MONTGOMERY C MEIGS

PART-2

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Montgomery Cunningham Meigs, 1816-1892

Daguerreotype of the early Capitol building

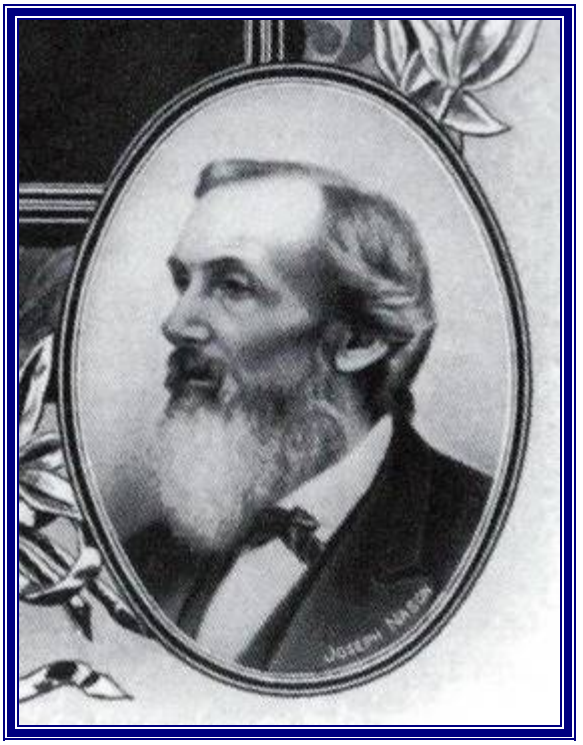
Building the Capitol's new dome at the time of President Abraham's inauguration in 1861

The United States Capitol, Washington DC

In 1855, the problems of heating and ventilating the new House and Senate were passed to Captain Montgomery Meigs. The existing building had been heated by sixteen warm air furnaces and Meigs considered this totally inadequate for the future, and he recognised the importance of ventilation "and the need to avoid vitiated air in any form." Having previously visited public buildings in Boston, New York, Brooklyn and Philadelphia, he moved the main hall to the centre of the building, reducing the effect of climate changes and then eliminating windows and natural lighting through the provision of overhead gas lighting. After deciding on the arrangement of rooms in the new wings, in 1855 Meigs called Joseph Nason to Washington to discuss the heating and ventilating requirements.

Joseph Nason is credited with the introduction of steam heating into the United States. On a trip to London he met Angier Perkins and worked for a time in his heating business. Through Perkins, he met with Thomas Russell of the pipe manufacturing family who had unsuccessfully tried to start a business in New York City. Russell sold this company to Nason and his partner, James Walworth. The new firm of Walworth & Nason was set up in 1841 and in 1842 moved to Boston and went on to complete a number of steam heating installations, and installed, possibly the first fan ventilation apparatus in the United States, in 1846 for the Boston Custom House. The Walworth and Nason Partnership was dissolved in 1852, with Nason operating his business from New York.

Nason proposed "to supply all necessary pipe and fittings at fifteen percent discount from printed list prices, to furnish an engineer and a draughtsman for six dollars a day, and first and second class workmen at proportionate rates." Nason's services were to be supplied at no extra charge. Meigs accepted.



Joseph Nason

The design covered "the intricate system of steam boilers, steam coils, brick-masonry ducts and huge centrifugal fans." Since no reliable data were available to determine the power requirements of the fans, Meigs arranged for the making of a one-tenth scale model driven by a weight on a cord, falling through a distance of 50 feet.

The engineering scheme adopted was that of a forced air or plenum ventilation installation which employed two large centrifugal fans, one 16 ft in diameter, the other of 12 ft, each driven by a vertical engine with their cranks “keyed onto the fan shaft.” These fans consisted of large diameter iron discs with “bolted cast-iron quadrilateral vanes” on the periphery of one side. These curved vanes were “placed on the line of a logarithmic spiral of 45 degrees.” The fans were designed by Robert Briggs, a consulting engineer from Boston, who was employed as Nason’s “engineer and draughtsman.” The intended output of the 16 ft fan was 50,000 cubic feet of air per minute at half an inch water gauge when running at 60 revolutions per minute, rising to 100,000 cu.ft/min (the maximum required) at some 120 revs/min.

The heating system consisted of 26 steam coils placed in brick chambers in the air stream, each coil being made from straight lengths of wrought iron pipe assembled with return bends to form a path for the steam which passed into a large pot-type steam trap. These chambers were connected “by means of subterranean airways of generous proportions” (about 64 sq.ft cross-section). Vertical flues within the massive brick masonry were used to distribute the heated air to “hooded outlets” at floor level.

As in the earlier schemes for England’s Houses of Parliament, the occupants of the building frequently complained. When Robert Briggs visited the Capitol to examine the completed heating and ventilating systems he came away convinced that “its proper operation was not clearly understood.”

