

Patent Asset Discovery and Recovery Service


US06919592B2

(12) **United States Patent**
Segal et al.

(10) **Patent No.:** US 6,919,592 B2
(45) **Date of Patent:** Jul. 19, 2005

(54) **ELECTROMECHANICAL MEMORY ARRAY USING NANOTUBE RIBBONS AND METHOD FOR MAKING SAME**

(75) **Inventors:** Brent M. Segal, Medford, MA (US); Darren K. Brock, Elmsford, NY (US); Thomas Rueckes, Watertown, MA (US)

(73) **Assignee:** Nantero, Inc., Woburn, MA (US)

(*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 430 days.

(21) **Appl. No.:** 09/915,093

(22) **Filed:** Jul. 25, 2001

(65) **Prior Publication Data**
US 2003/0021966 A1 Jan. 30, 2003

(51) **Int. Cl.:** H01L 29/73

(52) **U.S. Cl.:** 257/209; 343/773

(58) **Field of Search** 257/208, 209, 257/317, 320, 331, 343, 773, 438/668, 52, 283

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,448,302 A	6/1969	Shanefield	.....	307/318
3,740,404 A	6/1973	Danand et al.	.....
3,892,890 A	7/1975	Watanae et al.	.....
4,324,814 A	4/1982	Reichert	.....	427/86
4,378,629 A	4/1983	Borlev et al.	.....	29/590
4,496,355 A	1/1985	.....	.....	357/22
4,510,016 A	4/1985	Chi et al.	.....	156/643
4,524,431 A	6/1985	Hakem et al.	.....
4,673,474 A	6/1987	Ogawa	.....	204/157.64
4,694,427 A	9/1987	Miyamoto et al.	.....
4,701,842 A	10/1987	Olowisch	.....	364/200
4,707,197 A	11/1987	Hensel et al.	.....	437/189
4,758,534 A	7/1989	Derkis, Jr. et al.	.....	437/89

(Continued)

FOREIGN PATENT DOCUMENTS

EP	0 217 023 A2	4/1987
EP	0 269 225 A2	6/1988
EP	0 269 225 A3	6/1988

(Continued)

OTHER PUBLICATIONS

"Double-Sided 4Mb SRAM Coupled Cap PBGA Card Assembly Guide," International Business Machines Corp. (IBM), 1998.

Tyagi et al. "A 130nm Generation Logic Technology Featuring 70nm Transistors, Dual Vi Transistors and 6 Layers of Cu Interconnects," Portland Technology Development.

"Preliminary 8Mb (256Kx36 & 512Kx18) [IBM0418ASCBLB, IBM0418ACBLB, IBM0436ASCBLB, IBM0436ACBLB]." International Business Machines Corp. (IBM), 1998.

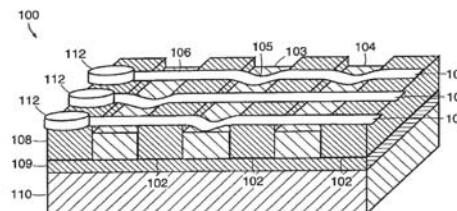
(Continued)

Primary Examiner—W. David Coleman
(74) **Attorney, Agent, or Firm—Hale and Dorr LLP**

(57) **ABSTRACT**

Electromechanical circuits, such as memory cells, and methods for making same are disclosed. The circuits include a structure having electrically conductive traces which extend from a surface of the substrate, and nanotube ribbons suspended by the supports that cross the electrically conductive traces, wherein each ribbon comprises one or more nanotubes. The electro-mechanical circuit elements are made by providing a structure having electrically conductive traces and supports, in which the supports extend from a surface of the substrate. A layer of nanotubes is provided over the supports, and portions of the layer of nanotubes are selectively removed to form ribbons of nanotubes that cross the electrically conductive traces. Each ribbon includes one or more nanotubes.

36 Claims, 16 Drawing Sheets



iValue LLC

PATENT ASSET DISCOVERY AND RECOVERY SERVICE

*i*Value LLC

Background

*i*Value is an independent multidisciplinary leader in methods for creating value from technology. As the name suggests, we care about the thoughtful use of technology. The Firm solves the most challenging problems encountered with the commercialization and management of technology.

Our clients are owners, CEOs, CFOs, CTOs, executives, investors, technical professionals, government officials, and heads of academic or other organizations. The track record for *i*Value is impressive, ranging from triggering the deployment of a new billion-dollar service, licensing an innovative technology platform, developing a patent acquisition strategy, to the turnaround of a major technology company.

We apply the principles of strategy and finance to patents. A quantitative approach is taken with a relentless focus on increasing value, not hyping technology. Our staff is comprised of talented professionals who are skilled in business and technical disciplines, including world-class executives, scientists, and patent experts. They can be thought of as "double majors" and have a record of academic excellence, with undergraduate and advanced degrees from top schools.

