

Patented nondestructive evaluation technology developed by the Forest Service for use in the wood products industry

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Abstract

Nondestructive Evaluation (NDE) technology is now a valuable part of the harvesting and manufacturing process for improved quality and consistency of the wood products produced. The Forest Service (FS) has developed and patented several NDE technologies applicable to the wood products industry. These patents allow wood harvesters and manufacturers to measure the physical and mechanical properties of wood material while still using the wood for its intended use. These patents put FS in a unique position to promote the research, development, and use of NDE technology, and to encourage environmentally-responsible practices, within the lumber and wood industry.

Keywords: patent, nondestructive evaluation, technology, Forest Service

Introduction

Traditionally, testing the physical and mechanical properties of wood and wood products was expensive, impractical on a large scale, and required either taking physical samples from the source or destroying the

material. However, recent developments in the field of Nondestructive Evaluation (NDE) technology allow for fast, reliable, and inexpensive testing of live and cut wood that does not harm or damage the product. NDE technology has become a critical part of the harvesting, manufacturing, and research, relating to wood products. The economic benefits of improved quality and consistency when using NDE on wood products are considerable. The Forest Service (FS), part of US Department of Agriculture, holds patent rights to NDE technologies (*appendix 1*) that make it possible for wood producers, harvesters, and manufacturers to measure the physical and mechanical properties of wood material while still using the material for its intended use. Additionally, FS encourages environmentally responsible practices within the lumber and wood industry and the use of NDE is one way to accomplish that goal.

Technology transfer in the Forest Service

The federal government fosters research and development of technology to promote collaboration between the federal laboratories, universities and/or industrial cooperators. Transfer of technology to the marketplace is the goal, as this creates jobs and the American economy benefits. These activities are governed by federal laws. The first law in a continuing series on federal technology transfer is the Stevenson-Wydler Technology Innovation Act of 1980 which promotes and defines technology transfer. The Act made it easier for federal laboratories to transfer technology to nonfederal parties and provided outside organizations with a means to access federal laboratory developments. The primary focus of the Stevenson-Wydler Act was to get federal laboratories more involved in the technology transfer process, which in turn helped with the dissemination of information from the federal government. The law requires laboratories to take an active role in technical cooperation.

The next applicable law is the Bayh-Dole Act of 1980 which established more boundaries regarding patents and licenses for federally funded research and development. Small businesses, universities, and not-for-profit organizations were allowed to obtain title to inventions developed with federal funds. Government-owned and government-operated (GOGO) laboratories were permitted to grant exclusive patent licenses to commercial organizations.

A particularly useful law is the Federal Technology Transfer Act of 1986 which was the second major piece of legislation to focus directly on technology transfer. All federal laboratory scientists and engineers are required to consider technology transfer an individual responsibility, and technology transfer activities are to be considered in employee performance evaluations. In addition, the law enabled government-owned and government-operated (GOGO) laboratories to enter into Cooperative Research and Development Agreements (CRADAs) and to negotiate licensing arrangements for patented inventions made at the laboratories. It also required that government-employed inventors share in royalties from patent licenses. Further, the law provided for the exchange of personnel, services, and equipment among federal laboratories and nonfederal partners. Other specific requirements, incentives and authorities were added, including the ability of GOGO laboratories to grant or waive rights to laboratory inventions and intellectual property, and permission for current and former federal employees to participate in commercial development, to the extent that there is no conflict of interest.

Lastly, Executive Order 12591 (1987) was signed which facilitates access to science and technology by requiring that federal laboratories and agencies assist universities and the private sector by transferring technical knowledge. The Order required agency and laboratory heads to identify and encourage individuals who would act as conduits of information among federal laboratories, universities, and the private sector. It also underscored the government's commitment to technology transfer and urged GOGOs to enter into cooperative agreements to the limits permitted by law. The Order also promoted commercialization of federally funded inventions by requiring that, to the extent permitted by law,

laboratories grant to contractors the title to patents developed in whole or in part with federal funds, as long as the government is given a royalty-free license for use.

