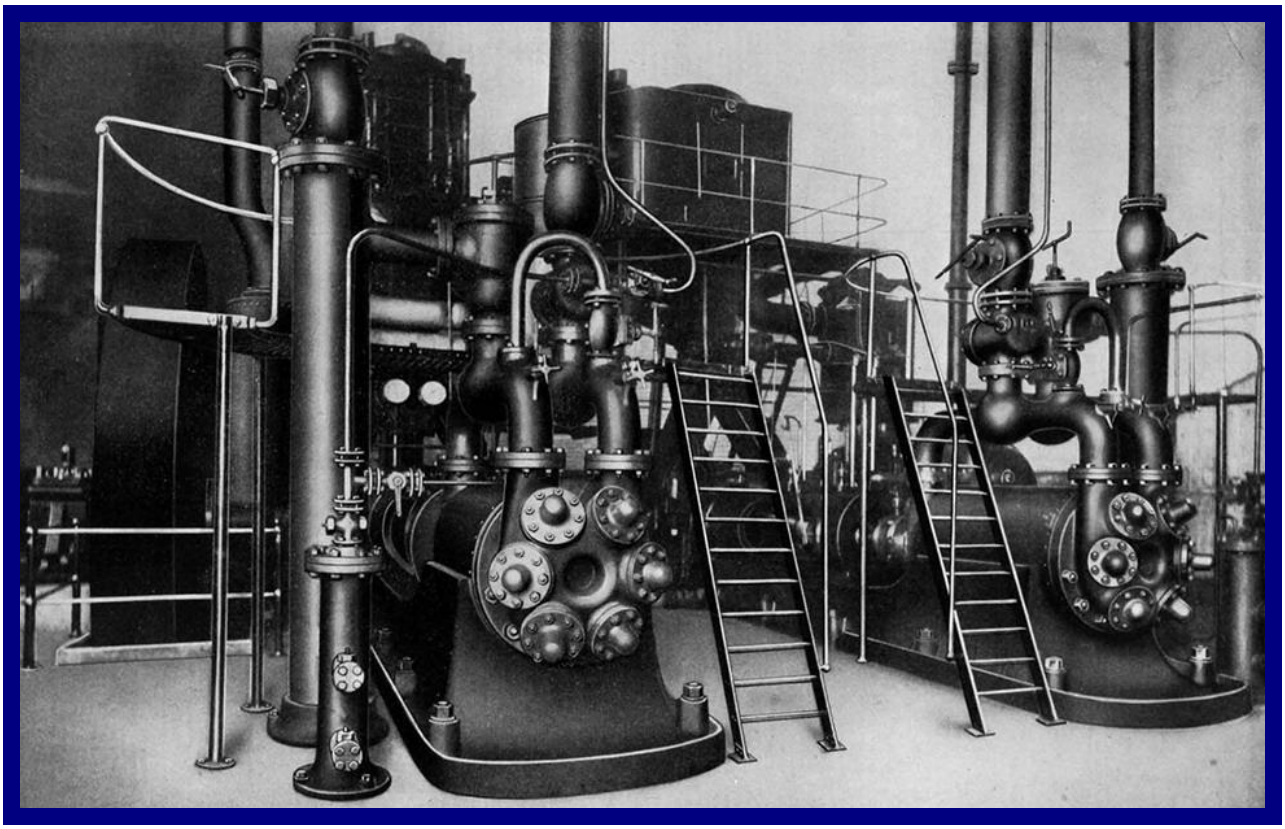


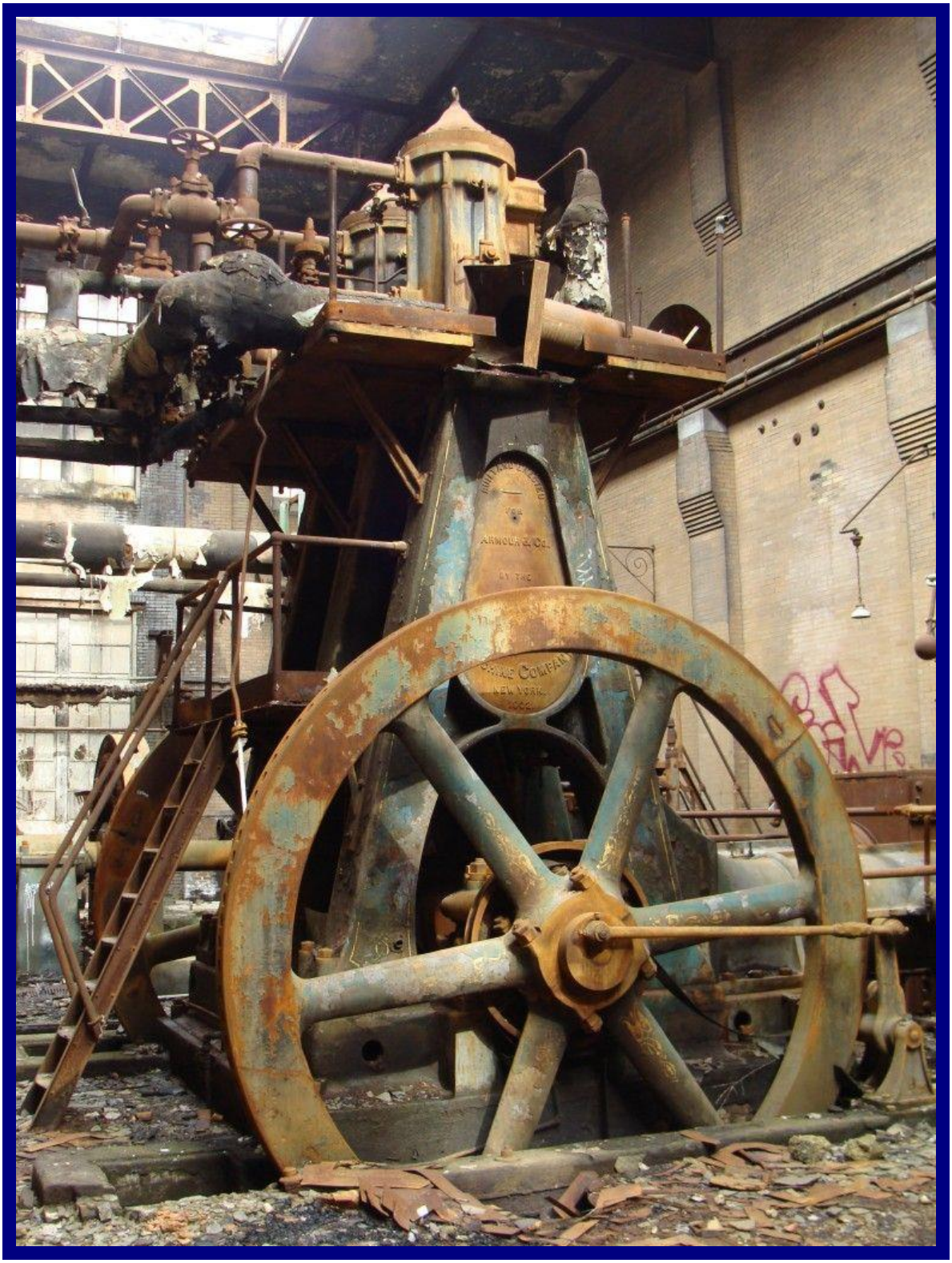
Linde Steam-Driven Refrigeration, Grimsby Ice Factory 1903

REFRIGERATION PART TWO

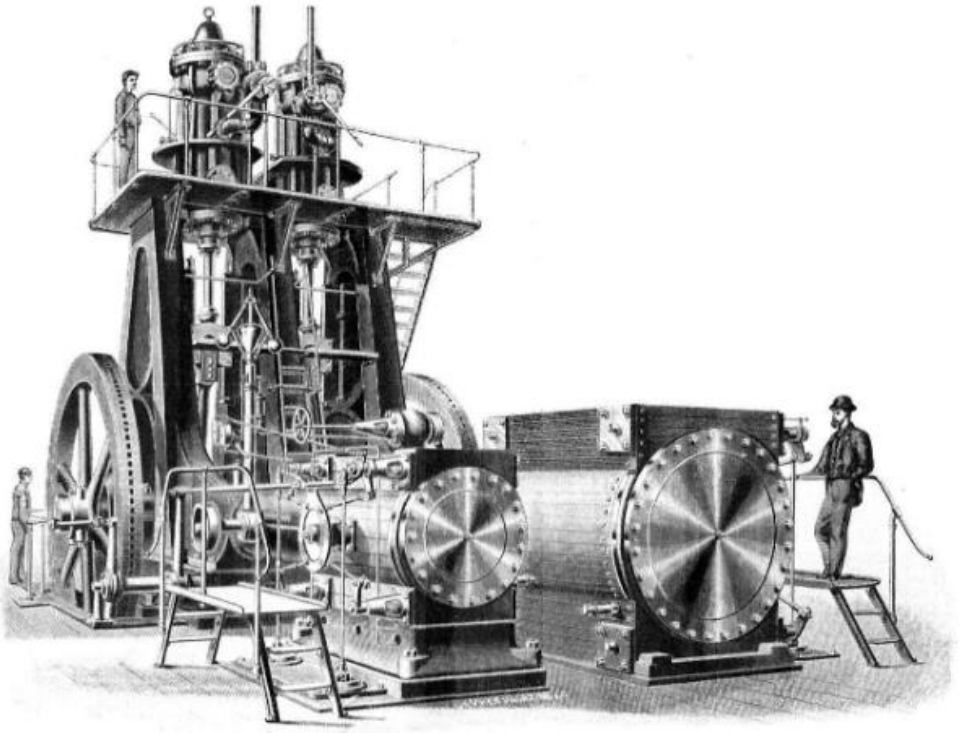
EARLY MASSIVE MACHINES

BRIAN ROBERTS

FRICK REFRIGERATION 350 TR
WITH DE LA VERGNE STEAM ENGINE
ARMOUR MEAT PACKING PLANT
ST LOUIS, MO. 1903



CONTENTS



Cross-Compound 500-Ton Refrigerating Machine.

