



THE 48<sup>TH</sup> ANNUAL

NATIONAL INVENTORS  
HALL OF FAME

*Induction Ceremony*

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2020 Inductees



## R. Rox Anderson

### Laser Dermatology

U.S. Patent No. 5,595,568

*Permanent Hair Removal Using Optical Pulses*

Inducted in 2020

*Photo Courtesy of George Anderson*

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#### Inductee Bio:

Physician Rox Anderson developed laser-based treatments and procedures now commonly used in medical care to remove birthmarks, scars and other skin lesions. Anderson's groundbreaking laser technology advanced laser-based solutions for other concerns, including permanent hair removal, acne treatment and tattoo removal.

In 1980, Anderson — then a Harvard University medical student — discovered a study on argon laser treatment for port wine stains (PWS). Though effective, the treatment carried a high risk of scarring. Anderson's quest for an alternative led to the idea of selective photothermolysis (SP), which stemmed from his theory that by using pulses of light at appropriate wavelengths, specific structures within skin could be targeted and destroyed without damaging surrounding structures. Anderson developed SP with Harvard colleague John Parrish, then worked with Candela Corp. to produce the first commercialized pulsed dye laser. SP proved a landmark concept, successfully addressing PWS and forming the basis for many other dermatological laser treatments.

With his colleague Dieter Manstein, Anderson also developed fractional photothermolysis (FP), a procedure that rehabilitates hypertrophic, or raised, scars using microscopic laser beams to initiate a natural wound healing response with no additional scarring. Anderson and Manstein also invented and developed selective cryolipolysis, which uses cold to selectively remove unwanted body fat. Cryolipolysis is now popular worldwide as a noninvasive alternative to liposuction.

Anderson has established charitable medical treatment facilities in several countries. When asked to describe himself in an interview with the National Inventors Hall of Fame®, Anderson responded, "I'm a guy who likes to solve problems, and I care about other people, and sometimes that gets expressed by solving problems in a lab, inventing and making technology work for people. I think of myself as a problem solver."

Named on more than 80 patents and the recipient of numerous awards, Anderson acquired his bachelor of science degree in life sciences from the Massachusetts Institute of Technology and his medical degree from Harvard Medical School. His laser technologies have been licensed to multiple companies, and he continues to research both laser and nonlaser applications for medicine.



#### Short Description:

NIHF Inductee Rox Anderson has improved lives across the world with his invention of laser dermatology treatments and procedures that are now commonly used to remove birthmarks, scars and other skin lesions.



## Sylvia Blankenship

**Invention Name: 1-MCP for Fruit, Vegetable and Flower Freshness**

U.S. Patent No. 5,518,988

*Official Patent Name: Method of counteracting an ethylene response in plants*

Inducted in 2020

*Photo Courtesy of Becky Kirkland/NC State University*

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### Inductee Bio:

Horticulturalist Sylvia Blankenship and biochemist Edward Sisler identified 1-methylcyclopropene (1- MCP), a novel compound that significantly extends the freshness and storage life of fruits, vegetables and cut floral products by mitigating the effects of ethylene. Contributing to large reductions in food waste, and year-round access to fresh fruit, 1-MCP is best known for its use with apple crops under the trade name SmartFresh™. For floriculture crops, it is known by the name EthylBloc™.

Ethylene, a naturally occurring gas, stimulates plant development and fruit ripening by docking in plant cell receptor sites. 1-MCP docks in these same sites, in place of ethylene, and alters the signals that drive cellular processes. As a result, produce and flowers treated with 1-MCP remain fresh much longer.

Blankenship, who as a young child had always been interested in nature, cultivated a passion for horticulture through her undergraduate and graduate education. This led her to North Carolina State University (NCSU), where she began working with Sisler to explore the properties of plant compounds. In speaking with the National Inventors Hall of Fame®, Blankenship emphasized the importance of collaboration: “If somebody has a little bit different expertise, you need to learn how you can benefit each other.”

1-MCP was patented in 1996 and was soon licensed by Floralife for floral crops. In 1996, AgroFresh was formed to commercialize 1-MCP for fruits and vegetables. Their product, SmartFresh, was approved by the Environmental Protection Agency for use in the United States and introduced in 2002. Today, SmartFresh is used on more than 30 crops, including 50 to 70% of the apples harvested in the United States. Licensing fees for 1-MCP have brought in more than \$25 million for NCSU, the highest royalty revenues in the school’s history.

Blankenship, who has received multiple awards for her work, earned her bachelor of science and master of science degrees in horticulture science at Texas A&M University, and a doctorate in horticulture science at Oregon State University. She is currently professor emerita at NCSU.



### Short Description:

NIHF Inductee Sylvia Blankenship co-invented 1-MCP, a compound that has become essential in preventing food waste, and increasing accessibility to fresh fruits, vegetables and cut flowers.



## Edward Sisler

**Invention Name: 1-MCP for Fruit, Vegetable and Flower Freshness**

U.S. Patent No. 5,518,988

*Official Patent Name: Method of counteracting an ethylene response in plants*

Inducted in 2020

*Photo Courtesy of Dr. Margrethe Serek*

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### Inductee Bio:

Edward Sisler, a biochemist at North Carolina State University (NCSU), had been studying the various aspects of ethylene physiology and biochemistry for years before collaborating with horticulturist Sylvia Blankenship in the 1980s. Sisler and Blankenship searched for compounds that could inhibit the production of ethylene, which promotes plant development, ripening and decay. Together they identified 1-methylcyclopropene (1-MCP), a novel compound now used globally to extend the storage life of fruits, vegetables and cut floral products by mitigating the effects of ethylene.

In 1996, 1-MCP was patented and the company AgroFresh was established to develop the compound as a commercial product for fruits and vegetables. Called SmartFresh™, it was approved by the Environmental Protection Agency for use in the United States in 2002.

Today, fruits, vegetables and flowers treated with 1-MCP help purveyors maintain product freshness longer, allowing more time for bringing products to market, enabling transportation over greater distances and reducing spoilage. Government agencies worldwide have found 1-MCP safe for consumption and the environment.

