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JOHNSON CONTROLS AUTOMATIC TEMPERATURE CONTROL SYSTEM

A Historic Mechanical Engineering Landmark

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The man who devised the thermostat, at all events in my private opinion, was a hero comparable to Shakespeare, Michelangelo or Beethoven.

H. L. Mencken (1880–1956)
20th century journalist

Warren Johnson was the quintessential inventor and entrepreneur. He created huge tower clocks. He experimented with wireless communication. And he developed steam-powered automobiles and trucks, including the first postal service trucks.

But it was Johnson's system of temperature regulation, invented while he was teaching at the State Normal School in Whitewater, Wisconsin, that became his most enduring legacy. He installed his electric *tele-thermoscopes* in classrooms to help keep students more comfortable – and minimize disturbances from the janitor.

Johnson traveled to Milwaukee in search of partners to fund manufacturing for the device. He resigned his teaching position to devote all of his time to further develop his inventions. On May 1, 1885, the Johnson Electric Service Company was organized as a Wisconsin corporation. The business moved around downtown Milwaukee three times before settling on the southeast corner of Michigan and Jefferson Streets in 1902, where Johnson built the company's headquarters. This location still serves as the headquarters for the global Building Efficiency business of Johnson Controls.

Warren S. Johnson TIMELINE

1847	Born in Vermont to pioneer farmers Charles and Emeline Johnson
1849/1850	Family moves by sailing vessel from Buffalo to Milwaukee
1864	Works on father's farm and in lumber mills when family moves to Dunn County in western Wisconsin. Attends one term in high school.
1871	Elected Dunn County superintendent of schools.
1876 -1885	Faculty member at the State Normal School in Whitewater, Wisconsin as an instructor of penmanship and mechanical drawing; ultimately head of Department of Natural Science.
1883	Begins business partnership (Milwaukee Electric Manufacturing Co.) in Milwaukee with financier William Plankinton to develop, manufacture, and market his inventions. Receives first patent: the electric tele-thermoscope.
1885	Forms the Johnson Electric Service Company with Plankinton. Johnson is vice president, treasurer, and general manager. Moves his family to Milwaukee.
1900	Forms American Wireless Telegraph Company with Charles Fortier
1901	Begins production of steam-powered vehicles
1902	Changes firm name to Johnson Service Company
1910	Goes to Los Angeles to encourage West Coast sales of autos
1911	Ceases active management of the company on September 1. Dies December 5 in Los Angeles of Bright's Disease (chronic nephritis).

IT WAS A COLD DAY.

The Wisconsin winter can put any heating system to the test, even with today's technology. But in the 1880s, keeping people warm took lots of hot air from fires and furnaces going full blast. And the only way to regulate the temperature in individual rooms was to shut down or open up dampers by hand. Of course, rooms would quickly become too hot or too cold, depending on how close they were to the heating source. Once an hour, a janitor would make the rounds of a building's rooms, inspect the thermometers and note which rooms were too warm or too cold. Then he would go to the basement to open or close dampers accordingly.

These were the ideal conditions for Warren Johnson. He invented the technology we take for granted today. An automatic temperature control system that keeps us warm when it's cold and cool when it's hot. Warren Johnson's pneumatic temperature control system, patented in 1895, made it practical to regulate individual room temperatures in commercial and public buildings. In no time, the technology was adopted in buildings around the world. And an industry was born.

The landmark system that launched the company's global reputation was the first of its kind to automatically and economically control temperature in different zones throughout a home or building.

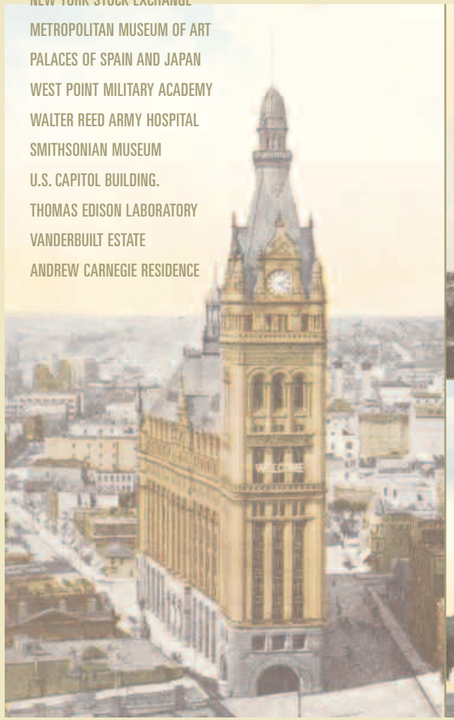
The 1895 system was completely mechanical, using compressed air to operate valves, dampers and draft regulators devised by Johnson to automatically control the indoor environment.