Beginning in 1878, Dr John Shaw Billings and others carried out detailed investigations of the internal building conditions when the ventilation plant was in operation. Billings published in his book a detailed table of the tests in 1892. This lists external and internal dry bulb temperatures, relative humidity, air velocities and direction, occupancy levels, wind and weather conditions, and levels of gas lighting.

These systems remained in use until 1906, when they were upgraded,

Dr John Shaw Billings, 1838-1913
Elected the First ASHVE Honorary Member in 1896

OBSERVATIONS RELATING TO THE MOVEMENTS OF AIR, ITS TEMPERATURE, RELATIVE HUMIDITY, ETC., AT THE HOUSE OF REPRESENTATIVES DURING THE MONTH OF FEBRUARY, 1892.

Date.	Temperature. Outside at 7 A.M.	Outside at 12 M	Outside at 2 P.M.	Outside at 4 P.M.	In the Hall. During Session. Hig't	In the Hall. During Session. L'w't	Lowest at Night.	At Louvers Above Ceiling During Session.	Hygrometer. Dry Bulb.	Relative Humidity.	Revolutions of the Fan per Minute.	Air Movement. In the Duct. Velocity in Feet per Minute.	In the Duct. Volume Cubic Feet per Minute.	At Louvers Above Ceil'g. Velocity in Feet per Minute.	At Louvers Above Ceil'g. Volume in Cubic Feet per Minute.	Average Number of Persons in the Hall.	Cubic Feet of Air per Minute per Person.	Wind. Velocity in Miles per Hour.	Direction.	Weather.	Barometer.	
1	44	50	54	70	68	62	70	65	73	42	400	30,000	290	29,000	500	60	6	S.	Cloudy	30.30	
2	53	57	58	71	70	67	71	68	70	41	390	29,250	285	28,500	450	65	6	S.	"	30.10	
3	45	45	45	70	70	68	70	69	70	42	440	33,000	310	31,000	500	60	10	N.W.	"	30.20	
4	46	46	47	70	70	67	70	65	49	46	450	33,750	315	31,500	500	67	18	N.W.	"	30.40	
5	33	33	33	71	69	69	90	68	51	41	470	35,250	340	34,000	600	58	28	N. E.	Snow	30.20	Outer row gas-lighted.
6	35	36	40	70	70	63	71	68	38	45	450	33,750	315	31,500	550	60	3	W.	Cloudy	30.50	
7	..	..	..	..	..	..	..	..	..	..	...	.....	...	. ..	...	..	..	.....	.....	..	
8	55	59	60	70	69	63	72	68	51	40	430	32,250	320	32,000	600	53	14	S.	Cloudy	30 0	
9	45	46	46	70	69	65	71	68	51	46	450	33,750	320	32,000	600	56	18	N.W	"	30.20	
10	42	45	45	71	69	65	72	69	50	45	470	35,250	360	36,000	550	64	7	S.	"	30.30	
11	46	46	48	71	69	65	90	70	53	45	460	35,000	350	35,000	500	70	17	W.	"	29.66	Outer row gas-lighted.
12	29	30	32	70	69	55	70	67	46	50	550	41,250	440	44,000	600	68	25	N.W.	"	29.80	
13	28	32	35	70	69	60	70	70	53	45	450	33,750	330	33,000	500	67	10	W.	"	30.20	
14	..	..	.	..	..	..	..	..	..	..	....	. ..	...	.....	...	..	..	.....	... ...	.....	
15	46	42	45	70	69	65	71	69	48	46	450	33,750	300	32,000	600	56	22	N.W.	Clear	30.30	
16	38	40	44	71	69	63	71	69	48	47	470	34,250	315	31,500	500	70	10	N.W.	"	30.60	
17	32	38	38	70	69	63	71	70	44	50	500	37,500	380	38,000	650	57	10	N.	"	30.80	
18	41	60	52	70	69	65	72	68	47	45	450	33,750	325	32,500	550	60	7	S.E.	"	30.40	
19	52	52	52	70	70	51	71	68	51	47	440	33,000	300	30 000	500	66	9	E.	Cloudy	30.40	
20	..	..	..	..	..	..	..	..	..	..	....	... ..	...	. ..	...	..	..	.....	.....	.....	
21	..	..	..	..	.	..	.	.	..	..	...	.. ..	...	.....	...	..	..	.. ..	... .	.. ..	
22	..	..	..	..	..	..	..	..	..	..	..	. ..	...	.. ..	..	..	..	.. ..	... .	.....	
23	..	..	..	..	..	..	..	..	..	..	..	. ..	...	.. ..	..	..	..	.. ..	... .	... .	
24	43	43	44	70	69	66	70	68	48	48	490	36,750	340	34,000	600	61	7	N.	Cloudy	30.50	
25	46	46	46	70	69	66	70	70	53	48	475	33,695	320	32,000	550	64	4	N.W.	Rain	30.40	
26	52	53	54	71	70	67	71	69	56	45	410	30,750	300	30,000	600	51	12	N.	Cloudy	30.40	
27	49	51	51	70	69	66	71	68	58	46	490	36,750	400	40,000	600	61	20	N. E.	"	30.55	
28	..		..	..	..	..	..	..	..	..	...	.. ...	...	.....	...	..	..	.....	... .	. ...	
29	41	41	41	69	68	65	71	68	60	52	470	35,250	400	40,000	600	58	23	N. E.	Rain	30.10	