1-MCP has provided NCSU the highest royalty revenues in the school's history; as of 2016, SmartFresh licensing fees topped \$25 million. AgroFresh products, including SmartFresh, EthylBloc™, RipeLock™, Harvista™ and LandSpring™, are licensed in more than 70 countries. SmartFresh alone is used in 45 countries and on up to 70% of apples harvested in the United States.

Sisler, a native of Friendsville, Maryland, earned bachelor of science and master of science degrees from the University of Maryland. He obtained his doctorate in plant physiology from NCSU, where he spent his career as a biochemistry professor and researcher. In an interview with the National Inventors Hall of Fame®, Blankenship described Sisler as one of the smartest people she has ever met.



### Short Description:

NIHF Inductee Edward Sisler co-invented 1-MCP, a compound that extends the freshness of fruits, vegetables and cut flowers, ensuring their availability for consumers around the world.



## Dana Bookbinder

### Invention Name: Bend-Insensitive Optical Fiber

U.S. Patent Nos. 7,450,806; 7,903,917; 8,385,701

Official Patent Names: *Microstructured optical fibers and methods; Low bend loss single mode optical fiber; Low bend loss optical fiber*

Inducted in 2020

*Photo Courtesy of Dana Bookbinder*

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#### Inductee Bio:

Corning Incorporated researchers Dana Bookbinder, Ming-Jun Li and Pushkar Tandon invented and developed the bend-insensitive ClearCurve® optical fiber. Introduced by Corning in 2007, ClearCurve optical fiber can bend without significant signal loss and can be used in locations where optical fiber installation was not previously possible.

Before optical fiber, copper wire was the standard means of transmitting phone calls and data over long distances. While copper uses electric current, optical fiber works by sending pulses of light. Because light travels in a straight line unless there is a way to steer it around a bend, optical fiber cables initially were most useful for long-distance data transmissions that ran straight cables from a central source to boxes outside of buildings that then transmitted data to conventional copper wires. Conventional fiber containing tight bends suffered from large losses in the signal. ClearCurve optical fiber eliminated this problem.

Bookbinder, Li and Tandon's bend-insensitive optical fiber could be bent to small diameters and around tight corners with significantly less signal loss. Moreover, unlike copper wire, optical fiber is not vulnerable to electromagnetic interference and can transmit many orders of magnitude more data. Key to industries such as telecommunications and computer networking, bend-insensitive optical fiber has helped make video streaming services common in businesses and homes and it enables the ever-growing demand for internet services including cloud computing and data storage. The technology opens up a whole new world for people to have a step-change increase in connections and communication for better learning and creativity in science, engineering, art, music, literature, medicine and business.

Discussing the broad impact of bend-insensitive optical fiber in an interview with the National Inventors Hall of Fame®, Bookbinder said, "It's exciting to work on things that matter to people, and the feeling of how much you're helping someone."

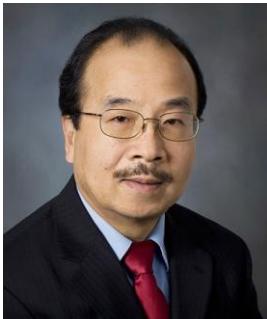
Bookbinder received his bachelor of science degree in organic chemistry from Northern Illinois University and his doctorate in inorganic chemistry from the Massachusetts Institute of Technology. Bookbinder holds more than 200 U.S. patents and shares several distinguished awards for ClearCurve optical fiber with Li and Tandon. He retired from Corning in 2018 as a Corporate Fellow.

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#### Short Description:



NIHF Inductee Dana Bookbinder co-invented the bend-insensitive ClearCurve® optical fiber. Because it can bend without significant signal loss, ClearCurve optical fiber has reached locations previously inaccessible to optical fiber and advanced data transmission across an array of industries.



## Ming-Jun Li

### Invention Name: Bend-Insensitive Optical Fiber

U.S. Patent Nos. 7,450,806; 7,903,917; 8,385,701

*Official Patent Names: Microstructured optical fibers and methods; Low bend loss single mode optical fiber; Low bend loss optical fiber*

Inducted in 2020

*Photo Courtesy of Corning Incorporated*

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#### Inductee Bio:

In 2004, experiments with new types of optical fiber led Corning Incorporated researchers Ming-Jun Li, Dana Bookbinder and Pushkar Tandon to develop what would be named ClearCurve®, a bend-insensitive optical fiber that can bend without significant signal loss. ClearCurve fiber enabled the installation of optical fiber in previously impossible locations and advanced the process of data transmission.

Before optical fiber, copper wire was used to transmit phone calls and data over long distances. Copper uses electric current, while optical fiber sends pulses of light. Fiber is less vulnerable to electromagnetic interference and can transmit far more data. However, conventional optical fiber required long, straight cables to transmit data without significant signal loss, and it could not transmit light around tight bends.

The group discovered that certain types of optical fiber could transmit light around tight bends when they explored wrapping the material around a cylindrical rod. The light continued traveling through the fiber and out the other end. Eventually, the trio created a fiber that caused light beams to be reflected smoothly back into the core rather than diffracted in the cladding at a sharp bend. This new fiber had a core surrounded with a low refractive index “optical trench.” The fiber structure was optimized for both single-mode fiber and high-bandwidth multimode fibers that were fully standards-compliant for fiber-to-the-home and data center applications.

A native of China, Li earned his bachelor of science degree in applied physics at Beijing Institute of Technology, his master of science degree in optics and signal processing at the University of Franche-Comté and his doctorate in physics at the University of Nice. A Corning Corporate Fellow, Li joined the company in 1994. In a conversation with the National Inventors Hall of Fame®, Li praised the culture at Corning: “I think the innovation culture is really important. In Corning, everybody is encouraged to discover new things, to come up with new designs, new innovations.”

Li holds more than 200 U.S. patents and shares several awards for ClearCurve optical fiber with Bookbinder and Tandon.

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#### Short Description:



NIHF Inductee Ming-Jun Li co-invented the bend-insensitive ClearCurve® optical fiber, which can bend without causing significant signal loss. This breakthrough technology has allowed optical fiber to reach more locations and provide greater bandwidth with fiber-to-the-home applications.



