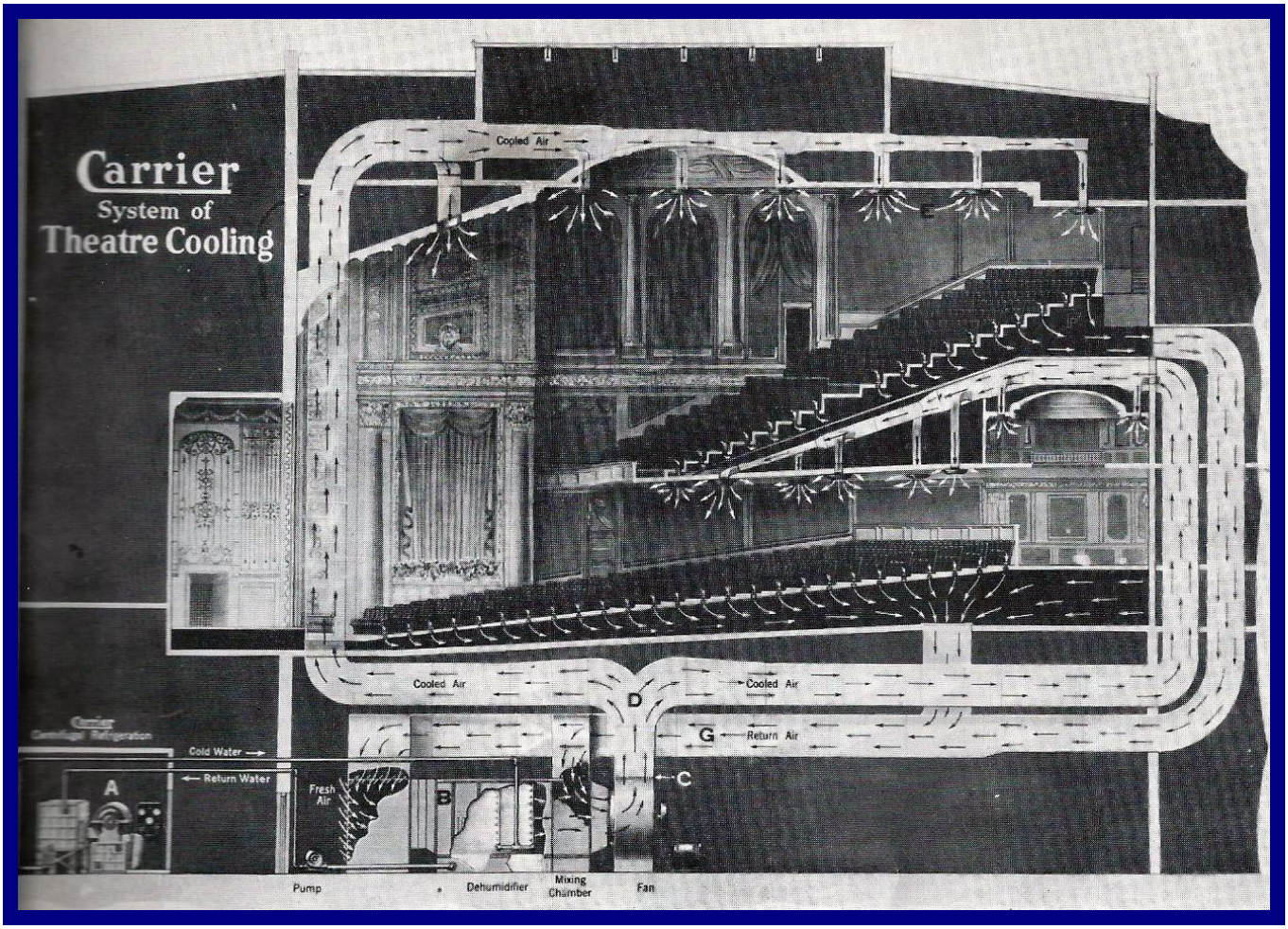
Air Conditioning American Movie Theatres 1917-1932



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Air Conditioning American Movie Theatres 1917-1932

Introduction

The Members of the Heritage Group have considerable experience and information on the history of Air Conditioning and Refrigeration covering systems, equipment and installations and on manufacturers, designers and contractors. In addition, the Heritage Group Archive, compiled over some forty-five years, holds a large collection of textbooks, catalogues and technical papers on the subject.

However, information on the **Air Conditioning of American Movie Theatres** is relatively small and that used in this ebook has been found by researching the magazines, technical papers, histories and websites on the film industry itself (listed under Sources of Information).

The majority of histories on the American film industry concentrate on the films and the film stars. This ebook looks at how the introduction of air conditioning in movie theatres created an enormous viewing public and the widespread building of "movie palaces" leading to the studio system which controlled film distribution and created a number of major theatre chains: Loews Incorporated (Metro-Goldwyn-Meyer), Warner Brothers, Fox, Paramount and Keith-Albee-Orpheum (later RKO).

The time span of **1917-1932** has been chosen for a reason. The year 1917 is the date on which the first full air conditioning system with mechanical refrigeration was installed in a movie theatre, the Balaban & Katz Central Park Theatre in Chicago. The installer was the Wittenmeier Machinery Company, also of Chicago. The owner was Frederick Wittenmeier, previously Chief Engineer of Kroeschell Brothers, who had set up his own company in the same year.

The small theatre chain of Balaban & Katz, with Wittenmeier, revolutionised the operation of theatres which previously having to close in hot summer months could now open year round. By the 1920s, pioneer companies providing air conditioning or refrigeration for movie theatre include the Wittenmeier Machine Company, Kroeschell Brothers (established 1879), Carrier Engineering Corporation (1915), York Ice Machinery Corporation (1874) and Brunswick-Kroeschell (merger of 1924).

A number of web sites incorrectly attribute the first movie theatre air conditioning to Carrier citing the 1924 installation at the Metropolitan Theatre in Los Angeles (where although the system was by Carrier, the refrigeration was by the Carbondale Machine Company), or that for the Rivoli Theatre, New York, in 1926.

Air Conditioning American Movie Theatres 1917-1932

However, Carrier made the greatest contribution to theatre comfort by their so-called *upside-down* air distribution system which overcame the problems with the under-seat mushroom supply of the Wittenmeier system by using high level supply with low level extract. They also developed, with the consulting engineer Walter Fleisher, the *return air bypass* system of control, the design patents being held by their jointly owned Auditorium Conditioning Corporation established in 1927. It is claimed that by 1946 the Auditorium Corporation had licenced an estimated 96% of the comfort air conditioning installations in the United States.

The other significant innovation due to Carrier was the introduction in 1922 of the centrifugal water-chilling refrigeration machine, which available in large capacities had advantages in cost, space and control over reciprocating compressor-direct expansion systems, and operated in conjunction with the spray-type air washer. In August, 1950, the two-thousandth centrifugal machine came off the Carrier production line.

In 1930, there was an important change in the American comfort air conditioning and refrigeration industry when an enlarged Carrier Corporation was formed through the merger of Carrier Engineering Corporation with Brunswick-Kroeschell and York Heating & Ventilating Corporation.