Background on the NDE industry

NDE technology allows wood producers, harvesters, and manufacturers to measure the physical and mechanical properties of a piece of wood without destroying the wood's future utility. NDE technology serves the integral function of optimizing the volume and quality of output from each tree saving both time and money in research, product evaluation, resources, and troubleshooting. NDE technology, and in particular scanning technology, is essential to measure sawn, peeled, sliced, or chipped products and to optimize sorting and further conversion. *See Figures 1 and 2 below.* NDE technology also allows for the optimal use of materials with varying internal properties and ensures that resulting products can be provided with consistent properties. NDE technology can evaluate each individual log or piece of wood and determine the most appropriate use for that log's shape and growth characteristics.



Figure 1 - An ultrasonic wood scanning machine, assigned to FS in U.S. Patent 6, 276, 209, “System and method of assessing the structural properties of wooden members using ultrasound.” This NDE technology uses vibrations to measure the internal structure of wooden planks.

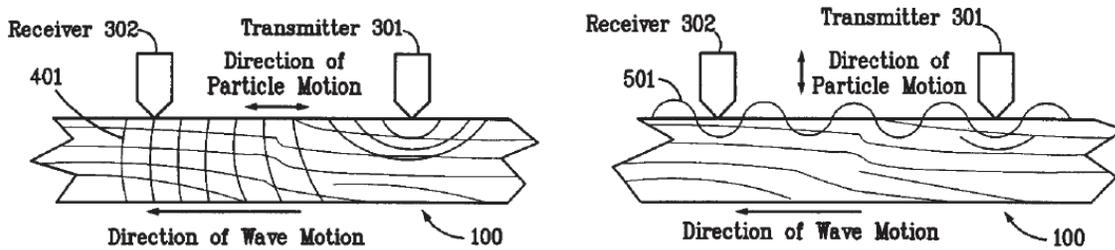


Figure 2 - A schematic showing the mechanism by which the NDE technology measures the wood's internal quality as shown in U.S. Patent No. 6,276,209 which was jointly developed by FS and an industrial collaborator.

NDE technology contributes significantly to the U.S. economy. The total U.S. market for NDE technology was valued at nearly \$2.5 billion in 2010, and is expected to be more than \$2.3 billion by 2015 (BBC Research 2010). The wood products industry supports over a million jobs in the U.S. alone (Ritter and Skog 2011) so NDE technology is a key component of the domestic job market.

Impact on the NDE Industry

Originally, scanning technology had been used only in sawmills and veneer plants to maximize volumetric yield, detect usable area, and eliminate waste in edging of boards. Now, by using the FS developed NDE technology, harvesters and processors can evaluate the internal quality of logs and trees prior to processing. Knot detection, grain direction, growth rate, and density are all key factors in determining timber value, and the timber industry can use its knowledge of these factors to maintain high-quality output and to maximize market value. Despite the value of on-site NDE technology, however, few harvesters or processors have the financial means or research capacity to develop their own NDE technology.

Additionally, FS collaborates with universities and companies to develop new NDE technologies. These collaborations benefit all the parties involved: it allows the universities to do additional relevant research and companies to develop their technology more quickly. It also can provide mechanisms for protecting any intellectual property developed during the collaboration. See *Figure 3* below.



Figure 3 - A schematic showing fibre-gen's "Hitman" automated system in which the NDE technology is mounted on field machinery and located within the harvester head and allows foresters to select and cut lumber based on wood stiffness because it enables real-time acoustic testing in operations.

For example, FS, a university, and an industrial collaborator jointly own NDE patents for standing timber. *See Figure 4 below.* The industrial collaborator is now commercializing the technology.