## Pushkar Tandon

### Invention Name: Bend-Insensitive Optical Fiber

U.S. Patent Nos. 7,450,806; 7,903,917; 8,385,701

*Official Patent Names: Microstructured optical fibers and methods; Low bend loss single mode optical fiber; Low bend loss optical fiber*

Inducted in 2020

*Photo Courtesy of Corning Incorporated*

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#### Inductee Bio:

Chemical engineer Pushkar Tandon is one-third of the Corning Incorporated research team that developed ClearCurve® optical fiber, a bend-insensitive optical fiber capable of bending without causing significant signal loss. In 2004, Tandon worked with his colleagues, chemist Dana Bookbinder and optical scientist Ming-Jun Li, and they applied their combined expertise to experiments leading to a new optical fiber that enabled the transmission of light around small, tight bends.

Before the introduction of bend-insensitive optical fiber, copper was the standard material used to connect the optical fiber telecommunications backbone with homes and buildings. However, it presented limitations. “We want all this information at our fingertips. Copper just does not have the capability to provide the same level of information that an optical fiber does,” Tandon explained in an interview with the National Inventors Hall of Fame®. The problem was that existing optical fiber required skilled labor, long installation times and careful management of bends around corners for successful data transmission inside a home, in multiple dwelling units and inside data centers. Fiber containing tight bends suffered from large losses in the signal, making it impossible to install around structures like indoor walls and door frames and for connecting inside data centers.

Corning had long been investigating residential uses of optical fiber; the company knew that running fiber directly into homes and offices — called fiber-to-the-home — would significantly increase the speed and volume of data delivery. As Tandon, Li and Bookbinder’s work evolved, Corning executives fast-tracked the project’s development.

Thanks to the invention of ClearCurve optical fiber, broadband fiber networks have enabled video streaming services to become commonplace in businesses and homes. The technology enables online gaming, internet of things, telemedicine, telecommuting and smart city technologies, and it meets the ever-growing need for internet services including cloud computing and data storage.

Tandon, a Corning Development Fellow, shares multiple awards for ClearCurve optical fiber with Bookbinder and Li, including the 2017 ACS Heroes of Chemistry Award. A native of India, he received his bachelor of technology degree from the Indian Institute of Technology in Delhi, and his doctorate from Yale University, both in chemical engineering. Tandon currently holds more than 135 U.S. patents.

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#### Short Description:



NIHF Inductee Pushkar Tandon co-invented the bend-insensitive ClearCurve® optical fiber, which enabled the installation of optical fiber in previously impossible locations, advanced the process of data transmission, and provided greater bandwidth to homes and businesses.



# National Inventors Hall of Fame®



## Lisa Lindahl

### Invention Name: Sports Bra

U.S. Patent No. 4,174,717

*Official Patent Name: Athletic brassiere*

Inducted in 2020

*Photo Courtesy of RLPhoto Studio*

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#### Inductee Bio:

Lisa Lindahl, Hinda Miller and Polly Smith created the Jogbra®, the first sports bra. Their groundbreaking invention removed a barrier to women's participation in athletics, advanced women's health and launched a global industry.

In 1977, while living in Burlington, Vermont, and running 30 miles each week, Lindahl found no garments that could adequately support a woman's breasts during athletic activities. She made a list of qualities an athletic bra should have, including stable straps, no chafing from seams or clasps, breathable fabric and enough compression to prevent excessive movement. Lindahl asked her childhood friend, Smith, to help develop her idea. After several prototypes, Smith sewed two jockstraps together and Lindahl tested it on a run. This became the first workable sports bra prototype.

Patented in 1979, the athletic brassiere was commercialized as the Jogbra, featuring a seamless, compressing front panel, non-chafing exterior seams, crossing elastic straps and a wide elastic rib band for support. "The sports bra has had an immeasurable, cumulative impact in the lives of ordinary women," Runner's World magazine reported. "Without a garment designed to support our bodies properly, millions of [women] wouldn't have taken up running."

Lindahl co-founded Jogbra Inc. – later renamed JBI – in 1977 and partnered with Hinda Miller in growing the company. In an interview with the National Inventors Hall of Fame®, Lindahl explained that the Jogbra "was the right product at the right time." Because the sports bra addressed a very real need shared by women everywhere, sales were brisk, and remarkably the company became profitable in its first year of operation. Lindahl served as CEO of JBI until 1990, when the company was sold to Playtex Apparel.

Diagnosed with epilepsy at age 4, Lindahl is a champion for women's health, and an artist and author. She served as the senior vice president on the board of the Epilepsy Foundation of America, and in 2001 she co-created the Bellisse Compression Comfort® Bra, a patented compression garment for breast cancer survivors.

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#### Short Description:



NIHF Inductee Lisa Lindahl invented the sports bra, advancing women's health and enabling their participation in athletic activities while breaking new ground by co-founding one of the first women-owned businesses in the sporting goods industry.



## Hindy Miller

### Invention Name: Sports Bra

U.S. Patent No. 4,174,717

Official Patent Name: *Athletic brassiere*

Inducted in 2020

*Photo Courtesy of RLPhoto Studio*

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#### Inductee Bio:

Hindy Miller, Lisa Lindahl and Polly Smith developed the first sports bra. Patented in 1979, the undergarment enabled women to comfortably participate in athletics, advanced women's health and is today a staple in women's wardrobes worldwide.

During the 1970s, more women than ever before were participating in sports and fitness activities. In 1977, Lindahl, who was a runner, asked Smith, a costume designer, to help fashion an undergarment to minimize the discomfort she experienced on runs. That summer, Miller was working with Smith as an assistant designer for a Shakespeare festival in Burlington, Vermont. As someone who had been physically active since childhood, she joined the project to develop an athletic brassiere. When Smith sewed two jockstraps together and Lindahl tested them on a run, they produced a working prototype.

Miller and Lindahl commercialized the invention as the Joggbra®, co-founding their company, Joggbra Inc. — later renamed JBI — in 1977 with Miller in charge of future product design, manufacturing, collaborating on marketing strategies and serving as company president. The Joggbra launched a multi-billion-dollar industry. According to Smithsonian.com, “The introduction of the sports bra did more than improve athletes’ performances. It represented a revolution in ready to wear clothing, and for many women athletes, the bra actually made sports possible.” In speaking with the National Inventors Hall of Fame®, Miller said, “We created the marketplace, and we made space for women of all sizes and all activities.”

