CARDEROCK DIVISION, NAVAL SURFACE WARFARE CENTER

TECH transfer UPDATE

Vol. 5, No. 2 March 2000

Annual Issue on Patents

From the Patent Counsel.....

One hundred and eleven Carderock Division inventors have documented their work in FY-99 by completing 69 invention disclosures. Ultimately, these disclosures are used to gauge innovativeness and as a starting point to protect the collective, scientific trust of knowledge at the Division. Thanks to these 111 inventors, the Division has exceeded its FY-99 goal for invention disclosures. This total of 69 disclosures is 18 more than in FY-98. Additionally, 43 patents were issued by the U.S. Patent and Trademark Office to Division inventors, and 40 new patent applications were filed in FY-99.

Patents are of major importance to the Carderock Division. Each month, the Division Board of Directors reviews the Division's progress toward its annual fiscal year goals. Patents are an important part of the review process since they are a recognized indicator of innovativeness. In addition, they make sound business sense. Top management is concerned that the intellectual capital developed within the Division for the U.S. Navy is fully protected. By disclosing their inventions, employees may help protect the Division's future and, ultimately, their own futures. Division inventors also receive numerous awards and incentives for their efforts. In addition to monetary awards, inventors share in royalties received by the Government from licenses issued to private sector organizations for commercial applications of their inventions.

"Inventions and patents are widely-recognized measures of the performance of research and development organizations. We need to ensure that our patent portfolio completely reflects the intellectual output of the Division," said Captain John Preisel, Division Commander. "As we become more involved in partnering and other non-traditional business arrangements, we must be careful to document our technical contributions to ensure the Division and the Navy receives proper credit for our efforts. Patents are the best means of protecting our interests."

In addition to the record number of disclosures received, one patent license agreement was signed in FY-99. Several more are in various stages of negotiation.

John Forrest
Carderock Division
Patent Counsel

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NAVSEA CARDEROCK Surface Warfare Center Division

Navy Vice Admiral Harold G. Bowen Patent Awar d

From left to right: Dennis Woolaver, Erich Baitis, and Rear Admiral Paul Gaffney. *Photo by Pam Lama.*

The Bowen Award recognizes inventions of great benefit to the Navy which have been patented by current or former civilian or military Navy personnel. The award honors one patent annually that is determined to have had a significant impact upon the sailor and the Navy. The award consists of a plaque and $5000. This past year, Erich Baitis and Dennis Woolaver were recognized by the Chief of Naval Research, Rear Admiral Paul Gaffney, for their invention that allows a ship to perform its motion-sensitive warfare tasks by reducing these motions with the rudders while simultaneously steering the ship as well or better.

The invention, called the Rudder Roll Stabilization (RRS), uses the rudders to compensate for wind- and wave-induced roll motions. The RRS invention provides very substantial roll reductions without negatively affecting either the ship's steering or the reliability of the steering machinery. Since every ship has to have a steering system, the use of this system to simultaneously stabilize the ship in roll and thus increase the ship's seakeeping qualities has provided the U.S. Navy with a cost-effective method of improving ship's capabilities to perform assigned missions in heavy weather.

The RRS function was incorporated into the DDG 51 production steering system by integrating it directly into the autopilot. This full integration into the steering system then deleted the additional steering redundancy featured in the patented system. A 20% to 30% operational gain using rudder roll stabilization was observed in rough weather seasons. In a combat situation, this could translate into the difference between successfully defending the ship or losing the ship. As a direct result of the experience on the first four ships of the DDG 51 Class, the decision was made to outfit the entire ship class with the RRS system as an integral part of the ships' steering controllers.

The U.S. Navy currently deploys 26 RRS systems, with one system each in DDGs 51 through 77. Furthermore, each of the follow-on ships will have the RRS system installed as a component of the normal steering system. The use of the RRS in future naval combatants will increase as the ships are built. Plans are being made to outfit the DD 21, and the follow-on CVs with RRS as part of their autopilot systems.

Licensing Navy Technology

U.S. Navy Patents can provide corporations with an extremely valuable opportunity to take technology developed for military applications into the commercial marketplace. The Technology Transfer Act of 1986, and subsequent legislation have greatly improved the transfer of technology to the private sector.