DIRECTOR ST300 -Functionality from Combined Technologies

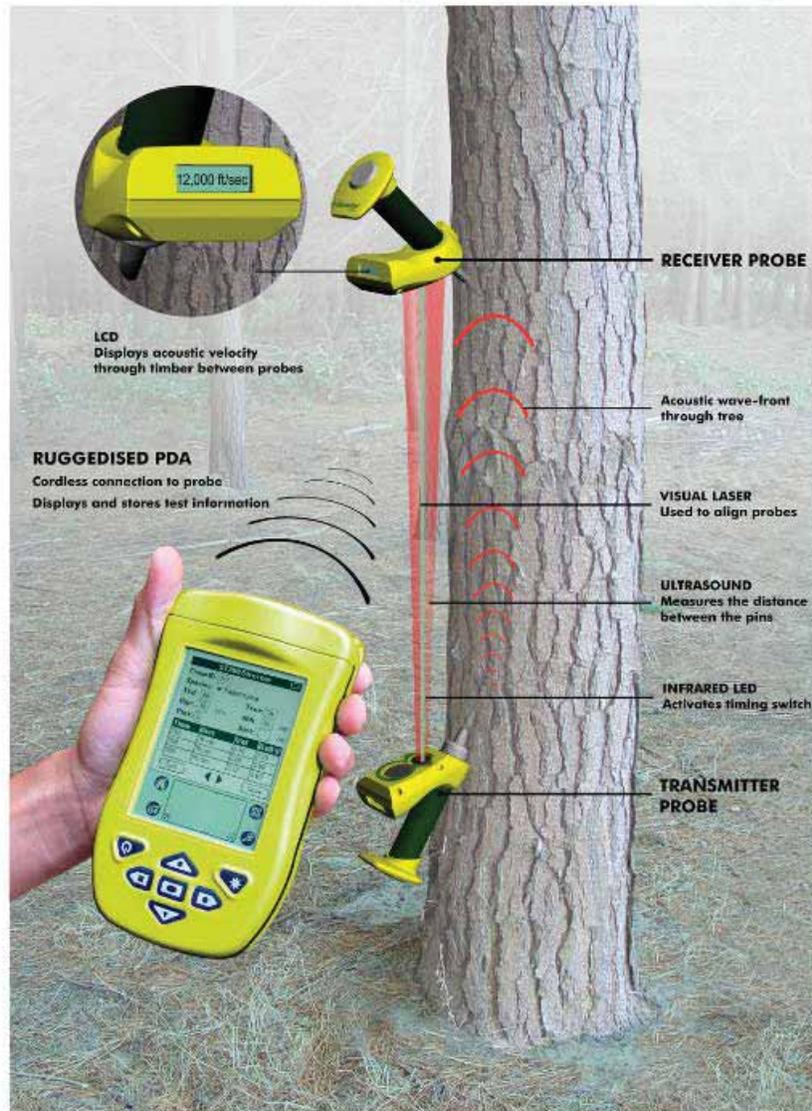


Figure 4 - A handheld NDE device capable of measuring the internal quality of standing timber. This product was developed using U.S. FS Patent No. 7,418,866 which was jointly developed and is jointly owned by FS and an industrial collaborator.

Conclusion

FS has played an invaluable role in the development and promotion of NDE technology throughout the wood products industry. Acoustic testing has become the industry standard for stiffness measurement. These technologies have made it possible to produce products that are more consistent and higher quality. The FS patents allow companies to participate in the NDE market and the FS's long history of academic

and commercial collaboration has developed technology that is revolutionizing the wood products industry.

References

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<http://bccresearch.wordpress.com/2010/11/23/u-s-market-for-ndt-technologies-to-reach-2-3-billion-in-2015/>

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U.S. Patent No. 6,276,209 entitled, “System and Method of Assessing the Structural Properties of Wooden Members.”

U.S. Patent No. 7,418,866 entitled, “Method and Apparatus for Evaluation of Standing Timber.”

NONDESTRUCTIVE EVALUATION PATENT PROSECUTION HISTORY
ROSS, et. al.
Updated July 30, 2013

Parent Application

SN: 06/843,717
Date Filed: March 25, 1986
Title: Method and Apparatus for Non-destructive Evaluation of the Mechanical Properties of Composite Materials
Inventors: Pellerin & Ross
Issued: June 13, 1989
Patent No.: 4,838,085
Status: **Expired** on 6/13/2006. All maint. fees paid through expiration.
Assignee: Washington State University Research Foundation, Inc.