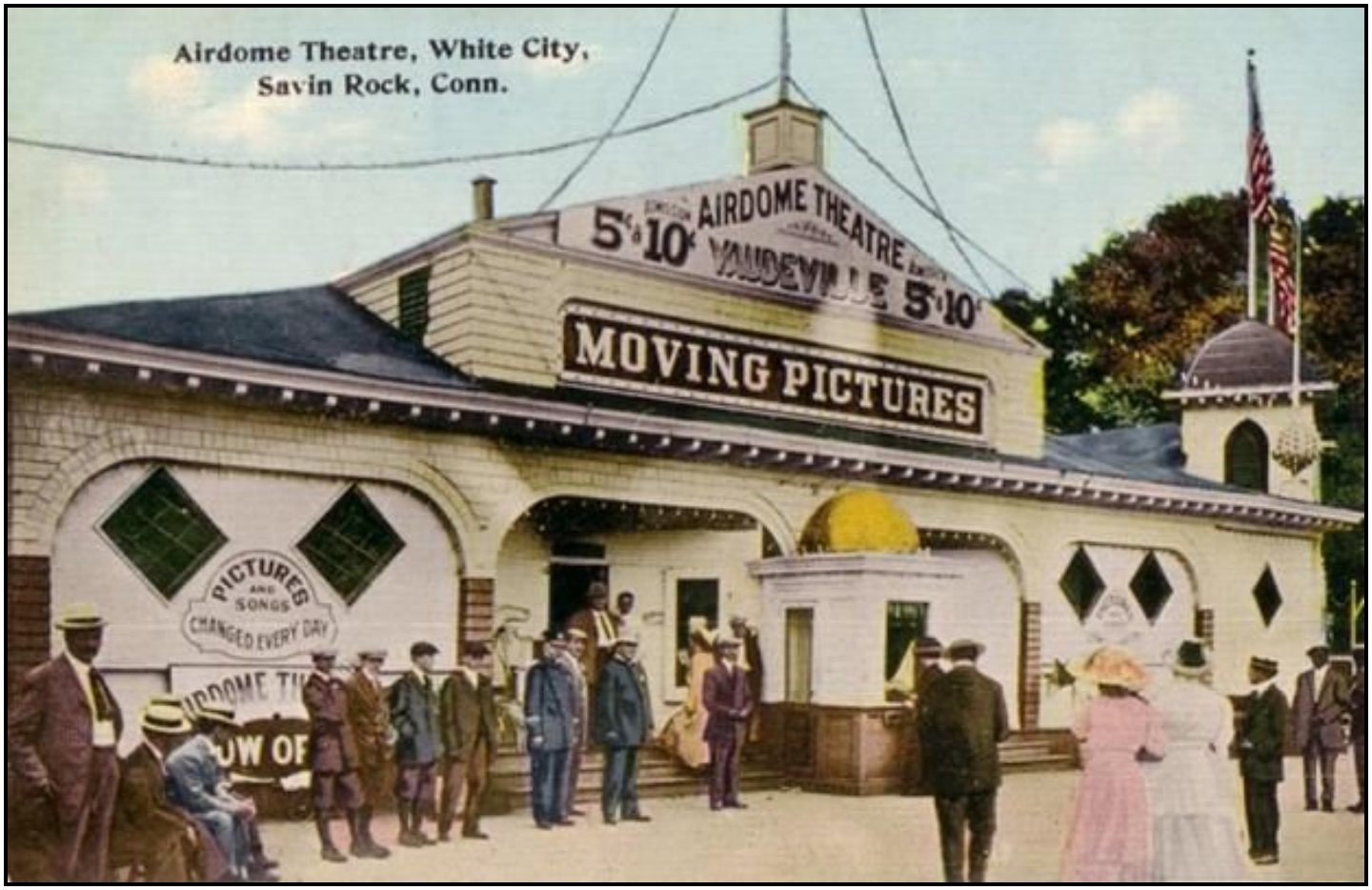
The end date of **1932** has been selected because it represents a change in both the movie theatre and air conditioning industries due to the continuing effects of the Depression, but it also saw the opening of probably the largest and most impressive “movie palace” ever constructed- the 6000 seat Radio City Music Hall in New York City.

The ebook Data Sheet for an individual theatre lists the following: theatre name and location; date built or opened; original seating capacity; owner or theatre operator; architect; air conditioning manufacturer/installer and refrigeration manufacturer/details. The cooling capacity of refrigeration installations, where known, is given in **tons of refrigeration** (TR), the units in use before the 1970s. This equates to a cooling capacity of 12,000 Btu/hr (3.516 kW) or 200 Btu/min.

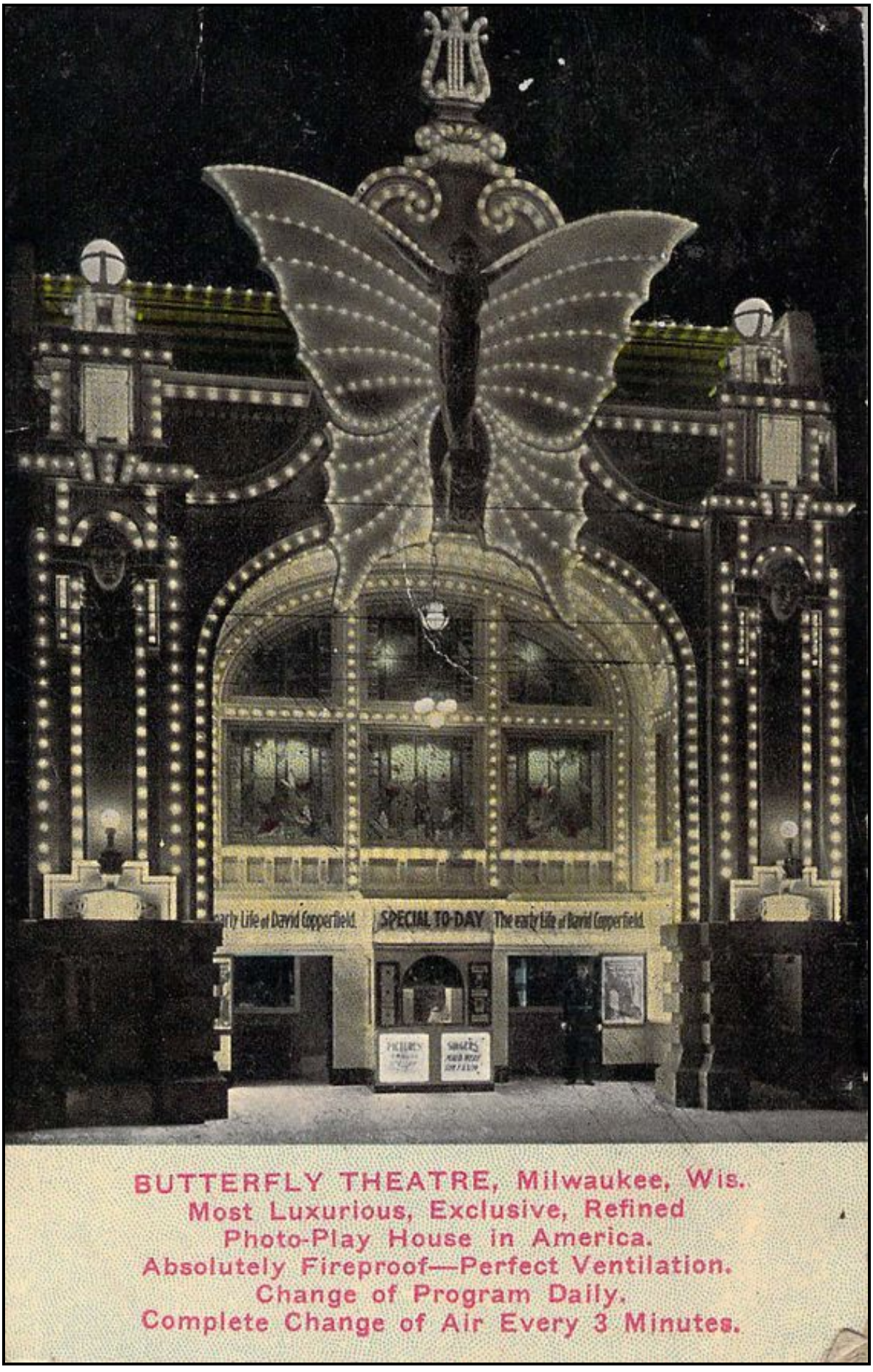
It should be noted that many of these details changed over time. Theatres changed both names and owners. Some were originally vaudeville houses or music halls. Dates quoted may be when originally built or where possible the year opened for movies. The date opened may not be the year air conditioning was installed. The architect named may be the original or the one responsible for remodelling. The seating capacity is generally the original but often this was amended. Much of this basic information has been taken from the website **cinematreasures** which lists data on some 49,000 theatres worldwide, including just under 30,000 in the Unites States. Lists of theatres air conditioned by a particular company have been obtained from their advertisements in movie magazines of the period.

