UNITED STATES CAPITOL
WASHINGTON DC

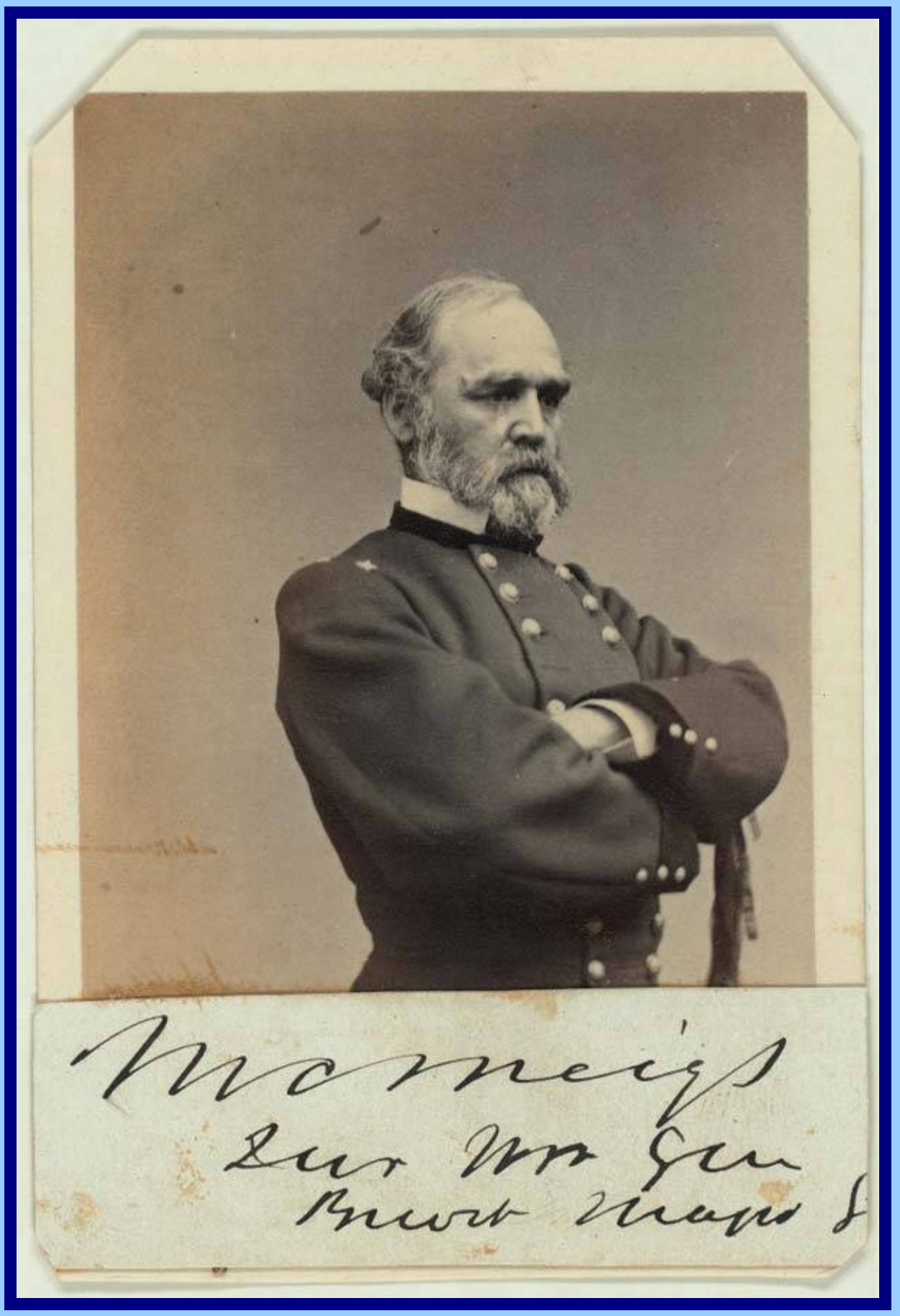
THE U.S. CAPITOL

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."

