JOSEPH BRAMAH
1748-1814

Devised a Water Closet

JOSEPH BRAMAH was the son of a farmer from Stainborough, near Barnsley, Yorkshire. He served an apprenticeship with the village carpenter, but in 1773 decided to seek work in London. He made the journey on foot and secured work as a journeyman cabinet maker working for a Mr Allen of Cross Court, Carnaby Market. While recovering from a serious fall at work he turned his attention to improving on Cunmmings' valve closet, and in 1778 patented his own improved design – only the third to be taken out for a water closet. This was his first patent and he soon set up business on his own as a cabinet maker in the less than salubrious Denmark Street in the parish of St Giles. Bramah's valve closets were a commercial success. He could probably have established fame and success on this invention alone, but this remarkably talented and inventive man went on to take out another seventeen patents covering improvements to water cocks, locks, fire engines, carriage brakes and suspension, printing presses and even fountain pens. He also invented the hydraulic press, without which many of the great engineering feats of the nineteenth century would have been impossible.

Joseph Bramah. (*Institution of Mechanical Engineers*)

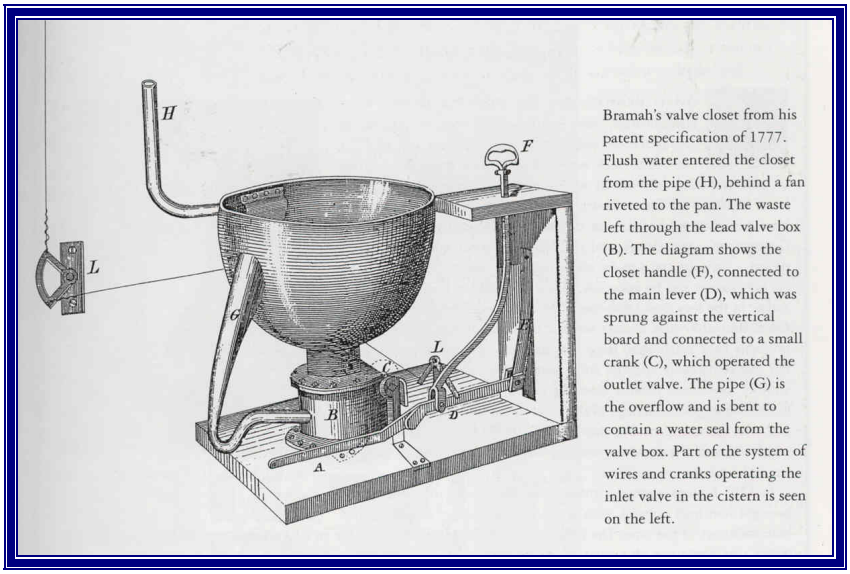
In 1783 he was elected a member of the Society of Arts, which brought him into contact with some of the leading engineers and manufacturers of the time. The following year he took out a patent for an entirely new type of lock that contained levers that could not be picked by the average picklock. Until the first patent by Chubb in 1818, Bramah had a virtual monopoly on high-class locks. In 1784 he also moved to more fashionable premises at the west end of Piccadilly. By 1785, when he took out a patent for a hydrostatical machine, he was describing himself as an engineer, and subsequently established works at Pimlico which included a foundry, machine or engineering shop, a pattern shop and a model or research room. He married Mary Lawton from near his family home in 1785 and had five children, three of whom adopted engineering as their career. The oldest, Timothy, had joined the family firm by 1813 when the name of the company changed from Bramah and Co. to Bramah and Sons, but in December 1814 Joseph Bramah died and was buried in Paddington churchyard. The firm continued in business until about 1890, by which time none of the family was involved.

From Bogs, Baths & Basins," David J Eveleigh, 2002 (CIBSE Heritage Group Collection)

Bramah had devised an extremely effective water closet. The basin contained a good depth of water in which solids were completely submerged and liquids diluted; it had a large exposed surface of water reducing to a minimum the possibility of fouling the basin and practically silent action. His cranking arrangement, which operated the two valves, was also more effective than Cummings's design. The main lever, one end of which was raised by pulling the flushing handle, was held against a wooden board by a spring. This ensured that when the handle was released it sprung back into position and also that the flap valve was held tight against the bottom of the pan. The mechanism included a shorter lever working