But before air conditioning, and mechanical refrigeration, a number of theatres experimented with ice-block cooling, various methods of fresh air ventilation and even roofless theatres (airdomes) open to the cooler dark night sky. All these systems had their limitations.

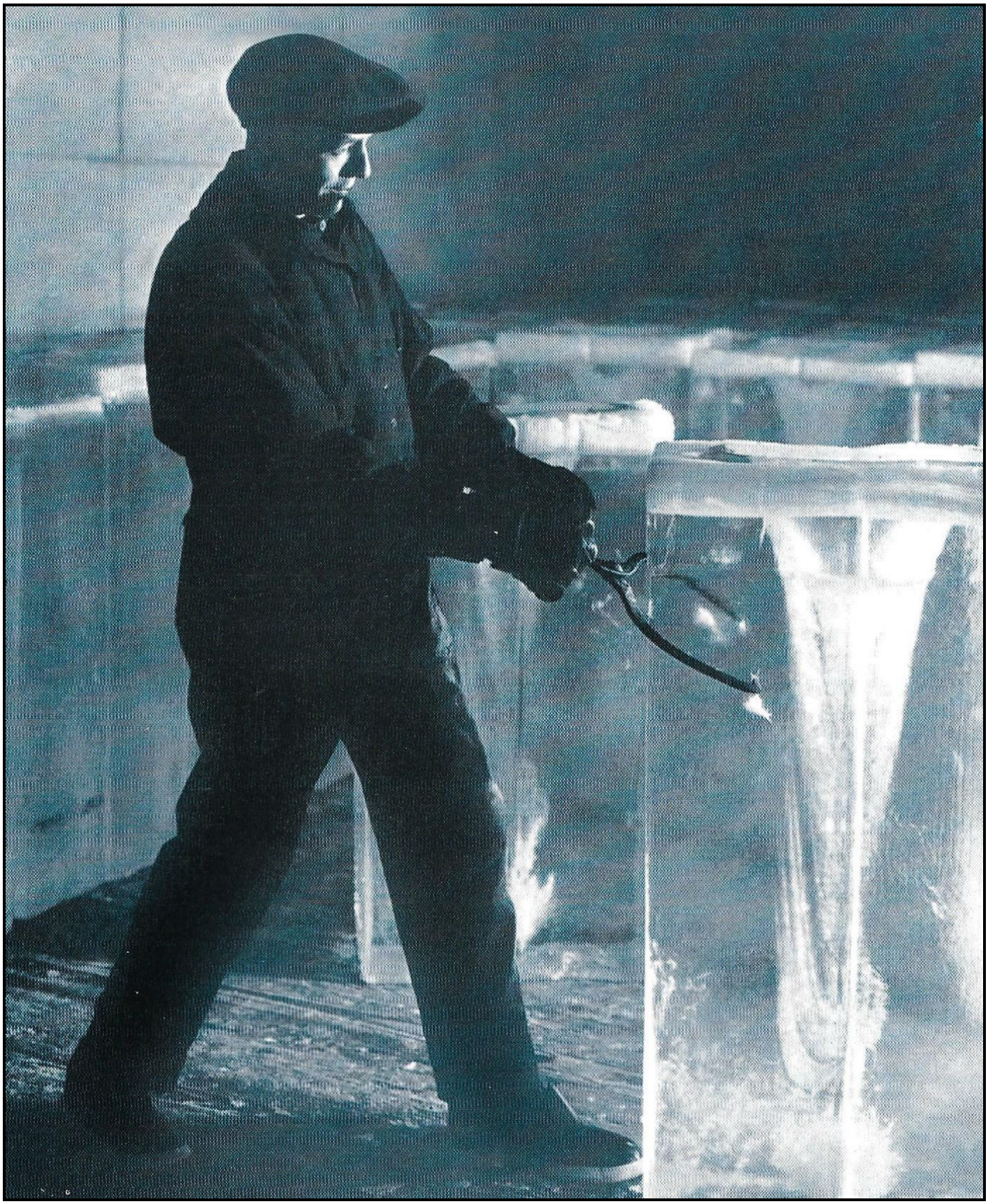
Before Air Conditioning-



An early “Airdome” movie theatre without a roof



The Butterfly Theatre in Milwaukee (1916) mechanically ventilated at 20 air changes per hour



Ice-Block Cooling

Problems with the air inside theatres (from Billings, 1896)

The last quarter of the 19th century saw increasing concerns over the quality of the air in theatres: overheating, though sometimes too cold, dirt and pollution, excessive humidity, concerns over lack of fresh air and fumes from gas lighting. But ducted mechanical ventilation with steam-driven fans promised improvements.

CHAPTER XVI.

THEATERS. AIR IN MANCHESTER THEATERS. GRAND OPERA HOUSE IN VIENNA. OPERA HOUSE AT FRANKFORT-ON-THE-MAIN. METROPOLITAN OPERA HOUSE, NEW YORK. MADISON SQUARE THEATER. ACADEMY OF MUSIC, BALTIMORE. PUEBLO OPERA HOUSE. EMPIRE THEATER, PHILADELPHIA.

AS a rule, theaters have insufficient and unsatisfactory arrangements for ventilation. They almost invariably become overheated when the audience is large, while the stage is, as a rule, cold and exposed to draughts. The difficulties in the way of obtaining satisfactory results are much the same as those in large legislative halls, and are to be overcome by much the same methods.

The following tables showing the condition of the air in the principal theaters in Manchester, taken as types of well-arranged English theaters, are taken from a paper by W. H. Collins, in the Report of the British Association for the Advancement of Science, 1890, p. 773.

If we could have similar reports for some of our modern theaters, such as are described in this chapter, they would add greatly to the limited stock of reliable information on this subject.

Samples of air were taken at stated periods during the performances in the months of December, 1889, and January, 1890. Duplicate samples were analyzed in all cases, and samples of the air outside the theater were taken simultaneously for the purpose of comparison. The examination of the samples was confined to the estimation of (1) carbonic acid (by Pettenkofer's method); (2) organic matter (by Carnelley's method, and (3) micro-organisms (by Hesse's method, "Mittheilungen aus dem kaiserlichen Gesundheitsamte," ii., 1892).

The results are contained in the tables given on pages 380 and 381.

Of late years more attention has been paid to the ventilation of opera houses and theaters by architects, and some very good results have been obtained.