Average relative humidity..... 53
" revolutions of fan per minute 46
" volume of air moved forward by each revolution..... 746

Average volume of air carried to the hall per minute 34,316
" " " " " " " per person 62
" " removed from the hall per min. " 60

CAPITOL AT WASHINGTON.

Record of Environmental Tests carried out in February, 1892

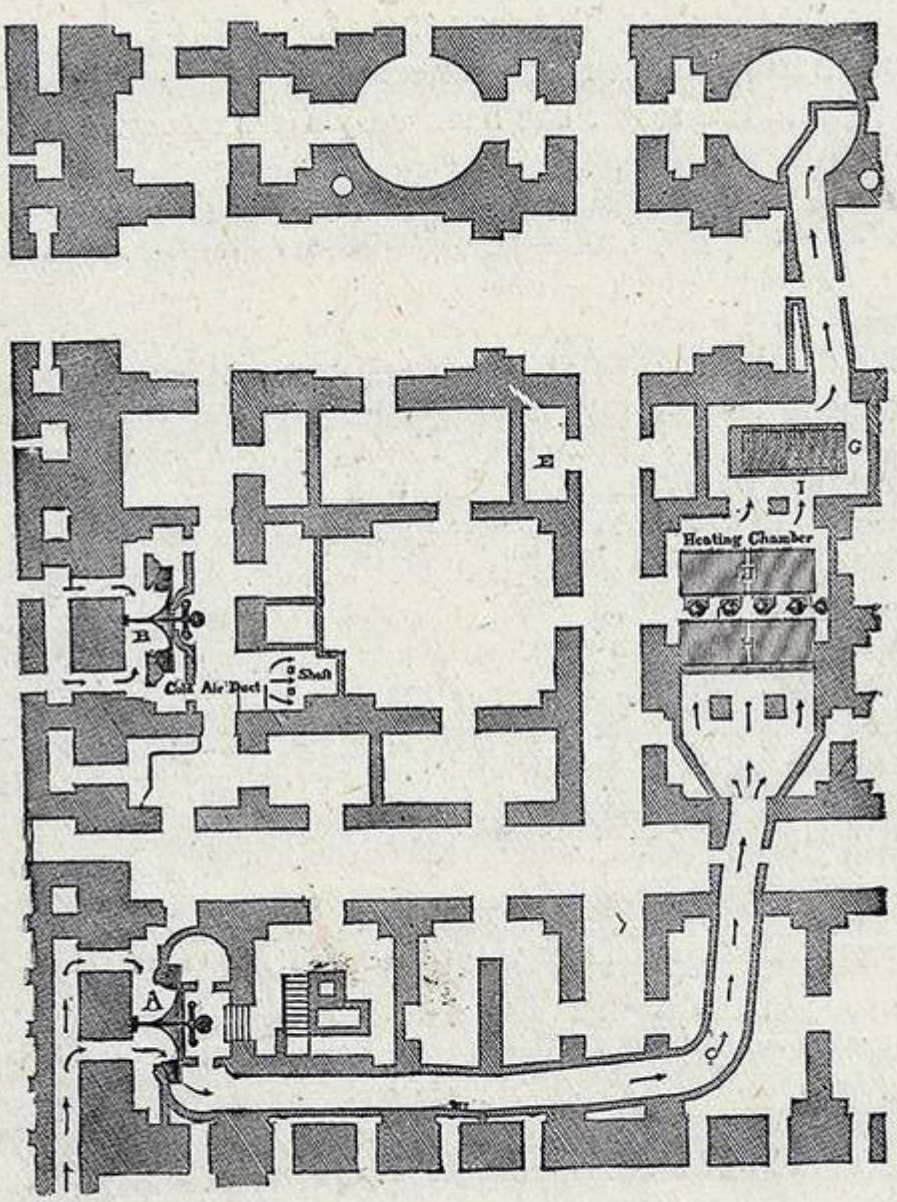
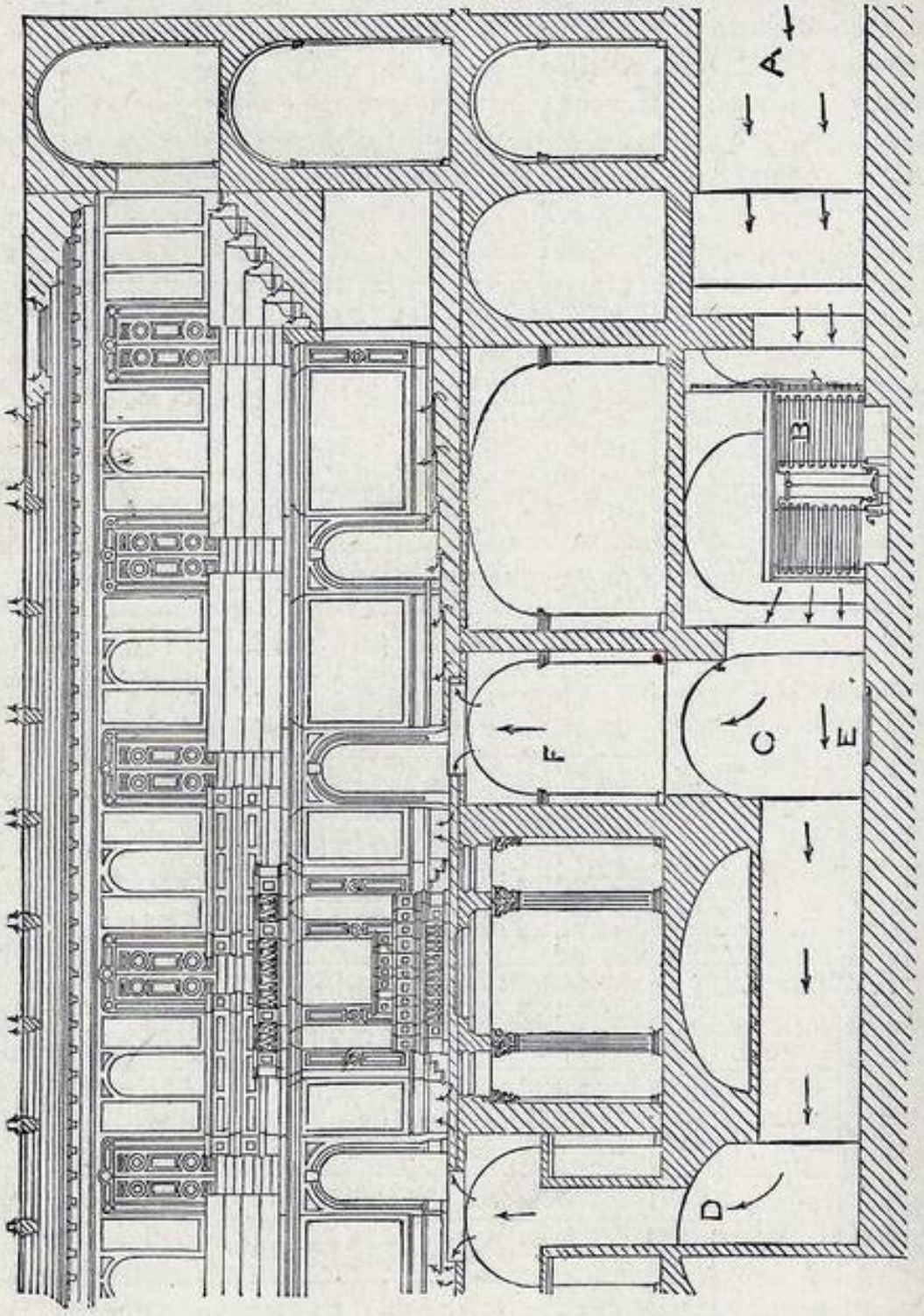