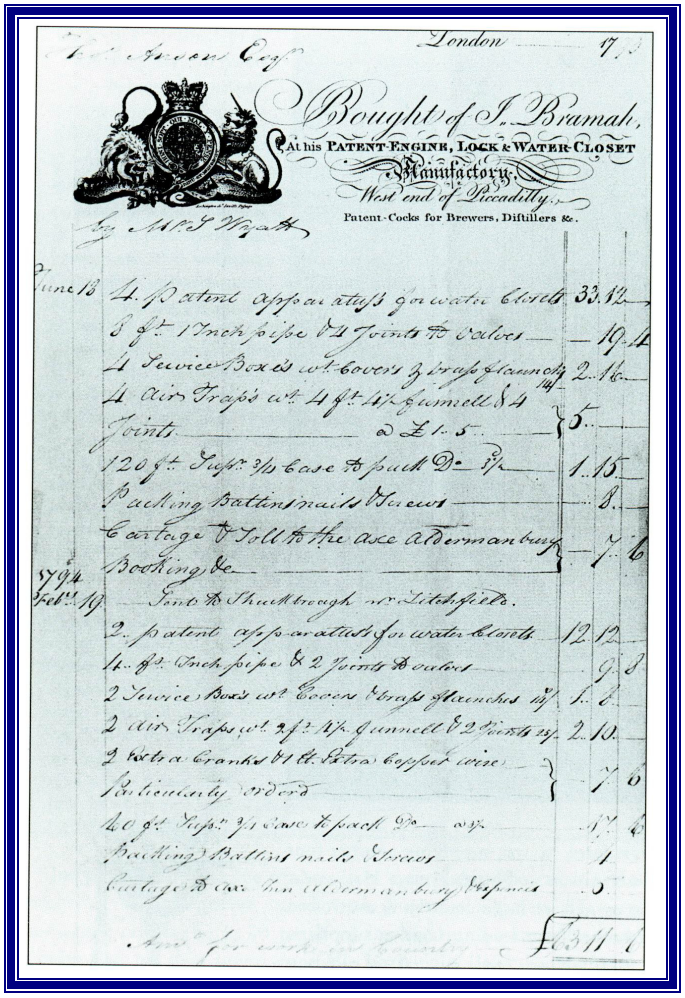
off the main lever so the water supply valve operated simultaneously. By the early nineteenth century, water closets controlled by a sprung lever like Bramah's, were being called 'spring valve closets'.

In place of a spring, many nineteenth-century Bramah-type closets used cast-iron counterweights attached to the end of the two levers: these also ensured the discharge valve snapped shut in a businesslike way. Bramah's outlet valve rotated – or flapped – within an iron valve box on which the pan or basin rested. The valve box was provided with its own ventilation and was also connected to an overflow pipe from the pan above: this overflow was made with a reverse curve to create a water-seal trap to prevent bad air from escaping from the apparatus. A short distance below the valve box was another seal – a water-seal trap – which provided a second barrier between the closet pan and the soil pipe. Bramah said nothing of this in his patent, and illustrations of valve closets as late as the 1850s suggest that they were usually fitted with the inefficient D trap. The trap was usually located under the floorboards and was, therefore, virtually impossible to get at for maintenance or cleaning, but the cranking mechanism, valve box and pan were enclosed in a wooden cabinet, usually of mahogany. The top contained the seat with its round hole above the pan and a smaller one at the side fitted with the cup and pull handle.



Bramah's valve closet from his patent specification of 1777. Flush water entered the closet from the pipe (H), behind a fan riveted to the pan. The waste left through the lead valve box (B). The diagram shows the closet handle (F), connected to the main lever (D), which was sprung against the vertical board and connected to a small crank (C), which operated the outlet valve. The pipe (G) is the overflow and is bent to contain a water seal from the valve box. Part of the system of wires and cranks operating the inlet valve in the cistern is seen on the left.