Information and illustrations are taken from the Heritage Group Archives.
BMR, Budleigh Salterton 2021.

OUTLINE HISTORY

REFRIGERATION COMPANY MANUFACTURERS

MASSIVE REFRIGERATION MACHINES

OUTLINE HISTORY ICE HARVESTING

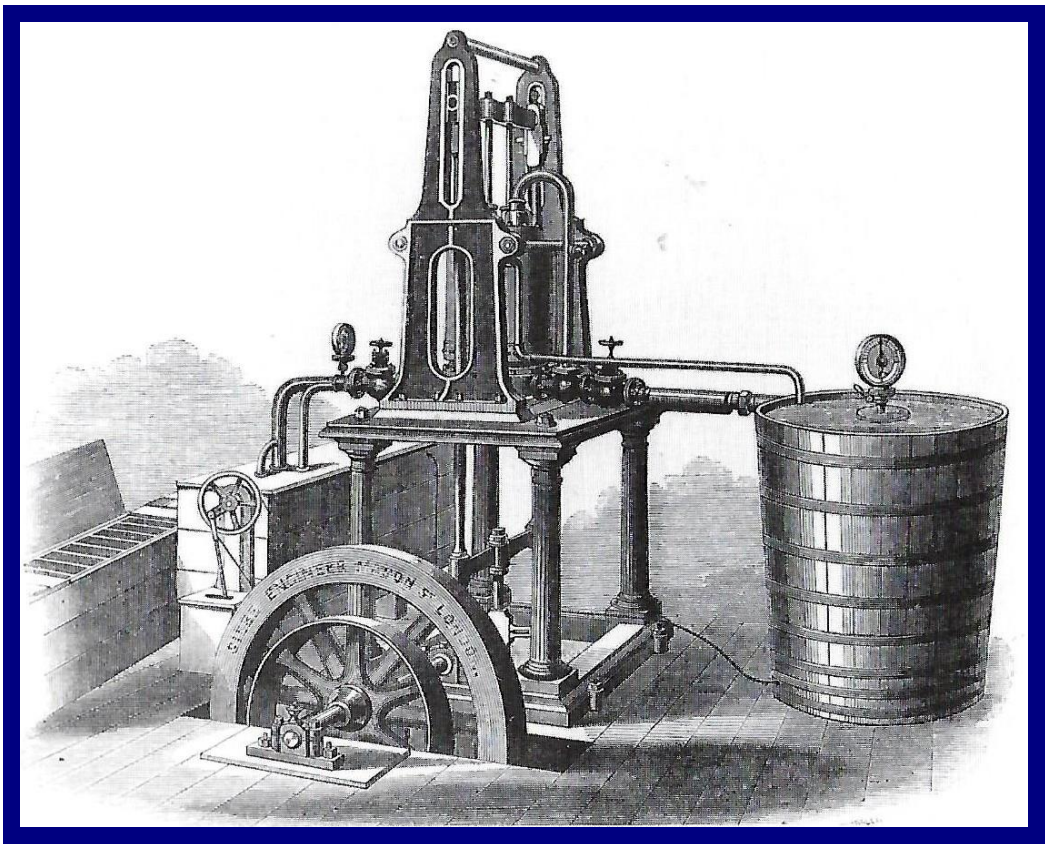
Harvesting ice in Holland 1770

Before the 19th century, ice harvesting and storage was a local or individual occupation. The ice was cut in winter from nearby frozen ponds, lakes and rivers and kept in deep pits or insulated sheds (to minimise thawing) to be used in summer.

As demand increased, local harvesting became inadequate and an international ice trade began, with large quantities of ice being exported from Norway and the United States. Most of the ice used in England and Europe came from Norway. The largest user in England was the fishing industry. In America, much of the ice harvested in the coldest Northern States was shipped to the warm Southern States and even to the Caribbean, South America and as far away as Asia.

As the 19th century wore on, there were improvements in ice-harvesting and storage technology and, by the 1890s, mechanical refrigeration was increasingly cost-effective as a means of producing ice. Large refrigeration machines were now being designed and built for ice-making, cold stores and particularly to cater for a huge demand from the brewing industry. German lager, which was popular with the many German immigrants in the USA, requires cool temperatures for fermentation (unlike British beer production) and this could be met efficiently by mechanical refrigeration. In 1895, the De La Vergne Refrigerating Machine Company listed 583 of their installations of which 369 were breweries.

OUTLINE HISTORY PIONEERS



The Harrison-Siebe Ice-Making Machine

Oliver Evans (1755-1819), is often regarded as the first to describe the closed vapour-compression refrigeration cycle. He did this in 1805, but he never followed up on his idea. However, his friend Jacob Perkins (1766-1844) who moved to Britain and patented a number of widely different inventions including steam engines and boilers, did follow up the ideas of Evans. In 1834. Perkins applied for and received British Patent 6662 for a system similar to that proposed by Evans. This patent was the basis upon which a small machine was constructed by his assistant John Hague and successfully produced a small quantity of ice.

The American civil engineer and professor, Alexander Catlin Twining (1801-1884), advanced the earlier work of Evans, Perkins and Hague and his machine was built in Cleveland, Ohio in 1855 and successfully produced ice for a few years. However, further development proved impossible during the American Civil War and his system never saw commercial manufacture.

Meanwhile, James Harrison (1816-1893) who had emigrated to Australia in 1837, began his experiments in vapour-compression refrigeration about 1854, receiving a patent from the then Colony of Victoria in 1855. Recognising the limitations of available technology he went to England where he worked with Daniel Siebe of the steam engineering firm Siebe & Company. The result was a new design, suitable for production, and covered by British Patent 2362 of 1857. The same year, the first machine was sold to the a London Brewery. In 1858, Harrison returned to Australia. More machines were built by Siebe in London and by P.N. Russell & Company in Sydney.

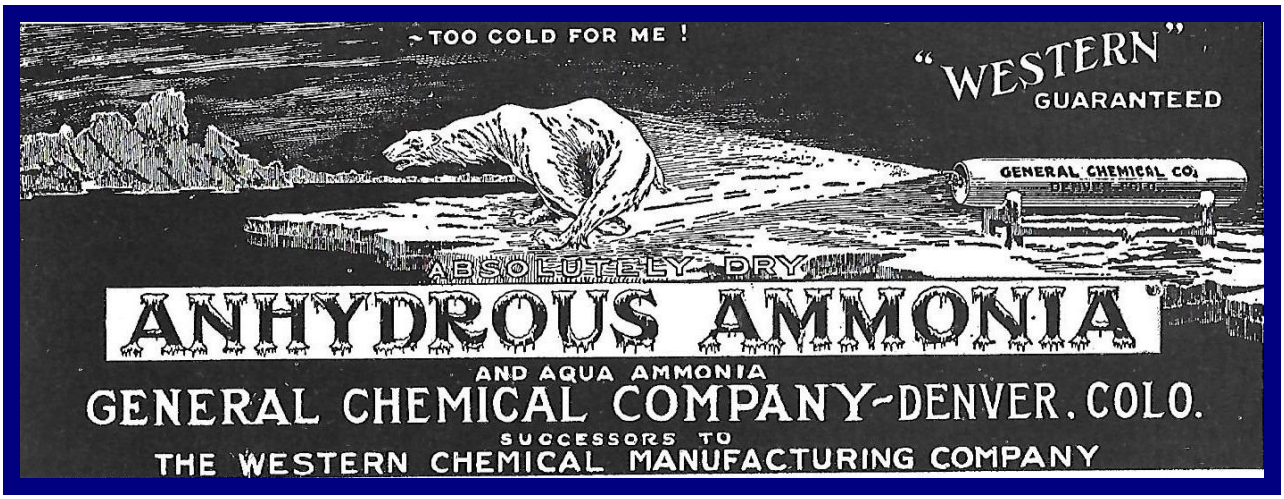
OUTLINE HISTORY PIONEERS

Professor Carle Linde (1842-1934)

Even in 1870, the mechanical refrigeration machines in use were of poor design and construction and it has been suggested were lucky to achieve even 20% efficiency. In Germany, Carl Linde in his 1870 paper looked at the first rigorous thermodynamic approach to refrigeration design by scientific theory. In 1873, he gave a paper at a Vienna Brewers' Convention, believing the brewing industry was greatly in need of mechanical refrigeration. This attracted financial backing. His first machine, using methyl chloride as the refrigerant, was completed in 1874 and tests proved its efficiency was double that of other existing equipment. Linde was not satisfied and by 1877 had designed and constructed an improved machine using ammonia as the refrigerant. In 1881, the Chicago engineer Fred W Wolf secured the rights to manufacture and sell Linde's machines in the USA. Linde's systems went on to achieve success in Britain and around the world.