Playtex Apparel bought JBI Inc. in 1990. In 1991, Sara Lee — the owner of Champion Products Inc. — bought Playtex and formed the Champion Joggbra division. Miller held roles as president, CEO and vice president of communications for Champion Joggbra before leaving in 1997.

A native of Montreal, Miller earned a bachelor of fine arts degree in environmental design from Parsons School of Design and a master of fine arts degree in theater design from New York University. She served as a Vermont state senator from 2003-12 and currently runs Deforest Concepts, a business consulting firm.



#### Short Description:

NIHF Inductee Hindy Miller invented and commercialized the sports bra, establishing one of the first women-owned businesses in sporting goods with a garment that has enabled greater inclusivity in athletic activities and advanced women's health.



## Polly Smith

**Invention Name: Sports Bra**

U.S. Patent No. 4,174,717

*Official Patent Name: Athletic brassiere*

Inducted in 2020

*Photo Courtesy of RLPhoto Studio***Inductee Bio:**

Polly Smith, Lisa Lindahl and Hinda Miller created the Jogbra® — the first sports bra. With its compressing front panel, smooth exterior seams, supportive elastic rib band and crossing elastic straps, the Jogbra enabled millions of women to comfortably participate in athletics, advancing women's health and launching a global industry.

Before the Jogbra, female athletes often experienced chest and upper torso discomfort while engaged in sports. Many women modified conventional brassieres or wrapped tight garments around their chests in attempts to curtail the discomfort. In 1977, Smith, a costume designer, was asked by her childhood friend Lindahl to apply her skills to address this problem. Miller, who had been working with Smith as an assistant designer for a Shakespeare festival in Burlington, Vermont, also joined the project to develop an athletic brassiere.

The bra required stable straps, no chafing from seams or clasps, breathable fabric and enough compression to prevent excessive movement. Smith achieved the first workable prototype by sewing together two jockstraps. In an interview with the National Inventors Hall of Fame®, Smith said, "When I see women in the gym wearing a sports bra, or women athletes, I'm very proud that I was a part of it. It's thrilling to see." Smith further advanced the design by choosing a cotton-Lycra® blend that recreated the shape of the prototype, held its form and met the desired requirements.

Smith, who earned a bachelor of fine arts degree in fashion design from Moore College of Art & Design and a master of fine arts degree in costume design from New York University, left the project in 1978 to become a designer with the Jim Henson Co., with whom she enjoyed a long and fulfilling career. She has won multiple awards, including seven Daytime Emmys, for her work.

**Short Description:**

NIHF Inductee and award-winning costume designer Polly Smith invented the sports bra, a revolutionary garment that has enabled women's participation in athletic activities and advanced women's health and well-being.



## James McEwen

### Invention Name: Automatic Surgical Tourniquet

U.S. Patent No. 4,469,099

*Official Patent Name: Pneumatic tourniquet*

Inducted in 2020

*Photo Courtesy of James McEwen*

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#### Inductee Bio:

Canadian biomedical engineer James McEwen invented the first microprocessor-controlled automatic surgical tourniquet system. Devices based on his innovations are used worldwide in close to 20,000 surgeries each day.

McEwen earned both his bachelor of applied science and doctoral degrees in electrical engineering from the University of British Columbia, and after completing doctoral research at Vancouver General Hospital, he established its biomedical engineering department. There, he investigated situations where patients suffered limb paralysis, nerve damage and other injuries due to surgical tourniquet use. At this time, in the mid-1970s, mechanical pneumatic tourniquets were standard. McEwen's research revealed problems with these, including an unreliable pressure-regulating mechanism and no fail-safe feature to limit maximum cuff pressure.

The design process for a new tourniquet began with McEwen's idea of using a computer to control the applied pressure. By 1980, he had developed a microprocessor-controlled system that was safer and more efficient than previous technology. An automatic timer provided an accurate record of inflation time, and if dangerously high or low cuff pressures were present, audiovisual alarms would activate. Safety features included automatic detection of air leakage, system integrity checks and a backup power source.

Almost all modern tourniquet systems used in western countries are based on the work of McEwen and his colleagues, including the A.T.S. series of automated surgical tourniquet systems from Zimmer Biomet. In an interview with the National Inventors Hall of Fame®, McEwen shared the question that motivates his work: "How can I use what I have, whether it's resources, talents or abilities, to help improve the lives of others?"

Named on more than 70 U.S. patents and many other international patents, McEwen received the Principal Award for Innovation from Canada's Ernest C. Manning Awards Foundation. He founded Delfi Medical Innovations to produce specialty tourniquets for applications including injury rehabilitation, emergency situations and military settings, and he continues to research tourniquet technology.



#### Short Description:

NIHF Inductee James McEwen invented the first microprocessor-controlled automatic surgical tourniquet system, and his innovations ensure safer outcomes in nearly 20,000 surgeries across the world each day.



## Mick Mountz

### Invention Name: Mobile Robotic Material Handling for Order Fulfillment

U.S. Patent No. 8,649,899

*System and method for maneuvering a mobile drive unit*

Inducted in 2020

*Photo Courtesy of Mick Mountz*

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#### Inductee Bio:

While e-commerce grew rapidly at the beginning of the 21<sup>st</sup> century, material handling within distribution centers still relied on decades-old techniques that were inefficient for order fulfillment in the era of online shopping. The Kiva system, a warehouse order fulfillment system developed by Mick Mountz, Peter Wurman and Raffaello D'Andrea, changed that. Kiva utilized thousands of mobile robots and sophisticated control software to bring inventory shelves to workers, dramatically improving all areas of fulfillment center operations from safety and productivity to cycle time and throughput.

In an interview with the National Inventors Hall of Fame®, Mountz shared that curiosity, experimentation and teamwork had been encouraged throughout his childhood. “Having parents that challenge you to play sports, pick leadership roles, be curious — I think all of that contributes to how you move through your education process and then some of your career decisions as well.”

Mountz earned his bachelor of science degree in mechanical engineering from the Massachusetts Institute of Technology (MIT) and a master of business administration degree from Harvard University, and in 2002, he conceived of a more efficient method for order fulfillment: robots delivering shelves of inventory to people working as pick-and-packers. He asked Wurman, his former MIT roommate, and a North Carolina State University professor, for software advice. Together, they decided on a centralized software architecture to wirelessly command the robots in real time. Shortly thereafter, D'Andrea, a robotics expert and professor from Cornell University, joined the company then known as Distrobot to develop the motion layer.