Bramah's Valve Closet, 1777



Bramah Invoice c.1793

ROBERT BRIGGS
1822-1882

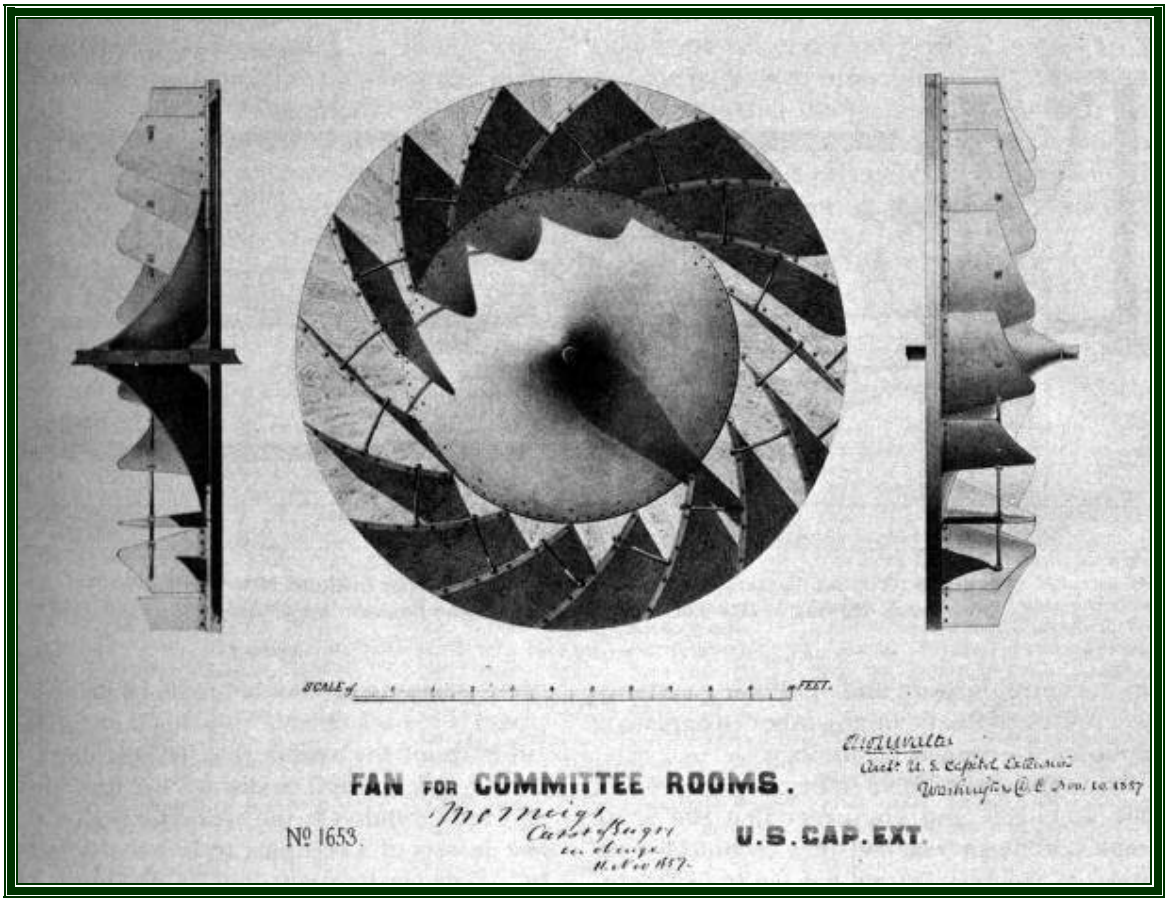
No portrait has so far been discovered

[205] Robert BRIGGS **1822-1882**

American civil engineer. Consulting engineer of Boston. Worked with Nason [206] for Meigs [207] on the heating and ventilating installation for the United States Capitol in Washington [from 1855]. The design of the giant fans was based upon methods suggested by Péclet [27] and on a study by Briggs of the workings of a 1/10th scale model. "The passages in which were located the large centrifugal fan rotors...were so shaped that no fan casing was required. The central cone of the fan was of cast-iron; the vanes were of wood, stiffened and fastened with metal angles and rods. The rotor was 14 feet in diameter."* His design was described in his paper, *On the Conditions and Limits Which Govern the Proportions of Rotary Fans* (Institution of Civil Engineers, 1869-1870). Jointly obtained a patent with Nason (1863) "for a steam radiator made up of vertical tubes screwed into a horizontal cast-iron base" (often called the *Nason* radiator). Briggs wrote a number of essays covering ventilation, moisture in the air, and heating of halls of audience. Editor of the Journal of the Franklin Institute (1876-1878).Wrote the textbook (1882), *American Practice in Warming Buildings by Steam* with additions by Wolff [211]. Briggs received the Watt Medal and the Telford Premium from the Institution of Civil Engineers (1871).

(Mini-biography from "The Comfort Makers," Brian Roberts, ASHRAE, 2000)

General Montgomery C. Meigs, who was responsible for coordinating the overall design and installation of the first heating and ventilating system in the U.S. Capitol, worked closely with Robert Briggs, a consulting engineer from Boston, and Joseph Nason from New York. The heating and ventilating systems were used in the south and north wings of the Capitol for the House of Representatives and the Senate, respectively. The systems included heating and ventilating for the legislative chambers of the House and Senate, as well as the numerous committee rooms, corridors, and the "great stairwells."



Fan Rotor of 14 ft diameter, US Capitol 1857 by Robert Briggs

The detailed design of the fans was based on a study by Robert Briggs, Jr., of the data collected from the model fan and dynamometer, mentioned earlier.[52] Briggs was the "engineer and draftsman," furnished as part of the piping contract, who was to become a recognized authority on heating and ventilating, reinforcing in the next generation the Nason approach.[53]

(From "Building Early America," Charles E Peterson (Ed), 1976)

Robert Briggs visited the Capitol to examine the heating and ventilating system and was convinced that its proper operation was not clearly understood by those who controlled its operation. He commented that:

> The prime object of the entire apparatus is to give the largest quantity of air at the lowest temperature that will answer to heat the rooms. The occupants of rooms will only tell you when they are too hot or too cold, but that they have enough air—which in the long run is the most important—rests upon your own care and observation.[30]

This system remained in operation until the beginning of the twentieth century, when, in 1906, it was upgraded.

The original steam distribution systems designed by Joseph Nason in 1845 were pipe coils located in the space that they heated. Nason's design for the U.S. Capitol in 1855 used "box-coils" referred to as "trombone coils" because of their distinctive shape. Stephen Gold introduced his "mattress" radiator in 1854, which was "amazingly like James Watt's invention of 1784"[49] (Figures 7-39 and 7-40). Samuel Gold did not introduce his cast-iron "pin" radiator until 1862 (Figure 7-41).

Wrought-iron radiators were eventually replaced by the more popular cast-iron radiators that could be manufactured in sectional components and with a variety of ornamental finishes. The earliest of these cast-iron radiators were considered to be "of homely design and were known as the Ox-bow and Wash-board" and were typically single castings or halves bolted together (Figure 7-42).

Cast-iron radiators were being manufactured by a number of foundries, and "fitters of those days made many attempts between 1848 and 1862 to produce vertical radiators from pipe, but with slight success, and it was not until 1862 that the problem was solved."[50] Joseph Nason and Robert Briggs received a patent in March 1863 for a steam radiator made up of vertical tubes screwed into a horizontal cast-iron base. Following this, numerous radiator

patents were given out and the vertical-pipe wrought-iron and cast-iron radiator business began to flourish.