The manufacture of refrigerating machines created a new industry producing ice for a variety of purposes and the building of cold stores to house food, particularly meat and dairy products. At the turn of the century, the major customers in the USA for mechanical refrigeration were the breweries. Comfort cooling for people was yet to come. The problem was with the refrigerants then in use. Ammonia, widely used, was toxic and its use in spaces occupied by people was avoided. Also experiments were conducted with sulphur dioxide, methyl and ethyl chloride with varying degrees of success in smaller systems. So a number of theatres, particularly in New York, experimented with ice-block cooling systems. However, this was to change from 1900 onwards, when the Kroeschell Brothers Ice Machine Company of Chicago began the manufacture of carbon dioxide refrigeration machines under European patents (CO_2 being a safe refrigerant). Then in 1911, their Company Chief Engineer, Frederick Wittenmeier took out patents for his air conditioning system.

Madison Square Theatre, New York, 1880
(Text extracts from Bernard Nagengast, ASHRAE)

Engineered Systems

The Sanitary Engineer reported in 1880 that New York's Madison Square Theater was using about 4 tons (3630 kg) of ice to cool patrons at evening summer performances. Fresh air was filtered through a 40-ft (12 m) long cheesecloth bag, passing over wooden inclined racks, containing 2 tons (1815 kg) of ice, and into an 8-ft (2.5 m) diameter centrifugal fan. The fan discharge was directed over another 2 tons (1815 kg) of ice, into ductwork to various openings through which the cool air "...poured into the house to reduce the temperature and to furnish a supply for respiration."[7]

The Madison Square Theater installation was a new type of comfort cooling system. It was an engineered system, provided by B. F. Sturtevant Co., an engineering and manufacturing firm that soon became the foremost purveyor of air side heating and ventilating systems in the U.S. Engineered building systems would frequent the U.S. landscape in the coming decades. Companies like Sturtevant that offered to engineer, make and install H&V equipment were forming with frequency after 1880. The technical staffs at these companies were the newborn in a new profession, that of the heating and ventilating engineer. Their increasing numbers would soon show the need for a specialized engineering society, the result being the organization of the American Society of Heating and Ventilating Engineers in 1894.

This new era saw building systems designed to provide specified results. At first such results were often broadly defined. This was especially true for the few comfort cooling systems that were designed between 1880 and the early 1890s. And those few systems were ice type systems.

Carnegie Hall, (New York Music Hall), 1889

Another cooling system was designed in 1889 for the Carnegie Music Hall by consulting engineer Alfred Wolff. Wolff was probably the first really successful heating and ventilating engineer, and he designed some of the most important comfort cooling systems around the turn of the nineteenth century. His first attempt used ice. The building's dedication records described the system:

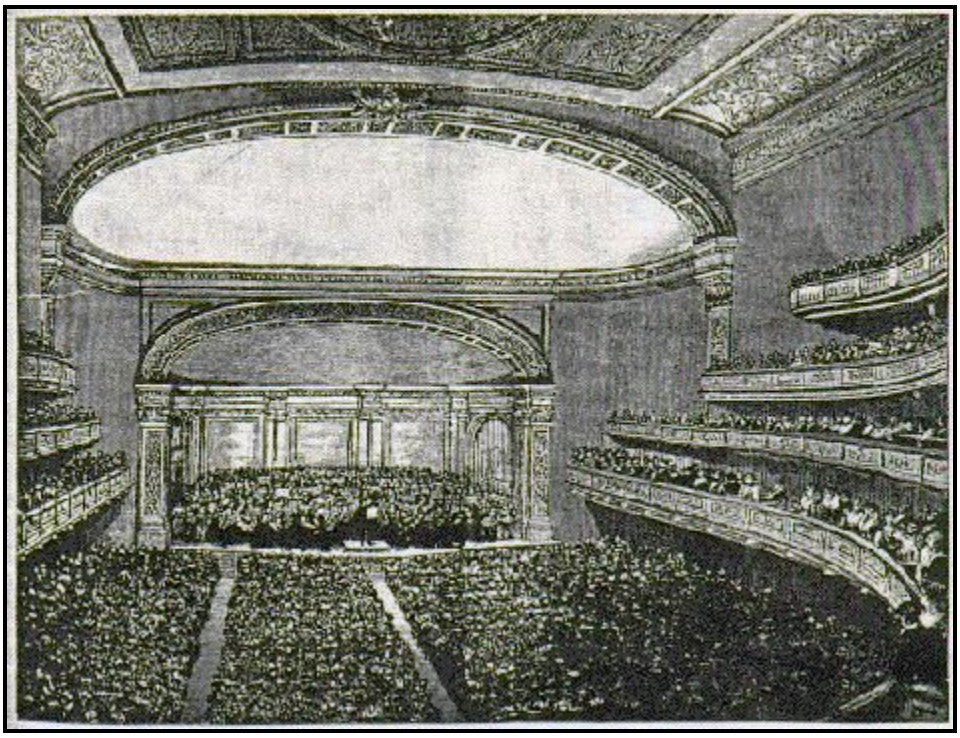
"Fresh air, at any temperature desired, in large volume but at a low velocity, is introduced, and the vitiated air is exhausted. Generally, the fresh (warmed or cooled) air enters through perforations in or near the ceilings, and the exhaust is effected through registers or perforated risers in or near the floors and, passing through an elaborate system of ducts, worked into the construction of the building, is expelled above the roof."

"Through [the] heating surface, or at will through the ice racks, the air is drawn by four powerful blowers, each 12 ft [3.7 m] high, and forced through the system of fresh air ducts into the various parts of the building."

"The heating surface and other appliances are so subdivided that atmospheric changes can be immediately compensated for, and the temperature of the air introduced suited to the winter weather or the heat of summer."[8]

The cooling side of this system was not engineered to maintain a specified temperature and humidity. Wolff was happy with a result that simply lowered the room temperature. The effectiveness of the Carnegie Hall system is unknown-confirmations of its use seem to be absent.

Carnegie Hall



Carnegie Hall, New York

Carnegie Hall (Next four pages from Billings)

With this amphitheater may be compared the New York Music Hall founded by Andrew Carnegie, a full description of which, with plans, is given in *The Engineering Record* of July 4, 1891, and February 6, 1892. The main concert hall has a seating capacity of 3,000, the recital hall beneath this seats 1,200. The fresh warmed air enters the music hall through numerous perforations in or near the ceiling,

