in view of Suzuki et al. (US 7,566,515)

The rejection is maintained for the reasons already of record. The reasons for rejection based on Nakayama as previously discussed under the pre-AIA 35 U.S.C. § 102(b) is applied towards the present claims. The examiner notes the amendment to claim 1 insofar as incorporating the subject matter of claim 3 (now canceled) in reciting that the electrode-separator assembly is in the form of a spiral winding whose end faces face in a direction of the flat bottom area and the flat top area. To this end, while Nakayama does not explicitly teach an electrode-separator assembly in the form of a spiral winding, Suzuki teaches electrode assemblies both in flat sheet form (Fig. 1) and in the form of a flat spiral winding, with end faces [2b] and [4b] facing in a direction of the flat bottom area and the flat top area. (Fig. 2, col. 6 line 43 et seq.) The prior art as a whole is maintained to recognize the equivalence of flat electrode assemblies (as disclosed in Nakayama and Suzuki) with spiral electrode assemblies (as disclosed in Suzuki). The prior art's clear recognition of mutual equivalence of these components, independent of applicant's disclosure, is herein relied upon as the rationale to support an obviousness rejection. *In re Ruff*, 256 F.2d 590, 118 USPQ 340 (CCPA 1958) Furthermore, the claims would have been obvious because the substitution of one known element for another would have yielded predictable results to one of ordinary skill in the art at the time the invention was made. Addtionally, Suzuki teaches that spiral windings "have the advantage that they are firmly wound and excellent in adhesion." (col. 6 line 61 et seq.)

Applicant's arguments filed with the present amendment have been fully considered, however these arguments are not found persuasive. Applicant concedes that Suzuki discloses a

spiral winding, but submits that the end faces of the winding in Fig. 2 of Suzuki do not face in the direction of the flat bottom area and the flat top area. In reply, it is asserted that Fig. 2 of Suzuki shows the spiral winding having a flat top end face [4b] and a flat bottom end face [2b] that is in direct contact with the flat top area and the flat bottom area of the battery housing. As the end faces are in direct contact, it naturally follows that the end faces face in the direction of the flat bottom area and the flat top area. As to applicant explaining advantages of a right-angled alignment of electrode layers, e.g. allowing for radial mechanical forces to be absorbed by the radial casing area, while this argument may have merit, it is noted that the claims are entirely silent on the spiral winding being in any angled alignment, such as a right-angled alignment. Applicant is reminded that the claims are given their broadest reasonable interpretation in a manner not inconsistent with applicant's disclosure.

Claims 7, 8 and 14 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Nakayama (US 4,224,387) in view of Suzuki et al. (US 7,566,515), and further in view of Cantave et al. (US 6,443,999)

The examiner notes that the sole argument for Cantave as applied under pre-AIA 35 U.S.C. 103(a) merely asserts that Cantave fails to cure alleged deficiencies with respect to the combination of Nakayama and Suzuki. The rejection based on Nakayama and Suzuki is maintained for the reasons set forth *supra*; the rejection based on Nakayama and Suzuki and further in view of Cantave is maintained for the reasons already of record.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Julian Anthony whose telephone number is (571) 272-1289. The examiner can normally be reached on Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick J. Ryan, can be reached on (571) 272-1292. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR

system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

/Julian Anthony/
Examiner, Art Unit 1726

/PATRICK RYAN/
Supervisory Patent Examiner, Art Unit 1726

Form PTO-1449 US DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY. DOCKET NO. RUF-11-1270	SERIAL NO. 13/146,669
	APPLICANT Eduard Pytlik, et al.	
LIST OF PUBLICATIONS CITED BY APPLICANT *(Use several sheets if necessary)*	FILING DATE July 28, 2011	GROUP 1726

US PATENT DOCUMENTS

EXAMINER INITIAL*		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
	AA						
	AB						
	AC						
	AD						
	AE						
	AF						
	AG						
	AH						
	AI						
	AJ						
	AK						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION YES	TRANSLATION NO
	AL	2007-294111	11/08/07	JP			x	
	AM	2003-31266	01/31/03	JP			x	
	AN	2008-262826	10/30/08	JP			x	
	AO	1-307176	12/12/89	JP			Abstract	
	AP	7-153488	06/16/95	JP			x	

OTHER PUBLICATIONS (Including Author, Title, Date, Pertinent Pages, Etc.)

	AR	
	AS	
	AT	

EXAMINER /Julian Anthony/	DATE CONSIDERED 08/23/2014

*EXAMINER: Initial if publication considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to Applicant.

EAST\76099625.1

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /J.A./

NEW SHEET

OK TO ENTER: /J.A./

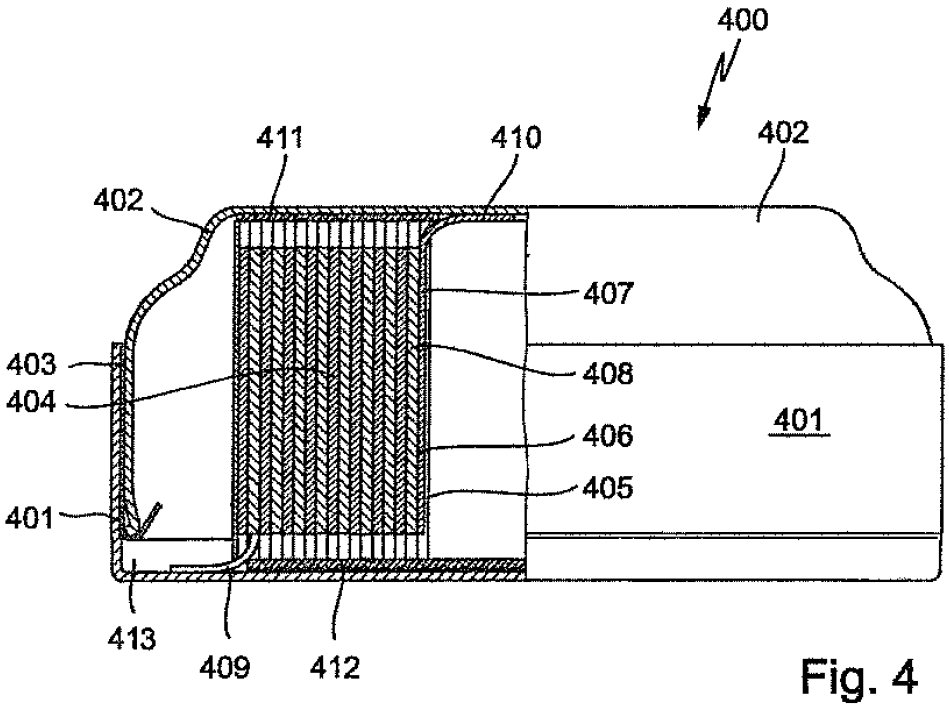

Fig. 4

PTO/SB/30 (09/04)

Approved for use through 07/31/2006. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Request For Continued Examination (RCE) Transmittal		
Address to: Mail Stop RCE Commissioner for Patents P.O. Box 1450 Alexandria, VA 22313-1450	Application Number	13/146,669
	Filing Date	July 28, 2011
	First Named Inventor	Eduard Pytlik
	Art Unit	6273
	Examiner Name	Julian Anthony
	Attorney Docket Number	RUF-11-1270

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application. Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. See Instruction Sheet for RCEs (not to be submitted to the USPTO) on page 2.

1. **Submission required under 37 CFR 1.114.** Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

a. ☒ Previously submitted. If a final Office Action is outstanding, any amendments filed after the final Office Action may be considered as a submission even if this box is not checked.
   i. ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____
   ii. ☐ Other _____

b. ☒ Enclosed
   i. ☒ Amendment/Reply
   ii. ☐ Affidavit(s)/Declaration(s)
   iii. ☒ Supplemental Information Disclosure Statement (SIDS)
   iv. ☐ Other _____

2. Miscellaneous

a. ☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of ___ months. (Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)
b. ☐ Other _____

3. Fees The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.

a. ☒ The Director is hereby authorized to charge the following fees, or credit any overpayments, to Deposit Account No. 50-2719.
   i. ☒ RCE fee required under 37 CFR 1.17(e) in the amount of $**1,200.00**.
   ii. ☐ Extension of time fee (37 CFR 1.136 and 1.17 _____
   iii. ☒ Other: any deficiencies

b. Check in the amount of $_____ enclosed

c. Payment by credit card (Form PTO-2038 enclosed)

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

SIGNATURE OF APPLICANT, ATTORNEY OR AGENT REQUIRED

Signature		Date	October 31, 2014
Name (Print/Type)	T. Daniel Christenbury	Registration No.	31,750

CERTIFICATE OF MAILING OR TRANSMISSION

I hereby certify that this correspondence is being electronically filed with the U.S. Patent and Trademark Office on the date shown below.

Signature			
Name (Print/Type)	Vivian I. Peña	Date	October 31, 2014

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Mail stop RCE, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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Attorney Docket No.: RUF-11-1270

In re Application of: Eduard Pytlik et al.
Serial No.: 13/146,669
Filed: July 28, 2011
For: BUTTON CELLS AND METHOD FOR PRODUCING SAME

Mail Stop RCE
Commissioner for Patents
P.O. Box 14508
Alexandria, VA 22313-1450

Sir:

A response to the outstanding official action in the above-identified application is enclosed, along with a Request for Continued Examination, Supplemental Information Disclosure Statement, Form PTO-1449 and 10 non-US publications.

☐ Small entity status of this application under 37 CFR §1.9 and §1.27 has been established.

☐ This is a Petition for an Extension of Time for the period noted below, as well as for any additional period necessary to render this submission timely.

☒ No additional fee is required.

		SMALL ENTITY	OTHER THAN SMALL ENTITY
TIME EXTENSION PETITION FEE	No. of month(s): 0		$0.00
Subtract time extension fee previously paid	No. of month(s): 0		($0.00)
TOTAL EXTENSION FEE DUE			$0.00

CLAIM FEE	CLAIM(S) REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	EXTRA CLAIM(S) PRESENT	RATE	ADD'L CLAIM FEE	RATE	ADD'L CLAIM FEE
TOTAL	13	MINUS	20	= 0	x 40=	$	x 80=	$0.00
INDEPENDENT	1	MINUS	3	= 0	x 210=	$	x 420=	$0.00
☐	FIRST PRESENTATION OF MULTIPLE CLAIM(S)				+ 390=	$	+ 780=	$0.00
	TOTAL ADDITIONAL CLAIM FEE DUE					$		$0.00
							TOTAL FEE DUE:	**$0.00**

☒ Please charge Deposit Account No. 50-2719 in the amount of **$1,200.00**. (RCE fee)

☒ The Commissioner is authorized to charge payment of the following fees associated with this communication or credit any overpayment to Deposit Account No. 50-2719.

☒ Any filing fees under 37 CFR §1.16 for the presentation of extra claims.

☒ Any patent application processing fees under 37 CFR §1.17.

Respectfully submitted,

T. Daniel Christenbury, Reg. No. 31,750

Date: October 31, 2014

TDC/vp
(215)656-3381

EAST\85651885.1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Art Unit	: 1726	**Customer No.: 035811**
Examiner	: Julian Anthony	
Serial No.	: 13/146,669	Docket No.: RUF-11-1270
Filed	: July 28, 2011	
Inventors	: Eduard Pytlik	
	: Jürgen Lindner	
	: Ulrich Barenthin	
	: Winfried Gaugler	Confirmation No.: 6273
Title	: BUTTON CELLS AND METHOD	
	: FOR PRODUCING SAME	
		Dated: October 31, 2014

RESPONSE

Mail Stop RCE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In response to the Official Action dated September 2, 2014, the Applicants amend the application as follows:

In the Claims

1. (Currently Amended) A button cell comprising:

a housing cup and a housing top separated from one another by an electrically insulating seal and which form a housing with a flat bottom area and a flat top area parallel to it, and

an electrode-separator assembly within the housing comprising at least one positive and at least one negative electrode in the form of flat layers and connected to one another by at least one flat separator,

wherein the electrode layers are aligned essentially at right angles to the flat bottom area and the top ~~areas~~ area and the button cell is closed without being beaded over, and the electrode-separator assembly is in the form of a spiral winding ~~whose~~ having end faces face in a direction of the flat bottom area and the flat top area.

2. (Previously Presented) The button cell as claimed in claim 1, wherein the electrodes and/or the separator are/is in the form of strips or ribbons.

3. (Cancelled)

4. (Previously Presented) The button cell as claimed in claim 1, wherein the winding has an axial cavity in its center, which axial cavity is at least partially filled by a winding core.

5. (Previously Presented) The button cell as claimed in claim 1, wherein the electrode-separator assembly has one of the following layer sequences:

negative electrode/separator/positive electrode/separator and

positive electrode/separator/negative electrode/separator.

6. (Previously Presented) The button cell as claimed in claim 1, wherein the positive electrode and/or the negative electrode are/is connected via an output conductor to the housing in an area of the flat bottom area and/or of the flat top area.

7. (Previously Presented) The button cell as claimed in claim 1, further comprising at least one insulator which prevents direct mechanical and electrical contact between the end faces of the winding and the flat bottom and top areas.

8. (Previously Presented) The button cell as claimed in claim 7, wherein the at least one insulator is a flat layer composed of plastic arranged between the end faces of the winding and the flat bottom and top areas.

9. (Previously Presented) The button cell as claimed in claim 1, which is rechargeable.

10. (Previously Presented) The button cell as claimed in claim 1, having a height:diameter ratio of < 1.

11. (Previously Presented) A method for producing a button cell according to claim 1, comprising inserting an electrode-separator assembly with electrodes in the form of a flat layer into the housing such that the electrode layers are aligned essentially at right angles to the flat bottom and top areas, wherein the housing comprises a metallic cup part and a metallic top part.

12. (Previously Presented) The method as claimed in claim 11, wherein the electrode-separator assembly is inserted as a winding.

13. (Previously Presented) The method as claimed in claim 12, further comprising:
inserting the winding into the metallic top part, and
inserting the metallic top part with the winding into a metallic cup part.

14. (Previously Presented) The method as claimed in claim 12, wherein the winding is heat-treated on its end faces before being installed, with it being at least for a short time subjected to a temperature at which the separator is thermoplastically deformable.

Remarks

The Applicants have amended Claim 1 to improve readability. No change of scope in the claim is intended. Entry of the amendments into the official file and consideration on the merits are respectfully requested.

The Applicants enclose a Supplemental Information Disclosure Statement and respectfully request that it be entered into the official file, considered on the merits and PTO-1449 be marked accordingly to reflect such consideration.

The Applicants also enclose a Request for Continued Examination to facilitate entry of the above amendments to Claim 1 as well as the Supplemental Information Disclosure Statement into the official file.

Claims 1, 2, 4-6 and 9-13 stand rejected under 35 USC §102 "as being anticipated" by Nakayama in view of Suzuki. The Applicants assume that the rejection is merely a typographical error and it is, in fact, a rejection under 35 USC §103 over a combination of Suzuki with Nakayama. The Applicants following comments will reflect that understanding.

The Applicants respectfully submit that the combination of Suzuki with Nakayama would result in a completely different button cell. In that regard, the Applicants note with appreciation the Examiner's frank acknowledgement that Nakayama does not disclose an electrode-separator assembly in the form of a spiral winding. Hence, the rejection turns to Suzuki to cure that deficiency. In that regard, the rejection relies on Fig. 2 of Suzuki and refers specifically to "end faces [2b] and [4b] facing in a direction of the flat bottom area and the flat top area."

The Applicants agree that Suzuki indeed discloses a spiral winding as shown in Fig. 2. However, that disclosure and its accompanying description are problematic in the context of a combination with Nakayama and in the context of Claims 1, 2, 4-6 and 9-13.

The Applicants first note that Suzuki does not refer to reference numbers 2b and 4b as "end faces" as noted in the rejection. Instead, those reference numbers are associated with a "cathode active material-containing layer" and an "active material-containing layer," respectively. Hence, there is no reference to "end faces" in Suzuki and no association with such "end faces" with reference numbers 2b and 4b.

In the context of ordinary understanding (to those of even less than ordinary skill in this art) of the constituent of spiral windings and in the context of the Applicants' disclosure as embodied in their specification and drawings, it is clear that reference numbers 2b and 4b of

Suzuki simply cannot be interpreted as end faces. At best, reference numbers 2b and 4b of Suzuki refer to lower and upper surfaces, respectively, of the spiral winding or refer to opposed side surfaces of the spiral winding. Further, those skilled in the art would understand that, at best, Fig. 2 of Suzuki shows a single end face taken in the Fig. 2 cross section.

That disclosure is sharply contrasted to the specific language in Claim 1 and a representative example as can be seen in the Applicants' Figs. 2, 3a and 3b. Specifically, Fig. 2 identifies with specificity "end faces" 204 and 205. Those end faces are shown in association with the spiral winding, as opposed to individual layers comprising the spiral winding. Fig. 3b in particular shows side surfaces of the winding (which are not associated with a reference number). Then, when the end faces specifically identified by the Applicants are applied to a housing cup and a housing top as shown in Figs. 4 and 5, for example, it can be seen that the end faces of the spiral winding are in an axial direction with respect to the flat bottom area and the flat top area of the housing cup and the housing top. This is sharply contrasted to Suzuki such as in Fig. 2 which shows the spiral winding orientated at 90° relative to the Applicants' spiral winding wherein the end faces of the spiral winding are oriented in the radial direction and are not oriented in the axial direction with respect to the flat bottom area and the flat top area.

Any other interpretation of the language in Claim 1 as presented in the context of the Applicants' entire disclosure relative to the disclosure of Suzuki is simply an improper manipulation of the specific language of Claim 1 to support a rejection when, in fact, the ordinary interpretation of that language compels a different interpretation and results in a completely different structure (for example as shown in Fig. 2 of Suzuki) versus the Applicants' Claim 1. Hence, the combination is inapplicable.

Moreover, the Applicants have discovered that orientation of the spiral winding is critical with respect to the longevity of the resulting button cell. In that regard, when a lithium electrode is in the form of spiraling wound flat layers, the extension/shrinking of the spiral winding during charging and discharging is directional. Hence, the spiral winding in the cell shown Fig. 2 of Suzuki would exert a significant pressure in the axial direction against the top and bottom of the cell during charging/discharging which could lead to movement of the housing cup and housing top relative to one another, thereby resulting in potential damage to the cell.

In sharp contrast, in the Applicants' button cells such as those recited in Claim 1, the alignment of electrode layers at a right angle to the flat bottom and flat top areas of the housing

of the cell insures that mechanical pressure during charging and discharging is exerted primarily in a radial direction instead of in the axial direction. This is far, far less likely to cause structural problems associated with the cell. Hence, it is important for the Applicants to orient the spiral winding such that the end faces of the spiral winding face in the direction of the flat bottom area and the flat top area which is completely contrary by 90° with respect to the orientation of Suzuki.

As a result, if one skilled in the art were to import the teachings of Suzuki into Nakayama, the resulting cell would be completely different from the cells recited in Claims 1, 2, 4-6 and 9-13. Withdrawal of the rejection is respectfully requested.

Claims 7, 8 and 14 stand rejected under 35 USC §103 over the further combination of Cantave with Suzuki and Nakayama. The Applicants respectfully submit that Cantave fails to cure the deficiencies set forth above with respect to the underlying combination of Suzuki with Nakayama. Withdrawal of the rejection is accordingly respectfully requested.

In light of the foregoing, the Applicants respectfully submit that the entire application is now in condition for allowance, which is respectfully submitted.

Respectfully submitted,

T. Daniel Christenbury
Reg. No. 31,750

TDC/vbm
(215) 656-3381

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Art Unit	: 1726	**Customer No.: 035811**
Examiner	: Julian Anthony	
Serial No.	: 13/146,669	Docket No.: RUF-11-1270
Filed	: July 28, 2011	
Inventors	: Eduard Pytlik	Confirmation No.: 6273
	: Jürgen Lindner	
	: Ulrich Barenthin	
	: Winfried Gaugler	
Title	: BUTTON CELLS AND METHOD	
	: FOR PRODUCING SAME	
		Dated: October 31, 2014

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

The Applicants enclose Form PTO-1449 together with a copy of each of the ten (10) listed non-US publications, including related US Official Action dated August 29, 2014. The publications are submitted under 37 CFR §1.56 and are believed related to this application for the reasons stated.

The Applicants respectfully request that this Supplemental Information Disclosure Statement be officially entered into the file and that appropriate notification be made that it was considered by the Examiner.

Respectfully submitted,

T. Daniel Christenbury
Reg. No. 31,750

TDC/vbm
(215) 656-3381

,m PTO-1449 US DEPARTMENT OF COMMERCE ATENT AND TRADEMARK OFFICE	ATTY. DOCKET NO. RUF-11-1270	SERIAL NO. 13/146,669
	APPLICANT Eduard Pytlik et al.	
LIST OF PUBLICATIONS CITED BY APPLICANT *(Use several sheets if necessary)*	FILING DATE July 28, 2011	GROUP 1726

US PATENT DOCUMENTS

EXAMINER INITIAL*		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
	AA	2012/0015224 (DE '859)	01/19/12	E. Pytlik et al.			
	AB	2002/0034680 (JP '040)	03/21/02	H. Inoue et al.			
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	AL	1 372 209	12/17/03	EP			Abstract	
	AM	3902330	04/04/07	JP			Abstract	
	AN	1 808 916	07/18/07	EP			Abstract	
	AO	2010/089152	08/12/10	WO			Abstract	
	AP	10 2009 008 859 (corres. to US 2012/0015224)	08/12/10	DE			X	

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	AR	US Official Action dated August 29, 2014 from related US Application No. 13/378,117.
	AS	
	AT	

EXAMINER	DATE CONSIDERED

*EXAMINER: Initial if publication considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to Applicant.

Form PTO-1449 US DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY. DOCKET NO. RUF-11-1270	SERIAL NO. 13/146,669
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	AP							

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EXAMINER	DATE CONSIDERED

*EXAMINER: Initial if publication considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to Applicant.

Bibliographic data: EP1372209 (A1) — 2003-12-17

BATTERY

Applicant(s): SHIBAMOTO GOROU [JP]; FUJITA SHIGERU [JP]; ADACHI MOMOE [JP]; AKASHI HIROYUKI [JP] ±
SONY CORP [JP] ±

Classification:

- **international:** ***H01M10/04; H01M10/40; H01M4/02; H01M4/04; H01M4/58; H01M6/10;*** (IPC1-7): H01M10/40; H01M4/02; H01M4/40; H01M4/58
- **European:** H01M10/04D; H01M10/052; H01M10/0525; H01M10/0587; Y02E60/12B

Application number: EP20020705328 20020319

Priority number(s): WO2002JP02586 20020319; JP20010078609 20010319

Also published as: JP2002280079 (A) WO02078113 (A1) US2004096733 (A1)

Abstract of EP1372209 (A1)

In a battery newly developed by inventors of the invention in which the capacity of the anode is represented by the sum of a capacity component by insertion and extraction of light metal and a capacity component by precipitation and dissolution of the light metal, a further improvement in a volume energy density or a weight energy density can be achieved. Moreover, a short circuit, damage or the like in the battery due to the external application of pressure or the like can be prevented from being extended in the vicinity of an outermost circumference or an innermost circumference of a spirally wound electrode body in the battery. An outermost circumferential surface of a spirally wound electrode body (20) is covered with a cathode current collector (21a). The cathode current collector (21a) has an exposed portion with an outer circumfernetial surface not covered with a cathode mixed layer (cathode active material layer) in a position corresponding to at least one turn around an outermost circumference of the spirally wound electrode body (20). When an outermost circumferential surface of the spirally wound electrode body (20) is covered with the anode current collector (22a), the anode current collector (22a) has a portion with an outer circumferential surface not covered with an anode mixed layer (anode active material layer) in a position corresponding to at least one turn around the outermost circumference of the spirally wound electrode body (20).

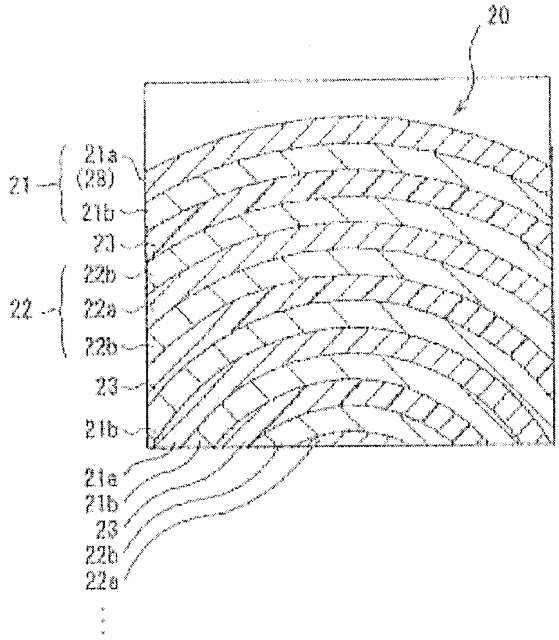


FIG. 3

Last updated: 5.12.2011 Worldwide Database 5.7.31; 93p

Espacenet

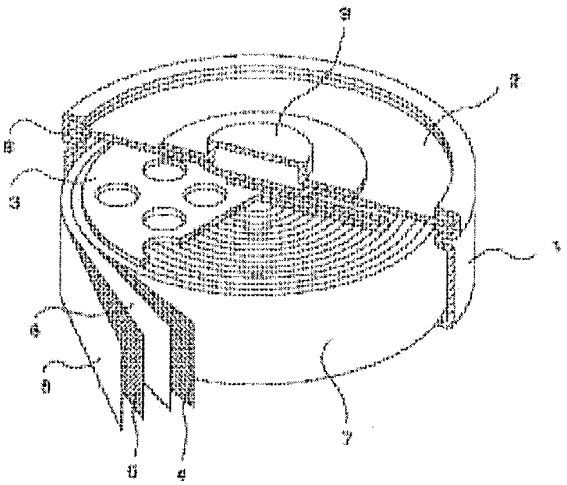
Bibliographic data: JP3902330 (B2) — 2007-04-04

CYLINDRICAL BATTERY

Inventor(s):	KITAOKA KAZUHIRO
Applicant(s):	SANYO ELECTRIC CO LTD
Classification:	**- international:** ***H01M10/04; H01M10/28***
	- European: Y02E60/12D
Application number:	JP19980157397 19980605
Priority number(s):	JP19980157397 19980605
Also published as:	JP11354150 (A)

Abstract of JP11354150 (A)

PROBLEM TO BE SOLVED: To keep discharge capacity and working voltage high, and suppress a rise of the temperature within a battery even at the time of large-current discharge, by causing the height of a cylinder to be equal to or smaller than the diameter of its top surface or bottom surface. SOLUTION: In a nickel-hydrogen battery, an electrode group 7 comprising a positive electrode 4 with a nickel-hydroxide active material, a negative electrode 4 with hydrogen-storage alloy powder, and separators 6 interposed between the positive and negative electrodes 4, 5, is wound in a spiral manner, disposed in a battery exterior can 1, and then an electrolyte made of a KOH water solution of 31 wt.% is injected thereinto. The negative electrode 5 is connected to a bottom surface part of the battery exterior can 1 by means of a negative-electrode collector.; A sealing plate 2 with its middle part opened is disposed on an upper part of the battery exterior can 1 with a gasket 8 interposed therebetween, and a positive-electrode terminal 9 is mounted on the sealing plate 2. The positive-electrode terminal 9 and the positive electrode 4 are connected to each other via a positive-electrode collector 3 and the sealing plate 2.



Last updated: 5.12.2011 Worldwide Database 5.7.31; 93p

Espacenet

Bibliographische Daten: JP11354150 (A) — 1999-12-24

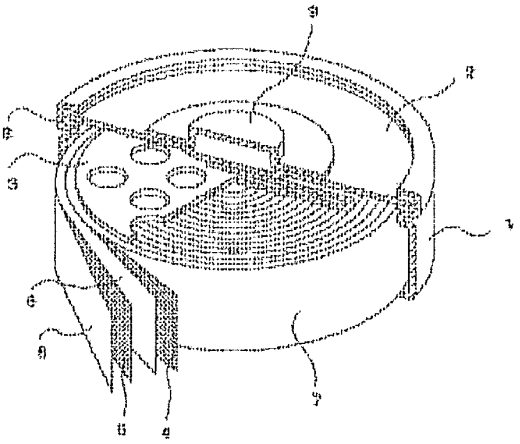
CYLINDRICAL BATTERY

Erfinder:	KITAOKA KAZUHIRO ±
Anmelder:	SANYO ELECTRIC CO ±

Klassifikation:	- **Internationale:**	***H01M10/28;*** (IPC1-7): H01M10/28
	- **Europäische:**	Y02E60/12D
Anmeldenummer:	JP19980157397 19980605	
Prioritätsnummer(n):	JP19980157397 19980605	
Auch veröffentlicht als	JP3902330 (B2)	

Zusammenfassung von JP11354150 (A)

PROBLEM TO BE SOLVED: To keep discharge capacity and working voltage high, and suppress a rise of the temperature within a battery even at the time of large-current discharge, by causing the height of a cylinder to be equal to or smaller than the diameter of its top surface or bottom surface. SOLUTION: In a nickel-hydrogen battery, an electrode group 7 comprising a positive electrode 4 with a nickel-hydroxide active material, a negative electrode 4 with hydrogen-storage alloy powder, and separators 6 interposed between the positive and negative electrodes 4, 5, is wound in a spiral manner, disposed in a battery exterior can 1, and then an electrolyte made of a KOH water solution of 31 wt.% is injected thereinto. The negative electrode 5 is connected to a bottom surface part of the battery exterior can 1 by means of a negative- electrode collector.; A sealing plate 2 with its middle part opened is disposed on an upper part of the battery exterior can 1 with a gasket 8 interposed therebetween, and a positive-electrode terminal 9 is mounted on the sealing plate 2. The positive-electrode terminal 9 and the positive electrode 4 are connected to each other via a positive-electrode collector 3 and the sealing plate 2.



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実開昭５９－０２０５６５（ＪＰ，Ｕ）
特開平１１－３４５６２６（ＪＰ，Ａ）
最終頁に続く

(54)【発明の名称】円筒形電池

(57)【特許請求の範囲】
【請求項１】
正極と負極とをセパレータを介して渦巻き状に巻き取った電極体を円筒形外装缶に挿入した円筒形電池において、前記円筒形電池の上面または底面の直径に対する円筒の高さの比が０．５以下であることを特徴とする円筒形電池。
【請求項２】
正極と負極とをセパレータを介して渦巻き状に巻き取った電極体を円筒形外装缶に挿入した円筒形電池において、前記円筒形電池の上面または底面の直径に対する円筒の高さの比が０．３７５以下であることを特徴とする円筒形電池。
【請求項３】
前記電極体の上面または底面に集電体を取り付けて集電することを特徴とする請求項１または請求項２記載の円筒形電池。
【請求項４】
前記負極は水素吸蔵合金を含有していることを特徴とする請求項１～３いずれかに記載の円筒形電池。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】
本発明は、電動工具や電気自動車等の大電流放電を必要とする用途に適した電池の構造に関する。

【０００２】
【従来の技術】
従来までの円筒形と呼ばれる二次電池は、例えばＡサイズやＣサイズ等の規格があり、これらは電池の上面または底面の直径よりも電池の高さ方向が大きいものであった。
【０００３】
電池が大型化し電流値が大きくなると電池の内部抵抗による電圧降下の影響が大きく、大きな出力をなかなか得ることができなかった。また、電池の大型化に伴って電池内部に熱がこもりやすく、高温による電池特性の劣化が著しいという問題があった。特に、電気自動車や電動工具等の大電流を要する用途、いわゆる動力用用途に適用した場合に上記問題が顕著に表れた。これは、これらの用途の電源として二次電池を使用する場合、電池には数十アンペアから数百アンペアの充放電電流が必要とされる。このような場合では、Ｅ＝ＩＲからもわかるとおり、電池の放電時の作動電圧は流す電流の絶対値が大きくなるほど、抵抗値の大きさに比例して極端に低下する。例えば、電圧が１．２Ｖのニッケルカドミウム蓄電池やニッケル水素蓄電池の場合、１００Ａの電流で放電すると内部抵抗が１ｍΩ大きくなるだけで電池の電圧が０．１Ｖ低下する。このような場合、電池は充分にその容量を放電することなしに放電終止電圧を迎えてしまうことになる。そこで大電流を取り出す場合には電池の内部抵抗を低減することが必須である。
【０００４】
また、円筒形電池を大型化していく手段として円筒の高さを長くしていく方向と巻き数を多くする方向の２つが考えられる。前者の場合、正極、負極それぞれの集電部間の距離が大きくなり、大電流を取り出したときに電池内での分極が大きくなる。その結果、電圧降下が起き、電池の作動電圧が低下する。後者の場合、巻き数が多くなってくると電池中心部の熱の放熱がしにくくなる。例え空冷などの冷却を行っても充放電時の発熱により、電池中心部の温度上昇を抑制できず、電池の劣化や充電効率の低下が著しくなる。特に、負極に水素吸蔵合金を備えた電池では、水素の吸蔵反応、即ち、電池の充電時が発熱反応であるため、充電効率の低下が著しく、また、電池内部の温度上昇が著しいと水素吸蔵合金が酸化されやすく、不活性なものとなり、電池容量の減少が著しいという問題があった。
【０００５】
【発明が解決しようとする課題】
本発明は、前記問題点に鑑みてなされたものであり、大電流で放電した時であっても、放電容量及び作動電圧が高く、また、電池内部温度の上昇を抑制した電気自動車及び電動工具の用途に適した電池を提供しようとすることを本発明の課題とする。
【０００６】
【課題を解決するための手段】
本発明の円筒形電池は、正極と負極とをセパレータを介して渦巻き状に巻き取った電極体を円筒形外装缶に挿入したものであって、前記円筒形電池の上面または底面の直径に対する円筒の高さの比が０．５以下であることを特徴とする。
【０００７】
【発明の実施の形態】
[実施例１]
以下、本発明の実施例について説明する。
【０００８】
本発明の構造を持つニッケル－水素電池を以下のように作製した。
【０００９】
まず、正極板は発泡体ニッケルからなる活物質支持体に水酸化ニッケルを主成分とするスラリーを充填した非焼結式ニッケル正極を使用した。この正極板を幅３０ｍｍ、長さ３０００ｍｍになるよう切断し、この極板の長辺方向の一辺の端部３ｍｍ幅で超音波振動による活物質の剥離を行った。この活物質の剥離部分、即ち、発泡体ニッケルが露出した部分に幅３ｍｍ、厚さ０．１ｍｍのニッケルリボンを抵抗溶接にて溶接した。
【００１０】

負極板は、一般式$MmNi_{3.4}Co_{0.8}Al_{0.2}Mn_{0.6}$で表される水素吸蔵合金を主成分とするスラリーをパンチングメタルの両面に、幅２ｍｍの合金未塗布部分が形成されるように塗布した水素吸蔵合金電極を使用した。

【００１１】

この負極板を幅３０ｍｍ、長さ３０００ｍｍになるよう切断した。

【００１２】

以上のように作製した正極板と負極板を幅３１ｍｍのポリプロピレン製不織布を介して、それぞれの芯体露出部分、即ち、正極のニッケルリボンと負極のパンチングメタルの合金未塗布部分が上下に突出するようにずらして巻き取り、直径８０．０ｍｍ、高さ３２ｍｍの円盤形極板群を作製した。この円盤形極板群の上面に正極用の複数の開口を有する円板状集電体を抵抗溶接にて溶接した後、極板群の底面にも負極用の複数の開口を有する円板状集電体を抵抗溶接にて溶接した。この極板群を内径８０．５ｍｍ、高さ３６ｍｍの円筒形外装缶に挿入し、封口体を溶接した後、３１重量％のＫＯＨ電解液を注液し、封口体をかしめて公称容量２５Ａｈの本発明電池Ａを作製した。

【００１３】

図１は前記の様に作製した本発明のニッケル水素電池Ａを示す断面図であり、水酸化ニッケル活物質を有する正極４と、水素吸蔵合金粉末を有する負極５と、これら正負両極板４、５間に介装されたセパレータ６とからなる電極群７は渦巻状に巻回されており、電池外装缶１内に配置した後、３１重量％のＫＯＨ水溶液からなる電解液を注入している。そして、上記負極５は負極集電体（図示せず）により電池外装缶１の底面部に接続されている。

【００１４】

他方、電池外装缶１の上部には、ガスケット８を介在させて、中央部が開口された封口板２が配設され、この封口板２に正極端子９が装着されている。また、正極端子９と正極板４は正極集電体３及び前記封口板２を介して接続されている。

【００１５】

[比較例１]

比較として１２０ｍｍ幅、長さ７５０ｍｍに切断した正極板と、１２０ｍｍ幅、長さ７５０ｍｍに切断した負極板とを、前記実施例１と同様にセパレータを介して巻き取り、直径３５．０ｍｍ、高さ１２２．０ｍｍの電極群を作製し、内径３５．５ｍｍ、高さ１２６．０ｍｍの円筒形外装缶に挿入し、封口体を溶接した後、３１重量％のＫＯＨ電解液を注液し、封口体をかしめて公称容量２５Ａｈの比較電池Ｂを作製した。

【００１６】

図２は前記比較例１の様に作製したニッケル水素電池Ｂを示す断面図であり、水酸化ニッケル活物質を有する正極４と、水素吸蔵合金粉末を有する負極５と、これら正負両極板４、５間に介装されたセパレータ６とからなる電極群７は渦巻状に巻回されており、電池外装缶１内に配置した後、３１重量％のＫＯＨ水溶液からなる電解液を注入している。そして、上記負極５は負極集電体（図示せず）により電池外装缶１の底面部に接続されている。

【００１７】

他方、電池外装缶１の上部には、ガスケット８を介在させて、中央部が開口された封口板２が配設され、この封口板２に正極端子９が装着されている。また、正極端子９と正極板４は正極集電体３及び前記封口板２を介して接続されている。

【００１８】

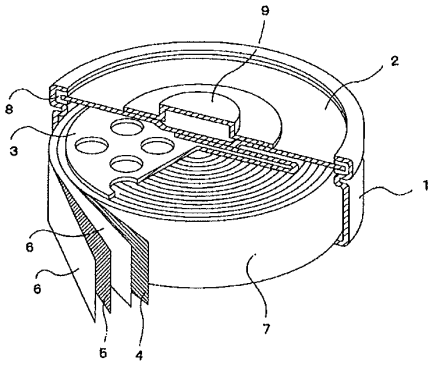
<実験１>

前記のように作製した本発明電池Ａ及び比較電池Ｂを、０．１Ｃで１６時間充電した後、１時間休止後、１／３Ｃ、１Ｃまたは３Ｃで放電した時の放電容量と作動電圧をそれぞれ測定した。その結果を図３に示す。

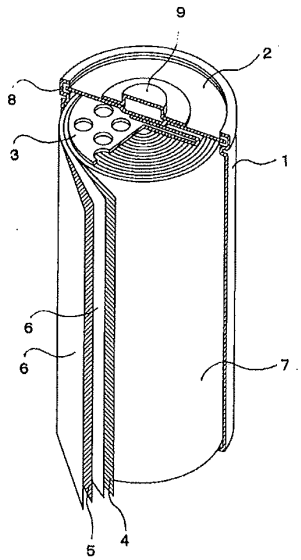
図３から明らかなように、本発明電池Ａは、比較電池Ｂよりも、すべての放電条件において、作動電圧及び放電容量が共に優れていることがわかる。

【００１９】
これは、電池の高さを小さくすることによって、正負極それぞれの集電体までの距離を従来の電池よりも短くすることができたため極板内部での分極の発生を抑制できたためであると考えられる。また、電池の上面または底面の円の部分の面積が大きいために、集電部分の面積が大きくなり、集電部分での電流密度が小さくなって、この部分での発熱及びＩＲ損も軽減でき、電池の作動電圧の降下を抑制できたためであると考えられる。
【００２０】
〈実験２〉
電池径を８０．０ｍｍとし、電池高さを高くしていった時の１Ｃ放電時の電池中心部と電池側面との温度上昇差の関係を図４に示す。
【００２１】
図４より、電池高さを高くしていくと、電池内部との温度差は著しくなることがわかる。電池の使用環境は－２０℃～６０℃の範囲であり、６０℃で使用した場合に電池内部との温度差が１０℃以上であると電池内温度は約７０℃を越え、電池の劣化が著しくなる。そのため、電池内外の温度上昇差が１０℃以下になる４０ｍｍ以下、特に３０ｍｍ以下の電池高さであることが望ましい。
【００２２】
即ち、電池径に対する電池高さの比が０．５以下、特に０．３７５以下に設定することが、電池の温度上昇を抑制する点で望ましいことがわかる。
【００２３】
【発明の効果】
本発明は以上のような円筒形電池の高さが、前記円筒形電池の上面または底面の直径に対する円筒の高さの比が０．５以下である、即ち、円盤形の形状とし、その広い面積を持つ上面または底面の円面に集電体を取り付けて集電することにより、大電流放電時の作動電圧及び放電容量を向上することができる。
【００２４】
また、円筒形電池の上面または底面の直径に対する円筒の高さの比が０．５以下、特に好ましくは円筒形電池の上面または底面の直径に対する円筒の高さの比が０．３７５以下に抑制することにより、１０Ａｈ以上の大容量を持つ大型電池であっても電池内に熱がこもって電池内部温度が高くなることを抑制し、電池の劣化を抑制することができる。特に、水素吸蔵合金を含有した負極をそなえた電池の場合、極めて顕著な効果を発揮する。
【図面の簡単な説明】
【図１】本発明のニッケル水素電池の一例を示す断面図である。
【図２】比較例のニッケル水素電池の一例を示す断面図である。
【図３】本発明電池Ａと比較電池Ｂの各放電レートに対する放電容量及び作動電圧を示した図である。
【図４】本発明電池の高さと電池内部温度上昇との関係を示した図である。
【符号の説明】
1　電池外装缶
7　渦巻き電極体

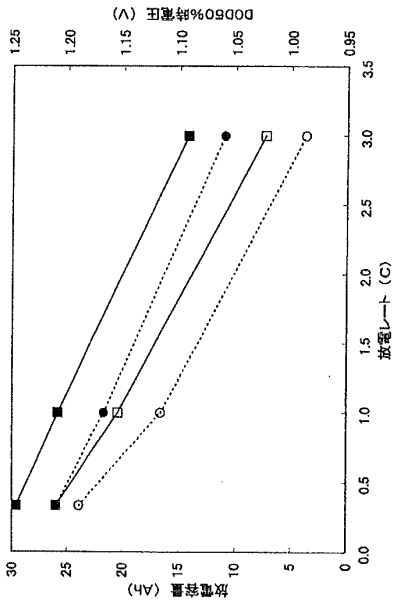
【図１】



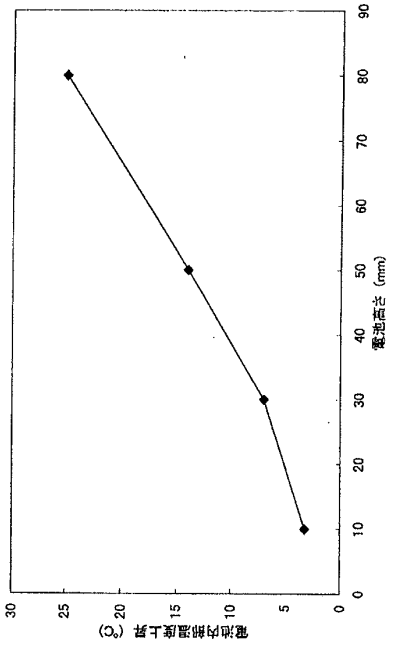
【図２】



【図３】



【図４】



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ENCLOSED BATTERY, ENCLOSED BATTERY-USE LEAD, AND ASSEMBLED BATTERY FORMED BY A PLURALITY OF ENCLOSED BATTERIES

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Abstract of EP1808916 (A1)

The object of the invention is to provide a sealed battery having a low resistance and is excellent in output power performance, and a lead suitable for the sealed battery, and a battery stack comprising a plurality of such sealed batteries as described above. Provided is a sealed battery comprising a lid (50) for closing the open end of a container (60) which has, at the center of its upper surface, a valve body (90) covered with a cap (80) to form a safety valve, and an upper current collecting plate (2) connected via lead (20, 30) to the inner surface of lid (50), wherein a welding point of lead (20) to the inner surface of lid (50) is, in a flat view, outside the periphery of cap (80), and the length of lead (20, 30) from the welding point (20) on the inner surface of lid (50) to the nearest welding point (30) on the upper current collecting plate (2); is 1 to 2.1 times as large as the shortest distance between the welding point (20) of lead on the inner surface of lid (50) and the upper surface of upper current collecting plate (2). In addition, a welding point formed by the lead (30) on the upper current collecting plate (2) falls in a circular band enclosed between a concentric circle around the center of upper current collecting plate (2) and having a radius 41% of the radius of said plate, and another concentric circle having a 69% radius. Welding points (100-1) formed between, the lower surface of a lower current collecting plate (100) and the upper surface of bottom of container (60) are disposed, in a flat view, laterally outside the peripheral margin of a cap (80). The lead used for such a sealed battery may be shaped like a ring (2D, 30) or a double-walled ring having a frame portion and lateral wall portions.; Such sealed batteries may be combined to form a battery stack

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[Fortsetzung auf der nächsten Seite]

(54) Title: BUTTON CELLS AND METHOD FOR PRODUCING SAME

(54) Bezeichnung : KNOPFZELLEN UND VERFAHREN ZU IHRER HERSTELLUNG

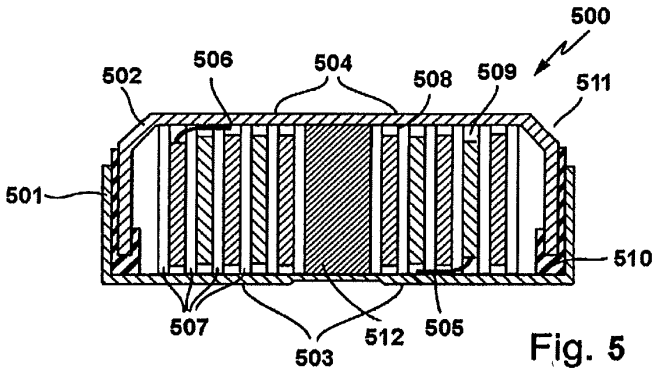

Fig. 5

(57) Abstract: A button cell (100; 400; 500) is described, comprising two metal housing halves (101, 102; 401, 402; 501, 502), which are sealingly connected to each other and form a housing having a planar base area (103; 503) and a planar cover area (104; 504) parallel thereto, wherein positive and negative electrodes (105, 106; 201, 202; 304, 305; 407, 408; 508, 509) are arranged as flat layers inside the housing and are connected to each other via an areal separator (107; 203; 302, 303; 405, 406; 507), wherein the electrode layers have an orthogonal orientation relative to the planar base and cover areas. Furthermore, a method for producing such a button cell is described.