However, different radiator sizes and capacities created problems of engineering and proper sizing for rooms. "From 1862 to about 1892, the practice of furnishing piping plans to any one who would buy boilers was the universal habit in this country. In this way men who were totally incompetent for the work came in time to the doing of the plan-making work for some of the manufacturers. That the results were not more disastrous than they often proved is a matter of wonder to some of those who look back upon those days from the standpoint of present knowledge."[51]

The Nason and Briggs radiator solved some of this problem by offering wrought-iron pipes and their proportionate amount of the cast-iron base and cap to be exactly one square foot of surface area to the air. The availability of radiators that could be selected according to absolute units of one square foot greatly simplified the design. Steam fitters requiring a specific area of surface, such as 24 square feet, could order standard radiators as 1 x 24, 2 x 12, 3 x 8, or 4 x 6. The most popular width, however, was the two-column type.

(From "Heat & Cold: Mastering the Great Indoors,"
Barry Donaldson & Bernard Nagengast, ASHRAE, 1994)

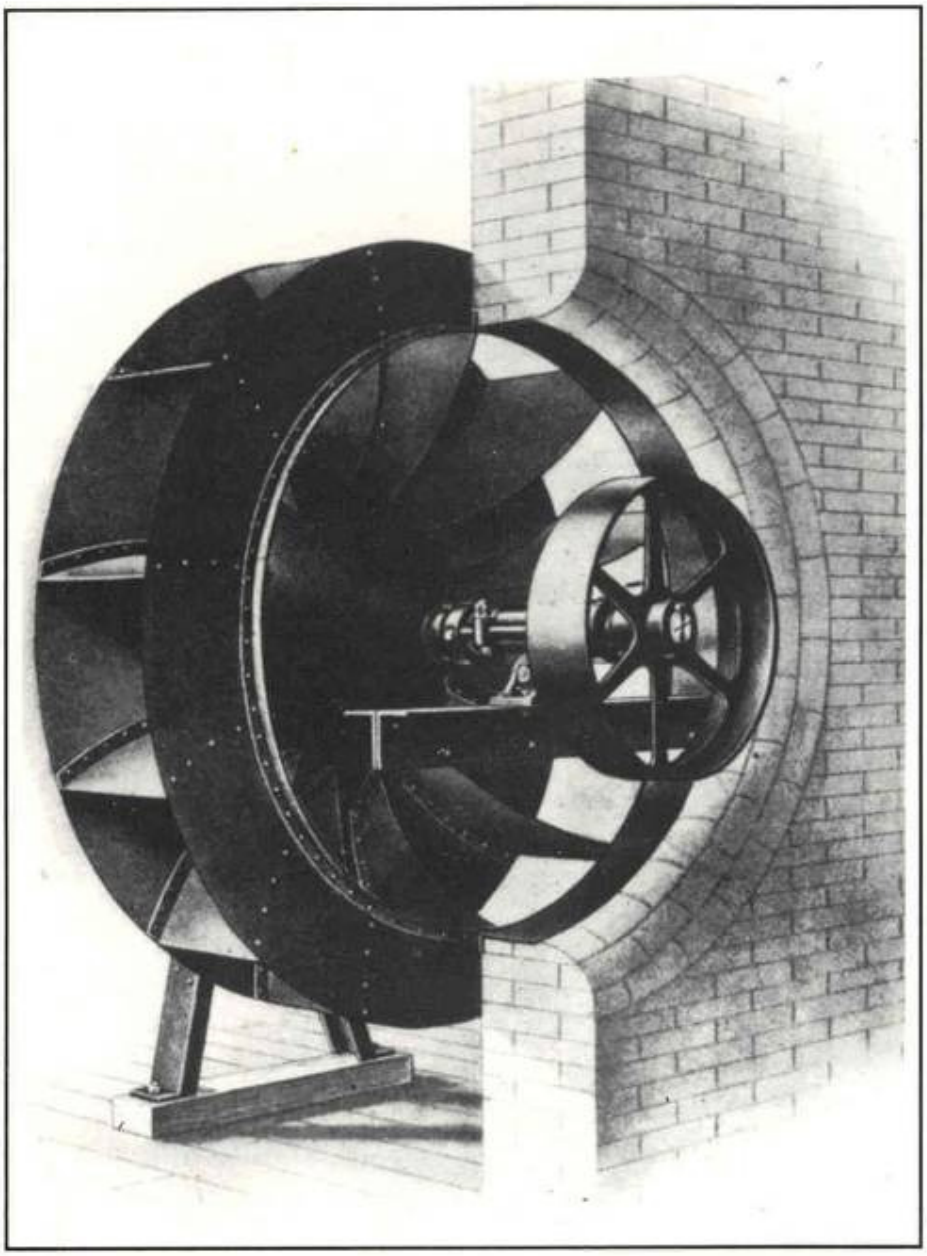
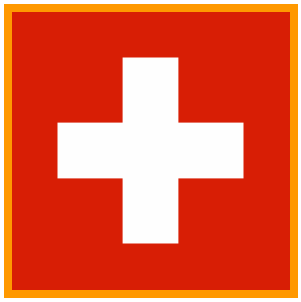
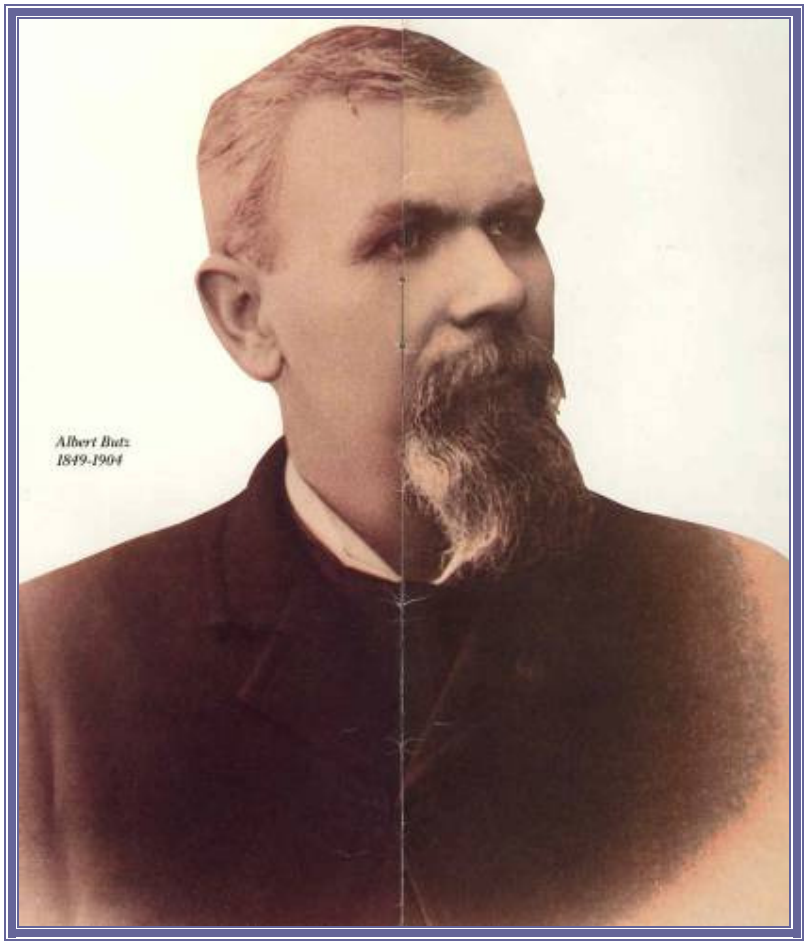


