RADIO CITY MUSIC HALL

Rockefeller Centre New York

PART ONE

BUILDING SERVICES ENGINEERING

HVAC & ELEVATORS

CIBSE HERITAGE GROUP

RADIO CITY MUSIC HALL, NEW YORK CITY

178

RADIO CITY MUSIC HALL

Rockefeller Centre New York

PART ONE

BUILDING SERVICES ENGINEERING

HVAC & ELEVATORS

Eur Ing BRIAN ROBERTS CEng Hon.FCIBSE
Life Member ASHRAE


RADIO CITY
RADIO CITY

RADIO CITY MUSIC HALL

Rockefeller Centre New York

BUILDING SERVICES ENGINEERING

INTRODUCTION

Showplace of the Nation

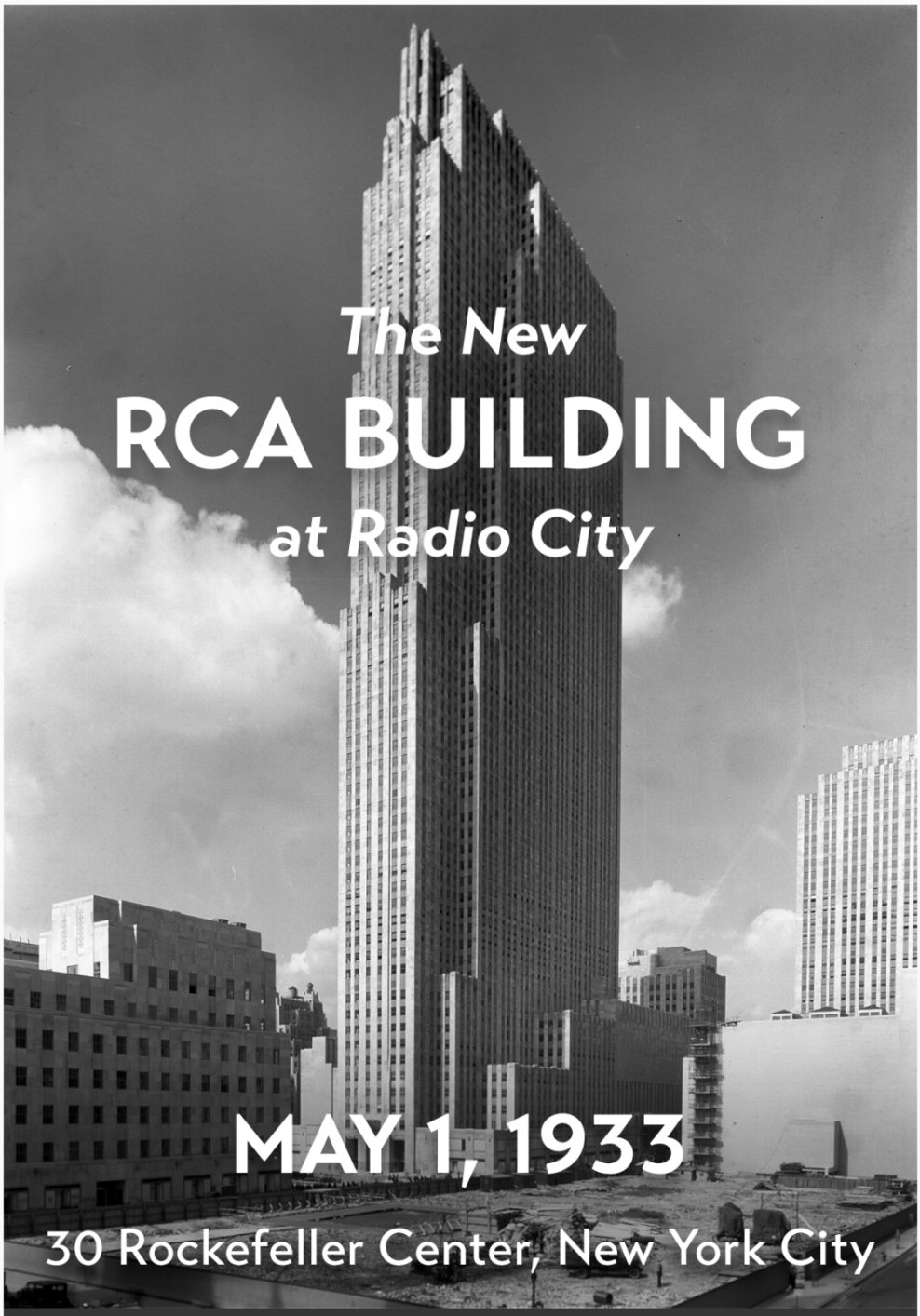
More than 300 million people have come to the Music Hall to enjoy stage shows, movies, concerts and special events. There's no place like it to see a show or stage a show. Everything about it is larger than life.

Radio City Music Hall is the largest indoor theatre in the world. Its marquee is a full city-block long. Its auditorium measures 160 feet from back to stage and the ceiling reaches a height of 84 feet. The walls and ceiling are formed by a series of sweeping arches that define a splendid and immense curving space. Choral staircases rise up the sides toward the back wall. Actors can enter there to bring live action right into the house. There are no columns to obstruct views. Three shallow mezzanines provide comfortable seating without looming over the rear Orchestra section below. The result is that every seat in Radio City Music Hall is a good seat.

The Great Stage is framed by a huge proscenium arch that measures 60 feet high and 100 feet wide. The stage is considered by technical experts to be the most perfectly equipped in the world. It is comprised of three sections mounted on hydraulic-powered elevators. They make it possible to create dynamic sets and achieve spectacular effects in staging. A fourth elevator raises and lowers the entire orchestra. Within the perimeter of the elevators is a turntable that can be used for quick scene changes and special stage effects.

The shimmering gold stage curtain is the largest in the world. For more than sixty-five years audiences have thrilled to the sound of the "Mighty Wurlitzer" organ, which was built especially for the theatre. Its pipes, which range in size from a few inches to 32 feet, are housed in eleven separate rooms. The Hall contains more than 25,000 lights and features four-color stage lighting. And what's a show without special effects? Original mechanisms still in use today make it possible to send up fountains of water and bring down torrents of rain. Fog and clouds are created by a mechanical system that draws steam directly from a Con Edison generating plant nearby.