Of the 50-plus patents Johnson received and assigned to the company, most were for devices aimed at harnessing power derived from air, steam or fluid pressure. The basic principles that Johnson incorporated into the 1895 system are still in use today, not only in pneumatic control systems but also in the industry's most advanced digital building automation and control systems. The invention of this economical and practical system before the turn of the 20th century spawned a global organization that continues to provide comfort, safety and energy efficiency to customers around the world today.

By the turn of the last century, the "Johnson System of Temperature Regulation" was being sold in parts of Europe and Asia, including royal palaces in Spain and Japan. Many of the best and most important public buildings in this country, including the U.S. Capitol, the Smithsonian Institution and the Chicago Post Office, specified it. Closer to home, it was installed in the Pfister Hotel, Milwaukee City Hall and Northwestern Mutual Life Insurance headquarters building, among many others.

The Johnson System of Temperature Regulation was adopted in many famous buildings around the world. Among them:

WALDORF-ASTORIA HOTEL
NEW YORK STOCK EXCHANGE
METROPOLITAN MUSEUM OF ART
PALACES OF SPAIN AND JAPAN
WEST POINT MILITARY ACADEMY
WALTER REED ARMY HOSPITAL
SMITHSONIAN MUSEUM
U.S. CAPITOL BUILDING.
THOMAS EDISON LABORATORY
VANDERBUILT ESTATE
ANDREW CARNEGIE RESIDENCE



THE JOHNSON SYSTEM OF TEMPERATURE REGULATION

Automatic controls are everywhere today, but in the late 1800s they were new and fairly unusual. They were also expensive and prone to failure. The 1895 Johnson system was the first complete temperature control system that was economical to install and operate, long-lasting and extremely effective in maintaining a constant temperature. It quickly became the world standard. Even today, many building systems are still based on the same principles and technology.

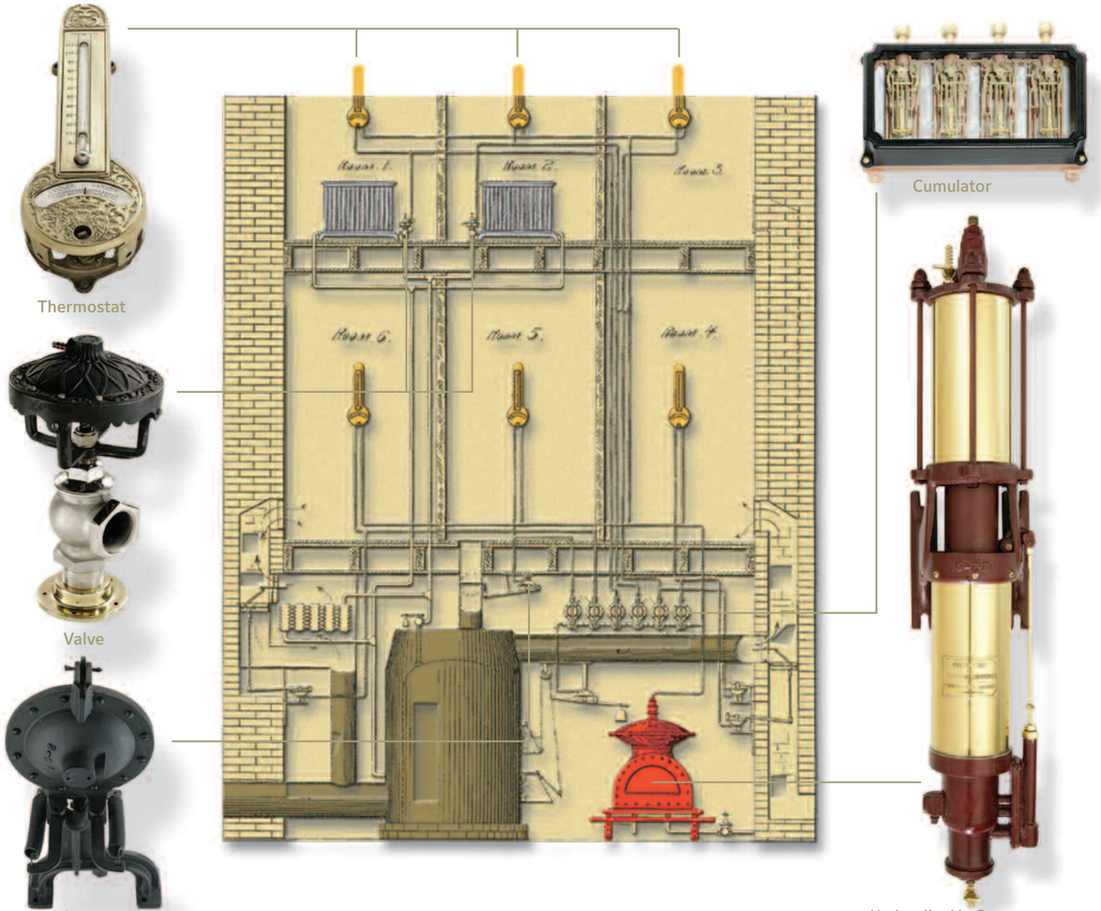
The heart of the system was the thermostat. One was placed in each room or "zone" needing temperature control. Inside the thermostat, a temperature sensing element made of fused brass and steel was designed to reliably change its shape at a constant rate in response to ambient room temperature changes. One end of the element was mounted in the unit, and the other end was attached to a three-way valve controlling compressed air. Since the two metals expand and contract at different rates, the movement of the strip would open or close the valve.