General Meigs wrote to his chief, the Honorable J.B. Floyd, then Secretary of War, that:

> The most difficult piece of engineering and construction which I have yet had to undertake is the heating and ventilating of the Capitol extensions (that is, the House and the Senate Wings). There is none which requires more laborious, complicated and tedious calculation, drawings and studies, none which requires so extensive an acquaintance with the general principles of science and physics of the properties of caloric and its effects on gases and solid bodies. There is none in which so many failures have been made, both in this country and in Europe. The history of the heating of the Houses of Parliament, in England, is a history of failures and blunders, of ignorance and waste.[25]

The heating system consisted of twenty-six indirect heaters built into brick chambers in the sub-basement of each wing. "These chambers were connected by means of subterranean airways of generous proportions, with a fan chamber in each building. The outside air was drawn through tunnels of approximately 64 sq. ft. cross-section, each tunnel terminating at the base of an open topped tower in the park west of the Capitol and some 400 ft. distant from the building"[26] (Figure 7-21). Vertical flues built into the massive brick masonry were used to distribute the heated air to "hooded outlets" near the floors of various spaces (Figure 7-22).



General Montgomery Cunningham Meigs, 1816-1892

The heaters were of a "box" pipe-coil pattern, each vertical trombone coil begin connected into a steam manifold at top and a corresponding condensate manifold at bottom. The number of trombone coils, or sections, in the heaters, varied from six for the smallest heater to eighteen for the largest. The number of pipes in vertical order in the trombone sections varied from 14 to 24. Each one of all these trombone sections, or elements, was valved at both the steam and condensate connections with respective manifolds, the valves being embodied in the manifolds[27] (Figure 7-23).

The air was carried to a 16-foot-diameter fan from which "was intended to supply at 60 revolutions per minute 50,000 cubic feet of air against a resistance of about half an inch of water column, and when running from 100 to 120 revolutions to give 100,000 cubic feet of air, which was supposed to be the maximum amount required."

At the Capitol the system recommended and adopted was that of a forced or plenum ventilation, the entering air being propelled by two large centrifugal fans, one 16 ft. and one 12 ft. in diameter, motive power being applied to the fan by vertical engines, the cranks of which were keyed on to the fan shaft. The volumes of air to be moved were much larger than had been handled in earlier work and a more refined analysis of the form and construction of the fan than previously had been made was deemed advisable, and, therefore, a long and costly series of experiments were made by Mr. Nason, in cooperation with Captain Meigs as to the best possible obtainable form for the fans. These fans as built were really air turbines reversed. They consisted of circular iron discs of diameters mentioned above on the periphery on one side of which were bolted cast-iron quadrilateral vanes.

These vanes were curved and placed on the line of a logarithmic spiral of 45 degrees. The fans were centered in a

ring of brick work the surfaces of which next to the moving parts was swept in mortar by the fans themselves. They were predecessors of the cone fan of today. The Boston Custom House fans were no doubt built of wood but the fans in question were built of iron by Morris, Tasker & Morris, of Philadelphia, who afterwards made many more for Walworth & Nason for use in insane asylums and hospitals.[28]

Despite the best of available design expertise and the latest heating and ventilating technology at this time, there still remained significant problems with the comfort of its esteemed occupants.

Experience has shown two errors in the design of the system; first, in the method of temperature control involving the human factor to an excessive degree; and, second, in the absence of means for tempering the air before reaching the heaters whose construction and valving exposed all trombone sections unfilled with steam to the liability of freezing cold weather.[29]