In 2005, Distrobot became Kiva Systems Inc. and produced the first commercially available, large-scale, autonomous mobile robot system. By 2012, Kiva's customers included dozens of companies including Staples, Walgreens, Zappos, the Gap and Saks Fifth Avenue. That same year, Amazon purchased Kiva Systems. By 2013, Amazon had reduced its “click-to-ship” time from 60 to 75 minutes to just 15 minutes per order.

Mountz holds more than 60 U.S. patents. In 2012, Fast Company magazine ranked Kiva Systems as one of the most innovative companies in the world for their game-changing solutions using mobile robotics. He is a member of MIT's School of Engineering Dean's Advisory Council.

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#### Short Description:



NIHF Inductee Mick Mountz invented the Kiva system — a revolutionary warehouse order fulfillment system that uses mobile robots and control software to bring inventory shelves to workers, dramatically improving all aspects of fulfillment operations.



# National Inventors Hall of Fame®



## Peter Wurman

**Invention Name: Mobile Robotic Material Handling for Order Fulfillment**

U.S. Patent No. 8,649,899

*Official Patent Name: System and method for maneuvering a mobile drive unit*

Inducted in 2020

*Photo Courtesy of Peter Wurman*

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### Inductee Bio:

In the early 2000s, Peter Wurman, Mick Mountz and Raffaello D'Andrea created the Kiva system, an entirely new approach for material handling in distribution centers that revolutionized warehouse order fulfillment. Kiva utilized thousands of mobile robots and sophisticated control software to bring inventory shelves to workers, significantly improving all areas of fulfillment center operations from safety and productivity to cycle time and throughput.

In 2002, while developing his idea to improve warehouse distribution efficiencies, Mountz contacted his former Massachusetts Institute of Technology (MIT) roommate Wurman, then assistant professor of computer science at North Carolina State University, for software advice. They decided on a multi-agent software architecture run on centralized computers to track inventory and wirelessly command robots to perform delivery tasks. D'Andrea, a robotics expert and professor from Cornell University, joined the company then known as Distrobot to develop the motion layer. As chief technology officer, Wurman was responsible for the system architecture and decision-making algorithms that allocated the tasks and coordinated the motion of the robot fleet.

The company's first customer was Staples, followed by dozens of others including Walgreens, whose fulfillment center used over 1,000 robots. In 2012, Amazon purchased Kiva and renamed the enterprise Amazon Robotics. At that time, Kiva had systems in more than 30 warehouses in North America and Europe.

Wurman earned his bachelor of science degree in mechanical engineering at MIT, and his master's degrees in mechanical engineering and computer science and doctorate in computer science at the University of Michigan. In an interview with the National Inventors Hall of Fame®, Wurman described what motivates him: "What I enjoy most is a combination of building systems and solving hard problems. I like challenging technology problems that have impact on the world, where you build something that other people really use."

Named on more than 60 U.S. patents, Wurman shares the 2008 IEEE/IFR Innovation and Entrepreneurship Award with Mountz and D'Andrea. He is currently director of Sony AI America.

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### Short Description:



NIHF Inductee Peter Wurman invented a warehouse order fulfillment system for e-commerce called the Kiva system, which uses autonomous mobile robots to efficiently select and move inventory, significantly reducing click-to-ship times.



# National Inventors Hall of Fame®



## Raffaello D'Andrea

**Invention Name: Mobile Robotic Material Handling for Order Fulfillment**

U.S. Patent No. 8,649,899

*Official Patent Name: System and method for maneuvering a mobile drive unit*

Inducted in 2020

*Photo Courtesy of ROBO Global*

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### Inductee Bio:

Raffaello D'Andrea, Mick Mountz and Peter Wurman created the Kiva system, which has dramatically advanced warehouse order fulfillment for e-commerce. Using thousands of autonomous mobile robots to lift and move racks of inventory shelves to workers who select items for individual shipments, the Kiva system substantially reduced the time from order placement to shipping.

In 2003, D'Andrea, a co-founder of the systems engineering program at Cornell University, and the faculty adviser and system architect of the four-time world champion Cornell robot soccer team, had just started his sabbatical at MIT when he met Mountz over a 15-minute cup of coffee. After several more meetings, D'Andrea quit his sabbatical at MIT and joined Mountz and Wurman in their quest to revolutionize order fulfillment. In 2005, the trio renamed their company to Kiva Systems, and this same year Staples became the first of its many customers. In 2012, Amazon bought Kiva and eventually named it Amazon Robotics.

From 2003-07, D'Andrea led the systems architecture, robot design, robot navigation and coordination, and learning-based control algorithms development at Kiva. In 2008, after having hired many of his former students and collaborators to Kiva, he returned to academia where he founded the Institute for Dynamic Systems and Control at ETH Zurich. He served as Kiva's chief technical adviser until 2012.

D'Andrea, an IEEE Fellow named on more than 40 U.S. patents, earned his bachelor of science degree in engineering science from the University of Toronto and his master of science and doctoral degrees in electrical engineering from the California Institute of Technology. He is the recipient of the 2001 Presidential Early Career Award for Scientists and Engineers, the 2015 Engelberger Robotics Award for Technology, and the 2016 IEEE Robotics and Automation Award. His TED and research videos, with tens of millions of views, have provided an inspiring view into the world of engineering, robotics and computer science.

In 2013, D'Andrea co-founded ROBO Global, which launched the world's first robotics exchange traded fund. In 2014, he founded Verity, which creates autonomous indoor drone systems, where he currently serves as CEO and chairman. In 2019, in collaboration with British Telecom, his team set the world record for the highest number of autonomous indoor drones, 160, coordinated by a single computer.



### Short Description:

NIHF Inductee and robotics expert Raffaello D'Andrea invented the Kiva system, a groundbreaking approach to warehouse order fulfillment that uses thousands of autonomous mobile robots to quickly and efficiently lift and move inventory.