CIBSE HERITAGE GROUP



Between 49th & 50th Streets, Fifth & Sixth Avenues
Raymond Hood, Architect

PHOTO COURTESY OF THE GOTTSCHO-SCHLEISNER COLLECTION

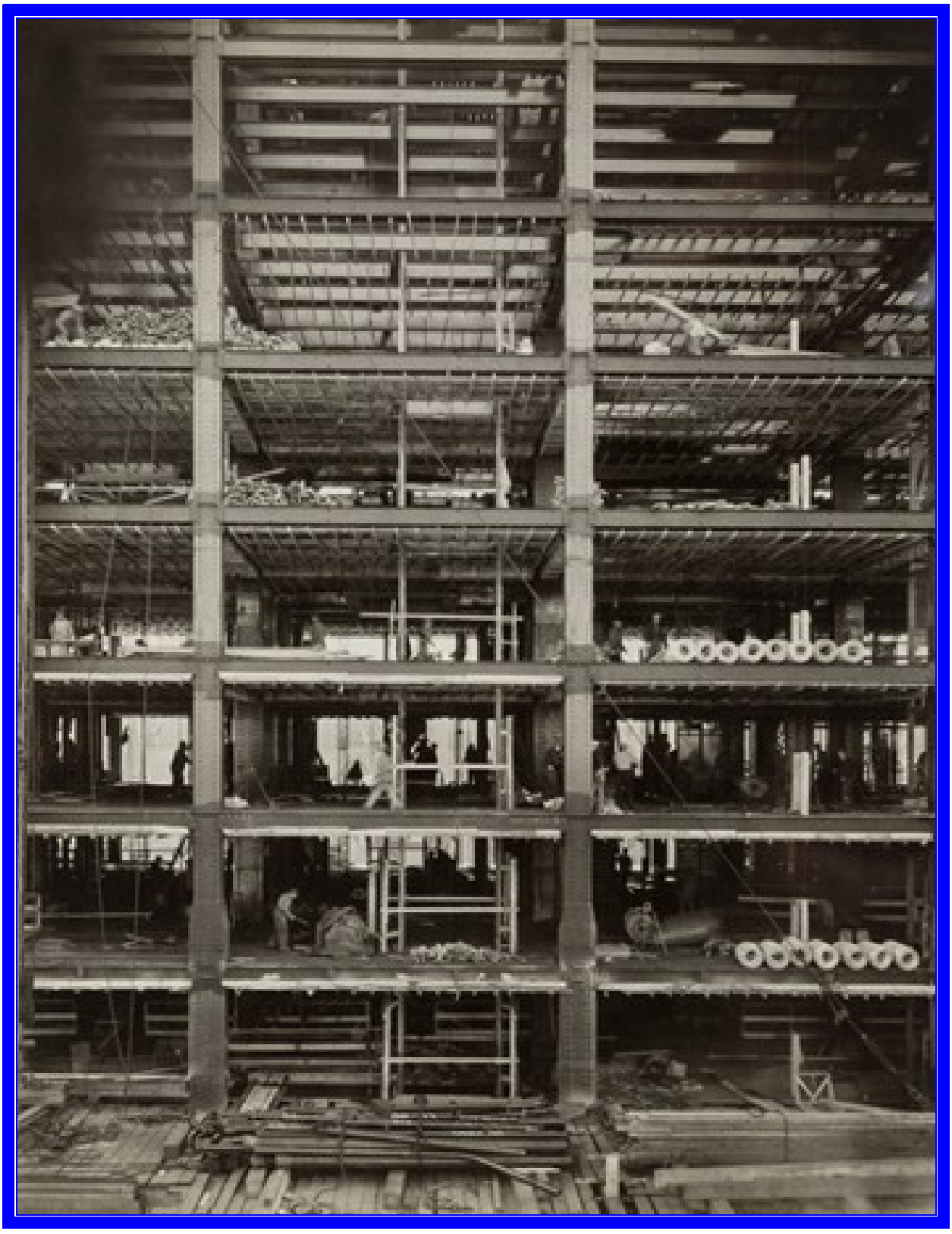
RADIO CITY MUSIC HALL

Rockefeller Centre New York

CONSTRUCTION
Rockefeller Centre

Building the RCA Tower

CONSTRUCTION
Rockefeller Centre

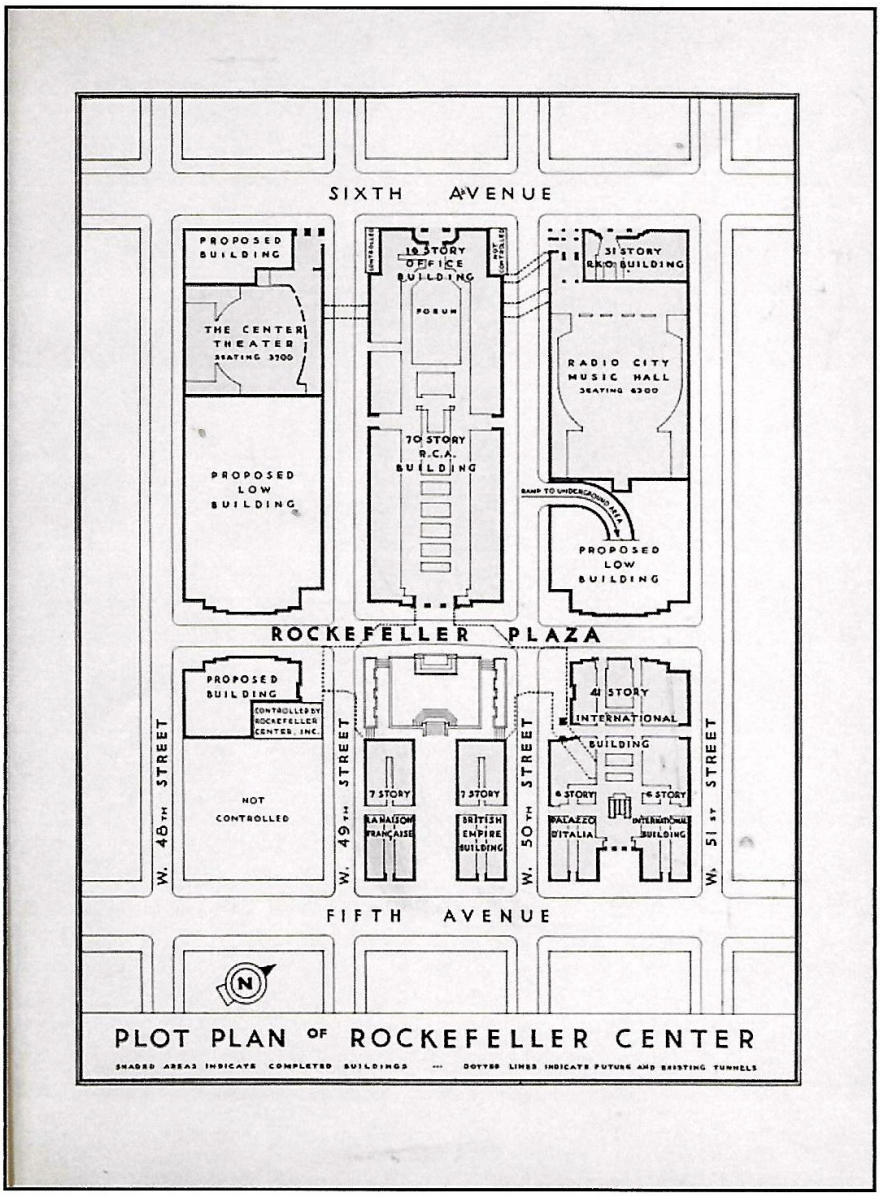


"Rockefeller Centre Going Up" photograph by Berenice Abbott (Heritage Actions)

CONSTRUCTION
Rockefeller Centre

The history of the Radio City Music Hall is inextricably linked with that of Rockefeller Centre. In 1928, the site's then-owner, Columbia University, leased the land to John D. Rockefeller who envisioned the construction of a new Metropolitan Opera building. This plan fell through.

Various plans were discussed before the Rockefeller family commissioned a complex of some one dozen buildings in Art Deco style which included a music hall and a 66-storey skyscraper, a sunken plaza and an ice-skating rink. One of the first buildings to be completed was the Music Hall which opened on 27th December, 1932, followed a few days later on 29th December by the Center Theater (which opened as the New RKO Roxy Theatre).

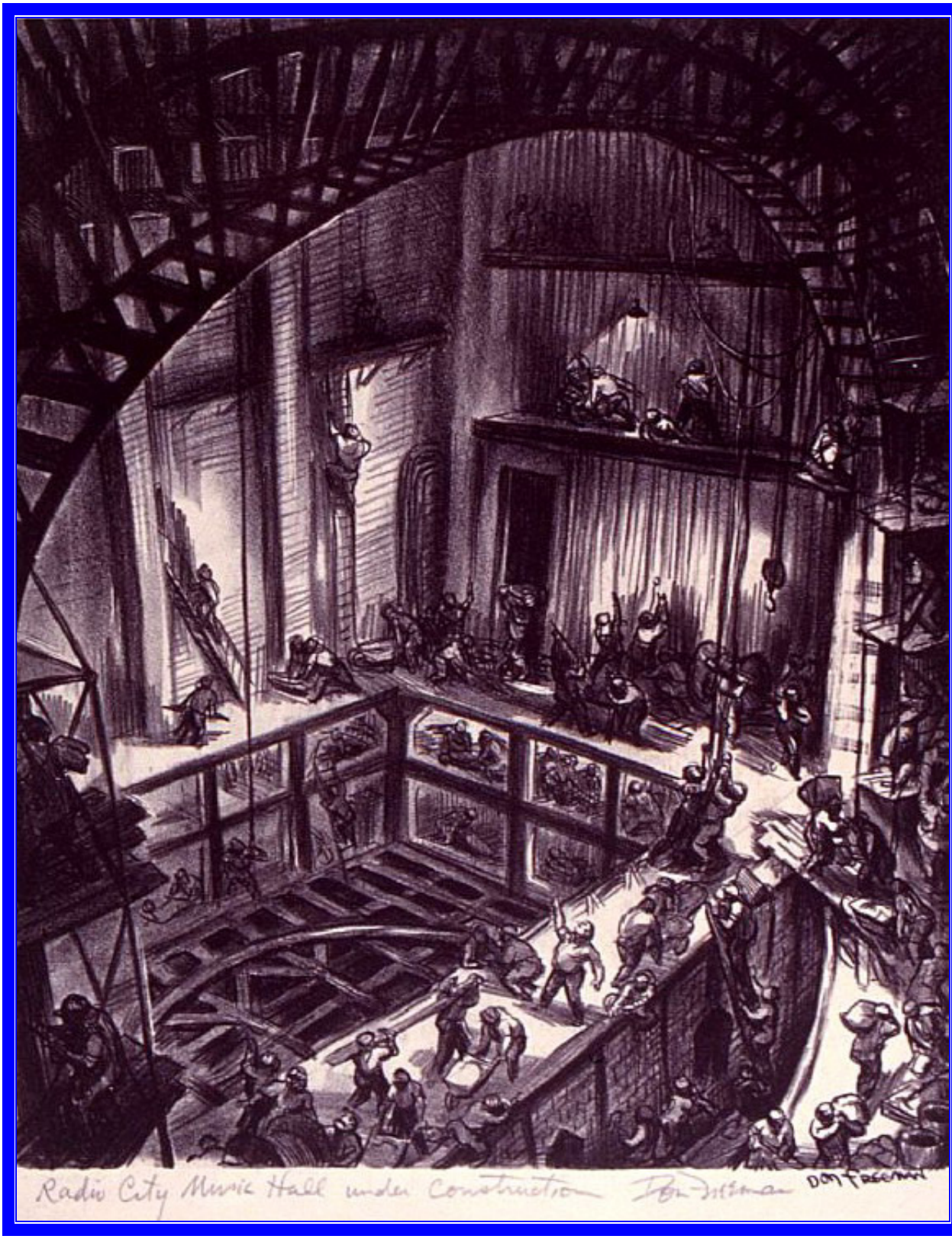


This plan of Rockefeller Centre shows Radio City Music Hall and the Center Theatre, located on opposite sides of the RCA Building

CONSTRUCTION
Rockefeller Centre

The 66 storey RCA Tower around the halfway stage

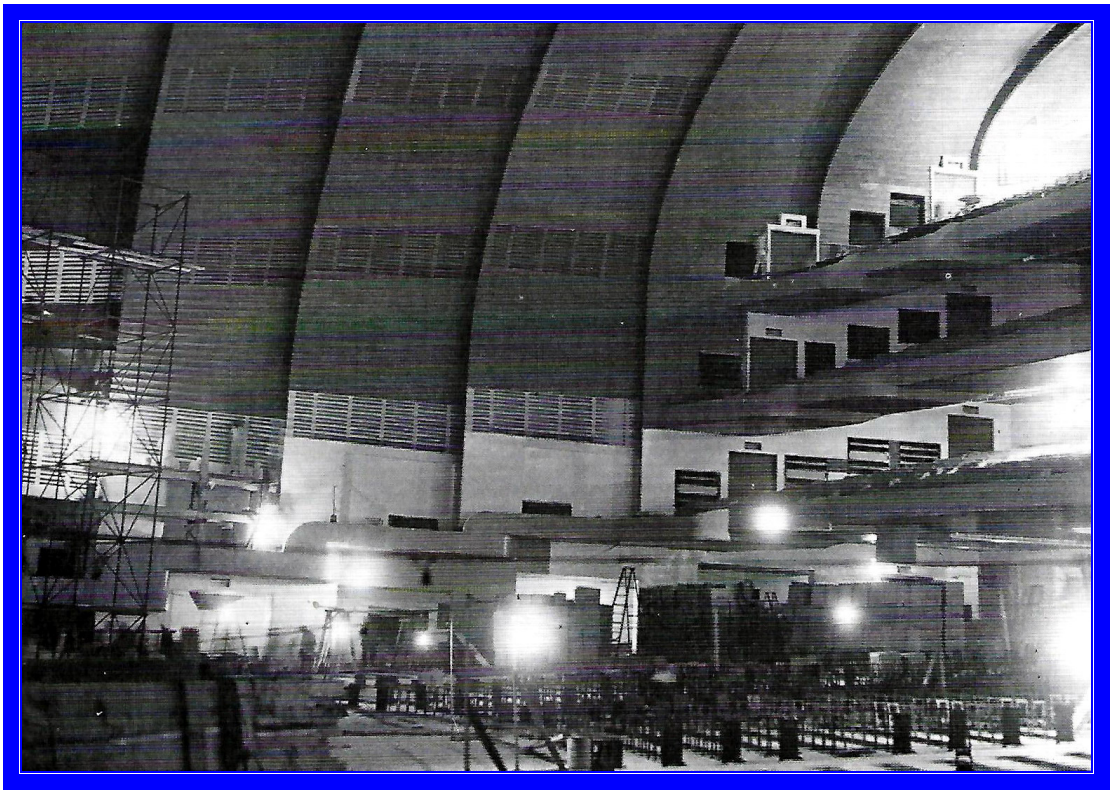
CONSTRUCTION
Radio City Music Hall



Signed drawing of Radio City Music Hall under construction

CONSTRUCTION
Radio City Music Hall

Building the auditorium (Works in Progress)



Building the auditorium (The Radio City Music Hall)