Continuation in Part of S/N: 06/843,717

SN: 07/365,218
Date Filed: June 12, 1989
Title: Non-destructive Evaluation of Structural Members
Inventors: Pellerin & Ross
Issued: June 18, 1991
Patent No.: 5,024,091
Status: **Expired** on 6/12/2009. All maint. fees paid through expiration.
Assignee: Washington State University Research Foundation, Inc

Parent Application

SN: 07/857,146
Date Filed: March 25, 1992
Title: Method and Apparatus for Evaluating the Drying Properties of Un-Dried Wood
Inventors: Ross
Issued: May 3, 1994
Patent No.: 5,307,679
Status: **Expired** on 5/3/2002 for failure to pay maint. fee
Assignee: US Forest Service

Child Application

SN: 08/147,522
Date Filed: Nov. 5, 1993
Title:
Inventors: Ross
Status: **Abandoned**

Parent Application

SN: 07/912,391
Date Filed: July 13, 1992
Title: Method and Apparatus for In Situ Evaluation of Wooden Members
Inventors: Ross, DeGroot, Geske, Nelson, Malinauskas, Cuevas
Issued: March 14, 1995
Patent No.: 5,396,799
Status: **Expired** on 3/14/2003 for failure to pay maint. fee
Assignee: US Forest Service

Title (Utility 09/151,432):

Ultrasonic Apparatus for Characterizing Wooden Members Using a Measurement of Wave Distortion

Title (Utility 09/196,674):

Method and Apparatus for Detecting and Characterizing Splits in Logs

Title (Utility 09/196,674):

Method and Apparatus for On-Line Monitoring of Log Sawing

Title (Divisional 09/800,551):

Method and Apparatus for On-Line Monitoring of Log Sawing

Title (Divisional 09/882,446):

Method and Apparatus for Detecting and Characterizing Splits in Logs

Title (International):

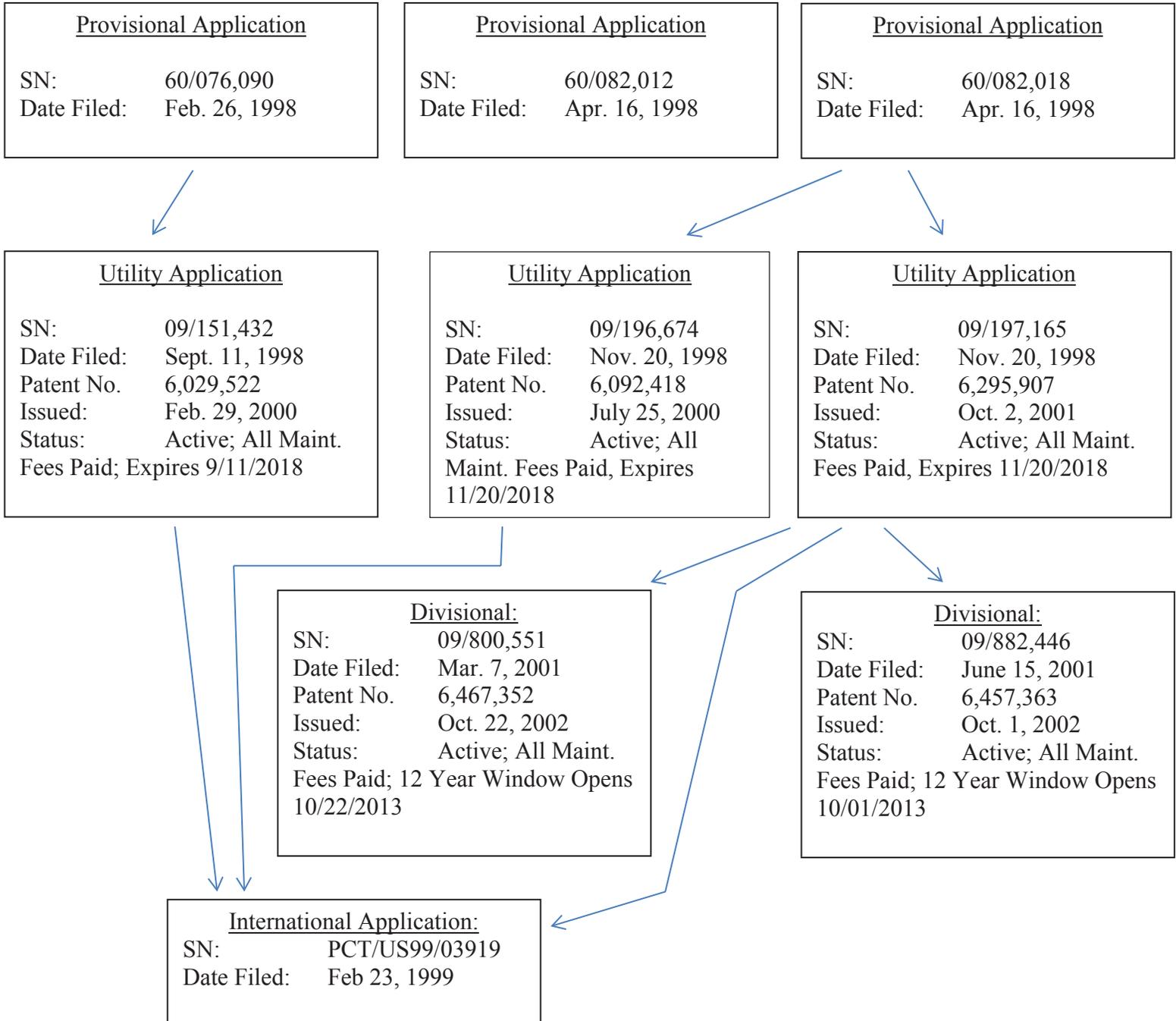
Ultrasonic Apparatus for Characterizing Wooden Members