# National Inventors Hall of Fame®



## Margaret Wu

### Invention Name: Synthetic Lubricants

U.S. Patent Nos. 4,827,064; 4,827,073

*Official Patent Names: High-viscosity-index synthetic lubricant compositions;  
Process for manufacturing olefinic oligomers having lubricating properties*

Inducted in 2020

*Photo Courtesy of Jay Premack/USPTO*

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#### Inductee Bio:

Industrial chemist Margaret Wu revolutionized the field of synthetic lubricants. Her work has changed how automobile and industrial lubricants are designed and synthesized, and resulted in products with better machine protection, improved energy efficiency and reduced waste oil.

Born and raised in Taiwan, Wu earned her bachelor of science degree in chemical engineering at the National Taipei University of Technology and her doctorate in physical organic chemistry at the University of Rochester. She joined Mobil in 1977, and by the mid-1980s she had begun developing a new class of polyalphaolefin (PAO), a type of synthetic base oil used in synthetic lubricants.

In an interview with the National Inventors Hall of Fame®, Wu explains what made her synthetic lubricants revolutionary. “The novelty of our product is that it has a very elegant chemical structure. It is put together in a very uniform and regular manner; and has no extraneous undesirable side branches. If you look at the old products, they have small branches sticking out here and there. Because of the new chemical composition, the new molecules have significantly better lubricating properties.”

Wu’s series of new PAO synthetic base oil demonstrated superior lubricating properties with greater wear prevention and less friction in formulated products. This resulted in improved engine performance, oil life and fuel economy, as well as reduced engine wear and waste oil. As a dedicated lab chemist, she attributes her years working in laboratories as a critical component to her success and creativity. “When I am in a lab setting up reactions or cleaning up glassware, etc., ideas flow to me,” Wu said. “I really think it’s important for creativity, for progress and for my personal well-being, to work in a lab.”

Today, synthetic lubricant products based on Wu’s work are used in myriad applications, from passenger car engines to industrial machines such as wind turbines. Wu officially retired from ExxonMobil Research and Engineering Co. in 2009 as senior scientific adviser, the highest technical rank in the company, and the first woman so named. She continued as emerita and consultant until 2016. She holds over 100 U.S. patents.



#### Short Description:

NIHF Inductee and industrial chemist Margaret Wu advanced the field of synthetic lubricants, and she has revolutionized the way both automotive and industrial lubricants are designed and synthesized.



# National Inventors Hall of Fame®



## James Abercrombie

**Invention Name: Blowout Preventer (BOP)**

U.S. Patent No. 1,569,247

*Official Patent Name: Blow-out preventer*

Inducted in 2020

*Photo Courtesy of Woodson Research Center, Fondren Library, Rice University*

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### Inductee Bio:

James Abercrombie, a Texas oil driller, and Harry Cameron, a machinist, designed the world's first reliable blowout preventer (BOP) to successfully contain catastrophic well blowouts — the dangerous, uncontrolled release of oil or natural gas caused by the failure of a pressure control system. Their mechanism allowed operators to close wells, control pressure during drilling operations, prevent surface oil accumulation at drilling sites and most importantly, save lives.

One of 13 children, Abercrombie spent his early years in farming and working on his family's dairy farm before getting involved in the oil business. In 1920, Abercrombie and Cameron formed Cameron Iron Works. There, the two developed Abercrombie's idea for a "ram-type" blowout preventer that would use hydrostatic pistons (rams) to clamp the drill stem and create a seal against well pressure during a blowout.

Before the invention of the BOP, oil wells were left to "blow out" after tapping to sufficiently reduce pressure for capping. Today, when installed on a wellhead, the BOP allows for complete control of pressure during drilling. Patented in 1926, Abercrombie and Cameron's "Type MO BOP" could withstand up to 3,000 pounds per square inch (psi), then an industry record.

Abercrombie earned a total of 30 U.S. patents and became one of Houston's most generous philanthropists. His many contributions include sizable donations to Rice University and the Texas Children's Hospital. Support for this hospital would continue through the James S. Abercrombie Foundation, which was established in 1968.

Cameron Iron Works evolved over the decades into Cameron International, which became part of Schlumberger Ltd. in 2016. Today, Cameron is a leading manufacturer of oil and gas pressure control and separation equipment, and the company remains one of the leading providers of BOPs in the industry.

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### Short Description:



NIHF Inductee James Abercrombie co-invented the world's first reliable blowout preventer (BOP) to successfully contain catastrophic blowouts from oil and natural gas wells. This mechanism allowed operators to close wells, control pressure during drilling operations, protect the environment and save lives.



## Harry Cameron

**Invention Name: Blowout Preventer (BOP)**

U.S. Patent No. 1,569,247

*Official Patent Name: Blow-out preventer*

Inducted in 2020

*Photo Courtesy of Houston Public Library, HMRC*

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### Inductee Bio:

Until Harry Cameron, a machinist, and James Abercrombie, a Texas oil driller, designed the world's first reliable blowout preventer (BOP), oil wells were left to "blow out" after tapping to sufficiently reduce pressure for capping, a perilous and sometimes deadly practice. The BOP prevented blowouts by allowing manual closure of a well and controlling pressure during drilling. The device also prevented surface oil accumulation at drilling sites and, above all, saved lives.

Born in Indianapolis, Cameron studied architectural and mechanical engineering at Christian Brothers College (now University) in Memphis, Tennessee. After moving to Dallas, he worked at a cement company for a year before working in the oil fields and soon established himself as a skilled machinist. In 1920, as partners in Cameron Iron Works, Cameron and Abercrombie developed Abercrombie's idea for a "ram-type" blowout preventer using hydrostatic pistons (or rams) to close on the drill stem and form a seal against the well pressure.

The team filed for a patent on their Type MO BOP in 1922, and soon after, Cameron filed a patent on an improvement to the original design to help eliminate leakage. Cameron would earn four U.S. patents in his lifetime.

Cameron and Abercrombie's work revolutionized the oil and natural gas industry, and the BOP became a safety standard. Although modern designs differ from their original design, blowout preventers continue to protect drilling rigs, workers and the environment from expensive, dangerous blowouts. The pioneering concept of rams closing around a drill pipe is still used today.

Cameron Iron Works evolved over the decades into Cameron International, which became part of Schlumberger Ltd. in 2016. Today, Cameron is a leading manufacturer of oil and gas pressure control and separation equipment, and it remains one of the leading providers of BOPs in the industry.