This allowed air to flow – or stopped air from flowing – into concealed pipes connected to the thermostat. The concealed pipes were connected to valves and/or dampers at the heat source. A flexible diaphragm on the valve or damper would fill with compressed air, opening the valve or damper to allow steam or hot water into radiators or hot air into heating vents.

When the desired temperature was reached, the sensing element would return to its former shape, closing off the compressed air. The valve or damper closed as well, since the diaphragms allowed a small amount of compressed air to escape. The system could be set up for "on-off" operation. The valves and dampers were either open or closed. Or it could be set up for "proportional" operation, meaning that valves and dampers could open or close in proportion to the amount of heating required.

Warren Johnson found compressed air to be a powerful, reliable and safe way to operate devices. His 1895 system was completely mechanical, operating off compressed air that used city water pressure.

The water pressure compressors were extremely reliable and long-lasting. They started automatically when air pressure in the attached compressed air chamber dropped below a fixed limit, and they stopped automatically when the high limit was reached, keeping pressure in the system uniform and using a minimum of water. A steam compressor was used for larger applications where high-pressure steam was available.



JOHNSON CONTROLS TODAY

That single invention, created to help make a classroom of students more comfortable and productive during the Wisconsin winters, also created Warren Johnson's legacy–Johnson Controls. Still headquartered in Milwaukee, the company is the global leader that brings ingenuity to the places where people live, work and travel. By integrating technologies, products and services, Johnson Controls creates smart environments that redefine the relationships between people and their surroundings.

Its team of 140,000 employees creates a more comfortable, safe and sustainable world through products and services for more than 200 million vehicles, 12 million homes and one million commercial buildings. The company's commitment to sustainability drives its environmental stewardship, good corporate citizenship in its workplaces and communities, and the products and services it provides to customers.

A HISTORIC MECHANICAL ENGINEERING LANDMARK

Automatic Temperature Control System

1895

WARREN S. JOHNSON (1847-1911) BUILT AND PATENTED THE FIRST MULTI-ZONE TEMPERATURE CONTROL SYSTEM THAT COULD BE ECONOMICALLY MANUFACTURED, INSTALLED AND MAINTAINED. THE JOHNSON CONTROLS PNEUMATIC TEMPERATURE CONTROL SYSTEM, REPRESENTED BY ARTIFACTS ON DISPLAY IN THIS BUILDING, BECAME THE STANDARD FOR COMMERCIAL AND PUBLIC BUILDINGS THROUGHOUT NORTH AMERICA AND HELPED LAUNCH THE MODERN BUILDING CONTROLS INDUSTRY.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS–2008

Bibliography

Donaldson, Barry and Nagengast, Bernard, 1994. *Heat & Cold – Mastering the Great Indoors.* Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

Fehring, T.H., 1980. *Mechanical Engineering: A Century of Progress*, published by the Milwaukee Section of the American Society of Mechanical Engineers.