Figure 7-24 *Type of fan installed at the U.S. Capitol, 1857 (from* Engineering Review, *September 1922, p. 27).*



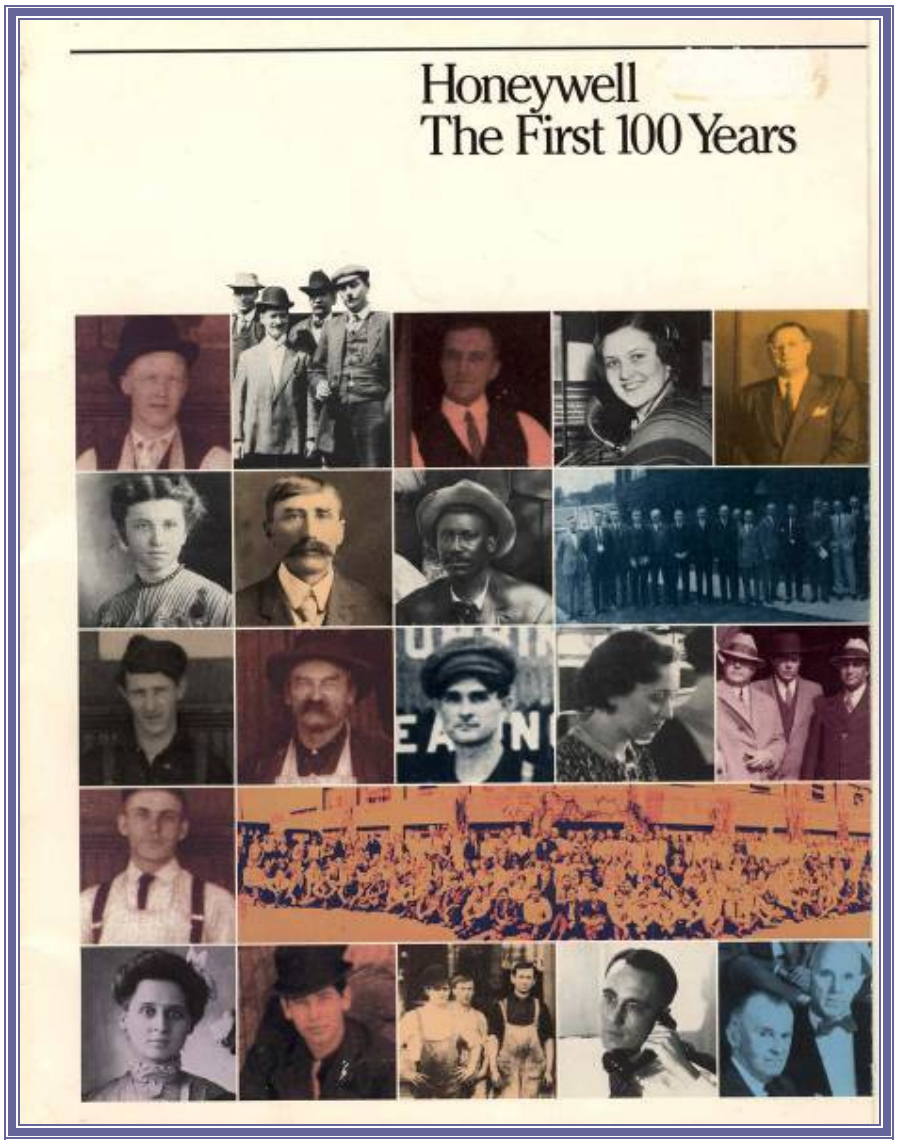
ALBERT BUTZ
1849-1904



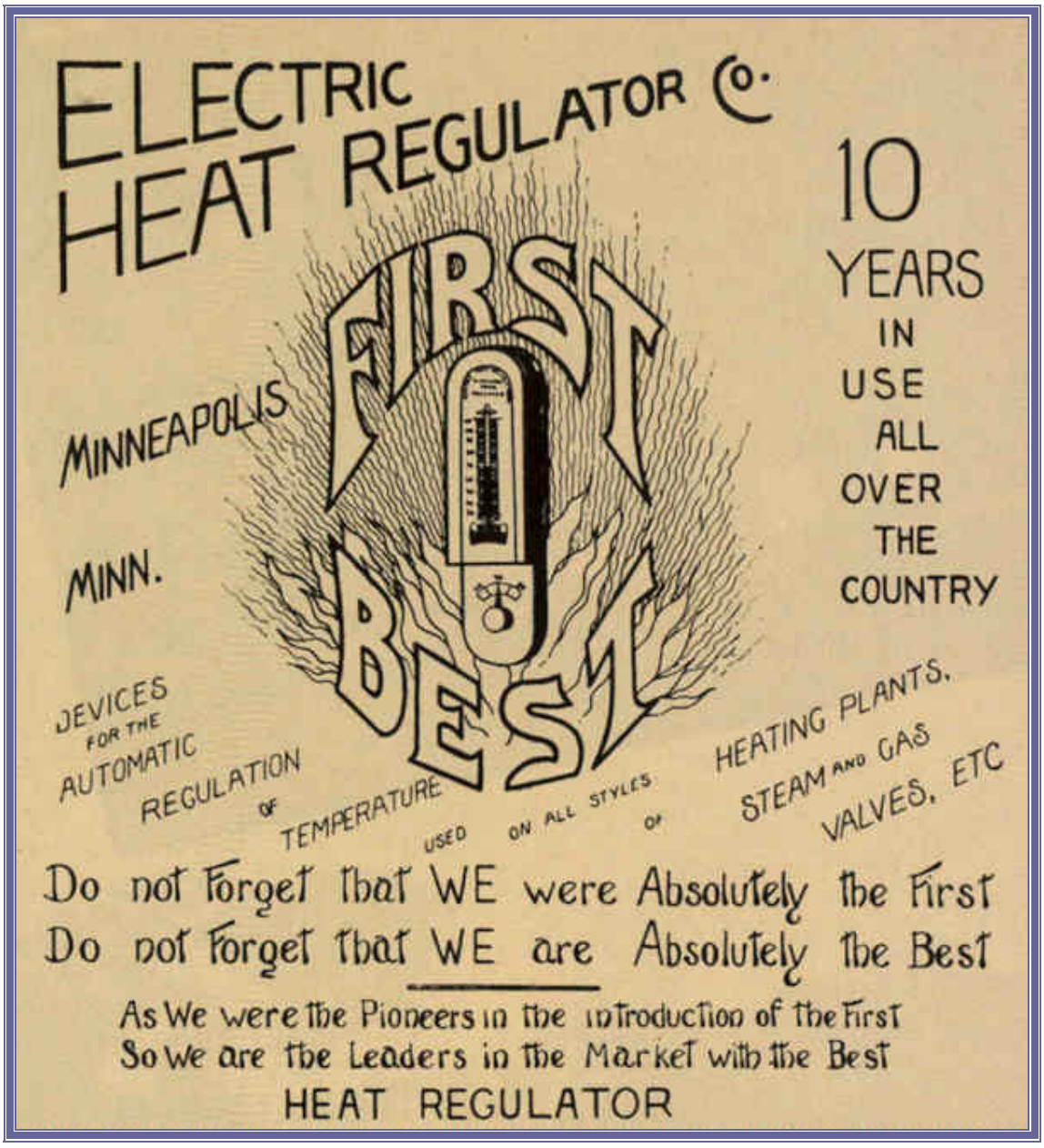
Invented the "Damper-Flapper"

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."

(Mini-biography from "The Comfort Makers," Brian Roberts, ASHRAE, 2000)



Honeywell Centenary Brochure, 1885
(CIBSE Heritage Group Collection)



Advertisement of 1895 (From "Honeywell –The First 100 Years")

When Albert Butz invented his "damper flapper" in 1885 he had no idea it was the seed of a company that would grow to reach around the earth and into space. No, Butz was a tinkerer, a gadgeteer who was happiest at his workbench.

Butz was born in Switzerland in 1849. He came to this country with his parents as an 8-year-old boy. At 16 he enlisted in the 47th Wisconsin Infantry of the Union Army and served six months until the end of the Civil War. Of his experience, Butz wrote, "Having no battles to fight and nothing to do but drill, about the most important event that took place was riding the captain on a rail out of camp for neglect of his company and too free use of liquor."

