Automatic Controls 1400-1985

Controls Pioneers

2000

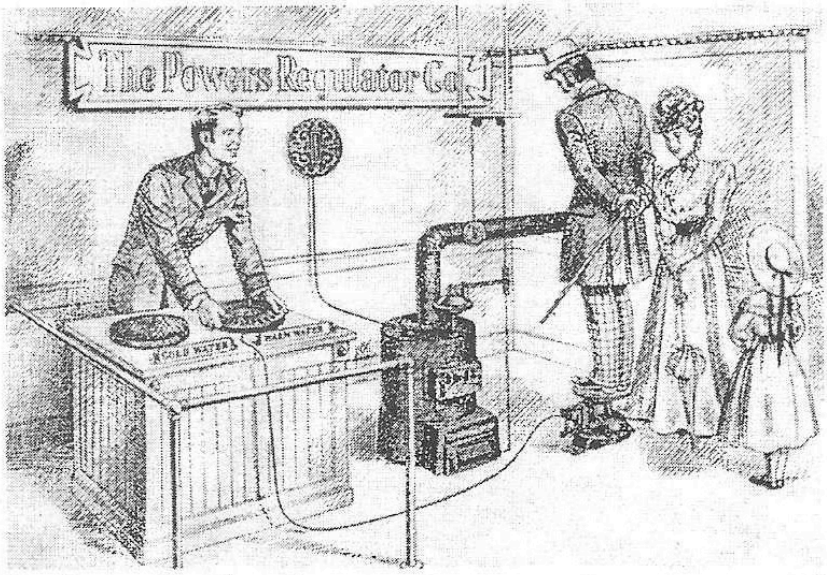
The COMFORT CONTROLLERS

Warren Johnson is one of the great benefactors of humanity.
I wouldn't swap him for a dozen Marconis, a regiment of Bells,
or a whole army corps of Edisons.

H.L. Mencken, quoted in *Right for the Times*,
(Johnson Controls, 100th Anniversary), 1985, p. 9.

Andrew URE [125]

24. *Advertisment: Electric Heat Regulator Co., New York.* Domestic Engineering, *Vol. 9, June 1985.*



The Powers Regulator Company demonstrates temperature control technology in the 19th Century. (Courtesy of Landis & Gyr Powers.)

25. *An Early Demonstration of Temperature Controls. The Powers Regulator Co., Chicago. The V in ASHRAE: A Historical Perspective, John E. Janssen,* ASHRAE Journal, *August 1994, p. 130.*

[116] Cardinal Nicolas DE CUSA 1401-1464

German theologian and mathematician. Studied at Heidelberg and Padua. Described a humidity measuring instrument called the *hygroscope*: "If you suspend from one side of a large balance a large quantity of wool, and from the other side stones, so they weigh equally in dry air, then you will see that when the air inclines towards dampness, the weight of the wool increases, and when it tends to dryness, it decreases."

98. *Billington and Roberts, Chap. 11.*

[117] GALILEO 1564-1642

Full name Galileo Galilie. Italian physicist and astronomer. Devised the *thermoscope* (1593), a primitive attempt to measure changes in temperature: "Galilie took a glass vessel about the size of a hen's egg, fitted to a tube the width of a straw, and about two spans long; he heated the glass bulb in his hands and turned the glass upside down so that the tube (could be) dipped in water contained in another vessel. As soon as the bulb cooled down the water rose in the tube the height of a span above the level of the vessel. This instrument he used to investigate degrees of heat and cold."

98. *Billington and Roberts, Chap. 11. Portrait from his* Istoria *(1613), frontispiece.*

[118] Cornelius DREBBEL 1572-1634

Dutch inventor. Worked for James I of England. Devised a temperature regulator: "Drebbel's apparatus consisted basically of a box with a fire at the bottom and above this an inner compartment containing air or alcohol with a U-shaped neck topped by mercury. As the temperature in the box rose, the increased pressure of the heated air or alcohol vapor pushed up the mercury, which in turn pushed up a rod; this mechanical force was applied to close a damper and throttle down the fire." Drebbel also demonstrated a submarine boat and a thunder-and-lightning machine. According to Francis Bacon [139], Drebbel showed the king an early cooling (air conditioning) device in the Great Hall at Westminster that "reduced the temperature in the Hall to such a degree that James and his attendants fled, shivering."

20. *David, p. 66.* **98.** *Billington and Roberts, Chap. 11.*

[119] Robert HOOKE 1635-1703

English scientist. Curator of experiments at the Royal Society (the only paid post). Produced Hooke's Law on elasticity, discussed development of the steam engine with Newcomen [7], and argued with Newton [143]. Hooke made a *hygroscope* that exploited the water-retaining properties "of the bristle of the wild oak."

[120] Guillaume AMONTONS **1663-1705**

French physicist. Interested in scientific instruments. Invented a new hygrometer (1687). Improved the air thermometer of Galileo [117] by trapping the air with mercury rather than water.