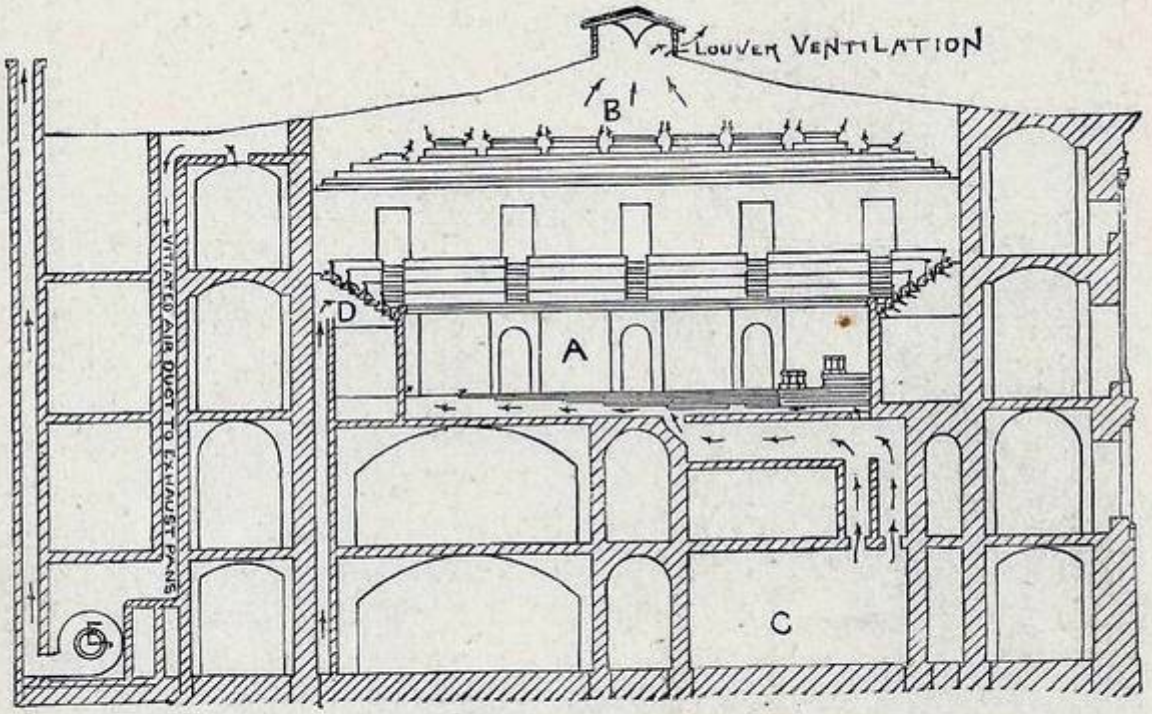
FIG. 125.—PLAN SHOWING AIR DUCTS, ETC., IN CONNECTION WITH HEATING APPARATUS, SOUTH WING, U. S. CAPITOL.