Firebird™ Service

There is significant value hidden in the large number of underutilized patents at corporations and universities. Our Firebird™ service provides active management of this neglected part of the corporate balance sheet or university endowment, using a modern focus on portfolios rather than individual patents. The margins achieved in monetizing these patent assets are as high as 90%. The discovery and recovery process has six steps: a) Identify the Most Promising Opportunities, b) Organize into Families of Inventions, c) Assess Return and Risk, d) Construct Preferred Combinations, e) Summarize the Monetization Strategy, f) Structure the Deals and Implement. To conduct this work a specialized team is assembled comprised of high technology researchers, industry executives, patent experts, and other important players with the talent, knowledge, and relationships to recognize and capitalize on distressed high technology patent assets. As a professional firm, *i*Value serves the corporation and its management in creating shareholder value from patents or, similarly, the university and its technology transfer office in achieving their mission of commercializing inventions that benefit society while funding education and research. The engagement fees can be structured on either a retainer or contingency basis.

Example: *i*Value has experience in patent strategy, technology licensing, and acquisitions. One qualification involves a major new software tool invented for C programmers that was nearing completion by a world-class team of developers. The development team wanted to license the product to a software publisher with marketing and distribution skills to reach the target user community, rather than try to build them de novo. Only a major software publishing company would have the necessary resources to do this successfully. The publisher had to be identified, contacted, convinced, and contracted to commercialize the software and create a viable long-term business. A business case was developed and a large database company was successfully approached to acquire an exclusive worldwide license. Negotiations were conducted and a mutually agreeable deal was structured worth an estimated \$10,000,000.

Management

Christopher Gardner is the founder of *iValue* and an industry leader in technology strategy. He is the author of *The Valuation of Information Technology* (John Wiley & Sons, 2000) which was favorably reviewed by the Harvard Business School, and *Measuring Value in Healthcare* (2008) highlighted as among the best papers on the science website arXiv.org. Previously he was a Partner at PricewaterhouseCoopers, a VP at Bain & Co, a Principal at A.T. Kearney and a Specialist at McKinsey and Co. He holds an MBA in Finance and a BS/BA in Physics from the University of Chicago. **Pierre Jean Everaert** is a distinguished thought leader at *iValue* and a top executive who has led a series of major international acquisitions. He is a Senior Advisor for Clearwater Capital Partners, was Chairman of the Board of InBev NV/SA, and served as Chairman and/or CEO/President of Baan, Philips Electronics NV, Koninklijke Ahold NV, and General Biscuits. He has served on numerous boards including Eurosia, Paribas NV, Scott Paper, Burry Inc., Ezaki-Glico, and various government associations. **Khasha Mohammadi** is a practice leader at *iValue* and an expert on patent strategies. At Bell Laboratories he helped develop industry standards and technologies as well as system architectures. He has received three patents and is an adjunct professor at Stevens Institute of Technology. He holds Masters and Ph.D. degrees in Electrical Engineering from the University of Minnesota. **Thomas Morgan** is a practice leader at *iValue* who has served over 200 enterprises in the negotiation, design, construction, and operation of large complex systems. Previously he was a Partner at PricewaterhouseCoopers. He is a member of IEEE/ASM, Carnegie Mellon University Software Engineering Institute, and the Project Management Institute. Tom holds a BS in Mathematics and Information Science from the University of Pittsburgh and the United States Military Academy.

Senior Advisors

Emanuele Ostuni is a scientific advisor for *iValue* specializing in nanotechnology. He is currently Vice President of Business Development at NanoTerra and has completed a number of licensing deals and technical collaborations to commercialize research. He completed his PhD in Physical Chemistry at Harvard under the supervision of George Whitesides, and has co-authored over 30 publications and is co-inventor on over 30 patents. **Derek Reisfield** is an investment advisor for *iValue* noted for innovative deals. He launched Marketwatch which was sold to Dow Jones for more than \$500M, and CBS.Sportsline. He is the founder of i-Hatch Ventures, was President of the CBS New Media division and VP of Business Development at The Westinghouse Electric Corporation. **Michele Spietsma** is a project advisor for *iValue*. She was a business development director and a senior product manager at Lucent Technologies. She holds an MS and a BS in Industrial Engineering and Operations Research from the Virginia Polytechnic Institute and State University. **Rainer Famulla** is a strategy advisor for *iValue* who has served large international corporations. He was a Senior Partner at Accenture, a Director at Bain & Company and a Senior Engagement Manager at McKinsey & Co. He holds a PhD in Economics from University of Karlsruhe, held a postgraduate fellowship at the University of Beijing, and worked for the United Nations in Latin America.

* * *

Clients: Abgenix, Baan, Citigroup, Nationwide, U.S. State Department, and similar F500 companies and institutions. **Press:** Articles can be found in The Economist, CFO, Wall Street & Technology, Chicago Tribune, and similar publications. **Locations:** New York and San Jose.

For further information please visit www.i-value.com