WISSEN RESEARCH
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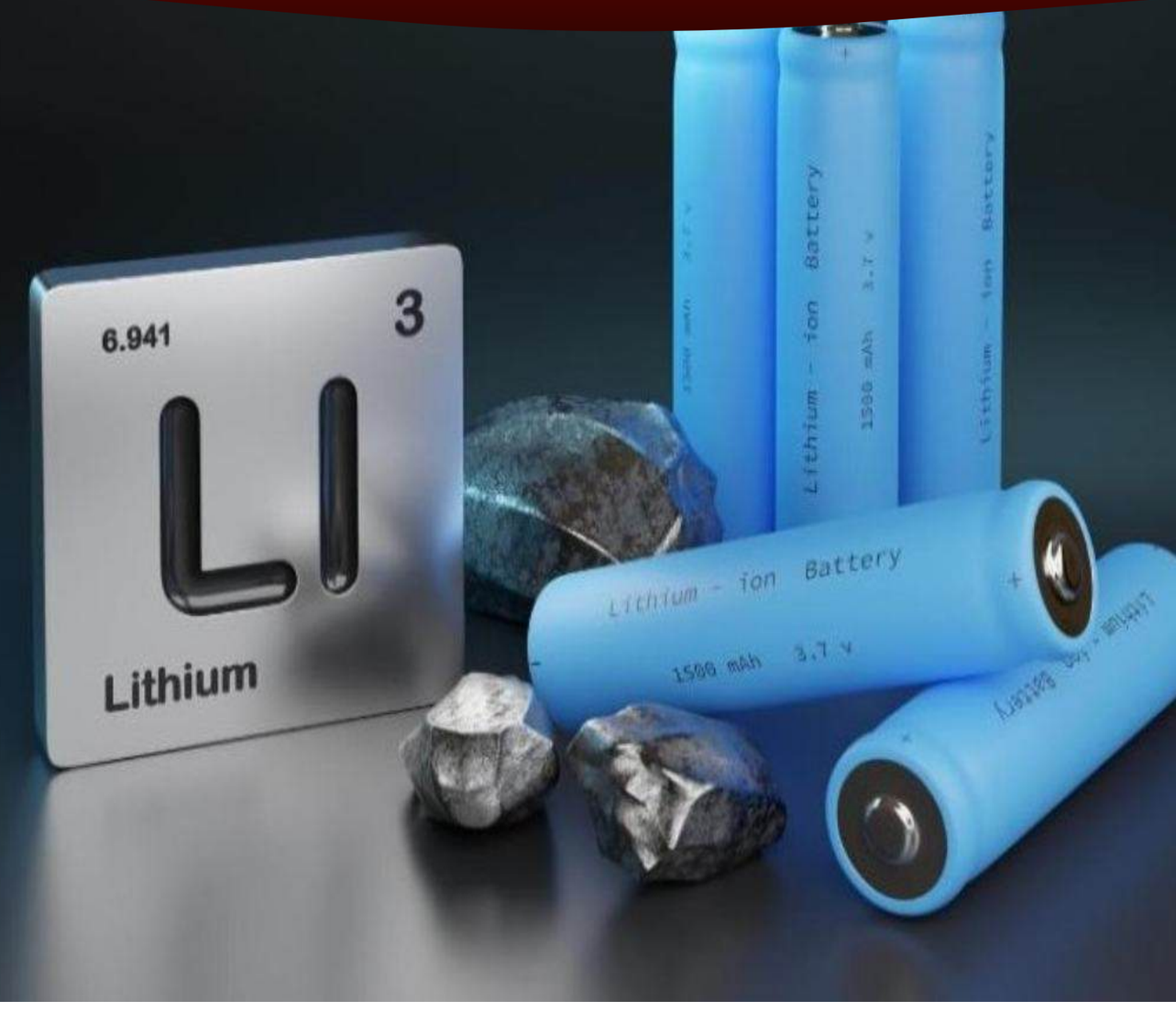
LITHIUM-ION BATTERIES

INVALIDATION CASE STUDY



INTRODUCTION TO THE PATENT IN QUESTION

The patent being challenged claimed a composition useful for lithium-ion batteries comprising discrete carbon nanotubes, crystals of lithium-ion active material, wherein the discrete carbon nanotubes have an aspect ratio of 10 to 400 and oxidation levels from 4% to 20% by weight of the carbon nanotube. The patent holder argued that this combination of features with specific aspect ratio and degree of oxidation represented a significant advancement over existing lithium battery technologies.