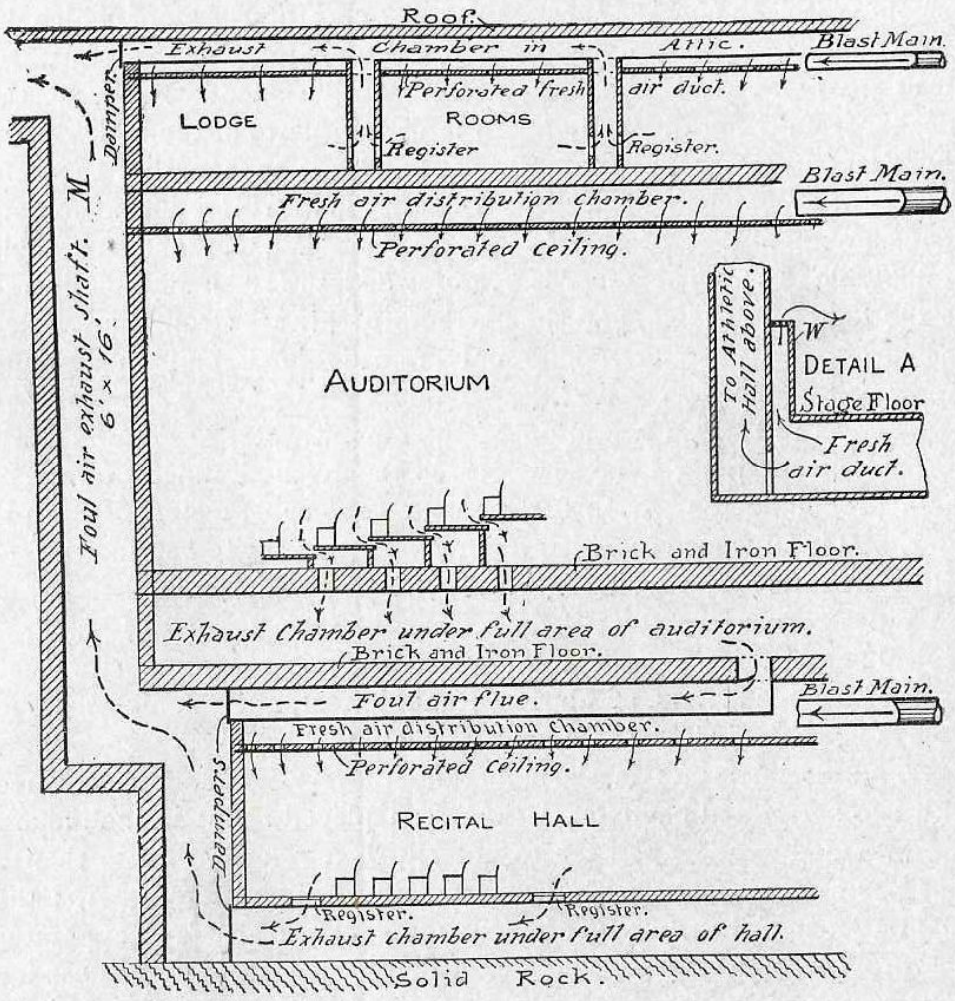


FIG. 129.

being forced in by two 7-foot Sturtevant blowers which draw it through heaters of 1¼-inch pipe containing 6,600 square feet of heating surface.

Figure 129 is a general vertical section of the main building, not to scale or accurate position, but intended as a diagram to show the distribution of fresh air and the withdrawal of foul air in the principal

Carnegie Hall

rooms. Detail A shows the method of supplying extra heat and air to the stage through perforations in the horizontal top of the 6-foot wainscoting *W*, around the walls.

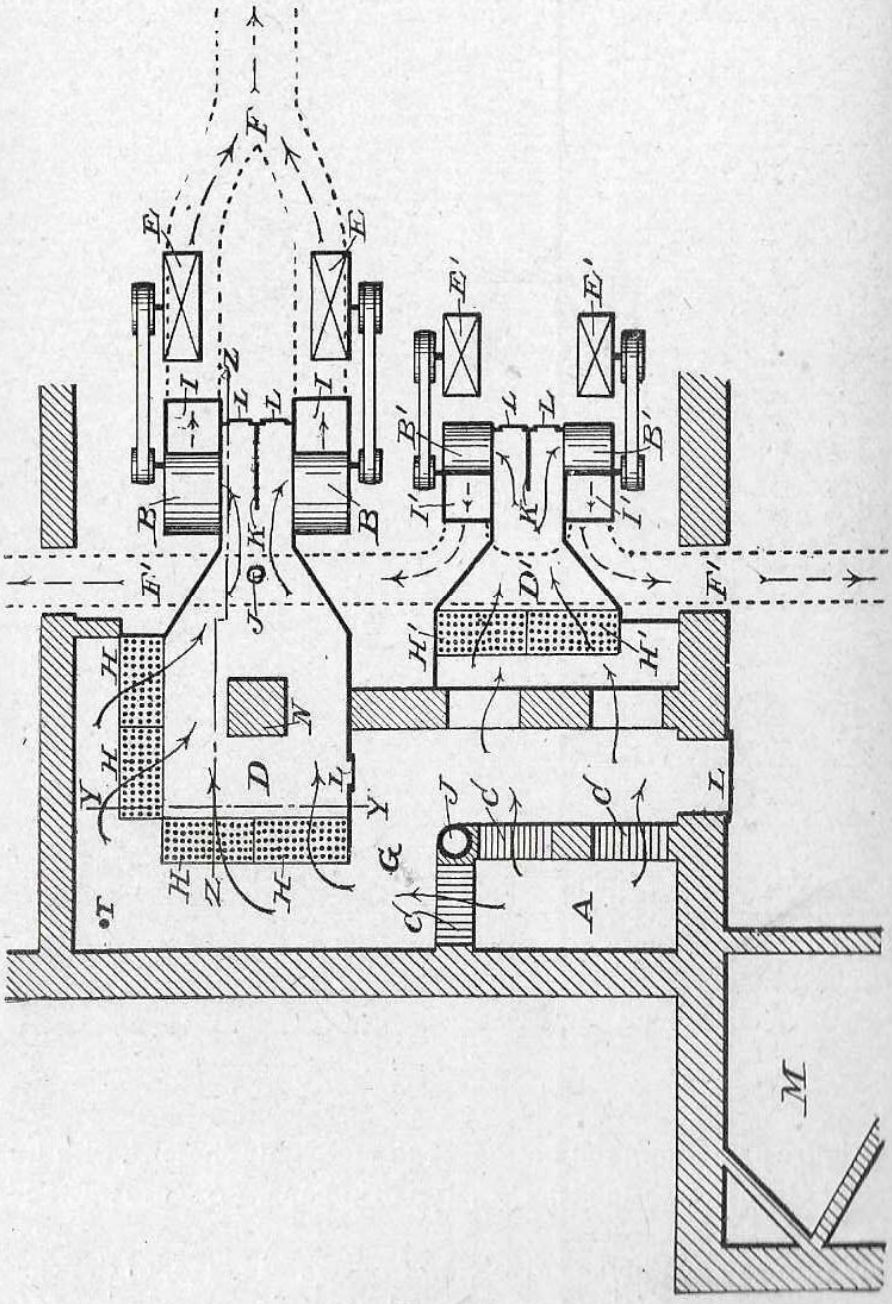


FIG. 130.

Figure 130 shows the heating, cooling and blowing plant. *A* is the fresh-air shaft from the roof, 6x12 feet, supplying the distributing

Carnegie Hall

chamber *G*. In warm weather ice may be placed in the racks *C C* to cool the air. The blowers *B B* draw the air into the chambers *D D* through the steam radiators *H H'*. *E E* are the engines driving the blowers, and *F* is the main air duct having a cross-section of 30 square feet.