ARCHITECTURE & DECOR
Rockefeller Centre

RCA Tower at Rockefeller Centre, originally the World's Largest Office Building

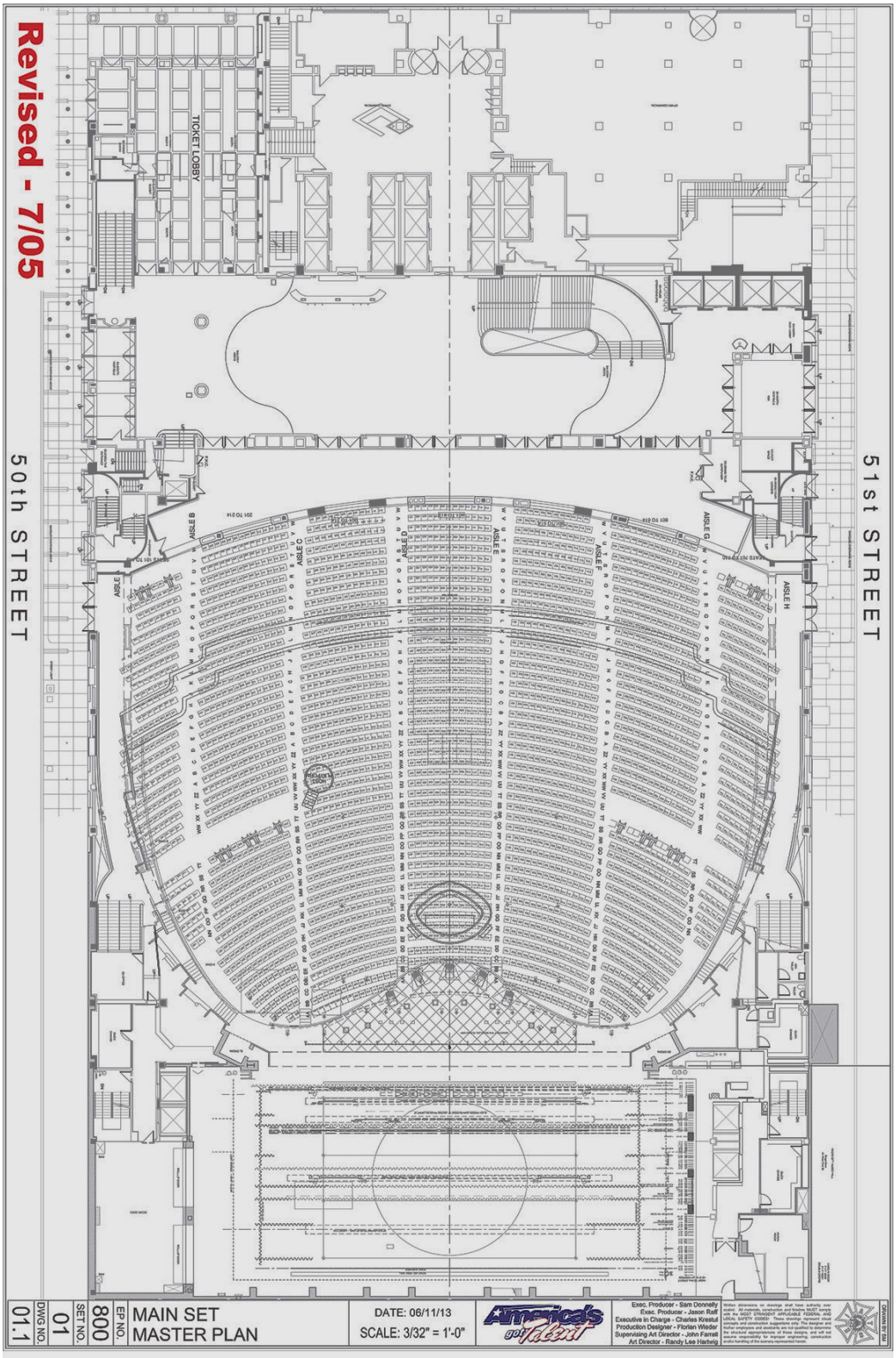
RADIO CITY MUSIC HALL

Opened 1932 Seats 6200
Architect: Edward Durrell Stone
Air Conditioning: Carrier Engineering Corporation
Consulting Engineers: Clyde R Place
Contractor: Wolff & Munier

Air Conditioning Systems
Number of Systems: 3
Total Refrigeration TR: 592
Total Outside Air cfm: 96,705
Total Supply Air cfm: 241,890

The Rockefeller Complex had an initial refrigeration capacity of 1500 TR

RADIO CITY MUSIC HALL



Updated plan of the Music Hall 2013

ARCHITECTURE & DECOR
Radio City Music Hall

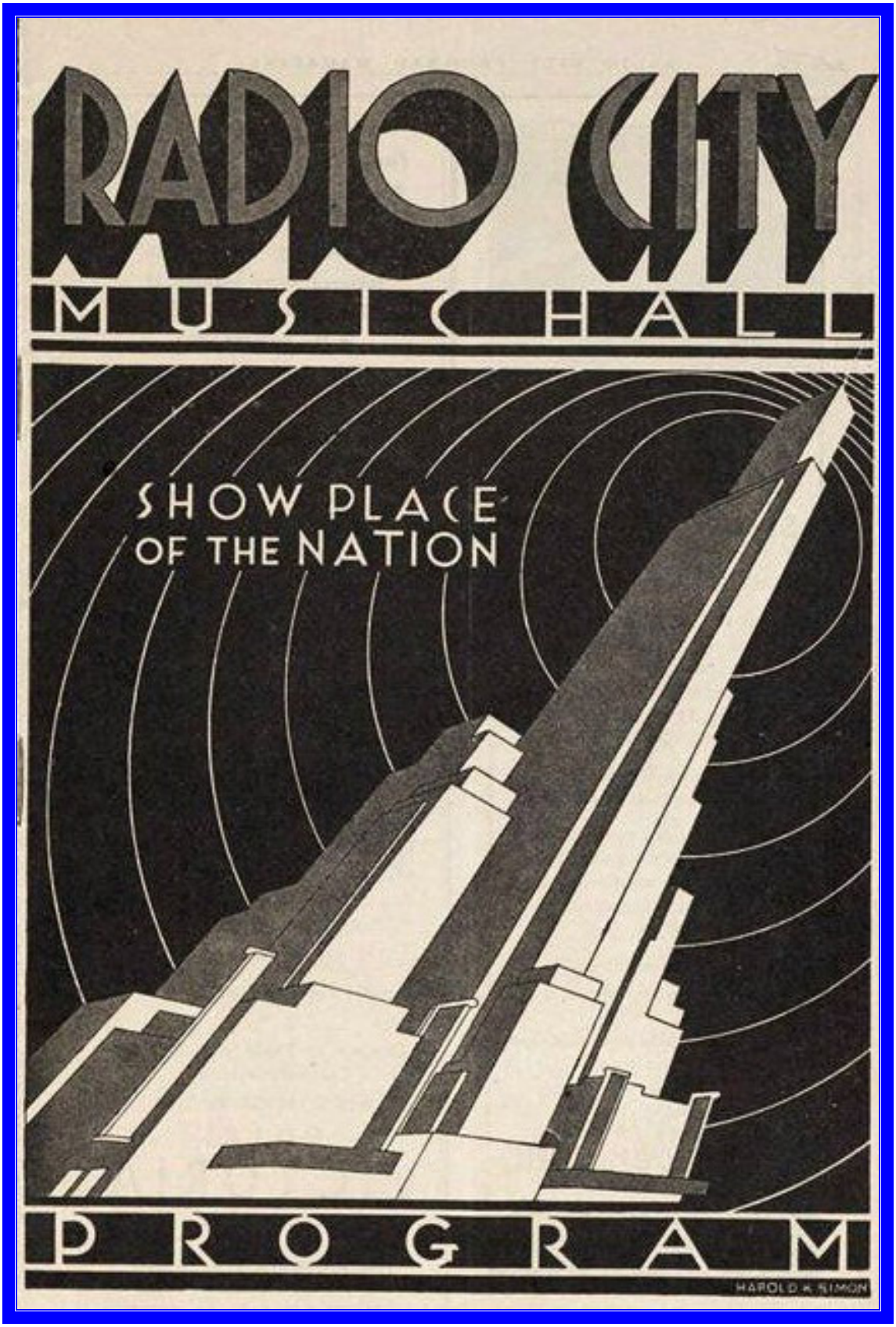
Murals in the Lobby: Interior Designer Donald Deskey (Aster Rathbun photograph)

Elevator doors

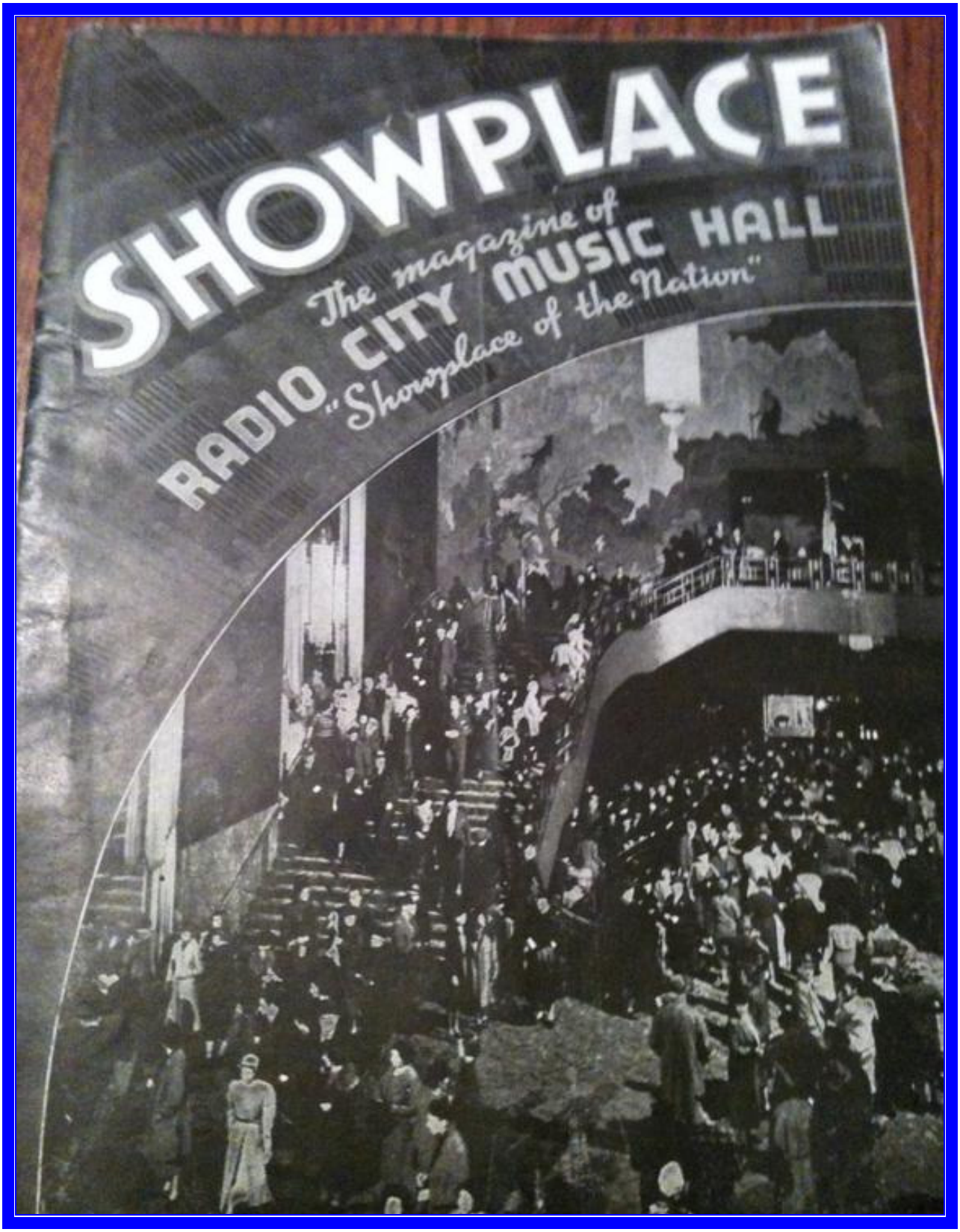
ARCHITECTURE & DECOR
Radio City Music Hall