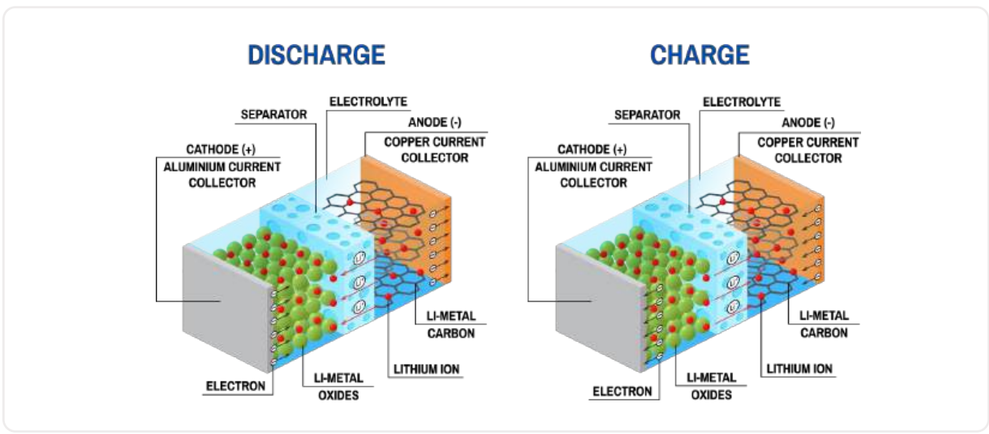
THE CHALLENGE: PROVING LACK OF NOVELTY

The patent's novelty hinged on two key features:

- The discrete carbon nanotubes have an aspect ratio of 10 to 400.
- The discrete carbon nanotubes have oxidation levels from 4% to 20% by weight of the carbon nanotube.

To invalidate the patent, we needed to demonstrate that these features were either already disclosed in prior art or could be derived through a combination of existing technologies.

Our goal was to invalidate the patent by identifying prior art that either explicitly described these features or implicitly suggested them through a combination of references, thereby challenging its novelty and non-obviousness.



INITIAL SEARCH STRATEGY

Commencing our analysis, we conducted a thorough examination of the subject patent, exploring its abstract, background, scope of invention, detailed description, provided examples, and accompanying images.

We conducted a comprehensive examination of the file wrapper, encompassing office actions, initial claims, amended claims, examiner's requisitions, non-final rejections, and the results cited by the examiner. Additionally, we considered the arguments and amendments put forth by the applicant.

Following this, we carefully examined the examiner's search strategy and the notice of allowance to gain a precise understanding of which specific points required accurate & informed searching.

After gaining a solid understanding of the intricacies of the invention and thoroughly examining its specific or innovative aspects through the file wrapper, we proceeded to commence the search process.

Throughout our search, we employed fundamental procedures to acquire a comprehensive understanding of the invention, identifying pertinent keywords along with their synonyms and technical equivalents.

Before beginning our search process, we initially made an exclusion list consisting of prior art that should not be a part of our shortlisted references, which includes known citations of the present invention, their family members, and the family members of the subject patent.

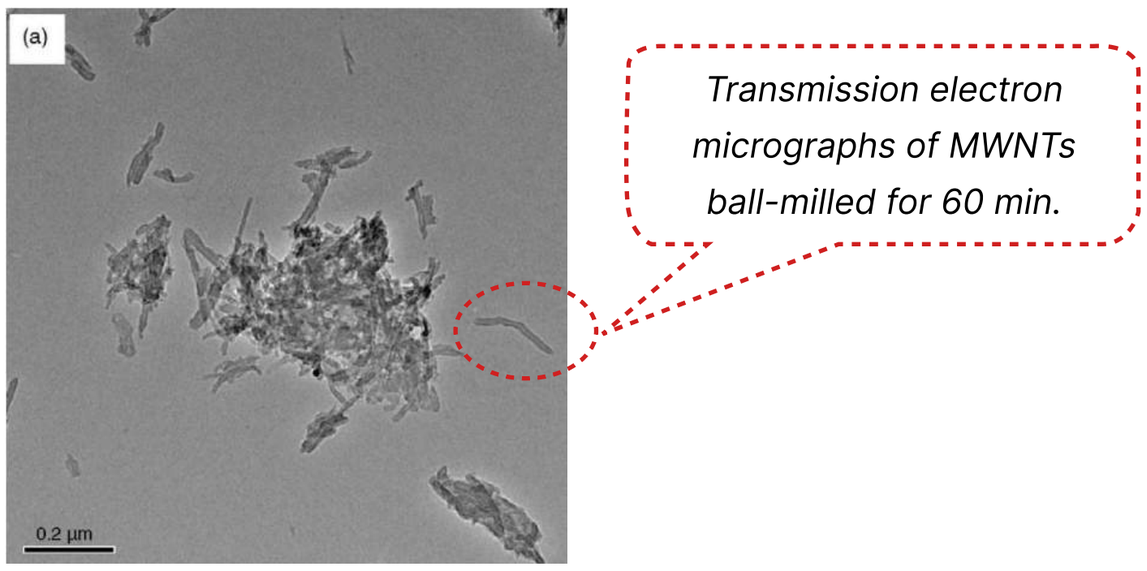
Initial searches using keywords like “lithium batteries,” “discrete carbon nanotubes,” and “aspect ratio” and performed keyword-based search with different combinations of keywords