(57) Zusammenfassung:

[Fortsetzung auf der nächsten Seite]

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Veröffentlicht:

— *mit internationalem Recherchenbericht (Artikel 21 Absatz 3)*

Beschrieben wird eine Knopfzelle (100; 400; 500), umfassend zwei metallische Gehäusehalbteile (101, 102; 401, 402; 501, 502), welche dichtend miteinander verbunden sind und ein Gehäuse mit einem ebenen Bodenbereich (103; 503) und einem dazu parallelen ebenen Deckelbereich (104; 504) ausbilden, wobei innerhalb des Gehäuses als flache Schichten ausgebildete positive und negative Elektroden (105, 106; 201, 202; 304, 305; 407, 408; 508, 509) angeordnet sind, die über einen flächigen Separator (107; 203; 302, 303; 405, 406; 507) miteinander verbunden sind, wobei die Elektrodenschichten orthogonal zu dem ebenen Boden- und Deckelbereich ausgerichtet sind. Weiterhin wird ein Verfahren zur Herstellung einer solchen Knopfzelle beschrieben.

Knopfzellen und Verfahren zu ihrer Herstellung

Die vorliegende Erfindung betrifft Knopfzellen umfassend zwei metallische Gehäusehalbteile, die durch eine elektrisch isolierende Dichtung voneinander getrennt sind und die ein Gehäuse mit einem ebenen Bodenbereich und einem dazu parallelen ebenen Deckelbereich ausbilden sowie innerhalb des Gehäuses mit einem Elektroden-Separator-Verbund, umfassend mindestens eine positive und mindestens eine negative Elektrode, die als flache Schichten ausgebildet und über mindestens einen flächigen Separator miteinander verbunden sind, sowie ein Verfahren zur Herstellung von solchen Knopfzellen.

Knopfzellen weisen üblicherweise ein Gehäuse aus zwei Gehäusehalbteilen, einem Zellenbecher und einem Zellendeckel, auf. Diese können beispielsweise aus vernickeltem Tiefziehblech als Stanzziehteile hergestellt werden. Gewöhnlich ist der Zellenbecher positiv und der Gehäusedeckel negativ gepolt. In dem Gehäuse können die verschiedensten elektrochemischen Systeme enthalten sein, beispielsweise Zink/MnO_2, primäre und sekundäre Lithium-Systeme oder sekundäre Systeme wie Nickel/Cadmium oder Nickel/Metallhydrid.

Sehr verbreitet sind z.B. wiederaufladbare Knopfzellen auf Basis von Nickel-Metallhydrid- oder Lithium-Ionen-Systemen. Bei Lithium-Ionen-Knopfzellen werden die elektrochemisch aktiven Materialien innerhalb des Knopfzellengehäuses üblicherweise nicht in Form von einzelnen, durch einen Separator voneinander getrennten, tablettenförmigen Elektroden angeordnet. Stattdessen werden bevorzugt vorgefertigte Elektroden-Separator-Verbünde flach in das Gehäuse eingelegt. Als Separator dient dabei bevorzugt eine poröse Kunststofffolie, auf welche die Elektroden flächig auflaminiert oder aufgeklebt sind. Der Gesamtverbund aus Separator und Elektroden ist dabei in der Regel maximal wenige 100 µm

dick. Um Knopfzellengehäuse üblicher Dimensionen ausfüllen zu können, werden daher häufig mehrere solcher Verbünde flach übereinander gelegt. Auf diese Weise lassen sich Stapel in grundsätzlich beliebiger Höhe erhalten, jeweils abgestimmt auf die zur Verfügung stehenden Dimensionen des Knopfzellengehäuses, in das der Stapel verbaut werden soll. So wird eine optimale Ausnutzung des zur Verfügung stehenden Gehäuseinnenraumes gewährleistet.

Konstruktionsbedingt treten bei Knopfzellen, die solche Stapel aus Elektroden-Separator-Verbünden enthalten, allerdings auch diverse Probleme auf. Zum einen ist es natürlich erforderlich, Elektroden von jeweils gleicher Polarität innerhalb des Stapels miteinander zu verbinden und dann jeweils mit dem entsprechenden Pol des Knopfzellengehäuses zu kontaktieren. Die erforderlichen elektrischen Kontakte verursachen Materialkosten, der durch sie eingenommene Raum steht zudem für Aktivmaterial nicht mehr zur Verfügung. Die Herstellung der Elektrodenstapel ist darüber hinaus kompliziert und teuer, da bei der Kontaktierung der Verbünde untereinander leicht Fehler auftreten können, die die Ausschussrate erhöhen. Zum anderen wurde festgestellt, dass Knopfzellen mit einem Stapel aus Elektroden und Separatoren sehr schnell undicht werden.

Der flüssigkeitsdichte Verschluss von Knopfzellen erfolgt klassisch durch Umbördeln des Randes des Zellenbechers über den Rand des Zellendeckels in Verbindung mit einem Kunststoffring, der zwischen Zellenbecher und Zellendeckel angeordnet ist und der gleichzeitig als Dichtungselement sowie zur elektrischen Isolierung des Zellenbechers und des Zellendeckels dient. Derartige Knopfzellen sind beispielsweise in der DE 31 13 309 beschrieben.

Alternativ ist es jedoch auch möglich, Knopfzellen zu fertigen, bei denen Zellenbecher und Zellendeckel in axialer Richtung ausschließlich durch eine kraftschlüssige Verbindung zusammengehalten werden und die keinen umgebördelten Becherrand aufweisen. Derartige Knopfzellen

sowie ein Verfahren zu ihrer Herstellung sind in der noch unveröffentlichten deutschen Patentanmeldung mit dem Aktenzeichen 10 2009 017 514.8 beschrieben. Ungeachtet der diversen Vorteile, die solche Knopfzellen ohne Bördelung aufweisen können, sind sie in axialer Richtung jedoch weniger belastbar als vergleichbare Knopfzellen mit umgebördeltem Becherrand, insbesondere was axiale mechanische Belastungen angeht, die ihre Ursache im Inneren der Knopfzelle haben. So sind zum Beispiel die Elektroden von wiederaufladbaren Lithium-Ionen-Systemen bei Lade- und Entladevorgängen stets Volumenänderungen ausgesetzt. Die dabei auftretenden axialen Kräfte können bei Knopfzellen ohne Bördelung natürlich vergleichsweise leichter zu Undichtigkeiten führen als bei Knopfzellen mit Bördelung.

Der vorliegenden Erfindung lag die Aufgabe zugrunde, eine Knopfzelle bereitzustellen, bei der die oben angesprochenen Probleme nicht oder nur in stark verringertem Maß auftreten. Die Knopfzelle soll insbesondere gegenüber in axialer Richtung auftretenden mechanischen Belastungen widerstandsfähiger sein als herkömmliche Knopfzellen, insbesondere auch dann, wenn sie als Knopfzelle ohne umgebördelten Becherrand gefertigt wird.

Diese Aufgabe wird gelöst durch die Knopfzelle mit den Merkmalen des Anspruchs 1. Bevorzugte Ausführungsformen der erfindungsgemäßen Knopfzelle sind in den abhängigen Ansprüchen 2 bis 10 definiert. Auch das Verfahren gemäß Anspruch 11 trägt zur Lösung der erfindungsgemäßen Aufgabe bei. Bevorzugte Ausführungsformen des erfindungsgemäßen Verfahrens sind in den abhängigen Ansprüchen 12 bis 14 definiert. Der Wortlaut sämtlicher Ansprüche wird hiermit durch Bezugnahme zum Inhalt dieser Beschreibung gemacht.

Eine erfindungsgemäße Knopfzelle umfasst stets zwei metallische Gehäusehalbteile, die durch eine elektrisch isolierende Dichtung voneinander getrennt sind und die ein Gehäuse mit einem ebenen Bodenbereich und einem dazu parallelen ebenen Deckelbereich ausbilden. Bei den

beiden Gehäusehalbteilen handelt es sich, wie eingangs bereits erwähnt, in der Regel um einen sogenannten Gehäusebecher und einen Gehäusedeckel. Als Gehäusehalbteile sind insbesondere Teile aus vernickeltem Stahl oder Blech bevorzugt. Weiterhin als metallischer Werkstoff geeignet sind insbesondere Trimetalle, beispielsweise mit der Abfolge Nickel, Stahl (oder Edelstahl) und Kupfer (wobei die Nickelschicht bevorzugt die Außen- und die Kupferschicht bevorzugt die Innenseite des Knopfzellengehäuses bildet).

Als Dichtung kann beispielsweise eine Spritzguß- oder eine Foliendichtung zum Einsatz kommen. Letztere sind beispielsweise in der DE 196 47 593 beschrieben.

Innerhalb des Gehäuses umfasst eine erfindungsgemäße Knopfzelle einen Elektroden-Separator-Verbund mindestens eine positive und mindestens eine negative Elektrode. Diese liegen jeweils in Form von flachen Elektrodenschichten vor. Miteinander verbunden sind die Elektroden über einen flächigen Separator. Bevorzugt sind die Elektroden auf diesen Separator auflaminiert oder aufgeklebt. Die Elektroden und der Separator weisen in der Regel jeweils nur Dicken im µm-Bereich auf. Als Separator dient in der Regel eine poröse Kunststofffolie.

Im Gegensatz zu den eingangs erwähnten Knopfzellen zeichnet sich die erfindungsgemäße Knopfzelle insbesondere dadurch aus, dass die Elektrodenschichten eine ganz besondere Orientierung aufweisen, sie sind nämlich im wesentlichen orthogonal zu dem ebenen Boden- und Deckelbereich ausgerichtet. Während aus dem Stand der Technik bekannte Knopfzellen mit gestapelten Elektroden-Separator-Verbünden diese stets flach eingelegt enthalten, so dass die Elektrodenschichten im wesentlichen parallel zu den ebenen Boden- und Deckelbereichen ausgerichtet sind, ist bei einer erfindungsgemäßen Knopfzelle das Gegenteil der Fall.

Die orthogonale Ausrichtung der Elektrodenschichten hat einen unerwartet deutlichen Vorteil, es wurde nämlich festgestellt, dass diese Ausrichtung mit einer deutlichen Verbesserung der Dichtigkeitseigenschaften einer erfindungsgemäßen Knopfzelle einhergeht, insbesondere bei Knopfzellen auf Basis von Lithium-Ionen-Systemen. Die Elektroden von wiederaufladbaren Lithium-Ionen-Systemen sind bei Lade- und Entladevorgängen stets Volumenänderungen ausgesetzt. Zu solchen Volumenänderungen kann es natürlich auch bei den Elektroden einer erfindungsgemäßen Knopfzelle kommen. Die dabei entstehenden mechanischen Kräfte wirken jedoch nicht mehr primär axial, wie das im Falle eines flach eingelegten Stapels aus Elektroden-Separator-Verbünden der Fall ist. Aufgrund der orthogonalen Ausrichtung der Elektroden wirken sie vielmehr radial. Radiale Kräfte können von dem Gehäuse einer Knopfzelle sehr viel besser aufgenommen werden als axiale. Vermutlich lassen sich darauf die verbesserten Dichtigkeitseigenschaften zurückführen.

Besonders bevorzugt sind die Elektroden und der flächige Separator einer erfindungsgemäßen Knopfzelle jeweils streifen- oder bandförmig ausgebildet. So kann zur Herstellung einer erfindungsgemäßen Knopfzelle beispielsweise von einem als Endlosband vorliegenden Separatormaterial ausgegangen werden, auf das die Elektroden flächig, insbesondere wieder in Form von Streifen oder zumindest von Rechtecken, aufgebracht, insbesondere auflaminiert, werden.

Im Gehäuse einer erfindungsgemäßen Knopfzelle liegt dieser Verbund besonders bevorzugt in Form eines Wickels, insbesondere in Form eines spiralförmigen Wickels, vor. Derartige Wickel lassen sich nach bekannten Verfahren (s. z.B. DE 36 38 793) recht einfach herstellen, indem auf einen als Endlosband vorliegenden Separator die Elektroden flächig, insbesondere in Form von Streifen, aufgebracht, insbesondere auflaminiert, werden. Aufgewickelt wird der Verbund aus Elektroden und Separatoren dabei in der Regel auf einen sogenannten Wickeldorn. Nach Abstreifen des Wickels vom Wickeldorn bleibt im Zentrum des Wi-

ckels ein axialer Hohlraum zurück. Das hat zur Folge, dass sich der Wickel gegebenenfalls in diesen Hohlraum hinein entspannen kann. Dies kann jedoch unter Umständen zu Problemen bei der elektrischen Kontaktierung der Elektroden mit den metallischen Gehäusehalbteilen führen, was im Folgenden noch genauer beschrieben wird.

Der Elektrodenwickel ist innerhalb einer erfindungsgemäßen Knopfzelle (damit die Elektrodenschichten des Wickels orthogonal zu dem ebenen Boden- und Deckelbereich des Gehäuses ausgerichtet sind) bevorzugt derart angeordnet, dass die Stirnseiten des Wickels in Richtung des ebenen Bodenbereichs und des ebenen Deckelbereichs weisen.

Gemäß der vorliegenden Erfindung ist es vorgesehen, dass eine erfindungsgemäße Knopfzelle in bevorzugten Ausführungsformen einen festen Wickelkern im Zentrum des Wickels aufweist, der den axialen Hohlraum im Zentrum des Wickels mindestens teilweise ausfüllt. Ein solcher Wickelkern fixiert den Elektrodenwickel in radialer Richtung und verhindert eine mögliche Implosion des Wickels in den axialen Hohlraum. Bei einer derartigen Entspannung des Wickels lässt auch der Druck nach, den die Stirnseiten des Wickels in axialer Richtung und damit in Richtung dort gegebenenfalls angeordneter Ableiter (hierzu unten noch mehr) ausüben. Wird dies unterbunden, so resultieren in der Regel auch keine Probleme mit der elektrischen Kontaktierung der Elektroden und der metallischen Gehäusehalbteile.

Daneben verbessert ein solcher Wickelkern auch die Stabilität der erfindungsgemäßen Knopfzelle gegenüber äußeren mechanischen Einflüssen. Eine Beschädigung des Elektrodenwickels in der Knopfzelle durch einen äußeren mechanischen Druck in axialer Richtung ist in der Regel nicht mehr möglich.

Gemäß der bevorzugten Ausführungsform des Elektrodenwickels als spiralförmiger Elektrodenwickel ist der erwähnte axiale Hohlraum im Zentrum des Wickels vorzugsweise im Wesentlichen zylindrisch (insbe-

sondere kreiszylindrisch) ausgebildet. Mantelseitig wird er durch den Wickel begrenzt, stirnseitig durch entsprechende Flächen des Boden- bzw. des Deckelbereichs des Knopfzellengehäuses.

Entsprechend ist auch der in einer erfindungsgemäßen Knopfzelle enthaltene Wickelkern bevorzugt als Zylinder, insbesondere als Hohlzylinder, ausgebildet. Die Höhe eines solchen Zylinders entspricht bevorzugt dem jeweiligen Abstand des ebenen Bodenbereichs von dem dazu parallelen ebenen Deckelbereich.

In besonders bevorzugten Ausführungsformen kann der Wickelkern radial selbstexpandierende Eigenschaften aufweisen. Es ist zum Beispiel möglich, den Wickelkern in einer radial komprimierten Konfiguration in den axialen Hohlraum des Wickels einer erfindungsgemäßen Knopfzelle einzuführen. Bei Entspannung des radial komprimierten Wickelkerns übt dieser einen radialen Druck auf den ihn umgebenden Elektrodenwickel aus und gewährleistet so einen Anpressdruck auch in axialer Richtung.

Als radial selbstexpandierender Wickelkern kann beispielsweise ein axial geschlitzter Hohlzylinder zum Einsatz kommen. Alternativ sind jedoch auch andere radial selbstexpandierende Materialien, beispielsweise auf Kunststoffbasis, denkbar.

Besonders bevorzugt besteht der Wickelkern aus einem Metall wie Edelstahl oder aus Kunststoff.

Besonders bevorzugt weist der Verbund aus Elektroden und Separator in einer erfindungsgemäßen Knopfzelle eine der folgenden Schichtabfolgen auf:

- negative Elektrode / Separator / positive Elektrode / Separator

oder

- positive Elektrode / Separator / negative Elektrode / Separator.

Derartige Verbünde lassen sich sehr einfach herstellen und aufwickeln, ohne dass es zu Kurzschlüssen zwischen entgegengesetzt gepolten Elektroden kommt.

Bei den in einer erfindungsgemäßen Knopfzelle einsetzbaren Separatoren handelt es sich vorzugsweise um Folien aus mindestens einem Kunststoff, insbesondere aus mindestens einem Polyolefin. Bei dem mindestens einen Polyolefin kann es sich beispielsweise um Polyethylen handelt. Es können aber auch mehrlagige Separatoren verwendet werden, beispielsweise Separatoren aus einer Abfolge verschiedener Polyolefinschichten, z.B. mit der Sequenz Polyethylen/Polypropylen/Polyethylen.

Zur Herstellung von Verbünden der oben genannten Abfolge müssen nicht zwingend mehrere separate Separatoren zum Einsatz kommen. Vielmehr kann ein Separator auch um das Ende einer der Elektroden umgeschlagen werden, so dass im Ergebnis beide Seiten dieser Elektrode von dem Separator bedeckt werden.

Die in einer erfindungsgemäßen Knopfzelle bevorzugt einsetzbaren Separatoren weisen bevorzugt eine Dicke zwischen 3 µm und 100 µm, insbesondere zwischen 10 µm und 50 µm, auf.

Die Elektroden einer erfindungsgemäßen Knopfzelle weisen bevorzugt eine Dicke zwischen 10 µm und 1000 µm, insbesondere zwischen 30 µm und 500 µm, auf.

In bevorzugten Ausführungsformen einer erfindungsgemäßen Knopfzelle sind die negative Elektrode und die positive Elektrode im Elektroden-Separator-Verbund innerhalb des Verbundes versetzt zueinander angeordnet. Unter einer versetzten Anordnung soll dabei verstanden werden, dass die Elektroden derart angeordnet sind, dass in der erfindungsge-

mäßen Knopfzelle eine jeweils unterschiedliche Beabstandung der Elektroden zu den ebenen Boden- und Deckelbereichen resultiert. Im einfachsten Fall können z.B. eine positive und eine negative Elektrode als gleich breite Streifen leicht versetzt auf die gegenüberliegenden Seiten eines Separatorbandes aufgebracht werden, so dass der Abstand der positiven Elektrode zum oberen Separatorrand größer ist als der vergleichbare Abstand von der negativen Elektrode aus gemessen. Umgekehrtes gilt dann natürlich im Hinblick auf den Abstand zum unteren Separatorrand.

In besonders bevorzugten Ausführungsformen liegt, vorzugsweise als Resultat dieser versetzten Anordnung, die positive Elektrode, insbesondere ein Rand der positiven Elektrode, unmittelbar am Becherteil an, insbesondere im ebenen Bodenbereich des Becherteils, während die negative Elektrode, insbesondere ein Rand der negativen Elektrode, unmittelbar am Deckelteil, insbesondere im ebenen Deckelbereich des Deckelteils, anliegt. In dieser Ausführungsform besteht ein unmittelbarer elektrischer und mechanischer Kontakt zwischen den Elektroden und dem Becher- bzw. Deckelteil. Die versetzte Anordnung der Elektroden zueinander ermöglicht also eine Kontaktierung der Elektroden mit den jeweiligen Gehäuseteilen, ohne dass zusätzliche elektrische Kontakte und Verbindungsmittel zum Einsatz kommen müssen.

In alternativen bevorzugten Ausführungsformen kann es allerdings auch bevorzugt sein, dass zumindest eine der Elektroden, vorzugsweise sowohl die mindestens eine negative als auch die mindestens eine positive Elektrode in einer erfindungsgemäßen Knopfzelle, über einen oder mehrere Ableiter mit den ebenen Boden- und Deckelbereichen verbunden sind. Bei den Ableitern kann es sich beispielsweise um Ableiterfahnen aus Kupfer oder einem anderen geeigneten Metall handeln. Elektrodenseitig können die Ableiter z.B. an einen Stromkollektor angebunden sein. Eine Anbindung der Ableiter ans Gehäuse und/oder an die Stromkollektoren kann z.B. über Verschweissung oder über eine Klemmverbindung erfolgen.

Im einfachsten Fall können als Ableiter auch die Stromkollektoren von positiver und negativer Elektrode selbst fungieren. Bei solchen Kollektoren handelt es sich in der Regel um metallische Folien oder Netze, die in das jeweilige Elektrodenmaterial eingebettet sind. Unbedeckte Teilbereiche, insbesondere Endstücke, solcher Kollektoren können umgebogen und in Kontakt mit dem Knopfzellengehäuse gebracht werden.

Die Verwendung von Ableitern kann insbesondere dann vorteilhaft sein, wenn die negative Elektrode und die positive Elektrode innerhalb des Verbundes derart zueinander angeordnet sind, dass für die Elektroden eine jeweils gleiche Beabstandung zu den ebenen Boden- und Deckelbereichen resultiert. Oder mit anderen Worten, wenn die Elektroden innerhalb des Elektroden-Separator-Verbundes nicht versetzt zueinander angeordnet sind, wie es oben beschrieben wurde.

Allerdings besteht bei gleicher Beabstandung entgegengesetzt gepolter Elektroden zu den ebenen Boden- und Deckelbereichen die Gefahr, dass eine positive und eine negative Elektrode gleichzeitig das metallische Becher- oder Deckelteil berühren, so dass ein Kurzschluss entsteht. In bevorzugten Ausführungsformen kann die erfindungsgemäße Knopfzelle deshalb mindestens ein Isoliermittel umfassen, das einen direkten und unmittelbaren mechanischen und elektrischen Kontakt zwischen den Stirnseiten des Wickels und den ebenen Boden- und Deckelbereichen unterbindet.

In Weiterbildung ist es bevorzugt, wenn die Elektroden in einer solchen erfindungsgemäßen Knopfzelle über die bereits erwähnten separaten Ableiter mit den ebenen Boden- und Deckelbereichen verbunden sind. Diese gewährleisten den elektrischen Kontakt zwischen den Elektroden und dem Gehäuse.

Dabei ist es bevorzugt, dass zumindest ein Teilabschnitt des oder der Ableiter im Boden- bzw. im Deckelbereich des Gehäuses flach an der

Innenseite der Gehäusehalbteile anliegt. Ideal ist die elektrische Kontaktierung der Ableiter mit den Innenseiten des Gehäuses natürlich dann, wenn sie zumindest leicht an das Gehäuse angepresst werden (falls sie nicht ohnehin angeschweisst sind). Überraschend effizient kann dies durch geeignete Anordnung des oben erwähnten Wickelkerns in einer erfindungsgemäßen Knopfzelle erreicht werden.

Bei dem Isoliermittel kann es sich z.B. um eine flache Schicht aus Kunststoff, beispielsweise um eine Kunststofffolie handeln, die zwischen den Stirnseiten des Wickels und den ebenen Boden- und Deckelbereichen des Gehäuses einer erfindungsgemäßen Knopfzelle angeordnet ist.

Bei der erfindungsgemäßen Knopfzelle handelt es sich entsprechend den obigen Ausführungen insbesondere um eine wiederaufladbare Knopfzelle. Besonders bevorzugt weist eine erfindungsgemäße Knopfzelle mindestens eine Lithium-interkalierende Elektrode auf.

Das Verhältnis von Höhe zu Durchmesser liegt bei Knopfzellen definitionsgemäß unterhalb von 1. Besonders bevorzugt liegt dieses Verhältnis bei einer erfindungsgemäßen Knopfzelle zwischen 0.1 und 0.9, insbesondere zwischen 0.15 und 0.7. Unter der Höhe soll dabei der Abstand zwischen dem ebenen Bodenbereich und dem dazu parallelen ebenen Deckelbereich verstanden werden. Der Durchmesser meint die maximale Entfernung zweier Punkte auf dem Mantelbereich der Knopfzelle.

Besonders bevorzugt handelt es sich bei der erfindungsgemäßen Knopfzelle um eine Knopfzelle ohne Bördelung, wie sie in der eingangs bereits erwähnten Patentanmeldung mit dem Aktenzeichen 10 2009 017 514.8 beschrieben ist. Entsprechend besteht zwischen den Gehäusehalbteilen bevorzugt eine ausschließlich kraftschlüssige Verbindung. Die erfindungsgemäße Knopfzelle weist also keinen umgebördelten Becherrand auf, wie dies bei aus dem Stand der Technik bekannten Knopfzellen stets der Fall ist. Die Knopfzelle ist bördelfrei verschlossen.

Für solche bördelfreien Knopfzellen greift man in der Regel auf übliche Zellenbecher und Zellendeckel zurück, die jeweils einen Boden- bzw. einen Deckelbereich, einen Mantelbereich, einen zwischen Boden- bzw. Deckelbereich und Mantelbereich angeordneten Randbereich und eine Schnittkante aufweisen. Zusammen bilden Zellenbecher und Zellendeckel ein Gehäuse, das eine Aufnahme für die üblichen Innenkomponenten einer Knopfzelle wie Elektroden, Separator etc. bildet. Wie üblich sind in diesem Gehäuse der Bodenbereich des Zellenbechers und der Deckelbereich des Zellendeckels im wesentlichen parallel zueinander ausgerichtet. Die Mantelbereiche von Zellenbecher und Zellendeckel sind in der fertigen Knopfzelle im wesentlichen orthogonal zum Boden- bzw. zum Deckelbereich ausgerichtet und weisen bevorzugt eine im wesentlichen zylindrische Geometrie auf. Vorzugsweise sind Innen- und Außenradius von Zellenbecher und Zellendeckel in den Mantelbereichen im wesentlichen konstant. Die erwähnten Randbereiche von Zellenbecher und Zellendeckel bilden den Übergang zwischen den Mantelbereichen und dem Deckelbereich bzw. dem Bodenbereich. Sie sind also bevorzugt zum einen begrenzt durch die im wesentlichen eben ausgebildeten Boden- und Deckelbereiche, zum anderen durch die orthogonal zu diesen angeordneten im wesentlichen zylindrischen Mantelbereiche. Die Randbereiche können beispielsweise als scharfe Kante oder auch abgerundet ausgebildet sein.

Zur Herstellung einer bördelfreien Knopfzelle geht man in der Regel so vor, dass zunächst eine Dichtung auf den Mantelbereich eines Zellendeckels aufgebracht wird. In einem weiteren Schritt wird dann der Zellendeckel mit der aufgebrachten Dichtung in einen Zellenbecher eingeschoben, so dass sich ein Bereich ergibt, in dem die Mantelbereiche von Zellenbecher und Zellendeckel überlappen. Die Größe des Überlappungsbereiches bzw. das Verhältnis von überlappendem Bereich zu nicht überlappendem Bereichen ist dabei durch die jeweilige Höhe der Mantelbereiche von Zellenbecher und Zellendeckel sowie durch die Tiefe des Einschubs festgelegt. Hinsichtlich des Mantelbereichs des Zel-

lendeckels ist es bevorzugt, dass zwischen 20 % und 99 %, insbesondere zwischen 30 % und 99 %, besonders bevorzugt zwischen 50 % und 99 %, mit dem Mantelbereich des Zellenbechers überlappen (die Prozentzahlen beziehen sich jeweils auf die Höhe des Mantels bzw. des Mantelbereichs). Vor dem Einschieben können in den Gehäusebecher und/oder in den Gehäusedeckel die sonstigen üblichen Bestandteile einer Knopfzelle (Elektroden, Separator, Elektrolyt etc.) eingesetzt werden. Nach dem vollständigen Einschieben des Zellendeckels in den Zellenbecher wird auf den Mantelbereich des Zellenbechers, insbesondere im Bereich der Schnittkante, ein Druck ausgeübt, um das Gehäuse abzudichten. Dabei sollen die zusammengefügten Gehäuseteile möglichst keinen oder nur sehr geringen Belastungen in axialer Richtung unterliegen. Der Druck wird daher insbesondere radial angelegt. Abgesehen von der bereits erwähnten Abdichtung des Gehäuses kann so auch der Außendurchmesser des Zellengehäuses kalibriert werden.

Besonders wichtig ist es dass die Höhen der Mantelbereiche von Zellenbecher und Zellendeckel derart aufeinander abgestimmt sind, dass die Schnittkante des Zellenbechers durch den Druck auf den Mantelbereich des Zellenbechers gegen den Mantelbereich des Zellendeckels gepresst wird. Die Höhen der Mantelbereiche sind also bevorzugt so gewählt, dass ein Umbiegen der Schnittkante des Zellenbechers nach innen über den Randbereich des vollständig in den Zellenbecher eingeschobenen Zellendeckels nicht möglich ist. Es findet entsprechend keine Umbördelung des Randes des Zellenbechers über den Randbereich des Zellendeckels statt. In Folge dessen weist der Zellenbecher einer nach dem erfindungsgemäßen Verfahren gefertigten Knopfzelle einen Mantelbereich mit einem im wesentlichen konstanten Radius in Richtung der Schnittkante auf.

Bei nach einem solchen Verfahren hergestellten Knopfzellen besteht zwischen den Gehäusekomponenten Zellenbecher, Zellendeckel und Dichtung vorzugsweise eine ausschließlich kraftschlüssige Verbindung.

Der Zusammenhalt der Komponenten wird also bevorzugt im wesentlichen nur durch Haftkraft gewährleistet.

Besonders bevorzugt wird zur Herstellung bördelfreier Knopfzellen ein Zellenbecher verwendet, der zumindest in einem Teilbereich seines Mantels konisch ausgebildet ist, so dass zumindest sein Innendurchmesser in Richtung der Schnittkante zunimmt. Dadurch wird das Einschieben des Zellendeckels in den Zellenbecher deutlich erleichtert. Die Dimensionen von Zellenbecher und Zellendeckel sind bevorzugt so aufeinander abgestimmt, dass größere Gegenkräfte vorzugsweise erst bei nahezu vollständigem Einschub des Deckels in den Becher auftreten. Vorzugsweise liegt der Konuswinkel dabei zwischen 10 min und 3°, insbesondere zwischen 30 min und 1° 30 min.

Der Zellendeckel, der mit aufgebrachter Dichtung in den Zellenbecher eingeschoben wird, ist in bevorzugten Ausführungsformen zumindest in einem Teil des Mantelbereiches zylindrisch ausgebildet. Dies betrifft gegebenenfalls insbesondere den Teil des Mantelbereiches, der nach dem Einschieben des Zellendeckels in den Zellenbecher mit dem erwähnten konisch ausgebildeten Teilbereich des Zellenbechermantels überlappt. Besonders bevorzugt ist der Mantel des Zellendeckels und damit auch der Mantelbereich zur Gänze zylindrisch ausgebildet. Vorzugsweise weist der Zellendeckel im Mantelbereich also einen konstanten Außenradius auf. Dies betrifft gegebenenfalls insbesondere den Teil, der nach dem Einschieben des Zellendeckels mit dem konisch ausgebildeten Teil des Mantelbereichs des Zellenbechers überlappt.

Beim Einschieben eines Zellendeckels mit zylindrischem Mantelbereich in einen zumindest in einem Teilbereich seines Mantels konisch ausgebildeten Zellenbecher, wie er oben beschrieben wurde, entsteht in der Regel ein sich nach oben öffnender Spalt zwischen Zellenbecher und Zellendeckel. Dieser Spalt wird in der Regel durch den Druck auf den Mantelbereich des Zellenbechers wieder beseitigt. So wird der Druck auf den Mantelbereich des Zellenbechers gegebenenfalls so gewählt, dass

der konisch ausgebildete Teil des Mantelbereichs des Zellenbechers nach innen gedrückt wird, bis die Innenseite des Zellenbechers und die Außenseite des Zellendeckels im überlappenden Bereich im wesentlichen gleichmäßig voneinander beabstandet sind. Die resultierende Knopfzelle weist Mantelbereiche auf, die parallel zueinander ausgerichtet sind, insbesondere im überlappenden Bereich.

Ein wichtiger Aspekt dabei ist die Wahl der Dichtung, die den Zellenbecher mit dem Zellendeckel verbindet. Bevorzugt handelt es sich bei der Dichtung um eine Kunststoffdichtung aus einem Thermoplasten.

Besonders bevorzugt handelt es sich bei der Kunststoffdichtung um eine Foliendichtung, wie sie z.B. in der bereits genannten DE 196 47 593 beschrieben ist, insbesondere um eine Foliendichtung aus einem Thermoplasten.

Foliendichtungen können mit einer sehr gleichmäßigen Dicke hergestellt werden. Beim Anlegen eines geeigneten Drucks auf den Mantelbereich des Zellenbechers ergibt sich eine Presspassung, infolge derer die hergestellte Knopfzelle ganz hervorragende Dichtigkeitseigenschaften aufweist. So ermöglicht nicht zuletzt die Verwendung von Foliendichtungen den Verzicht auf ein Umbördeln des Randes des Zellenbechers, ohne im Gegenzug Nachteile bei sonstigen wichtigen Eigenschaften in Kauf nehmen zu müssen.

Ganz besonders bevorzugt kommen vorliegend Kunststoffdichtungen, insbesondere Kunststofffolien, auf Basis von Polyamid oder auf Basis von Polyetheretherketonen zum Einsatz.

Es ist bevorzugt, dass die Dichtung einer bördelfreien Zelle eine Ausgangsdicke im Bereich zwischen 50 µm und 250 µm, besonders bevorzugt zwischen 70 µm und 150 µm, insbesondere von ca. 100 µm, aufweist. Unter dem Begriff „Ausgangsdicke" soll dabei die Dicke verstanden werden, die die Dichtung aufweist, bevor sie auf den Mantel des

Zellendeckels aufgebracht wird. Im Gegensatz dazu soll unter dem Begriff „Enddicke" die Dicke der Dichtung in der fertigen Zelle verstanden werden. Es ist klar, dass diese zumindest im überlappenden Bereich in der Regel dem Abstand zwischen der Innenseite des Zellenbechers und der Außenseite des Zellendeckels entspricht.

Damit eine ausreichend hohe Reibung zwischen Zellenbecher und Zellendeckel entstehen kann, sollten sowohl die Außen- als auch die Innenradien von Becher und Deckel aufeinander sowie auf die Dicke der Foliendichtung abgestimmt werden. Nur so kann ein ausreichend hoher Pressdruck entstehen, der die beiden Einzelteile zusammenhält. Für die dabei verwendeten Teile gilt bevorzugt, dass die Differenz zwischen dem Außenradius des in den Zellenbecher einzuschiebenden Zellendeckels an der Schnittkante des Zellendeckels und dem kleinsten Innenradius des Zellenbechers in dem Teil des Mantelbereichs, der mit dem Mantelbereich des Zellendeckels überlappt, kleiner ist als die Ausgangsdicke der verwendeten Dichtung. Besonders bevorzugt beträgt die Differenz zwischen 10 % und 90 % der Ausgangsdicke, insbesondere zwischen 30 % und 70 %, ganz besonders bevorzugt ca. 50 %.

Nach dem Einschieben des Zellendeckels in den Zellenbecher kann ein Teil des Mantelbereiches des Zellenbechers radial nach innen eingezogen werden. Es handelt sich dabei insbesondere um den Teil des Mantelbereichs, der nicht mit dem Mantelbereich des Zellendeckels überlappt.

Es wurde gefunden, dass durch diesen radialen Einzug deutlich verbesserte Dichtigkeitseigenschaften erzielt werden können. Durch das Einziehen des Bechermantels wird ein radialer Druck auf den an der Innenwand des Gehäusebechers anliegenden Randabschnitt bzw. auf die zwischen Gehäusedeckel und Gehäusebecher angeordnete Dichtung ausgeübt, die in der Folge in diesem Bereich zusammengepresst wird.

Das Einziehen kann zeitgleich zu der bereits erwähnten Druckausübung auf den Mantelbereich des Zellenbechers erfolgen, bevorzugt erfolgt das Einziehen aber in einem späteren separaten Schritt.

Das erfindungsgemäße Verfahren zur Herstellung einer Knopfzelle kann insbesondere zur Herstellung von Knopfzellen dienen, wie sie vorstehend beschrieben wurde, also von Knopfzellen mit einem Gehäuse mit einem ebenen Bodenbereich und einem dazu parallelen ebenen Deckelbereich. Es eignet sich sowohl zur Herstellung von bördelfreien Knopfzellen als auch von solchen mit Bördelung.

Betreffend die bevorzugten Ausführungsformen der einzelnen in einem erfindungsgemäßen Verfahren verwendeten Komponenten (Gehäuseteile und –dimensionen, Elektroden, Separator etc.) kann somit vollumfänglich auf die obenstehenden Ausführungen und Erläuterungen Bezug genommen und verwiesen werden.

Das Gehäuse wird in der Regel aus einem metallischen Becherteil (Gehäusebecher) und einem metallischen Deckelteil (Gehäusedeckel) zusammengefügt, wobei ein Elektroden-Separator-Verbund mit als flache Schicht ausgebildeten Elektroden derart in das Gehäuse eingesetzt wird, dass die Elektroden orthogonal zu dem ebenen Boden- und Deckelbereich ausgerichtet sind.

Wie bereits erwähnt, wird der Elektroden-Separator-Verbund bevorzugt in Form eines Wickels verbaut, insbesondere als spiralförmiger Wickel.

In aller Regel umfasst das erfindungsgemäße Verfahren stets die Schritte

- Einsetzen des Wickels in das metallische Deckelteil und
- Einsetzen des metallischen Deckelteils mit dem Wickel in ein metallisches Becherteil.

Danach erfolgt optional das Umbördeln des Randes des Becherteils über den Rand des Deckelteils.

Sofern eine bördelfreie Knopfzelle hergestellt wird, werden die entsprechenden oben beschriebenen Schritte durchgeführt.

Vor dem Schließen des Gehäuses werden die Elektroden üblicherweise noch mit Elektrolytlösung getränkt.

Der Wickel befindet sich beim Einsetzen bevorzugt aufgerollt auf einem Wickeldorn. Nach dem oder beim Einsetzen kann der Wickeldorn dann entfernt werden. Gegebenenfalls wird dann der oben erwähnte Wickelkern eingesetzt. Alternativ kann der Elektroden-Separator-Verbund auch gleich unmittelbar auf einen solchen Kern aufgewickelt werden.

Besonders bevorzugt wird der spiralförmige Wickel vor dem Verbauen an seinen Stirnseiten wärmebehandelt. Dabei wird er zumindest kurzfristig einer Temperatur ausgesetzt, bei der der Separator in dem Wickel thermoplastisch verformbar ist. In der Regel steht der Separator an den Stirnseiten des Wickels etwas über, selbst unter der Voraussetzung, dass die Elektroden mit dem oben beschriebenen Versatz zueinander angeordnet sind. Durch die Wärmebehandlung kann der Separator etwas zusammenschrumpfen und dadurch gegebenenfalls sogar den Rand einer benachbarten Elektroden freilegen, so dass dieser unmittelbar am Knopfzellengehäuse anliegen kann.

Die genannten und weitere Vorteile der Erfindung ergeben sich aus der nun folgenden Beschreibung der Zeichnungen in Verbindung mit den Unteransprüchen. Dabei können die einzelnen Merkmale der Erfindung für sich allein oder in Kombination miteinander verwirklicht sein. Die beschriebenen Ausführungsformen dienen lediglich zur Erläuterung und zum besseren Verständnis der Erfindung und sind in keiner Weise einschränkend zu verstehen.

Figurenbeschreibung

Fig. 1 zeigt schematisch den Querschnitt einer bevorzugten Ausführungsform einer erfindungsgemäßen Knopfzelle.

Fig. 2 illustriert den Effekt der Wärmebehandlung eines aufgewickelten Elektrode-Separator-Verbundes, welche bei bevorzugten Ausführungsformen des erfindungsgemäßen Verfahrens zum Einsatz kommt.