Art Deco designs by Hildreth Meiere

SHOW PLACE OF THE NATION



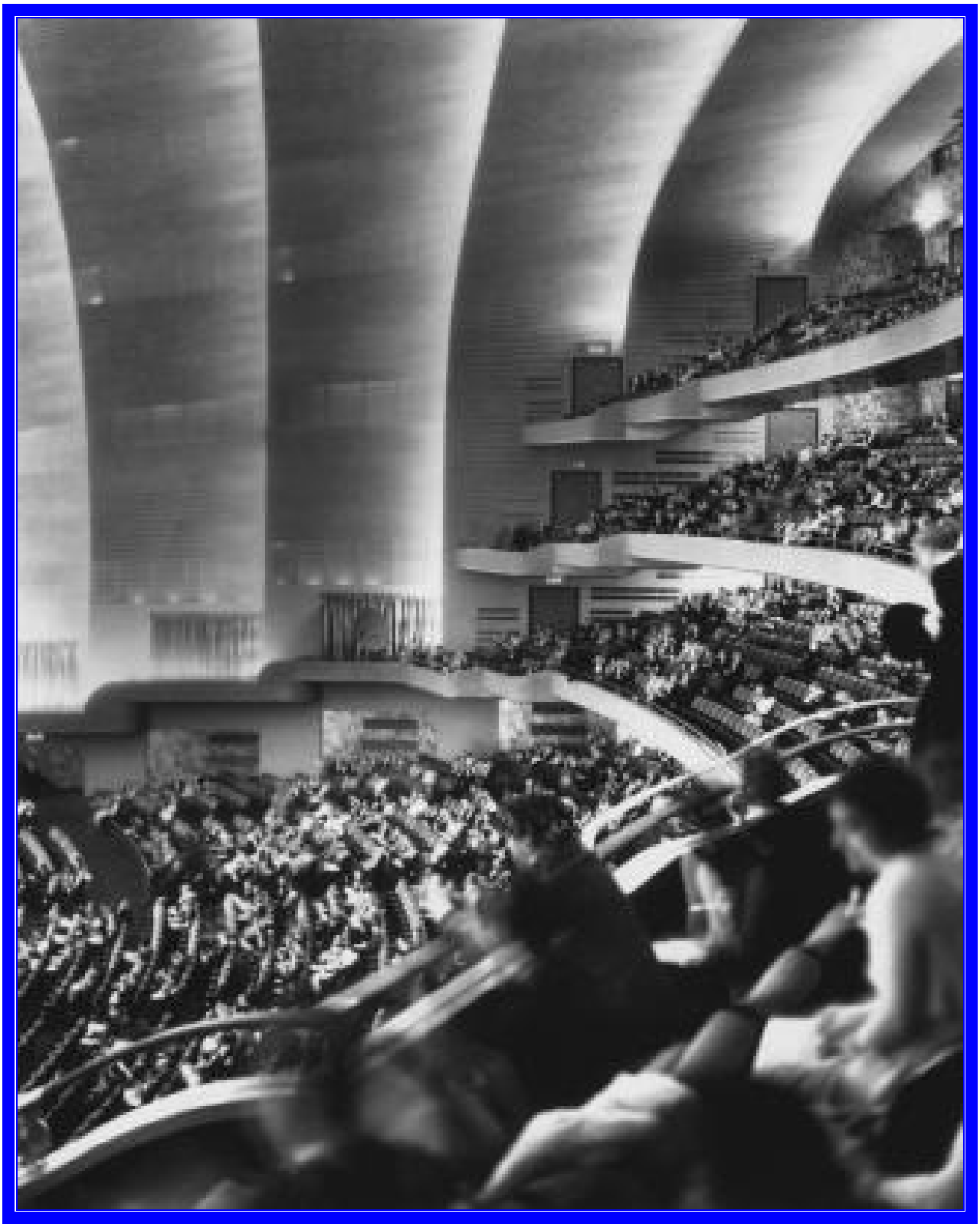
SHOW PLACE OF THE NATION



SHOW PLACE OF THE NATION

SHOW PLACE OF THE NATION

MUSIC HALL ENGINEERING SERVICES
Air Conditioning



The audience taking their places in the air conditioned auditorium, opening night 27 December1932

MUSIC HALL ENGINEERING SERVICES
Air Conditioning

Rockefeller Center. III. Air Conditioning the Music Hall.

Author(s) : Merle, A.
Journal article : Heating and Ventilating 1932 Vol.29 pp.47-50

Abstract : The International Music Hall, which forms a part of the Rockefeller centre project, is one of the numerous buildings to be equipped with a modern air conditioning system. The architectural and building construction called for special designs for most of the supply outlets and considerable care had to be exercised in routing the enormous amount of duct work, of which 40 tons were utilized in the main ceiling alone. The air *is* supplied through a downward system, entering the conditioned spaces through ceiling outlets and being exhausted through side wall or floor registers. The air conditioning apparatus includes equipment for refrigerating, washing, filtering and dehumidifying the air. A certain amount of radiation is also used to remove objectionable odours. The system is guaranteed to maintain during spring, summer and fall a dry bulb temperature of 77°F., and a relative humidity of 55 per cent. For winter a 70° dry bulb and 45 per cent.-50 per cent. relative humidity are to be maintained. The system was designed for outdoor conditions, ranging from 95° dry bulb and 75° wet bulb in summer and 0° in winter, with a temperature difference between entering air and indoor air not to exceed 16°. The ventilation for the mezzanines has been designed and balanced so as to have a slight excess of exhaust air over that supplied in order to prevent spilling of air over the mezzanine rail on to the audience on the main floor. In order to maintain the above conditions in a theatre the size of the International Music Hall, the systems were divided so that sections calling for large variations in entering air temperatures would be served by separate and independent systems. There are three such systems or units in the present theatre and the equipment contained in each unit is described in much detail and illustrated by photographs and sketches.

Record Number : 19332700096
Language of text : not specified

MUSIC HALL ENGINEERING SERVICES
Air Conditioning

Rockefeller Center

III

Air Conditioning the Music Hall

By ANDRE MERLE†

Wide World

Fig. 1. The International Music Hall, showing progress as of April 27.

Introduction

ONE can not describe the air conditioning system being installed in the International Music Hall without paying tribute to the vision, courage and faith which the owners and lessees have shown in their support of the whole Rockefeller Center project. The fact that they have such faith in the future and the courage to proceed with this immense project means much to the country at large, and possibly means even more to the thousands of men who are employed in the construction of the buildings which will comprise Rockefeller Center.

To the consulting engineer, Clyde R. Place, who is in charge of the design of mechanical and electrical equipment, fell the responsibility of planning the various air conditioning systems for the different buildings. Rockefeller Center will have the greatest amount of air conditioning of any building project ever built, the cost of this work alone being $4,000,000. The plans for the whole project call for approximately 10,000 tons of mechanical refrigeration with 4,000,000 cu. ft. of conditioned air circulated per minute. Approximately 15,000 tons of air ducts will distribute cooled and filtered air for 130,000 people.

It will be recalled by those who read the first installment of this series[1] that the International Music Hall is designed to stage exhibits and revues on a large scale, and that it can be converted, if desired, for use as a sound motion picture or legitimate theater. It will cover a ground area of over 60,000 sq. ft., and will have a stage 143 ft. wide and 62 ft. deep.

The air conditioning system installed in the Music Hall (Theater 10) represents the latest practice. The architectural and building construction called for special designs for most of the supply outlets, and great care had to be taken in the routing of ductwork of which approximately 40 tons were used in the main ceiling alone. The air is supplied through a downward system, entering the spaces to be conditioned through ceiling outlets and exhausted through floor or side wall registers.

The air conditioning apparatus includes that for refrigerating, washing, filtering and dehumidifying. In winter the air can be humidified and tempered. Radiion is applied to remove objectionable odors.

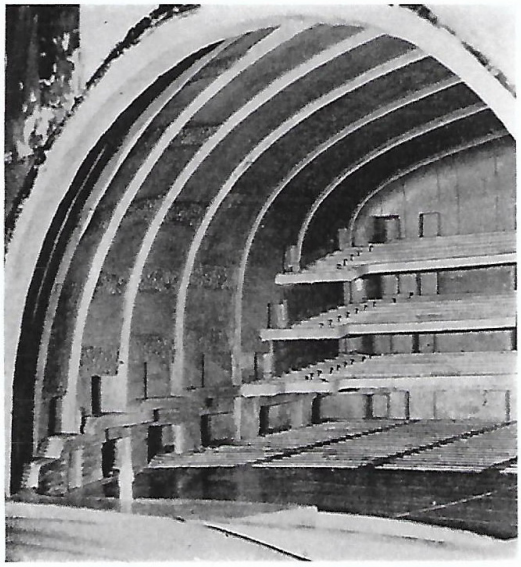
Heat Load

The heat gain is especially large in the International Music Hall and adds considerably to the required capacity of the refrigerating machinery. The lighting

†Of the office of Clyde R. Place, Consulting Engineers, New York.

[1]Rockefeller Center—1, HEATING AND VENTILATING, May, 1932, page 19.

MUSIC HALL ENGINEERING SERVICES
Air Conditioning



Walter H. Kilham, Jr.

Fig. 2. Architect's model—interior of Music Hall

of the theater calls for approximately 285,000 watts, distributed as shown in Table 1. Another factor which increased the gain was the location of the theater, with two sides exposed. The Fiftieth Street side has a southerly exposure from which a large heat gain will result in the afternoon. During the overture—15 min.—the lighting load will not exceed 285 kw., and during the stage show the maximum load will be 210 kw.

Performance Guarantee

The guarantees call for 77° dry bulb temperature and 55% relative humidity to be maintained during the summer, spring and fall. A 70° dry bulb and 45%-50% relative humidity are called for in the winter. Allowable variations from the specified conditions are plus or minus 2° temperature and plus or minus 4% relative humidity. Outdoor conditions for which the systems were designed are 95° dry bulb and 75° wet bulb in the summer and 0° in the winter.

The temperature difference between the entering air and the room temperature should not exceed 16°, which is the maximum permitted in this office. The following table outlines good practice for the temperature difference between the entering air and the room temperature:

Height of Room, Feet	Temperature Difference
10	10°
15	12°
25	14°
30	16°

The mezzanines have been designed and balanced so as to have a slight excess of exhaust air over that supplied. This feature prevents spilling of air over the mezzanine rail on to the occupants directly below.

TABLE 1
ELECTRICAL LOAD

Location	Connected, Kw.	Maximum Demand, Kw.
Stage footlights	42	20
Valance border	70	30
Cove	240	90
Chordal runway	32	16
First mezzanine soffit	30	15
Second mezzanine soffit	28	14
Third mezzanine soffit	25	12.5
Main ceiling arc spot light cove D	90	60
Musicians' flood lights cove C	48	48
Main ceiling perforations	72	18

Grand foyer	5 watts per sq. ft.	100%
Lobbies	3 watts per sq. ft.	100%
Mezzanine promenade	1 watt per sq. ft.	100%
Lounge	2 watts per sq. ft.	100%

The Three Air Conditioning Systems

In order properly to maintain the conditions as outlined, and due to the immense size of this theater, the systems were divided so that sections calling for large variations in entering air temperatures would be served by separate and independent systems. For simplicity, these systems or units are termed A, B, and C. Table 2 clearly indicates the sections served, air quantities, etc., and the schematic diagrams, Figs. 3, 5, and 6, indicate the position of the supply and exhaust air outlets. This zoning arrangement will result in economy of operation.