A.—Main fan for hall.
B.—Small fan for committee rooms.
G.—Evaporator and mixing chamber.
H.—Heating coils.



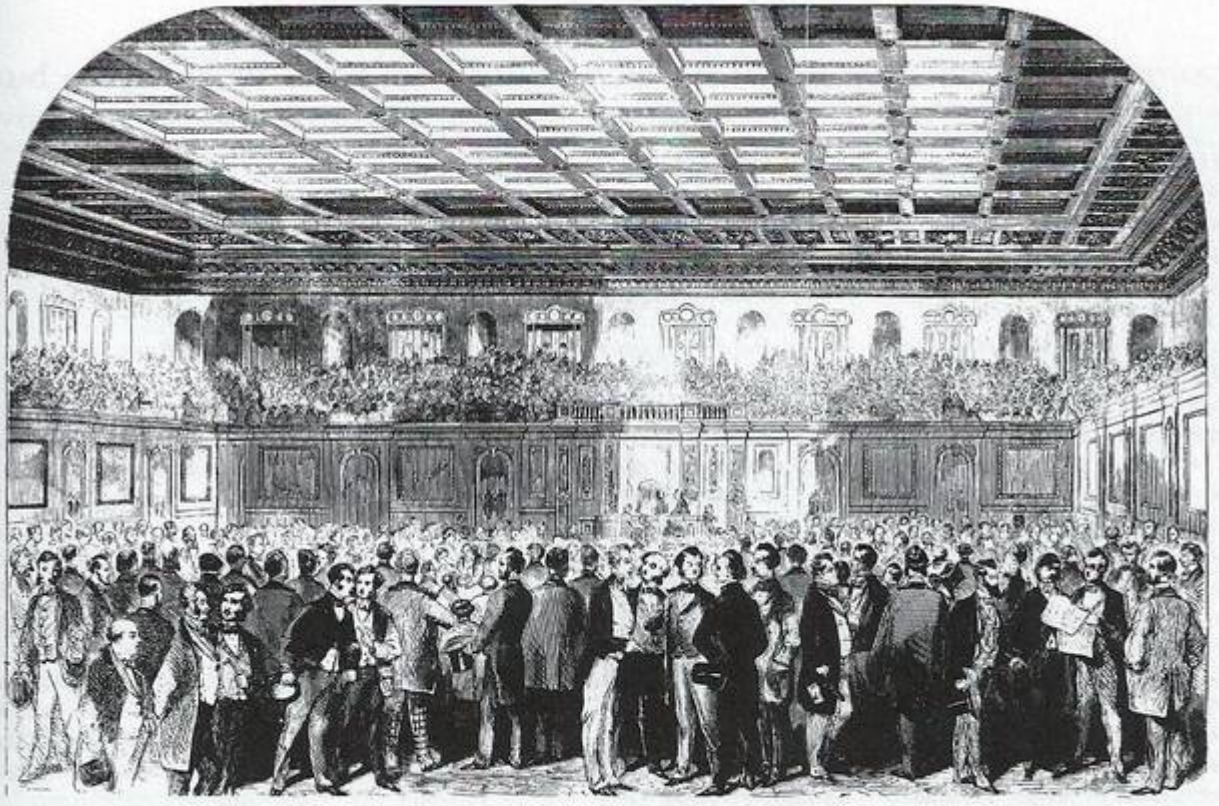
SECTION THROUGH AIR DUCTS AND HEATING APPARATUS OF SOUTH WING, U. S. CAPITOL.