The most natural initial contact occurs when a Navy scientist or engineer works with a corporation on a dual use Navy project or at a meeting attended by inventors from both the private and government sectors. Their shared interest in a technology can lead to a Cooperative Research and Development Agreement (CRADA), allowing the government and the corporation to share the cost and benefits associated with developing a new technology.

Often initial contact occurs when a company makes an inquiry concerning the availability of a patent for licensing or simply wants to know what the Navy is doing in its field of interest. The Technology Transfer Office can quickly inform the company what patents are available for licensing in the particular area of interest and can also place the company's technical experts in contact with their opposites at the Navy Laboratory.

Completion of the License Application Form (form and instructions can be found at www.dt.navy.mil/techpat) is the first formal step in applying for a license. A key part of this process is the plan for development and/or marketing the invention, section 14. This plan should contain specific information regarding the amount of fiscal resources, facilities and equipment, technical and other personnel resources, marketing mechanisms, or other resources needed to carry out the plan to bring the invention to the commercial market place. The plan must identify a target date by which the invention is to be introduced and should include milestones which measure progress toward reaching that target. In addition, the plan should include projected yearly sales figures for several years of the license. This business plan is required because the government can only license to companies intent on actually commercializing a product. We can not grant a license to a company to

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Licensing Navy Technology

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prevent a technology from following into a competitor's hands.

If a partially exclusive or an exclusive license is requested, a notice of intent to grant exclusive license must be advertised in the Federal Register for a period of 60 days in order to give other corporations an opportunity to protest. If at the end of this period no other license applications are forth coming, a letter of determinations and findings is prepared and signed by the commanding officer. When this process is complete no other company can enter into negotiation with the government to license the technology until the license has expired or the company abandons the application.

Each negotiation is a unique process based on the perceived value of the technology, the stage of development of the technology, and the scope of the license. Licenses must be fair and reasonable for the Navy and the licensee to insure commercial application of the invention. Most licenses will include an up-front fee, a running royalty, and a minimum annual royalty.

The licensing of an invention may include a CRADA with the Navy for the transfer of the detail technology, know how, and/or further development of the invention. The use of a CRADA is an excellent approach for a licensee. CRADAs are the means to establish a contractual partnership for commercial development, and to benefit the Navy. Also, both parties have specific rights to new inventions made while doing work under a CRADA. Detailed information on CRADAs is available from the Carderock Technology Transfer Office and the web site www.dt.navy.mil/techpat

High Power Magnetostrictive Materials

Introduction

A runner eats a piece of cheese before he runs a marathon. His body converts the chemical energy stored in the cheese into mechanical energy to propel his body over the 26 plus miles of the course. The runner's body acts as a transducer, changing energy from one form to another. We encounter many transducers in everyday life; a telephone, for example has a microphone which converts sound into electrical energy and an earpiece which makes the conversion in the opposite direction. One of the important ways that electrical energy can be converted into mechanical energy is via magnetostrictive materials. In many applications magnetostriction is considered to be highly undesirable because it leads to audible noise and energy losses. In fact, a great deal of time and effort has been spent suppressing the effect. For example, Permalloy (Fe0.8Ni0.2), an alloy widely used in magnetic recording heads, is a composition chosen to have zero magnetostriction. One person's problem is another person's opportunity however, and materials with large magnetostrictions have proven to be technologically valuable.

Magnetostriction is the name given to the process whereby some materials alter their physical dimensions when a magnetic field is applied. Magnetostrictive materials can produce very high forces, but the range of motion is small. A 2.5 inch diameter rod 10 inches long, for example, can lift a 70,000 pound object 0.015 inches with the application of a modest magnetic field. These materials utilize low voltages and are, in general, rugged, impervious to adverse environmental conditions, and have a record of high reliability.

Applications

Applications of high power magnetostrictive materials are legion. Magnetostrictive materials are used to generate sound in a wide variety of forms, as the active element in motors and for a variety of other uses. Most applications are for room temperature use and utilize Terfenol-D.