The three systems are designed so as to produce comfortable conditions during intermediate seasons

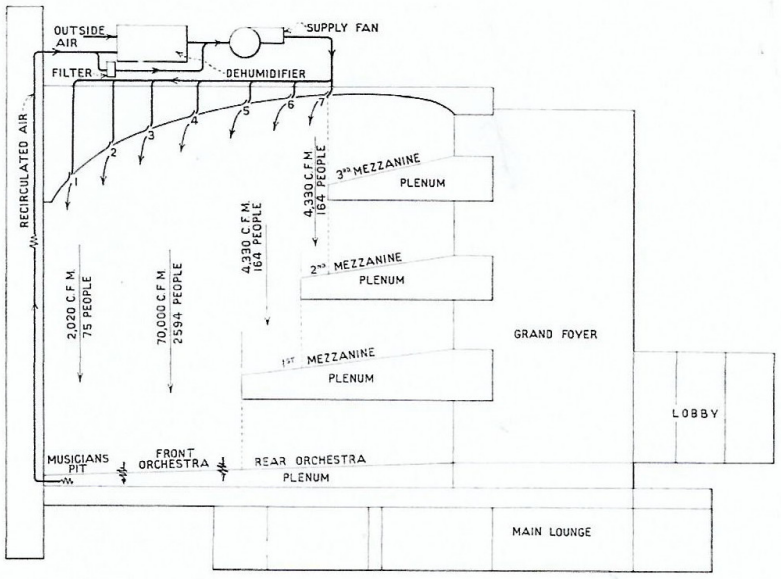


Fig. 3. Capacities and areas served by System A.

MUSIC HALL ENGINEERING SERVICES
Air Conditioning

TABLE 2
CAPACITIES OF THE THREE SYSTEMS

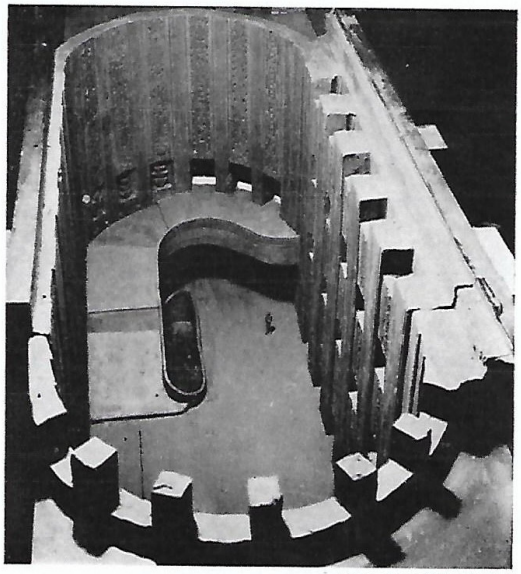
System	Section Conditioned	Population	Air Supply, c.f.m.	Approx. c.f.m. per person
A	Front orchestra	2594	70,000	27
	First mezzanine (front)	164	4,330	27
	Musicians' pit	75	2,020	27
	Second mezzanine (front)	164	4,330	27
B	Rear orchestra	1200	28,620	24
	Rear orchestra (standees)	300	9,000	30
	Grand foyer (1/3)	300	9,330	31
	Lobbies	152	4,370	29
	Main lounge	450	14,400	32
	First mezzanine (rear)	778	23,340	30
	First mezzanine promenade, etc.	165	5,350	32
C	Second mezzanine (rear)	689	20,670	30
	Second mezzanine promenade, etc.	120	3,930	32
	Third mezzanine	683	21,990	32
	Third mezzanine promenade	50	1,500	30
	Grand foyer (2/3)	600	18,350	30

without use of mechanical refrigeration so long as outside air does not exceed 48° wet bulb temperature, which is below the theater dew point. This is accomplished by admitting a high percentage of outdoor air through specially designed combination dehumidifiers and air washers. Should outside climatic conditions permit, 100% outside air may be introduced.

System A

System A supplies air to the front orchestra, musicians, and a portion of the first and second mezzanine, as indicated in Fig. 3. The summary of engineering data is outlined in detail in Table 2. This system employs but one fan which acts as both supply and return.

A special feature of the system is the method used to vent the exhaust air. On each side of the main orchestra a series of exhaust air louvres and dampers has been installed. These function automatically with the large outside air dampers. When the maximum amount of outside air enters the theater, a like amount of used air is exhausted through this relief. When the minimum amount of fresh air is being circulated, the used air is exhausted at the floor through special chair exhausters which convey this air to a large plenum and then to the conditioning apparatus. These exhausters are located throughout the main orchestra floor, approximately 20% being evenly distributed at the front third of the orchestra, 30% in the middle portion, and 50% in the balance of the space. The purpose of this arrangement is to keep a balanced condition of temperature, humidity and air motion throughout the main orchestra.



Walter H. Kilham, Jr.

Fig. 4. Architect's model—interior of grand foyer

Systems B and C

Systems B and C are similar to A with the addition of the exhaust fans. This arrangement maintains an air balance at all times in the sections served, especially when maximum outside air is used. All of the supply and exhaust fans are of the constant speed type. The arrangements are shown in Figs. 5 and 6. To operate the fans at reduced speed and air volume is apt to produce spotty, drafty conditions and, in time, a stuffy odor throughout the theater. Separate smoke exhaust fans are installed to remove the smoke from the second and third mezzanine, and the main lounge.

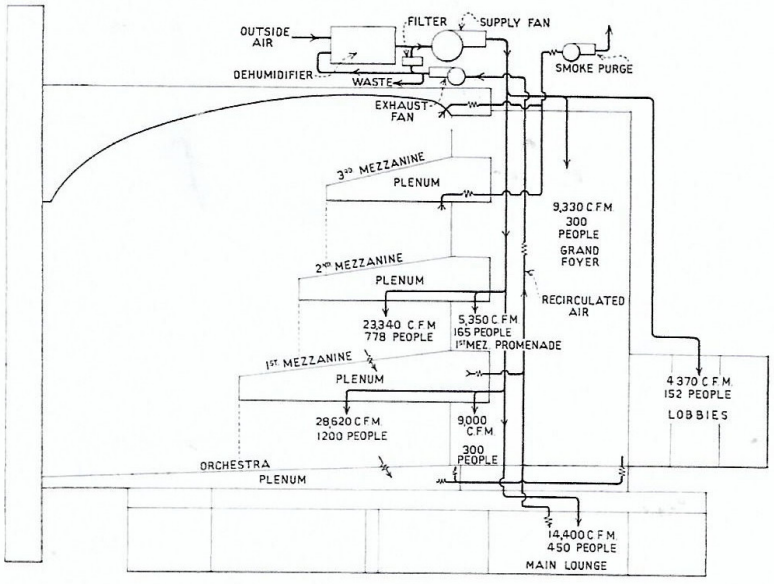


Fig. 5. Capacities and areas served by System B.

MUSIC HALL ENGINEERING SERVICES
Air Conditioning

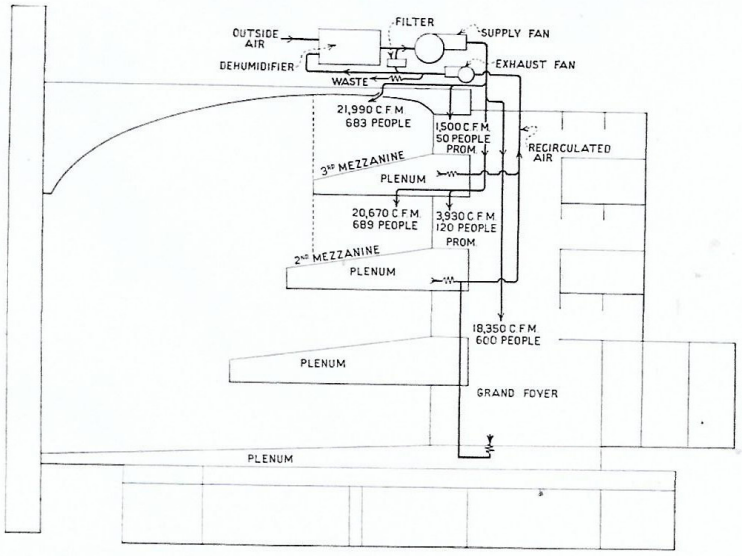


Fig. 6. Capacities and areas served by System C.

Air Conditioning Apparatus

The refrigeration machinery is located in the basement, the other conditioning apparatus being on the sixth floor. There are three complete systems of centrifugal refrigeration installed, the refrigerant being dichloromethane. Whenever the theater is not fully occupied, and when weather conditions permit, each system may be run at reduced capacity, or any unit may be cut out entirely. This arrangement provides for efficient and economical operation. The machinery room was designed so that ample space has been provided for operation and minor repairs. Space has also been provided for the removal of any section of the equipment which may require extensive repairs or replacement. Automatic temperature control of the refrigerated water is obtained through a single duty temperature regulator and thermostat which controls and regulates the condenser water by actuating a reverse acting regulating valve. The amount of water passing through the cooler is controlled by a differential electric control which regulates the performance of the liquid pump. An orifice plate is inserted on the suction side of the cooler and the difference in pressure on either side of this orifice plate starts or stops the liquor pump. The entire cycle of refrigerant is under a vacuum.

The cold water piping has been installed as a closed water system using the dehumidifiers as balancers. Only one cold water circulating pump is used. The velocities at no point exceed 8 ft. per sec. in the pipes. A special feature of the piping system is the arrangement of flooding nozzles installed in the combination dehumidifier washer. Cold water is recirculated by an independent pump to these nozzles which cleans the air along with the dehumidifying spray nozzles. A complete system of water treatment equipment has been installed for rust prevention.

In addition to the city water, a modern condenser water cooling system has been installed to cool approximately 1776 gal. of condenser water each minute. Separate cooling towers have been installed for each refrigeration machine. Due to space available and architectural treatment, tower A is the forced type, while towers B and C are the induced type.

TABLE 3
UNIT DATA FOR THE AIR CONDITIONING DESIGN

Item	System A	B	C	Total
1—Number of people.....	2,997	3,150	2,097	8,244
2—Outside air, min., c.f.m.	32,350	37,785	26,570	96,705
3—Return air, c.f.m.....	31,400	33,715	26,080	91,195
4—Dehumidified air, max., c.f.m.	63,750	71,500	52,650	187,900
5—Recirculated air, min., c.f.m.	48,330	56,985	39,870	145,185
6—Total air supply, c.f.m.	80,680	94,770	66,440	241,890
7—Tons of refrigeration..	246	205	141	592
8—Cold water, g.p.m.....	843	703	484	2,030
9—Preheat condensate, lb. per hr.	1,150	1,350	950	3,450
10—Reheat condensate, lb. per hr.	3,130	3,310	2,345	8,785
11—Condenser water, g.p.m.	738	615	423	1,776
12—Cooling tower, c.f.m...	102,000	86,000	58,000	246,000
13—Smoke exhaust, c.f.m..	None	5,000	5,000	10,000
14—Air supply per person, c.f.m.	27	30	32	29
15—Outside air per person, c.f.m.	11	12	12½	11½
16—Number of persons per ton of refrigeration.	12.2	15.4	14.9	13.9
17—C.f.m. air supply per ton of refrigeration.	328	461	470	410

Noise Prevention

The theater-going public is becoming more and more noise conscious, so much so that present-day air conditioning installations must give due consideration to noise prevention. Modern theaters equipped with the latest and most modern sound picture projectors demand and require absolute quiet. The plans and specifications for the Music Hall limited the increase in noise level due to the operation of the conditioning equipment to not more than 5 decibels above normal room noise level.

In order to obtain these results all of the apparatus, foundations and ductwork were carefully insulated for noise prevention as well as heat insulation. Special care was given to the number and location of all sound absorbers. All piping connections between pumps, coolers and condensers are insulated with flexible rubber joints for noise and vibration prevention. The fans are also insulated, and canvas connections have been provided to all ductwork.

