HVAC IN HISTORIC BUILDINGS OF USA
PART TWO
BOSTON, PHILADELPHIA, WASHINGTON, CHICAGO

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BELLVUE STRATFORD PHILADELPHIA
The Heritage Group has recorded details of the history and engineering services in a variety of early buildings in four United States cities (1859-1933): Boston, Philadelphia, Washington and Chicago.

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SYMPHONY HALL BOSTON
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Heating and ventilation 1901.
Heating and ventilation 1901.
MAJESTIC THEATRE BOSTON
MAJESTIC THEATRE BOSTON

Heating and ventilation 1906.
BOSTON OPERA HOUSE

Diagram of General Ventilation Scheme.

Ventilation system (top) 1911.
BOSTON OPERA HOUSE

Ventilation system 1911.
Steam systems and electrical plant 1901.
Supply air ventilation plant and plenum chamber 1901.
PHILADELPHIA U.S. MINT
PHILADELPHIA U.S. MINT 1902

HALF PLAN OF FIRST FLOOR, SHOWING HEATING MAIN.
Machinery and extract ventilation 1902.
PHILADELPHIA U.S. MINT

Machinery and ventilation 1902.
Steam heating plant 1902.
Fresh air ventilation systems 1902.
Old and new Department Store buildings.
PHILADELPHIA WANAMAKER STORE

Atrium entrance and trading floor.
PHILADELPHIA WANAMAKER STORE

Mechanical services 1902.
PHILADELPHIA WANAMAKER STORE

Figure 45b(84). Department store (1905).

Power House 1905.
PHILADELPHIA WANAMAKER STORE

Engine Room and Boiler Plant 1905.
PHILADELPHIA WANAMAKER STORE

General Plan of Boiler Room and Piping, Wanamaker Power Plant.

Coal Storage Room Plan, Wanamaker Power House, Philadelphia.

Boiler Room and Coal Storage 1905.
PHILADELPHIA BELVVUE STRATFORD

Historic Skyscraper Hotel.
PHILADELPHIA BELLVUE STRATFORD

Plans of Fifth Basement, Hotel Belmont, Containing Power Plant, Refrigerating Machinery and Elevator Equipment.

Air Supply and Exhaust Units in the Seventeenth Story; Details of Air Filters.

Engineering services 1905.
PHILADELPHIA BELLVUE STRATFORD

Public and Service rooms ventilation 1905.
Fresh air, and warm air supply and extract ventilation 1903
Heating and ventilation 1881.
Heating and ventilation 1881.
WASHINGTON D.C. CAPITOL

P.11 Section through air ducts & heating apparatus, South Wing, US Capitol, c.1880 [Ventilation & Heating, Billings, 1896].

A cold air duct   B heating coil   C Mixing chamber
D Fresh air shaft  E Evaporator (sprays?)  F Fresh air shaft

1896.
CHICAGO NATIONAL BANK

FIRST FLOOR PLAN, CHICAGO NATIONAL BANK BUILDING.

1901.
Heating and ventilation 1901.
CHICAGO ARMOUR OFFICES

Heating and ventilation plant with Webster spray air washers 1908.
CHICAGO CENTRAL PARK THEATRE

Wittenmeier air conditioning with Kroeschell CO₂ refrigeration 1917.
CHICAGO TIVOLI THEATRE

1921.
Air conditioned with CO2 refrigeration by the Automatic Carbonic Machine 1921. Refrigeration capacity 150 TR with brine storage.
Air conditioned in 1924, designed by Otto Armspach, with Kroeschell CO2 refrigeration.
CHICAGO RIVIERA THEATRE

Wittenemeier's rule of thumb figures for theatre cooling were 2.5 tons of refrigeration for every 1000 cubic feet per minute of supply air in the northern states, increased by 25% for southern areas and appear to be based on 50% outside air. His evaporator design was based on using 1.25-inch iron pipe coils calculated at 35 feet per ton of refrigeration (finned coils were not then in use). Recirculated washer spray water was installed before and after the face of the coils at the rate of 3.5 US gallons per square foot with the air face velocity at 500 feet per minute and a spray water temperature of 58 deg F (to prevent build up of ice). The evaporating temperature of the CO2 was suggested as 22 deg F. The condensing temperature using cooling tower water, often as high as 85 deg F, resulted in a gauge pressure of 1240 pounds per square inch necessitating heavy-duty construction of compressor parts and heavy steel pipe and fittings. (Pressure gauges were often scaled in atmospheres to "avoid scaring the operators," for example a pressure of 1240 psig would read 83 atmospheres).

The air conditioned Riviera opened in 1919 with a CO2 refrigerating plant by the Wittenemeier Machine Company. It has been recorded that the Wittenemeier system "provided for humidification but lacked an effective method for adjusting the humidity level. Air left the air conditioner nearly 100 percent saturated, and the body heat of the audience raised it by about 8 degrees. In the Riviera, that produced a relative humidity of approximately 70 percent. Wittenemeier routinely furnished a temperature of 76-78 (deg F) and a relative humidity of 75 percent. I assure you that you will feel comfortable in such a house, he maintained." Later, other air conditioning engineers and researchers would not agree with Wittenemeier's statement and the audience complained about cold draughts due to the discharge of cold supply air through floor-mounted mushroom outlets by their feet. (In the past, these outlets had been satisfactory when supplying warm air for heating purposes).
CHICAGO ROOSEVELT THEATRE

1922.

REFERENCES AND FURTHER READING

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HVAC System and Equipment Plans, Sections and Drawings are from The Engineering Record magazine of New York. Other information from the Heritage Group Archive and website.