Mencken, H.L., 1982. *A Mencken Chrestomathy: His Own Selection of His Choicest Writings.* New York: Vintage Books.

Rietschel, Prof. Hermann , 1913, *Leitfaden zum Berechnen und Entwurfen von Lüftungs- und Heizungs-Anlagen* (Textbook for the Calculation and Design of Ventilating and Heating Systems), Royal Prussian Ministry of Public Works, 5th Edition

THE HISTORY AND HERITAGE PROGRAM OF ASME

The History and Heritage Landmarks Program of ASME (the American Society of Mechanical Engineers) began in 1971. To implement and achieve its goals, ASME formed a History and Heritage Committee initially composed of mechanical engineers, historians of technology and the curator of mechanical engineering at the Smithsonian Institution, Washington, D.C. The History and Heritage Committee provides a public service by examining, noting, recording and acknowledging mechanical engineering achievements of particular significance. This Committee is part of ASME's Center for Public Awareness.

For further information, please contact:
Public Awareness at ASME, Three Park Avenue, New York, NY 10016-5990, 1-212-591-7020
and http://www.asme.org/history.

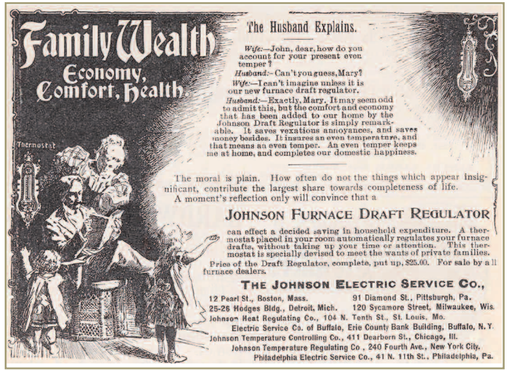
DESIGNATION

Since the History and Heritage Program began in 1971, nearly 250 landmarks have been designated as historic mechanical engineering landmarks, heritage collections or heritage sites. Each represents a progressive step in the evolution of mechanical engineering and its significance to society in general. Site designations note an event or development of clear historic importance to mechanical engineers. Collections mark the contributions of a number of objects with special significance to the historical development of mechanical engineering.

The Landmarks Program illuminates our technological heritage and encourages the preservation of the physical remains of historically important works. It provides an annotated roster for engineers, students, educators, historians and travelers. It helps establish persistent reminders of where we have been and where we are going along the divergent paths of discovery.

Founded in 1880 as the American Society of Mechanical Engineers, ASME is a not-for-profit professional organization promoting the art, science and practice of mechanical and multi-disciplinary engineering and allied sciences. With more than 127,000 members worldwide, ASME is a global engineering society focused on technical, educational and research issues. ASME develops codes and standards that enhance public safety, and provides lifelong learning and technical exchange opportunities benefiting the engineering and technology community.

Early Advertisement



The Johnson Service Company literature of the day promotes the fact that the system could maintain the temperature in a space reliably to within one degree above or below the set-point, and did so silently and automatically. While this may be more or less expected today, 100 years ago it was a significant advancement – one that greatly improved the lives and comfort of people everywhere.

Pfister Hotel

An illustration of an early application of the Johnson system of temperature regulation can be found at Milwaukee's Pfister Hotel, located a few blocks from the headquarters for the global Building Efficiency business of Johnson Controls. This hotel was the first in the world with automatic room temperature controls, employing an early version of the multi-zone, automatic temperature control system.

Acknowledgements

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Artifacts, photographs, and other materials relating to the Johnson System of Temperature Regulation as seen in the ASME National Historic Mechanical Engineering Landmark brochure and displays were provided by the Johnson Controls Archives. The Johnson Controls Archives, established in 1982, serves as the repository for the Company's permanently valuable materials. The Archives documents the significant activities that define the Company's nearly 125-year history.