Wolff & Munier, Inc., are the heating contractors for the building.

ROCKEFELLER ENGINEERING SERVICES
Central Refrigeration

Three Million Pounds of Ice for Rockefeller Center

Carrier's November 1932 agreement to air condition the RCA Building at Rockefeller Center in New York City was the largest air-conditioning contract booked to that time, and people were dazzled by the size and scope of the project.

The RCA Building rose 70 stories over the Center and required air conditioning equivalent to three million pounds of melting ice a day. In hot weather, dehumidifiers removed 700 gallons of water from the air every hour. "Two batteries of great centrifugal refrigerating units will take care of the areas to be air-conditioned," the *New York Daily Investment News* reported. "One battery will serve the nine studio floors to be occupied by the National Broadcasting Company." The system also included state-of-the-art silencing equipment, and air filters to rid offices of dust. Each of NBC's 27 studios operated on its own system.

Carrier management proudly noted that this was the third project to be awarded the company in Rockefeller Center, having won two contracts the previous spring to air condition the 6,000-seat International Music Hall and the new R.K.O. Roxy Theatre.

Carrier grew alongside Rockefeller Center in New York, providing comfort air to its offices and entertainment ven

ROCKEFELLER CENTRE & MUSIC HALL
Refrigeration & Air Conditioning

Carrier Air Conditioning at Rockefeller Centre.

NOEL P. HUNT, of Carrier (Aust.) Ltd., advises that Carrier has installed the world's largest air-conditioning plant at the recently-completed Rockefeller Centre in New York.

In addition to the RCA Building, comprised of 77 stories, Carrier plant is also operating in the RKO-Roxy and the International Music Hall, which has a 6,200 capacity.

THE contract is the largest one for air-conditioning on record, and the building order alone was an investment of £200,000. During the summer season batteries of huge refrigerating units will provide refrigeration equal to three million pounds of melting ice a day.

Nearly 15 miles of duct work and more than 1,000 outlets and returns will be required for the distribution of the conditioned air. Under extreme hot weather conditions about 18,000,000 British thermal units of heat will be removed from the building every hour. This is equivalent to the hourly heat requirement for about 400 average-sized homes during the winter season.

Moisture Removal.

The moisture removed from the air by dehumidifiers in hot weather would make 700 gallons of water an hour. In the actual operation of the system 300,000 gallons of water an hour will be refrigerated.

Two batteries of great centrifugal refrigerating units will take care of the areas to be air-conditioned. One battery will serve the nine studio floors, from the third to the eleventh inclusive, to be occupied by the National Broadcasting Company. Another battery will serve the basement, ground and first floors.

Throughout the offices in the rest of the building provision will be made for the installation of the Maxim-Campbell silencer and air filter, which prevents noise from entering offices through ventilating spaces and absorbs dirt, soot, dust and germs.

Solves New Problems.

The magnitude of the system is matched by its intricacy and the

N.Z. aerodromes, in conjunction with "Smithy's" apearances in the Dominion with Universal's "Air Mail."

interesting solution of many new problems. One of these was presented by the broadcasting studios, with their severe requirements for sound-proofing and acoustics. Each of the 27 studios will be operated on an individual system separately controlled for temperature. All changes in the number of persons in the studio and all variations in illumination will be compensated for immediately by the automatic devices keyed to that particular studio.

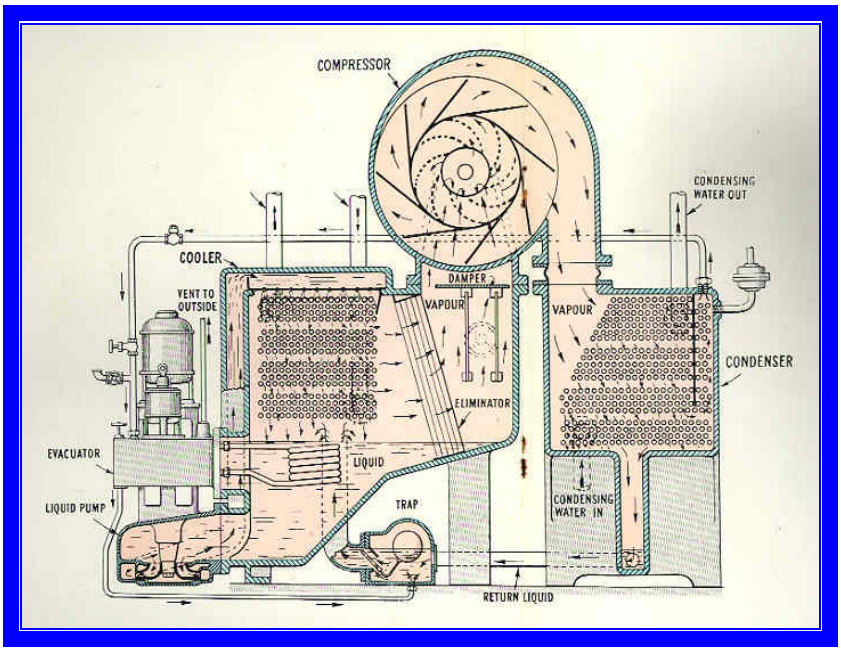
The air-conditioning system will deliver 400,000 cubic feet of conditioned air a minute, with an average temperature of 70 degrees fahrenheit in winter and a maximum of 85 degrees fahrenheit in summer. Humidity is to be varied between 40 per cent in the winter and a maximum of 50 per cent in the summer.

The public will be able to view the main distributing floor for the gigantic air-conditioning system. This floor will be located above the broadcasting studios. It will contain practically all the mechanically operated fans, motors and dehumidifiers. While the system is almost entirely automatic, it will be under the constant supervision of one man, who will be located in the main fan room. Here will be a central control board which will indicate the functioning of all the apparatus and will provide for any mechanical adjustment that may become necessary.

Willis H. Carrier, in charge of the installation of the system, was the engineer responsible for the air-conditioning of the Capitol in Washington and the White House executive offices.

(Article in Everyones, Australia 1933)

ROCKEFELLER CENTRE & MUSIC HALL
Refrigeration & Air Conditioning



Carrier centrifugal water-chiller refrigeration machine (1930s catalogue)

The Carrier advertisement (previous page) quotes the capacity of the refrigeration plant for one of the first phases of the construction of the Rockefeller Centre as equivalent to three million pounds of melting ice, which equates to 1500 TR.

The advertisement also refers to Carrier refrigeration installations for the Radio City Music Hall and Center Theatres but the capacity of the centrifugal water chillers is not given. Refrigeration plant installed in the nearby Roxy Theatre in 1926 comprised two Carrier machines providing 420 TR. The Roxy and the Radio City Music Hall had similar seating provision, about 6000 patrons. However, the Music Hall is said to be the largest movie theatre ever built, and an assumption is that the refrigeration capacity was between 500 and 600 TR (discounting any standby provision).

A history of the Music Hall reads:

> Apertures in the ceiling help provide the Music Hall patrons with a luxury that was a marvel of modern technology in 1932: air conditioning. The cooled air, forty cubic feet of it a minute for each patron in the theater, falls in a uniform blanket over the audience. The air is withdrawn through triangular outlets under the seats, and the recirculating process keeps the air purified even though smoking is permitted in the mezzanines.

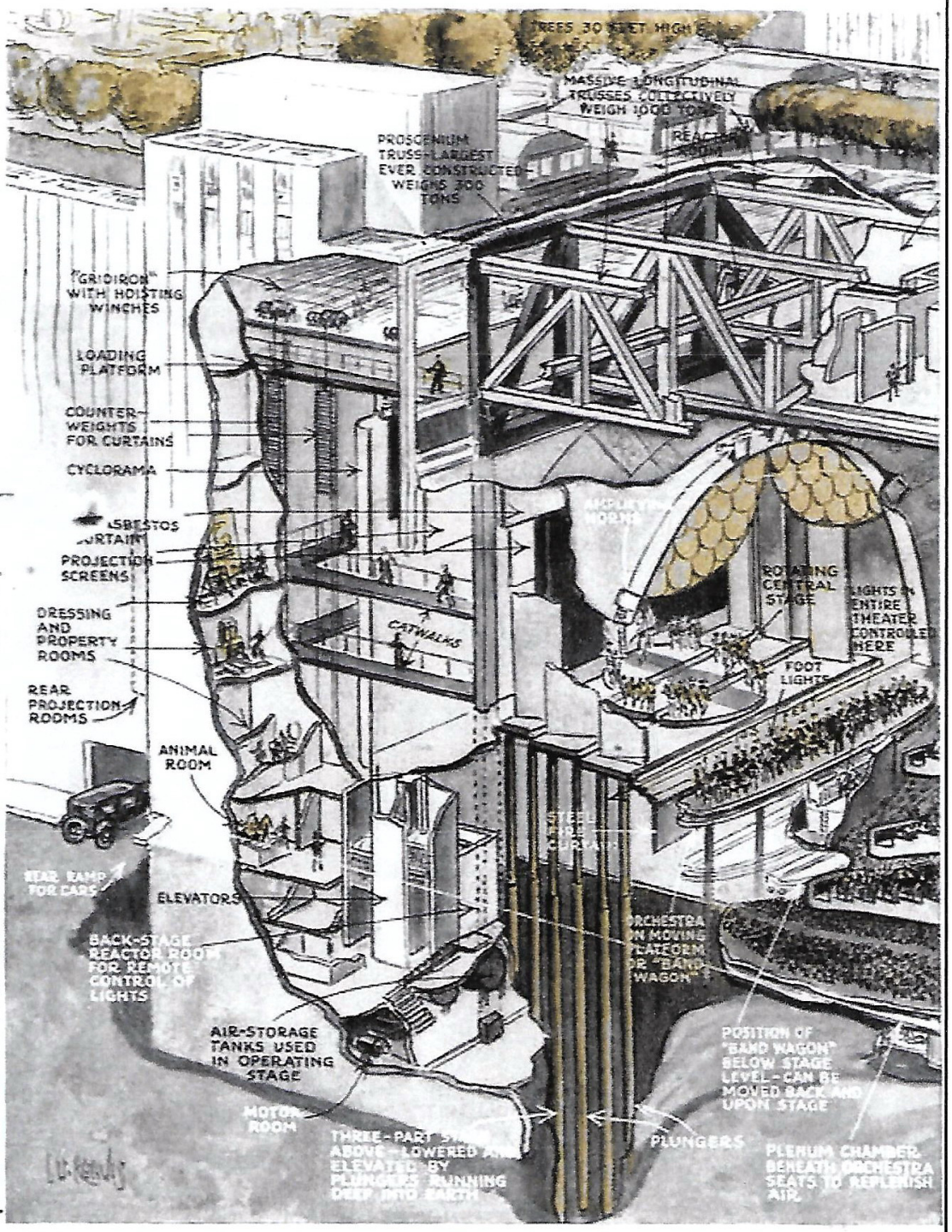
With a seating capacity of 6000 this results in a supply air volume of 240,000 ft3/min. At typical New York design conditions and assuming 10 ft3/min of fresh air per person an estimate of the cooling load is some 600 TR. Using similar assumptions for the smaller 3500 seat Center Theatre gives about 300 TR. Actual refrigeration capacities have not been discovered.