Inventors:

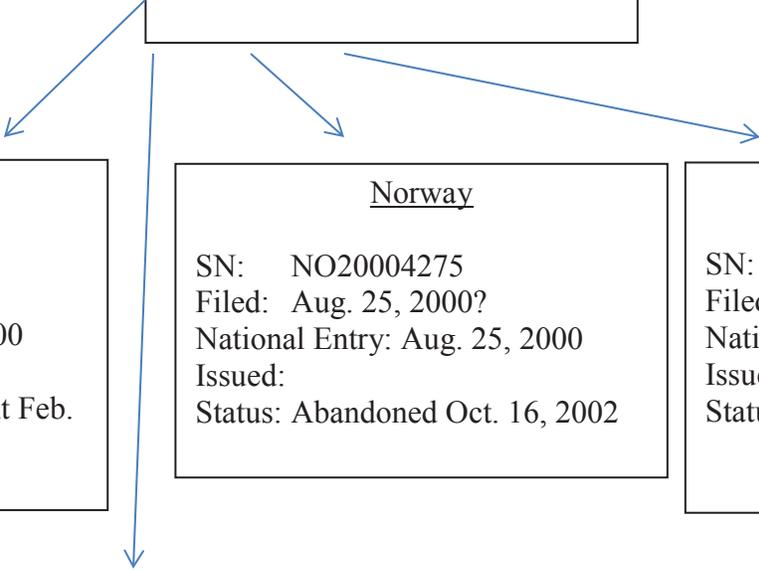
Shafer and Ross

Assignees:

USDA, U.S. Natural Resources Inc. (formerly Perceptron Inc.)



International Application:
SN: PCT/US99/03919
Date Filed: Feb 23, 1999



Canada
SN: CA2321576
Filed: Feb. 22, 1999
National Entry: Aug. 25, 2000
Issued: Dec. 4, 2007
Status: Issued, Next Payment Feb. 24, 2014

Norway
SN: NO20004275
Filed: Aug. 25, 2000?
National Entry: Aug. 25, 2000
Issued:
Status: Abandoned Oct. 16, 2002

EU
SN: EP1057011
Filed: Feb. 23, 1999
National Entry: Dec. 6, 2000?
Issued: Sept. 5, 2000 (National fee)
Status: Application withdrawn July 16, 2013

Australia
SN: AU1999027832
Filed: Feb. 22, 1999
National Entry: Sept. 5, 2000
Issued: Mar. 13, 2003 (granting date)
Status: Issued, Paid Feb 16, 2013, Next Fee Due Feb 23, 2014.