Industry wanted machines with greater cooling output than that typically available. Some machines became massive in physical size, and weight. The increase in height required the addition of stairs, hand rails and platforms to enable operation and servicing. They required additional operating staff, but above all they needed larger driving machines to power the compressors. Before electric motors were available, this need was met by powerful steam engines (typically the Corliss engine) with huge flywheels, the largest some 30 feet in diameter. All this required steam boilers, fuel supplies and refrigeration condensing equipment (often water-cooled atmospheric coils, i.e. no fans). A number of pioneers took up the challenge and began the manufacture of refrigeration equipment. These included Daniel Livingston Holden, David Boyle, John and Louis De La Verne and Thomas Shipley for York.

OUTLINE HISTORY REFRIGERANTS



1918

A refrigerant is the working heat exchange fluid in a vapour compression refrigeration system. It provides low temperature cooling by abstracting unwanted heat from one source and rejecting it elsewhere at a higher temperature. In the 19th century it became the most used refrigeration system throughout the world.

During this period, many volatile fluids were tried as refrigerants. These included ether, methyl chloride and ethyl chloride while sulphur dioxide was used by Pictet in Europe. However, it was ammonia that was chosen by the majority of equipment manufacturers. These included Artic, De La Vergne, J & E Hall, Holden Brothers, Frick, Linde, Vilter, Wood-Bailie and York, though Hall used carbon dioxide for many years.

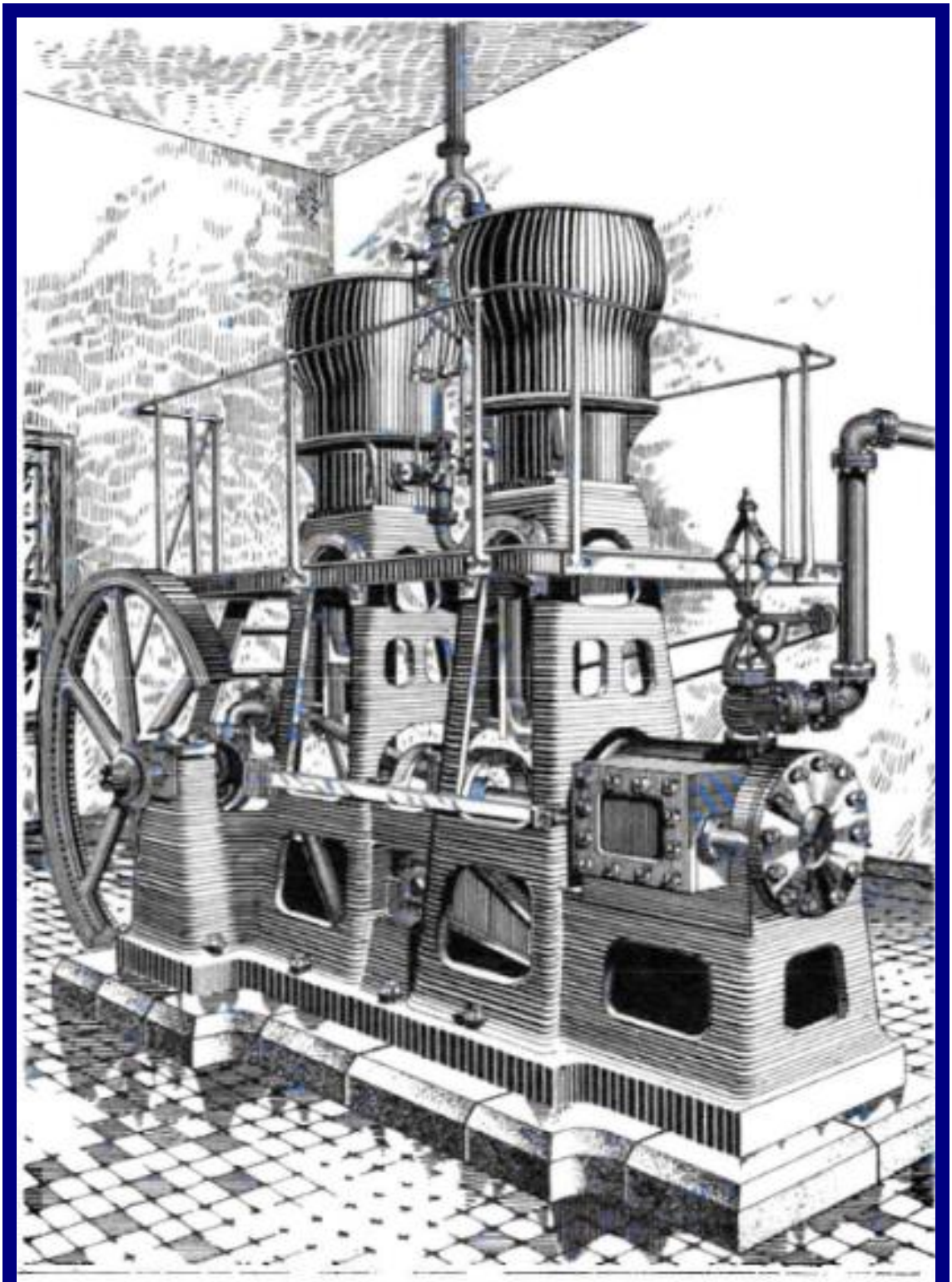
Ammonia was toxic and though suitable for ice-making, cold stores and brewing it was considered unsafe for comfort cooling of people in occupied spaces. This application had to await the development of carbon dioxide machines by Kroeschell and Wittenmeier in Chicago in 1917 and then by York. The introduction of the centrifugal water chiller by Carrier in the 1920s, using safe refrigerants, became widely used, particularly in movie theatres. Then the early 1930s saw the availability of the "Freon" family of refrigerants. Now, in the 21st century, ammonia is now coming back into use as refrigeration technology advances.

ACKNOWLEDGEMENT

The information in this brief Outline History is based largely on Chapters 6 & 8 of the book "Heat & Cold. Mastering the Great Indoors", Barry Donaldson and Bernard Nagengast, ASHRAE, Atlanta, 1994, and the Heritage Group Archives. Any mistakes are mine.

BMR, Budleigh Salterton 2021.

ANTARTIC REFRIGERATION



PERSPECTIVE VIEW—ANTARCTIC REFRIGERATING MACHINE—BEAM PATTERN—TEN TON.