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

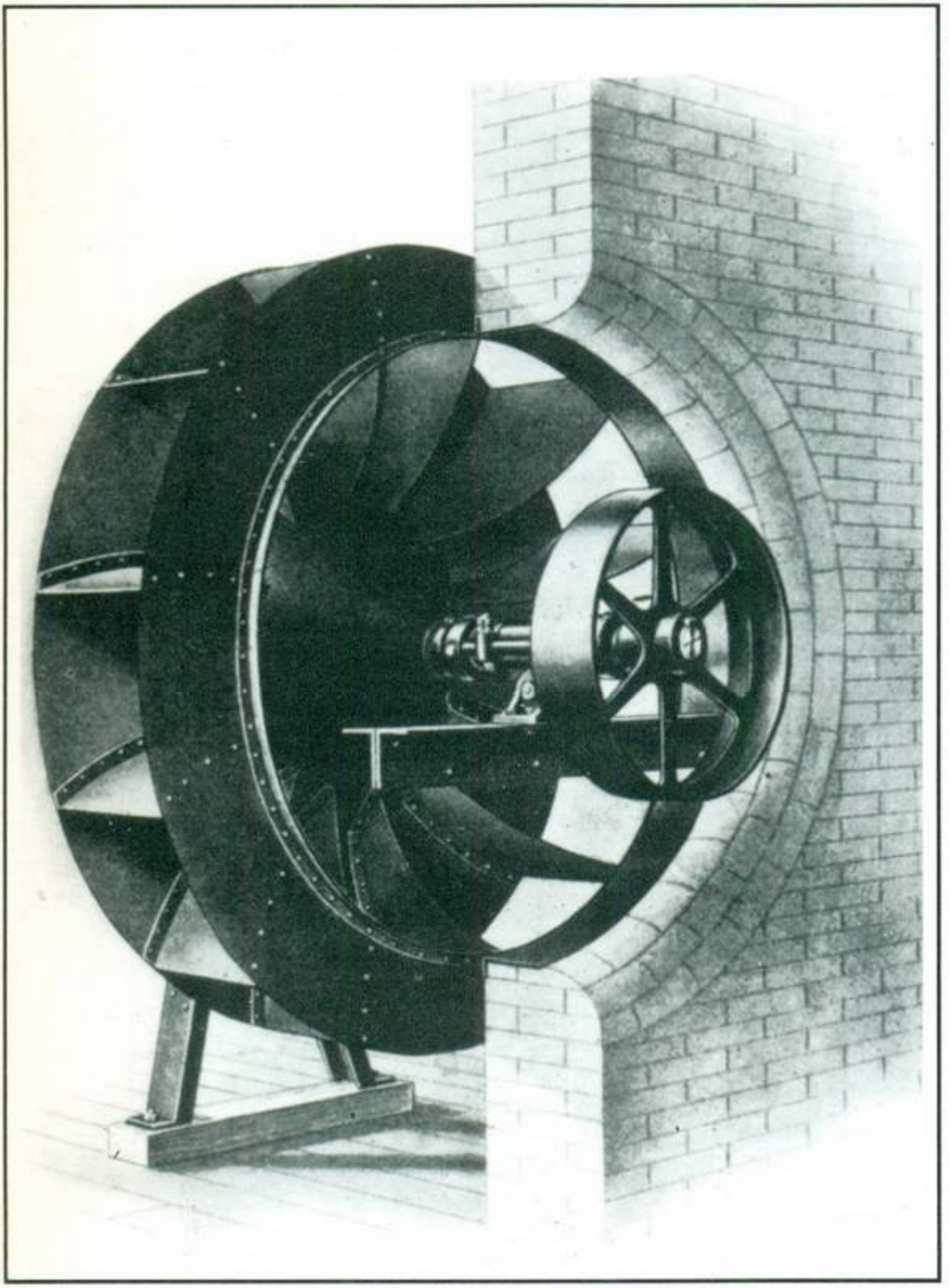


Figure 7-24 *Type of fan installed at the U.S. Capitol, 1857 (from* Engineering Review, *September 1922, p. 27).*

> 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.

Nason introduced an innovative radiator design in 1862, "built of pipes screwed into a cast-iron base and so adjusted that each pipe and the base for it contained exactly one square foot of superficial surface. This radiator was the first to be constructed on strictly scientific lines and I think it can be fairly stated that all radiator ratings in use today in this country are primarily based upon the Nason radiator."[31]

> In this way, from 1862 to 1879, the vertical-pipe wrought-iron radiator business fell into the hands of concerns of great capital and great business ability. These were the men who had the inventive power and the business capacity to make the steam-heating development in this country in those 17 years one of the business marvels of the nineteenth century. After the close of the Civil War, the heating-business began to attract the attention of the manufacturers of cast-iron.[32]

The firm of Walworth and Nason continued to thrive during the next thirty years, designing and installing steam heating and fan-powered ventilating systems in many large projects throughout the northeastern United States. Walworth and Nason ultimately merged into "the great manufacturing concern" known as the Walworth Manufacturing Company.