A.—Cold-air duct.
B.—Heating coil.
C.—Mixing chamber.
D.—Fresh-air shaft.
E.—Evaporator.
F.—Fresh-air shaft.

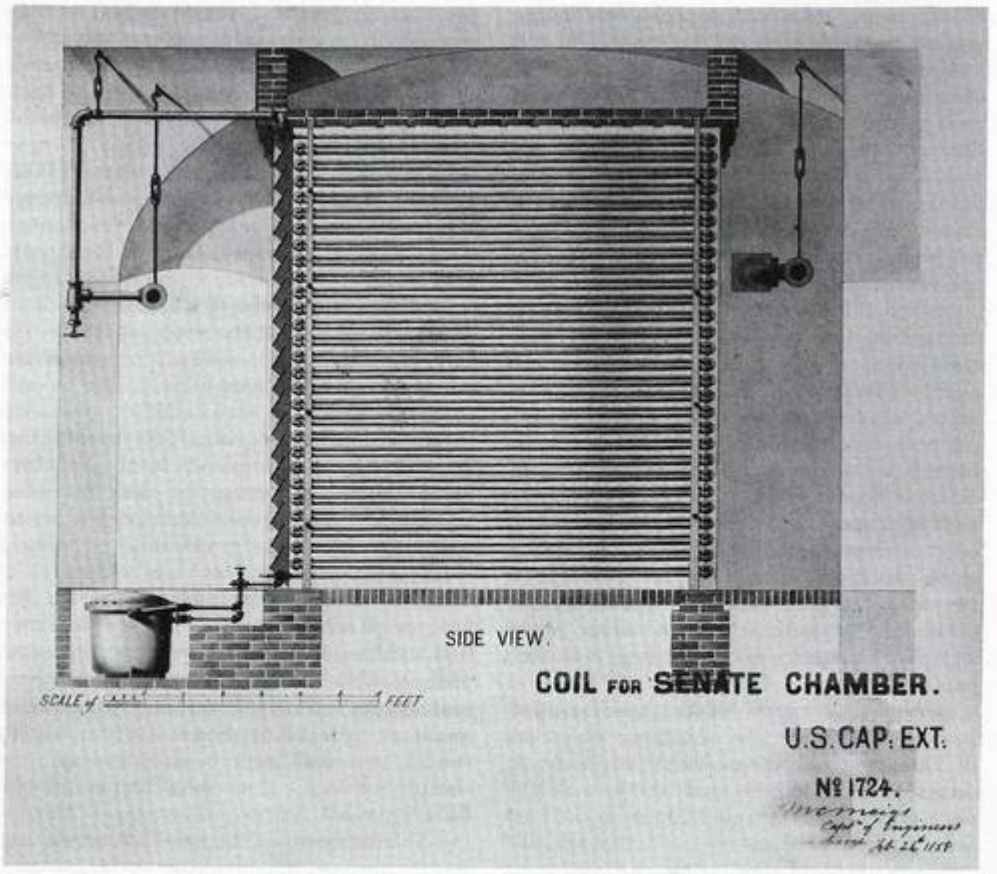


TRANSVERSE SECTION THROUGH SOUTH WING, U. S. CAPITOL.