THE ARTIC COMPANY, OHIO 1879

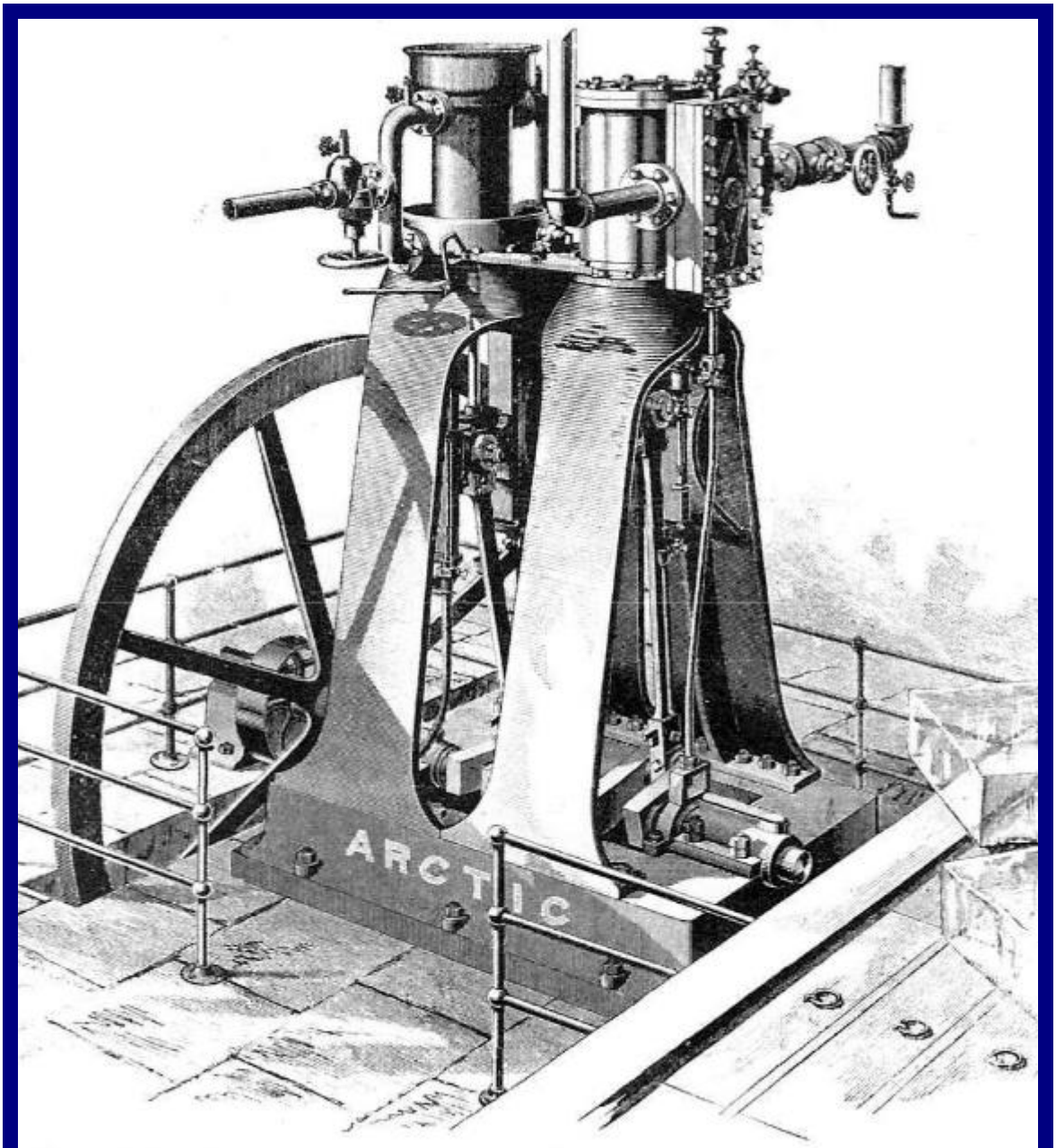


FIG. 192.—TYPE OF ARCTIC AMERICAN MACHINE BUILT IN 1879.

THE ARTIC COMPANY, OHIO

The Arctic Co.

Main Office and Works:

Canton, Ohio.

Manufacturers of

"Arctic" Ammonia and

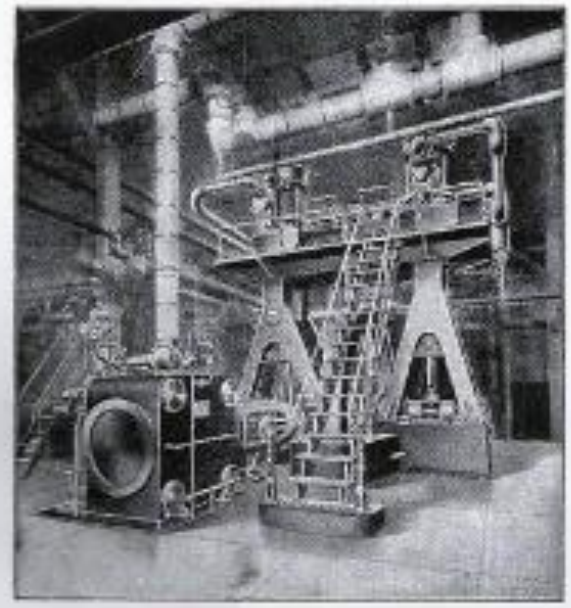
"Hall's" Patent Carbonic Anhydride (CO_2)

(Under Patents of J. & E. Hall, Ltd.)

Ice Making and Refrigerating Machines

...ALSO...

TANKS, BOILERS, BRINE COOLERS, CONDENSERS, both for Steam and Ammonia, STEAM PURIFIERS, PIPING



Ammonia Fittings and Valves

Unequalled Facilities for Getting Out Work

OUR RECORD

Arctic Machines in Continuous Service for 25 Years

Correspondence Solicited

BOYLE ICE MACHINE CO, CHICAGO

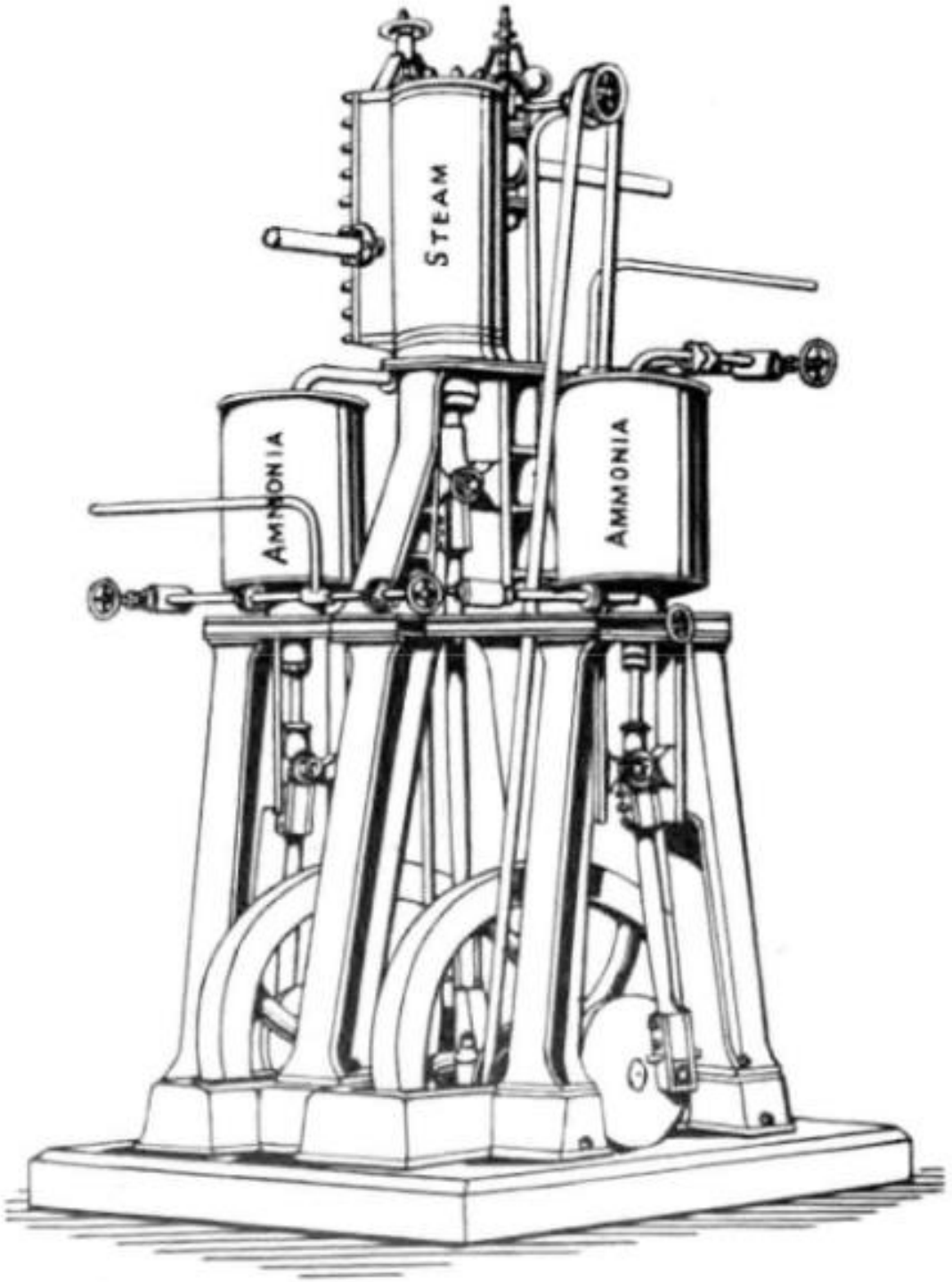


FIG. 87.—AMMONIA COMPRESSOR—ORIGINAL BOYLE PATTERN.

DE LA VERGNE, NEW YORK 1892

REFERENCE PAMPHLET.