Fig. 3 zeigt einen Elektroden-Separator-Verbund in Form eines Wickels, wie er in einer erfindungsgemäßen Knopfzelle verbaut werden kann.

Fig. 4 zeigt eine geschnittene Darstellung einer weiteren bevorzugten Ausführungsform einer erfindungsgemäßen Knopfzelle.

Fig. 5 zeigt schematisch den Querschnitt einer bevorzugten Ausführungsform einer erfindungsgemäßen Knopfzelle, bei der der Rand des Zellenbechers nicht über den Rand des Zellendeckels gebördelt ist.

Fig. 1 zeigt schematisch den Querschnitt einer bevorzugten Ausführungsform einer erfindungsgemäßen Knopfzelle **100**. Diese weist ein metallisches Becherteil **101** und ein metallisches Deckelteil **102** auf. Über eine Dichtung **109** sind die beiden Teile dichtend miteinander verbunden. Zusammen bilden sie ein Gehäuse mit einem ebenen Bodenbereich **103** und einem dazu parallelen ebenen Deckelbereich **104** aus. Im Gebrauchszustand bilden diese ebenen Bereiche **103** und **104** die Pole der Knopfzelle, an denen eine Stromabnahme durch einen Verbraucher

erfolgen kann. Der Rand **110** des Zellenbechers **101** ist nach innen über den Rand des Zellendeckels **102** gebördelt.

Im Inneren der Elektrode ist ein Verbund aus einer streifenförmigen Elektrode **105**, einer streifenförmigen Elektrode **106** und den streifenförmigen Separatoren **107** angeordnet. Der Verbund aus den Elektroden **105** und **106** sowie den Separatoren **107** liegt dabei in Form eines Wickels vor, der mit seinen Stirnseiten an den ebenen Bodenbereich **103** und den dazu parallelen ebenen Deckelbereich **104** anstösst. Aufgewickelt ist der Verbund auf dem Kern **108** im Zentrum der Knopfzelle **100**. Sowohl der Kern **108** als auch die um ihn gewickelten Elektroden und Separatoren sind orthogonal zu den ebenen Boden- und Deckelbereichen **104** und **103** ausgerichtet. Sofern die Elektroden bei einem Lade- oder Entladevorgang an Volumen gewinnen oder verlieren, wirken die dabei resultierenden mechanischen Kräfte überwiegend radial und können vom Mantelbereich der Knopfzelle **100** aufgefangen werden.

Hervorzuheben ist, dass die positive Elektrode **105** und die negative Elektrode **106** jeweils unmittelbar an dem Becherteil **101** bzw. an dem Deckelteil **102** der Knopfzelle **100** anliegen. Ein separater Ableiter zum Verbinden der Elektroden mit dem Deckelteil **102** und dem Becherteil **101** ist nicht erforderlich.

Fig. 2 zeigt den Effekt der Wärmebehandlung eines Elektroden-Separator-Wickels **200**, die in bevorzugten Ausführungsformen des erfindungsgemäßen Verfahrens zur Herstellung einer Knopfzelle vorgesehen ist. Dargestellt ist schematisch ein Wickel **200** aus einem Verbund aus einer positiven Elektrode **201** (quergestreifte Balken), einer negativen Elektrode **202** (weisse Balken) und den Separatoren **203** (Ausschnitt). Die positive und die negative Elektroden **201** und **202** sind jeweils versetzt zueinander angeordnet. Die Separatoren **203** bestehen aus einem thermoplastisch verformbaren Material.

Setzt man die sich an den Stirnseiten **204** und **205** des Wickels **200** befindlichen Separatorränder einer hohen Temperatur aus (beispielsweise 250 °C, wie dargestellt), so schrumpfen diese Separatorränder. Die Separatoren ziehen sich zumindest teilweise zwischen benachbarte Elektroden zurück. Dabei werden an der Stirnseite **204** die Ränder der negativen Elektrode **202** freigelegt, während die Ränder der positiven Elektrode **201** abgedeckt werden. An der Stirnseite **205** werden die Ränder der positiven Elektrode **201** freigelegt, während die Ränder der negativen Elektrode **202** abgedeckt werden.

Beim Einsatz eines so behandelten Wickels ist gewährleistet, dass Elektroden gleicher Polarität jeweils nur am Gehäusebecher oder am Gehäusedeckel unmittelbar anliegen können. Separate elektrische Verbindungen zwischen den Elektroden und den Gehäuseteilen sind nicht erforderlich.

Fig. 3 zeigt einen Elektroden-Separator-Verbund für erfindungsgemäße Knopfzellen in Form eines Wickels **300**, wobei die Darstellung A eine Draufsicht senkrecht von oben auf eine der Stirnseiten **301** des Wickels **300** abbildet, während in der Darstellung B der Wickel **300** in einer Ansicht schräg von oben dargestellt ist. Zu erkennen ist in beiden Fällen, dass der Verbund zwei Lagen Separator **302** und **303** sowie zwei Elektrodenschichten **304** und **305** (eine positive und eine negative Elektrode) umfasst. Der Verbund ist spiralförmig aufgewickelt und wird durch ein Klebeband **306** auf seiner Außenseite zusammengehalten.

Fig. 4 zeigt eine geschnittene Darstellung einer bevorzugten Ausführungsform einer erfindungsgemäßen Knopfzelle **400**. Zu erkennen ist das Gehäuse der Knopfzelle aus dem Becherteil **401** und dem Deckelteil **402**, zwischen denen die Dichtung **403** angeordnet ist. Innerhalb des Gehäuses ist ein Verbund aus Elektroden und Separatoren, wie er in Fig. 3 dargestellt ist, als spiralförmiger Wickel **404** (im Querschnitt schematisch dargestellt) enthalten. Gut zu erkennen sind auch hier die Separatorlagen **405** und **406** sowie die entgegengesetzt gepolten Elektroden

407 und **408**. Die Elektrode **407** ist dabei über den Ableiter **410** mit dem Deckelteil **402** verbunden, während die Elektrode **408** über den Ableiter **409** mit dem Becherteil **402** verbunden ist. Der Ableiter **410** ist vorzugsweise mit dem Deckelteil **402** verschweisst. Dagegen ist der Ableiter **409** mit dem Becherteil **402** über eine Klemmverbindung verbunden (er ist zwischen dem Stützring **413**, auf dem der Rand des Zellendeckels aufliegt, und dem Boden des Zellenbechers eingeklemmt). Zwischen den Stirnseiten des Wickels und dem Becherteil **401** und dem Deckelteil **402** sind die Isoliermittel **411** und **412** angeordnet, bei denen es sich jeweils um dünne Kunststoffscheiben handelt. Durch diese wird verhindert, dass Elektroden entgegengesetzter Polarität gleichzeitig in Kontakt mit dem Becher- oder dem Deckelteil **401** und **402** kommen können. Einem Kurzschluss wird dadurch vorgebeugt.

Fig. 5 zeigt schematisch den Querschnitt einer bevorzugten Ausführungsform einer erfindungsgemäßen Knopfzelle **500**.

Diese weist ein metallisches Becherteil **501** und ein metallisches Deckelteil **502** auf. Über eine Dichtung **510** sind die beiden Teile dichtend miteinander verbunden. Zusammen bilden sie ein Gehäuse mit einem ebenen Bodenbereich **503** und einem dazu parallelen ebenen Deckelbereich **504** aus. Im Gebrauchszustand bilden diese ebenen Bereiche **503** und **504** die Pole der Knopfzelle, an denen eine Stromabnahme durch einen Verbraucher erfolgen kann.

Der Zellendeckel **502** ist in den Zellenbecher **501** eingeschoben, so dass die Mantelbereiche des Zellendeckels und des Zellenbechers überlappen, wobei der Innenradius des Zellenbechers **501** im überlappenden Bereich in Richtung der Schnittkante im wesentlichen konstant ist. Der Rand des Zellenbechers **501** ist also nicht über den Rand **511** des Zellendeckels **502** gebördelt, bei der vorliegend beschriebenen bevorzugten Ausführungsform einer erfindungsgemäßen Knopfzelle **500** handelt es sich somit um eine bördelfreie Knopfzelle.

Im Inneren der Elektrode ist ein Verbund aus einer streifenförmigen Elektrode **508**, einer streifenförmigen Elektrode **509** und den streifenförmigen Separatoren **507** angeordnet. Der Verbund aus den Elektroden **508** und **509** sowie den Separatoren **507** liegt dabei in Form eines Wickels vor, dessen Stirnseiten in Richtung des ebenen Bodenbereichs **503** und des dazu parallelen ebenen Deckelbereichs **504** weisen. Aufgewickelt ist der Verbund auf dem Wickelkern **512** im Zentrum der Knopfzelle **500**. Sowohl der Kern **512** als auch die um ihn gewickelten Elektroden und Separatoren sind orthogonal zu den ebenen Boden- und Deckelbereichen **504** und **503** ausgerichtet. Sofern die Elektroden bei einem Lade- oder Entladevorgang an Volumen gewinnen oder verlieren, wirken die dabei resultierenden mechanischen Kräfte überwiegend radial und können vom Mantelbereich der Knopfzelle **500** aufgefangen werden.

Kontaktiert sind die positiven und die negativen Elektroden mit den Gehäusehalbteilen Becher und Deckel über den Ableiter **505** und den Ableiter **506**. Der Ableiter **505** besteht aus Aluminium, der Ableiter **506** aus Nickel (oder alternativ aus Kupfer). Bei beiden Ableitern handelt es sich um dünne Folien, die flach zwischen den Stirnseiten des Wickels und den ebenen Deckel- bzw. Bodenbereichen **503** und **504** zum Liegen kommen. Bedingt durch den Wickelkern **512** wird ein steter leichter Anpressdruck auf die Ableiter aufrechterhalten. Von den Stirnseiten des Wickels sind die Ableiter bevorzugt durch ein separates Isolatorelement (in der Zeichnung nicht dargestellt) getrennt, beispielsweise durch eine dünne Folie.

Patentansprüche

1. Knopfzelle (100; 400; 500), umfassend

   - zwei metallische Gehäusehalbteile (101, 102; 401, 402; 501, 502), die durch eine elektrisch isolierende Dichtung (109; 403; 510) voneinander getrennt sind und die ein Gehäuse mit einem ebenen Bodenbereich (103; 503) und einem dazu parallelen ebenen Deckelbereich (104; 504) ausbilden sowie
   - innerhalb des Gehäuses einen Elektroden-Separator-Verbund umfassend mindestens eine positive und mindestens eine negative Elektrode (105, 106; 201, 202; 304, 305; 407, 408; 508, 509), die als flache Schichten ausgebildet und über mindestens einen flächigen Separator (107; 203; 302, 303; 405, 406; 507) miteinander verbunden sind,

   wobei die Elektrodenschichten im Wesentlichen orthogonal zu dem ebenen Boden- und Deckelbereich ausgerichtet sind.

2. Knopfzelle nach Anspruch 1, dadurch gekennzeichnet, dass die Elektroden und/oder der Separator streifen- oder bandförmig ausgebildet sind.

3. Knopfzelle nach Anspruch 1 oder Anspruch 2, dadurch gekennzeichnet, dass der Elektroden-Separator-Verbund als Wickel (200; 300; 404) vorliegt, insbesondere als spiralförmiger Wickel, dessen Stirnseiten (204, 205; 301) in Richtung des ebenen Bodenbereichs und des ebenen Deckelbereichs weisen.

4. Knopfzelle nach Anspruch 3, dadurch gekennzeichnet, dass der Wickel in seinem Zentrum einen axialen Hohlraum aufweist, der mindestens teilweise von einem Wickelkern (108; 512) ausgefüllt ist.

5. Knopfzelle nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass der Elektroden-Separator-Verbund eine der folgenden Schichtabfolgen aufweist:

   - negative Elektrode / Separator / positive Elektrode / Separator
   - positive Elektrode / Separator / negative Elektrode / Separator

6. Knopfzelle nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass die positive Elektrode (408; 509) und/oder die negative Elektrode (407; 508) über einen Ableiter (409, 410; 505, 506) mit dem Gehäuse im Bereich des ebenen Boden- und/oder des ebenen Deckelbereichs verbunden sind.

7. Knopfzelle nach einem der Ansprüche 3 bis 6, dadurch gekennzeichnet, dass sie mindestens ein Isoliermittel (413, 414) umfasst, das einen direkten mechanischen und elektrischen Kontakt zwischen den Stirnseiten des Wickels und den ebenen Boden- und Deckelbereichen unterbindet.

8. Knopfzelle nach Anspruch 7, dadurch gekennzeichnet, dass es sich bei dem mindestens einen Isoliermittel (413, 414) um eine flache Schicht aus Kunststoff, beispielsweise um eine Kunststofffolie handelt, die zwischen den Stirnseiten des Wickels und den ebenen Boden- und Deckelbereichen angeordnet ist.

9. Knopfzelle nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass sie wiederaufladbar ist.

10. Knopfzelle nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass sie ein Verhältnis Höhe : Durchmesser < 1, vorzugsweise zwischen 0.1 und 0.9, insbesondere zwischen 0.15 und 0.7, aufweist.

11. Verfahren zur Herstellung einer Knopfzelle, insbesondere einer Knopfzelle (100; 400; 500) nach einem der vorhergehenden Ansprüche, wobei aus metallische Gehäusehalbteilen, insbesondere einem metallischen Becherteil (101; 401; 501) und einem metallischen Deckelteil (102; 402; 502), ein Gehäuse mit einem ebenen Bodenbereich (103; 503) und einem dazu parallelen ebenen Deckelbereich (104; 504) montiert wird und wobei ein Elektroden-Separator-Verbund mit als flache Schicht ausgebildeten Elektroden (105, 106; 201, 202; 304, 305; 407, 408; 508, 509) derart in das Gehäuse eingesetzt wird, dass die Elektrodenschichten im Wesentlichen orthogonal zu dem ebenen Boden- und Deckelbereich (103, 104; 503, 504) ausgerichtet sind.

12. Verfahren nach Anspruch 11, dadurch gekennzeichnet, dass der Elektroden-Separator-Verbund als Wickel (200; 300; 404) eingesetzt wird, insbesondere als spiralförmiger Wickel.

13. Verfahren nach Anspruch 12, umfassend die Schritte

- Einsetzen des Wickels (200; 300; 404) in das metallische Deckelteil (102; 402; 502),
- Einsetzen des metallischen Deckelteils mit dem Wickel in ein metallisches Becherteil (101; 401; 501),
- Gegebenenfalls Umbördeln des Randes des Becherteils.

14. Verfahren nach Anspruch 12 oder 13, dadurch gekennzeichnet, dass der Wickel (200; 300; 404) vor dem Verbauen an seinen Stirnseiten (204, 205; 301) wärmebehandelt wird, wobei er zumindest kurzfristig einer Temperatur ausgesetzt wird, bei der der Separator (107; 203; 302, 303; 405, 406; 507) thermoplastisch verformbar ist.

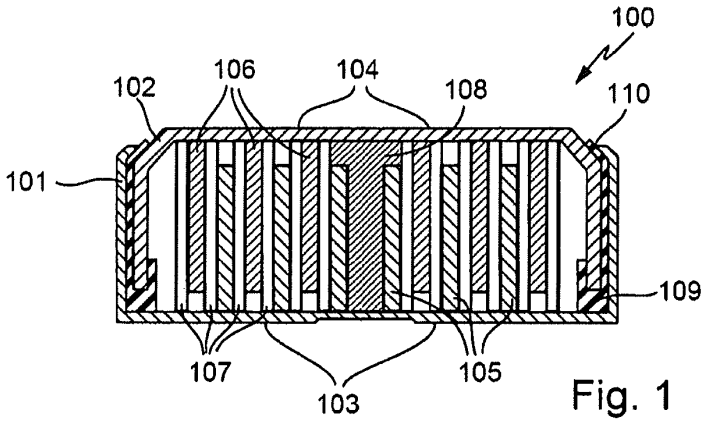
100
102
106
104
108
110
101
109
107
103
105

Fig. 1

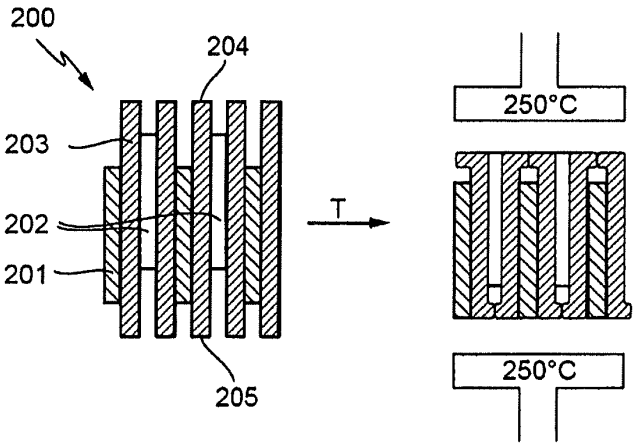
200
204
203
202
201
205
T
250°C
250°C

Fig. 2

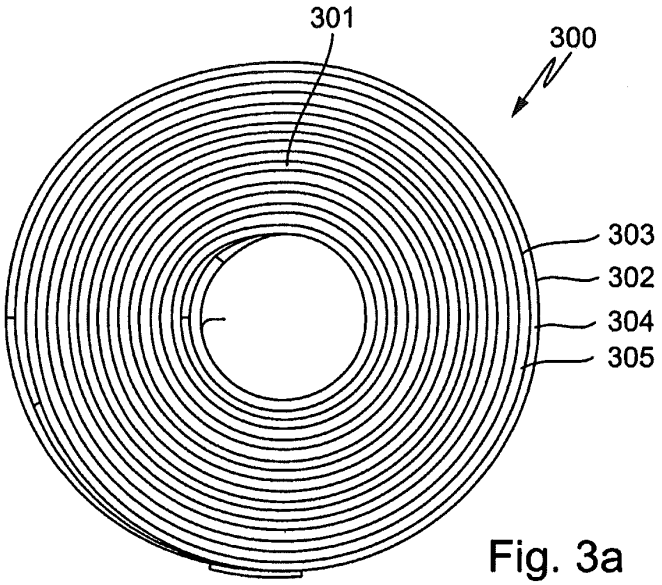

Fig. 3a

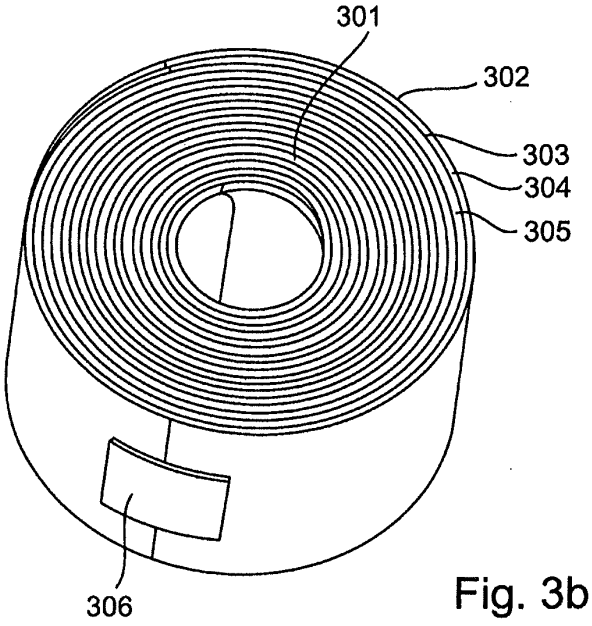

Fig. 3b

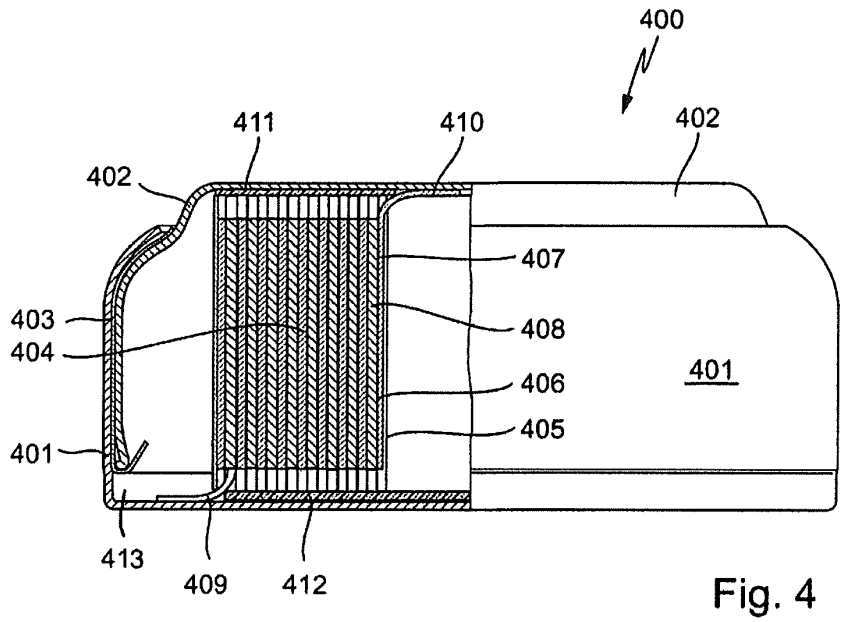
400
411
410
402
402
407
403
408
404
401
406
405
401
413
409
412

Fig. 4

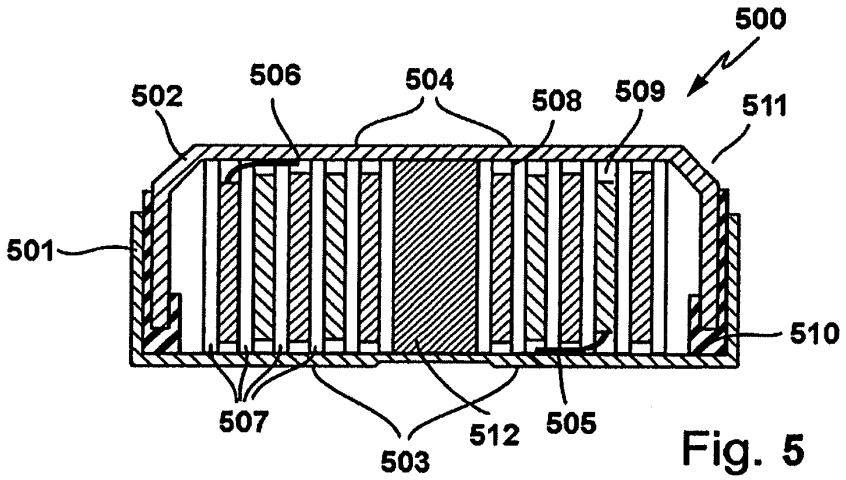
500
502
506
504
508
509
511
501
510
507
503
512
505

Fig. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2010/000787

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01M10/04 H01M2/02
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 265 100 B1 (SAASKI ELRIC W [US] ET AL) 24 July 2001 (2001-07-24) column 5, lines 31-60 column 24, line 9 - column 26, line 18 column 26, line 35 - column 29, line 57	1-13
A	DE 198 57 638 A1 (VARTA GERAETEBATTERIE GMBH [DE]) 15 June 2000 (2000-06-15) the whole document	1-14

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents :

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 May 2010	19/05/2010

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Panitz, J

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2010/000787

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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DE 19857638 A1	15-06-2000	AT 246404 T	15-08-2003
		BR 9908650 A	17-10-2000
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INTERNATIONALER RECHERCHENBERICHT

Internationales Aktenzeichen
PCT/EP2010/000787

A. KLASSIFIZIERUNG DES ANMELDUNGSGEGENSTANDES
INV. H01M10/04 H01M2/02
ADD.

Nach der Internationalen Patentklassifikation (IPC) oder nach der nationalen Klassifikation und der IPC

B. RECHERCHIERTE GEBIETE

Recherchierter Mindestprüfstoff (Klassifikationssystem und Klassifikationssymbole)
H01M

Recherchierte, aber nicht zum Mindestprüfstoff gehörende Veröffentlichungen, soweit diese unter die recherchierten Gebiete fallen

Während der internationalen Recherche konsultierte elektronische Datenbank (Name der Datenbank und evtl. verwendete Suchbegriffe)
EPO-Internal

C. ALS WESENTLICH ANGESEHENE UNTERLAGEN

Kategorie*	Bezeichnung der Veröffentlichung, soweit erforderlich unter Angabe der in Betracht kommenden Teile	Betr. Anspruch Nr.
X	US 6 265 100 B1 (SAASKI ELRIC W [US] ET AL) 24. Juli 2001 (2001-07-24) Spalte 5, Zeilen 31-60 Spalte 24, Zeile 9 - Spalte 26, Zeile 18 Spalte 26, Zeile 35 - Spalte 29, Zeile 57	1-13
A	DE 198 57 638 A1 (VARTA GERAETEBATTERIE GMBH [DE]) 15. Juni 2000 (2000-06-15) das ganze Dokument	1-14

☐ Weitere Veröffentlichungen sind der Fortsetzung von Feld C zu entnehmen ☒ Siehe Anhang Patentfamilie

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"&" Veröffentlichung, die Mitglied derselben Patentfamilie ist

Datum des Abschlusses der internationalen Recherche	Absendedatum des internationalen Recherchenberichts
11. Mai 2010	19/05/2010

Name und Postanschrift der Internationalen Recherchenbehörde	Bevollmächtigter Bediensteter
Europäisches Patentamt, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Panitz, J

Formblatt PCT/ISA/210 (Blatt 2) (April 2005)

INTERNATIONALER RECHERCHENBERICHT

Angaben zu Veröffentlichungen, die zur selben Patentfamilie gehören

Internationales Aktenzeichen
PCT/EP2010/000787

Im Recherchenbericht angeführtes Patentdokument	Datum der Veröffentlichung	Mitglied(er) der Patentfamilie	Datum der Veröffentlichung
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		US 6312848 B1	06-11-2001

(19) Deutsches Patent- und Markenamt

(10) **DE 10 2009 008 859 A1** 2010.08.12

(12) # Offenlegungsschrift

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(51) Int Cl.[8]: ***H01M 10/38*** (2006.01)

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(56) Für die Beurteilung der Patentfähigkeit in Betracht zu ziehende Druckschriften:

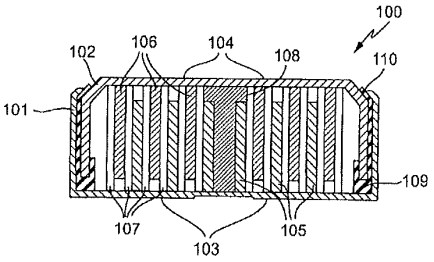
EP 02 02 857 B1
EP 697 00 312 T2

Die folgenden Angaben sind den vom Anmelder eingereichten Unterlagen entnommen

Rechercheantrag gemäß § 43 Abs. 1 Satz 1 PatG ist gestellt.

(54) Bezeichnung: **Knopfzelle und Verfahren zu ihrer Herstellung**

(57) Zusammenfassung: Beschrieben wird eine Knopfzelle (100), die ein metallisches Becherteil (101) und ein metallisches Deckelteil (102) aufweist, welche dichtend miteinander verbunden sind und ein Gehäuse mit einem ebenen Bodenbereich (103) und einem dazu parallelen ebenen Deckelbereich (104) ausbilden, wobei innerhalb des Gehäuses als flache Schichten ausgebildete positive und negative Elektroden (105, 106; 201, 202) angeordnet sind, die über einen flächigen Separator (107; 203) miteinander verbunden sind, wobei die Elektrodenschichten (105, 106; 201, 202) im Wesentlichen orthogonal zu dem ebenen Boden- und Deckelbereich (103, 104) ausgerichtet sind. Weiterhin wird ein Verfahren zur Herstellung einer solchen Knopfzelle beschrieben.



Beschreibung

[0001] Die vorliegende Erfindung betrifft eine Knopfzelle mit einem Gehäuse aus einem metallischen Becherteil und einem metallischen Deckelteil, die dichtend miteinander verbunden sind, sowie ein Verfahren zur Herstellung von solchen Knopfzellen.

[0002] Wiederaufladbare Knopfzellen können unterschiedliche elektrochemische Systeme enthalten. Sehr verbreitet sind z. B. Knopfzellen auf Basis von Nickel-Metallhydrid- sowie auf Basis von Lithium-Ionen-Systemen. Insbesondere bei Lithium-Ionen-Knopfzellen werden die elektrochemisch aktiven Materialien innerhalb des Knopfzellengehäuses üblicherweise nicht in Form von einzelnen, durch einen Separator voneinander getrennten, tablettenförmigen Elektroden angeordnet. Stattdessen werden bevorzugt vorgefertigte Elektroden-Separator-Verbünde flach in das Gehäuse eingelegt. Als Separator dient dabei bevorzugt eine poröse Kunststofffolie, auf welche die Elektroden flächig auflaminiert oder aufgeklebt sind. Der Gesamtverbund aus Separator und Elektroden ist dabei in der Regel maximal wenige 100 µm dick. Um Knopfzellengehäuse üblicher Dimensionen ausfüllen zu können, werden daher häufig mehrere solcher Verbünde flach übereinander gelegt. Auf diese Weise lassen sich Stapel in grundsätzlich beliebiger Höhe erhalten, jeweils abgestimmt auf die zur Verfügung stehenden Dimensionen des Knopfzellengehäuses, in das der Stapel verbaut werden soll. So wird eine optimale Ausnutzung des zur Verfügung stehenden Gehäuseinnenraumes gewährleistet.

[0003] Konstruktionsbedingt treten bei Knopfzellen, die solche Stapel aus Elektroden-Separator-Verbünden enthalten, allerdings auch diverse Probleme auf. Zum einen ist es natürlich erforderlich, Elektroden von jeweils gleicher Polarität innerhalb des Stapels miteinander zu verbinden und dann jeweils mit dem entsprechenden Pol des Knopfzellengehäuses zu kontaktieren. Die erforderlichen elektrischen Kontakte verursachen Materialkosten, der durch sie eingenommene Raum steht zudem für Aktivmaterial nicht mehr zur Verfügung. Die Herstellung der Elektrodenstapel ist darüber hinaus kompliziert und teuer, da bei der Kontaktierung der Verbünde untereinander leicht Fehler auftreten können, die die Ausschußrate erhöhen. Zum anderen wurde festgestellt, dass Knopfzellen mit einem Stapel aus Elektroden und Separatoren sehr schnell undicht werden können.

[0004] Der vorliegenden Erfindung lag die Aufgabe zugrunde, Knopfzellen bereitzustellen, bei denen die genannten Probleme nicht auftreten. Die bereitzustellenden Knopfzellen sollten eine möglichst einfache Konstruktionsweise aufweisen, höchsten Anforderungen im Hinblick auf die Dichtigkeit im Betrieb genügen und sehr einfach herzustellen sein.

[0005] Diese Aufgabe wird gelöst durch die Knopfzelle mit den Merkmalen des Anspruchs 1 sowie das Verfahren mit den Merkmalen des Anspruchs 9. Bevorzugte Ausführungsformen der erfindungsgemäßen Knopfzelle sind in den abhängigen Ansprüchen 2 bis 8 angegeben. Bevorzugte Ausführungsformen des erfindungsgemäßen Verfahrens finden sich in den Ansprüchen 10 bis 12. Der Wortlaut sämtlicher Ansprüche wird hiermit durch Bezugnahme zum Inhalt dieser Beschreibung gemacht.

[0006] Eine erfindungsgemäße Knopfzelle weist ein metallisches Becherteil und ein metallisches Deckelteil auf, die dichtend miteinander verbunden sind. Zusammen bilden die beiden Teile ein Gehäuse aus, das einen ebenen Bodenbereich und einen dazu parallelen ebenen Deckelbereich ausbildet. Als Becher- und Deckelteil sind insbesondere Teile aus vernickeltem Stahl oder Blech bevorzugt. Weiterhin als metallischer Werkstoff geeignet sind insbesondere Trimetalle, beispielsweise mit der Abfolge Nickel, Stahl (oder Edelstahl) und Kupfer (wobei dann die Nickelschicht bevorzugt die Außen- und die Kupferschicht bevorzugt die Innenseite des Knopfzellengehäuses bildet). Als Dichtung kann beispielsweise eine Spritzguss- oder eine Foliendichtung zum Einsatz kommen.

[0007] Innerhalb des Gehäuses sind mindestens eine positive und mindestens eine negative Elektrode angeordnet, und zwar jeweils in Form von flachen Elektrodenschichten. Die Elektroden sind dabei über einen flächigen Separator miteinander verbunden. Vorzugsweise sind die Elektroden auf diesen Separator auflaminiert oder aufgeklebt. Die Elektroden und der Separator weisen in der Regel jeweils nur Dicken im µm-Bereich auf. Sie bilden zusammen einen Elektroden-Separator-Verbund aus, wie er bereits eingangs erwähnt wurde.

[0008] Im Gegensatz zu den eingangs erwähnten Knopfzellen zeichnet sich die erfindungsgemäße Knopfzelle jedoch insbesondere dadurch aus, dass die Elektrodenschichten eine ganz besondere Orientierung aufweisen, sie sind nämlich im wesentlichen orthogonal zu dem ebenen Boden- und Deckelbereich ausgerichtet. Während aus dem Stand der Technik bekannte Knopfzellen mit gestapelten Elektroden-Separator-Verbünden diese stets flach eingelegt enthalten, so dass die Elektrodenschichten im wesentlichen parallel zu den ebenen Boden- und Deckelbereichen ausgerichtet sind, ist bei einer erfindungsgemäßen Knopfzelle das Gegenteil der Fall.

[0009] Die orthogonale Ausrichtung der Elektrodenschichten hat einen unerwartet deutlichen Vorteil, es wurde nämlich festgestellt, dass diese Ausrichtung mit einer deutlichen Verbesserung der Dichtigkeitseigenschaften einer erfindungsgemäßen Knopfzelle einhergeht, insbesondere bei Knopfzellen auf Basis

von Lithium-Ionen-Systemen. Die Elektroden von wiederaufladbaren Lithium-Ionen-Systemen sind bei Lade- und Entladevorgängen stets Volumenänderungen ausgesetzt. Zu solchen Volumenänderungen kann es natürlich auch bei den Elektroden einer erfindungsgemäßen Knopfzelle kommen. Die dabei entstehenden mechanischen Kräfte wirken jedoch nicht mehr primär axial, wie das im Falle eines flach eingelegten Stapels aus Elektroden-Separator-Verbünden der Fall ist. Aufgrund der orthogonalen Ausrichtung der Elektroden wirken sie stattdessen radial. Radiale Kräfte können von dem Gehäuse einer Knopfzelle allerdings sehr viel besser aufgenommen werden als axiale, worauf vermutlich die verbesserten Dichtigkeitseigenschaften zurückzuführen sind.

[0010] Besonders bevorzugt sind die Elektroden und der flächige Separator einer erfindungsgemäßen Knopfzelle jeweils streifen- oder bandförmig ausgebildet. So kann zur Herstellung einer erfindungsgemäßen Knopfzelle beispielsweise von einem als Endlosband vorliegenden Separatormaterial ausgegangen werden, auf das die Elektroden flächig, insbesondere wieder in Form von Streifen oder zumindest von Rechtecken, aufgebracht, insbesondere auflaminiert werden.

[0011] Wenn die Elektroden streifenförmig auf einen solchen Separator aufgebracht werden, so lässt sich der entstehende Verbund aus streifenförmigen Elektroden und streifenförmigem Separator gut aufwickeln. In bevorzugten Ausführungsformen enthält eine erfindungsgemäße Knopfzelle entsprechend den Verbund aus Elektroden und Separator als Wickel, besonders bevorzugt als spiralförmigen Wickel.

[0012] Besonders bevorzugt weist der Verbund aus Elektroden und Separator in einer erfindungsgemäßen Knopfzelle eine der folgenden Schichtabfolgen auf:

- negative Elektrode/Separator/positive Elektrode/Separator oder
- positive Elektrode/Separator/negative Elektrode/Separator.

[0013] Derartige Verbünde lassen sich sehr einfach herstellen und aufwickeln, ohne dass es zu Kurzschlüssen zwischen entgegengesetzt gepolten Elektroden kommt.

[0014] In besonders bevorzugten Ausführungsformen einer erfindungsgemäßen Knopfzelle sind die negative Elektrode und die positive Elektrode im Elektroden-Separator-Verbund innerhalb des Verbundes versetzt zueinander angeordnet. Unter einer versetzten Anordnung soll dabei verstanden werden, dass die Elektroden derart angeordnet sind, dass in der erfindungsgemäßen Knopfzelle eine jeweils unterschiedliche Beabstandung der Elektroden zu den ebenen Boden- und Deckelbereichen resultiert. Im einfachsten Fall können z. B. eine positive und eine negative Elektrode als gleich breite Streifen leicht versetzt auf die gegenüberliegenden Seiten eines Separatorbandes aufgebracht werden, so dass der Abstand der positiven Elektrode zum oberen Separatorrand größer ist als der vergleichbare Abstand von der negativen Elektrode aus gemessen. Umgekehrtes gilt dann natürlich im Hinblick auf den Abstand zum unteren Separatorrand.

[0015] In besonders bevorzugten Ausführungsformen liegt, vorzugsweise als Resultat dieser versetzten Anordnung, die positive Elektrode, insbesondere ein Rand der positiven Elektrode, unmittelbar am Becherteil an, insbesondere im ebenen Bodenbereich des Becherteils, während die negative Elektrode, insbesondere ein Rand der negativen Elektrode, unmittelbar am Deckelteil, insbesondere im ebenen Deckelbereich des Deckelteils, anliegt.

[0016] Die versetzte Anordnung der Elektroden zueinander ermöglicht also eine Kontaktierung der Elektroden mit den jeweiligen Gehäuseteilen, ohne dass zusätzliche elektrische Kontakte und Verbindungsmittel zum Einsatz kommen müssen.

[0017] Bei den in einer erfindungsgemäßen Knopfzelle einsetzbaren Separatoren handelt es sich vorzugsweise um Folien aus mindestens einem Kunststoff, insbesondere aus mindestens einem Polyolefin. Bei dem mindestens einen Polyolefin kann es sich beispielsweise um Polyethylen handelt. Es können aber auch mehrlagige Separatoren verwendet werden, beispielsweise Separatoren aus einer Abfolge verschiedener Polyolefinschichten, z. B. mit der Sequenz Polyethylen/Polypropylen/Polyethylen.

[0018] Die in einer erfindungsgemäßen Knopfzelle bevorzugt einsetzbaren Separatoren weisen bevorzugt eine Dicke zwischen 3 µm und 100 µm, insbesondere zwischen 10 µm und 50 µm, auf.

[0019] Die Elektroden einer erfindungsgemäßen Knopfzelle weisen bevorzugt eine Dicke zwischen 10 µm und 1000 µm, insbesondere zwischen 30 µm und 500 µm, auf.

[0020] Wie bereits eingangs erwähnt wurde, handelt es sich bei der erfindungsgemäßen Knopfzelle insbesondere um eine wiederaufladbare Knopfzelle. Besonders bevorzugt weist eine erfindungsgemäße Knopfzelle mindestens eine Lithium interkalierende Elektrode auf.

[0021] Das Verhältnis Höhe: Durchmesser einer erfindungsgemäßen Knopfzelle beträgt vorzugsweise < 1. Besonders bevorzugt liegt es zwischen 0.1 und 0.9, insbesondere zwischen 0.15 und 0.7. Unter der Höhe soll dabei der Abstand zwischen dem ebenen Bodenbereich und dem dazu parallelen ebenen De-

ckelbereich verstanden werden. Der Durchmesser meint die maximale Entfernung zweier Punkte auf dem Mantelbereich der Knopfzelle.

[0022] Das erfindungsgemäße Verfahren zur Herstellung einer Knopfzelle kann insbesondere auch zur Herstellung einer Knopfzelle dienen, wie sie vorstehend beschrieben wurde, also einer Knopfzelle mit einem Gehäuse mit einem ebenen Bodenbereich und einem dazu parallelen ebenen Deckelbereich. Betreffend die bevorzugten Ausführungsformen der einzelnen in einem erfindungsgemäßen Verfahren verwendeten Komponenten (Gehäuseteile und -dimensionen, Elektroden, Separator etc.) kann somit vollumfänglich auf die obenstehenden Ausführungen und Erläuterungen Bezug genommen und verwiesen werden.

[0023] Das Gehäuse wird aus einem metallischen Becherteil und einem metallischen Deckelteil zusammengefügt, wobei ein Elektroden-Separator-Verbund mit als flache Schicht ausgebildeten Elektroden derart in das Gehäuse eingesetzt wird, dass die Elektroden orthogonal zu dem ebenen Boden- und Deckelbereich ausgerichtet sind.

[0024] Wie bereits erwähnt, wird der Elektroden-Separator-Verbund in Form eines Wickels verbaut, insbesondere als spiralförmiger Wickel.

[0025] In aller Regel umfasst das erfindungsgemäße Verfahren stets die Schritte

- Einsetzen des Wickels in das metallische Deckelteil,
- Einsetzen des metallischen Deckelteils mit dem Wickel in ein metallisches Becherteil,
- Umbördeln des Randes des Becherteils.

[0026] Vor dem Schließen des Gehäuses werden die Elektroden üblicherweise noch mit Elektrolytlösung getränkt.

[0027] Der Wickel befindet sich beim Einsetzen bevorzugt aufgerollt auf einem Wickeldorn. Nach dem oder beim Einsetzen kann der Wickeldorn dann entfernt werden.

[0028] Besonders bevorzugt wird der spiralförmige Wickel vor dem Verbauen an seinen Stirnseiten wärmebehandelt. Dabei wird er zumindest kurzfristig einer Temperatur ausgesetzt, bei der der Separator in dem Wickel thermoplastisch verformbar ist. In der Regel steht der Separator an den Stirnseiten des Wickels etwas über, selbst unter der Voraussetzung, dass die Elektroden mit dem oben beschriebenen Versatz zueinander angeordnet sind. Durch die Wärmebehandlung kann der Separator etwas zusammenschrumpfen und dadurch gegebenenfalls sogar den Rand einer benachbarten Elektroden freilegen, so dass dieser unmittelbar am Knopfzellengehäuse anliegen kann.

[0029] Die genannten und weitere Vorteile der Erfindung ergeben sich aus der nun folgenden Beschreibung der Zeichnungen in Verbindung mit den Unteransprüchen. Dabei können die einzelnen Merkmale der Erfindung für sich allein oder in Kombination miteinander verwirklicht sein. Die beschriebenen Ausführungsformen dienen lediglich zur Erläuterung und zum besseren Verständnis der Erfindung und sind in keiner Weise einschränkend zu verstehen.

Figurenbeschreibung

[0030] Fig. 1 zeigt schematisch den Querschnitt einer erfindungsgemäßen Knopfzelle.

[0031] Fig. 2 illustriert den Effekt der Wärmebehandlung eines aufgewickelten Elektrode-Separator-Verbundes, welche bei bevorzugten Ausführungsformen des erfindungsgemäßen Verfahrens zum Einsatz kommt.

[0032] Fig. 1 zeigt schematisch den Querschnitt einer erfindungsgemäßen Knopfzelle **100**. Diese weist ein metallisches Becherteil **101** und ein metallisches Deckelteil **102** auf. Über eine Dichtung **109** sind die beiden Teile dichtend miteinander verbunden. Zusammen bilden sich ein Gehäuse mit einem ebenen Bodenbereich **103** und einem dazu parallelen ebenen Deckelbereich **104** aus. Im Gebrauchszustand bilden diese ebenen Bereiche **103** und **104** die Pole der Knopfzelle, an denen eine Stromabnahme durch einen Verbraucher erfolgen kann. Der Rand **110** des Zellenbechers **101** ist nach innen über den Rand des Zellendeckels **102** gebördelt.