[121] Gabriel Daniel FAHRENHEIT **1686-1736**

German-Dutch physicist. Invented a practical mercury thermometer (1714) to overcome many of the limitations of the alcohol, fluid type, then in use. His later report earned him election to the Royal Society (1724).

[122] Louis Francois de BOURBON **1717-1776**

Prince of Conti. Devised a stove temperature control (c. 1760).
From **106.** *Usemann.*

[123] BONNEMAIN **active 1777**

French engineer. Heated an incubator by means of hot water pipes (1777). His system contained correctly laid and vented pipes, an expansion tank, and automatic control of the boiler. "The primary air control was by water temperature, relying on the expansion of a rod to close the boiler damper." He was awarded a prize for his invention, which may have been suggested by the compensated grid-iron pendulum of the clockmaker, James Harrison (1726), and his later true bimetallic strip (1761). The "heat regulator" of Bonnemain "was founded upon the unequal dilatation of different metals by the same degree of heat."

98. *Billington and Roberts, p. 110.* **99.** *Donaldson and Nagengast, pp. 193-194.*

[124] Horace Benedict de SAUSSURE **1740-1799**

Swiss scientist. Professor at Geneva University. Devised a hygrometer that made use of the moisture absorbing properties of human hair to measure atmospheric humidity (1780).

98. *Billington and Roberts, Chap. 11.*

[125] Andrew URE **1778-1857**

Born in Scotland. Doctor of Medicine (Glasgow, 1801). Professor of Chemistry and Natural Philosophy. Appointed analytical chemist to the Board of Customs in London (1830). Granted a patent for *An Apparatus for Regulating Temperature in Vaporisation, Distillation and Other Processes* (BP 6014: 1830). He coined the word *thermostat*. He designed an air-heating stove with thermostatic control (BP 6016: 1830). Ure is also remembered for his *Dictionary of Arts, Manufactures and Mines* (1839).

99. *Donaldson and Nagengast, pp. 194-195. Portrait from Ure's* Dictionary.

[126] Neil ARNOTT 1788-1874

Doctor of Medicine, FRS, and Physician Extraordinary to Queen Victoria. Lectured to the Royal Institution on his Thermometer Stove (1836). Went on to write the book, *On Warming and Ventilating with Directions for Making and Using the Thermometer-Stove, or Self-Regulating Fire, and Other New Apparatus* (1838). Arnott described the use of fires, chimneys, and stoves, explained heating by steam, hot water, and hot air, their application to various buildings, and how to make a thermometer-stove. He believed his stove would reduce England's consumption of coal by half, if controlled by one of his thermometer regulators. "In one design he used a long bimetallic strip, one end of which was fixed to the casing of the stove and the other was attached to the combustion air damper. Other regulators described by Arnott relied upon the expansion of air in a tube closed by mercury: a float on the mercury surface was linked to the damper. All these devices controlled the temperature inside the stove casing, not that of the room."

98. *Billington and Roberts, Chap. 11.*

[127] John George APPOLD c. 1851

English inventor. His apparatus for regulating temperature and keeping the air in a building at any desired degree of moisture is described in the Proceedings of the Royal Society of London (1866-1867) and explained by Billings [73]: "This instrument consists of a glass tube having bulbs at each end. The tube is filled, as also about half of each bulb, with mercury, the lower bulb, containing ether to the depth of half an inch, which floats on the mercury. The tube is secured to a plate of boxwood, and supported on knife edges, on which it turns freely. At the end of the plate, underneath the highest bulb, is a lever to which a string is attached. This string is carried by means of bell cranks to the supply valve of a gas stove or the damper of a furnace." (The evaporation/ liquefaction of the ether with temperature moved the balance assembly and controlled the string.)

98. *Billington and Roberts, Chap. 11.*

[128] Warren S. JOHNSON 1847-1911

Born in Vermont. Worked in Wisconsin as printer, superintendent of schools, and then a surveyor of the Plains. Later appointed Professor at the State Normal School, Whitewater (1876). Used his laboratory for experiments with electric storage batteries. Johnson also experimented with control of the school's heating system. As recounted by his son, Paul, many years later (1939), "The Normal School was heated by enormous hot-air furnaces. On cold days when they were going full blast, from the large registers in the floor of the lower halls, we could see the red glow of the cast-iron furnaces. The only control of room heat was by hand-operated dampers at the furnaces. Once an hour or so, the janitor would make the rounds of the rooms and note which rooms were too warm or too cold. He would then go to the basement to open or close dampers accordingly. This disturbed the classes considerably, so Professor Johnson installed electric thermostats in each room and connected them to annunciators, which he invented, so that when the thermostat made contact on the warm side, the indicator for that room would show 'Warm' and ring a bell, and when the contact was on the cold side, the indicator showed 'Cold.' All the janitor had to do besides firing his furnaces and keeping the place clean, was to watch the annunciator every time it rang and shift the proper damper. That was the first Johnson System of Temperature Regulation." Warren Johnson was granted a patent (USP 281,844: 1883) for an *electric tele-thermoscope.* Two years later the Johnson Electric Service Co. was established in Milwaukee. However, Johnson soon received a patent for his first pneumatic system of temperature regulation (1885) using his experience of developing giant public clocks powered by air pressure. He went on to obtain some 50 patents in fluid-powered control devices.