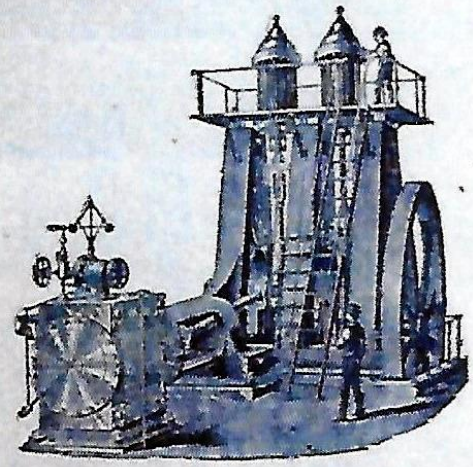
ICE-MANUFACTURE

—BY THE—

PROCESSES AND APPARATUS

—OF—

The De La Vergne Refrigerating Machine Co.



MANUFACTURERS OF

REFRIGERATING AND ICE MACHINES,

AND OF

ANHYDROUS AMMONIA.

OFFICE AND WORKS:

Foot of East 138th Street (Port Morris).

NEW YORK:

JOHN C. DE LA VERGNE, President;
LOUIS E. DE LA VERGNE, Vice-President;
CHAS. H. CONE, Secretary.

1892.

DE LA VERGNE, NEW YORK 1890

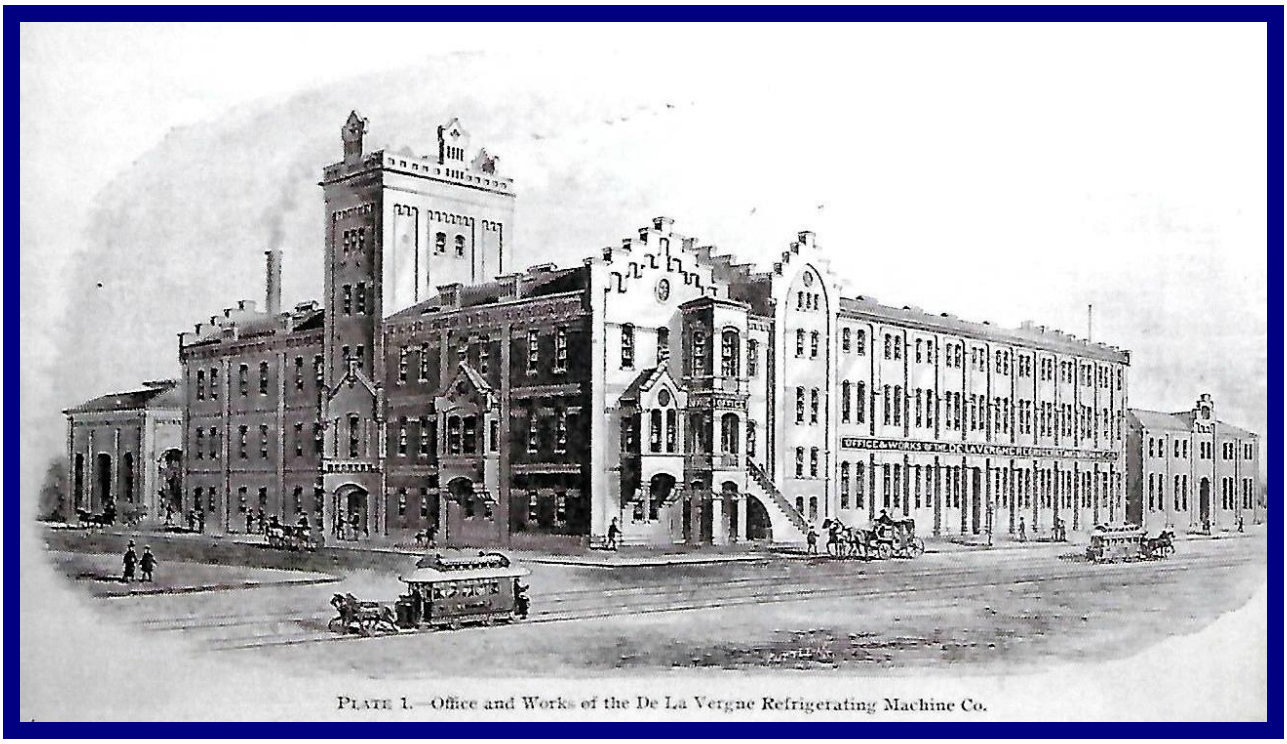


PLATE 1.—Office and Works of the De La Vergne Refrigerating Machine Co.

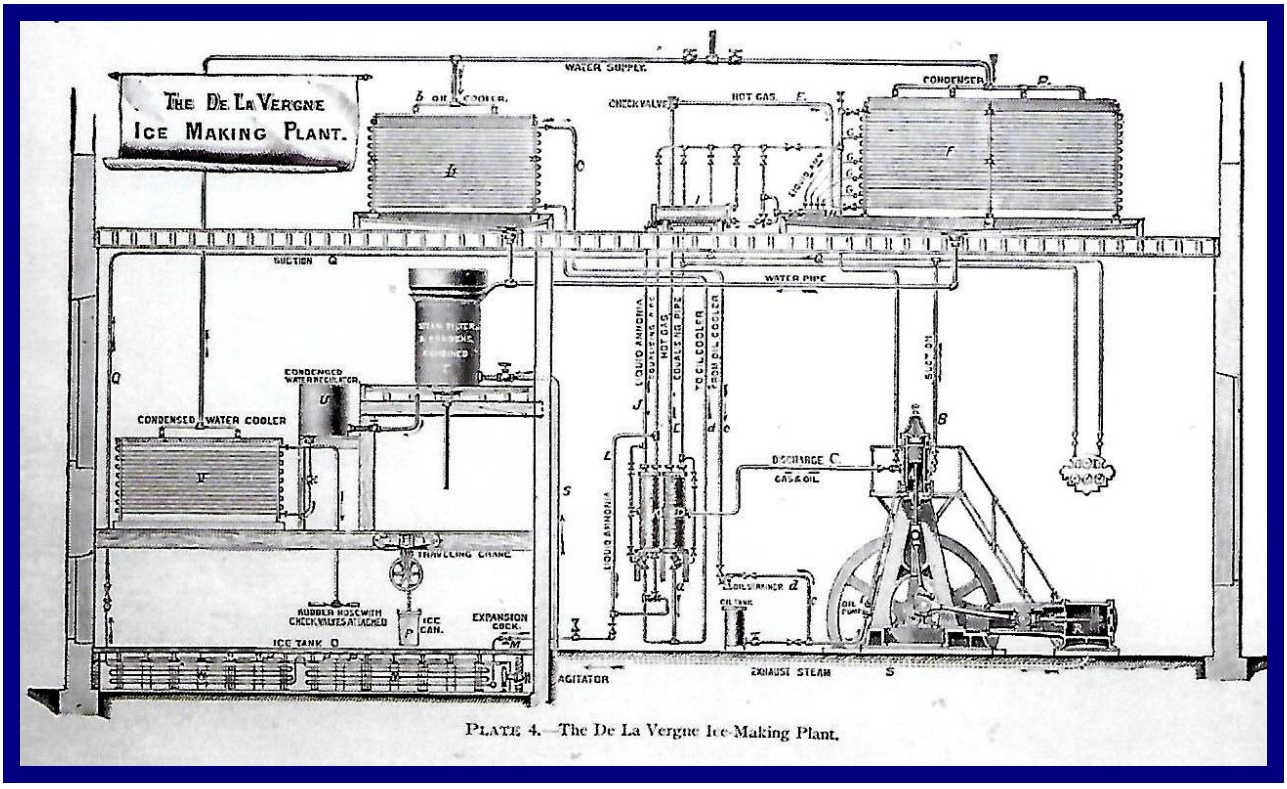
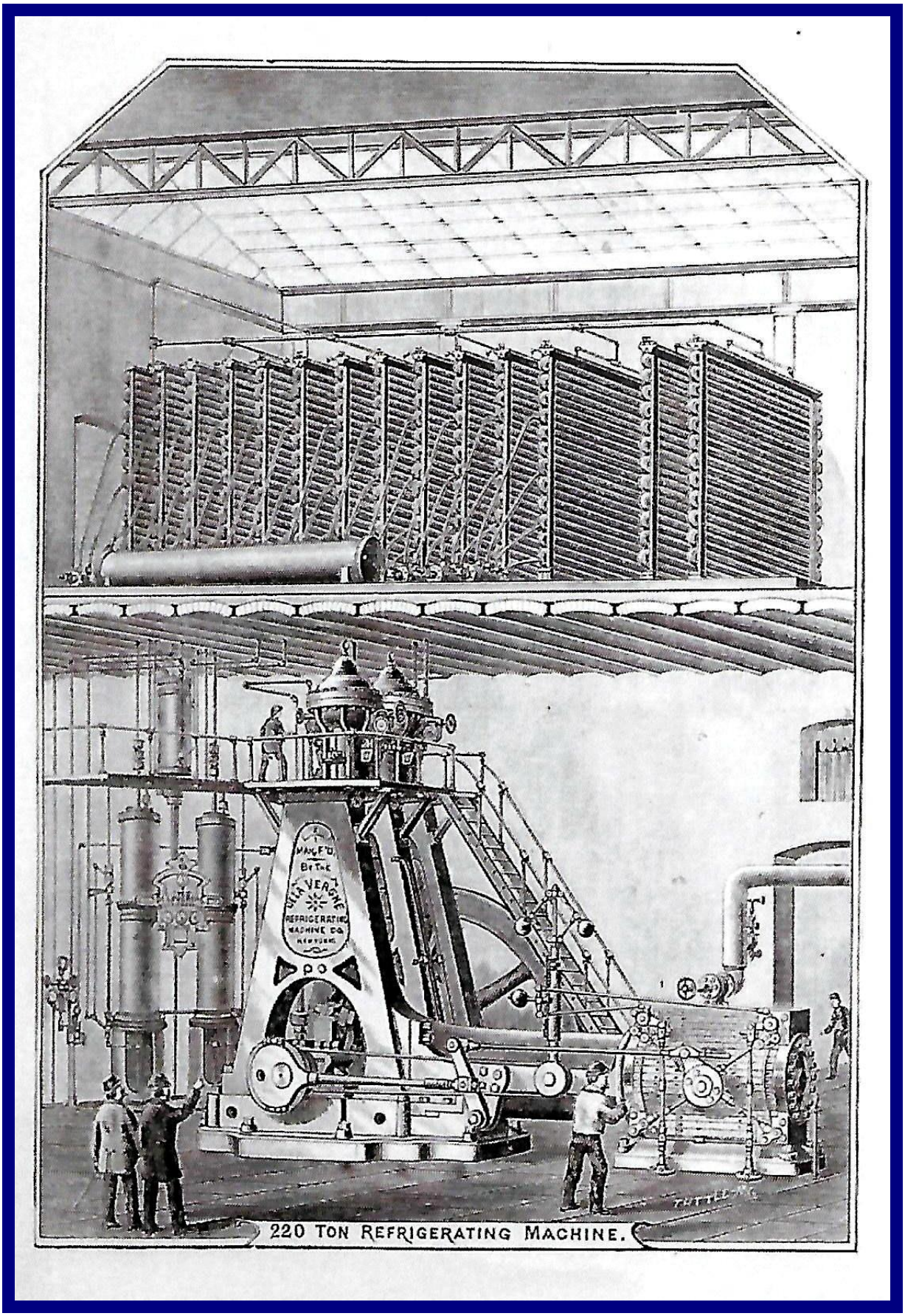