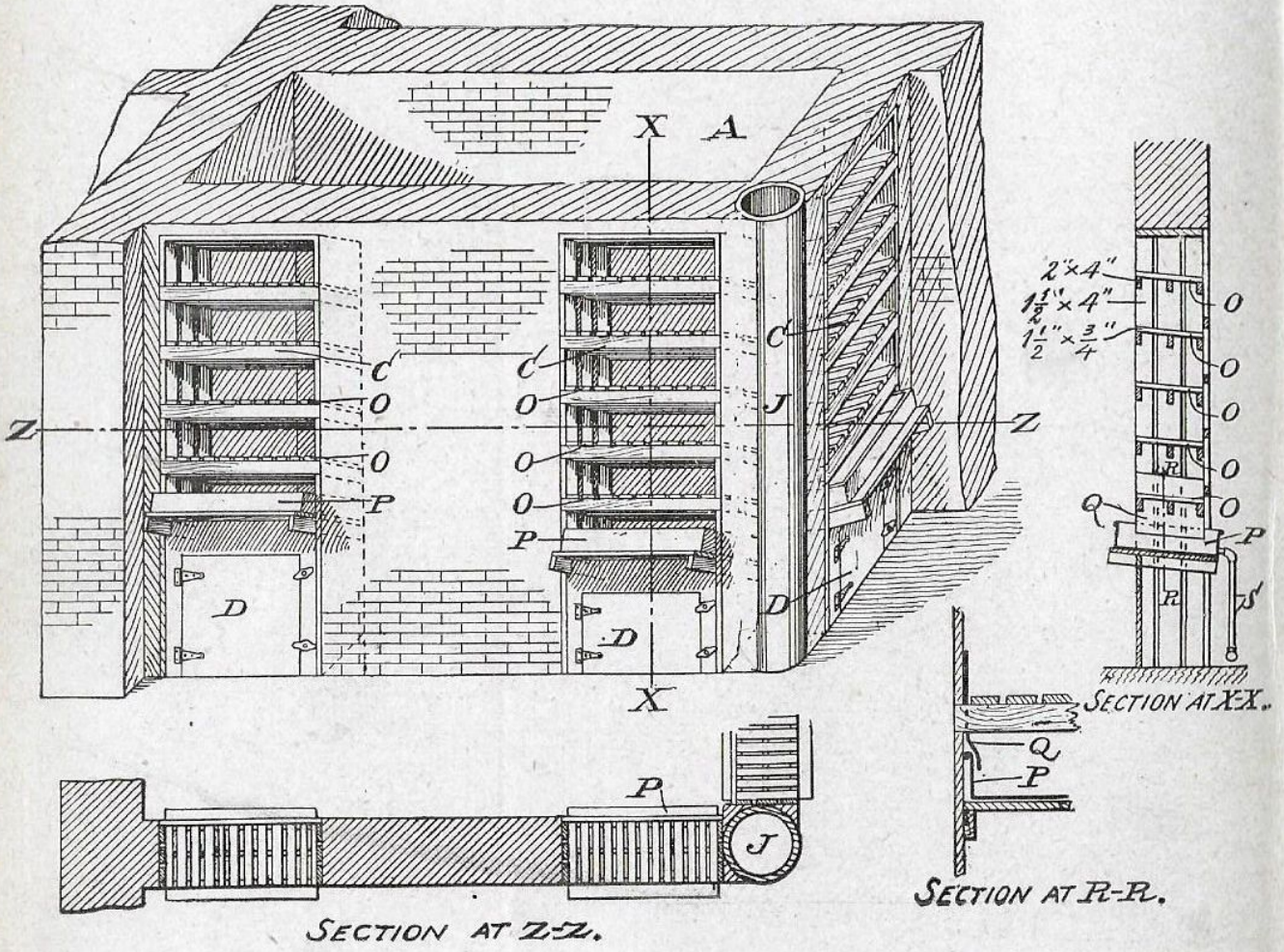


FIG. 131.

Figure 131 shows the bottom of the fresh-air shaft *A*, with its outlets. *O O* are the ice-racks; *P P*, iron drip-pans. *S S* are waste-pipes; *D D*, doors.

Figure 132 is a perspective view from *T*, Fig. 130, of the chamber *D*, two sides of which are composed of radiators *H H*. *U* is the steam supply and *V* the drip pipe.

Figure 133 is a section at *z z* Fig. 130 showing the inlet to the blower and the check valve *F*, which opens with the blast but closes against

Carnegie Hall

back pressure. The air is drawn out from the hall by a separate fan system, being taken from or near the floor levels, and carried in a shaft to the roof where the exhaust fans are located. It will be seen that this

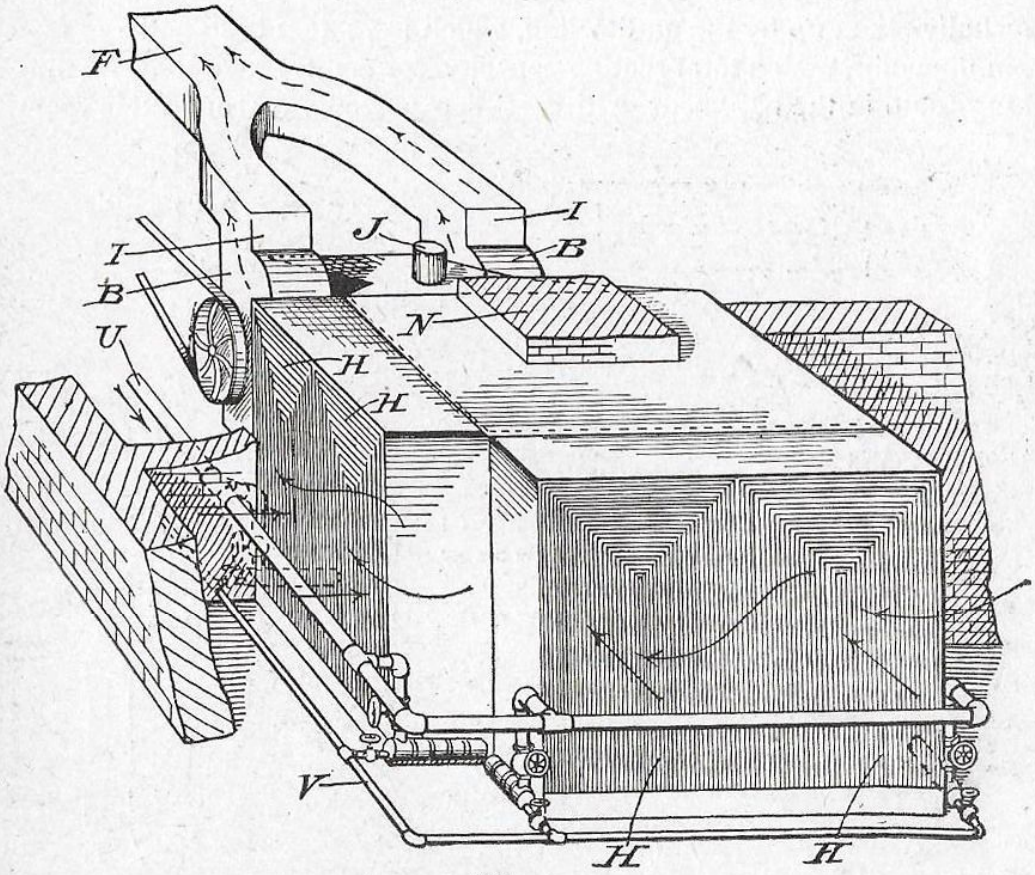


FIG. 132.

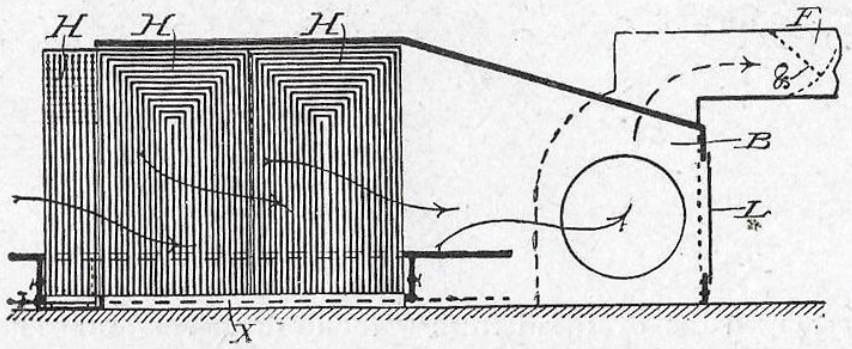


FIG. 133.

is a system of downward ventilation, the efficiency of which can only be maintained by a considerable expenditure for power.