Butz disappears from recorded history until 1881 when he shows up in St. Paul as a subscription book salesman for G.W. Borland and Company. Three years later he and a partner formed Butz and Mendenhall Hand Grenade Fire Extinguisher Co., a firm which manufactured glass spheres filled with water which hung from ceilings in baskets. When fire broke out the basket would burn, the sphere would drop to the floor and break and, theoretically, the water would extinguish the fire.

Meanwhile, Butz was at his workbench tinkering with a spring motor equipped with a crank arm that would operate chains or wires to adjust the dampers of a coal-fired furnace or boiler in response to the demands of a room thermostat. The purpose of his invention was to maintain an even temperature in the home and

relieve the home-owner of the tedious job of opening and closing the damper by hand. Because of the way it worked Butz's gadget became known as a "damper flapper."

It looked promising. He and a group of investors formed Butz Thermo-Electric Regulator Company to manufacture his damper flapper in a barn-size, drafty building in what is now downtown Minneapolis.

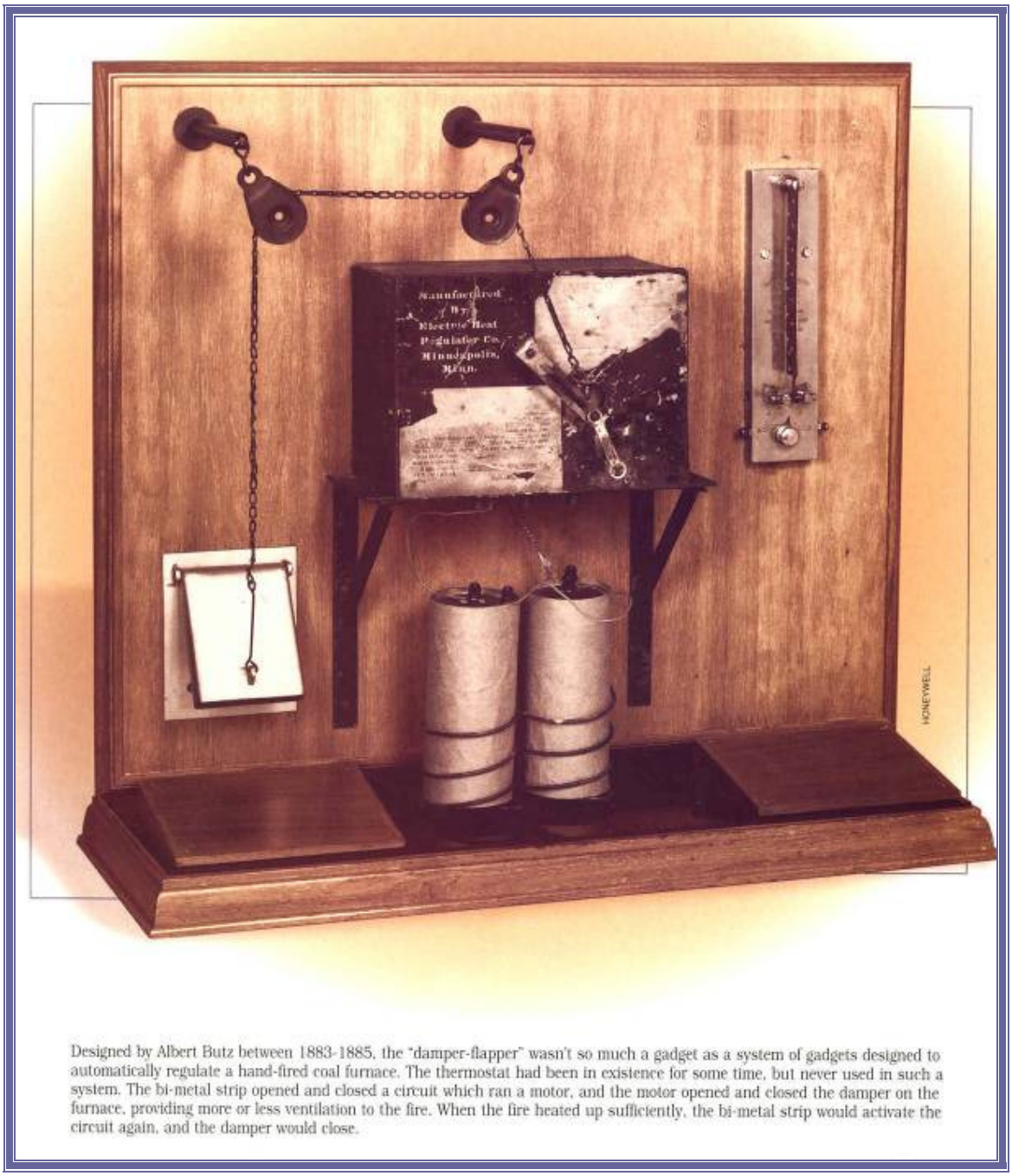
The year was 1885.

Demand for the damper flapper was not overwhelming. Home-owners had to go to the cellar to put coal on the fire anyway—and, to make matters worse, few furnaces and boilers manufactured at the time had the type of lift dampers that could be connected to the device. Furthermore, Al Butz was no fireball of a salesman. In fact, it's doubtful many were sold at all.

The next we hear about him is in 1888 when he moved to Oak Park, Illinois, where he went to work for Chicago Heat Regulator Company. Upon his death in 1904 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 of great value."