PLATE 4.—The De La Vergne Ice-Making Plant.

DE LA VERGNE, NEW YORK 1890



220 TON REFRIGERATING MACHINE.

DE LA VERGNE, NEW YORK 1892

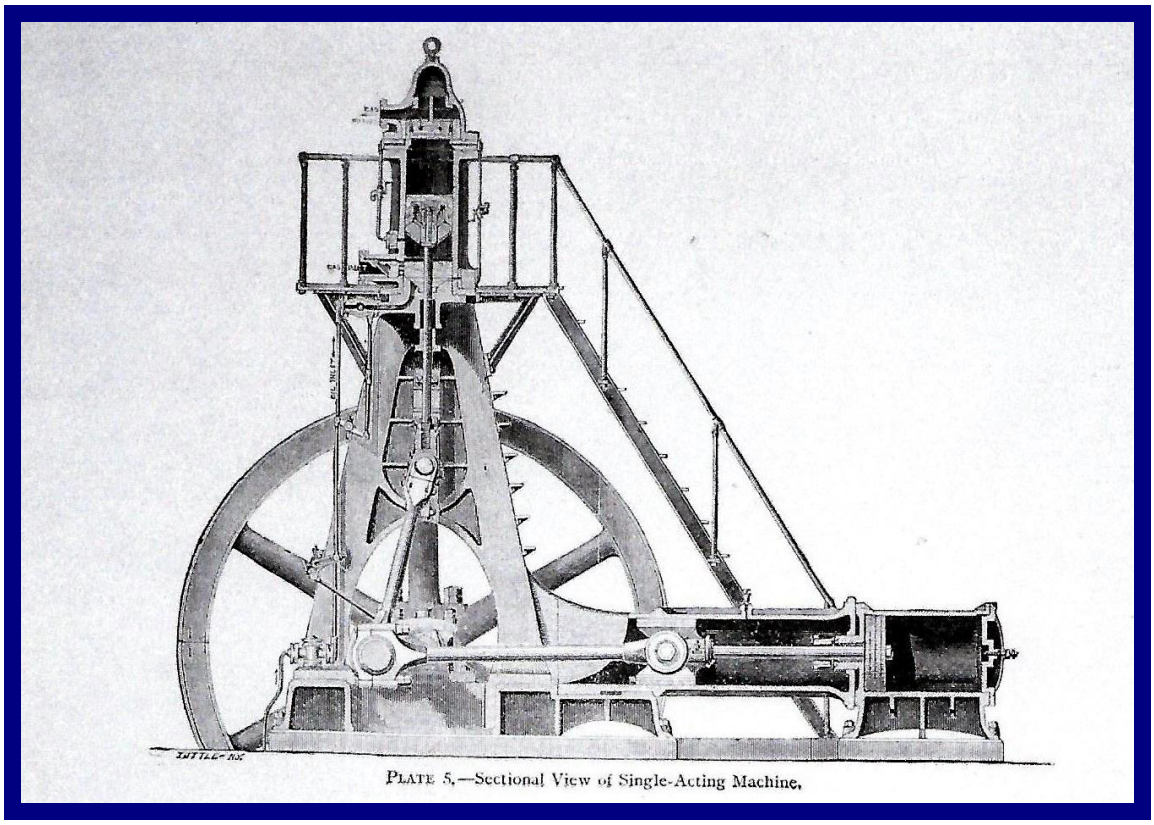


PLATE 5.—Sectional View of Single-Acting Machine.

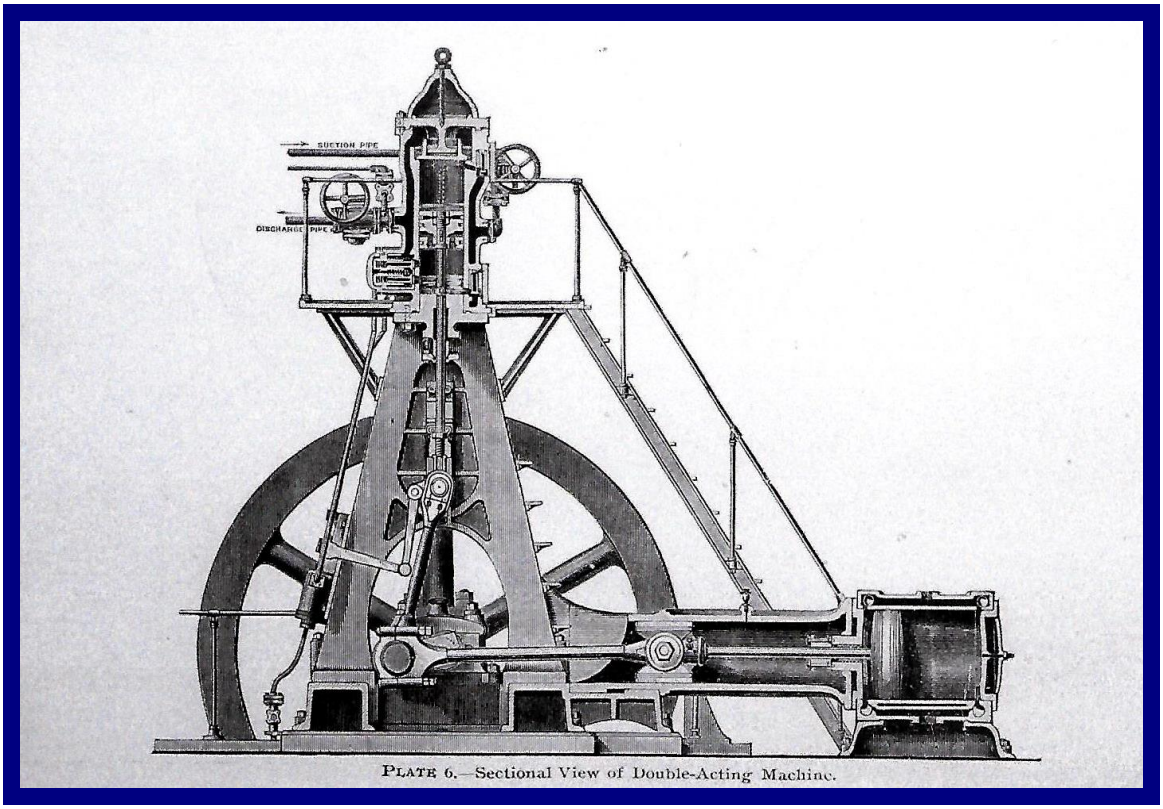


PLATE 6.—Sectional View of Double-Acting Machine.