### Short Description:

NIHF Inductee Harry Cameron co-invented the world's first reliable blowout preventer (BOP), a device that prevents the uncontrolled release of crude oil at drilling sites, protecting workers and the environment from dangerous blowout situations.



## Stewart Adams

### Invention Name: Ibuprofen

U.S. Patent No. 3,228,831

Official Patent Name: *Compositions and method for treating symptoms of inflammation, pain and fever*

Inducted in 2020

*Photo Courtesy of The Boots Archive*

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#### Inductee Bio:

In the early 1950s, Stewart Adams, a pharmacologist at Boots Pure Drug Co. in England, was tasked with finding new treatments for rheumatoid arthritis. Adams was joined in 1956 by chemist John Nicholson, and the two collaborated over the next decade to develop ibuprofen. Today, ibuprofen is one of the safest, most effective and most widely used treatments for reducing the pain, fever and inflammation caused by conditions such as arthritis, headaches and the common cold.

Adams, who would go on to earn 14 U.S. patents, earned his doctorate in pharmacology from the University of Leeds. When he began working with Nicholson, they understood that existing treatments for rheumatoid arthritis were either toxic or exposed patients to negative long-term effects. Aspirin, the preferred alternative, was prescribed in high doses, carrying risks of gastrointestinal problems and allergic reactions.

Adams and Nicholson initially focused on aspirin's anti-inflammatory properties and tested more than 200 compounds derived from salicylates, but none proved superior to aspirin. They tested hundreds of other compounds over several years before their research led to investigating propionic compounds. Among those they tested — including on Adams himself — was 2-(4-isobutylphenyl) propionic acid, later called ibuprofen.

Adams and Nicholson demonstrated that ibuprofen was safer and more effective than many previous pain relievers. In fact, long-term use effectively treated rheumatoid arthritis without significant side effects.

In 1969, ibuprofen became available by prescription in the United Kingdom as Brufen, and in the United States as Motrin in 1974. After proving effective in treating non-rheumatic conditions, it was approved in the 1980s as an over-the-counter drug in the United Kingdom (Nurofen) and the United States (Advil).

Ibuprofen is on the World Health Organization's Model List of Essential Medicines and is one of the world's most widely available and bestselling non-steroidal anti-inflammatory drugs. For his work in developing this medicine, Adams was appointed an officer of the Order of the British Empire in 1987.



#### Short Description:

NIHF Inductee and pharmacologist Stewart Adams co-developed ibuprofen, which is used worldwide to safely and effectively treat pain, fever and inflammation related to conditions from headaches to arthritis.



## John Nicholson

**Invention Name: Ibuprofen**

U.S. Patent No. 3,228,831

*Official Patent Name: Compositions and method for treating symptoms of inflammation, pain and fever*

Inducted in 2020

*Photo Courtesy of the Nicholson Family*

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**Inductee Bio:**

Chemist John Nicholson and pharmacologist Stewart Adams developed ibuprofen during the 1950s and 1960s at Boots Pure Drug Co. in England. Today, ibuprofen is a popular first-line treatment for safely reducing pain, fever and inflammation, and it is available in more than 80 countries.

When Nicholson, who had obtained a bachelor's degree in chemistry and doctorate from the University of Oxford, began to collaborate with Adams, the two were determined to discover a treatment for rheumatoid arthritis that was safer and had fewer side effects than aspirin and other options available at the time.

Believing aspirin's anti-inflammatory properties were key to treating rheumatoid arthritis, they tested more than 200 compounds derived from salicylates before further analysis and new data steered them toward propionic compounds. Among those they tested was 2-(4-isobutylphenyl) propionic acid, later named ibuprofen.

Ibuprofen proved a safer, better tolerated rheumatoid arthritis treatment than many established pain relievers and could be taken long-term with no serious side effects. Even in lower doses, it performed as well as aspirin. Nicholson and Adams earned a U.S. patent for ibuprofen in 1966, and Nicholson would hold a total of six U.S. patents in his lifetime.

Ibuprofen was first made available by prescription in 1969 in the United Kingdom, and availability in the United States soon followed. In the 1980s, it was approved as an over-the-counter drug for its effectiveness in treating non-rheumatic conditions, and the medicine's uses continue to evolve.

Ibuprofen has become the preferred drug for treating patent ductus arteriosus, a congenital heart defect that can weaken heart muscles and, if left uncorrected, eventually lead to congestive heart failure.

**Short Description:**

NIHF Inductee and chemist John Nicholson co-developed the safe and effective medicine ibuprofen, which is used by people worldwide to treat pain, fever and inflammation without significant side effects.



## Evelyn Berezin

**Invention Name: Computer Systems for Business Use**

U.S. Patent No. 3,253,262

*Official Patent Name: Data processing system*

Inducted in 2020

*Photo Courtesy of the Computer History Museum*

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### Inductee Bio:

Evelyn Berezin was an expert in logic design and data transmission. She designed one of the earliest computer reservations systems for airlines and founded a company that developed the first computerized standalone word processor for business use.

Born in New York City in 1925, Berezin earned a bachelor of science degree and completed coursework for a doctorate, both in physics, at New York University. Challenging societal norms and barriers, Berezin was often the first or only woman technologist at the companies where she worked.

In 1957, Berezin joined Teleregister Corp. as the head of logic design. She and her team soon began developing the Instamatic reservations system for United Airlines — at the time, the largest interconnected electronic data processing system ever built for business use.

The Instamatic was operational by 1961, using microwave link technology and transistors to transmit and process data on airline reservations in a matter of seconds. This sophisticated communication system connected terminals in 60 cities nationwide to a central computer in Denver. The system was structured so that problems were isolated and resolved without crippling the entire network. In 11 years of operation, the central computer never suffered a shutdown.

Following this success, in 1969, Berezin and three colleagues founded Redactron, where they developed the first computerized word processor. One of the earliest commercial products to contain a microprocessor, the Data Secretary debuted in 1971 and boasted advanced features including the ability to record and play back what users had typed, so it could be edited or reprinted. Users also could delete or cut and paste text. By 1974, Redactron's total revenue was \$16.2 million. Redactron was sold to the Burroughs Corp. in 1976, and Berezin served as president of its Redactron Division until 1980.