[0033] Im Inneren der Elektrode ist ein Verbund aus einer streifenförmigen Elektrode **105**, einer streifenförmigen Elektrode **106** und den streifenförmigen Separatoren **107** angeordnet. Der Verbund aus den Elektroden **105** und **106** sowie den Separatoren **107** liegt dabei in Form eines Wickels vor. Aufgewickelt ist der Verbund auf dem Kern **108** im Zentrum der Knopfzelle **100**. Sowohl der Kern **108** als auch die um ihn gewickelten Elektroden und Separatoren sind orthogonal zu den ebenen Boden- und Deckelbereichen **104** und **103** ausgerichtet. Sofern die Elektroden bei einem Lade- oder Entladevorgang an Volumen gewinnen oder verlieren, wirken die dabei resultierenden mechanischen Kräfte radial und können vom Mantelbereich der Knopfzelle **100** aufgefangen werden.

[0034] Hervorzuheben ist, dass die positive Elektrode **105** und die negative Elektrode **106** jeweils unmittelbar an dem Becherteil **101** bzw. an dem Deckelteil **102** der Knopfzelle **100** anliegen. Ein separater Ableiter zum Verbinden der Elektroden mit dem Deckelteil **102** und dem Becherteil **101** ist nicht erforderlich.

[0035] Fig. 2 zeigt den Effekt der Wärmebehandlung eines Elektroden-Separator-Wickels **200**, die in bevorzugten Ausführungsformen des erfindungsgemäßen Verfahrens zur Herstellung einer Knopfzelle vorgesehen ist. Dargestellt ist schematisch ein Wickel **200** aus einem Verbund aus einer positiven Elektrode **201** (schwarze Balken), einer negativen Elektrode **202** (weisse Balken) und den (quergestreiften) Separatoren **203** (Ausschnitt). Die positive und die negative Elektroden **201** und **202** sind jeweils versetzt zueinander angeordnet. Die Separatoren **203** bestehen aus einem thermoplastisch verformbaren Material.

[0036] Setzt man die sich an den Stirnseiten **204** und **205** des Wickels **200** befindlichen Separatorränder einer hohen Temperatur aus (beispielsweise 250°C, wie dargestellt), so schrumpfen diese Separatorränder. Die Separatoren ziehen sich zumindest teilweise zwischen benachbarte Elektroden zurück. Dabei werden an der Stirnseite **204** die Ränder der negativen Elektrode **202** freigelegt, während die Ränder der positiven Elektrode **201** abgedeckt werden. An der Stirnseite **205** werden die Ränder der positiven Elektrode **201** freigelegt, während die Ränder der negativen Elektrode **202** abgedeckt werden.

[0037] Beim Einsatz eines so behandelten Wickels ist gewährleistet, dass Elektroden gleicher Polarität jeweils nur am Gehäusebecher oder am Gehäusedeckel unmittelbar anliegen können. Separate elektrische Verbindungen zwischen den Elektroden und den Gehäuseteilen sind nicht erforderlich.

Patentansprüche

1. Knopfzelle (**100**), umfassend ein metallisches Becherteil (**101**) und ein metallisches Deckelteil (**102**), welche dichtend miteinander verbunden sind und ein Gehäuse mit einem ebenen Bodenbereich (**103**) und einem dazu parallelen ebenen Deckelbereich (**104**) ausbilden, sowie innerhalb des Gehäuses als flache Schichten ausgebildete positive und negative Elektroden (**105**, **106**; **201**, **202**), die über einen flächigen Separator (**107**; **203**) miteinander verbunden sind, wobei die Elektrodenschichten (**105**, **106**; **201**, **202**) im wesentlichen orthogonal zu dem ebenen Boden- und Deckelbereich (**103**, **104**) ausgerichtet sind.

2. Knopfzelle nach Anspruch 1, dadurch gekennzeichnet, dass die Elektroden (**105**, **106**; **201**, **202**) und/oder der Separator (**107**; **203**) streifen- oder bandförmig ausgebildet sind.

3. Knopfzelle nach Anspruch 1 oder Anspruch 2, dadurch gekennzeichnet, dass sie den Elektroden-Separator-Verbund als Wickel (**200**) enthält, insbesondere als spiralförmigen Wickel.

4. Knopfzelle nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass der Verbund eine der folgenden Schichtabfolgen aufweist:
- negative Elektrode/Separator/positive Elektrode/Separator
- positive Elektrode/Separator/negative Elektrode/Separator

5. Knopfzelle nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass die negative Elektrode (**106**; **202**) und die positive Elektrode (**105**; **201**) innerhalb des Verbundes versetzt zueinander angeordnet sind, so dass für die Elektroden eine jeweils unterschiedliche Beabstandung zu den ebenen Boden- und Deckelbereichen (**103**, **104**) resultiert.

6. Knopfzelle nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass die positive Elektrode (**105**; **201**), insbesondere ein Rand der positiven Elektrode (**105**; **201**), unmittelbar am Becherteil (**101**), insbesondere im ebenen Bodenbereich (**103**), und die negative Elektrode (**106**; **202**), insbesondere ein Rand der negativen Elektrode (**106**; **202**), unmittelbar am Deckelteil (**102**), insbesondere im ebenen Deckelbereich (**104**), anliegt.

7. Knopfzelle nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass sie wiederaufladbar ist.

8. Knopfzelle nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass sie ein Verhältnis Höhe: Durchmesser < 1, vorzugsweise zwischen 0.1 und 0.9, insbesondere zwischen 0.15 und 0.7, aufweist.

9. Verfahren zur Herstellung einer Knopfzelle, insbesondere einer Knopfzelle (**101**) nach einem der vorhergehenden Ansprüche, wobei aus einem metallischen Becherteil (**101**) und einem metallischen Deckelteil (**102**) ein Gehäuse mit einem ebenen Bodenbereich (**103**) und einem dazu parallelen ebenen Deckelbereich (**104**) gebildet wird und wobei ein Elektroden-Separator-Verbund mit als flache Schicht ausgebildeten Elektroden (**105**, **106**; **201**, **202**) derart in das Gehäuse eingesetzt wird, dass die Elektroden (**105**, **106**; **201**, **202**) orthogonal zu dem ebenen Boden- und Deckelbereich (**103**, **104**) ausgerichtet sind.

10. Verfahren nach Anspruch 9, dadurch gekennzeichnet, dass der Elektroden-Separator-Verbund als Wickel (**200**) eingesetzt wird, insbesondere als spiralförmiger Wickel.

11. Verfahren nach Anspruch 10, umfassend die Schritte
- Einsetzen des Wickels (**200**) in das metallische Deckelteil (**102**),
- Einsetzen des metallischen Deckelteils (**102**) mit

dem Wickel (**200**) in ein metallisches Becherteil (**101**),
– Umbördeln des Randes (**110**) des Becherteils (**101**).

12. Verfahren nach Anspruch 10 oder 11, dadurch gekennzeichnet, dass der Wickel (**200**) vor dem Verbauen an seinen Stirnseiten wärmebehandelt wird, wobei er zumindest kurzfristig einer Temperatur ausgesetzt wird, bei der der Separator (**203**) thermoplastisch verformbar ist.

Es folgt ein Blatt Zeichnungen

Anhängende Zeichnungen

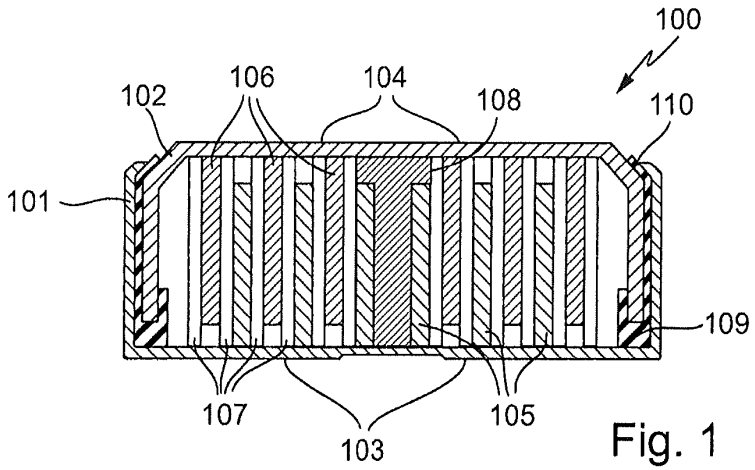


Fig. 1

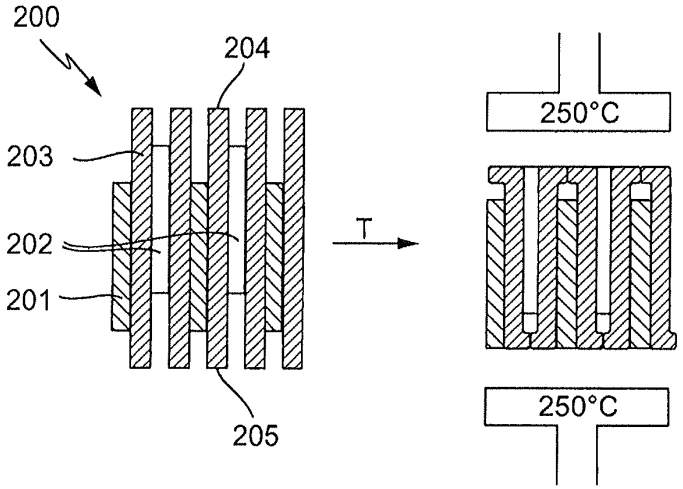


Fig. 2

I. DESCRIPTION JP 2004-158318

[0001] The present invention relates to, and a method for manufacturing the cylindrical cell.

More specifically, it relates to a read method of welding a cylindrical cell of welding by irradiating a laser the lead to the battery case and the weld structure of the lead battery case of cylindrical battery more. [

0002] cell may Oita one battery such as a lithium battery or dry cell, a rechargeable battery such as a lithium ion battery or nickel-hydrogen batteries can be roughly divided into the technology of the general prior art.

In addition, when classified by shape, there is a cylindrical, square, and coin, There are many types of combination thereof.

A battery case made of metal such as iron or aluminum, insert composed generation portion cathode, a negative electrode and a separator called an electrode material, the configuration of the main battery, these Ya nickel is welded to the positive electrode and the negative electrode and accordingly, the welded to the lid and case lead made of aluminum. [

[0003]], a cylindrical battery with a focus on PC and negative electrode is inserted into the cylindrical casing an electrode body formed by winding spirally with a separator and a positive electrode plate and the negative electrode plate, it is welded to the negative electrode plate and has structure in which leads are welded to the bottom of the case is generally used.

Lead and battery case, in order to expand the volume of the electrode body for the purpose of increase of battery capacity, tend to be thin.

As a result, it has become necessary technology for welding in a stable lead battery case. [

0004] Hereinafter, will be described in detail with reference to FIG 7, a method of welding the lead and the battery case in the prior art. [

First 0005], is brought into contact with the bottom of the five cylindrical case and lead 2 Insert the electrode rod 14 of a conductive material such as carbon and copper in the center of the electrode body 4, and place on the bottom outside of the five cylindrical case and electrode bar 14 (For example, see Patent Document 1) is performed by resistance welding for passing current between the electrodes 15 to the.

The method for forming a molten part around the contact portion of the lead case, no molten portion (the inside of the battery) leads and the surface (the outside of the battery) surface of the case, good appearance devices, and is inexpensive some.

Further, if the iron casing of the lithium ion battery is nickel-plated, the molten portion is exposed to the lead surface, but there may be a hole due to a case iron and electrolytic solution reacts, This problem was also hard to occur in resistance welding. [

[0009] However, thickness of the lead and the battery case come getting advanced, the control range of the current to obtain the desired bonding strength and to prevent lead exposed surface of the molten portion becomes narrower.

This caused the influence of variation in the shape change of the electrode rod and the thickness of the lead case and, due to the contact area between the lead and the case is large, the melted portion position of the lead inside becomes unstable, perforated occurs had.

Further, the weld area around the lead case, scattering of the casing material is also confirmed, which was also the cause of the case hole opening. [

0007] (page 6, and Figure 9) [Patent Document 1] JP Patent Publication No. 2000-58024 [0008] From the above challenges that [invention is to provide, for the welding of the lead and battery case The challenge is to establish its structure and manufacturing method eliminates the scattering of the lead between the casing and exposed to

the lead surface of the molten portion, which causes the bore opening is of poor quality after obtaining the bonding strength.

Further, in order to correspond to thinning of the lead and the case, it is to establish a welding method and stable wide control range. [

0009] cylindrical cell according to the first aspect means present application to solve the problem, in the cylindrical battery that is welded by applying a laser from the outside of the case the lead made of a metal in a battery case made of a metal The match, and in that there is a region of the lead inside the casing outer surface of molten portion formed in the lead with the battery case, it is not exposed on the lead surface. [

It is preferred 0010] At this time, if there is lead in the nickel and iron in the battery case is nickel-plated. [

The 0011] A method for manufacturing a cylindrical battery for welding a lead made of a metal in a battery case made of a metal, a manufacturing method of a cylindrical battery according to the second aspect of the invention is, 50W / m thermal conductivity / be welded to melt the inside of the lead from the case surface by contacting with the case of the lead by pressing the lead surface the rod-shaped jig in the heat resistance of K or more, it is irradiated with a laser from the case side I is characterized by. [

[0012] A method for manufacturing a cylindrical battery that is welded by applying a laser leads made of a metal in a battery case made of a metal, a manufacturing method of a cylindrical battery according to the third aspect the present application, the lead surface and in that to control the pulse energy of the laser by stopping the output of the laser when the signal rises to the threshold performed measuring the temperature, we fixed the position of the molten portion of the lead therein. [

0013] At this time, it is preferable to measure with a thermocouple the temperature of the lead surface. [

Also 0014], it is preferable and is nickel and lead in iron battery case is nickel-plated. [

[0015]] The laser to be irradiated is preferable to be the fundamental wave of YAG. [

[0016], it is suitable and is a tungsten rod-shaped jig of heat resistance. [

It is further preferred 0017], and is more than 0.1kgf force is pressed against the rod-shaped jig of heat resistance. [

By its lead welding method and cylindrical battery of 0018 above, there is no scattering and lead surface exposure of the molten portion, control range of a wide range of output with high welding strength can be obtained, and high yield welding and the lead and battery case Because it is possible, it can be supplied at low cost cylindrical cell having a high welding quality. [

0019] Embodiment] The following embodiments of the invention will be described with reference to the drawings, embodiments of the present invention. [

I will explain 0020] First Embodiment First, a first embodiment of the present invention.

Figure 1 is a sectional view schematically showing a cylindrical battery according to an embodiment of the present invention, the structure of the joint portion of the lead case bottom.

To melt the surface of the case bottom 1 by applying a laser from the side (lower side in FIG 1) outside of one case bottom.

Over the time of illumination, to reach the bonding surface of the lead 2 is fused portion 3, by stopping the laser irradiation where it proceeds to read further inside, molten portion 3 is positioned inside the lead 2 from the surface of one case bottom it is weld structure to.

Melting proceeds if the melting proceeds from the surface of the bottom one case as this, to lead two from the bottom of the case 1 is also at a junction, scattering between the leads and the bottom of the case does not occur. [

Distal end of the 0021 melt part 3 is no problem if the inner lead is basically, for example if it is intended to ensure 1kgf or tensile strength in the vertical direction of the lead 2, 5μm or more is required.

Further, since the exposure of the molten portion and a small cracks cause apertured, the distance between the surface of the lead 2 and the tip of the melt part 3 is required to substantially 5μm above the surface of the lead 2.

Therefore, when using a lead of 100μm thickness in the range of from 5 to 95% of the thickness of the lead is preferably positioned at the tip of the molten portion 3. [

I is shown in Figure 6 the structure of the junction between the lead and the case bottom part 0022] As a conventional example, using resistance welding.

In resistance welding, by applying a current between the electrodes disposed on the surface of each of the lead 2 and the bottom of the case 1, the melting occurs around the joint with high resistance most molten portion 3 lead 2 and the bottom of the case 1 I go to the surface of the spread. [

For insertion into the central portion after inserting the case the electrode assembly is wound, electrode 0023] Lead 2 side, has an electrode of an elongated rod-shaped, the shape of the electrode tip is deformed into each successive welding times order to go, making constant the size and shape of the molten portion 3 resistance between the electrodes is changed is difficult.

Also, if for contacts within the current of the lead 2 and the bottom of the case 1 flows is not uniform, no current flows in a uniform current density at the junction overall current density of the peripheral portion is increased, the case bottom Sometimes 13 is generated scattering between lead 1 and 2. [

Iron, or aluminum, 0024] the bottom of the case 1 is made of an alloy composed mainly of them.

May also be plated with nickel metals.

In addition, nickel, copper or lead 2 is made of alloy mainly containing them.

The cylindrical battery, nickel is generally iron case bottom part 1 is nickel-plated, the lead 2. [

I will explain 0025] (Second Embodiment) Next, a second embodiment of the present invention.

In a cylindrical battery according to an embodiment of the present invention, FIG 2 is a sectional view schematically showing a method of bonding the lead and the case bottom.

Is inserted into the cylindrical case 5 electrode 4 formed by winding spirally with a separator and a positive electrode plate and the negative electrode plate.

I overlap the bottom portion of the cylindrical case 5 in the central portion of the case the lead 2 that is welded to the negative electrode plate.

Insert (referred to as "contact bar" hereinafter) rod-shaped jig that thermal conductivity is made of a material higher 50W/m/K above the opening of the central portion 4 of the electrode body 6, the bottom portion of 5 cylindrical case I contacting the lead 2.

By irradiating a laser 7 from the surface of the cylindrical case 5, and welding by melting a portion of the lead 2 and the cylindrical bottom of the case. [

Thermal conductivity, such as metals, typically copper, iron, tungsten, aluminum, gold, nickel is a material high 50W/m/K above 0026] contact bar 6 is obtained by a rod-like shape.

Not particularly limited in shape, for contacting the lead 2 is inserted into the small opening of the 4 electrode body shape which is formed in a tapered shape, without damaging the lead 2 and electrode 4 is the distal end portion in a cylindrical It is preferable easily inserted into.

Melting the bottom surface of the cylindrical casing 5 by irradiating the laser 7, the melting unit will proceed to the second internal lead subsequently.

At this time, as those transmitted to the contact rod 6 through the lead 2 from the bottom surface of 5 cylindrical case, and those transmitting in the lateral direction inside the lead 2 and the bottom portion of 5 cylindrical case the heat flow But, the heat in the vicinity near the center of the irradiated portion of the laser 7, is transmitted to the longitudinal direction of the contact rod 6.

At this time, the thermal conductivity of the contact rod 6 uses a high material 50W/m/K more similar to the metal of the lead 2 and the cylindrical casing 5, the lead for heat is transferred quickly to the contact rod 6 A steep thermal gradient is generated at the junction of the contact bar 76 from the junction of the cylindrical case 5 within the 2, control of the position of the tip of the molten portion 3 is enabled. [

I will explain 0027] (Third Embodiment) A third embodiment of the present invention.

In a cylindrical battery according to an embodiment of the present invention, FIG 3 is a diagram illustrating a method of measuring the temperature of the lead surface at the time of bonding the lead and the case bottom, used for power control of the laser temperature signal.

In Figure 3, contacting the thermocouple 8 on the surface of the lead 2, welded to the bottom of 5 cylindrical case leads 2 by irradiating a laser 7 from the bottom surface of 5 cylindrical casing in the same manner as the second embodiment be.

I downloaded to the computer 9 the current signal normalized representative of the temperature from the thermocouple 8 at this time.

When the value of the current signal reaches the threshold value set in advance by the personal computer 9, and sends it to the laser oscillator 10 a signal to stop the output of the laser 7.

The laser oscillated by the laser oscillator 10 is irradiated to the bottom of the cylindrical casing 5 by a laser 7 is introduced into the barrel 12 through the fiber 11.

By stopping the irradiation of 7 laser when the surface temperature of the lead 2 reaches the threshold, the molten part 3 inside the lead 2 does not depend on such variations and material thickness of the lead 2 and the case bottom, adhesion quality of bonding which stabilizes the position of the tip, to reduce the exposure of the surface of the lead 2 of the molten portion and to obtain a desired bonding strength can be achieved. [

In Modes 2 and 3 of 0028] In this embodiment, contact bar 6 is no problem thermal conductivity and that satisfies the features transmitted to the contact bar the heat as long as the material of high 50W/m/K more than a thermal conductivity of 150W / tungsten m / K or more, copper, gold, aluminum is preferred.

tungsten melting point hardly thermally deformed higher is most preferred. [

In 3 and 0029] In this embodiment 2, iron, aluminum, or the bottom of the case 1 is made of alloy mainly containing them.

May also be plated with nickel metals.

In addition, nickel, copper or lead 2 is made of alloy mainly containing them.

The cylindrical battery, nickel is generally iron case bottom part 1 is nickel-plated, the lead 2. [

In 3 and 0030] In the present embodiment 2, carbon dioxide laser, YAG fundamental laser, YAG second harmonic laser, such as LD laser is used as a laser to melt the metal, but the output control can be easily high output can be obtained than the possible oscillation of the pulse width of 20ms from 1 and, fundamental laser of YAG is preferred there. [

In 3 Modes 2 and 0031] In this embodiment, the force pressed against the lead 2 the contact bar 6 is equal to 0.1kgf or more, it is brought into contact with the bottom of the five cylindrical case and lead 2 in the entire region of the surface of the contact bar 6 It is possible. [

0032] Next, I will detail the specific example of the embodiment described earlier. [

In the laser welding of lead 2 and the bottom of the 5 cylindrical case in 0033] Figure 3, using a nickel iron plated with nickel cylindrical case 5, to lead 2, use the pulse YAG laser with a wavelength of 1064nm laser oscillator 10 had.

The contact bar 76 in the cylindrical shape of the tungsten was set to tip performs taper machining, is pressed against the lead 2 1kgf.

I Figure 4 shows the position of the tip of the molten portion 3 from the junction with the current signal normalized taken out from the thermocouple 8.

The output time of the laser in welding the lead case bottom is in the range of 20ms from 1 by the thickness of the lead and the case bottom part, but in the present exemplary embodiment, 300μm the case thickness, a 100μm lead thickness, the laser irradiation time I was 10ms.

It was found that, as is apparent from FIG 4, the position of the molten tip is moved to read the surface of the junction signal strength according to the increase, there is a correlation between the position of the molten tip and the signal strength.

When the tip of the molten portion 3 has reached the position of 50μm, which is the center of the lead 2 with the relationship, it is configured to generate a control signal for stopping the irradiation of the laser 7, 30 welding lead case bottom I went once.

Welding 2000A constant inter-electrode current (b), the resistance welding in the conventional FIG 5 when not generating a signal for stopping the irradiation of the laser 7 (a), as a comparative example 5 the position of the molten tip at the The are shown in Figure 5 (c) and if they match. [

First 0034, when the comparison between (b) and (c), was welded to the lead 2 and the bottom portion of 5 cylindrical casing by irradiating the laser to the position of the molten tip than the resistance welding in the conventional Figure 5 It is understood that it is concentrated in 50μm.

In resistance welding, include the following 10μm to melting tip from the surface, the risk of surface exposure of the molten portion is higher in mass production.

On the other hand, if it is welded by the laser, also close to the surface of the lead 2 and most is 20μm or until melted tip from the surface, the lead exposed surface of the molten portion does not occur.

Further, scattering was observed several in resistance welding, and improve the welding quality is confirmed not observed by laser welding. [

Then 0035], by comparison of (a) and (b), when controlling the laser power by measuring the surface temperature of the lead 2 FIG 5, the position of the molten tip becomes more constant.

Is due to reduce the influence of the output variation of the laser and the contact variation between the lead case and this, according to the bonding strength and the desired thickness of the lead and the case, which, in any position of the molten tip it means that it is controlled. [

In 0036] In this example, to measure the surface temperature of the lead 2 by means of a thermocouple, but the same effect can be obtained using a thermometer of the non-contact system. [

0037] By thermal conductivity to 50W/m/K or contact rod by irradiating the laser from EFFECT case bottom side of the invention, is a structure in which the position of the molten tip is positioned to the lead inside the desired In order to prevent the scattering and melting tip is not exposed to lead surface requires the bonding strength, quality of the junction can be achieved.

Further, by using the laser output, controls the reading surface temperature be measured stabilization of the position of the molten tip, bonding quality according to the dimensions and the material is obtained.

From the above, the production of cylindrical battery of high capacity can be achieved in a small and low cost due to yield improvement. [

BRIEF DESCRIPTION OF THE DRAWINGS] schematically a method of bonding lead and the bottom of the case cylindrical battery of the present invention, FIG cross sectional view of the junction of the lead and the bottom of the case cylindrical battery of the present invention; FIG graph showing the relationship between the end position of the fused portion and the signal intensity of [Figure 4] lead surface temperature diagram schematically illustrating a method of bonding lead and the bottom of the case cylindrical battery of the present invention; FIG cross-sectional view shown in resistance of lead and the bottom of the case cylindrical cell of Figure 7 a conventional cross-sectional view of the structure of the junction of the lead and the bottom of the case cylindrical cell of Figure 6 a conventional diagram showing the position of FIG. 5 melting tip section scattering 6 contact bar 7 laser 8 thermocouple 9 PC 10 laser oscillator 11 fiber barrel 12 13 5 cylindrical case 1 case bottom 2 lead 3 melting section 4 electrode body PARTS LIST cross-sectional view schematically showing the welding 15 resistance welding electrode 14 for resistance welding electrode rod

II. CLAIMS JP 2004-158318

A cylindrical battery was welded by applying a laser from the outside of the case the lead made of a metal in a battery case made of a metal, the molten part formed in the inner lead and the battery case of the lead inside the casing outer surface cylindrical cell, characterized in that located in the region, it is not exposed on the lead surface.

The cylindrical battery according to claim 1, wherein the lead is nickel and iron where the battery case is nickel-plated.

A method of manufacturing a cylindrical battery of welding leads made of a metal in a battery case made of a metal, the thermal conductivity is pressed against the lead surface jig rod-like heat resistance of 50W/m/K more method of manufacturing cylindrical cells, characterized in that the weld is melted inside the lead from the case surface by contacting with the case and the lead, and irradiated with a laser from the case side.

The output of the laser when the signal rises to the threshold value A method of manufacturing a cylindrical battery that is welded by applying a laser leads made of a metal in a battery case made of a metal, subjected to measure the temperature of the lead surface method of manufacturing cylindrical cells, characterized in that to control the pulse energy of the laser by stopping, we fixed the position of the molten portion of the lead therein.

The manufacturing method of a cylindrical battery according to claim 4, characterized in that it is measured with a thermocouple the temperature of the lead surface.

The manufacturing method of a cylindrical battery according to any one of claims 3 to 5, characterized in that the lead is nickel and iron where the battery case is nickel-plated.

The manufacturing method of a cylindrical battery according to any one of claims 3 to 6, wherein the laser to be irradiated is a fundamental wave of YAG.

The manufacturing method of a cylindrical battery according to any one of claims 3 to 7, wherein the rod-shaped jig in the heat resistance is tungsten.

The manufacturing method of a cylindrical battery according to any one of claims 3 to 8, wherein the force pressing the rod-shaped jig in the heat resistance is 0.1kgf or more.

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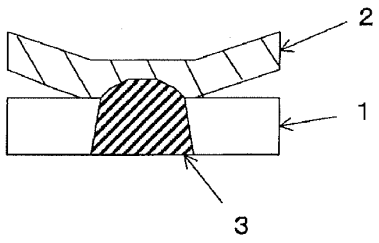
最終頁に続く

(54)【発明の名称】円筒形電池とその製造方法

(57)【要約】
【課題】電池ケース底部とリードの溶接において、穴開きの原因となるリード表面への溶融部露出と飛散りを無くす構造及び溶接方法を提供する。また、制御範囲の広い安定した溶接手法を提供する。
【解決手段】電池ケースとリードを溶接する手法としてケース外側よりレーザを照射を行い、溶融部がケース外側表面からリード内部の領域にあり、リード表面に露出していない構造とする。熱伝導率が５０Ｗ／ｍ／Ｋ以上の耐熱性の棒状の治具をリード表面に押し当てることによりリードをケースに接触させ、ケース側よりレーザを照射することによりケース及びリードの一部を溶融させ溶接する。更に、リード表面の温度の測定を行い　値に達した時点でレーザの出力を停止することにより、リード内部の溶融部位置を一定にする。
【選択図】　図１



１・・ケース底部
２・・リード
３・・溶融部

【特許請求の範囲】
【請求項１】
金属よりなる電池ケースに金属よりなるリードを前記ケース外側からレーザを照射することにより溶接した円筒形電池であって、前記電池ケースとリード内に形成された溶融部がケース外側表面からリード内部の領域にあり、リード表面に露出していないこと
を特徴とする円筒形電池。
【請求項２】
電池ケースがニッケルめっきされた鉄で且つリードがニッケルであること
を特徴とする請求項１に記載の円筒形電池。
【請求項３】
金属よりなる電池ケースに金属よりなるリードを溶接する円筒形電池の製造方法であって、熱伝導率が５０Ｗ／ｍ／Ｋ以上の耐熱性の棒状の治具を前記リード表面に押し当てることにより前記リードを前記ケースに接触させ、前記ケース側よりレーザを照射することによりケース表面からリードの内部を溶融させ溶接すること
を特徴とする円筒形電池の製造方法。
【請求項４】
金属よりなる電池ケースに金属よりなるリードをレーザを照射することにより溶接する円筒形電池の製造方法であって、リード表面の温度を測定を行いその信号が　値まで上昇したときにレーザの出力を停止させることによりレーザのパルスエネルギを制御し、リード内部の溶融部の位置を一定とすること
を特徴とする円筒形電池の製造方法。
【請求項５】
リード表面の温度を熱電対により測定することを特徴とする請求項４に記載の円筒形電池の製造方法。
【請求項６】
電池ケースがニッケルめっきされた鉄で且つリードがニッケルであること
を特徴とする請求項３～５の何れか一項に記載の円筒形電池の製造方法。
【請求項７】
照射するレーザがＹＡＧの基本波であることを特徴とする請求項３～６の何れか一項に記載の円筒形電池の製造方法。
【請求項８】
耐熱性の棒状の治具がタングステンであることを特徴とする請求項３～７の何れか一項に記載の円筒形電池の製造方法。
【請求項９】
耐熱性の棒状の治具を押し当てる力が０．１ｋｇｆ以上であること
を特徴とする請求項３～８の何れか一項に記載の円筒形電池の製造方法。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】
本発明は、円筒形電池およびその製造方法に関する。より具体的には、円筒形電池の電池ケースとリードの溶接部構造及び電池ケースとリードをレーザを照射して溶接する円筒形電池のリード溶接方法に関する。
【０００２】
【従来の技術】
一般に電池は、大きく分けて乾電池やリチウム電池などの一次電池、ニッケル水素電池やリチウムイオン電池などの充電可能な二次電池に大分できる。また、形状で分類すると、円筒型、角型、コイン型などがあり、その組み合わせにより多くの種類が存在する。これらの主な電池の構成は、鉄やアルミニウムなどの金属からなる電池ケースに、電極体と呼ばれる正極、セパレータ及び負極から構成される発電部分を挿入して、正極及び負極に溶接されたニッケルやアルミニウムからなるリードをケースや蓋に溶接したものとなってい

る。
【０００３】
また、パソコン用を中心とした円筒形電池は、正極板と負極板とをセパレータを介して渦巻状に巻回してなる電極体を円筒形ケースに挿入し、負極板に溶接された負極リードがケース底部に溶接されている構造が一般的となっている。電池ケースやリードは、電池容量の増大を目的として電極体の容積を拡大するため、薄くなる傾向にある。これに伴い、電池ケースとリードを安定して溶接する技術が必要となっている。
【０００４】
以下、従来の電池ケースとリードとの溶接方法を、図７を参照しながら詳述する。
【０００５】
まず、電極体４の中心に銅やカーボンなどの導電性の電極棒１４を差し込んでリード２と円筒形ケース５の底部を接触させ、電極棒１４と円筒形ケース５の底部外側に配置した電極１５間に電流を流す抵抗溶接で行われている（例えば、特許文献１参照）。この方法は、装置が安価であり、またケースとリードの接触部を中心として溶融部を形成するため、ケース表面（電池外部）及びリード表面（電池内部）に溶融部が無く、外観が良好である。また、リチウムイオン電池のケースがニッケルめっきされた鉄の場合、リード表面に溶融部が露出していると、電解液と鉄とが反応してケースに穴が開く原因となることがあるが、抵抗溶接ではこの問題も生じ難かった。
【０００６】
しかし、近年電池ケース及びリードの薄型化が進んでくると、溶融部のリード表面露出を防止し且つ所望の接合強度を得るための電流の制御範囲が狭くなる。これは、ケースやリードの厚さや電極棒の形状変化、ケースとリードとの接触面積などによるばらつきの影響が大きくなり、リード内部の溶融部位置が不安定となり、穴開きが発生する原因となっていた。また、ケースとリードとの溶接部周辺に、ケース材料の飛散りも確認され、これもケース穴開きの原因となっていた。
【０００７】
【特許文献１】
特開２０００－５８０２４号公報（第６頁、第９図など）
【０００８】
【発明が解決しようとする課題】
以上のことから、電池ケースとリードとの溶接についての課題は、接合強度を得たうえで品質不良である穴開きの原因となる溶融部のリード表面への露出とケースとリード間の飛散りを無くす構造及びその製造方法を確立することにある。また、ケース及びリードの薄型化に対応するため、制御範囲の広い安定した溶接手法を確立することである。
【０００９】
【課題を解決するための手段】
本願第１の発明に係る円筒形電池は、金属よりなる電池ケースに金属よりなるリードを前記ケース外側からレーザを照射することにより溶接した円筒形電池であって、前記電池ケースとリード内に形成された溶融部がケース外側表面からリード内部の領域にあり、リード表面に露出していないことを特徴とする。
【００１０】
このとき、電池ケースがニッケルめっきされた鉄で且つリードがニッケルであると好適である。
【００１１】
また、本願第２の発明に係る円筒形電池の製造方法は、金属よりなる電池ケースに金属よりなるリードを溶接する円筒形電池の製造方法であって、熱伝導率が５０Ｗ／ｍ／Ｋ以上の耐熱性の棒状の治具を前記リード表面に押し当てることにより前記リードを前記ケースに接触させ、前記ケース側よりレーザを照射することによりケース表面からリードの内部を溶融させ溶接することを特徴とする。
【００１２】

また、本願第３の発明に係る円筒形電池の製造方法は、金属よりなる電池ケースに金属よりなるリードをレーザを照射することにより溶接する円筒形電池の製造方法であって、リード表面の温度を測定を行いその信号が　値まで上昇したときにレーザの出力を停止させることによりレーザのパルスエネルギを制御し、リード内部の溶融部の位置を一定とすることを特徴とする。

【００１３】

このとき、リード表面の温度を熱電対により測定すると好適である。

【００１４】

また、電池ケースがニッケルめっきされた鉄で且つリードがニッケルであると好適である。

【００１５】

また、照射するレーザがＹＡＧの基本波であると好適である。

【００１６】

また、耐熱性の棒状の治具がタングステンであると好適である。

【００１７】

更に、耐熱性の棒状の治具を押し当てる力が０．１ｋｇｆ以上であると好適である。

【００１８】

以上の円筒形電池及びそのリード溶接法により、溶融部のリード表面露出と飛散りが無く、高い溶接強度を有する広範囲な出力の制御範囲が得られ、電池ケースとリードとの高歩留まり溶接が可能となるため、接合品質の高い円筒形電池を低コストで供給することができる。

【００１９】

【発明の実施の形態】

以下、本発明の実施の形態について図面を参照しつつ説明する。

【００２０】

（第１の実施形態）

まず、本発明の第１の実施形態について説明する。図１は、本発明の実施形態にかかる円筒形電池の、ケース底部とリードの接合部の構造を模式的に示す断面図である。ケース底部１の外側（図１の下側）からレーザを照射することによりケース底部１の表面を溶融する。照射時間の経過と共に、溶融部３はリード２との接合面に達し、更にリード内部へと進んだところでレーザ照射を停止して、溶融部３がケース底部１の表面からリード２の内部に位置する溶接部構造となる。このようにケース底部１の表面から溶融が進む場合は、接合部においてもケース底部１からリード２へと溶融が進み、ケース底部とリード間に飛散りは発生しない。

【００２１】

溶融部３の先端は、基本的にはリード内であれば問題無いが、例えばリード２の垂直方向の引張り強度を１ｋｇｆ以上確保しようとした場合、５μｍ以上は必要となる。また、リード２の表面においては僅かなクラックや溶融部の露出が穴開きの原因となるため、溶融部３の先端とリード２の表面との距離は、実質５μｍ以上は必要となる。従って、厚さ１００μｍのリードを用いた場合、溶融部３の先端の位置はリードの厚さの５から９５％の範囲が好ましい。

【００２２】

従来例として、抵抗溶接を用いたケース底部とリードとの接合部の構造を図６に示す。抵抗溶接においては、ケース底部１とリード２のそれぞれ表面に配置された電極間に電流を流すことにより、最も抵抗の高い接合部を中心に溶融が起こり、溶融部３がケース底部１とリード２の表面へ拡がっていく。

【００２３】

リード２側の電極は、巻回した電極体をケースに挿入後にその中央部に挿入するため、細長い棒状の電極となっているが、溶接回数を重ねるごとに電極先端の形状が変形していくため、電極間の抵抗が変化し溶融部３の大きさや形を一定にすることが困難である。また

、ケース底部１とリード２の電流が流れる範囲内の接触が一様でないため、接合部全体に一様な電流密度で電流が流れず、周辺部分の電流密度が高くなった場合、ケース底部１とリード２の間に飛散り１３が発生することもある。

【００２４】

ケース底部１は鉄、アルミニウム或いは、それらを主成分とした合金からなる。これらの金属にニッケルをめっきする場合もある。また、リード２はニッケル、銅或いは、それらを主成分とした合金からなる。円筒形電池としては、ケース底部１はニッケルめっきされた鉄、リード２はニッケルが一般的である。

【００２５】

（第２の実施形態）

次に、本発明の第２の実施形態について説明する。図２は、本発明の実施形態にかかる円筒形電池において、ケース底部とリードの接合方法を模式的に示す断面図である。正極板と負極板とをセパレータを介して渦巻状に巻回してなる電極体４を円筒形ケース５に挿入する。負極板に溶接されているリード２をケースの中央部にて円筒形ケース５の底部に重ねる。電極体４の中央部の開口部より熱伝導率が５０Ｗ／ｍ／Ｋ以上の高い材料からなる棒状の治具（以下「接触棒」と称す）６を挿入し、円筒形ケース５の底部にリード２を接触させる。円筒形ケース５の表面よりレーザ７を照射することにより、円筒形ケース底部とリード２の一部を溶融して溶接する。

【００２６】

接触棒６は、銅、鉄、タングステン、アルミニウム、金、ニッケルに代表される金属などの熱伝導率が５０Ｗ／ｍ／Ｋ以上の高い材料であり、棒状の形状をしたものである。形状に特に制限は無いが、電極体４の僅かな開口部に挿入しリード２と接触するため、円柱状で先端部はテーパ状に形成された形状が、電極体４やリード２を傷つけずに挿入し易く好ましい。レーザ７を照射して円筒形ケース５の底部表面を溶融し、その後溶融部はリード２内部へと進んでいく。このとき、熱の流れは円筒形ケース５の底部表面からリード２を通って接触棒６へ伝達するものと、円筒形ケース５の底部及びリード２の内部を横方向に伝達するものとがあるが、レーザ７の照射部分の中心部とその近傍付近の熱は、接触棒６の縦方向に伝達する。このとき、接触棒６の熱伝導率が円筒形ケース５やリード２の金属と同様な５０Ｗ／ｍ／Ｋ以上の高い材料を用いることにより、接触棒６へ熱が迅速に伝達されるためリード２の内部の円筒形ケース５との接合部から接触棒６との接合部に急峻な熱勾配が発生し、溶融部３の先端の位置の制御が可能となる。

【００２７】

（第３の実施形態）

次に、本発明の第３の実施形態について説明する。図３は、本発明の実施形態にかかる円筒形電池において、ケース底部とリードの接合時におけるリード表面の温度を計測し、温度信号をレーザの出力制御に用いる方法を示す図である。図３において、リード２の表面に熱電対８を接触させ、第二の実施の形態と同様に円筒形ケース５の底部表面よりレーザ７を照射してリード２を円筒形ケース５の底部へ溶接する。このときの熱電対８より温度を表す規格化した電流信号をパソコン９に取り込む。パソコン９で事前に設定した　値に電流信号の値が到達したときに、レーザ７の出力を停止する信号をレーザ発振器１０へ送る。レーザ発振器１０で発振したレーザは、ファイバ１１を通って鏡筒１２へ導入されレーザ７となって円筒形ケース５の底部へ照射される。リード２の表面温度が　値に到達したときにレーザ７の照射を停止することにより、ケース底部やリード２の厚さや材質、密着性のばらつきなどに依存せずリード２の内部における溶融部３の先端の位置を安定化し、所望の接合強度を得て且つ溶融部のリード２の表面への露出を抑える接合の高品質化が可能となる。

【００２８】

本実施の形態２及び３において、接触棒６は熱を接触棒へ伝達する機能を満たす熱伝導率が５０Ｗ／ｍ／Ｋ以上の高い材料であれば問題無いが、熱伝導率が１５０Ｗ／ｍ／Ｋ以上のタングステン、銅、金、アルミニウムが好ましい。融点が高く熱変形し難いタングステ

ンが最も好ましい。

【００２９】

本実施形態２及び３において、ケース底部１は鉄、アルミニウム或いは、それらを主成分とした合金からなる。これらの金属にニッケルをめっきする場合もある。また、リード２はニッケル、銅或いは、それらを主成分とした合金からなる。円筒形電池としては、ケース底部１はニッケルめっきされた鉄、リード２はニッケルが一般的である。

【００３０】

本実施形態２及び３において、金属を溶融するレーザとしては炭酸ガスレーザ、ＹＡＧ基本波レーザ、ＹＡＧ第二高調波レーザ、ＬＤレーザなどが用いられるが、高出力が得られ出力制御が容易であり且つ１から２０ｍＳのパルス幅の発振が可能なことより、ＹＡＧの基本波レーザが好ましい。

【００３１】

本実施の形態２及び３において、接触棒６をリード２に押し当てる力が０．１ｋｇｆ以上であれば、接触棒６の表面の全域においてリード２と円筒形ケース５の底部を接触させることが可能である。

【００３２】

次に、前述する本実施形態における具体例を詳述する。

【００３３】

図３における円筒形ケース５の底部とリード２のレーザ溶接において、円筒形ケース５にニッケルめっきを施した鉄、リード２にニッケルを用い、レーザ発振器１０に波長１０６４ｎｍのパルスＹＡＧレーザを用いた。接触棒６はタングステンの円柱状の形状で、先端はテーパ加工を施し、１ｋｇｆでリード２に押し当てるよう設定した。熱電対８より取り出した規格化した電流信号と接合部からの溶融部３の先端の位置を図４に示す。ケース底部とリードの溶接におけるレーザの出力時間はケース底部やリードの厚さにより１から２０ｍＳの範囲になるが、本実施形態においては、ケース厚を３００μｍ、リード厚を１００μｍとし、レーザ照射時間を１０ｍＳとした。図４から明らかなように、信号強度が上昇するに従い溶融部先端の位置が接合部からリード表面へと移動し、信号強度と溶融部先端の位置とは相関があることを見出した。この関係を用いてリード２の中心である５０μｍの位置に溶融部３の先端が到達したところで、レーザ７の照射を停止する制御信号を発生するように設定し、ケース底部とリードの溶接を３０回行った。このときの溶融部先端の位置を図５（ａ）、比較例としてレーザ７の照射を停止する信号を発生しないときを図５（ｂ）、従来の抵抗溶接において電極間電流を２０００Ａ一定で溶接したときを図５（ｃ）にそれぞれ示す。

【００３４】

まず、図５（ｂ）と（ｃ）との比較により、レーザを照射して円筒形ケース５の底部とリード２を溶接したときに、従来の抵抗溶接よりも溶融部先端の位置が５０μｍに集中していることが分かる。抵抗溶接では、表面から溶融部先端まで１０μｍ以下のものがあり、量産において溶融部の表面露出の危険性が高い。一方、レーザで溶接した場合は、最もリード２の表面に近いものでも、表面から溶融部先端まで２０μｍ以上あり、溶融部のリード表面露出は起きない。また、抵抗溶接では飛散りがいくつか見られたが、レーザ溶接では見られず接合品質の向上が確認された。

【００３５】

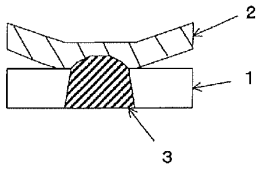
次に、図５（ａ）と（ｂ）との比較により、リード２の表面温度を測定してレーザ出力を制御すると、溶融部先端の位置が更に一定となる。これは、ケースとリードとの接触ばらつきやレーザの出力ばらつきなどの影響を低減によるものであり、このことは、ケース及びリード厚さや所望の接合強度に応じて、溶融部先端の位置を任意に制御可能であることを意味する。

【００３６】

本実施例では、熱電対によりリード２の表面温度を測定したが、非接触系の温度計を用いても同様の効果が得られる。

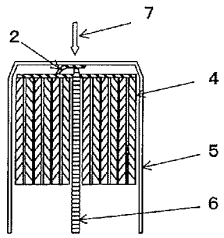
【００３７】
【発明の効果】
ケース底部側からレーザを照射して接触棒を熱伝導率が５０Ｗ／ｍ／Ｋ以上にすることにより、溶融部先端の位置がリード内部に位置する構造となり、所望の接合強度を要しリード表面に溶融部先端が露出せず且つ飛散りを防止するため、接合の高品質化が可能となる。また、リード表面温度をレーザ出力制御に用いることにより、溶融部先端の位置の安定化が図れ、材料や寸法に応じた接合品質が得られる。以上のことより、歩留まり向上による低コスト化と小型で高容量の円筒形電池の製造が可能となる。
【図面の簡単な説明】
【図１】本発明の円筒形電池のケース底部とリードの接合部の構成の断面図
【図２】本発明の円筒形電池のケース底部とリードの接合方法を模式的に示す断面図
【図３】本発明の円筒形電池のケース底部とリードの接合方法を模式的に示す図
【図４】リード表面温度の信号強度と溶融部の先端位置との関係を示す図
【図５】溶融部先端の位置を示す図
【図６】従来の円筒形電池のケース底部とリードの接合部の構成の断面図
【図７】従来の円筒形電池のケース底部とリードの抵抗溶接を模式的に示す断面図
【符号の説明】
１　ケース底部
２　リード
３　溶融部
４　電極体
５　円筒形ケース
６　接触棒
７　レーザ
８　熱電対
９　パソコン
１０　レーザ発振器
１１　ファイバ
１２　鏡筒
１３　飛散り部
１４　抵抗溶接用電極棒
１５　抵抗溶接用電極

【図１】

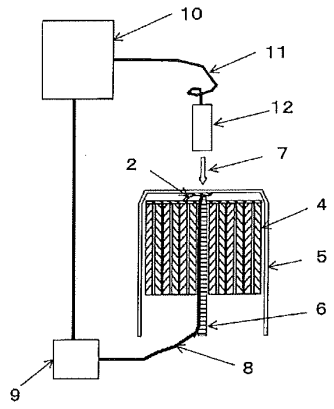


１・・ケース底部
２・・リード
３・・溶融部

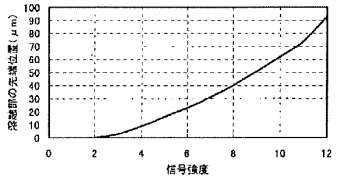
【図２】



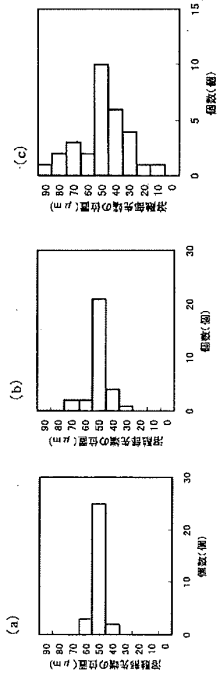
【図３】



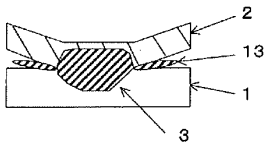
【図４】



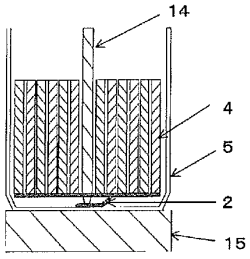
【図５】



【図６】



【図７】



フロントページの続き

Fターム(参考) 5H011 AA03 AA04 CC06 DD18
5H022 BB17 CC02 CC12 EE03

I. DESCRIPTION JP 2008-251192

The present invention relates to a method of manufacturing a battery nickel-cadmium storage batteries, such as nickel-hydrogen storage battery.