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High Power Magnetostrictive Materials

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Sound Generation

The first use of magnetostrictive materials was for sound generation, e.g. sonar, and sound generation continues to be a large portion of current applications. Large, high power, low frequency sonar transmitters are particularly suited to magnetostrictive materials and several prototypes and commercial version have been produced. At ultrasonic frequencies, a 6 kW, 20 kHz continuously operating source is available for use in sonochemistry. A high power device to generate pressure waves in oil wells, which can increase production is also available. Terfenol-D magnetostrictive materials can operate at the high temperatures occurring deep in the earth where other materials fail.

On a smaller scale, magnetostrictive transducers about the size of the eraser on the end of a pencil, have been developed for use as hearing aids. Human teeth are connected via the jaw to the ear, so a sound induced in a tooth is clearly heard. In the hearing aid application the transducer, power supply and receiver are mounted on a dental plate placed in the mouth and the transducer is hooked to a tooth. Inside the mouth low operating voltages are a real plus! A microphone and transmitter worn in a shirt pocket transmits the signal to the plate. A similar device is a commercially available underwater communications system which places the transducer in a scuba mouthpiece; the diver bites the mouthpiece to make the transducer-tooth connection. Surprisingly, the mouthpiece also functions a microphone.

Motors

Magnetostrictive materials can be used as the active elements in both linear and rotary motors. Careful mechanical design is required to convert the high force, short stroke provided into a continuous motion. Almost all of the designs offer high forces with no gearing necessary and lock when the power is removed, so that additional braking hardware is not required. The Navy is developing prototype motors with the goal of replacing hydraulic systems and their attendant hazardous materials.

Other Uses

Actuators can also incorporate magnetostrictive materials, especially where high forces and small movements are needed. One use is in machining where slightly elliptical parts can be cut or tool chatter can be suppressed. Actuators can also be used for active vibration control to reduce noise generated by machinery.

Conclusion

Magnetostrictive transduction is a powerful, robust way of converting electrical energy into mechanical energy. The number of applications for these materials is rapidly growing and new magnetostrictive materials are constantly being developed here at the Carderock Division of the Naval Surface Warfare Center. (See the following table for a list of the Carderock Division magnetostrictive technology patents.)

Carderock Division Magnetostrictive Patents

Patent No.	Title
3,949,351	Variable Delay Line
4,158,368	Magnetostrictive Transducer
4,308,474	Rare Earth-Iron Magnetostrictive Materials and Devices Using These Materials
4,378,258	Conversion Between Magnetic Energy and Mechanical Energy
4,763,030	Magnetomechanical Energy Conversion
4,906,879	Terbium-Dysprosium Magnetostrictive High Power Transducers
4,996,692	Laser Communication System with Wide Band Magnetostrictive Modulation
5,039,894	Magnetostrictive Linear Motor
5,041,753	High Torque Angular Positioning Motor
5,168,760	Magnetic Multilayer Strain Guage
5,201,964	Magnetostrictive Torque Sensor
5,315,881	Magnetostrictive Torque Sensor
5,347,872	Magnetomechanical Sensor Attachment Method
5,451,821	Magnetostrictive Actuator with Auxiliary Leakage Reducing Magnetic Bias
5,530,312	Multi-Cycle Electric Motor System
5,600,239	Strain Sensing System Including a Magnetostrictive Material Having a Piezomagnetic Property Selected for Maximizing Electrical Impedance to Current Applied to a Predetermined Skin Depth
5,602,434	Pulse Controlled Motion Conversion System for Magnetostrictive Motor
5,693,154	Terbium-Dysprosium-Zinc and Terbium-Gadolinium-Zinc Magnetostrictive Materials and Devices
5,705,863	High Speed Magnetostrictive Linear Motor