PATENT DATABASES

- Paid & free patent databases, such as Orbit, Patsnap, Google Patents, United States Patent and Trademark Office (USPTO), European Patent Office (EPO), etc.
- Non-patent databases, such as Google, ScienceDirect Google Scholar, ACS, Research Gate, Springerlink, Osti.Gov, Wiley Online Library, Pubmed, Google Books, etc.
- Explored native databases, such as Chinese Patent Databases (CNIPA), and Japanese Patent Databases, such as J-PLAT PAT, J-STAGE, The Japan Foundation Japanese Language Center, KJC Korea Journal Central, and East View Information Services. etc.

CHALLENGES WE FACED

- **Aspect Ratio**: The prior arts we initially encountered were lithium-ion batteries with multi wall carbon nanotubes. However, no such references disclosed carbon nanotubes having an aspect ratio of 10 to 400.



source: https://sci-hub.se/https://doi.org/10.1016/j.jpowsour.2005.08.024

REFINED SEARCH STRATEGY

We further refined our search by applying different relevant logic to get better results:

- **Broader terminology**: We included terms that can cover the invention in a broader aspect, like “length and diameter of Carbon nanotubes,” to capture alternative phrasing.

- **Combining Keywords and Classes**: Used classes like Y10S977/742 (Carbon nanotubes, CNTs), Y02E60/10 (Energy storage using batteries), and Y10S977/948 (Energy storage/ generating using nanostructure, e.g., fuel cell, battery) and performed a keyword-based search using terms like “aspect ratio,” “length,” and “diameter”.

- **Global Prior Art**: Included patents and applications from Japan, South Korea, and China to uncover region-specific innovations. We even looked for jurisdiction-specific patent databases.

- **Assignee Analysis**: Focused on companies working on lithium-ion batteries and performed assignee-based search.

- **Inventor Analysis**: Investigated prolific inventors in battery and electrode design, particularly those with expertise in lithium-ion batteries. Traced their patent portfolios and publications to uncover overlooked references, including prototypes or experimental designs.

- **Combination Analysis**: Evaluated initially shortlisted patents to check whether any combination of prior arts is possible on common grounds.

BREAKTHROUGH FINDINGS

The refined search uncovered critical prior art that, when combined, disclosed all features of the patented invention.

Prior Art 1:

The prior art discloses the effects of ball-milling on Li insertion as anode into individual multi-walled carbon nanotubes (MWNTs). The individual multi-carbon nanotube has a length of over 10µm & a diameter of about 10–20 nm.

Later on, the article mentioned the average length of the MWNTs is reduced to about 0.2 µm after ball milling for 60 min (i.e., equivalent to a 10 to 20 aspect ratio by applying the formula aspect ratio = length of a particle divided by its diameter).

By applying this formula, the aspect ratio comes under the broad range of aspect ratios disclosed in the subject patent, i.e., 10-400. Also, the cited reference discloses that the oxygen content in surface functional groups of purified MWNTs is about 0.6937 to 8.0720.

Prior Art 2:

The prior art discloses discloses lithium-ion batteries, LBLMWNTs, and a litigated Li4Ti5O12 (LTO) negative electrode. The length of MWCT Wranges from approximately 1 to 20nm, and the outer diameter is 15+5 nm of a multi-wall carbon nanotube (i.e., the aspect ratio of MWNT is likely to be between 20 and 66), with an oxygen content of 10.6%.

OUTCOME AND IMPACT

- **Novelty Invalidated**: References themselves and also the combination of references demonstrated that the discrete carbon nanotubes used in lithium-ion batteries with an aspect ratio of 10 to 400 and oxidation levels from 4% to 20% by weight of the carbon nanotube were not novel.

- **Inventor Credibility**: The inventor's prior work established that discrete carbon nanotubes used in lithium-ion batteries with an aspect ratio of 10 to 400 and oxidation levels from 4% to 20% by weight, were an obvious extension of existing solutions, weakening the patent's "non-obviousness" argument.

CONCLUSION

Overall, the identified references cover all the claim elements of the composition used in lithium-ion batteries comprising discrete carbon nanotubes, crystals of lithium-ion active material, wherein the discrete carbon nanotubes have an aspect ratio of 10 to 400 and oxidation levels from 4% to 20% by weight of the carbon nanotube. This invention is an extension of existing work, lacking novelty. This case demonstrates the power of a multifaceted patent search strategy in challenging the validity of a patent. Such efforts ensure patents drive genuine innovation rather than stifle competition, promoting a dynamic technological landscape.