Refer to the Heating & Ventilating magazine of 1932 for technical information (previous pages).
The diagrams on the following two pages are cut-away views of the Radio City Music Hall.
The second of these views (page 253) shows two fan rooms (one left, one right, both about three-quarters from bottom of page) with a refrigeration room (bottom left corner).

The first diagram (252)shows stage and passenger elevators and stage lighting

MUSIC HALL ENGINEERING SERVICES
Air Conditioning

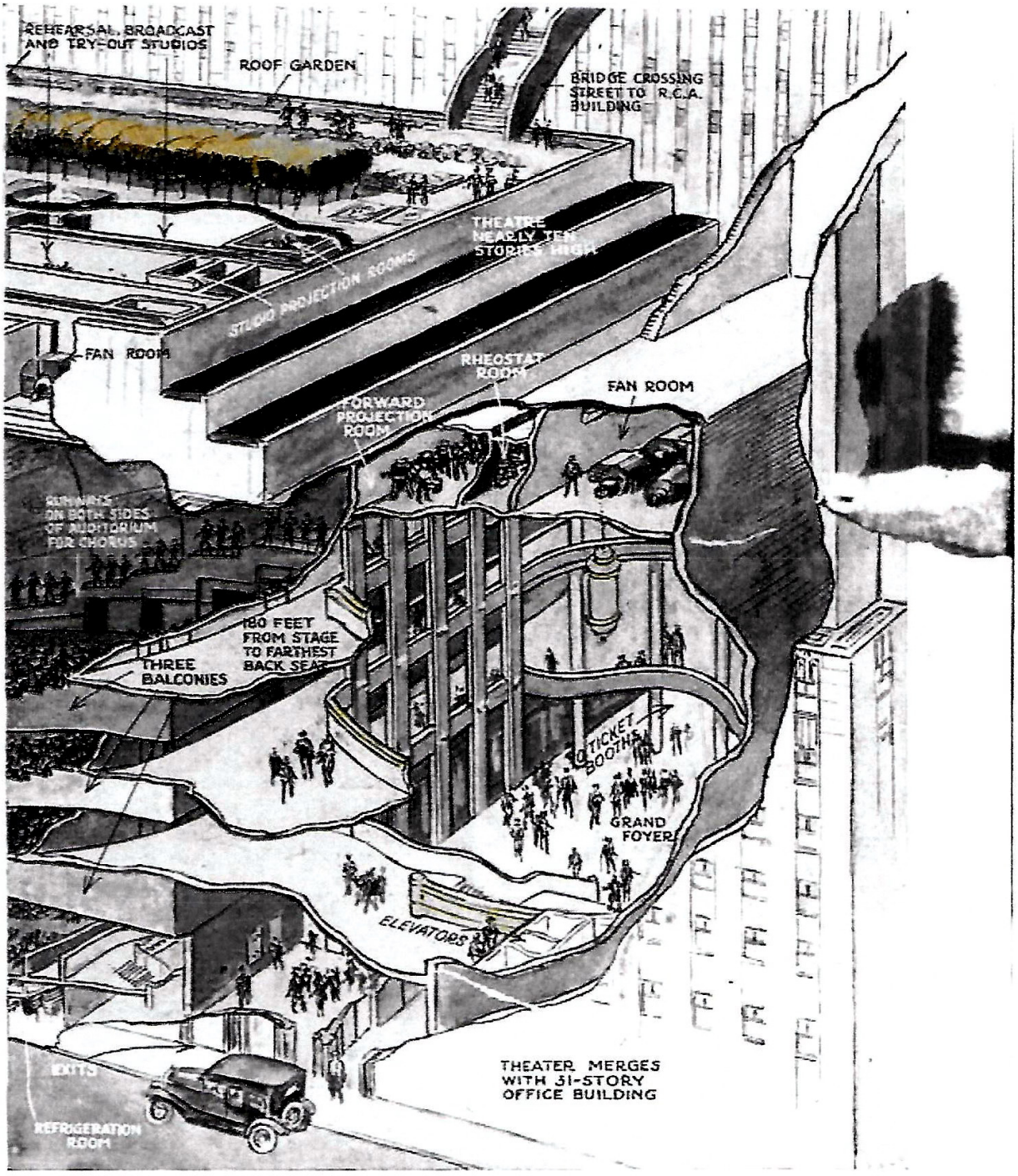
World's Largest Theater in Rockefeller



Sectional Drawing of International Music Hall under Construction at Rockefeller Center in New York; It is Nearly Ten Stories High and Will Seat Over 6,100 P ns

MUSIC HALL ENGINEERING SERVICES
Air Conditioning

Center Will Seat Six Thousand Persons

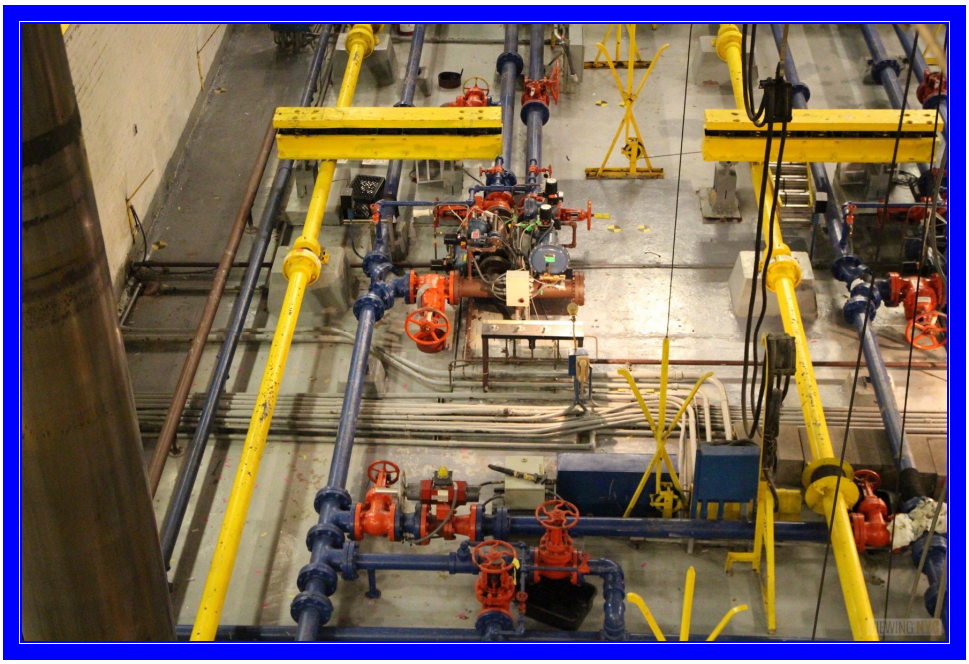


Note Revolving Central Stage and "Band Wagon" on Which Orchestra Can Be Moved from Position in Front to Place on Stage; the Stages" Triplicate, Can Be Elevated Thirty-Two Feet

MUSIC HALL ENGINEERING SERVICES
Elevators

Cut-Away Drawing of the Stage Elevators lifting performers

MUSIC HALL ENGINEERING SERVICES
Elevators



The music hall opened December 27, 1932, to acclaim as the "greatest achievement of the theatrical world" (New York Times). Popular Mechanics, April 1950, described it as a "hall of a thousand illusions." As it did then, the stage (100 feet wide) consists of four moveable platforms (two pistons each), one of which carries the orchestra's bandwagon. The orchestra bandwagon is a self-propelled car, accommodating a 35-piece orchestra and its accouterments including two grand pianos. It typically travels some 200 feet a show, horizontally or vertically along an elevator shaft that allows it to shuttle back and forth from the sub-basement level or to the rear of the stage. "Jumping on the bandwagon" has never been so apropos.

Pit beneath the orchestra lift at Radio City Music Hall.

The other three platform stages (each 70 feet wide and 12-16 feet deep) move, using the hydraulic system, independently or together from a point 27 feet below to 13 feet above the stage level, at a rate of 1 foot a second. When the three platform stages are at the same elevation, they can combine into a 43-foot diameter turntable that rotates (on rollers driven by a motor) in either direction. The staging then can be programmed to coordinate with the performances.

Originally, the eight-piston hydraulic system used synchronizing gears to automatically equalize the plungers. Special water (treated against bacteria) was pumped through pipes at 400 pounds pressure per square inch. The system used a 20,000-gallon pressure tank, built to raise or lower 190 tons of stage and could hoist an additional 96,000 pounds. The elevators were equipped with automatic pre-set stops or manually operated push-button stations, set from a bronze control panel.

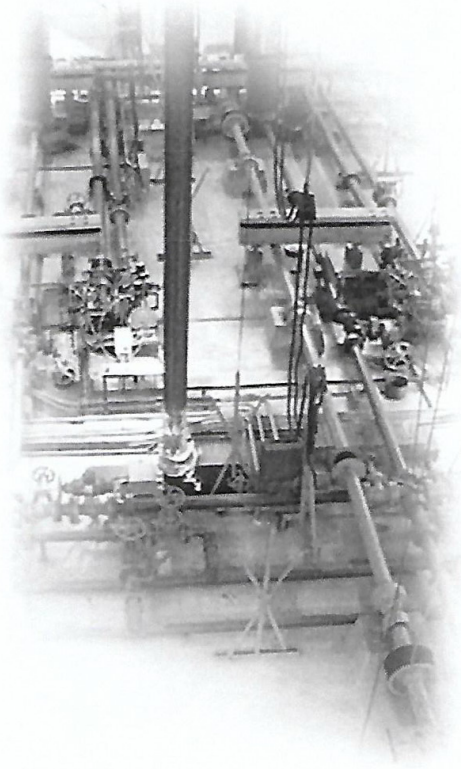
An eight-month renovation of the entire hall was completed in the fall of 1999, which included an overhaul of the hydraulic system and its controls. Today, the staging is choreographed from a computer, which was designed and installed by J.R. Clancy of Syracuse, N.Y. The original control panel has been updated, however, and is operational.

MUSIC HALL ENGINEERING SERVICES
Elevators

#217 Radio City Music Hall Hydraulically Actuated Stage

1932

One of the largest movable stages in the world with innovative hydraulic equipment and controls, a forerunner of other stage designs as well as early aircraft carrier elevator systems



Pit beneath the orchestra lift at Radio City Music Hall.

The precision "choreographed" staging of Radio City Music Hall offers size and versatility, unlike any other. Built in 1932 by Peter Clark, its innovative elevator system is a forerunner of other stage designs (including the Metropolitan Opera House) as well as aircraft carrier systems built in World War II. These elevators can handle people, animals, props and scenery at variable speeds, delivering them to the stage or above and also dropping out of sight in front to reappear again in the back, just as effectively.