The outer can for alkaline storage batteries such as nickel-metal hydride battery and nickel-cadmium storage batteries, which nickel-plated steel sheet surface has been used.

And in order to prevent corrosion by the electrolyte of the steel sheet, which is for preventing rust due to moisture in the external environment for an alkaline storage battery is an alkaline electrolyte such as potassium hydroxide.

Note that the production method of the outer can of the above, for example, as described in Patent Document 1, plated with nickel on the steel surface by barrel plating and after processed into a shape of the outer can by pressing a steel plate, the so-called after plating there is processed into the shape of the outer can by pressing a steel sheet plated with nickel in advance to the one surface, for example, as described in Patent Document 2, so-called first plating.

Outer can by first plating the above (previously plated outer can), has the advantage of excellent quality for plating is applied uniformly to the entire steel sheet.

On the other hand, nickel tissue of the nickel plating is hard and only nickel-plated, and poor press workability when processing the shape of the outer can after it is necessary to perform heat treatment (annealing), and the heat treatment there is a problem that the production cost is increased by heat treatment flaw is easily regard for the nickel tissue softened by.

Outer can by after plating (aftergilding outer can), there may be poor as compared with that of the previously plated in the plating quality as described above but, nickel tissue manufacturing cost is relatively low because the heat treatment described above is not required Since Do not softened, has the advantage that the scratches less obvious outer can, it is widely used.

The alkaline storage battery is made as below normal.

To prepare an electrode body, for example, by winding via a separator, and a positive electrode plate and the active material nickel hydroxide primarily a negative electrode plate as an active material cadmium hydroxide or hydrogen absorbing alloys.

Next, I inserted into the outer can electrode body that is mounting attachment, this collector by means of welding or the like current collector in each positive and negative electrodes of the electrode body.

Then, it is electrically connected by, for example, are electrically connected by welding the outer can collector of the negative electrode side, while it is welded to the sealing lid acting as a cathode terminal current collectors on the positive electrode side.

Then, by injecting the alkaline electrolyte in the outer can, it is sealed with sealing lid, the alkaline storage battery is a positive electrode terminal closing lid, the negative terminal of the outer can is completed.

Conventionally, in the manufacturing process of the alkaline storage battery, the connection of the current collector of one pole and the outer can and has been done by resistance welding is performed by inserting a welding rod to the outer can, the efficiency of the recent production process Laser welding for welding by irradiating a laser to the portion that connects the current collector and outer can, as described in Patent Document 3 for the is adapted to be employed.

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So, you are trying to connect by laser welding the current collector and plating outer can after the above-mentioned, but when you see the laser irradiated portion of the outer can to the welding later, or peeling nickel plating around the laser irradiation or floating that there are observed.

Peeling problem like this occurs, the rust resistance of the outer can is lowered occurs.

Since the post-plating the outer can not subjected to heat treatment after plating, while there is a characteristic flaw that hard to hard and nickel organization itself of nickel plating, there is also a characteristic of poor ductility.

It is believed that when irradiated the laser with high energy density to the extent of performing the welding (welding laser) Therefore, they are believed to thermal stress is generated in the irradiated part around nickel tissue poor ductility peeled.

A was made in view of the above problems, the present invention is an alkaline storage battery, etc. without while retaining the advantages of the plating outer can after having the characteristics scratch resistant, to reduce the rust-preventive property even after the laser welding It is to provide a process for producing batteries.

Using the plating can then it is not yet performed a heat treatment after nickel plating as the outer can, by inserting the electrode body mounted the collector into the outer can of the present invention, the outer can and the collector In the method of manufacturing the battery to be welded by welding laser irradiation from the outer can outside, in front of the welding with the welding laser irradiation, low energy than the welding laser in and around the part for receiving the welding laser irradiation of the outer can and in that heat-treating the portion by irradiating a laser density.

As the present invention, prior to irradiating the welding laser with high energy density is relatively, by irradiating a laser of low energy density (heat treatment laser) than the welding laser, and heat treating the nickel plating of the portion irradiated with the thermal treatment laser Then, since the ductility is increased nickel of the partial tissue is softened and absorbs thermal stress even when it is irradiated with the laser welding, it is possible to prevent the peeling plating.

In the manufacturing method of the present invention, since the other parts are not affected by heat followed by heat treatment to only a portion of peeling the plating is likely to occur, plating most organizations are not modified, thus is hard to be damaged it is possible to maintain the properties of.

In further accordance with the present invention, it can be performed in association with the laser welding of the current collector and outer can in the manufacturing process of the alkaline storage battery wherein the heat treatment is not required to be previously subjected to a heat treatment to the outer can advance, it is possible to suppress an increase in manufacturing costs.

Hereinafter, I will explain a manufacturing method of an alkaline storage battery according to an embodiment of the present invention. (

I prepare a positive electrode plate of rectangular as an active material nickel hydroxide mainly made of 1) electrode body, a negative electrode plate of rectangular as an active material mainly cadmium hydroxide.

In this case, a sintered nickel positive electrode plate filled with an active material on the sintered substrate that is formed by sintering nickel powder on the perforated metal core member, the positive electrode plate filled with an active material paste on the foamed nickel substrate It is possible to use a paste type nickel positive electrode plate consisting of Te.

Further, the negative electrode plate may be used paste type cadmium negative electrode plate formed by Nuri-gi the active material paste to the conductive core material such as punched metal or sintered cadmium negative electrode plate filled with an active material on the sintered substrate .

It is also possible in place of cadmium negative electrode plate as the negative electrode uses a hydrogen storage alloy negative electrode plate.

Here, one end of each of the long sides, by forming the (active material unfilled portion in the case of paste-type nickel positive electrode plate) substrate exposed portion for connecting the current collector after the both positive plates, negative plates made.

An axis direction of the short side of each electrode plate are wound with the separator in between, to produce the electrode body of the cylindrical positive and negative electrode plate prepared as described above.

The substrate exposed portion of the electrode plate is made to protrude on the bottom surface of each electrode body in the shape of a circular cylinder.

Then, the welding by resistance welding current collectors to the circular bottom surface of the electrode body of the cylindrical substrate exposed portion of the electrode plate protrudes.

The current collector has been prepared by punching a nickel plate, the tab portion for connection to the sealing cap after is provided with the current collector of the positive electrode side in particular.

Electrode body fitted with a current collector in this manner is produced.

Those that have been modified outer can form a bottomed cylinder by pressing a manufacturing steel plate (2) an alkaline storage battery, providing a plated outer can after being subjected to nickel plating on the surface by barrel plating.

The heat treatment after the plating has not been made after the plating outer can.

Inserting the electrode body fitted with a current collector was prepared as described above in the plating package can thereafter.

At this time, as the current collector of the negative electrode side and the outer can is connected exterior can bottom later, is inserted to the current collector of the negative electrode side facing the exterior bottom of the can.

Then performed by laser irradiation and heat treatment of the peripheral portion of the outer can and the negative electrode current collector is connected to the (connecting portion), the welding of the outer can and the negative electrode current collector.

First, is irradiated onto the region of and around the connecting portion of the low laser energy density (laser heat treatment), relatively heat treatment.

Then placed apart from the irradiation of the laser heat treatment, to connect the outer can and the negative electrode side current collector is irradiated onto the connection portion of the laser high energy density (laser welding) relatively.

The energy density of the heat treatment laser and the welding laser, varies depending on the thickness or the like of the outer can, and by a half of the energy density of the welding laser energy density of the heat treatment laser generally, and to prevent separation of the nickel plating I could.

After connecting the outer can and the anode-side current collector in this manner is connected by resistance welding and the sealing lid and the tab portion of the cathode-side current collector.

Then after the grooving by the outer can diameter near the opening, and injecting the alkaline electrolyte.

The sealed by mounting the closing lid to the reduced diameter portion which is formed by the grooving of the sealing lid, and caulking the outer can opening, the alkaline storage batteries of the sealed type is completed.

It should be noted that the gasket made of resin is sandwiched between the outer can and sealing lid, a package can and sealing lid to prevent short-circuiting.

Now be described with reference to the sectional view of FIG 1 for alkaline storage battery of the present invention.

Cell of the present invention, is sealed into insert the electrode assembly 2 to the outer can 1 is sealed with a sealing lid 3 the opening of the outer can 1.

The electrode body 2 as it is formed by winding via a separator 6 between the 5 positive electrode plate and the negative electrode plate 4, the cathode-side current collector 7, the negative electrode substrate exposed portion 5a is the positive electrode substrate exposed portion 4a negative electrode current collector 8 is connected to.

Positive electrode current collector 7 are connected to the sealing lid 3, the sealing lid 3 as a cathode terminal thereby.

Negative electrode current collector 8 is connected by laser welding to the can bottom portion 1a of the outer can 1.

In the connecting part 1b of the can bottom 1a and the negative electrode current collector 8 is connected, the projection which projects one inner surface of the outer can to make the connection more reliably is provided.

By irradiating than one external outer can in the region negative side current collector 8 is in contact with the projection of the connecting portion 1b welding laser, and is connected to the connection portion 1b is welded to the negative electrode current collector 8.

Note that the battery of the present invention, is irradiated to and around the connecting portion 1b laser heat treatment of lower energy density than the welding laser before irradiation with the laser welding.

Thus, it is possible to prevent the peeling of the plating in the welding by laser welding nickel-plated portion of the can bottom portion 1b of the outer can 1 is heat treated, is performed subsequently.

Was attached to the positive and negative electrodes both a collector of making an electrode material as described above using a sintered cadmium negative electrode and (Example) Shoyui-shiki nickel positive electrode was produced by punching a nickel plate to the electrode body.

Then prepared (those steel base material thickness 0.35mm, nickel plating thickness 2.0μm) plated outer can after the cylindrical plated with nickel on the surface of the steel plate green body, insert the electrode body to the outer can.

Incidentally, in order to ensure the connection between the current collector (diameter 2.5mm, 0.2mm height) protrusions protruding outer can inner surface can bottom center portion is provided on the outer can after plating .

Then, with respect to the projection of the outer can and the negative electrode current collector of the electrode body is connected, from the outside of the outer can laser irradiation heat treatment for heat treatment (energy density; 6.

0 radius from the center of the projection; 8J/mm2, laser irradiation range.

75. I went to 20ms); circle, irradiation time of mm.

After exposure to the laser heat treatment, then with respect to the projection welding laser irradiation for welding (energy density; 12.

Circle of radius 0.5mm, irradiation time from the center of the projection;; 7J/mm2, laser irradiation range is carried out 3 times) 8ms, it was connected to the outer can and the negative electrode side current collector.

After that, I was prepared sealed alkaline storage battery of SC size in accordance with the manufacturing method of alkaline storage battery described above.

I will as in Example battery this.

Thereby producing a sealed alkaline storage battery SC size in the same manner, except that in the production process (Comparative Example) The example batteries, it was not the laser irradiation for the heat treatment.

I the comparative example battery this.

I have observed the plating condition of the portion receiving the laser irradiation of the Comparative Example and batteries (Evaluation) The example batteries.

I is shown in Figures 2 and 3 that state.

The example cell is shown in FIG 3 FIG 2, and Comparative Example batteries.

In Figure 3 Comparative Example battery was subjected to welding by the laser irradiation, it is found that the plating of the weld around the peeling, it is floated (figure A).

On the other hand, in FIG 2 of Example batteries were laser irradiation heat treatment prior to welding the parts, there is no peeling of the plating as seen in Comparative Example battery, thereby maintaining a good condition.

Above, a heat treatment is performed by irradiating the heat treatment laser in the portion before irradiation with the welding laser, it is possible to prevent the peeling of the plating that occurs in the portion, according to the present invention.

Further, since the portion subjected to the heat treatment is part of the outer can, it is possible to maintain the properties of the plating outer can most not affected by heat, scratch is hard stick.

Note that the embodiments of the present invention has been described on the basis of the alkaline storage battery of the cylindrical shape and the present invention is not limited to the above embodiment whatsoever.

For example, the outer shape to apply the present invention as in the case of a cylindrical battery even in the square are possible.

The invention is not limited to the alkaline storage battery, if you are connected by laser irradiation current collector and aftergilding outer can, it is possible other cell types, may be applied to, for example, a lithium ion battery.

Is a cross-sectional view of an alkaline storage battery according to the present invention.

And shows a state of laser irradiation portion of Example batteries.

And shows a state of laser irradiation of the Comparative Example battery.

1 ... the outer can, 2, ... electrode body, 3, ... sealing lid, 4 ... positive electrode, 5 ... 6 ... negative electrode separator, 7 ... the positive side collector, 8- · the negative electrode side collector

II. CLAIMS JP 2008-251192

Using the plating can then it is not yet performed a heat treatment after nickel plating as the outer can, by inserting the electrode body mounted the collector into the outer can in the outer Kangaibu the outer can and the collector In the method of manufacturing the battery to be welded by welding laser irradiation from, in front of the welding with the welding laser irradiation, the laser of low energy density than that of the welding laser in and around the part for receiving the welding laser irradiation of the outer can battery manufacturing method which is characterized by heat treating said portion is irradiated.

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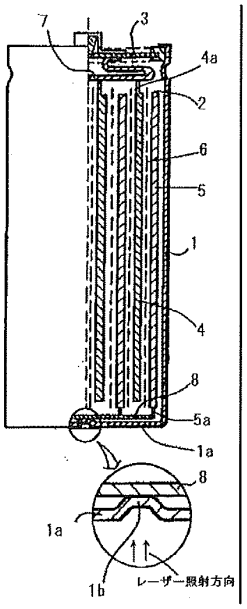
最終頁に続く

(54)【発明の名称】電池の製造方法

(57)【要約】
【課題】
鋼板を外装缶形状に加工した後、バレルメッキ等により表面をニッケルでメッキしてなる後メッキ外装缶と、正負極を組み合わせてなる電極体に取り付けられた集電体を、溶接レーザーを照射して溶接した場合に、前記溶接レーザー照射部周辺に生ずるメッキの剥がれを防止する。
【解決手段】
前記溶接レーザー照射による溶接の前に、前記外装缶の前記溶接レーザー照射を受ける部分とその周辺に前記溶接レーザーよりも低エネルギー密度のレーザーを照射して当該部分を熱処理し、ニッケルメッキに延性を付与することにより、メッキ剥がれを防ぐ。
【選択図】図１



【特許請求の範囲】
【請求項1】
外装缶としてニッケルメッキ後の熱処理を未実施である後メッキ缶を用い、前記外装缶中に集電体の取り付けられた電極体を挿入し、前記集電体と前記外装缶を前記外装缶外部からの溶接レーザー照射により溶接する電池の製造方法において、
前記溶接レーザー照射による溶接の前に、前記外装缶の前記溶接レーザー照射を受ける部分とその周辺に前記溶接レーザーよりも低エネルギー密度のレーザーを照射して当該部分を熱処理することを特徴とする電池の製造方法。

【発明の詳細な説明】
【技術分野】
【0001】
本発明はニッケル・カドミウム蓄電池、ニッケル・水素蓄電池などの電池の製造方法に関する。
【背景技術】
【0002】
ニッケル・カドミウム蓄電池やニッケル・水素蓄電池などのアルカリ蓄電池用の外装缶としては、鋼板表面にニッケルメッキが施されたものが用いられている。これは、アルカリ蓄電池が水酸化カリウムなどのアルカリ電解液を用いているため鋼板の電解液による腐蝕を防止するためと、外部環境の水分による錆びを防止するためである。
【0003】
なお上述の外装缶の製法としては、例えば特許文献１に記載されるように、鋼板をプレス加工により外装缶の形状に加工してからバレルメッキにより鋼板表面にニッケルメッキを施す、いわゆる後メッキによるものと、例えば特許文献２に記載されるように予め表面にニッケルメッキを施した鋼板をプレス加工により外装缶の形状に加工する、いわゆる先メッキによるものがある。
【0004】
上述の先メッキによる外装缶（先メッキ外装缶）は、メッキが鋼板全体に一様に施されているため品質に優れるという利点がある。一方、ニッケルメッキを施したのみではニッケルメッキのニッケル組織が硬く、後の外装缶への形状に加工する際のプレス加工性に乏しいため、熱処理（アニール処理）を施す必要があるが、前記熱処理により前記ニッケル組織が軟化するためキズがつきやすく、また熱処理を行うことにより製造コストが高くなるという問題がある。
【0005】
後メッキによる外装缶（後メッキ外装缶）は、上述のようにメッキ品質において先メッキのものに比べ劣る場合があるものの、上述の熱処理が不要であるため比較的製造コストが低く、またニッケル組織が軟化されていないため、外装缶にキズがつきにくいという利点があり、広く用いられている。
【0006】
なお、アルカリ蓄電池は通常以下のようにして作られる。
主に水酸化ニッケルを活物質とする正極板と、水素吸蔵合金や水酸化カドミウムを活物質とする負極板を、セパレータを介して巻回するなどして電極体を作製する。次いで、前記電極体の正負極それぞれに集電体を溶接などにより取り付け、この集電体が取り付けされた電極体を外装缶に挿入する。そして、例えば負極側の集電体を外装缶と溶接して電気的に接続し、一方正極側の集電体を正極端子を兼ねる封口蓋と溶接することにより電気的に接続する。この後、外装缶内にアルカリ電解液を注入し、封口蓋で封止することにより、封口蓋を正極端子とし、外装缶を負極端子とするアルカリ蓄電池が完成する。
【0007】
従来、上記アルカリ蓄電池の製造プロセスにおいて、外装缶と一方の極の集電体の接続は、外装缶内に溶接棒を挿入して行う抵抗溶接により行われてきたが、近年製造プロセスの効率化のため特許文献３に記載されるように外装缶と集電体を接続する部分にレーザー

を照射して溶接するレーザー溶接が採用されるようになっている。

【0008】

【特許文献1】特開昭５７－１３７５００号公報

【特許文献2】特開２００５－８５４８０号公報

【特許文献3】特開２０００－７７０４０号公報

【発明の開示】

【発明が解決しようとする課題】

【0009】

そこで、上述の後メッキ外装缶と集電体をレーザー溶接により接続しようとしたが、前記溶接後に外装缶のレーザー照射部分を確認すると、レーザー照射した周辺のニッケルメッキが浮いたり剥れたりしているものが見られた。このような剥がれが生じると、外装缶の防錆性が低下するという問題が生ずる。

後メッキ外装缶はメッキ後の熱処理を行っていないため、ニッケルメッキのニッケル組織自体が硬くキズがつきにくいという特性がある一方、延性に乏しいという特性もある。そのため溶接を行う程の高エネルギー密度のレーザー（溶接レーザー）を照射すると、照射部分周辺に熱応力が生じ、延性の乏しいニッケル組織が剥がれたものであると考えられる。

【0010】

本発明は上記の問題を鑑みてなされたものであって、キズがつきにくい特性をもつ後メッキ外装缶の利点を残しつつ、レーザー溶接を行っても防錆性を低下させることなくアルカリ蓄電池等の電池を製造できる方法を提供するものである。

【課題を解決するための手段】

【0011】

本発明は、外装缶としてニッケルメッキ後の熱処理を未実施である後メッキ缶を用い、前記外装缶中に集電体の取り付けられた電極体を挿入し、前記集電体と前記外装缶を前記外装缶外部からの溶接レーザー照射により溶接する電池の製造方法において、前記溶接レーザー照射による溶接の前に、前記外装缶の前記溶接レーザー照射を受ける部分とその周辺に前記溶接レーザーよりも低エネルギー密度のレーザーを照射して当該部分を熱処理することを特徴とする。

【発明の効果】

【0012】

本発明のように、比較的高エネルギー密度の溶接レーザーを照射する前に、溶接レーザーよりも低エネルギー密度のレーザー（熱処理レーザー）を照射して、当該熱処理レーザーを照射した部分のニッケルメッキを熱処理すると、当該部分のニッケル組織が軟化し延性が高まり、前記溶接レーザーを照射した場合でも熱応力を吸収するため、メッキ剥がれを防止することができる。

また、本発明の製造方法では、前記メッキ剥がれが生じやすい部分のみに熱処理を行いその他の部分は熱影響を受けないことから、大部分のメッキ組織は変性しておらず、よってキズがつきにくいという特性を維持することができる。

更に本発明によれば、前記熱処理はアルカリ蓄電池の製造プロセスにおいて外装缶と集電体のレーザー溶接に付随して行うことができるので、予め外装缶に熱処理を施しておくことを必要とせず、製造コストの上昇を抑制することができる。

【発明を実施するための最良の形態】

【0013】

以下、本発明の一実施の形態に係るアルカリ蓄電池の製造方法について説明する。

（１）電極体の作製

主として水酸化ニッケルを活物質とする長方形の正極板と、主として水酸化カドミウムを活物質とする長方形の負極板を用意する。この場合、前記正極板はパンチングメタル芯体上にニッケル粉末を焼結させてなる焼結基板中に活物質を充填した焼結式ニッケル正極板や、発泡ニッケル基板中に活物質ペーストを充填してなるペースト式ニッケル正極板を

用いることができる。また、前記負極板は焼結基板中に活物質を充填した焼結式カドミウム負極板やパンチングメタルなどの導電芯体に活物質ペーストを塗着してなるペースト式カドミウム負極板を用いることができる。なお、負極板としてカドミウム負極板に代え、水素吸蔵合金負極板を用いることもできる。

ここで、正極板、負極板ともにそれぞれの長辺の一端には、後に集電体を接続するための芯体露出部（ペースト式ニッケル正極板の場合は活物質未充填部）を形成してなる。

【0014】

上記の用意した正・負極板を各極板の短辺方向を軸として、間にセパレータを介して巻回し、円筒状の電極体を作製する。なお、各極板の芯体露出部は円筒状の電極体のそれぞれの底面に突出するよう作製される。

次いで、各極板の芯体露出部が突出した円筒状の電極体の各底面に円形状の集電体を抵抗溶接により溶接する。集電体はニッケル板を打ち抜いて作成されたものであり、特に正極側の集電体は後に封口蓋と接続するためのタブ部が設けられている。

このようにして集電体を取り付けた電極体が作製される。

【0015】

（２）アルカリ蓄電池の作製

鋼板をプレス加工により有底円筒の外装缶形状に加工したものに、バレルメッキにより表面にニッケルメッキを施した後メッキ外装缶を用意する。なお、前記後メッキ外装缶はメッキ後の熱処理はなされていない。

この後メッキ外装缶に上述のようにして作製した集電体を取り付けた電極体を挿入する。この時、前記外装缶と負極側の集電体が後に外装缶底で接続されるよう、負極側の集電体が外装缶底に面するよう挿入する。

【0016】

次いで、負極側集電体と外装缶が接続される部分（接続部）とその周辺部の熱処理と、負極側集電体と外装缶の溶接をレーザー照射により行う。

まず、比較的低エネルギー密度のレーザー（熱処理レーザー）を接続部とその周辺部の領域に照射し、熱処理を行う。次いで、前記熱処理レーザーの照射から間隔を置き、比較的高エネルギー密度のレーザー（溶接レーザー）を接続部に照射し負極側集電体と外装缶を接続する。

なお、上記溶接レーザーや熱処理レーザーのエネルギー密度は、外装缶の厚み等により異なるが、概ね熱処理レーザーのエネルギー密度を溶接レーザーのエネルギー密度の半分程度とすることにより、ニッケルメッキの剥がれを防止することができる。

【0017】

このように負極側集電体と外装缶を接続した後、正極側集電体のタブ部と封口蓋とを抵抗溶接により接続する。そして外装缶開口部近傍を縮径して溝入れ加工を行った後、アルカリ電解液を注入する。

そして前記封口蓋を前記溝入れ加工により形成した縮径部に封口蓋を載置し、外装缶開口部をかしめ加工することにより封止し、密閉型のアルカリ蓄電池が完成する。なお、封口蓋と外装缶の間には樹脂製のガスケットが挟まれ、封口蓋と外装缶が短絡しないように構成される。

【0018】

ここで、本発明のアルカリ蓄電池について図１の断面図を用いて説明する。本発明の電池は、外装缶１中に電極体２を挿入し、前記外装缶１の開口部を封口蓋３で封止され密閉化される。また、電極体２は正極板４及び負極板５の間にセパレータ６を介して巻回してなるもので、正極芯体露出部４ａには正極側集電体７が、負極芯体露出部５ａには負極側集電体８がそれぞれ接続されている。正極集電体７は封口蓋３に接続され、これにより封口蓋３は正極端子となる。

負極側集電体８は、外装缶１の缶底部１ａにレーザー溶接により接続される。なお、負極集電体８と缶底部１ａが接続される接続部１ｂには、より確実に接続を行うために外装缶１内面に突出する突起が設けられている。溶接レーザーを接続部１ｂの前記突起と負極

側集電体８が接する領域に外装缶１外部より照射することにより、負極側集電体８と接続部１ｂが溶接され接続される。

なお本発明の電池では、上記溶接レーザーを照射する前に溶接レーザーよりも低エネルギー密度の熱処理レーザーを接続部１ｂとその周辺に照射する。これにより、外装缶１の缶底部１ｂの一部のニッケルメッキが熱処理され、引き続いて行われる溶接レーザーによる溶接においてメッキの剥がれを防止することができる。

【実施例】

【0019】

（実施例）

焼結式ニッケル正極と焼結式カドミウム負極を用いて上述のように電極体を作製し、この電極体にニッケル板を打ち抜いて作製した集電体を正負極ともに取り付けた。

次いで、鋼板素地の表面にニッケルをメッキした円筒形の後メッキ外装缶（鋼鉄素地厚み０．３５ｍｍ、ニッケルメッキ厚み２．０μｍのもの）を用意し、前記外装缶内に電極体を挿入した。なお、当該後メッキ外装缶には集電体との接続を確実とするため、缶底中心部に外装缶内面に突出する突起（直径２．５ｍｍ、高さ０．２ｍｍ）が設けられている。

そして、前記電極体の負極側集電体と前記外装缶が接続される前記突起に対して、前記外装缶の外部から熱処理のための熱処理レーザー照射（エネルギー密度；６．８Ｊ／ｍｍ^2、レーザー照射範囲；前記突起の中心から半径０．７５．ｍｍの円内、照射時間；２０ｍｓ）を行った。

熱処理レーザーを照射後、次に前記突起に対して溶接のための溶接レーザー照射（エネルギー密度；１２．７Ｊ／ｍｍ^2、レーザー照射範囲；前記突起の中心から半径０．５ｍｍの円内、照射時間；８ｍｓを３回）を行い、負極側集電体と外装缶を接続した。

その後、上述のアルカリ蓄電池の製法に従いＳＣサイズの密閉型アルカリ蓄電池を製造した。これを実施例電池とする。

【0020】

（比較例）

上記実施例電池の製造プロセスにおいて、熱処理のためのレーザー照射を行わなかった以外は同様にしてＳＣサイズの密閉型アルカリ蓄電池を製造した。これを比較例電池とする。

【0021】

（評価）

上記実施例電池および比較例電池のレーザー照射を受けた部分のメッキ状態を観察した。その状態を図２および図３に示す。なお、実施例電池が図２、比較例電池が図３である。

【0022】

比較例電池の図３においては、レーザー照射による溶接を行ったところ、溶接部周辺のメッキが剥がれ、浮いた状態になっていることが分かる（図中Ａ）。一方、当該部分に溶接の前に熱処理のレーザー照射を行った実施例電池の図２においては、比較例電池で見られたようなメッキの剥がれがなく、良好な状態を維持している。

【0023】

以上、本発明によれば溶接レーザーを照射する前に当該部分に熱処理レーザーを照射し熱処理を施すことにより、当該部分に発生するメッキの剥がれを防止することができる。また、熱処理を施す部分が外装缶の一部であるため、大部分の外装缶のメッキは熱影響を受けず、キズがつきにくいという特性を維持することができる。

【0024】

なお、本発明の実施の形態については、円筒形のアルカリ蓄電池に基づいて説明したが、本発明は何ら上記実施の形態に限定されるものでは無い。例えば、外形が角形の電池においても円筒形の場合と同様に本発明を適用することが可能である。

また、アルカリ蓄電池に限らず、後メッキ外装缶と集電体をレーザー照射により接続す

るのであれば、他種の電池、例えばリチウムイオン蓄電池に適用することも可能である。

【図面の簡単な説明】

【0025】

【図1】本発明に係るアルカリ蓄電池の断面図である。

【図2】実施例電池のレーザー照射部の状態を示す図である。

【図3】比較例電池のレーザー照射部の状態を示す図である。

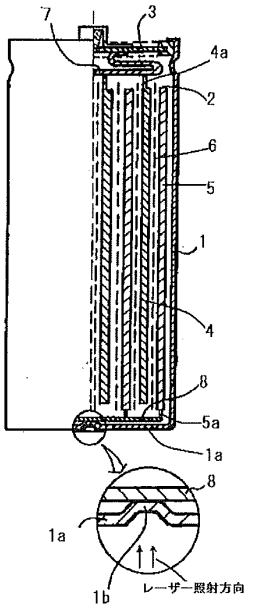
【符号の説明】

【0026】

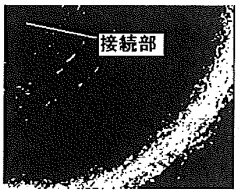
１・・・外装缶、２・・・電極体、３・・・封口蓋、４・・・正極、５・・・負極

６・・・セパレータ、７・・・正極側集電体、８・・・負極側集電体

【図1】



【図2】



【図3】

Ｆターム(参考) 5H043 AA07 BA15 CA03 CA12 DA03 DA14 EA35 EA39 GA31 HA17E
JA01D JA01E

(19)日本国特許庁（ＪＰ）　(12) 公開特許公報（A）　(11)特許出願公開番号
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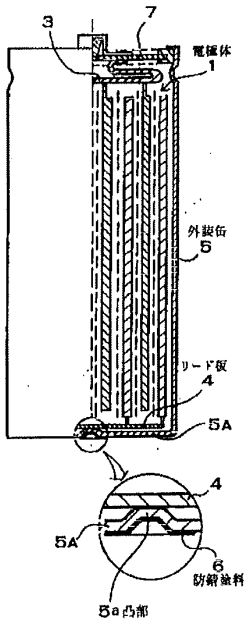
最終頁に続く

(54)【発明の名称】　電　池

(57)【要約】
【課題】　リード板を外装缶に確実に溶着する。
【解決手段】　電池は、筒状の外装缶５に電極体１を挿入しており、外装缶５に外側から照射されるエネルギービームで、電極体１に接続されたリード板３、４を、外装缶５の内面に溶着している。外装缶５に、内面に突出する凸部５ａを設けており、外装缶５の外側から凸部５ａにエネルギービームを照射して、凸部５ａの内面にリード板３、４を溶着している。



【特許請求の範囲】
【請求項１】　筒状の外装缶(5)に電極体(1)を挿入しており、外装缶(5)に外側から照射されるエネルギービームで、電極体(1)に接続されたリード板(4)を、外装缶(5)の内面に溶着してなる電池において、
外装缶(5)に、内面に突出する凸部(5a)を設けており、外装缶(5)の外側から凸部(5a)にエネルギービームを照射して、凸部(5a)の内面にリード板(4)を溶着してなることを特徴とする電池。
【請求項２】　外装缶(5)に設けた凸部(5a)の突出面が、中央凸に湾曲し、あるいは円錐状に突出している請求項１に記載される電池。
【請求項３】　リード板(4)に溝形に切り欠き(12)を設けて、切り欠き(12)の内側に弾性変形片(4A)を設けており、弾性変形片(4A)が外装缶(5)の凸部(5a)に溶着されてなる請求項１に記載される電池。
【請求項４】　弾性変形片(4A)が外装缶(5)の凸部(5a)に向かって突出している請求項３に記載される電池。
【請求項５】　外装缶(5)の外側であって、エネルギービームを照射した部分に防錆塗料(6)が付着されてなる請求項１に記載される電池。
【請求項６】　防錆塗料が導電性を有する請求項５に記載される電池。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、電極体に接続しているリード板を、外装缶の底板にレーザー等のエネルギービームで溶着している電池に関する。
【０００２】
【従来の技術】電極体に接続しているリード板を、外装缶の底板に溶着している従来の電池は、以下のようにして製造される。
①　正極板と負極板をセパレータを介して積層して渦巻状に捲回して電極体を製作する。捲回された電極体には、中心に溶接用電極棒を挿入するための中心孔が形成されている。
②　電極体を、有底円筒状の外装缶に挿入する。
③　電極体の底に接続されたリード板を、外装缶の底板に溶着して接続する。このリード板は、図１に示すように、電極体１の中心孔に溶接用電極棒２を挿入して、この電極棒２でリード板４を外装缶５の底板に押し付けて溶接される。
④　電極体１の上方に引き出されたリード板３を、外装缶５の開口部を閉塞する封口板の電極に接続し、外装缶に電解液を充填した後、封口板を外装缶の開口部に固定する。外装缶は、封口板で気密に密閉される。
【０００３】以上の工程は、電極体１に接続しているリード板４を、外装缶５の底板に確実に溶接して固定できる特長がある。しかしながら、この構造の電池は、電極体１の中心に、溶接用電極棒よりも太い外径の中心孔を設ける必要があるので、これによって、電極体の実質的な体積が小さくなり、電池の容量が少なくなる。電極体の中心孔を細くして、電池の容量を大きくすることも考えられるが、中心孔が細くなると溶接用電極棒を挿入できないという問題が生じる。
【０００４】この構造の電池の欠点を解消するために、リード板を外装缶の底板に、外部からレーザー溶接して接続する技術が開発されている（特開平４－１６２３５１号公報、特開平８－２９３２９９号公報）。これ等の公報に記載される電池は、溶接用電極棒を使用しないで、図２に示すように、外装缶５の底板５Ａに外側からレーザー等のエネルギービームを照射する。エネルギービームは、底板５Ａとリード板４の一部を溶融して、リード板４を底板５Ａに溶接して固定する。
【０００５】
【発明が解決しようとする課題】図２に示すように、外装缶の外部からレーザー光線等のエネルギービームを照射して、リード板を底板に溶着する電池は、電極体に中心孔を設ける必要がない。このため、電極体の実質体積を大きくして、電池の放電容量を大きくできる特長がある。しかしながら、前述したような外装缶の外方からリード板の溶着を行う電池は、リード板を確実に底板に溶着できないことがある。たとえば、電極体を外装缶に入れた状態で、リード板が底板から離れていると、外装缶の底板は溶融されるが、リード板が溶融されず、エネルギービームはリード板を底板に確実に溶着できない状態となる。また、リード板と底板との間に異物があっても、エネルギービームで確実に溶着できなくなる。とくに、この構造の電池は、リード板がどのような状態で、底板に溶着されているかどうか外部からわからず、品質の評価が難しいので、より確実に溶着することが極めて大切である。
【０００６】本発明は、この欠点を解決することを目的に開発されたものである。本発明の重要な目的は、リード板を外装缶に確実に溶着できる電池を提供することにある。
【０００７】
【課題を解決するための手段】本発明の電池は、筒状の外装缶５に電極体１を挿入している。外装缶５に外側から照射されるエネルギービームで、電極体１に接続されたリード板４は、外装缶５の内面に溶着されている。
【０００８】さらに、本発明の請求項１の電池は、外装缶５に、内面に突出する凸部５ａを設けており、外装缶５の外側から凸部５ａにエネルギービームを照射して、凸部５ａの内面にリード板４を溶着している。
【０００９】本発明の請求項２の電池は、外装缶５に設けた凸部５ａの突出面を、中央凸に湾曲させ、あるいは円錐状に突出させる形状としている。
【００１０】本発明の請求項３の電池は、リード板４に溝形に切り欠き１２を設けて、切り欠き１２の内側に弾

性変形片４Ａを設けている。この弾性変形片４Ａが、外装缶５の凸部５ａに溶着されている。

【００１１】本発明の請求項４の電池は、弾性変形片４Ａを、外装缶５の凸部５ａに向かって突出させている。

【００１２】本発明の請求項５の電池は、外装缶５の外側であって、エネルギービームを照射した部分に、防錆塗料６を付着している。請求項６の電池は、防錆塗料６に導電性のあるものを使用している。

【００１３】

【発明の実施の形態】以下、本発明の実施例を図面に基づいて説明する。ただし、以下に示す実施例は、本発明の技術思想を具体化するための電池を例示するものであって、本発明は電池を以下のものに特定しない。

【００１４】さらに、この明細書は、特許請求の範囲を理解しやすいように、実施例に示される部材に対応する番号を、「特許請求の範囲の欄」、および「課題を解決するための手段の欄」に示される部材に付記している。ただ、特許請求の範囲に示される部材を、実施例の部材に特定するものでは決してない。

【００１５】図３に示す電池は、ニッケル－水素電池、ニッケル－カドミウム電池、リチウムイオン電池等の二次電池であって、円筒状の外装缶５と、この外装缶５に挿入している電極体１と、電極体１を外装缶５に接続するリード板３、４とを備える。図に示す電池は、外装缶を円筒状としているが、本発明は、電池の外装缶を円筒状に特定しない。外装缶は、図示しないが、たとえば、四角筒状ないし楕円筒状とすることもできる。

【００１６】外装缶５は鉄製で、その表面をニッケルメッキしている。外装缶５の材質は、電池の種類と特性を考慮して最適な金属が選択される。外装缶５は、例えば、ステンレス、アルミニウム、アルミニウム合金製とすることもある。金属製の外装缶５は、上端の開口部を、封口板７で気密に密閉している。図の封口板７は、外装缶５をかしめる構造で、外装缶に絶縁して固定されている。封口板は、レーザー溶接する等の方法で外装缶に気密に固定することもできる。この構造の封口板は、絶縁して電極を固定する。封口板７は電池の一方の電極を固定している。