Broadway Theatre, New York, 1890s

More ice-type cooling systems were installed in the next score of years. The Broadway Theater in New York used an ice cooled ventilating system for at least 10 years beginning in the early 1890s. The system forced outside air over ice blocks placed on wooden troughs, through ducts to registers in the theater. Keith's Theater in Philadelphia allegedly used a ton of ice per performance in 1903. That system was described as using natural induction, with hot air exiting through windows at the top of the auditorium. One engineer, a Mr. C. M. Stokes, commented: "... I have been in the auditorium in pretty warm weather. In fact I go there on a hot day to get cooled off. You can look down the floor register and see the ice in there."[9]

These systems had been mentioned in a technical session at the January 1903 meeting of the American Society of Heating and Ventilating Engineers. This was the first time the topic of comfort cooling using ice was presented to that Society. The subject obviously interested the H&V engineers—the discussion following the paper took up three times as much space as the paper did when it was published in the ASHVE Transactions.

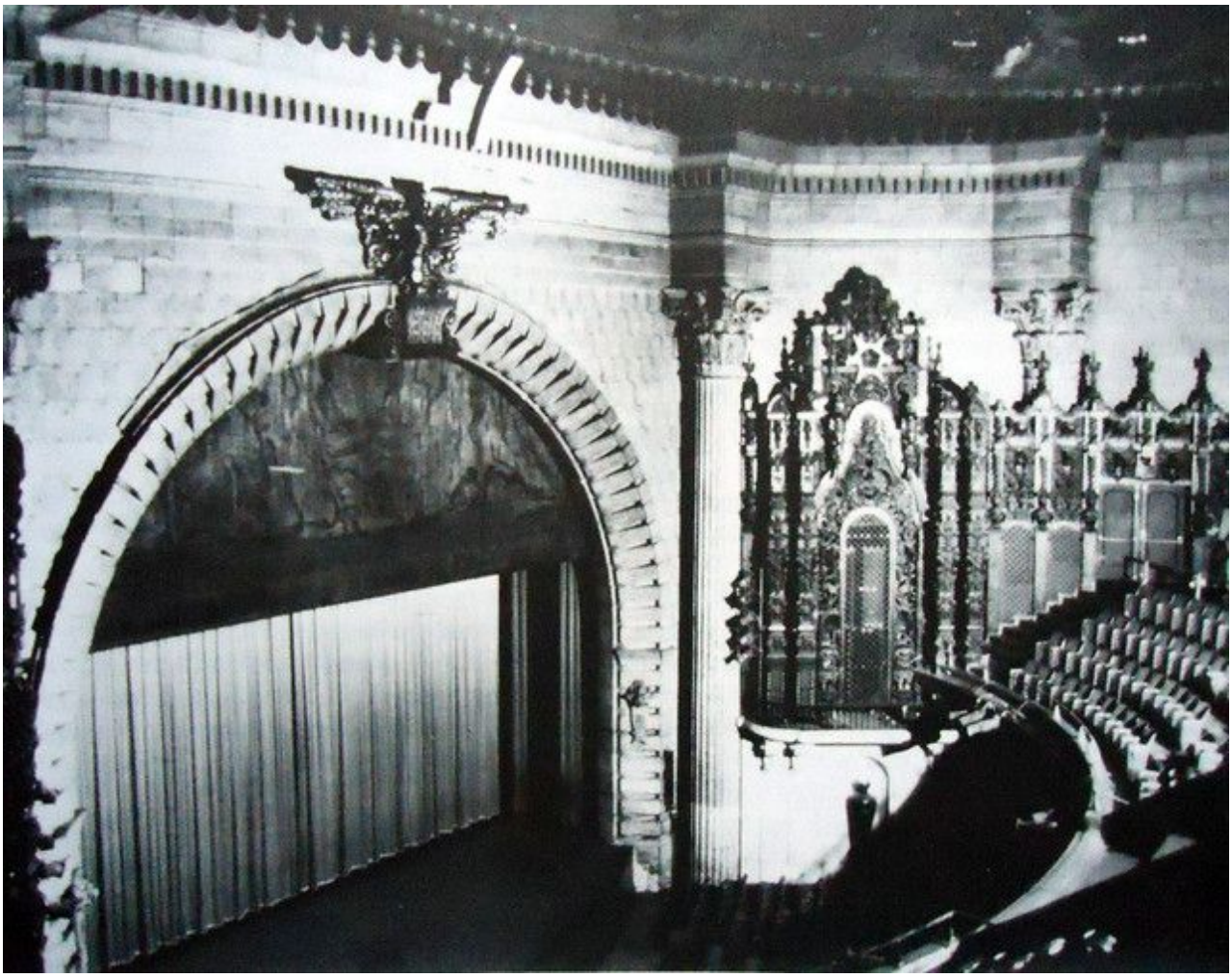
Unknown Indianapolis Theatre, 1907

Four years later, Theodore Weinshank, ASHVE member, described an Indianapolis theater cooling system that used ice before 1907:

"At the opening of one of their theaters the engineer undertook to cool the building. The outside temperature was 85°F (29°C). The outside air was taken into a fan through a large galvanized iron duct. Into this duct they placed a number of wire baskets... filled with crushed ice. The baskets were so arranged that the air entering the fan had to pass over or through the ice. The engineer succeeded in reducing the temperature of the auditorium to 70°F (21°C), but it kept four ice men hauling ice to the building as fast as they could go." Weinshank estimated that about 20 tons (1800 kg) of ice were used for the performance.[11]

Ice was being used, at least in some comfort cooling systems. Could it compete with mechanical refrigeration?