DE LA VERGNE, NEW YORK 1892

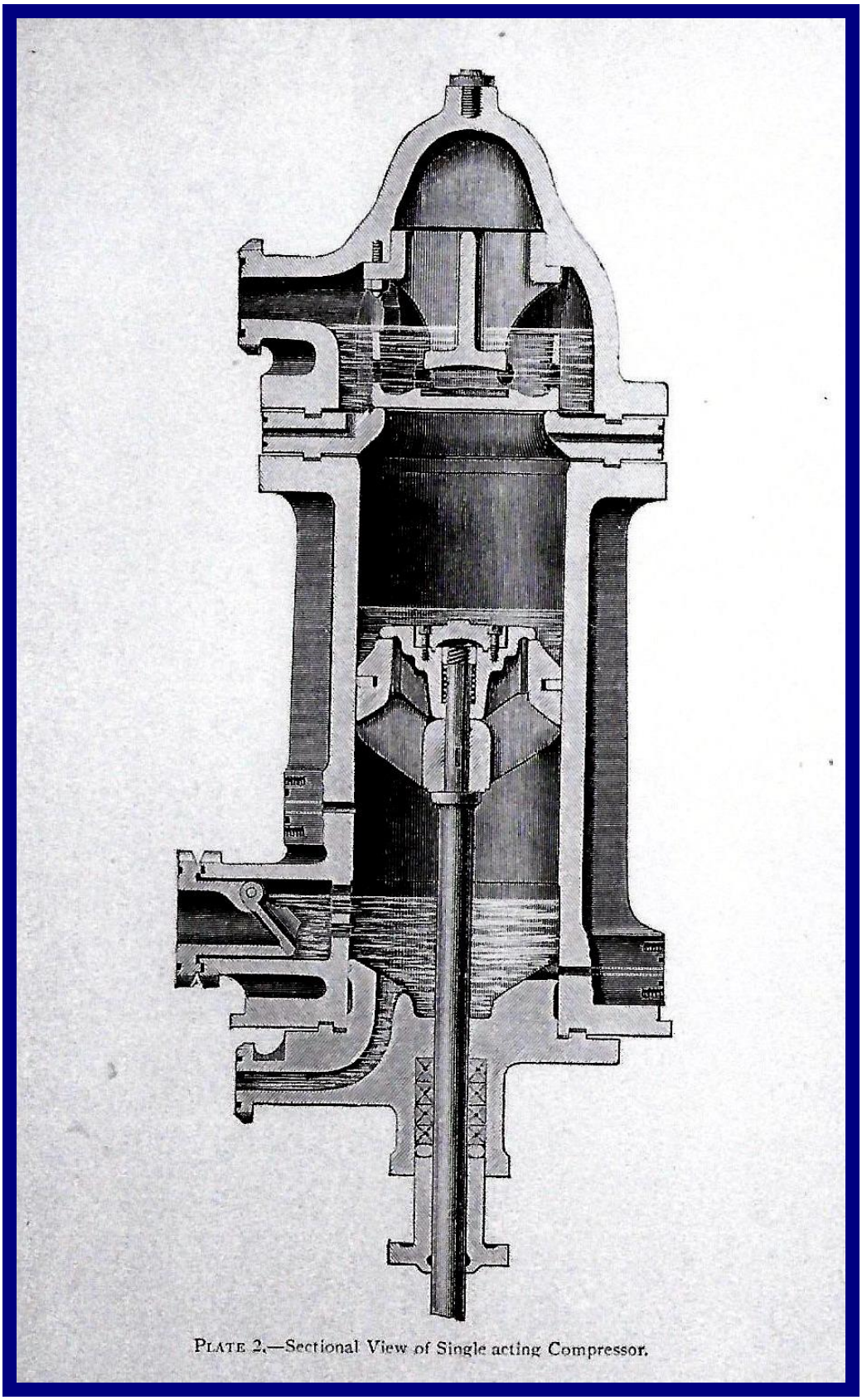


PLATE 2.—Sectional View of Single acting Compressor.

DE LA VERGNE, NEW YORK 1892

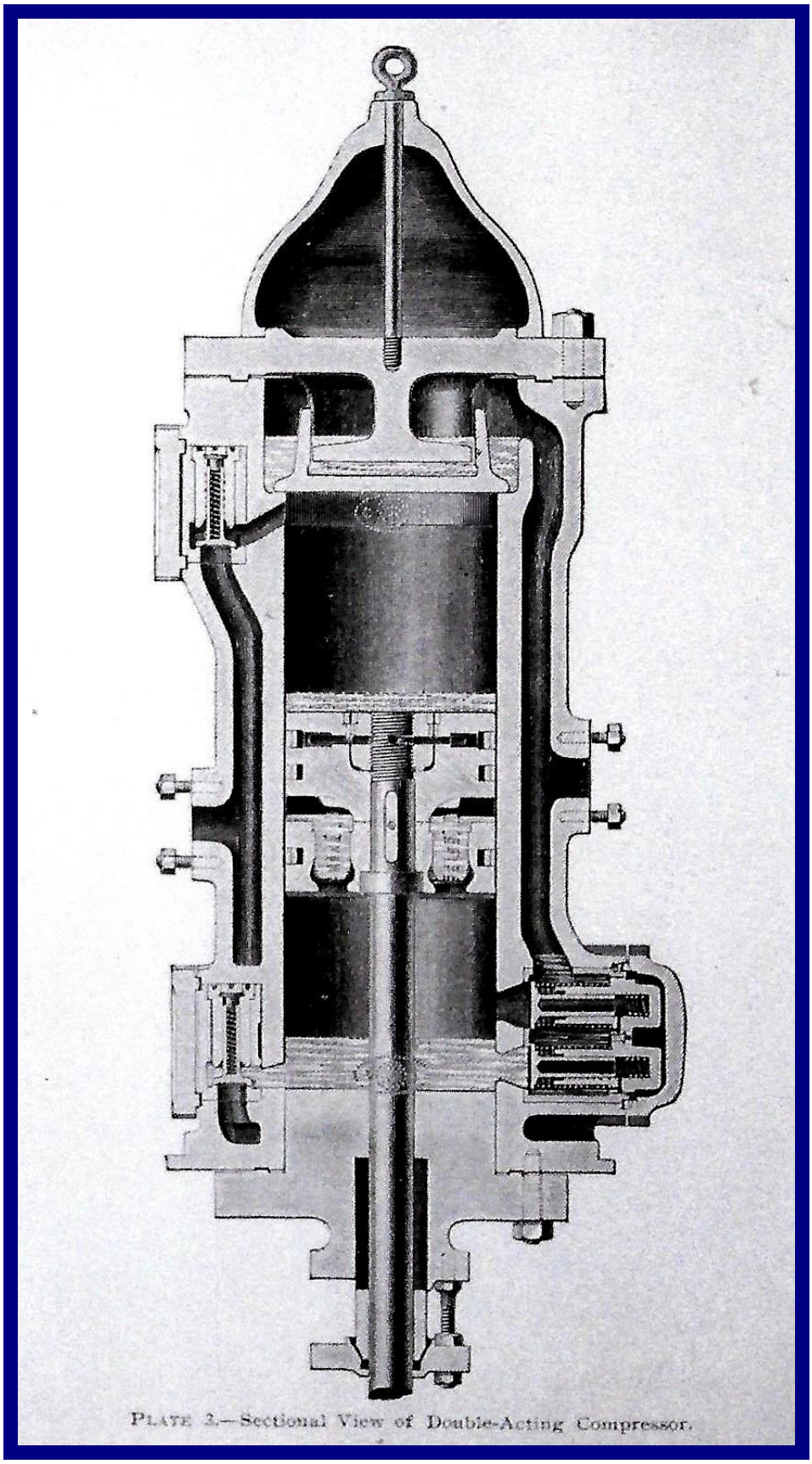
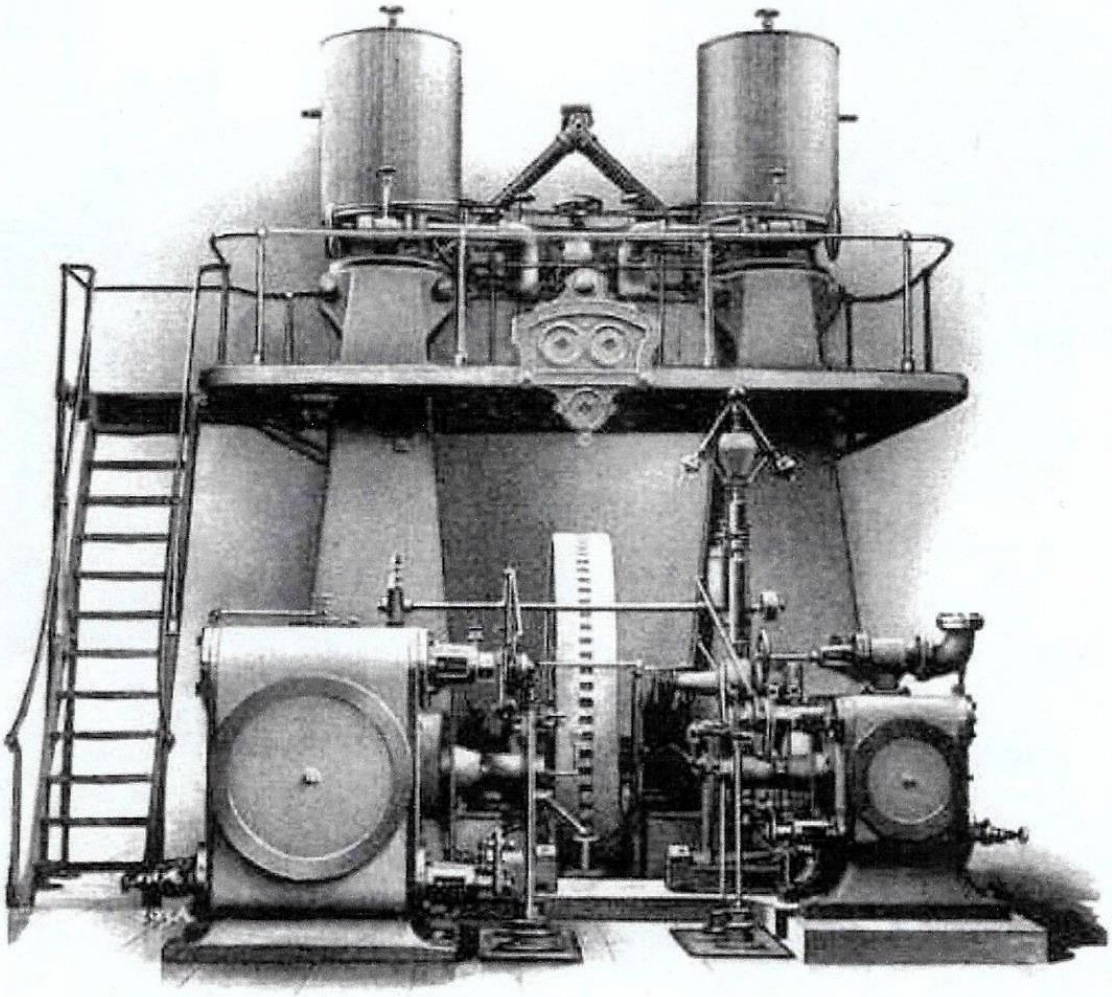