Selected Recent Patents with Commercial Potential

Patent No.	Title	Inventors
5,486,811	Fire Detection and Extinguishment System	John Wehrle, Ernest Dahl, James Lugar
5,521,132	Ash-Based Ceramic Materials	Inna Talmy, Deborah Haught, Curtis Martin
5,987,397	Neural Network System for Estimation of Helicopter Gross Weight and Center of Gravity Location	Kelly McCool, David Haas
5,553,871	Fluid Tight Door Gasket	Marlin Rowe, Francis McMullin
5,960,026	Organic Waste Disposal System	Eugene Nolting, Jon Colfield, Roy Richard, Steven Peterson
5,858,801	Patterning Antibodies on a Surface	Robert A. Brizzolara
5,833,782	High-Energy-Absorbing Enclosure for Internal Explosion Containment	Roger M. Crane, Paul A. Coffin
5,958,229	Electrolytic Disinfectant System	George Filliopoulos, Thomas Wenzel
5,814,250	Method of Protecting a Structure	Philip Dudt, John Martin
5,932,091	Oily Waste Water Treatment System	Kevin Tompkins, Jerome Stefanko, Brian Owsenek, Lawrence Tomlinson, Joseph Gavin
5,890,101	Neural Network Based Method for Estimating Helicopter Low Airspeed	Carl Schaefer, Kelly McCool, David Haas
5,473,718	Fiber Optic Loose Tube Buffer to Fan Out Tube Adapter System	Keith Sommer
5,468,570	Lightweight Zinc Electrode	William Ferrando
5,411,697	Method for Processing Contaminated Plastic Waste	Peter McGraw, John Drake, Thomas Hane
5,389,411	Composite Structure Forming a Wear Surface	Edward Cohen
5,859,535	System for Detecting Size and Location of Defects in Material by Use of Microwave Radiation	John Liu
5,379,711	Retrofittable Monolithic Box Beam Composite Hull System	Eugene Fischer, Roger Crane
5,439,402	Design of an Integrated Inlet Duct for Efficient Fluid Transmission	Charles Dai, Christopher Kerr, Phuc Nguyen, Han-Ch'ing Wang
5,476,401	Compact Water Jet Propulsion System for a Marine Vehicle	Frank Peterson, Charles Dai, John McMahon

Selected Recent Patents with Commercial Potential

Patent No.	Title	Inventors
5,591,057	Hull Supported Steering and Reversing Gear for Large Waterjets	Charles Dai, John Allison
5,362,580	Lightweight Battery Electrode and Method of Making It	William Ferrando, Amarnath Divecha
5,337,288	Acoustic and Vibration Attenuation Composite Material	Usman Sorathia, Joseph Killian, Andrew Jarrett
5,047,990	Underwater Acoustic Data Acquisition System	Adamandios Gafos, Donald Maxwell, Frank Halliwell, Dana Lynn, Christopher Sears
5,266,099	Method for Producing Closed Cell Spherical Porosity In Spray Formed Metals	Paul Kelly
5,408,874	Location of Fluid Boundary Interfaces for Fluid Level Measurement	Charles Fleck, Sr., Charles Fleck, Jr.
5,751,609	Neural Network Based Method for Estimating Helicopter Low Airspeed	Carl Schaefer, Kelly McCool, David Haas
5,797,965	Suppression of Epileptiform Activity	Mark Spano, Steven Schiff, Bruce Gluckman, William Ditto
5,601,867	Method and Apparatus for Generating Fingerprints and Other Skin Prints	Harold Riedl, Robert Jehle
5,760,388	Biomedical Imaging by Optical Phase Conjugation	James Swandic
5,727,381	Duct Flow Control System	Ernest Rogers
5,779,440	Flow Energizing System for Turbomachinery	John Stricker, John Purnell
5,712,424	Method and Apparatus for Measuring Diesel Engine Cylinder Pressure	Jay Reed

http://www.dt.navy.mil

Patent Licensing and Technology Transfer at Carderock

We can work for you!

Tech Transfer includes more than patent licensing and CRADAs. Our laboratories and personnel are national assets for maritime R&D. Often this fact is not understood. The specialized knowledge and facilities of the Carderock labs are available to support industry, academia, and state and federal government activities. Public law 568 (1937) noted that "experiments may be made at this establishments for private parties." Our current mission states we are to support the Maritime Administration and the Nation's maritime industry. The extent of these lab capabilities is reported in the recently published book, "*Where the Fleet Begins*." This book details the work of these laboratories to transform vision into reality, and keep innovation flowing form cutting edge science and technology into the Navy's ships and submarines. The capability is also available to support you and the Nation's maritime industry.

For futher information, please use our internet address: www.dt.navy.mil, or contact the Technology Transfer Office. The phone numbers and e-mail addresses are shown on this page.

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