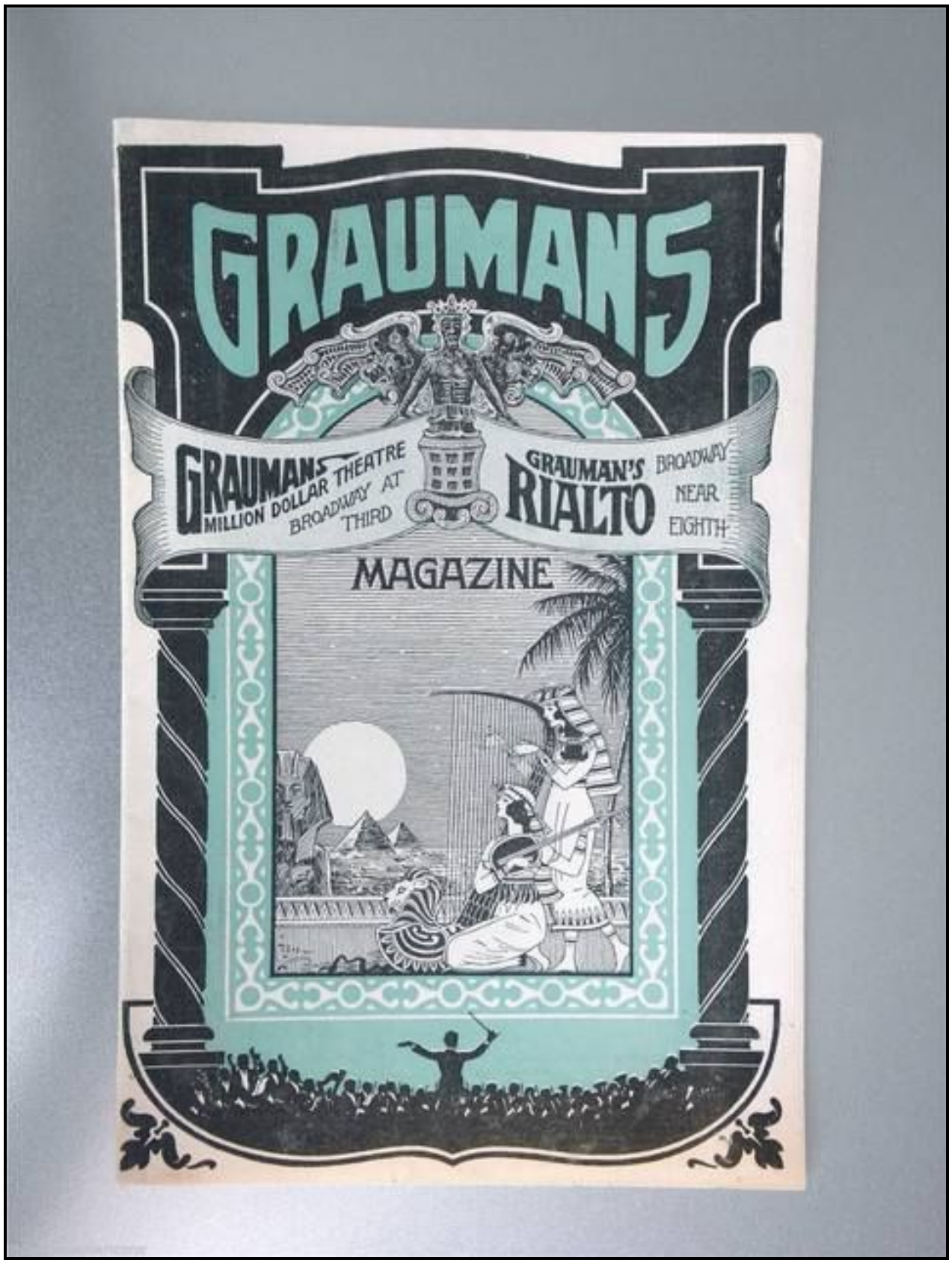
Grauman's Million Dollar Theatre, Los Angeles, 1918



Date Built: 1918
Seating Capacity: 2345
Owner: Sid Grauman
Architect: Albert C Martin & William Lee
Mechanical Ventilation with washer by Buffalo Forge
The operating engineers are said to have increased the Cooling Capacity by depositing cakes of ice in the washer tank

Grauman's Million Dollar Theatre, Los Angeles, 1918

Grauman's Million Dollar Theatre, Los Angeles, 1918



Air Conditioning Changes the Movie Industry

Air Conditioning changes the Movie Industry

The Balaban & Katz chain in Chicago was not one of the big five. However, by a combination of astute management, impressive theatre architecture and the introduction of air conditioning in 1917, they revolutionised the film and movie theatre industry. The big chains soon followed suit while B&K expanded from six to some one hundred and twenty-five theatres.

Air Conditioning

Balaban & Katz's Central Park Theatre, opened in 1917, was the first mechanically air cooled theatre in the world. Other theatre entrepreneurs had tried crude experiments with blowing air across blocks of ice to cool auditoria, but these never functioned without severe breakdown. Prior to the Central Park, most movie houses in the Midwest, South, and far West simply closed during the summer or opened to small crowds. Great progress toward safe mechanical cooling was made during the first two decades of the twentieth century. Technological change centered in Chicago, because firms in that city still slaughtered and processed most of the meat in the United States. The Kroeschell Bros. Ice Machine Company of Chicago developed a carbon dioxide system that efficiently cooled large spaces but required an investment of thousands of dollars as well as a room full of equipment. Thus Kroeschell Bros. sold it only to industries with a cash flow to justify the expense. Customers remained mainly meat packers, although a carbon dioxide system was installed to cool the banquet hall of Chicago's Congress Hotel.[47]

Before Barney Balaban entered the movie business he worked in the office of the Western Cold Storage Company. He knew firsthand of the advances in the art of air cooling. Consequently as Balaban & Katz planned the Central Park Theatre, they convinced Kroeschell Bros.' chief engineer and inventor to work up a system specifically designed to cool movie patrons. Wittenmeyer adapted a carbon dioxide system first for the Central Park and then an improved system for the Riveria a year later. Both only *cooled* the air, by forcing it through vents in the floor. The air then exhausted through ducts in the ceiling. Chicago movie fans became, for the first time, patrons of the movies year round.

But these early systems had two distinct disadvantages. First, the cool air

on the floor bothered patrons, especially women with long skirts. Second, the air remained too dry or too moist. So a method of dehumidification to perfect true air conditioning was needed. Wittenmeyer worked on both problems and the improved system for the Tivoli and Chicago theatres solved them. The air entered from the side and was dehumidified.[48]

These air conditioners were no window units. The apparatus took up a vast basement room. For the Chicago Theatre the equipment included more than fifteen thousand feet of heavy duty pipe, a 240-horsepower electric motor, and two all-steel, seven-foot flywheels, each weighing seven thousand pounds. An engineer was always on duty to watch over the equipment and effect necessary repairs.[49]

Once in place, these air cooled fantasy worlds became famous as summertime escapes from the brutal Chicago summers. Balaban & Katz's publicity constantly reminded Chicagoans of the rare treat in store inside. Icicles were hung from all newspaper advertisements. Announcements were made, in an almost public service fashion, that the Balaban & Katz theatre was a marvel of modern-day engineering and comfort. Others helped. The Public Health Commissioner of the city of Chicago proclaimed that Balaban & Katz theatres had purer air than Pike's Peak and that anyone with a lung disease or women in the final trimester of pregnancy ought to regularly spend time "at the movies." In their advertisements the Chicago Chamber of Commerce heralded Chicago as a wonderland of summer fun, in part because of the pleasures inside a Balaban & Katz movie palace.[50]

The results of Balaban & Katz's pioneering efforts in building a movie theatre chain were nothing short of phenomenal. Movie trade papers noted the consistently high grosses during the summer months and could find no better explanation than the comfort inside. Indeed, box-office receipts in the summer regularly exceeded those during the normally peak months during the winter. The location, architecture, service, stage shows, and indeed the movies themselves simply did not matter. Movie palaces provided relief from the heat that no other institution in the city could provide from May through September. No wonder millions embraced Balaban & Katz's unique brand of movie show in the years just after the First World War.[51]

Text extract from *Shared Pleasures: A History of Movie Presentation in the United States*, Douglas Gomery

The Balaban & Katz Chicago Theatre in Chicago opened in 1921, air conditioned by Wittenmeier

Air-conditioning too was a movie house breakthrough and a prime marketing tool for management who advertised the theatres as oases during long hot summers in a time when home and workplace cooling was only a wish. The Chicago Theatre's clever system pulled 50 degree air from the city's honeycomb of subterranean freight tunnels, passed the air through scrubbers and forced it into the house through under-seat registers called mushrooms.

Quote from *Rapp & Rapp, Architects*, Charles Edward Rapp, 2014