Title: System and Method of Assessing the Structural Properties of Wooden Members Using Ultrasound
Inventors: Schafer, Ross, Erickson, and DeGroot
Assignees: US Natural Resources Inc (formerly Perceptron Inc.), and USDA Forest Service

Provisional Application
SN: 60/157,182
Date Filed: Sept. 30, 1999



Utility Application
SN: 09/466,750
Date Filed: Dec. 17, 1999
Patent No. 6,276, 209
Issued: Aug. 21, 2001
Status: Active; 12 yr fee paid on 1/16/2013



International Application
SN: PCT/US00/25839
Date Filed: Sept. 21, 2000



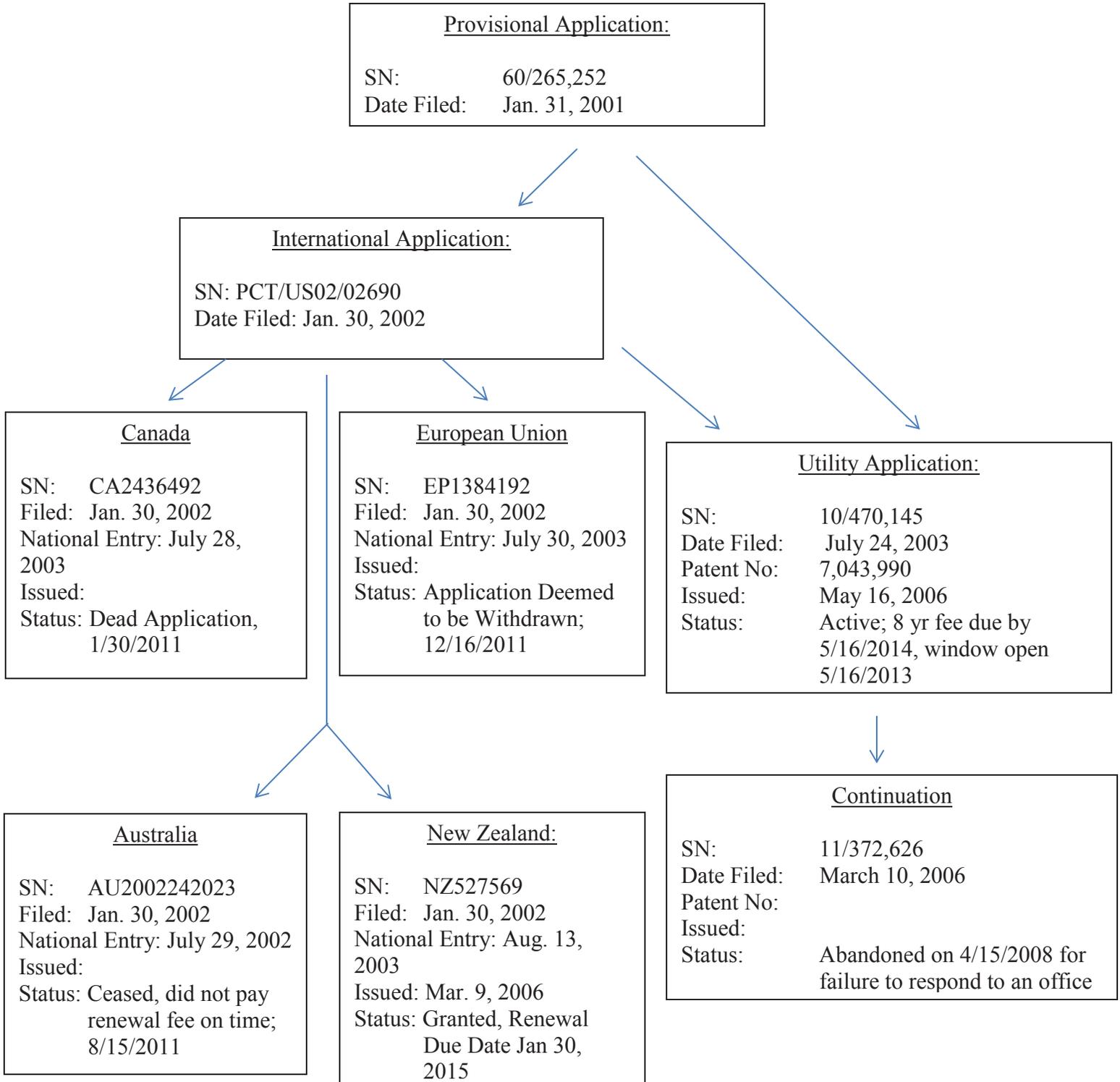
European Union
SN: EP1228364
Filed: 9/21/2000
National Entry: 3/12/2002
Issued:
Status: Lapse of patent in contracting state