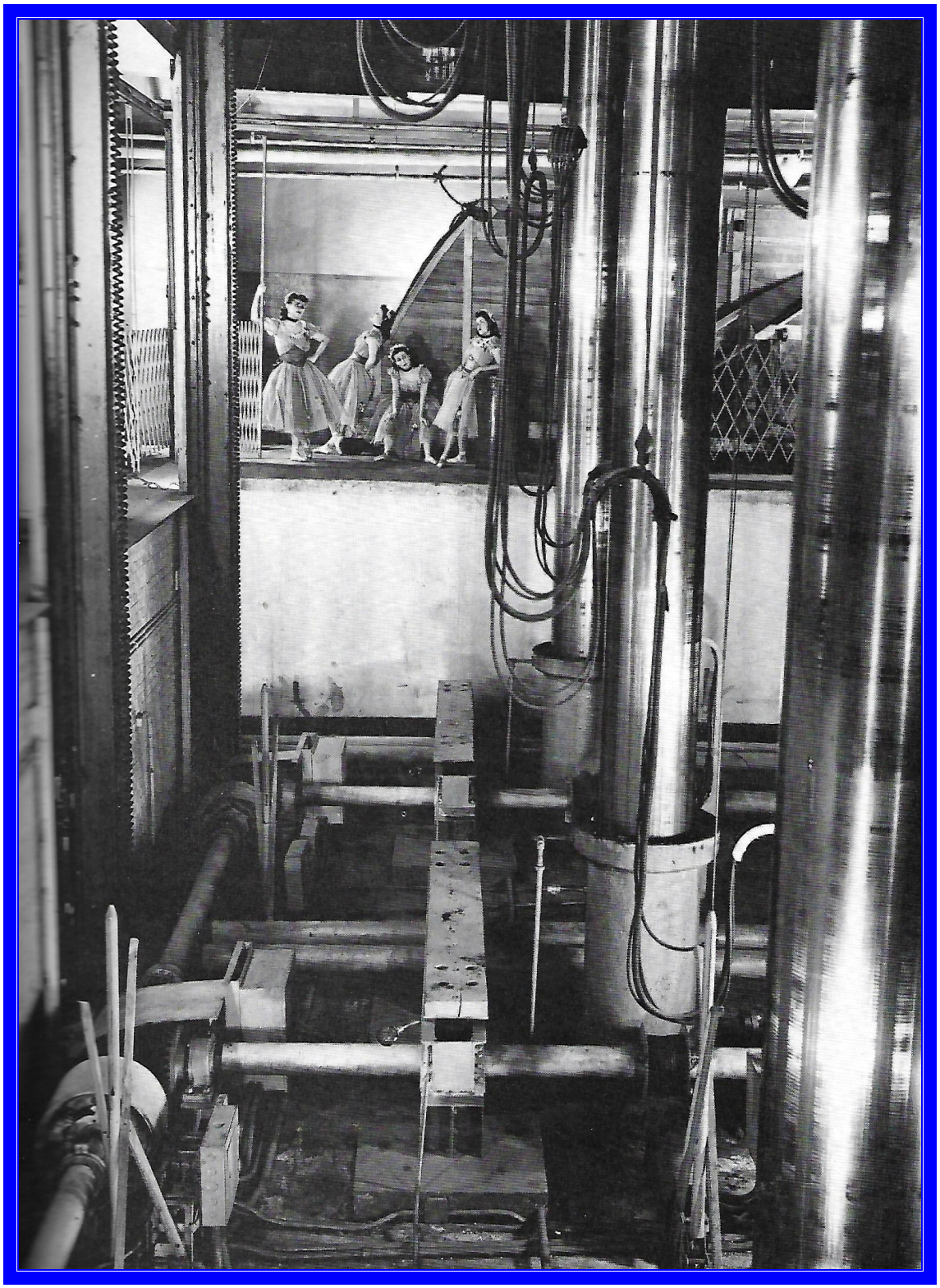
(ASME)

MUSIC HALL ENGINEERING SERVICES
Elevators

Samuel L Rothafel "Roxy" (centre) with J D Rockefeller at the Yonkers Factor of Otis to review progress with the manufacture of the giant hydraulic stage lifting elevators for the Music Hall.

Roxy was the operator of the 5920 seat New York Roxy Theatre which opened in 1927 and was consulted in the early stages over the Music Hall design

MUSIC HALL ENGINEERING SERVICES
Elevators



"Radio City ballerinas, on the second level, look down at the giant elevator pistons, which have raised their platforms to stage level high above them."
(The Radio City Music Hall)

MUSIC HALL ENGINEERING SERVICES
Elevators

One of the stage elevator giant hydraulic pistons

MUSIC HALL ENGINEERING SERVICES
Elevators

The original stage elevators control board

MUSIC HALL ENGINEERING SERVICES
Stage Drape (Curtain) Controls

Original control panel for stage curtains

15 — RADIO CITY MUSIC HALL, NEW YORK CITY

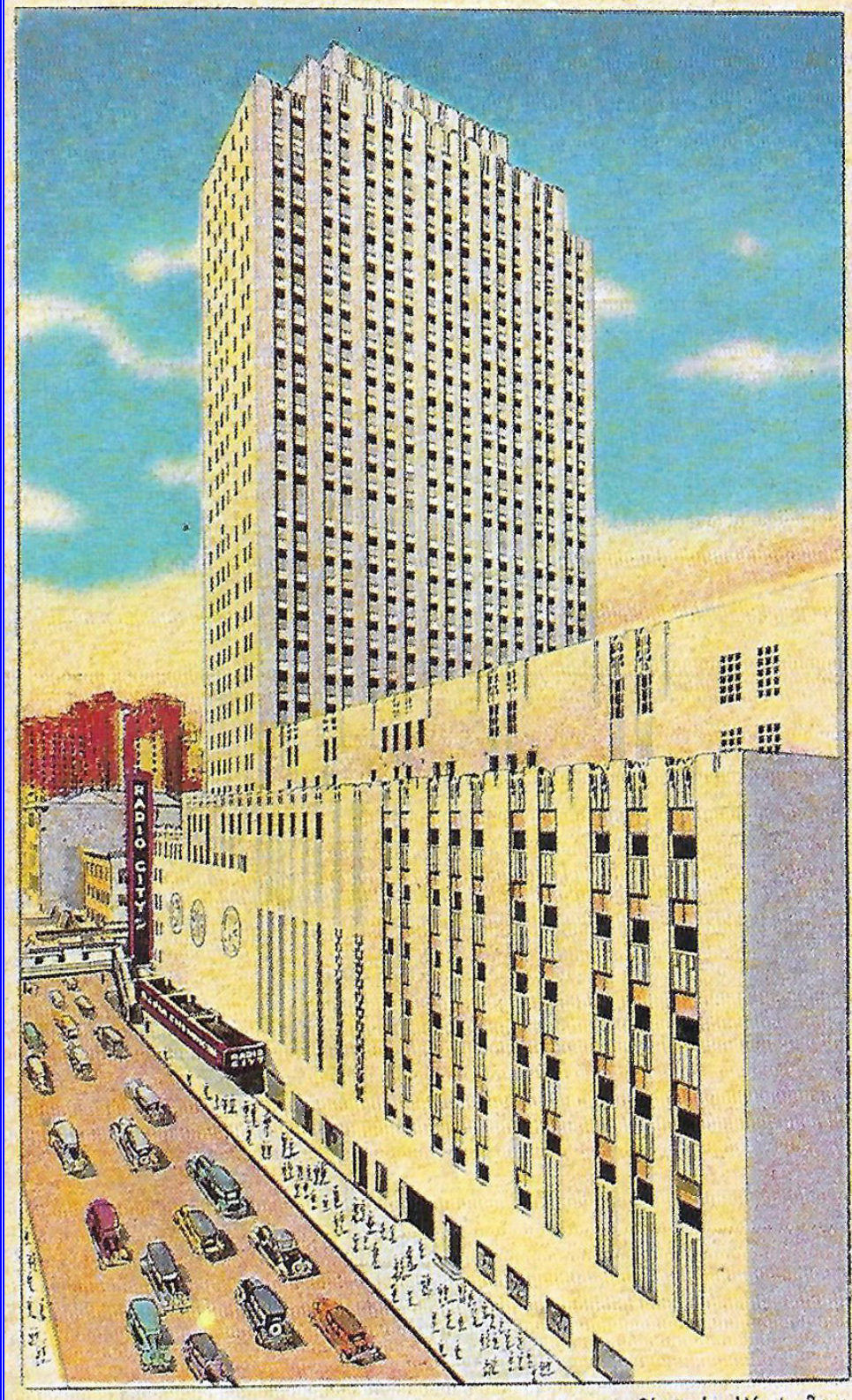


Photo by Wurtz Bros.

REFERENCES & SELECT BIBLIOGRAPHY

1. Works in Progress, Alvin Rosenbaum, Pomegranate Artbooks, San Francisco, 1994.

2. World's Largest Theatre in Rockefeller, Popular Mechanics, c.1932, pp.252 & 253.

3. Rockefeller Centre: Air Conditioning the Music Hall, Heating and Ventilating, Vol.29, pp.47-52, 1932.

4. Radio City Music Hall Hydraulically Actuated Stage, ASME Engineering History, 1932.

5. Iconic New York City Property Kept Cool With Help of Energy-Storage Technology, HPAC Engineering, September 2012.

6. The Radio City Music Hall, Charles Francisco, E P Dutton, New York, 1979.

7. American Movie Theatres, Radio City Music Hall, Brian Roberts, www.heritage-heritage.org

8. Three Million Pounds of Ice for Rockefeller Centre, Carrier Advertisement, c.1932

9. Movie Palaces: Survivors of an Elegant Era, Ave Pildas with text by Lucinda Smith, Clarkson N Potter, Philadelphia.

10. Ticket to Paradise: American Movie Theatres And How We Had Fun, John Margolies & Emily Gwathmey, Bullfinch Press, Boston.

11. The Best Remaining Seats: The Golden Age of the Movie Palace, Ben M Hall, A Da Capo Paperback. New York, 1957 (Describes in detail with photographs The Roxy Theatre in New York which opened in 1927 and with 5920 seats makes an interesting comparison with the 1932 Radio City Music Hall with 6015 seats).

12. Hall of a Thousand Illusions (Radio City Music Hall), Richard F Dempewolf, Popular Mechanics, April 1950.

13. When Movies Were Theatre, William Paul, Columbia University Press, New York, 2016.

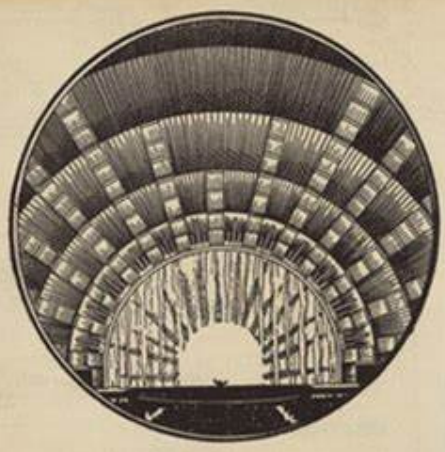
14. Carrier Air Conditioning at Rockefeller Centre, Noel P Hunt, Everyones, Australia, 15 Feb 1933.

15. Secrets of the Magic Theatre, Popular Mechanics, January 1941, pp.27-31 & 145A.

Lunch on top a skyscraper (Bettmann Collection/Corbis)

For many years, this well-known photograph was thought to be of steel workers on the Empire State Building. However, more recently, it is now said to have been taken on 20 September 1932 at the top of the RCA Building (later the GE Building) under construction in Rockefeller Centre.


R C A BUILDING, ROCKEFELLER CENTER, AT NIGHT, NEW YORK CITY 67
PHOTO WENDELL MC RAE



RADIO - KEITH - ORPHEUM

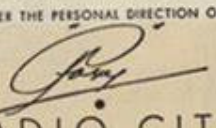
PROUDLY PRESENTS

THE INAUGURAL PROGRAM

OF THE

RADIO CITY MUSIC HALL

UNDER THE PERSONAL DIRECTION OF



RADIO CITY

IN ROCKEFELLER CENTER

RADIO CITY MUSIC HALL

FIFTIETH STREET AND SIXTH AVE. NEW YORK

TWO PERFORMANCES DAILY...5:15...8:15 P. M.

BEGINNING DECEMBER 27, 1932