【００１７】外装缶５は、リード板４を溶接して固定する部分に、図３と図４に示すように、凸部５ａを設けている。図に示す電池は、外装缶の底板５Ａに凸部５ａを設けて、この凸部５ａにリード板４を溶着している。外装缶５は、図６の底面図に示すように、底板５Ａの中心に凸部５ａを設けている。ここに凸部５ａを設けている外装缶５は、レーザー溶接のようなエネルギービームでリード板４を溶着する位置を、簡単に、しかも正確に位置決めできる特長がある。外装缶５がどの姿勢に回転していても、エネルギービームでリード板４を溶着する位置が変化しないからである。ただ、凸部は、必ずしも底板の中心に設ける必要はない。また、凸部は、外装缶の底板に設ける必要もなく、たとえば、図７に示すように、外装缶５の周壁に設けることもできる。ただ、凸部をどの位置に設けても、リード板４は凸部５ａに溶着される。

【００１８】凸部５ａの外径は、溶着する面積を考慮して最適値に設計される。凸部の外径を小さくすると、凸部の先端を確実にリード板に溶着できる。しかしながら、凸部の外径が小さすぎると、リード板と外装缶との溶着面積が小さくなる。

【００１９】凸部５ａを外装缶５の内面に高く突出させることは、凸部５ａとリード板４の溶着状態を向上させる。ただ、凸部５ａを高く突出させることは、外装缶５に挿入される電極体１を押し上げることになる。このため、電極体の高さを低くする必要があって、電極体の実質的な容量を減少させる。

【００２０】凸部５ａは、図４の断面図に示すように、突出面を中央凸に湾曲する形状とし、あるいは、図５に示すように、円錐状に突出する形状とする。凸部５ａの突出面をこの形状とする電池は、リード板４を隙間なく凸部５ａに接触させて、リード板４と凸部５ａとをより確実に溶着できる特長がある。ただ、凸部５ａは突出面を平面状とすることもできる。

【００２１】電極体１は、正極板と負極板を、セパレータを介して積層している。図３に示す電池は、セパレータを介して互いに積層された正極板と負極板を捲回している。渦巻状の電極体１は、円筒状の外装缶５に挿入される。渦巻状の電極体１は、両側からプレスして楕円形に変形させて、楕円形または角形の外装缶に挿入することができる。さらに、角筒状の外装缶に挿入される電極体は、板状に裁断された複数枚の正極板と負極板を、セパレータを介して積層して製作することもできる。

【００２２】電極体１は、正極板と負極板にリード板３、４を接続している。リード板３、４は、電極体１の上下に配設されて、正極板と負極板とに接続される。電極体１は、図３に示すように、正極板と負極板の芯体を上下に突出させて、突出部をリード板３、４に接続している。図の電極体１は、下方に配設しているリード板４を外装缶５に接続している。電極体１の上方に配設されるリード板３は、封口板７に接続している。

【００２３】電極体１の上下に接続されるリード板３、４は、図８と図９に示すように、金属板を外装缶５の内形よりも小さい円板状に切断したものである。電極体１の上面に接続されるリード板３は、図９に示すように、外周からリード片３Ａを突出させている。リード片３Ａは、外装缶５の開口部に絶縁して固定される封口板７に接続される。図９に示す形状のリード板３は、電極体の下面を外装缶の側面に接続するのにも使用できる。

【００２４】この構造のリード板３、４は、図１１の断面図に示すように、溶接用の電極８を介して電極体１に押圧されて、抵抗電気溶接して確実に接続される。図８

と図９に示すリード板３、４は、確実に電極体１の電極に電気接続するために、複数の貫通孔９を開口している。リード板３、４に設けた貫通孔９は、図１０の拡大断面図に示すように、その周縁に、下方に突出する突起１０を設けている。突起１０は電極体の電極板に接続させる。さらに、電極体１の上部に接続するリード板３は、図９に示すように、抵抗電気溶接するときの無効電流を少なくするために、中心孔１１の両側にスリット１３を設けている。

【００２５】電極体１の下面に連結されるリード板４は、図８に示すように、溝形の切り欠き１２を設けて、切り欠き１２の内側に弾性変形片４Ａを設けている。弾性変形片４Ａは、外装缶５の凸部５ａに向かって突出している。弾性変形片４Ａは、リード板３、４のほぼ中央にあって、外装缶５の凸部５ａに溶着される。

【００２６】この構造の電池は、リード板３、４を複数部分で電極体１に接続できるので、大電流特性に優れている。内部抵抗を小さくできるからである。さらに、この構造の電池は、エネルギービームでリード板４を確実に底板５Ａに溶着できる特長もある。それは、電極体１を外装缶５に挿入して、リード板４を外装缶の底板５Ａの内面に密着できるからである。

【００２７】ただ、本発明の電池は、電極体を外装缶に接続するリード板を、以上の構造に特定しない。リード板は、たとえば、図１２に示すように、帯状とすることもできる。このリード板４は、極板の芯体露出部に接続して、電極体１の下方に導出させて、端部を外装缶５の内面に溶着する。また、この構造のリード板４は、図７に示すように、電極体１の側部に導出して、外装缶５の側面に溶着することもできる。

【００２８】リード板４は、外装缶５の内面に溶着される。リード板４を溶着する方法としてはレーザービームや電子ビーム等のエネルギービームを使用する。エネルギービームは、外装缶５とリード板４の両方を溶融して、リード板４を外装缶５に溶着する。

【００２９】レーザービームは、図５に示すように、凸部５ａの全体を含む広い領域に照射して、外装缶５とリード板４を溶着する。

【００３０】外装缶５の外面に、レーザー等のエネルギービームを照射すると、外装缶５の表面に付着している耐腐性金属のメッキの効果がなくなる。このため、エネルギービームを照射した部分が腐食しやすくなる。この弊害は、エネルギービームを照射した部分に、図３の要部拡大断面図に示すように、防錆塗料６を塗布して解消できる。外装缶５の底面に防錆塗料６を塗布すると、電池を使用するときに、防錆塗料６が原因で接触不良を起こすことがある。防錆塗料６には、導電性のない有機系の塗料が使用されるからである。この弊害は、防錆塗料６にカーボンや金属粉等の導電材を混合して解消できる。

【００３１】防錆塗料は、霧状にスプレーして塗布し、あるいは、刷毛を使用して塗布できる。さらに、防錆塗料は、細いノズルから噴射するインクジェット方式で塗布することもできる。インクジェット方式は、エネルギービームを照射した正確な位置に正確な厚さに塗布できる特長がある。さらに、防錆塗料は、電池の外装缶に、製造年月日や使用年月日をインクジェットで印刷するときに、一緒に塗布することもできる。

【００３２】

【実施例】［実施例１］以下の工程でニッケル－カドミウム電池を製造して、リード板が外装缶に接続される状態をテストした。外装缶には、図４に示すように、底面の中央に凸部５ａを設けたものを使用した。凸部５ａは、突出面を中央凸に湾曲させる形状とした。凸部５ａの外径は約２ｍｍ、突出高さを０．２ｍｍ、突出面の曲率半径を１５ｍｍとした。

【００３３】電極体１の底面に接続するリード板４は、図８に示すように、弾性変形片４Ａを設けた形状のものを使用した。弾性変形片４Ａは、約０．２ｍｍ突出させたものを使用した。

【００３４】この構造の外装缶５に、セパレータを介して渦巻き状に巻き取られた電極体であって、両端にリード板３、４を溶着したものを挿入した。リード板３、４には、多数の貫通孔９があり、貫通孔９の周縁に突起１０を設けたものを使用した。外装缶に電極体を挿入し、外装缶の底面に設けた凸部５ａによる凹部にレーザーを照射して、リード板４を外装缶５に溶着した。この外装缶底面外表面のレーザー溶接部分に塗料として株式会社日立製作所の「ＪＰ－Ｋ２８」を塗布した。電極体の上面に接続しているリード板３を封口板７に溶着した後、電解液を注液して、封口板７で外装缶５の開口部を閉塞してニッケル－カドミウム電池を作製した。

【００３５】［実施例２］電極体の下面に接続するリード板に、弾性変形片のないものを使用する以外、実施例１と同じようにして、ニッケル－カドミウム電池を試作した。この電池のリード板は、外装缶に溶着する部分を平面状とした。

【００３６】［比較例］外装缶の底面に凸部を設けない以外、実施例１と同様にしてニッケル－カドミウム電池を試作した。

【００３７】以上のようにして試作した電池のリード板と外装缶の溶着成功率を比較すると以下のようになった。

実施例１の電池…１００％
実施例２の電池……９８％
比較例の電池……９７％

【００３８】以上の試験結果から、本発明の実施例１と実施例２の電池は、リード板と外装缶とが確実に接続された。とくに、実施例１の電池は、リード板と外装缶の溶着不良が皆無になった。

【００３９】

【発明の効果】本発明の電池は、リード板を確実に外装缶に溶着できる特長がある。それは、本発明の電池が、外装缶に凸部を設けて、この凸部にリード板を溶着しているからである。凸部を設けた外装缶は、凸部を確実にリード板に接触できる。このため、凸部に向かってレーザー等のエネルギービームを照射することにより、外装缶をリード板に確実に溶着できる特長がある。とくに、リード板と外装缶とを確実に接触して溶着できる本発明の電池は、衝撃を受けたときにリード板が外装缶が離れるのも確実に防止できる特長がある。

【００４０】本発明の請求項２電池は、凸部の突出面を中央凸に湾曲させ、あるいは、円錐状に突出させているので、凸部をさらに好ましい状態でリード板に接触させて溶着できる。このため、リード板と外装缶との接続状態をさらに改善できる特長がある。

【００４１】さらに、本発明の請求項３の電池は、リード板に弾性変形片を設けて、この弾性変形片を外装缶の凸部に溶着し、さらに、請求項４の電池は、弾性変形片を外装缶の凸部に向かって突出させているので、リード板と外装缶との接続をさらに向上できる特長がある。

【００４２】また、本発明の請求項５の電池は、外装缶の外側であって、エネルギービームを照射した部分に導電性の防錆塗料が付着しているので、エネルギービームを照射した部分が錆るのを有効に阻止できると共に、防錆塗料による接触不良を解消できる特長がある。

【図面の簡単な説明】

【図１】従来の電池の製造方法を示す断面図

【図２】従来の電池の製造方法を示す断面図

【図３】本発明の実施例にかかる電池の断面図

【図４】図３に示す電池の外装缶の底部を示す断面図

【図５】本発明の他の実施例にかかる電池の外装缶の底部を示す断面図

【図６】図４に示す外装缶の底面図

【図７】本発明の他の実施例にかかる電池の底部を示す断面図

【図８】図３に示す電池の底部に内蔵されるリード板を示す平面図

【図９】図３に示す電池の上部に内蔵されるリード板を示す平面図

【図１０】リード板の拡大断面図

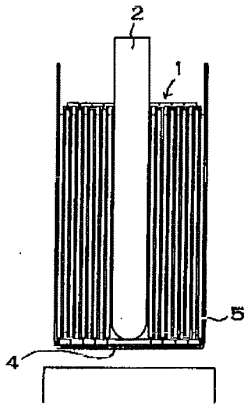
【図１１】電極体をリード板に溶着する状態を示す断面図

【図１２】本発明の電池に内蔵される他の構造のリード板を示す正面図

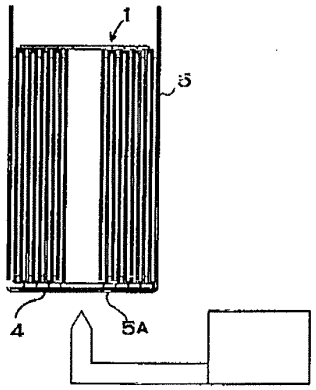
【符号の説明】

1…電極体
2…溶性用電極棒
3…リード板（上のリード板）　３A…リード片
4…リード板（下のリード板）　４A…弾性変形片
5…外装缶　５A…底板　５a…凸部
6…防錆塗料
7…封口板
8…溶接用の電極
9…貫通孔
１0…突起
１1…中心孔
１2…切り欠き
１3…スリット

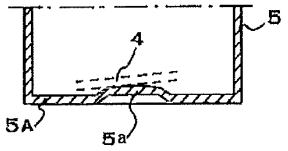
【図１】



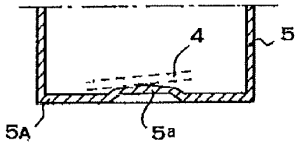
【図２】



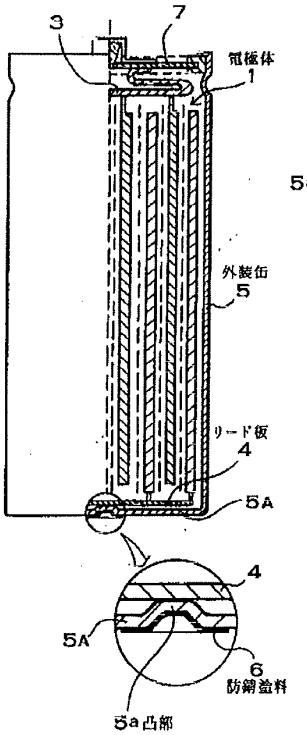
【図４】



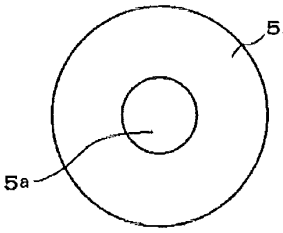
【図５】



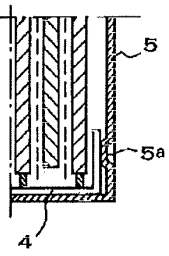
【図3】



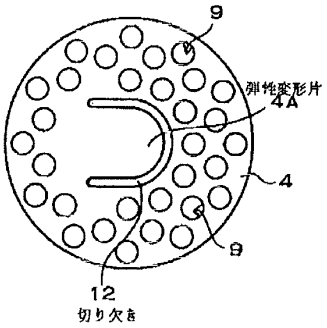
【図6】



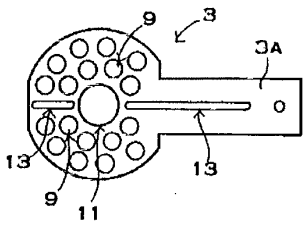
【図7】



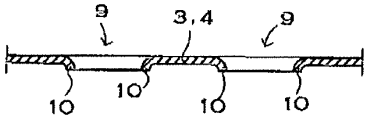
【図8】



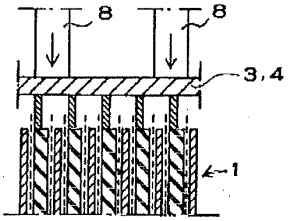
【図9】



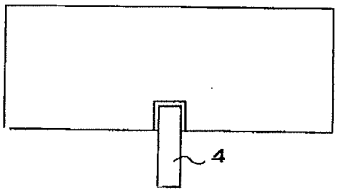
【図10】



【図11】



【図12】



フロントページの続き

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I. DESCRIPTION JP 2002-352789

The present invention relates to relates to a secondary battery, in particular, the battery can made of metal having an open end, and an electrolytic solution electrode group having a separator and the positive and negative electrodes are housed, said open end secondary battery, which is sealed with a metal lid.

In recent years, in the field of rechargeable secondary battery, lead-acid battery, nickel - cadmium batteries, nickel - aqueous solution of hydrogen based battery cells and the like was the mainstream.

However, miniaturization of the electric equipment, weight progresses, secondary batteries having high energy density is of interest, that study, the development and commercialization have led to proceed rapidly.

In addition, the problem of fuel depletion and global warming, hybrid electric vehicles and electric vehicles have been developed by automobile manufacturers, secondary battery of high capacity is also required by the power supply.

Of such a secondary battery, for example, as shown in FIG 2, a cylindrical bottomed battery case 23 made of metal having an open end upward, the cylindrical battery, a hollow cylindrical winding synthetic resin electrode assembly 22 are wound through a separator the anode and cathode about the axis 24 is inserted.

The lower end of the electrode 22 group, one of the positive and negative contrast collector plate 25 the convex portion is formed on the battery case 23 side to the central current collector tabs which are derived from are joined by ultrasonic welding (negative normally) But it has been fixed.

Where the inner bottom surface of the battery can 23 and the protrusion 25 of the collector plate is in contact, is fixed by resistance welding for joining with heat generated by electrical resistance current is supplied.

In order to join by resistance welding, it is necessary to supply a current to the joint, is inserted a cylindrical electrode rod 20 by using a winding shaft hole 21 of the winding axis 24, collecting the tip of the electrode rod 20 comprising contacting the recess of the collector plate 25, is sandwiched between the another electrode (not shown) with the electrode rod 20 a joint, and a current flows.

However, problems to be solved by the invention, the resistance welding described above, and a winding shaft hole 21 is required for the electrode assembly 22 for inserting the electrode rod 20.

In the case of cylindrical secondary batteries, can be utilized winding shaft hole 21, in the case of prismatic type secondary battery, tabular thin with a separator interposed positive and negative electrodes without the Kai-jiku 24 winding hollow cylinder electrode group because it is made by winding around the winding axis of, making a winding shaft hole for inserting the electrode rod 20 is difficult.

Further, in order to improve the volumetric efficiency of the battery, the case of a flat crushing electrode group, the electrode group since the close contact, making a winding shaft hole for inserting the electrode rod 20 is difficult.

The present invention aims the light of these circumstances, to provide a secondary battery excellent in volumetric efficiency winding shaft hole is unnecessary.

In order to solve the above problems, according to one aspect of the present invention, the battery can made of metal having an open end, an electrolyte and electrode assembly having a separator and positive and negative electrodes are housed, the present invention, the In the secondary battery in which the open end is sealed by the upper cover of the metal in the battery can through the collector plates, one of which is fixed by laser welding from the outside of the battery can any of the positive and negative electrode of the electrode group and is characterized in that it is.

In the present invention, that the battery can, and is fixed by laser welding of the battery can outwardly through the collector plate to one of the positive and negative electrodes of the electrode group, the electrode group was necessary when fixed by resistance welding winding shaft hole becomes unnecessary, it is possible to provide a secondary battery excellent in volumetric efficiency without the winding shaft hole.

By in this case, in the same manner as the laser welding, the rear surface of the current collector plate that is welded with the convex portion formed on the inner bottom surface of the battery can, and current collecting tabs derived from one of the positive and negative electrodes , it can be closely fixed to the convex portion and the back surface of the current collector plate in the form of a flat plate.

Further, by forming by causing projections on the open end side of the bottom of the battery can convex portion, can be formed the same as the thickness of the battery can and the thickness of the convex portion, the efficiency of the laser emitted from the battery can outside It can be utilized better.

BEST MODE FOR CARRYING OUT THE INVENTION Hereinafter, with reference to the drawings, will be described embodiment applied to the secondary battery prismatic lithium mounted a hybrid electric vehicle (HEV) the present invention.

As shown in (A) and (B) FIG 1, the rectangular battery can 8 made of metal having an open end upward, the secondary battery 10 prismatic lithium present exemplary embodiment, the Kai-jiku 7 winding tabular electrode group 9 are wound around the winding 7 Kai-ban resin via a separator around positive and negative electrodes is inserted.

The battery can 8 is assembled into a box shape by laser welding a nickel-plated steel plate of 0.5mm thickness, the convex portion 8a having a substantially circular shape to the projections on the open end side by the draw processing to the inner bottom surface of the central portion and is formed as.

Therefore, a recessed portion is formed corresponding to the convex portion 8a is the outer bottom surface of the battery can 8 of the convex portion 8a.

The upper surface of the convex portion 8a is planar, the height almost equal to the thickness of the nickel plated steel battery case 8, about one fifth of the width of the longitudinal direction of the battery can 8, width battery can length It is about one-half of the thickness of approximately 8.

Lithium manganate 10μm in ($LiMn_2O_4$), and carbon powder 3μm, the average particle size was added to polyvinylidene fluoride and vinylidene as a binder, the positive electrode, fabricated dispersed in N-methyl-2-pyrrolidone solvent having an average particle size and in which was coated on an aluminum foil both sides of 20μm thick slurry that was, it was dried, and then are pressed and integrated, was obtained by cutting.

The positive electrode, one side is cut the width of the coating portion so as to have 94mm, the positive electrode current collector tab 5 is formed by being cut in a rectangular shape and the other side.

The negative electrode is coated on a copper foil both sides of 10μm thickness, a slurry of carbon particles of 20μm, the average particle size was added and polyvinylidene fluoride as a binder, and fabricated by being dispersed in N-methyl-2-pyrrolidone as a solvent It is intended After, it was dried, and are pressed and integrated, was obtained by cutting.

The negative electrode, one side is cut the width of the coating portion so as to have 94.5mm, the negative electrode current collector tab 6 is formed by being cut in a rectangular shape and the other side.

The separator to prevent contact of the anode and cathode, 25μm thickness that allows the passage of lithium ions, microporous polyethylene membrane of 100mm wide are used.

The Mekumawaita 7, a polypropylene 2mm in thickness, width 60mm, 105mm in height, the lower end is welded to the vertical direction in the central portion of the anode current collector plate 2 made of nickel with a rectangular flat plate.

The upper surface of the second negative electrode current collector plate. and is ultrasonically welded negative electrode current collector tab 6 is gathered.

The back surface portion of the part that is joined to the protruding portion 8a of the second negative electrode current collector plate is a planar negative electrode current collector tab 6 is not ultrasonically welded, 6 itself the negative electrode current collector tab was cut.

The negative current collector plate 2 and the convex portions 8a, and is welded by YAG laser from the bottom surface outside of the battery case 8 in a state where the negative current collector plate 2 is pressed against the convex portion 8a.

Using the lens of focal length 160mm to the YAG laser, the output 15Hz, of 170W, at 4mm / s feed rates, three muscles of 5mm in length is formed at the junction.

On the other hand, the upper end of Mekumawaita 7 is welded perpendicularly to the central portion of one positive electrode current collector plate made of aluminum with a rectangular flat plate.

The lower surface of the one positive electrode current collector plate, and is ultrasonically welded positive current collector tab 5 is gathered.

Further, the central portion of the upper surface of the one positive electrode current collector plate, one end of the 14 positive electrode lead piece bent to shape an aluminum flat plate is substantially dog is welded.

The central portion of the top cover plate 15 of the plate-shaped nickel-plated steel, the circular hole of the positive electrode terminal for are formed.

The circular hole, the hollow Liberation head To through a packing 12 to insulate the top cover plate 15 and the hollow rivet 11 and 13 receiving plate annular nickel-plated iron for connection to the positive electrode lead piece 14 11 is caulked.

Of EPDM rubber valve 16 that is in contact placed on the head of the hollow Liberation head To 11 is covered by the positive electrode terminal cap 17 of the U-shaped cross section is compressed, hollow and Li flange portion of the positive terminal cap 17 the positive terminal is made the head unformatted 11 should is resistance welding.

It has been resistance welding after caulking of the hollow rivet 11 and the plate 13 receiving the lower end of the hollow Liberation head To 11, the other end of the 14 positive electrode lead plate, the electrical resistance is lowered is resistance-welded to the bottom surface of the plate 13 receiving have.

Also, injection port of the screw plug 18 is screwed is formed in the upper cover plate 15.

Board determines for a step is formed in the outer peripheral portion of the top cover 15 plate, and is sealed by laser welding from the side of the battery can 8 dropped into the battery can 8 side.

The non-aqueous electrolyte solution (not shown) the battery can 8 is a predetermined amount of injection, the secondary battery 10 prismatic lithium is produced.

In the present exemplary embodiment, by laser welding, the convex portion 8a and the negative current collector plate 2, is joined by the bottom surface outside of the battery case 8, the winding shaft hole is not required in the electrode group 9, and excellent volumetric efficiency it is possible to obtain a secondary battery.

In particular, it is suitable for the welding of the bottom of the battery can of the battery 8 for the purpose of improving the volumetric efficiency is thin.

Since is almost equal to the height of the protruding portion 8a of the thickness of the nickel plated steel battery case 8, it is effective for the volumetric efficiency of the battery.

Further, in the present exemplary embodiment, the inner central portion of the bottom surface of the battery can 8, the convex portion 8a is formed, because the upper surface of the convex portion 8a is flat, the negative current collector plate 2 on the upper surface of the convex portion 8a When the laser welding in a state of being pressed, and can be closely fixed to the upper surface of the convex portion 8a, and a rear surface of the second negative electrode current collector plate to the negative electrode current collector tab 6 is ultrasonically welded.

The negative electrode current collector tab 6 has not been welded to the surface portion is joined to the protruding portion 8a of the second negative electrode current collector plate, the pattern of the welding jig is transferred to the negative electrode current collector plate 2 ultrasonic welding it is possible to prevent the laser welding failure between the convex portion 8a and the negative electrode current collector plate 2 by.

Furthermore, since in the present exemplary embodiment, to form the convex portion 8a such that the projections on the open end side of the inner central portion of the bottom surface of the battery can 8 in drawing process, the thickness of the battery can 8 the thickness of the convex portion 8a It is possible to also, when laser welding from the outside bottom surface of the battery can 8, it can be efficiently irradiated with a laser.

In the present exemplary embodiment, an example of forming the convex portion 8a of the one place circular shape on the inner bottom surface of the central portion of the battery can 8, the shape and number of portions of the convex portion 8a is not limited thereto , it may be a projection of the substantially rectangular shape or form of the projections on the plurality of positions.

Further, in the present exemplary embodiment, when laser welding the anode current collector plate 2 on the convex portion 8a, and an example of using the YAG laser, but is not limited to this type of laser Ya carbon dioxide gas it is possible to use a laser of various excimer laser.

Is also shown the preferred frequency, feed rates, the length of the laser welding, the muscle shape and muscle number of laser welding YAG laser, but is not limited to the shape or the numbers thereof, the laser used it is sufficient to change accordingly.

Further, it is also possible to such curved or polygonal line may streaks shape of the laser welding.

As described in the foregoing, according to the present invention, since the battery can be fixed by laser welding of the battery can outwardly through the collector plate to one of the positive and negative electrodes of the electrode group, the resistance it is possible to obtain the effect of the axial hole and the winding of the electrode group was necessary when fixing by welding is not required, thereby it can provide a secondary battery excellent in volumetric efficiency without the winding shaft hole.

II. CLAIMS JP 2002-352789

In the secondary battery in the battery can made of metal having an open end, an electrolyte and electrode assembly having a separator and positive and negative electrodes are housed, the open end is sealed by the upper cover of the metal, the positive of the electrode group The secondary battery is characterized in that the battery can through the collector plates, one of which is fixed by laser welding from the outside of the battery can any of the negative electrode.

The collector plate is welded current collecting tabs derived from one of the positive and negative electrodes, a current collector plate that is welded, wherein the current collector tabs and the convex portion formed on the inner bottom surface of the battery can The secondary battery as claimed in claim 1, characterized in that the back surface is laser welded.

The protrusion A secondary battery according to claim 1 or 2, characterized in that it is formed by causing the convex open end side bottom of the battery can.

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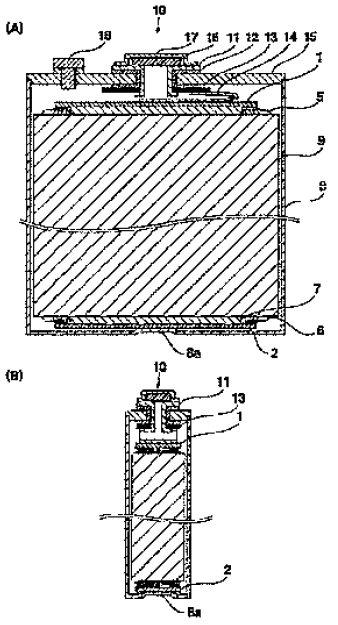
CC16 CC19 CC21

(54)【発明の名称】　二次電池

(57)【要約】
【課題】　捲回軸穴が不要で体積効率に優れた二次電池を提供する。
【解決手段】　捲回板７は下端が負極集電板２に溶着されている。負極集電板２の上面には集電タブ６が超音波溶接されている。負極集電板２と凸部８ａとが押しつけられた状態で電池缶８の底面外側からＹＡＧレーザで溶接され固定されている。



【特許請求の範囲】
【請求項１】　開放端を有する金属製の電池缶内に、正負極及びセパレータを有する電極群と電解液とが収容され、前記開放端が金属製の上蓋で封口された二次電池において、前記電極群の正負極のいずれか一方が集電板を介して前記電池缶に、前記電池缶の外側からのレーザ溶接で固定されていることを特徴とする二次電池。
【請求項２】　前記集電板は前記正負極のいずれか一方から導出された集電タブが溶接されており、前記電池缶の内底面に形成された凸部と前記集電タブが溶接された集電板の裏面とがレーザ溶接されていることを特徴とする請求項１に記載の二次電池。
【請求項３】　前記凸部は前記電池缶の底部を前記開放端側に凸起させて形成されていることを特徴とする請求項１又は請求項２に記載の二次電池。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は二次電池に係り、特に、開放端を有する金属製の電池缶内に、正負極及びセパレータを有する電極群と電解液とが収容され、前記開放端が金属製の上蓋で封口された二次電池に関する。
【０００２】
【従来の技術】近年、再充電可能な二次電池の分野では、鉛電池、ニッケル－カドミウム電池、ニッケル－水素電池等の水溶液系電池が主流であった。しかしながら、電気機器の小型化、軽量化が進むにつれ、高エネルギー密度を有する二次電池が着目され、その研究、開発及び商品化が急速に進められるに至っている。また、地球温暖化や枯渇燃料の問題から、電気自動車やハイブリッド電気自動車が各自動車メーカーで開発され、その電源用により高容量の二次電池も求められている。
【０００３】このような二次電池のうち、例えば円筒型電池は、図２に示すように、上方に開放端を有する金属製の円筒状有底電池缶２３内に、合成樹脂製で中空円筒状捲回軸２４の周りに正極及び負極をセパレータを介して捲回した電極群２２が挿入されている。電極群２２の下端には、正負極のいずれか一方（通常は負極）から導出された集電タブが超音波溶接で接合され中央に電池缶２３側に凸部が形成された集電板２５が固定されている。集電板２５の凸部と電池缶２３の内底面とが接触した箇所は、電流が通電され電気抵抗により発生する熱で接合する抵抗溶接によって固定されている。抵抗溶接で接合するためには、接合箇所に電流を流す必要があるので、捲回軸２４内の捲回軸穴２１を利用して円柱状電極棒２０を差し込み、電極棒２０の先端を集電板２５の凹部に接触させて、接合箇所を電極棒２０と図示しない別の電極とで挟み、電流を流している。
【０００４】
【発明が解決しようとする課題】しかしながら、上述した抵抗溶接では、電極棒２０を差し込むために電極群２２に捲回軸穴２１が必要となる。円筒型二次電池の場合は、捲回軸穴２１を利用できるが、角型二次電池の場合は、中空円筒状捲回軸２４を使用せずに正負極をセパレータを介して薄い平板状の捲回軸の周りに捲回して電極群が作製されているので、電極棒２０を差し込むために捲回軸穴を作製することは難しい。
【０００５】また、電池の体積効率を向上させるために、電極群を押し潰し扁平状とする場合には、電極群は密着しているので、電極棒２０を差し込むために捲回軸穴を作製することは困難である。
【０００６】本発明は、上記事案に鑑み、捲回軸穴が不要で体積効率に優れた二次電池を提供することを課題とする。
【０００７】
【課題を解決するための手段】上記課題を解決するために、本発明は、開放端を有する金属製の電池缶内に、正負極及びセパレータを有する電極群と電解液とが収容され、前記開放端が金属製の上蓋で封口された二次電池において、前記電極群の正負極のいずれか一方が集電板を介して前記電池缶に、前記電池缶の外側からのレーザ溶接で固定されていることを特徴とする。
【０００８】本発明では、電極群の正負極のいずれか一方を集電板を介して電池缶に、電池缶外側からレーザ溶接で固定することで、抵抗溶接で固定するときに必要であった電極群の捲回軸穴が不要となるので、捲回軸穴のない体積効率に優れた二次電池を提供することができる。
【０００９】この場合に、電池缶の内底面に形成された凸部と、正負極のいずれか一方から導出された集電タブが溶接された集電板の裏面と、をレーザ溶接するようにすることで、平板状の集電板の裏面と凸部とを密着固定させることができる。また、凸部を電池缶の底部を開放端側に凸起させて形成することで、凸部の厚さを電池缶の厚さと同一に形成できるので、電池缶外側から照射されるレーザを効率よく利用することができる。
【００１０】
【発明の実施の形態】以下、図面を参照して、本発明をハイブリッド電気自動車（ＨＥＶ）に搭載される角型リチウム二次電池に適用した実施の形態について説明する。
【００１１】図１（Ａ）（Ｂ）に示すように、本実施形態の角型リチウム二次電池１０は、上方に開放端を有する金属製の角型電池缶８内に、平板状捲回軸７の周りに正負極をセパレータを介して樹脂製の捲回板７の廻りに捲回した電極群９が挿入されている。電池缶８は、厚さ０．５ｍｍのニッケルメッキ鋼板をレーザ溶接することで箱状に組み立てられ、内底面中央部には絞り加工により略円形状の凸部８ａが開放端側に凸起するように形成されている。このため、凸部８ａの電池缶８の外底面は凸部８ａに対応して凹部が形成されている。この凸部８

aの上面は平面状で、高さは電池缶8のニッケルメッキ鋼板の厚さとほぼ同程度、幅は電池缶8の長手方向の幅の5分の1程度、長さは電池缶8の厚さのほぼ2分の1程度とされている。

【0012】正極は、平均粒径が10μmのマンガン酸リチウム（$LiMn_2O_4$）に、平均粒径が3μmの炭素粉末と、結着剤としてポリフッ化ビリニデンとを添加し、溶媒のNメチル2ピロリドンに分散させて製作したスラリを、厚さ20μmのアルミニウム箔両面に塗布し、乾燥させた後、プレスして一体化し、裁断して得られたものである。正極は、塗布部の幅が94mmになるように一側が切断されており、他側は矩形状に切り欠かれて正極集電タブ5が形成されている。

【0013】負極は、平均粒径が20μmの炭素粒子に、結着剤としてポリフッ化ビニリデンを添加し、溶媒であるNメチル2ピロリドンに分散させて製作したスラリを、厚さが10μmの銅箔両面に塗布し、乾燥させた後、プレスして一体化し、裁断して得られたものである。負極は、塗布部の幅が94．5mmになるように一側が切断されており、他側は矩形状に切り欠かれて負極集電タブ6が形成されている。

【0014】正極及び負極の接触を防止するセパレータには、リチウムイオンの通過を許容する厚さ25μm、幅100mmのポリエチレン製微多孔膜が用いられている。

【0015】捲回板7は、厚さ2mm、幅60mm、高さ105mmのポリプロピレン製で、下端が矩形平板状でニッケル製の負極集電板2の中央部に垂直方向に溶着されている。負極集電板2の上面には、負極集電タブ6がまとめられて超音波溶接されている。なお、負極集電板2の凸部8aに接合される部分の裏面部分は、負極集電タブ6が超音波溶接されておらず、負極集電タブ6自体が切り取られた平面状である。凸部8aと負極集電板2とは、凸部8aに負極集電板2が押しつけられる状態で電池缶8の底面外側からYAGレーザで溶接されている。YAGレーザには焦点距離160mmのレンズを使用し、15Hz、170Wの出力により、送り速さ4mm/秒で、長さ5mmの3筋が接合部に形成されている。

【0016】一方、捲回板7の上端は、矩形平板状でアルミニウム製の正極集電板1の中央部に垂直に溶着されている。正極集電板1の下面には、正極集電タブ5がまとめられて超音波溶接されている。また、正極集電板1の上面中央部には、アルミニウム製平板が略く字状に折り曲げられた正極リード片14の一端が溶接されている。

【0017】鉄にニッケルメッキが施された平板状の上蓋板15の中央部には、正極端子用の円形孔が形成されている。この円形孔には、正極リード片14との接続用で鉄にニッケルメッキが施された環状受け板13及び中空リベット11と上蓋板15とを絶縁するパッキン12を介して中空リベット11がカシメられている。中空リベット11の頭部に当接載置されたEPDM製ゴム弁16が、圧縮されて断面ハット状の正極端子キャップ17で覆われており、正極端子キャップ17の鍔部と中空リベット11の頭部とが抵抗溶接されて正極端子が作製されている。中空リベット11の下端と受け板13とは中空リベット11のカシメ後に抵抗溶接されており、正極リード板14の他端は、受け板13の底面に抵抗溶接され電気抵抗が下げられている。また、上蓋板15にはねじ栓18が螺着される注液口が形成されている。上蓋板15の外周部には板決用段差が形成されており、電池缶8側に落とし込んだ電池缶8の側面からレーザ溶接することで封口されている。なお、電池缶8内には図示しない非水電解液が所定量注入されて、角型リチウム二次電池10が作製されている。

【0018】本実施形態では、電池缶8の底面外側からレーザ溶接により、負極集電板2と凸部8aとが接合されているので、電極群9に捲回軸穴が不要となり、体積効率の優れた二次電池を得ることができる。特に、薄型で体積効率の向上を目的とした電池の電池缶8の底面の溶接に好適である。凸部8aの高さは電池缶8のニッケルメッキ鋼板の厚さとほぼ同程度であるので、電池の体積効率向上のために効果的である。

【0019】また、本実施形態では、電池缶8の内底面中央部に、凸部8aが形成されており、凸部8aの上面は平面状であるため、凸部8aの上面に負極集電板2が押しつけられた状態でレーザ溶接するときに、凸部8aの上面と、負極集電タブ6が超音波溶接された負極集電板2の裏面と、を密着固定させることができる。なお、負極集電板2の凸部8aに接合される表面部分に負極集電タブ6が溶接されていないので、超音波溶接時に溶接治具のパターンが負極集電板2に転写されることによる負極集電板2と凸部8aとのレーザ溶接不良を防止することができる。

【0020】更に、本実施形態では、絞り加工で電池缶8の内底面中央部に凸部8aが開放端側に凸起するように形成したことから、凸部8aの厚さを電池缶8の厚さと同じくすることができるので、電池缶8の底面外側からレーザ溶接するとき、レーザを効率よく照射することができる。

【0021】なお、本実施形態では、電池缶8の内底面中央部に1箇所円形状の凸部8aを形成した例を示したが、凸部8aの箇所数や形状はこれに限定されるものではなく、複数箇所に凸部を形成したり略矩形状の凸部をするようにしてもよい。

【0022】また、本実施形態では、凸部8aに負極集電板2をレーザ溶接するときに、YAGレーザを使用した例を示したが、レーザの種類はこれに限定されるものではなく、炭酸ガスレーザやエキシマレーザ等の種々の

レーザを使用することができる。また、YAGレーザに好適な振動数、送り速さ、レーザ溶接の長さ、レーザ溶接の筋数及び筋形状を示したが、これらの数値又は形状に限定されるものではなく、使用するレーザに応じて変更するようにすればよい。また、レーザ溶接の筋形状も折れ線状や曲線状などにしてもよい。

【0023】

【発明の効果】以上説明したように、本発明によれば、電極群の正負極のいずれか一方を集電板を介して電池缶に、電池缶外側からレーザ溶接により固定することで、抵抗溶接で固定するときに必要であった電極群の捲回軸穴が不要となるので、捲回軸穴のない体積効率に優れた二次電池を提供できる、という効果を得ることができる。

【図面の簡単な説明】

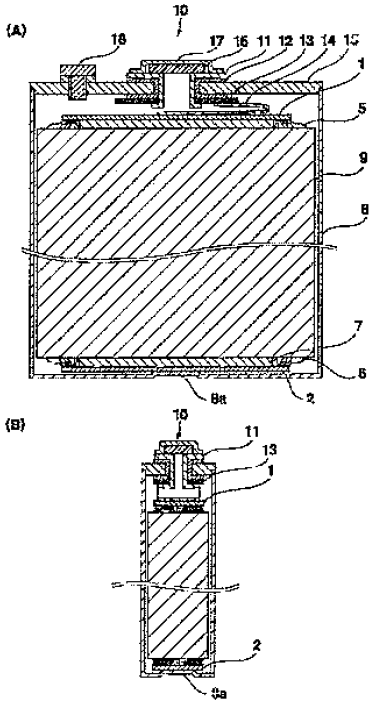
【図1】本発明が適用可能な実施形態の角型リチウム二次電池の断面図であり、(A)は正面図、(B)は側面図である。

【図2】従来の電極棒を用いた電池缶底の溶接を示す断面図である。

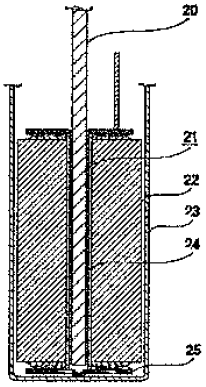
【符号の説明】

1 正極集電板
2 負極集電板(集電板)
6 負極集電タブ(集電タブ)
8 電池缶
8a 凸部
9 電極群
10 角型リチウム二次電池(二次電池)
15 上蓋板(上蓋)

【図1】



【図2】



Electronic Patent Application Fee Transmittal	
Application Number:	13146669
Filing Date:	07-Sep-2011
Title of Invention:	BUTTON CELLS AND METHOD FOR PRODUCING SAME
First Named Inventor/Applicant Name:	Eduard Pytlik
Filer:	Thomas Daniel Christenbury/Vivian Pena
Attorney Docket Number:	RUF-11-1270
Filed as Large Entity	

U.S. National Stage under 35 USC 371 Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
Request for Continued Examination	1801	1	1200	1200
		Total in USD ($)		**1200**

Electronic Acknowledgement Receipt	
EFS ID:	20578316
Application Number:	13146669
International Application Number:	
Confirmation Number:	6273
Title of Invention:	BUTTON CELLS AND METHOD FOR PRODUCING SAME
First Named Inventor/Applicant Name:	Eduard Pytlik
Customer Number:	35811
Filer:	Thomas Daniel Christenbury/Vivian Pena
Filer Authorized By:	Thomas Daniel Christenbury
Attorney Docket Number:	RUF-11-1270
Receipt Date:	31-OCT-2014
Filing Date:	07-SEP-2011
Time Stamp:	16:08:05
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$1200
RAM confirmation Number	2815
Deposit Account	502719
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. 1.492 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Request for Continued Examination (RCE)	RUF-11-1270-RCE.pdf	139443 3f2842f007bf0a1d0a632eda36405442707cecb0	no	1
Warnings:					
This is not a USPTO supplied RCE SB30 form.					
Information:					
2	Miscellaneous Incoming Letter	RUF-11-1270-ATL.pdf	106012 9332517f5934977fcc59376ac9cae37de2e1bbd4	no	1
Warnings:					
Information:					
3		RUF-11-1270-Response.pdf	514892 e24cbe6b259be7231787fe6d824eb2af231e32f4	yes	6

Multipart Description/PDF files in .zip description

Document Description	Start	End
Response After Final Action	1	1
Claims	2	3
Applicant Arguments/Remarks Made in an Amendment	4	6

Warnings:					
Information:					
4	Transmittal Letter	RUF-11-1270-SIDS.pdf	70348 401d6359771b17da6cbec8ccde2b01398a58b598	no	1
Warnings:					
Information:					
5	Information Disclosure Statement (IDS) Form (SB08)	RUF-11-1270-PTO-1449.pdf	227312 2c15dcfcb33ffebf4fd1f58d360ed670fb6f341a	no	2
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					

6	Foreign Reference	EP1372209.pdf	151651 f8a1f97ba93b8ac2f92792c7c1d6ea5c7b849691	no	2
Warnings:					
Information:					
7	Foreign Reference	JP3902330.pdf	713931 159fac1c51afbbdf5c5626e1c6f77f0ef24f760f	no	8
Warnings:					
Information:					
8	Foreign Reference	EP1808916.pdf	120450 002916d54577a52f23c3262bcd156ffe90167033	no	1
Warnings:					
Information:					
9	Foreign Reference	WO2010-089152.pdf	3538583 f661432a628485f2c24934bdcbb0f9f0321a6c5e	no	35
Warnings:					
Information:					
10	Foreign Reference	DE102009008859.pdf	890035 25fc25dae415c03f2355d46313cf9f88034b217f	no	7
Warnings:					
Information:					
11	Foreign Reference	JP2004-158318.pdf	1475372 273379deec18fe4f664f8dfae2c692407bfc5c78	no	15
Warnings:					
Information:					
12	Foreign Reference	JP2008-251192.pdf	1170289 dfefecc40ffa92452caf4c4d7c0acb1fa6619d6c	no	13
Warnings:					
Information:					
13	Foreign Reference	JP2000-70040.pdf	793455 963c9e20992d4a2f6d3a0578ddacafba82c652eb	no	7
Warnings:					
Information:					
14	Foreign Reference	JP2002-352789.pdf	217402 c140986e5abded3b8303b007d071e3e5562999b7	no	8
Warnings:					
Information:					

15	Non Patent Literature	USOfficeAction-08-29-14.pdf	899467 8be73826fcfef2a45b08108b01b64b43d161b029	no	11
Warnings:					
Information:					
16	Fee Worksheet (SB06)	fee-info.pdf	30650 3775790e428d02ff30ca52c1e1b5035bd051427d	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	11059292	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 13/146,669	Filing Date 09/07/2011	☐ To be Mailed

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)		
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	10/31/2014	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 13	Minus	** 20	= 0	X $80 =	0
	Independent (37 CFR 1.16(h))	* 1	Minus	***3	= 0	X $420 =	0
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	0

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
/eugenia v. hardy/

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/146,669	09/07/2011	Eduard Pytlik	RUF-11-1270	6273

35811 7590 01/05/2015
IP GROUP OF DLA PIPER LLP (US)
ONE LIBERTY PLACE
1650 MARKET ST, SUITE 4900
PHILADELPHIA, PA 19103

EXAMINER	
ANTHONY, JULIAN	

ART UNIT	PAPER NUMBER
1726	

NOTIFICATION DATE	DELIVERY MODE
01/05/2015	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

pto.phil@dlapiper.com

Office Action Summary	Application No. 13/146,669	Applicant(s) PYTLIK ET AL.	
	Examiner JULIAN ANTHONY	Art Unit 1726	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *three* MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *10-31-14*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5)☒ Claim(s) _____ is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1,2 and 4-14* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date *10-31-14*.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on October 31, 2014 has been entered.