Canada
SN: CA2386173
Filed: 9/21/2000
National Entry: 3/28/2002
Issued: 11/18/2008
Status: Active, next payment due 9/23/13

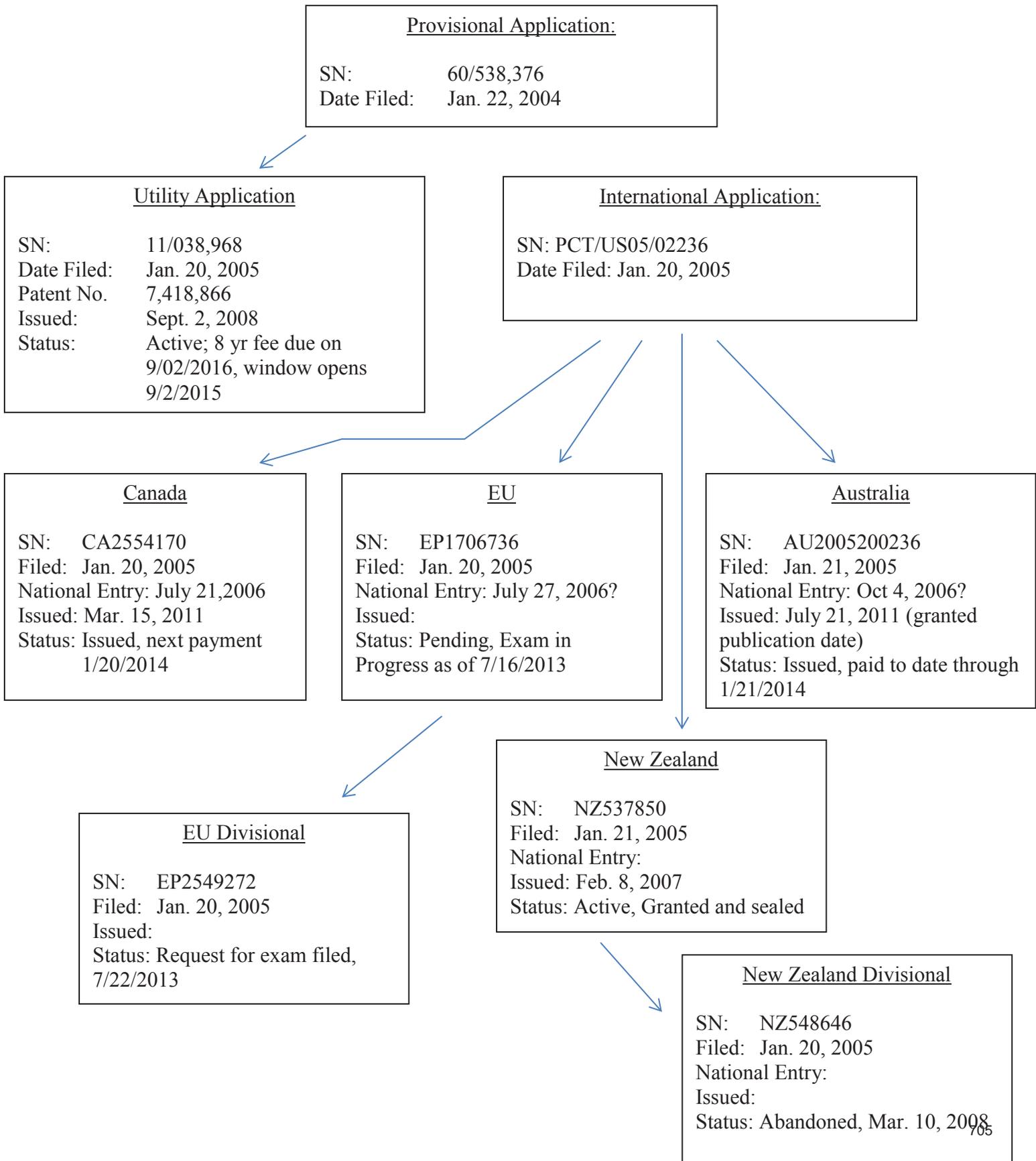
Australia
SN: AU4024801
Filed: 9/21/2000
National Entry:
Issued:
Status: Lapsed, 6/6/2002