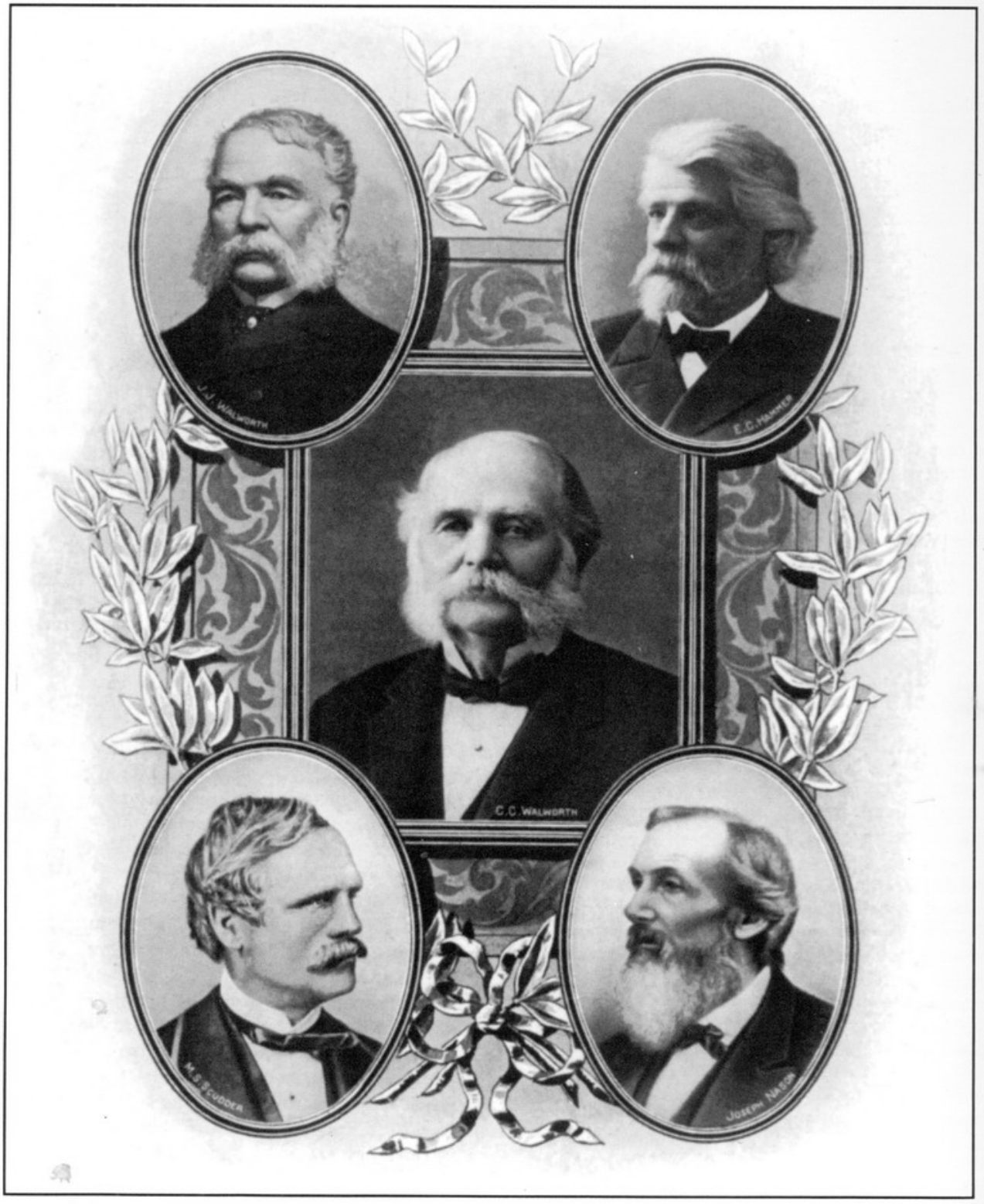


Figure 7-20 *Pioneers of Walworth Manufacturing Company (from the Walworth Co.).*