Information Disclosure Statement

The IDS filed on October 31, 2014 has been considered by the examiner.

Claim Rejections - 35 USC § 112

The following is a quotation of 35 U.S.C. 112(b):
(b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:
The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1, 2 and 4-14 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor, or for pre-AIA the applicant regards as the invention.

Claim 1 recites the limitation "the top area" in line 9. There is insufficient antecedent basis for this limitation in the claim. It is suggested to change "the top area" to --the flat top area--.

Claims 2 and 4-14 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being dependent upon a rejected base claim.

Claim Rejections - 35 USC § 103

The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 2, 4-6 and 9-13 are rejected under Nakayama (US 4,224,387) in view of Suzuki et al. (US 7,566,515)

The rejection is maintained for the reasons already of record. The examiner notes the amendment to claim 1 now reciting a flat bottom area and a top area, which appears to be merely an alternative recitation of "flat bottom and top areas" as previously recited. In addition, the amendment to claim 1 reciting the spiral winding having end faces appears to be similar to "whose end faces" previously recited.

Applicant's arguments filed with the present amendment have been fully considered, however these arguments are not found persuasive. Applicant submits that the combination of Suzuki with Nakayama would result in a completely different button cell. To this end, applicant

submits that while Suzuki discloses a spiral winding, the disclosure and accompanying description are problematic in the context of a combination of Suzuki with Nakayama. Specifically, applicant submits that reference numbers 2b and 4b in Suzuki do not refer to "end faces". The examiner concedes that Suzuki does not use the term "end faces". However, the active material (the term used by Suzuki) is nonetheless asserted as being structurally similar if not identical to applicant's claimed end face. Applicant's specification discloses that the end faces of the winding face in the direction of the flat bottom area and of the flat top area. This configuration is found in Suzuki; see Figure 2, where the only portions of the spiral winding that are in contact with the flat bottom area and flat top area is the area in proximity to reference numbers 2b and 4b. For at least this reason, the flat portions along 2b and 4b are asserted as being end faces of the spiral winding.

Applicant further submits that at best, reference numbers 2b and 4b refer to lower and upper surfaces of the spiral winding or refer to opposed side surfaces of the spiral winding. In contrast to this, applicant relies on Figs. 3b, 4 and 5 of the disclosed invention to show side surfaces of the winding in an axial direction with respect to the flat bottom area and the flat top area and which is said to be critical in ensuring the mechanical pressure during charge/discharge being exerted in a radial direction (instead of in the axial direction). While this argument may have merit in comparison to Suzuki's spiral winding being orientated at 90°, this argument does not have patentable weight or meaning as the scope of the present claims are entirely silent on the end faces being defined by side surfaces of the spiral winding in an axial direction relative to the flat bottom area and the flat top area. Applicant is reminded that though understanding the claim language may be aided by explanations contained in the written description, it is improper

to import into a claim limitations that are not part of the claim. *Superguide Corp. v. DirecTV Enterprises, Inc.*, 358 F.3d 870, 875, 69 USPQ2d 1865, 1868 (Fed. Cir. 2004), see also *Liebel-Flarsheim Co. v. Medrad Inc.*, 358 F.3d 898, 906, 69 USPQ2d 1801, 1807 (Fed. Cir. 2004)

Claims 7, 8 and 14 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Nakayama (US 4,224,387) in view of Suzuki et al. (US 7,566,515), and further in view of Cantave et al. (US 6,443,999)

The examiner notes that the sole argument for Cantave as applied under pre-AIA 35 U.S.C. 103(a) merely asserts that Cantave fails to cure alleged deficiencies with respect to the combination of Nakayama and Suzuki. The rejection based on Nakayama and Suzuki is maintained for the reasons set forth *supra*; the rejection based on Nakayama and Suzuki and further in view of Cantave is maintained for the reasons already of record.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Julian Anthony whose telephone number is (571) 272-1289. The examiner can normally be reached on Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick J. Ryan, can be reached on (571) 272-1292. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications

may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

/Julian Anthony/
Examiner, Art Unit 1726

/PATRICK RYAN/
Supervisory Patent Examiner, Art Unit 1726

,m PTO-1449 US DEPARTMENT OF COMMERCE
ATENT AND TRADEMARK OFFICE

ATTY. DOCKET NO.	SERIAL NO.
RUF-11-1270	13/146,669
APPLICANT: Eduard Pytlik et al.	
FILING DATE: July 28, 2011	GROUP: 1726

LIST OF PUBLICATIONS CITED BY APPLICANT
(Use several sheets if necessary)

US PATENT DOCUMENTS

EXAMINER INITIAL*		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
	AA	2012/0015224 (DE '859)	01/19/12	E. Pytlik et al.			
	AB	2002/0034680 (JP '040)	03/21/02	H. Inoue et al.			
	AC	2005/0271938	12/08/05	M. Suzuki et al.			
	AD	2008/0003500	01/03/08	Issav et al.			
	AE	3,960,599	06/01/76	Reynier et al.			
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	AG						
	AH						
	AI						
	AJ						
	AK						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION YES	TRANSLATION NO
	AL	1 372 209	12/17/03	EP			Abstract	
	AM	3902330	04/04/07	JP			Abstract	
	AN	1 808 916	07/18/07	EP			Abstract	
	AO	2010/089152	08/12/10	WO			Abstract	
	AP	10 2009 008 859 (corres. to US 2012/0015224)	08/12/10	DE			X	

OTHER PUBLICATIONS (Including Author, Title, Date, Pertinent Pages, Etc.)

	AR	US Official Action dated August 29, 2014 from related US Application No. 13/378,117.
	AS	
	AT	

EXAMINER	/Julian Anthony/	DATE CONSIDERED	12/28/2014

*EXAMINER: Initial if publication considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to Applicant.

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /J.A./

Form PTO-1449 US DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY. DOCKET NO. RUF-11-1270	SERIAL NO. 13/146,669
	APPLICANT Eduard Pytlik et al.	
LIST OF PUBLICATIONS CITED BY APPLICANT *(Use several sheets if necessary)*	FILING DATE July 28, 2011	GROUP 1726

US PATENT DOCUMENTS

EXAMINER INITIAL*		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
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	AB						
	AC						
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	AF						
	AG						
	AH						
	AI						
	AJ						
	AK						

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	AM	2008-251192	10/16/08	JP			X	
	AN	2000-77040 (corres. To US 2002/0034680)	03/14/00	JP			X	
	AO	2002-352789	12/06/02	JP			X	
	AP							

OTHER PUBLICATIONS (Including Author, Title, Date, Pertinent Pages, Etc.)

	AR	
	AS	
	AT	

EXAMINER /Julian Anthony/	DATE CONSIDERED 12/28/2014

*EXAMINER: Initial if publication considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to Applicant.

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /J.A./

Search Notes

Application/Control No.	Applicant(s)/Patent under Reexamination
13/146,669	PYTLIK ET AL.
Examiner	**Art Unit**
JULIAN ANTHONY	1726

SEARCHED			
Class	Subclass	Date	Examiner
429	162	12/22/2014	JA
429	174	12/22/2014	JA
29	623.1	12/22/2014	JA
29	623.5	12/22/2014	JA

INTERFERENCE SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	DATE	EXMR
H01M2/0207, 10/0436, 10/0587, 10/0431	12/22/2014	JA

Form PTO-1449 US DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY. DOCKET NO. RUF-11-1270	SERIAL NO. 13/146,669
	APPLICANT Eduard Pytlik et al.	
LIST OF PUBLICATIONS CITED BY APPLICANT *(Use several sheets if necessary)*	FILING DATE July 28, 2011	GROUP 1726

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	AB						
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	AD						
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	AG						
	AH						
	AI						
	AJ						
	AK						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION YES	TRANSLATION NO
	AL	8-293299	11/05/96	JP			X	
	AM							
	AN							
	AO							
	AP							

OTHER PUBLICATIONS (Including Author, Title, Date, Pertinent Pages, Etc.)

	AR	
	AS	
	AT	

EXAMINER	DATE CONSIDERED

*EXAMINER: Initial if publication considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to Applicant.

DESCRIPTION JP H-08293299

[0001]

The present invention relates to, a manufacturing method of the battery.

[0002]

BACKGROUND ART Nickel hydride batteries, nickel-cadmium batteries, the batteries such as lithium batteries or lithium-ion batteries, high by accommodating the positive and negative poles by interposing a separator electrode group wound in a spiral shape in the outer can capacity is achieved.

Batteries of this type are prepared as follows.

First, a separator sheet between the positive and negative electrodes is interposed, to produce an electrode group wound in a spiral shape by these jigs having a core.

Then, the electrode group while housed in the outer can, a lead derived from one electrode of the electrode group was welded to the bottom inner surface of the outer can, and a lead derived from the other electrode to the sealing lid welding to.

Next, after injecting the electrolyte solution into the outer can, to produce the battery by sealing the mouth by attaching the sealing cap to the opening of the outer can.

[0003]

Meanwhile, welding of the inner bottom surface of the lead and the outer can is performed using a welding electrode rod conventionally.

That is, this method is that the rear fabricated electrode group is formed by extracting the winding core insert the welding electrode rod in the space of the central portion, and resistance welding the lead to the inner bottom surface within the outer can is.

[0004]

However, the central portion space of the electrode group, a 3mm~5mm diameter of about because the lower limit of its diameter is restricted in order to provide sufficient strength to the winding core along with it is desired small from the viewpoint of enhancing the volumetric efficiency it is often.

Moreover, the beginning of the separator wound is traverses to bisecting the space left in this space.

From these it is difficult to insert the welding electrode rod in the space.

Furthermore, the position of the central space is changed by the electrode group, to confirm the position of the central space for each product, it is necessary to insert a welding electrode rod to fit the position.

[0005]

For this reason, a method for welding by irradiating a laser beam from the center space of the electrode group as Hei 4-230953 JP the lead in the bottom inner surface of the outer can or JP-A-4-162351, As publication, the lead is contacted with the bottom surface of the outer can, by irradiating a laser beam from the outside, a method of welding the lead to the inner bottom surface of the outer can has been proposed.

[0006]

An object of the invention is to provide a] According to this method, the insertion of the problem of the welding electrode rod is eliminated.

However, in the method, a solid outgoing laser, for example, Nd- (referred to hereinafter YAG lasers) yttrium-aluminum-garnet laser, as shown in Figure 4, condenses the excitation light to the YAG rod (Y3Al5O12) 11 It is intended to obtain an optical laser.

This is a solid-state laser light laser as the initial state of emission as a feature of being fired concluded small opening angle θ, as in Figure 4 (A), the light emission is started at about the same time the rod 11 is thermally expanded, open angle θ is stabilized by changes in θ + dθ.

As shown in this order FIG. 4 (B), and condenses the light laser work surface by the objective lens 12 (welding surface of the battery and the lead terminals), those welding set position in the initial was in f, f + dx I will move to.

Therefore, initially, even if you set the welding operation of work in the weld strength is maximum of position, initially of the set position in the welding strength of the weld strength and work after the start of the welding point of welding points of the battery at work start position becomes that it is carried out welding work out from several Among the production the battery lot consequently day, weld strength in lead and outer can inside bottom surface is weak as compared with others was to be produced.

[0007]

SUMMARY In order to achieve the present invention is intended to solve these problems, a light emitting initial laser beam of a solid outgoing laser to emit light in a blank-beating state without irradiating the workpiece surface, stabilizing rod the workpiece surface after the state was and is intended to solve by irradiating a laser beam.

[0008]

[Action] By adopting the above method, always the energy density can be irradiated with a laser beam on the work surface in a stable state, a strong welding strength in all batteries are produced, and those that can be realized with less welding state variation is.

[0009]

EXAMPLES The following, I will be described with reference to figure one embodiment of the present invention.

Examples include the welding of the inner bottom surface of the lead and the outer can, and will be described with the example was performed by irradiating a YAG laser beam to the outer bottom surface of the outer can.

As shown in Figure 1, winding spirally through a separator 3 formed of a negative electrode 2 sheet comprising a sheet-like positive electrode 1 and the metal lithium as a main active material of manganese dioxide from the microporous film made of polypropylene , to produce an electrode group 5 having a central portion space 4 withdrawn core used in the winding.

Note that the upper side of the electrode group 5, the positive electrode lead 1a is derived from the positive electrode 1.

The lower side of the electrode group 5, the negative electrode lead 2a made of nickel plate of the thickness of 0.1mm to end the metallic lithium of the negative electrode 2 is pressed is derived.

[0010]

Next, place an insulating plate 6 on the bottom surface of the electrode group 5, the after the negative electrode lead 2a bent along the lower surface of the insulating plate 6 and the electrode above the bottomed cylindrical outer can in 7 opened Groups 5, the negative electrode lead 2a as shown in FIG. 2 I is accommodated across the central portion 7a of the outer can 7 bottom.

In addition, the package can 7 I have a thickness of 0.3mm made of iron plate.

[0011]

Then, as shown in Figure 3, the laser beam is oscillated from a YAG laser oscillator 8, the central portion of the laser beam is focused by the convex lens 10 through the optical fiber 9 having a diameter of 0.6mm the outer can 7 bottom by irradiating from outside 7a, is fixed by welding the negative electrode lead 2a in the central portion 7a to 5 joules of energy welding of the outer can 7 bottom.

In this case the laser beam is being irradiated to the welding portion after the blank shot at least once.

Thereafter, the positive electrode lead 1a was welded to a sealing lid (not shown), was further injected an electrolyte solution into the outer can 7, the can the sealing cap mounted on the upper opening of the outer can 7 manufacturing a lithium battery by sealing the mouth.

[0012]

Then, to that the welding strength of the lead and the outer can in the bottom of the resulting cell by the method of the present invention, the resulting leads and outer can in the bottom by resistance welding by inserting a conventional welding electrode rods I was compared.

I shows the results (Table 1).

Numbers in the table are 3-lot production cell production number 15000 as one lot, was allowed to fall naturally into a concrete surface from a height of 3m, a few Although the battery voltage showed a 0V, the words drop impact, lead weld I is a number deviating from the outer can in the bottom.

[0014]

[0014] (Table 2) is irradiated with a YAG laser beam of the present invention, among the examples of the method was welded to lead the inner bottom surface of the outer can, the same manner as described above to compare the weld strength due to idle driving frequency of the laser in and is obtained by comparison.

Test method, even the number of tests was carried out in the same manner.

[0016]

[Effect of the Invention above, (Table 1), it is apparent cell produced by the method of the present invention from (Table 2) can achieve a welding state in which the welding strength is constant in the lead and the outer can in the bottom, Also in productivity can be improved 30% to 40% production efficiency than the method according to conventional resistance welding.

In the above, although the YAG laser beam shown in those irradiated from the bottom exterior surface direction of the outer can, the other a YAG laser beam is passed through the central portion space of the electrode assembly from the inside of the outer can to be irradiated to the inner bottom surface to that the same effect can be obtained by the method is one that has been found by experiment.

CLAIMS JP H-08293299

[0001]

In addition to housing the electrode group wound in a spiral shape the positive electrode and the negative electrode through the separator into the outer can, and contacts the lead derived from any one electrode of the electrode group in the bottom inner surface of the outer can After placement as, in the production process of the battery to weld the inner bottom surface of the lead and outer can and irradiated solid outgoing laser beam on the bottom outer surface of the outer Sokan the welding of the inner bottom surface of the lead and the package can A method is carried out by, after being idle striking one or more times the solid outgoing laser, method for producing a battery which is characterized by irradiating a laser beam to the contact surface of the inner bottom surface of the lead and the outer can.

[0002]

In addition to housing the electrode group wound in a spiral shape the positive electrode and the negative electrode through the separator into the outer can, and contacts the lead derived from any one electrode of the electrode group in the bottom inner surface of the outer can After placement as, in the production process of the battery to weld the inner bottom surface of the lead and the outer can, the bottom inner surface of the outer can from the lead and the central portion space of the spiral electrode group to the welding of the inner bottom surface of the outer can A method carried out by irradiating a solid outgoing laser beam, the after being idle striking one or more times a solid outgoing laser, characterized by irradiating a laser beam to the contact surface of the inner bottom surface of the lead and the outer can to battery method of manufacturing.

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Ｂ23Ｋ　26/00	310		Ｂ23Ｋ　26/00	310Ｇ	

審査請求　未請求　請求項の数2　ＯＬ　（全 4 頁）

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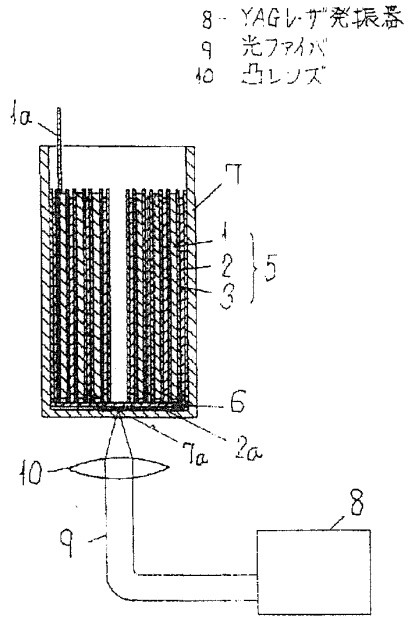
(54)【発明の名称】　電池の製造法

(57)【要約】

【目的】　一方の電極から導出されたリードと外装缶内面における固体発信レーザ溶接による溶接強度の向上を図るとともにバラツキを抑制する。

【構成】　固体発信レーザを１回以上空打ちさせた後、レーザ光をリードと外装缶の内底面との溶接部分に照射する。



【特許請求の範囲】
【請求項１】正極と負極とをセパレータを介して渦巻状に巻回した電極群を外装缶内に収納すると共に、前記電極群のいずれか一方の電極から導出されたリードを前記外装缶の底部内面に接触するように配置した後、前記リードと外装缶の底部内面とを溶接する電池の製造法において、前記リードと外装缶の底部内面との溶接を該外装缶の底部外面に固体発信レーザ光を照射することにより行う方法であって、前記固体発信レーザを一回以上空打ちさせた後、リードと外装缶の底部内面の接触面にレーザを照射することを特徴とする電池の製造法。
【請求項２】正極と負極とをセパレータを介して渦巻状に巻回した電極群を外装缶内に収納すると共に、前記電極群のいずれか一方の電極から導出されたリードを前記外装缶の底部内面に接触するように配置した後、前記リードと外装缶の底部内面とを溶接する電池の製造法において、前記リードと外装缶の底部内面との溶接を渦巻状電極群の中央部空間より外装缶の底部内面に固体発信レーザ光を照射することにより行う方法であって、前記固体発信レーザを一回以上空打ちさせた後、リードと外装缶の底部内面の接触面にレーザを照射することを特徴とする電池の製造法。
【発明の詳細な説明】
【０００１】
【産業上の利用分野】本発明は、電池の製造法に関するものである。
【０００２】
【従来の技術】ニッケル水素蓄電池、ニッケルカドミウム電池、リチウム電池やリチウムイオン電池等の電池は、正負極をセパレータを介在して渦巻状に巻回した電極群を外装缶内に収納することによって高容量化が図られている。この種の電池は次のように製造されている。まず、シート状の正負極間にセパレータを介在させ、これらを巻芯を有した治具で渦巻状に巻回した電極群を作製する。次いで、この電極群を外装缶内に収納すると共に、該電極群の一方の電極から導出されたリードを前記外装缶の底部内面に溶接し、かつ他方の電極から導出されたリードを封口蓋に溶接する。次いで、電解液を前記外装缶内に注入した後、外装缶の開口部に前記封口蓋を取りつけて密封口することにより電池を製造する。
【０００３】ところで、前記リードと前記外装缶の底部内面との溶接は、従来より溶接用電極棒を用いて行われている。即ち、この方法は、前記電極群の作製後に前記巻芯を抜き取ることにより形成される中央部の空間に溶接用電極棒を挿入し、前記リードを前記外装缶内の底部内面に抵抗溶接するものである。
【０００４】しかしながら、前記電極群の中央部空間は、容積効率を高める観点から小さいことが望まれると共に巻芯に充分な強度を持たせるためにその直径の下限が規制されることから３ｍｍ～５ｍｍ径程度となることが多い。しかも、この空間には巻回始めのセパレータが空間を左右で二分するように横断している。これらのことから前記空間に溶接用電極棒を挿入するのが困難となる。更に、前記電極群によって中央部空間の位置が変動するため、製品毎にその中央部空間の位置を確認し、その位置に合わせて溶接用電極棒を挿入する必要がある。
【０００５】このようなことから、特開平４－２３０９５３号公報記載のように電極群の中央部空間からレーザ光を照射して前記リードを外装缶の底部内面に溶接する方法、あるいは特開平４－１６２３５１号公報記載のように、前記リードを外装缶の底面と接触させ、外側からレーザ光を照射して、前記リードを外装缶の底部内面に溶接する方法が提案されている。
【０００６】
【発明が解決しようとする課題】このような方法によれば、溶接用電極棒の挿入性の問題は解消される。しかしながら、前記の方法では、固体発信レーザ、例えばＮｄ－イットリウム・アルミニウム・ガーネットレーザ（以後ＹＡＧレーザと称す）は、図４に示すように、ＹＡＧロッド（$Y_3Al_5O_{12}$）１１に励起光を集光して光レーザを得るものである。この固体レーザの特徴として発光の初期の状態として光レーザは図４（Ａ）のような微小な開き角θをもって発射されるが、発光が開始されるとほぼ同時にロッド１１は熱膨張し、開き角θは$\theta+d\theta$に変化して安定化する。このため図４（Ｂ）に示すように、この光レーザを対物レンズ１２によってワーク面（電池とリード端子の溶接面）に集光すると、初期において溶接設定位置がｆにあったものが、ｆ＋ｄｘに移動する。このため、当初、溶接強度が最大の位置でワークの溶接作業を設定していても、作業開始時の電池の溶接点の溶接強度と作業開始後の溶接点の溶接強度とでは当初の設定位置から外れた位置で溶接作業を行っていることとなり、その結果として１日に生産した電池のロットのなかに数個、リードと外装缶内底面における溶接強度が他のものに比べて弱いものが生産されることがあった。
【０００７】
【課題を解決するための手段】本発明はこれらの問題点を解決するもので、固体発信レーザの発光初期のレーザ光をワーク面に照射せずに空打ち状態で発光させ、ロッドを安定化させた状態とした後にワーク面にレーザ光を照射することで解決するものである。
【０００８】
【作用】以上の方法を採ることにより、常にエネルギー密度が安定した状態でワーク面にレーザ光が照射でき、生産されるすべての電池において溶接強度が強く、かつバラツキの少ない溶接状態を実現できるものである。
【０００９】
【実施例】以下、本発明の一実施例を図とともに説明する。実施例としては、リードと外装缶の底部内面との溶

接を、外装缶の底部外面にＹＡＧレーザ光を照射して行った例でもって説明する。図１に示すように、二酸化マンガンを主活物質とするシート状の正極１と金属リチウムからなるシート状の負極２とをポリプロピレン製のマイクロポーラスフィルムからなるセパレータ３を介して渦巻状に巻回し、この巻回に用いた巻芯を抜き取って中央部空間４を有する電極群５を作製する。なお、前記電極群５の上側には、正極１から正極リード１ａが導出されている。前記電極群５の下側には、前記負極２の金属リチウムに一端が圧着された厚さ０．１ｍｍのニッケル板からなる負極リード２ａが導出されている。

【００１０】次いで、前記電極群５の底面に絶縁板６を配置し、前記負極リード２ａを前記絶縁板６の下面に沿って折り曲げた後、上方が開口した有底円筒形の外装缶７内に前記電極群５を、図２に示すように前記負極リード２ａが外装缶７底部の中心部分７ａを横切るように収納する。なお、外装缶７は厚さ０．３ｍｍの鉄板製とした。

【００１１】次いで、図３に示すように、ＹＡＧレーザ発振器８からレーザ光を発振させ、このレーザ光を直径０．６ｍｍの光ファイバ９に通して凸レンズ１０で集光して前記外装缶７底部の中心部分７ａに外側から照射することにより、前記負極リード２ａを外装缶７底部の中心部７ａに５ジュールの溶接エネルギーで溶接して固定する。この時レーザ光は１回以上空打ちを行った後溶接部分に照射している。この後、前記正極リード１ａは封口蓋（図示せず）に溶接し、さらに前記外装缶７内に電解液を注液した後、前記封口蓋を外装缶７の上方開口部に取り付けて缶を密封口することによりリチウム電池を製造する。

【００１２】次に、本発明の製造方法によって得られた電池のリードと外装缶内底面の溶接強度を、従来の溶接用電極棒を挿入してリードと外装缶内底面を抵抗溶接によって得られたものとを比較した。その結果を（表１）に示す。表中の数字は電池の生産数１５０００個を１ロットとして３ロット生産し、３ｍの高さからコンクリート面に自然落下させた後、電池電圧が０Ｖを示したものの数、即ち落下衝撃によって、リード溶接部が外装缶内底面から外れた数を示す。

【００１３】

【表１】

	ロット１	ロット２	ロット３
本発明品（レーザ空打ち３回）	０	０	０
従来品（抵抗溶接）	２９	１３	２４

【００１４】また（表２）は本発明のＹＡＧレーザ光を照射し、リードを外装缶の内底面に溶接した方法の例のうち、レーザの空打ち回数による溶接強度の比較を上記と同じ方法で比較したものである。テスト方法、テスト回数も同様に実施した。

【００１５】

【表２】

	空打ち回数	電圧０Ｖを示した数
実施例	空打ち１回	０
	空打ち２回	０
	空打ち５回	０
	空打ち１０回	０
比較例	空打ち０回	７

【００１６】

【発明の効果】以上、（表１）、（表２）から明らかなように本発明の方法で製造された電池は、リードと外装缶内底面における溶接強度が一定した溶接状態を実現でき、また生産性においても従来の抵抗溶接による方法より３０～４０％生産効率の向上が図れる。また上記では、ＹＡＧレーザ光を外装缶の底部外面方向より照射したもので示したが、この他にＹＡＧレーザ光を外装缶の内側より電極群の中央部空間を通過させて底部内面に照射する方法でも同様の効果が得られることが実験により判明しているものである。

【図面の簡単な説明】

【図１】実施例における電極群を示す断面図

【図２】同電極群を外装缶内に収納した断面図

【図３】実施例におけるレーザ光の照射を示す説明図

【図４】（Ａ）　固体発信レーザの発光初期におけるレーザ光の軌跡の説明図

（Ｂ）　固体発信レーザの安定状態におけるレーザ光の軌跡の説明図

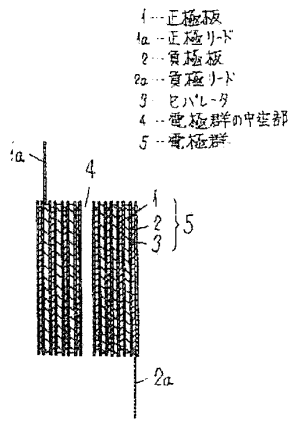
【符号の説明】

１　正極板
１ａ　正極リード
２　負極板
２ａ　負極リード
３　セパレータ
４　電極群の中空部
５　電極群
６　絶縁板
７　外装缶
７ａ　外装缶底部の中心部分
８　ＹＡＧレーザ発振器
９　光ファイバ
１０　凸レンズ

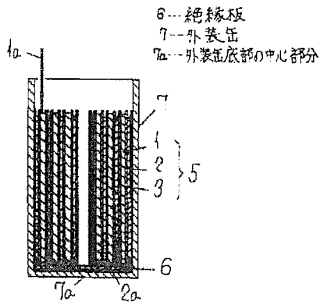
１１　ロッド

１２　対物レンズ（凸レンズ）

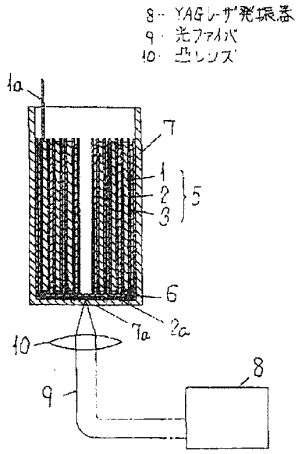
【図１】



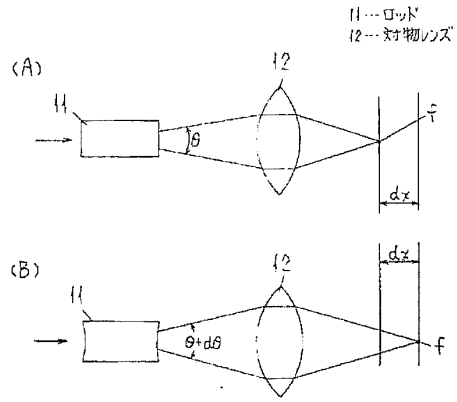
【図２】



【図３】



【図４】



Electronic Acknowledgement Receipt

EFS ID:	21350124
Application Number:	13146669
International Application Number:	
Confirmation Number:	6273
Title of Invention:	BUTTON CELLS AND METHOD FOR PRODUCING SAME
First Named Inventor/Applicant Name:	Eduard Pytlik
Customer Number:	35811
Filer:	Thomas Daniel Christenbury/Kelly Eccleston
Filer Authorized By:	Thomas Daniel Christenbury
Attorney Docket Number:	RUF-11-1270
Receipt Date:	29-JAN-2015
Filing Date:	07-SEP-2011
Time Stamp:	18:23:19
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	SIDS.pdf	265151 00b6e4b56d31f1b98911ab0508b9d0dcdb996b4c	no	1

Warnings:	
Information:	

2	Information Disclosure Statement (IDS) Form (SB08)	1449.pdf	48948 06d3e7f12673db666b3d3bb888c26f1288eafc00	no	1
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
3	Foreign Reference	299.pdf	356620 5990f2a29acbb4c0070cc24435ff876824c6a539	no	7
Warnings:					
Information:					
			Total Files Size (in bytes):	670719	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Art Unit	: 1726	**Customer No.: 035811**
Examiner	: Julian Anthony	
Serial No.	: 13/146,669	Docket No.: RUF-11-1270
Filed	: July 28, 2011	
Inventors	: Eduard Pytlik	Confirmation No.: 6273
	: Jürgen Lindner	
	: Ulrich Barenthin	
	: Winfried Gaugler	
Title	: BUTTON CELLS AND METHOD	
	: FOR PRODUCING SAME	
		Dated: January 28, 2015

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

The Applicants enclose Form PTO-1449 together with a copy of a listed non-US publication cited in a related Chinese Examination Report dated November 4, 2014. The publication is submitted under 37 CFR §1.56 and is believed related to this application for the reasons stated.

Applicants certify that each item of information contained in the Information Disclosure Statement was first cited in any communication from any foreign patent office in a counterpart foreign application not more than three months ago.

The Applicants respectfully request that this Supplemental Information Disclosure Statement be officially entered into the file and that appropriate notification be made that it was considered by the Examiner.

Respectfully submitted,

T. Daniel Christenbury
Reg. No. 31,750

TDC/ke
(215) 656-3381

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Art Unit	: 1726	**Customer No.: 035811**
Examiner	: Julian Anthony	
Serial No.	: 13/146,669	Docket No.: RUF-11-1270
Filed	: July 28, 2011	
Inventors	: Eduard Pytlik	
	: Jürgen Lindner	
	: Ulrich Barenthin	
	: Winfried Gaugler	Confirmation No.: 6273
Title	: BUTTON CELLS AND METHOD	
	: FOR PRODUCING SAME	
		Dated: March 19, 2015

RESPONSE

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In response to the Official Action dated January 5, 2015, the Applicants amend the application as follows:

In the Claims

1. (Currently Amended) A button cell comprising:

a housing cup and a housing top separated from one another by an electrically insulating seal and which form a housing with a flat bottom area and a flat top area parallel to it, and

an electrode-separator assembly within the housing comprising at least one positive and at least one negative electrode in the form of flat layers and connected to one another by at least one flat separator,

wherein the electrode layers are aligned essentially at right angles to the flat bottom area and the flat top area and the button cell is closed without being beaded over, and the electrode-separator assembly is in the form of a spiral winding having end faces defining side surfaces of the spiral winding ~~face~~ facing in [[a]] an axial direction [[of]] relative to the flat bottom area and the flat top area.

2. (Previously Presented) The button cell as claimed in claim 1, wherein the electrodes and/or the separator are/is in the form of strips or ribbons.

3. (Cancelled)

4. (Previously Presented) The button cell as claimed in claim 1, wherein the winding has an axial cavity in its center, which axial cavity is at least partially filled by a winding core.

5. (Previously Presented) The button cell as claimed in claim 1, wherein the electrode-separator assembly has one of the following layer sequences:

negative electrode/separator/positive electrode/separator and

positive electrode/separator/negative electrode/separator.

6. (Previously Presented) The button cell as claimed in claim 1, wherein the positive electrode and/or the negative electrode are/is connected via an output conductor to the housing in an area of the flat bottom area and/or of the flat top area.

7. (Previously Presented) The button cell as claimed in claim 1, further comprising at least one insulator which prevents direct mechanical and electrical contact between the end faces of the winding and the flat bottom and top areas.

8. (Previously Presented) The button cell as claimed in claim 7, wherein the at least one insulator is a flat layer composed of plastic arranged between the end faces of the winding and the flat bottom and top areas.

9. (Previously Presented) The button cell as claimed in claim 1, which is rechargeable.

10. (Previously Presented) The button cell as claimed in claim 1, having a height:diameter ratio of < 1.

11. (Previously Presented) A method for producing a button cell according to claim 1, comprising inserting an electrode-separator assembly with electrodes in the form of a flat layer into the housing such that the electrode layers are aligned essentially at right angles to the flat bottom and top areas, wherein the housing comprises a metallic cup part and a metallic top part.

12. (Previously Presented) The method as claimed in claim 11, wherein the electrode-separator assembly is inserted as a winding.

13. (Previously Presented) The method as claimed in claim 12, further comprising:

inserting the winding into the metallic top part, and

inserting the metallic top part with the winding into a metallic cup part.

14. (Previously Presented) The method as claimed in claim 12, wherein the winding is heat-treated on its end faces before being installed, with it being at least for a short time subjected to a temperature at which the separator is thermoplastically deformable.

Remarks

Claim 1 has been amended to recite "a spiral winding having end faces defining side surfaces of the spiral winding facing in an axial direction relative to the flat bottom area and the flat top area." Support for the amendments can be found, for example, in paras. [0022] to [0026] and Figs. 1, 2, 4 and 5 of the Applicants' specification.

The Applicants note with appreciation the Examiner Interview of March 13, 2015. The Applicants discussed amendment of Claim 1 to incorporate the language suggested on page 4 of the Official Action of January 5, 2015. The Examiner indicated that the amendment of Claim 1 to incorporate language similar to that set forth in the Official Action would be helpful in distinguishing over the Suzuki reference. However, no agreement was reached.

Claims 1, 2, and 4-14 are rejected under 35 USC §112, first paragraph, as indefinite. Specifically, the rejection states that the term "the top area" lacks antecedent basis. In light of the amendment of Claim 1, the Applicants respectfully submit that Claim 1 is clear and definite. Withdrawal of the rejection is respectfully requested.

Claims 1, 2, 4-6, and 9-13 are rejected under 35 USC §103(a) as obvious over Nakayama in view of Suzuki. The rejection concedes that Nakayama does not disclose a spiral winding as recited in Claim 1 and turns to Suzuki to cure this deficiency.

The Applicants respectfully submit that the combination of Nakayama and Suzuki does not result in the subject matter of the rejected claims. As can be seen by comparison of Fig. 1 of the Applicants' specification (shown below on the left) with Fig. 2 of Suzuki (shown below on the right), the end faces of the spiral windings face in different directions. In particular, as further clarified by the amendment of Claim 1, the end faces of the winding define side surfaces of the spiral winding and face in an axial direction relative to the flat bottom area and the flat top

area. This is sharply contrasted to Fig. 2 of Suzuki, which shows the spiral winding orientated at 90° relative to the Applicants' spiral winding wherein the end faces of the spiral winding are oriented in the radial direction and are not oriented in the axial direction with respect to the flat bottom area and the flat top area.

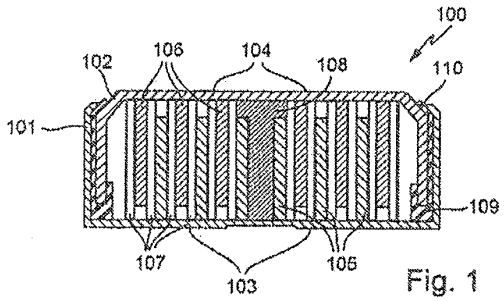

Fig. 1

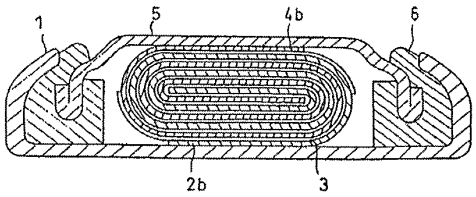

FIG. 2

Moreover, the Applicants have discovered that orientation of the spiral winding is critical with respect to the longevity of the resulting button cell. In that regard, when a lithium electrode is in the form of spiraling wound flat layers, the extension/shrinking of the spiral winding during charging and discharging is directional. Hence, the spiral winding in the cell shown Fig. 2 of Suzuki would exert a significant pressure in the axial direction against the top and bottom of the cell during charging/discharging which could lead to movement of the housing cup and housing top relative to one another, thereby resulting in potential damage to the cell.

In sharp contrast, in the Applicants' button cells such as those recited in Claim 1, the alignment of electrode layers at a right angle to the flat bottom and flat top areas of the housing of the cell insures that mechanical pressure during charging and discharging is exerted primarily in a radial direction instead of in the axial direction. This is far, far less likely to cause structural problems associated with the cell.

As a result, if one skilled in the art were to import the teachings of Suzuki into Nakayama, the resulting cell would be completely different from the cells recited in Claims 1, 2, 4-6 and 9-13. Withdrawal of the rejection is respectfully requested.

Claims 7, 8 and 14 stand rejected under 35 USC §103 over the further combination of Cantave with Suzuki and Nakayama. The Applicants respectfully submit that Cantave fails to cure the deficiencies set forth above with respect to the underlying combination of Suzuki with Nakayama. Withdrawal of the rejection is accordingly respectfully requested.

In light of the foregoing, the Applicants respectfully submit that the entire application is now in condition for allowance, which is respectfully submitted.

Respectfully submitted,

T. Daniel Christenbury
Reg. No. 31,750

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(215) 656-3381

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Art Unit	: 1726	**Customer No.: 035811**
Examiner	: Julian Anthony	
Serial No.	: 13/146,669	Docket No.: RUF-11-1270
Filed	: July 28, 2011	
Inventors	: Eduard Pytlik	Confirmation No.: 6273
	: Ulrich Barenthin	
	: Winfried Gaugler	
Title	: BUTTON CELLS AND METHOD	
	: FOR PRODUCING SAME	
		Dated: March 19, 2015

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

The Applicants enclose Form PTO-1449 listing a US publication cited in a related Chinese Examination Report dated January 13, 2015. The publication is submitted under 37 CFR §1.56 and is believed related to this application for the reasons stated.

Applicants certify that each item of information contained in the Supplemental Information Disclosure Statement was first cited in any communication from any foreign patent office in a counterpart foreign application not more than three months ago.

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Respectfully submitted,

T. Daniel Christenbury
Reg. No. 31,750

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Form PTO-1449 US DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY. DOCKET NO. RUF-11-1270	SERIAL NO. 13/146,669
	APPLICANT Eduard Pytlik, et al.	
LIST OF PUBLICATIONS CITED BY APPLICANT *(Use several sheets if necessary)*	FILING DATE July 28, 2011	GROUP 1726

US PATENT DOCUMENTS

EXAMINER INITIAL*		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
	AA	4,487,819	12/11/84	R. Koga			
	AB						
	AC						
	AD						
	AE						
	AF						
	AG						
	AH						
	AI						
	AJ						
	AK						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION YES	TRANSLATION NO
	AL							
	AM							
	AN							
	AO							
	AP							

OTHER PUBLICATIONS (Including Author, Title, Date, Pertinent Pages, Etc.)

	AR	
	AS	
	AT	

EXAMINER	DATE CONSIDERED

*EXAMINER: Initial if publication considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to Applicant.