In recognition of her inventions and entrepreneurship, Berezin's honors include induction into the Women in Technology International (WITI) Hall of Fame. In 2015, she was made a Fellow of the Computer History Museum.

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### Short Description:



An expert in logic design and data transmission, NIHF Inductee Evelyn Berezin invented a computer reservations system for airlines and founded a company that developed the first computerized standalone word processor for business use.



## Edward W. Bullard

**Invention Name: Hard Hat**

U.S. Patent No. 1,699,133

*Official Patent Name: Hat crown*

Inducted in 2020

*Photo Courtesy of Bullard***Inductee Bio:**

Edward W. Bullard invented the hard hat, the first commercially available industrial head protection device. Bullard's lightweight, non-conducting hard hat design was sturdy enough to withstand many falling objects. This invention has since become a mandatory piece of equipment for protecting millions of workers around the world.

A graduate of the University of California at Berkeley, Bullard served in the U.S. Army in France during WWI. Once home, he returned to work at the E.D. Bullard Co. in San Francisco, founded in 1898 by his father, Edward Dickinson Bullard, to sell carbide lamps and mining equipment to gold and copper miners. Realizing the need for greater safety within the mines, Bullard designed a hard hat for miners inspired by the steel doughboy helmet he wore as a soldier.

Bullard first produced the Hard Boiled® Hat by alternating layers of canvas and glue, then steaming the stiff canvas to make it temporarily pliable. Next, he glued together overlapping layers of the canvas to form the shell, covered the shell inside and out with water-resistant shellac and added leather front and rear brims. The Hard Boiled Hat met the miners' needs and quickly spread to other industries. It was used by workers on both the Hoover Dam and Golden Gate Bridge projects. Bullard went on to patent several improvements to his original design, including an adjustable suspension system that distributes the force of a blow.

With the introduction of the hard hat, the Bullard Co. expanded and began manufacturing industrial safety equipment. Owned by the Bullard family and led by E.W. Bullard's great-granddaughter, today the company is a leading manufacturer of personal protective equipment and systems that are marketed worldwide.

**Short Description:**

NIHF Inductee Edward W. Bullard invented the hard hat, the first commercially available industrial head protection device. Originally designed for miners, hard hats are now used by millions of people in an array of industries.



# National Inventors Hall of Fame®



## Floyd Smith

### Invention Name: Modern Parachute

U.S. Patent Nos. 1,340,423; 1,462,456

*Official Patent Names: Parachute; Parachute pack and harness, etc.*

Inducted in 2020

*Photo Courtesy of the National Museum of the United States Air Force*

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#### Inductee Bio:

The first working modern parachute was developed by trapeze artist turned aviator Floyd Smith. He became interested in parachutes after having survived a near-fatal airplane accident while working as a test pilot. Smith soon realized that a safer and more effective solution than the static-line parachutes of the era was for aviators to instead carry the chute on their back and open it manually when clear of the plane.

After having gained aviation experience by building his own plane and working as a mechanic and test pilot for the Glenn L. Martin Co., Smith was hired by the U.S. Army Air Service to test and inspect planes at South Field in Dayton, Ohio. Around that same time, in July 1918, he filed a patent for his parachute.

Worn on the body and featuring a release mechanism attached to the pack itself, Smith's emergency bailout chute model enabled jumpers to deploy the canopy manually with a ripcord instead of using a static-line parachute attached to the plane, which could become entangled when jumping. This chute design would both set the standard for decades to come and jumpstart the entire parachute industry.

During World War I, an increasing number of military pilot fatalities led the Army to seek a practical parachute for emergency escape from aircraft, and Smith was part of the team at McCook Field in Dayton tasked with this project. His parachute was among many tested in 1919 and was the one that best met the Army's requirements. Soon, the "Type A" design, which was closely based on Smith's original version, became the standard parachute for the Army. Smith's design was noted for its adaptability in escaping from planes in spins, dives or inverted positions. By World War II, parachutes were saving pilots and flight crews of disabled planes.

Smith left government service in 1919. He licensed his patents to several parachute manufacturers and founded companies of his own, including the Floyd Smith Aerial Equipment Co. and Pioneer Parachute Co.

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#### Short Description:



NIHF Inductee Floyd Smith invented the modern parachute. A trapeze artist turned aviator, Smith's invention led to the creation of the parachute industry and provided safe landings across the world, saving countless lives.



## Frank Zybach

**Invention Name: Center-Pivot Irrigation**

U.S. Patent No. 2,604,359

*Official Patent Name: Self-propelled sprinkling irrigating apparatus*

Inducted in 2020

*Photo Courtesy of History Nebraska*

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### Inductee Bio:

In the mid-20th century, Nebraska farmer Frank Zybach invented center-pivot irrigation and transformed agricultural production worldwide. Using Zybach's machine, farmers in the semi-arid regions of the Great Plains could efficiently irrigate acres at a time and thereby increase yields on previously marginal land. By 2013, center pivots irrigated nearly 28 million acres on 57,000 U.S. farms, making it the most widely used irrigation technology in the country.

Having left school in the seventh grade to help with his father's farm and blacksmith shop, Zybach became both a skilled metalworker and an inventor who would go on to earn nine patents. His first was for a driverless tractor that plowed fields in concentric circles — a tractor he built in his father's shop while still in his teens.

Zybach began developing a self-propelled irrigation system after observing another farmer irrigate crops by using a tractor to systematically tow a long pipe, outfitted with sprinklers, across the field. By 1947, Zybach's system featured two sections of pipes on skids, suspended by cables from two towers. By 1949, the device included five towers with pipes running on wheels and could irrigate 40 acres. Zybach then added water valves for siphoning pressurized water from the main pipe to drive the wheels and maintain tower alignment. In 1952, Zybach was granted a patent on a larger irrigation system with a 600-foot boom that could water a 135-acre circle (all but the corners of a standard 160-acre section of land).

In 1954, Valley Manufacturing, a small manufacturer of farm equipment, acquired the patent rights from Zybach, and its engineers improved the machine's efficiency and dependability. Today, the Omaha-based company, since renamed Valmont Industries Inc., is a global leader for center-pivot systems and other agricultural products.



### Short Description:

NIHF Inductee Frank Zybach invented the center-pivot irrigation technology that has revolutionized agricultural production not only in America's heartland but throughout the world.