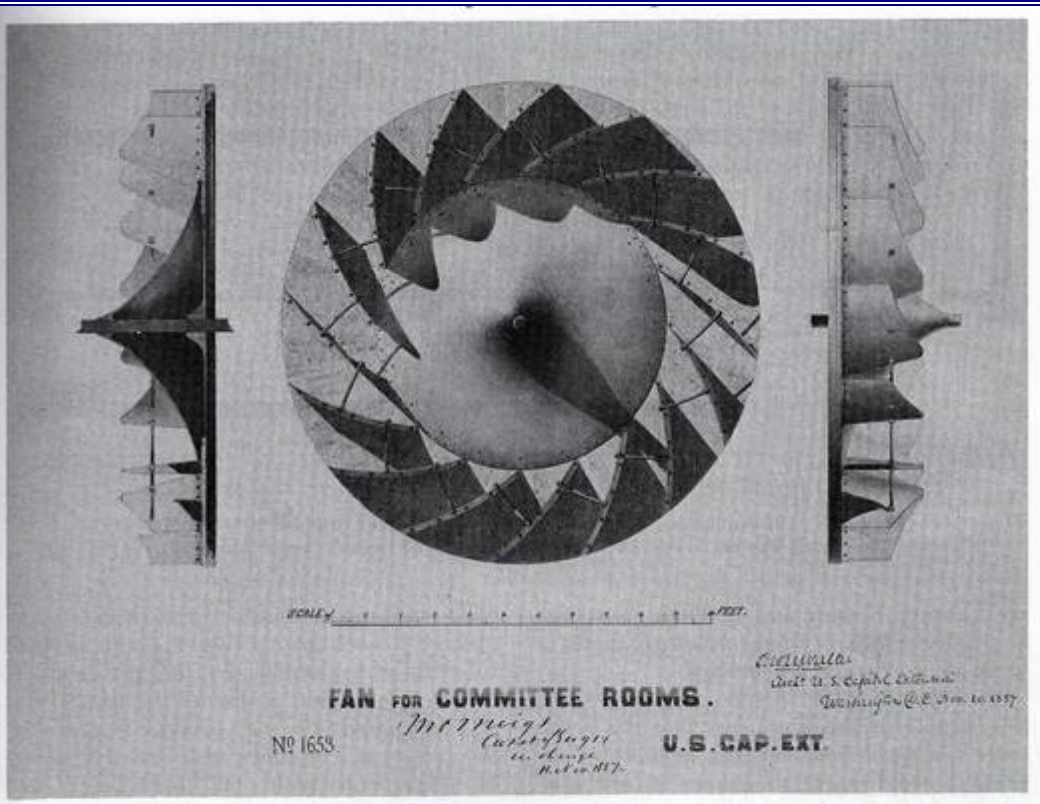
A.—Main hall.
B.—Space over hall.
C.—Main fresh-air duct.
D.—Fresh-air supply to galleries.
E.—Exhaust fan.



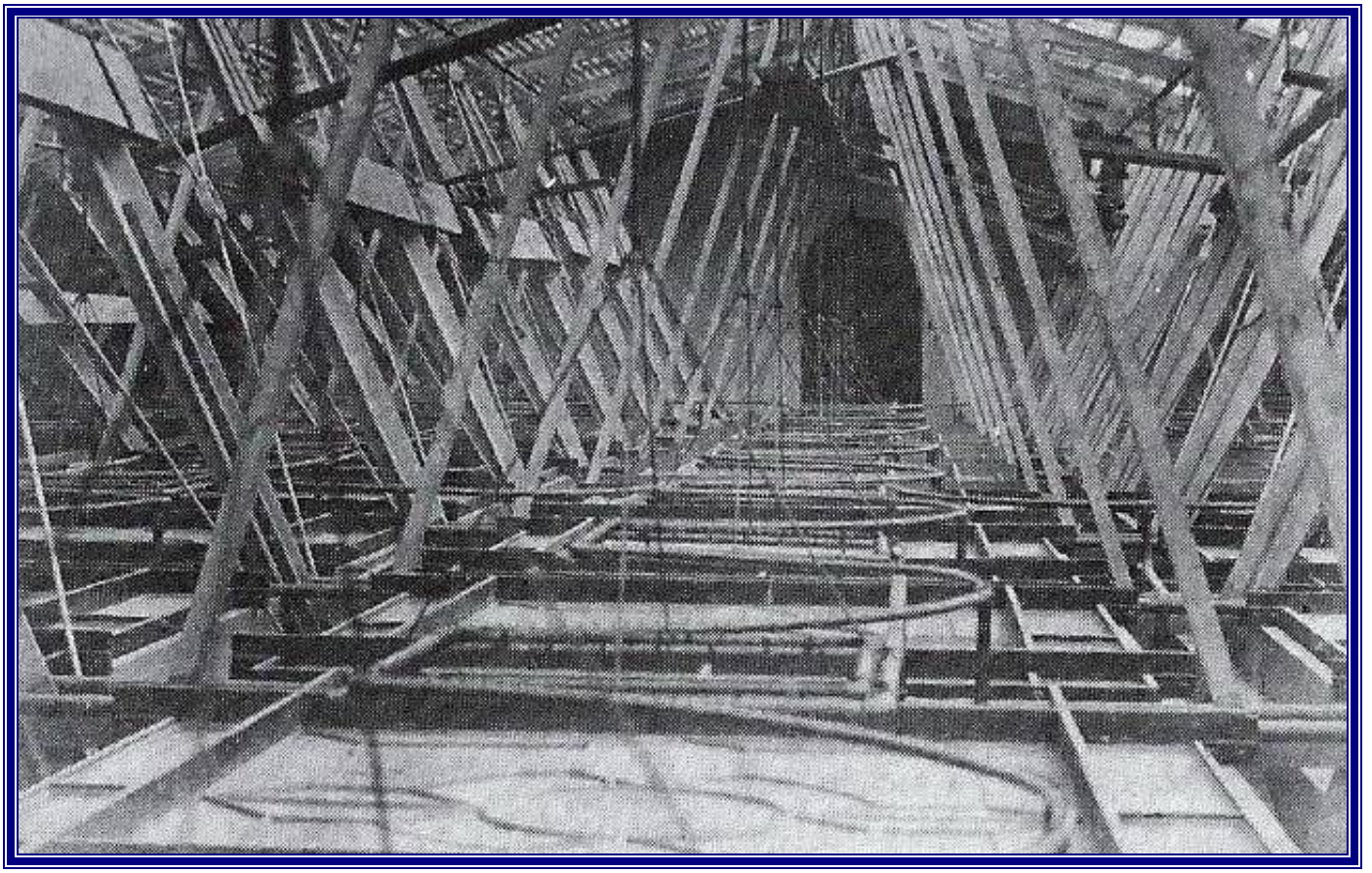
The House of Representatives meeting in its new hall December 3, 1860.
Harper's Weekly for December 15, 1860.