Austria
SN: AT514077
Filed:
National Entry:
Issued:
Status:

Title: System and Method for Performing Nondestructive Evaluation Techniques on a Log or Round Timber
Inventors: Wang, Ross, Mattson, Erickson, Forsman, Geske & Wehr
Assignees: Michigan Technological University and USDA Forest Service



Title: Method and Apparatus for the Evaluation of Standing Timber
Inventors: Wang, Ross, Carter, Sharplin
Assignees: University of Minnesota, fibre-gen, and USDA Forest Service





United States Department of Agriculture
Forest Service

Forest
Products
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General
Technical
Report

FPL-GTR-226

Proceedings

18th International Nondestructive Testing and Evaluation of Wood Symposium

Madison, Wisconsin, USA
2013



Abstract

The 18th International Nondestructive Testing and Evaluation of Wood Symposium was hosted by the USDA Forest Service's Forest Products Laboratory (FPL) in Madison, Wisconsin, on September 24–27, 2013. This Symposium was a forum for those involved in nondestructive testing and evaluation (NDT/NDE) of wood and brought together many NDT/NDE users, suppliers, international researchers, representatives from various government agencies, and other groups to share research results, products, and technology for evaluating a wide range of wood products, including standing trees, logs, lumber, and wood structures. Networking among participants encouraged international collaborative efforts and fostered the implementation of NDT/NDE technologies around the world. The technical content of the 18th Symposium is captured in this proceedings.

Keywords: International Nondestructive Testing and Evaluation of Wood Symposium, nondestructive testing, nondestructive evaluation, wood, wood products

September 2013 (Corrected October 2013, pages 716–722)

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Contents

Session 1. Industrial Applications of NDT Technologies

Session 2. Nondestructive Evaluation and Hazard Assessment of Urban Trees

Session 3. Nondestructive Evaluation of Standing Timber

Session 4. Nondestructive Evaluation of Logs

Session 5. Condition Assessment of Historic Wood Structures—Experience from Around the Globe

Session 6. Nondestructive Evaluation of Composite Materials—Nanocellulosic Films to Glued Laminated Timber

Session 7. Nondestructive Evaluation of Structural Materials I—New Techniques and Approaches

Session 8. Nondestructive Evaluation of Structural Materials II—Enhancements to Traditional Methods and New Applications

Session 9. Material Characterization I—Acoustic-Based Techniques

Session 10. Material Characterization II—Near Infrared, Neutron Imaging, and Other Techniques

Session 11. Structural Condition Assessment I—NDT Fundamentals and Assessment Methods

Session 12. Structural Condition Assessment II—New Techniques and Field Experiences

Session 13. Poster Session