Before leaving for Oak Park, however, he sold his patent for the damper flapper to his attorneys, Paul, Merwin and Sanford, and the patent remained in the Twin Cities where it formed the basis for the company that would eventually be called Honeywell. Butz's patent was the first application of the principle of feedback on which is based the science of automated control, an industry that would transform the world.

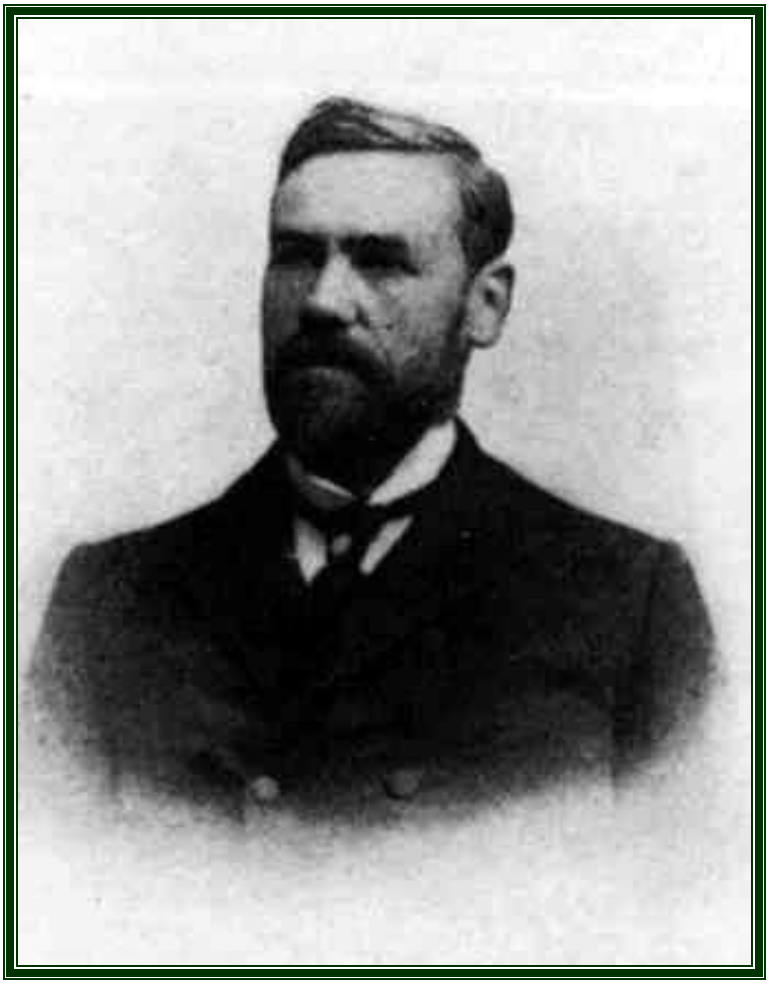
(From "Honeywell –The First 100 Years")



Designed by Albert Butz between 1883-1885, the "damper-flapper" wasn't so much a gadget as a system of gadgets designed to automatically regulate a hand-fired coal furnace. The thermostat had been in existence for some time, but never used in such a system. The bi-metal strip opened and closed a circuit which ran a motor, and the motor opened and closed the damper on the furnace, providing more or less ventilation to the fire. When the fire heated up sufficiently, the bi-metal strip would activate the circuit again, and the damper would close.

(From "The Legend of Honeywell," Jeffrey L Rodengen, 1995)

ROLLA CLINTON CARPENTER
1852-1919



3rd President ASHVE in 1896

[253] Rolla C. CARPENTER **1852-1919**

Third President of ASHVE (1896). From Ithaca, N.Y. Professor of Experimental Engineering at Cornell University. Author of the textbook *Heating and Ventilating Buildings* (1895). He attempted to rationalize heat loss calculations, building on the work of European pioneers, and conducted some of the first controlled tests on the output of steam radiators (1900-1903), while Chairman of the Tests Committee.

(Mini-biography from "The Comfort Makers," Brian Roberts, ASHRAE, 2000)

1896

ASHVE

ROLLA C. CARPENTER

1852-1919

ITHACA, NY

"Our engineering society...has doubtless prospered and can certainly be recognized as one of the great engineering societies of this country. It has established a strong foundation for a broad and noble society and is now in position to commence active work for the benefit of the science and art of heating and ventilation, and it should have and doubtless will have the confidence and support of every desirable person engaged in this work in this country." (p. 68, *ASHVE Trans.*, 1897)

(From "Proclaiming the Truth," ASHRAE, 1995)

Early Scientific Air Conditioning in the United States

"The time is not far distant when mechanical refrigerating machinery will be applied to the cooling of hotels and dwellings in summer in a manner similar to that by which the heating is now done in winter, and a portion of the heating apparatus will be used for this purpose . . .," said the editors of the steam journal *The Stationary Engineer* in 1891.[41] Indeed, Professor Rolla Carpenter noted in his heating and ventilating book: "Cooling of rooms . . . bids fair to be at some time an industry of considerable importance. Rooms may be artificially cooled by a system constructed similar to that described for hot blast heating."[42] The heating system that lent itself to easy use for room cooling was the so-called hot blast system.

(From "Heat & Cold: Mastering the Great Indoors,"
Barry Donaldson & Bernard Nagengast, ASHRAE, 1994)