Electronic Acknowledgement Receipt

EFS ID:	21824559
Application Number:	13146669
International Application Number:	
Confirmation Number:	6273
Title of Invention:	BUTTON CELLS AND METHOD FOR PRODUCING SAME
First Named Inventor/Applicant Name:	Eduard Pytlik
Customer Number:	35811
Filer:	Thomas Daniel Christenbury/Vivian Pena
Filer Authorized By:	Thomas Daniel Christenbury
Attorney Docket Number:	RUF-11-1270
Receipt Date:	19-MAR-2015
Filing Date:	07-SEP-2011
Time Stamp:	16:41:09
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Miscellaneous Incoming Letter	RUF-11-1270-ATL.pdf	106293 be6752cecb3ebf753c10de4573043fbd0d673e30	no	1
Warnings:					
Information:					

2		RUF-11-1270-Response.pdf	471701 bd0f8d8c7b6744ebeb51167b543e7d0f2e115ed7	yes	7

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Amendment/Req. Reconsideration-After Non-Final Reject	1	1
Claims	2	4
Applicant Arguments/Remarks Made in an Amendment	5	7

Warnings:					
Information:					
3	Transmittal Letter	RUF-11-1270-SIDS.pdf	77633 765e1727a6e9e4f689ffaf7eb04db3bff6c028c8	no	1
Warnings:					
Information:					
4	Information Disclosure Statement (IDS) Form (SB08)	RUF-11-1270-PTO-1449.pdf	107542 37f10723de3e1f7e08427ef47bacb3f6339ab9d7	no	1
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
		Total Files Size (in bytes):	763169		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Attorney Docket No.: RUF-11-1270

In re Application of: Eduard Pytlik et al.
Serial No.: 13/146,669
Filed: July 28, 2011
For: BUTTON CELLS AND METHOD FOR PRODUCING SAME

Mail Stop Amendment
Commissioner for Patents
P.O. Box 14508
Alexandria, VA 22313-1450

Sir:

A response to the outstanding official action in the above-identified application is enclosed, along with a Supplemental Information Disclosure Statement and Form PTO-1449.

☐ Small entity status of this application under 37 CFR §1.9 and §1.27 has been established.

☐ This is a Petition for an Extension of Time for the period noted below, as well as for any additional period necessary to render this submission timely.

☒ No additional fee is required.

		SMALL ENTITY	OTHER THAN SMALL ENTITY
TIME EXTENSION PETITION FEE	No. of month(s): 0		$0.00
Subtract time extension fee previously paid	No. of month(s): 0		($0.00)
TOTAL EXTENSION FEE DUE			$0.00

CLAIM FEE	CLAIM(S) REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	EXTRA CLAIM(S) PRESENT	RATE	ADD'L CLAIM FEE	RATE	ADD'L CLAIM FEE
TOTAL	13	MINUS	20	= 0	x 40=	$	x 80=	$0.00
INDEPENDENT	1	MINUS	3	= 0	x 210=	$	x 420=	$0.00
☐	FIRST PRESENTATION OF MULTIPLE CLAIM(S)				+ 390=	$	+ 780=	$0.00
	TOTAL ADDITIONAL CLAIM FEE DUE					$		$0.00
							TOTAL FEE DUE:	**$0.00**

☒ Please charge Deposit Account No. 50-2719 in the amount of $ ___.

☒ The Commissioner is authorized to charge payment of the following fees associated with this communication or credit any overpayment to Deposit Account No. 50-2719.

☒ Any filing fees under 37 CFR §1.16 for the presentation of extra claims.

☒ Any patent application processing fees under 37 CFR §1.17.

Respectfully submitted,

T. Daniel Christenbury, Reg. No. 31,750

Date: March 19, 2015

TDC/vp
(215)656-3381

EAST\96764331.1

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 13/146,669	Filing Date 09/07/2011	☐ To be Mailed

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 = *		X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 = *		X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	03/19/2015	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 13	Minus	** 20	= 0	X $80 =	0
	Independent (37 CFR 1.16(h))	* 1	Minus	***3	= 0	X $420 =	0
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	0

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
/DORIS BURNS/

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/146,669	09/07/2011	Eduard Pytlik	RUF-11-1270	6273

35811 7590 03/30/2015

IP GROUP OF DLA PIPER LLP (US)
ONE LIBERTY PLACE
1650 MARKET ST, SUITE 4900
PHILADELPHIA, PA 19103

EXAMINER	
ANTHONY, JULIAN	

ART UNIT	PAPER NUMBER
1726	

NOTIFICATION DATE	DELIVERY MODE
03/30/2015	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

pto.phil@dlapiper.com

Applicant-Initiated Interview Summary	**Application No.** 13/146,669	**Applicant(s)** PYTLIK ET AL.	
	Examiner JULIAN ANTHONY	**Art Unit** 1726	

All participants (applicant, applicant's representative, PTO personnel):

(1) *Julian Anthony*. (3)_____.

(2) *Lisa Lint*. (4)_____.

Date of Interview: *13 March 2015*.

Type: ☒ Telephonic ☐ Video Conference
☐ Personal [copy given to: ☐ applicant ☐ applicant's representative]

Exhibit shown or demonstration conducted: ☐ Yes ☒ No.
If Yes, brief description: _____.

Issues Discussed ☐101 ☐112 ☐102 ☐103 ☒Others
(For each of the checked box(es) above, please describe below the issue and detailed description of the discussion)

Claim(s) discussed: *pending claims*.

Identification of prior art discussed: *N/A*.

Substance of Interview
(For each issue discussed, provide a detailed description and indicate if agreement was reached. Some topics may include: identification or clarification of a reference or a portion thereof, claim interpretation, proposed amendments, arguments of any applied references etc...)

Discussed prior office action, applicant will consider claim language that reflects features suggested on page 4 of the prior office action.

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

☐ Attachment

/Julian Anthony/ Examiner, AU 1726	/PATRICK RYAN/ Supervisory Patent Examiner, Art Unit 1726

Summary of Record of Interview Requirements

Manual of Patent Examining Procedure (MPEP), Section 713.04, Substance of Interview Must be Made of Record
A complete written statement as to the substance of any face-to-face, video conference, or telephone interview with regard to an application must be made of record in the application whether or not an agreement with the examiner was reached at the interview.

Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews
Paragraph (b)

In every instance where reconsideration is requested in view of an interview with an examiner, a complete written statement of the reasons presented at the interview as warranting favorable action must be filed by the applicant. An interview does not remove the necessity for reply to Office action as specified in §§ 1.111, 1.135. (35 U.S.C. 132)

37 CFR §1.2 Business to be transacted in writing.
All business with the Patent or Trademark Office should be transacted in writing. The personal attendance of applicants or their attorneys or agents at the Patent and Trademark Office is unnecessary. The action of the Patent and Trademark Office will be based exclusively on the written record in the Office. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is disagreement or doubt.

———

The action of the Patent and Trademark Office cannot be based exclusively on the written record in the Office if that record is itself incomplete through the failure to record the substance of interviews.

It is the responsibility of the applicant or the attorney or agent to make the substance of an interview of record in the application file, unless the examiner indicates he or she will do so. It is the examiner's responsibility to see that such a record is made and to correct material inaccuracies which bear directly on the question of patentability.

Examiners must complete an Interview Summary Form for each interview held where a matter of substance has been discussed during the interview by checking the appropriate boxes and filling in the blanks. Discussions regarding only procedural matters, directed solely to restriction requirements for which interview recordation is otherwise provided for in Section 812.01 of the Manual of Patent Examining Procedure, or pointing out typographical errors or unreadable script in Office actions or the like, are excluded from the interview recordation procedures below. Where the substance of an interview is completely recorded in an Examiners Amendment, no separate Interview Summary Record is required.

The Interview Summary Form shall be given an appropriate Paper No., placed in the right hand portion of the file, and listed on the "Contents" section of the file wrapper. In a personal interview, a duplicate of the Form is given to the applicant (or attorney or agent) at the conclusion of the interview. In the case of a telephone or video-conference interview, the copy is mailed to the applicant's correspondence address either with or prior to the next official communication. If additional correspondence from the examiner is not likely before an allowance or if other circumstances dictate, the Form should be mailed promptly after the interview rather than with the next official communication.

The Form provides for recordation of the following information:
- Application Number (Series Code and Serial Number)
- Name of applicant
- Name of examiner
- Date of interview
- Type of interview (telephonic, video-conference, or personal)
- Name of participant(s) (applicant, attorney or agent, examiner, other PTO personnel, etc.)
- An indication whether or not an exhibit was shown or a demonstration conducted
- An identification of the specific prior art discussed
- An indication whether an agreement was reached and if so, a description of the general nature of the agreement (may be by attachment of a copy of amendments or claims agreed as being allowable). Note: Agreement as to allowability is tentative and does not restrict further action by the examiner to the contrary.
- The signature of the examiner who conducted the interview (if Form is not an attachment to a signed Office action)

It is desirable that the examiner orally remind the applicant of his or her obligation to record the substance of the interview of each case. It should be noted, however, that the Interview Summary Form will not normally be considered a complete and proper recordation of the interview unless it includes, or is supplemented by the applicant or the examiner to include, all of the applicable items required below concerning the substance of the interview.

A complete and proper recordation of the substance of any interview should include at least the following applicable items:
1) A brief description of the nature of any exhibit shown or any demonstration conducted,
2) an identification of the claims discussed,
3) an identification of the specific prior art discussed,
4) an identification of the principal proposed amendments of a substantive nature discussed, unless these are already described on the Interview Summary Form completed by the Examiner,
5) a brief identification of the general thrust of the principal arguments presented to the examiner,
   (The identification of arguments need not be lengthy or elaborate. A verbatim or highly detailed description of the arguments is not required. The identification of the arguments is sufficient if the general nature or thrust of the principal arguments made to the examiner can be understood in the context of the application file. Of course, the applicant may desire to emphasize and fully describe those arguments which he or she feels were or might be persuasive to the examiner.)
6) a general indication of any other pertinent matters discussed, and
7) if appropriate, the general results or outcome of the interview unless already described in the Interview Summary Form completed by the examiner.

Examiners are expected to carefully review the applicant's record of the substance of an interview. If the record is not complete and accurate, the examiner will give the applicant an extendable one month time period to correct the record.

Examiner to Check for Accuracy

If the claims are allowable for other reasons of record, the examiner should send a letter setting forth the examiner's version of the statement attributed to him or her. If the record is complete and accurate, the examiner should place the indication, "Interview Record OK" on the paper recording the substance of the interview along with the date and the examiner's initials.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

35811 7590 06/22/2015

IP GROUP OF DLA PIPER LLP (US)
ONE LIBERTY PLACE
1650 MARKET ST, SUITE 4900
PHILADELPHIA, PA 19103

EXAMINER	
ANTHONY, JULIAN	
ART UNIT	PAPER NUMBER
1726	

DATE MAILED: 06/22/2015

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/146,669	09/07/2011	Eduard Pytlik	RUF-11-1270	6273

TITLE OF INVENTION: BUTTON CELLS AND METHOD FOR PRODUCING SAME

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$960	$0	$0	$960	09/22/2015

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

35811 7590 06/22/2015
IP GROUP OF DLA PIPER LLP (US)
ONE LIBERTY PLACE
1650 MARKET ST, SUITE 4900
PHILADELPHIA, PA 19103

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/146,669	09/07/2011	Eduard Pytlik	RUF-11-1270	6273

TITLE OF INVENTION: BUTTON CELLS AND METHOD FOR PRODUCING SAME

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$960	$0	$0	$960	09/22/2015

EXAMINER	ART UNIT	CLASS-SUBCLASS
ANTHONY, JULIAN	1726	429-094000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
- ❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:
- ❑ Issue Fee
- ❑ Publication Fee (No small entity discount permitted)
- ❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ❑ A check is enclosed.
- ❑ Payment by credit card. Form PTO-2038 is attached.
- ❑ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
- ❑ Applicant certifying micro entity status. See 37 CFR 1.29 — NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
- ❑ Applicant asserting small entity status. See 37 CFR 1.27 — NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
- ❑ Applicant changing to regular undiscounted fee status. — NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

PTOL-85 Part B (10-13) Approved for use through 10/31/2013. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/146,669	09/07/2011	Eduard Pytlik	RUF-11-1270	6273

35811 7590 06/22/2015

IP GROUP OF DLA PIPER LLP (US)
ONE LIBERTY PLACE
1650 MARKET ST, SUITE 4900
PHILADELPHIA, PA 19103

EXAMINER	
ANTHONY, JULIAN	
ART UNIT	PAPER NUMBER
1726	

DATE MAILED: 06/22/2015

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 13/146,669	Applicant(s) PYTLIK ET AL.	
	Examiner JULIAN ANTHONY	Art Unit 1726	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *3-19-2015*.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on_____.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are *1,2 and 4-14*. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov .
4. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☒ All b) ☐ Some *c) ☐ None of the:
   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☒ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 3-19-2015, 1-29-2015
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
5. ☒ Examiner's Amendment/Comment
6. ☒ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Lisa Lint on June 12, 2015.

The application has been amended as follows:

1. Claim 1 has been replaced with the following:

--1. A button cell comprising:

a housing cup and a housing top separated from one another by an electrically insulating seal and which form a housing with a flat bottom area and a flat top area parallel to it,

an electrode-separator assembly within the housing comprising at least one positive and at least one negative electrode in the form of flat layers and connected to one another by at least one flat separator, and

an insulating means,

wherein the electrode layers are aligned essentially at right angles to the flat bottom area and the flat top area and the button cell is closed without being beaded over, and the electrode-separator assembly is in the form of a spiral winding having end faces defining side surfaces of the spiral winding face facing in an axial direction relative to the

flat bottom area and the flat top area, and wherein the insulating means is arranged between the end faces of the spiral winding and the housing cup and the housing top.--

Allowable Subject Matter

Claims 1, 2 and 4-14 are allowed. The following is an examiner's statement of reasons for allowance: the prior art of record does not teach or suggest the instant invention regarding a button cell having a housing cup and housing top, wherein electrode layers of a spiral electrode-separator assembly are aligned essentially at right angles to a flat bottom area and flat top area, and the electrode-separator assembly has end faces defining side surfaces of the spiral winding face facing in an axial direction relative to the flat bottom area and the flat top area, with an insulating means being arranged between the end faces of the spiral winding and the housing cup and the housing top.

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. US 2007/0200101 to Asao et al. is cited to teach a cylindrical battery having a spiral electrode-separator assembly at right angles to a flat bottom area and flat top area with side surfaces facing in an axial direction. (Asao in Figure 5)

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Julian Anthony whose telephone number is (571) 272-1289. The examiner can normally be reached on Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick J. Ryan, can be reached on (571) 272-1292. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

/Julian Anthony/
Examiner, Art Unit 1726

/PATRICK RYAN/
Supervisory Patent Examiner, Art Unit 1726

Notice of References Cited	Application/Control No. 13/146,669	Applicant(s)/Patent Under Reexamination PYTLIK ET AL.	
	Examiner JULIAN ANTHONY	Art Unit 1726	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-2007/0200101	08-2007	Asao et al.	252/500
	B	US-			
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13146669	PYTLIK ET AL.
	Examiner	**Art Unit**
	JULIAN ANTHONY	1726

CPC							
Symbol						**Type**	**Version**
H01M		10	/	0427		F	2013-01-01
Y10T		29	/	49108		A	2015-01-15
H01M		2	/	0222		I	2013-01-01
H01M		6	/	10		I	2013-01-01
H01M		10	/	0431		I	2013-01-01
H01M		10	/	05		I	2013-01-01
H01M		10	/	24		I	2013-01-01
H01M		10	/	34		I	2013-01-01
Y02E		60	/	124		A	2013-01-01
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CPC Combination Sets								
Symbol					**Type**	**Set**	**Ranking**	**Version**
			/					
			/					

/JULIAN ANTHONY/ Examiner, Art Unit 1726	6-15-15	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	13	
/PATRICK RYAN/ Supervisory Patent Examiner.Art Unit 1726	06/15/2015	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	4

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13146669	PYTLIK ET AL.
	Examiner	**Art Unit**
	JULIAN ANTHONY	1726

US ORIGINAL CLASSIFICATION						INTERNATIONAL CLASSIFICATION										
CLASS	SUBCLASS					CLAIMED					NON-CLAIMED					
429	94					H	0	1	M	4 / 00 (2006.01.01)						
CROSS REFERENCE(S)						H	0	1	M	6 / 10 (2006.01.01)						
						H	0	1	M	6 / 12 (2006.01.01)						
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)					H	0	1	M	6 / 46 (2006.01.01)						
429	162	164	171	172		H	0	1	M	2 / 02 (2006.01.01)						
						H	0	1	M	6 / 08 (2006.01.01)						
						H	0	1	M	2 / 08 (2006.01.01)						

/JULIAN ANTHONY/ Examiner, Art Unit 1726	6-15-15	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	13	
/PATRICK RYAN/ Supervisory Patent Examiner.Art Unit 1726	06/15/2015	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	4

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13146669	PYTLIK ET AL.
	Examiner	**Art Unit**
	JULIAN ANTHONY	1726

☒ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original

/JULIAN ANTHONY/ Examiner, Art Unit 1726	6-15-15	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	13	
/PATRICK RYAN/ Supervisory Patent Examiner.Art Unit 1726	06/15/2015	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	4

Search Notes

Application/Control No.	Applicant(s)/Patent under Reexamination
13/146,669	PYTLIK ET AL.
Examiner	**Art Unit**
JULIAN ANTHONY	1726

SEARCHED			
Class	Subclass	Date	Examiner
H01M	2/0222	6/6/2015	JA
H01M	2/08	6/6/2015	JA
H01M	6/08	6/6/2015	JA
H01M	6/10	6/6/2015	JA
429	94	6/6/2015	JA
429	162	6/6/2015	JA
429	164	6/6/2015	JA
429	171	6/6/2015	JA
429	172	6-06-15	JA

INTERFERENCE SEARCHED			
Class	Subclass	Date	Examiner
PGPub interference search		6/6/2015	JA

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	DATE	EXMR
EAST limited class/keyword search	6/6/2015	JA
inventor search	6-06-15	JA

Form PTO-1449 US DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY. DOCKET NO. RUF-11-1270	SERIAL NO. 13/146,669
	APPLICANT Eduard Pytlik, et al.	
LIST OF PUBLICATIONS CITED BY APPLICANT *(Use several sheets if necessary)*	FILING DATE July 28, 2011	GROUP 1726

US PATENT DOCUMENTS

EXAMINER INITIAL*		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
/J.A./	AA	4,487,819	12/11/84	R. Koga			
	AB						
	AC						
	AD						
	AE						
	AF						
	AG						
	AH						
	AI						
	AJ						
	AK						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION YES	TRANSLATION NO
	AL							
	AM							
	AN							
	AO							
	AP							

OTHER PUBLICATIONS (Including Author, Title, Date, Pertinent Pages, Etc.)

	AR	
	AS	
	AT	

EXAMINER /Julian Anthony/	DATE CONSIDERED 06/15/2015

*EXAMINER: Initial if publication considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to Applicant.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

BIB DATA SHEET

CONFIRMATION NO. 6273

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
13/146,669	09/07/2011 RULE	429	1726	RUF-11-1270

APPLICANTS

INVENTORS

Eduard Pytlik, Ellwangen, GERMANY;
Jürgen Lindner, Ellwangen, GERMANY;
Ulrich Barenthin, Ellwangen, GERMANY;
Winfried Gaugler, Ellwangen, GERMANY;

**** CONTINUING DATA ***************************

This application is a 371 of PCT/EP10/00787 02/09/2010

**** FOREIGN APPLICATIONS ***************************

GERMANY 10 2009 008 859.8 02/09/2009
GERMANY 10 2009 060 788.9 12/22/2009
GERMANY 10 2009 030 359.6 06/18/2009

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ****

10/06/2011

Foreign Priority claimed	35 USC 119(a-d) conditions met	Verified and Acknowledged	Met after Allowance	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
☑ Yes ☐ No	☑ Yes ☐ No	/JULIAN ANTHONY/ Examiner's Signature	☐ Initials	GERMANY	3	14	1

ADDRESS

IP GROUP OF DLA PIPER LLP (US)
ONE LIBERTY PLACE
1650 MARKET ST, SUITE 4900
PHILADELPHIA, PA 19103
UNITED STATES

TITLE

BUTTON CELLS AND METHOD FOR PRODUCING SAME

FILING FEE RECEIVED	FEES: Authority has been given in Paper	
1110	No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

Form PTO-1449 US DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY. DOCKET NO. RUF-11-1270	SERIAL NO. 13/146,669
	APPLICANT Eduard Pytlik et al.	
LIST OF PUBLICATIONS CITED BY APPLICANT *(Use several sheets if necessary)*	FILING DATE July 28, 2011	GROUP 1726

US PATENT DOCUMENTS

EXAMINER INITIAL*		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
	AA						
	AB						
	AC						
	AD						
	AE						
	AF						
	AG						
	AH						
	AI						
	AJ						
	AK						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION YES	TRANSLATION NO
/J.A./	AL	8-293299	11/05/96	JP			X	
	AM							
	AN							
	AO							
	AP							

OTHER PUBLICATIONS (Including Author, Title, Date, Pertinent Pages, Etc.)

	AR	
	AS	
	AT	

EXAMINER	/Julian Anthony/	DATE CONSIDERED	06/15/2015

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/146,669	09/07/2011	Eduard Pytlik	RUF-11-1270	6273

35811 7590 07/07/2015

IP GROUP OF DLA PIPER LLP (US)
ONE LIBERTY PLACE
1650 MARKET ST, SUITE 4900
PHILADELPHIA, PA 19103

EXAMINER	
ANTHONY, JULIAN	

ART UNIT	PAPER NUMBER
1726	

NOTIFICATION DATE	DELIVERY MODE
07/07/2015	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

pto.phil@dlapiper.com

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

Application No. : 13146669
Applicant : Pytlik
Filing Date : 09/07/2011
Date Mailed : 07/07/2015

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Notice of Allowance Mailed

This application has been accorded an Allowance Date and is being prepared for issuance. The application, however, is incomplete for the reasons below.

Applicant is given two (2) months from the mail date of this Notice within which to respond. This time period for reply is extendable under 37 CFR 1.136(a) for only TWO additional MONTHS.

The informalities requiring correction are indicated in the attachment(s). If the informality pertains to the abstract, specification (including claims) or drawings, the informality must be corrected with an amendment in compliance with 37 CFR 1.121 (or, if the application is a reissue application, 37 CFR 1.173). Such an amendment may be filed after payment of the issue fee if limited to correction of informalities noted herein. See Waiver of 37 CFR 1.312 for Documents Required by the Office of Patent Publication, 1280 Off. Gaz. Patent Office 918 (March 23, 2004). In addition, if the informality is not corrected until after payment of the issue fee, for purposes of 35 U.S.C. 154(b)(1)(iv), "all outstanding requirements" will be considered to have been satisfied when the informality has been corrected. A failure to respond within the above-identified time period will result in the application being ABANDONED.

See attachment(s).

A copy of this notice MUST be returned with the reply. Please address response to "Mail Stop Issue Fee, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450".

/Shirley Winslow/
Publication Branch
Office of Data Management
(571) 272-4200

Application No. 13146669 **Drawings filed: 05/02/2014**

IDENTIFICATION OF DRAWING DEFICIENCIES

- [ ] There is a hole or the image thereof within the illustration. FIG(s)
- [ ] The illustration is penetrated or traversed by a solid or broken line that is not intended to be part of the drawing, such as a dark line caused by a flaw in the copying process. FIG(s)
- [ ] An ink stamp or the image thereof obscures part of the illustration. FIG(s)
- [ ] The drawing is marred by black smudges, obliterations, or fax/copier marks (for example, speckles or dots in a substantial portion of the drawing). FIG(s)
- [ ] Figure numbers are duplicated or missing. FIG(s)
- [ ] Drawing sheet or figure is missing. FIG(s)
- [ ] Numbers, letters, or reference characters in the drawing have been crossed out or are illegibly handwritten. FIG(s)
- [ ] The character of the lines, numbers, and letters is poor. FIG(s)
- [ ] The drawing's background shows that the original drawing was made on graph paper or other paper with a pattern or decoration. FIG(s)
- [ ] The FIG. number label is placed in a location that causes the drawing to be read upside down. FIG(s)
- [ ] Data, a reference number, or part of the drawing is truncated or missing, or a lead line has no reference number. FIG(s)
- [ ] The drawing and/or the FIG. label contain(s) foreign language. FIG(s)
- [ ] This utility application contains a photograph of a view that is capable of being illustrated as a line drawing. FIG(s)
- [ ] A petition under 37 CFR 1.84(a)(2) to accept color drawings has been granted, but the brief description of the drawings in the specification does not contain (or has not been amended to contain) the paragraph required by 37 CFR 1.84(a)(2)(iii).
- [ ] This reissue application contains added and/or amended drawings that are not labeled as "New" or "Amended" or "Canceled" as required by 37 CFR 1.173(b)(3). FIG(s)
- [ ] This Design reissue application contains a drawing that is labeled as "Canceled" but is not surrounded by brackets, or a drawing that is surrounded by brackets but is not labeled as "Canceled." See 37 CFR 1.173(b)(3). FIG(s)
- [X] OTHER: see below
- [X] COMMENTS:
  Drawings filed 05/02/2014 contains a replacement sheet for FIG. 4 but did not include FIG. 5. Per 37 CFR 1.121(d) the replacement sheet shall include all of the figures appearing on the immediate prior version, even if only one figure is being amended.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Art Unit	: 1726	**Customer No.: 035811**
Examiner	: Julian Anthony	
Serial No.	: 13/146,669	Docket No.: RUF-11-1270
Filed	: July 28, 2011	
Inventors	: Eduard Pytlik	
	: Jürgen Lindner	
	: Ulrich Barenthin	
	: Winfried Gaugler	Confirmation No.: 6273
Title	: BUTTON CELLS AND METHOD	
	: FOR PRODUCING SAME	Not. Of Allow.; 06/22/15
		Dated: July 7, 2015

TRANSMITTAL LETTER

Mail Stop Issue Fee
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In response to the Notice to File Corrected Application Papers dated July 7, 2015, Applicants submit one (1) sheet of replacement drawings comprising Figs. 4 and 5.

No fee is required in connection with the filing of the drawings. However, the Commissioner is authorized to charge any fees which may be required in connection with submission of the drawings to Deposit Account No. 50-2719.

Respectfully submitted,

T. Daniel Christenbury
Reg. No. 31,750

TDC/cc
(215) 656-3381

EAST\101783770.1

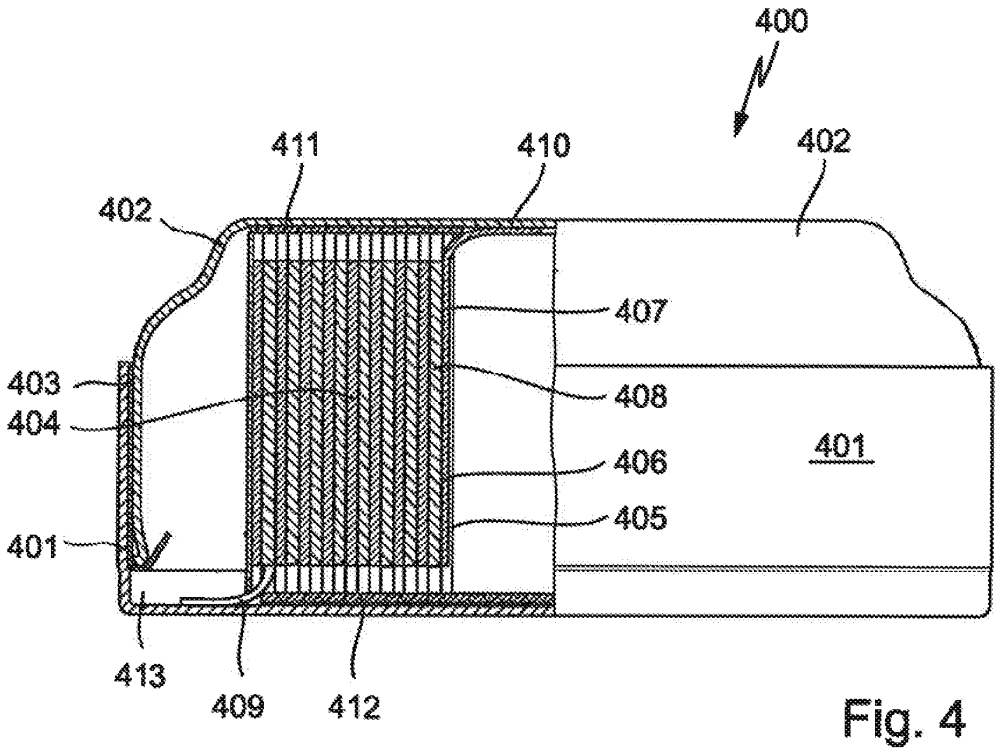
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Fig. 4

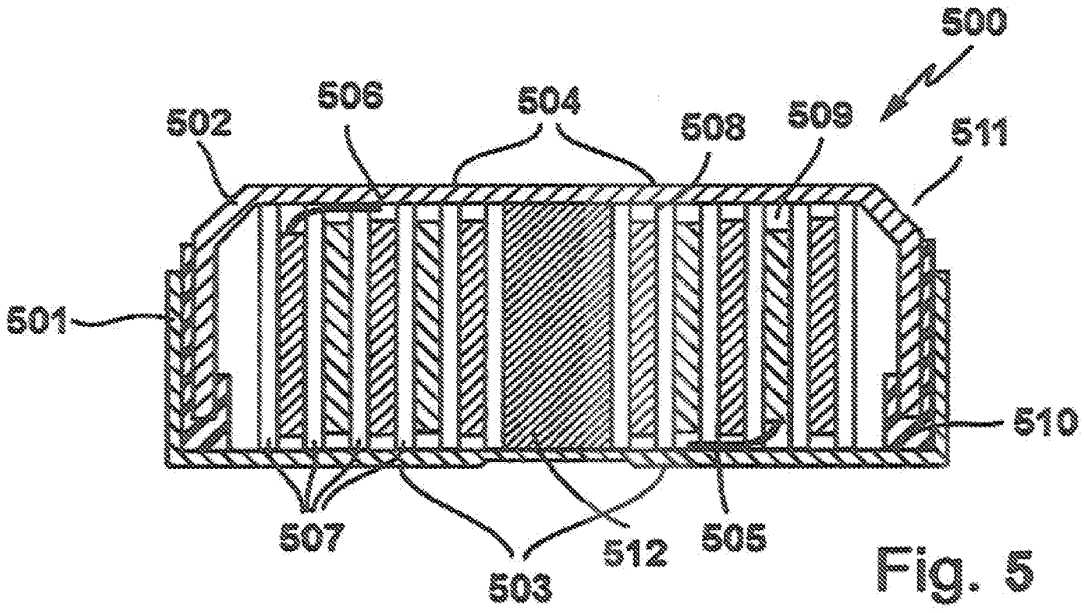
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Fig. 5

Electronic Acknowledgement Receipt

EFS ID:	22846349
Application Number:	13146669
International Application Number:	
Confirmation Number:	6273
Title of Invention:	BUTTON CELLS AND METHOD FOR PRODUCING SAME
First Named Inventor/Applicant Name:	Eduard Pytlik
Customer Number:	35811
Filer:	Thomas Daniel Christenbury/Carol Coney
Filer Authorized By:	Thomas Daniel Christenbury
Attorney Docket Number:	RUF-11-1270
Receipt Date:	07-JUL-2015
Filing Date:	07-SEP-2011
Time Stamp:	15:47:41
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	transmittal.pdf	63436 e29da9443feab4da59a32f200e9f367a2e443adf	no	1
Warnings:					
Information:					

2	Drawings-only black and white line drawings	replacementdrawing.pdf	210653 48d114eeda0334a01ede5e7aa75f733b022fda48	no	1

Warnings:	
Information:	
Total Files Size (in bytes):	274089

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Form PTO-1449 US DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY. DOCKET NO. RUF-11-1270	SERIAL NO. 13/146,669
	APPLICANT Eduard Pytlik et al.	
LIST OF PUBLICATIONS CITED BY APPLICANT *(Use several sheets if necessary)*	FILING DATE July 28, 2011	GROUP 1726

US PATENT DOCUMENTS

EXAMINER INITIAL*		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
	AA	2001/0009737	07/26/01	R. Lane			
	AB						
	AC						
	AD						
	AE						
	AF						
	AG						
	AH						
	AI						
	AJ						
	AK						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION YES	TRANSLATION NO
	AL							
	AM							
	AN							
	AO							
	AP							

OTHER PUBLICATIONS (Including Author, Title, Date, Pertinent Pages, Etc.)

	AR	
	AS	
	AT	

EXAMINER	DATE CONSIDERED

*EXAMINER: Initial if publication considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to Applicant.

Electronic Patent Application Fee Transmittal

Application Number:	13146669
Filing Date:	07-Sep-2011
Title of Invention:	BUTTON CELLS AND METHOD FOR PRODUCING SAME
First Named Inventor/Applicant Name:	Eduard Pytlik
Filer:	Thomas Daniel Christenbury/Kelly Eccleston
Attorney Docket Number:	RUF-11-1270

Filed as Large Entity

Filing Fees for U.S. National Stage under 35 USC 371

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
Submission- Information Disclosure Stmt	1806	1	180	180
		Total in USD ($)		**180**

Electronic Acknowledgement Receipt	
EFS ID:	23073331
Application Number:	13146669
International Application Number:	
Confirmation Number:	6273
Title of Invention:	BUTTON CELLS AND METHOD FOR PRODUCING SAME
First Named Inventor/Applicant Name:	Eduard Pytlik
Customer Number:	35811
Filer:	Thomas Daniel Christenbury/Kelly Eccleston
Filer Authorized By:	Thomas Daniel Christenbury
Attorney Docket Number:	RUF-11-1270
Receipt Date:	30-JUL-2015
Filing Date:	07-SEP-2011
Time Stamp:	16:03:54
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$180
RAM confirmation Number	2722
Deposit Account	502719
Authorized User	DLA PIPER US LL
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. 1.492 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	SIDS.pdf	38156 351304ab5f7599d416f1957536bb7d7776fc c6c9	no	1
Warnings:					
Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	1449.pdf	44471 f716f11f3e04243e365ce1f99fac84eb6b292 ddc	no	1
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
3	Fee Worksheet (SB06)	fee-info.pdf	30801 d33c8e1b4accc55fdc26ced2f881a9437992 f8a8	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	113428		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Art Unit	: 1726	**Customer No.: 035811**
Examiner	: Julian Anthony	
Serial No.	: 13/146,669	Docket No.: RUF-11-1270
Filed	: July 28, 2011	
Inventors	: Eduard Pytlik	Confirmation No.: 6273
	: Jürgen Lindner	
	: Ulrich Barenthin	
	: Winfried Gaugler	
Title	: BUTTON CELLS AND METHOD	
	: FOR PRODUCING SAME	
		Dated: July 30, 2015

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

The Applicants enclose Form PTO-1449 which lists a relevant US publication cited in related US Serial No. 13/378,117. The publication is submitted under 37 CFR §1.56 and is believed related to this application.

Applicants certify that each item of information contained in the Information Disclosure Statement was first cited in any communication from any foreign patent office in a counterpart foreign application not more than three months ago.

The Commissioner is authorized to charge the $180 fee as well as any insufficiency to Deposit Account No. 50-2719.

The Applicants respectfully request that this Supplemental Information Disclosure Statement be officially entered into the file and that appropriate notification be made that it was considered by the Examiner.

Respectfully submitted,

T. Daniel Christenbury
Reg. No. 31,750

TDC/ke
(215) 656-3381

EAST\102564455.1

Form PTO-1449 US DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY. DOCKET NO. RUF-11-1270	SERIAL NO. 13/146,669
	APPLICANT Eduard Pytlik et al.	
LIST OF PUBLICATIONS CITED BY APPLICANT *(Use several sheets if necessary)*	FILING DATE July 28, 2011	GROUP 1726

US PATENT DOCUMENTS

EXAMINER INITIAL*		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
/J.A./	AA	2001/0009737	07/26/01	R. Lane			
	AB						
	AC						
	AD						
	AE						
	AF						
	AG						
	AH						
	AI						
	AJ						
	AK						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION YES	TRANSLATION NO
	AL							
	AM							
	AN							
	AO							
	AP							

OTHER PUBLICATIONS (Including Author, Title, Date, Pertinent Pages, Etc.)

	AR	
	AS	
	AT	

EXAMINER /Julian Anthony/	DATE CONSIDERED 08/24/2015

*EXAMINER: Initial if publication considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to Applicant.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

35811 7590 06/22/2015
IP GROUP OF DLA PIPER LLP (US)
ONE LIBERTY PLACE
1650 MARKET ST, SUITE 4900
PHILADELPHIA, PA 19103

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/146,669	09/07/2011	Eduard Pytlik	RUF-11-1270	6273

TITLE OF INVENTION: BUTTON CELLS AND METHOD FOR PRODUCING SAME

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$960	$0	$0	$960	09/22/2015

EXAMINER	ART UNIT	CLASS-SUBCLASS
ANTHONY, JULIAN	1726	429-094000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 DLA Piper LLP (US)
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: Varta Microbattery GmbH
(B) RESIDENCE: (CITY and STATE OR COUNTRY): Germany

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:
☒ Issue Fee
☐ Publication Fee (No small entity discount permitted)
☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
☐ A check is enclosed.
☐ Payment by credit card. Form PTO-2038 is attached.
☒ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number 50-2719 (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
☐ Applicant certifying micro entity status. See 37 CFR 1.29
NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
☐ Applicant asserting small entity status. See 37 CFR 1.27
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
☐ Applicant changing to regular undiscounted fee status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date August 26, 2015
Typed or printed name T. Daniel Christenbury Registration No. 31,750

PTOL-85 Part B (10-13) Approved for use through 10/31/2013. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Art Unit	: 1726	**Customer No.: 035811**
Examiner	: Julian Anthony	
Serial No.	: 13/146,669	Docket No.: RUF-11-1270
Filed	: July 28, 2011	
Inventors	: Eduard Pytlik	Confirmation No.: 6273
	: Jürgen Lindner	
	: Ulrich Barenthin	
	: Winfried Gaugler	
Title	: BUTTON CELLS AND METHOD	
	: FOR PRODUCING SAME	Not. Of Allow.: 06/22/15
		Dated: August 26, 2015

TRANSMITTAL LETTER

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Applicants submit herewith Form PTOL-85B.

The Commissioner is authorized to charge the $960.00 fee to Deposit Account No. 50-2719 to cover the fee for payment of the issue fee.

The Commissioner is also authorized to charge any additional fees to Deposit Account No. 50-2719.

Respectfully submitted,

T. Daniel Christenbury
Reg. No. 31,750

TDC/cc
(215)656-3381

EAST\103978747.1

Electronic Patent Application Fee Transmittal

Application Number:	13146669
Filing Date:	07-Sep-2011
Title of Invention:	BUTTON CELLS AND METHOD FOR PRODUCING SAME
First Named Inventor/Applicant Name:	Eduard Pytlik
Filer:	Thomas Daniel Christenbury/Carol Coney
Attorney Docket Number:	RUF-11-1270

Filed as Large Entity

Filing Fees for U.S. National Stage under 35 USC 371

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Utility Appl Issue Fee	1501	1	960	960

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**960**

Electronic Acknowledgement Receipt	
EFS ID:	23315838
Application Number:	13146669
International Application Number:	
Confirmation Number:	6273
Title of Invention:	BUTTON CELLS AND METHOD FOR PRODUCING SAME
First Named Inventor/Applicant Name:	Eduard Pytlik
Customer Number:	35811
Filer:	Thomas Daniel Christenbury/Carol Coney
Filer Authorized By:	Thomas Daniel Christenbury
Attorney Docket Number:	RUF-11-1270
Receipt Date:	26-AUG-2015
Filing Date:	07-SEP-2011
Time Stamp:	13:34:15
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$960
RAM confirmation Number	15910
Deposit Account	502719
Authorized User	CHRISTENBURY, T DANIEL
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. 1.492 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	FormPTOL85.pdf	148363 6c2def5746a3a4ab6d0714e12a414004962d6891	no	1
Warnings:					
Information:					
2	Transmittal Letter	transmittal.pdf	58997 f72758061f708355598219348 2f2cb925f28cf17	no	1
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	30664 d18275617b1621a232c927341e630b8462f44b1f	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	238024		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/146,669	10/06/2015	9153835	RUF-11-1270	6273

35811 7590 09/16/2015

IP GROUP OF DLA PIPER LLP (US)
ONE LIBERTY PLACE
1650 MARKET ST, SUITE 4900
PHILADELPHIA, PA 19103

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 624 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Eduard Pytlik, Ellwangen, GERMANY;
Jürgen Lindner, Ellwangen, GERMANY;
Ulrich Barenthin, Ellwangen, GERMANY;
Winfried Gaugler, Ellwangen, GERMANY;

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Eastern District of Texas - Marshall Division on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
2:20-cv-00029	2/5/2020	Eastern District of Texas - Marshall Division

PLAINTIFF	DEFENDANT
VARTA Microbattery GmbH	Samsung Electronics America, Inc.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	9,153,835	10/6/2015	VARTA Microbattery GmbH
2	9,496,581	11/15/2016	VARTA Microbattery GmbH
3	9,799,913	10/24/2017	VARTA Microbattery GmbH
4			
5			

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director **Copy 3—Upon termination of action, mail this copy to Director**
Copy 2—Upon filing document adding patent(s), mail this copy to Director **Copy 4—Case file copy**

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Eastern District of Texas - Marshall Division on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
2:20-cv-00054	2/24/2020	Eastern District of Texas - Marshall Division

PLAINTIFF	DEFENDANT
VARTA Microbattery GmbH	Best Buy Co., Inc.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	9,153,835	10/6/2015	VARTA Microbattery GmbH
2	9,496,581	11/15/2016	VARTA Microbattery GmbH
3	9,799,913	10/24/2017	VARTA Microbattery GmbH
4	9,799,858	10/24/2017	VARTA Microbattery GmbH
5			

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
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In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Eastern District of Texas - Marshall Division on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
2:20-cv-00052	2/24/2020	Eastern District of Texas - Marshall Division

PLAINTIFF	DEFENDANT
VARTA Microbattery GmbH	Amazon.com, Inc.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	9,153,835	10/6/2015	VARTA Microbattery GmbH
2	9,496,581	11/15/2016	VARTA Microbattery GmbH
3	9,799,913	10/24/2017	VARTA Microbattery GmbH
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In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
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☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
2:20-cv-00051	2/24/2020	Eastern District of Texas - Marshall Division

PLAINTIFF	DEFENDANT
VARTA Microbattery GmbH	Costco Wholesale Corporation

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	9,153,835	10/6/2015	VARTA Microbattery GmbH
2	9,496,581	11/15/2016	VARTA Microbattery GmbH
3	9,799,913	10/24/2017	VARTA Microbattery GmbH
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In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Eastern District of Texas - Marshall Division on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
2:20-cv-00029	2/5/2020	Eastern District of Texas - Marshall Division

PLAINTIFF	DEFENDANT
VARTA Microbattery GmbH	Samsung Electronics America, Inc.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	9,153,835	10/6/2015	VARTA Microbattery GmbH
2	9,496,581	11/15/2016	VARTA Microbattery GmbH
3	9,799,913	10/24/2017	VARTA Microbattery GmbH
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In the above—entitled case, the following patent(s)/ trademark(s) have been included:

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