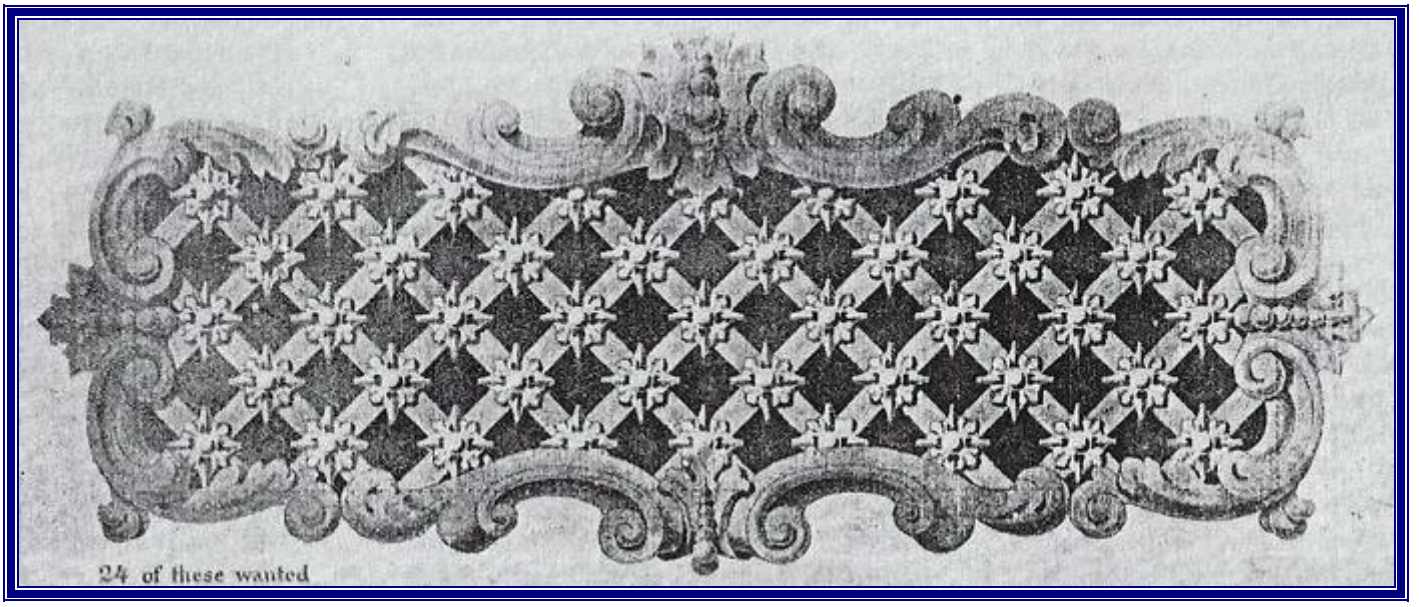
Heating coil, U.S. Capitol, 1858. Wrought iron pipe, assembled with return bands, formed a continuous steam coil to heat air that was blown across it. Note the large pot-type steam trap at lower left. *(Photograph, kindness of the Architect of the Capitol.)*



Fan rotor, U.S. Capitol, 1857. The passages in which were located the large centrifugal fan rotors, designed by Robert Briggs, 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. This rotor was 14 feet in diameter. *(Photograph, kindness of the Architect of the Capitol.)*



Suspended gas lights, between the glass ceiling and the skylights, arranged in curves with "the jets near enough together to light each other from a small perpetual burner" the result being described as "a blazing inferno." Photograph of 2 February, 1858



Ornamental design for ventilating register

Additional References

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(Reviews Joseph Nason's contributions*)*

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