45. *Johnson, pp. 3-12. Portrait from Johnson Controls, Inc.*

[129] Alfred BUTZ 1849-1904

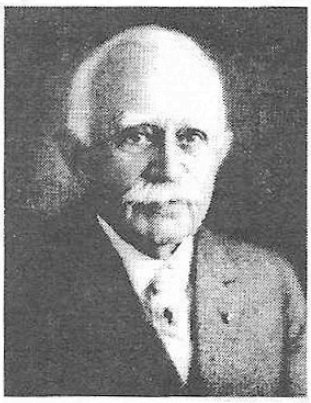
Born in Switzerland. Emigrated to America at the age of eight. Served with Union Army toward the end of the Civil War. Formed Butz & Mendenhall Hand Grenade Fire Extinguisher Co. (1884). Developed a spring motor and crank to operate a boiler or furnace damper, known as the Butz *damper flapper.* Established Butz-Electric Regulator Co. in Minneapolis (1885) and obtained patents (USP 341,093: 1886; 347,866: 1886). Butz later worked for Chicago Heat Regulator Co. (1888), having sold his patent rights to the company that was to become Honeywell. His obituary said, "He had been an inventor for many years, and had only recently perfected a heat regulator, which was recognized by experts as being of great value."

42. *Honeywell, pp. 2-3.*

[130] William Richard SWEATT 1867-1937

Established the Sweatt Manufacturing Co. in Minneapolis to make wooden wheelbarrows and wooden washing machines (1891). Invested in the Electric Thermostat Co., which was then manufacturing the *damper flapper* of Butz [129]. After a number of difficult years, Sweatt bought out the other stock holders (1900). Later (1905), the company made a thermostat and two types of damper motors and that year introduced a clock thermostat. The company became (1912) the Minneapolis Heat Regulator Co. The company expanded and prospered under the direction of his son, Harold W. Sweatt, later (1927) merging with the business of Mark Honeywell [133].

44. *Rodengen, Chap. 2. Portrait from* Trade Winds, *Minneapolis-Honeywell Regulator Co., February 1960, p. 9.*



[131] William Penn POWERS c. 1890

American businessman. Started W.P. Powers & Co. in LaCrosse, Wisconsin (1867). Later became interested in automatic controls and established the Powers Regulator Co., Chicago (1890). Its first thermostat design was round (15-in. diameter) and used in a church, being connected to a large diaphragm motor that controlled double mixing dampers on a fan heating system (1893). The company grew and prospered: two of its most famous control installations (c. 1930) were for New York's Chrysler and Empire State buildings.

99. *Donaldson and Nagengast, pp. 198-202. Portrait from* The Aerologist, *June 1927, p. 11.*

[132] Howard D. COLMAN 1873-1942

American engineer and co-founder (with W.A. Barber) of Barber-Colman Co., controls manufacturer of Rockford, Illinois. Invented an automated knot-tying and finishing device for the textile industry (1894). With a group of engineers, he identified needs and developed further inventions, both for the textile industry and in other fields: fractional horsepower motors, electric fans, and various temperature control systems.

45. *Barber-Colman, p. 5. Portrait from* Barber-Colman, Centennial Celebration, *23 October 1994, back cover.*

[133] Mark HONEYWELL — active 1920s

American inventor. Went into business as a plumbing and heating engineer in Wabash, Indiana (1906). Later invented the Honeywell Heat Generator that allowed heating systems to be pressurized. Formed the Honeywell Heating Specialty Co. and its success eventually led to a merger (1927) between the Minneapolis Heat Regulator Co. of Sweatt [130] and Honeywell. The new company soon became the U.S. leader in home heating controls and developed into one of the world's leading automatic control manufacturers.

44. *Rodengen, pp. 27-50. Portrait from* **42.** *p 9.*

[134] Mads CLAUSEN — 1905-1966

Danish engineer and businessman. Like Carrier [101], he was born on a farm. Founded Danfoss (1933) and directed his first efforts to the production of controls for refrigerating plants. His first success was with an expansion valve. Clausen was described as "a man who could both inspire people and see matters from all sides, while never losing sight of the main objective." The company he founded has grown to one of the largest in its field.

41. *Danfoss Journal, June 1983 with portrait from p. 1.*

[135] John E. HAINES — 1903-1967

American businessman and controls engineer. President ASHRAE (1955). Introduced the classic *Engineering Manual of Automatic Control* (Honeywell 1958, first published in 1934). This manual and Haines' textbook, *Automatic Control of Heating and Ventilating*, explained the art of controls engineering to a wider audience by extensive use of system and control schematics.

Portrait from **94.** *p. 190.*