PLATE 3.—Sectional View of Double-Acting Compressor.

FRICK COMPANY, WAYNESBORO, 1905

THE WORLD'S STANDARD



FRICK COMPANY

WAYNESBORO, PA., U. S. A.

SOLE BUILDERS OF THE

ECLIPSE MACHINES

FOR ICE MAKING AND REFRIGERATING USE

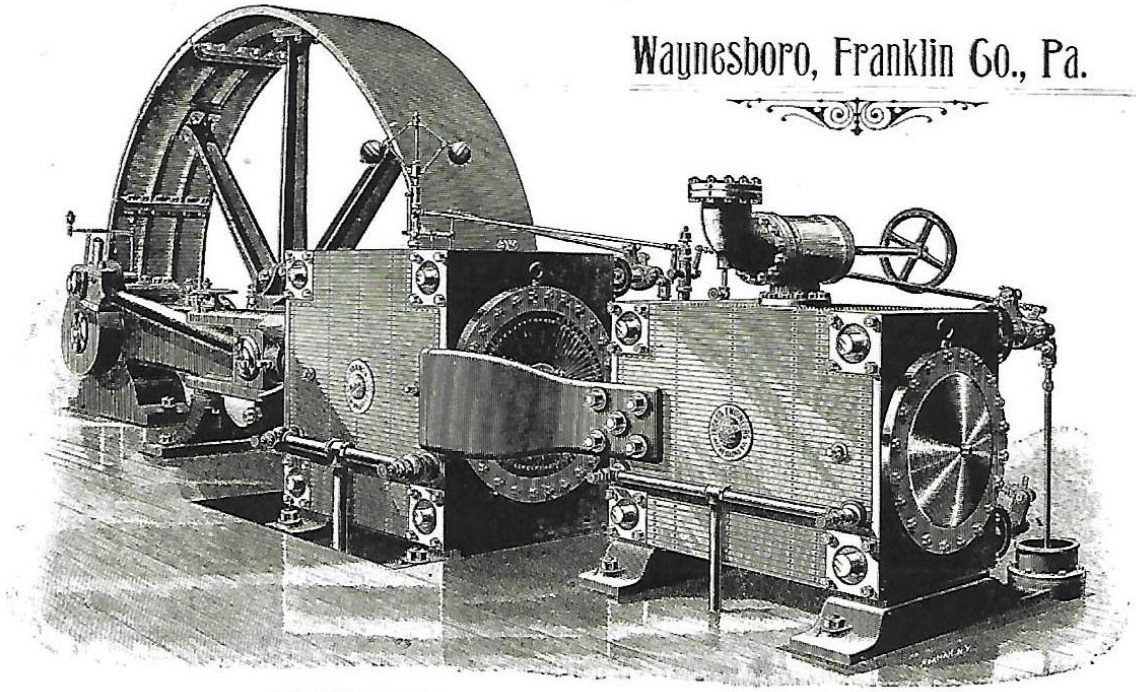
Get Our Estimate for New Equipment or for Improving of Present Plant

COMPLETE OUTFITS FOR REFRIGERATION AND ICE MANUFACTURE

FRICK COMPANY, WAYNESBORO 1893

FRICK COMPANY, ENGINEERS,

Waynesboro, Franklin Co., Pa.



A GENUINE CORLISS ENGINE WITH ALL THE LATEST IMPROVEMENTS.

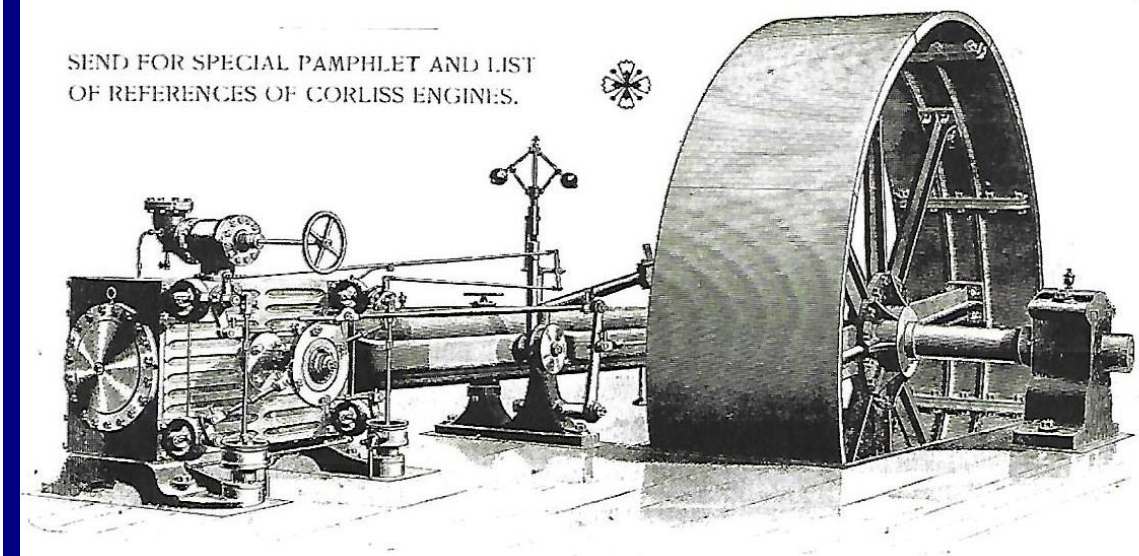
"EGLIPSE" CORLISS TANDEM COMPOUND CONDENSING ENGINE

UP TO 3000 HORSE POWER

We have complete line of patterns and build Corliss Horizontal Stationary Engines, Corliss Vertical Engines, Condensing or Non-Condensing, Single or in Pairs. Corliss Compound Engines, Tandem or Cross Compound. Corliss Engines for any service, 40 to 3000 horse power, in a single engine.

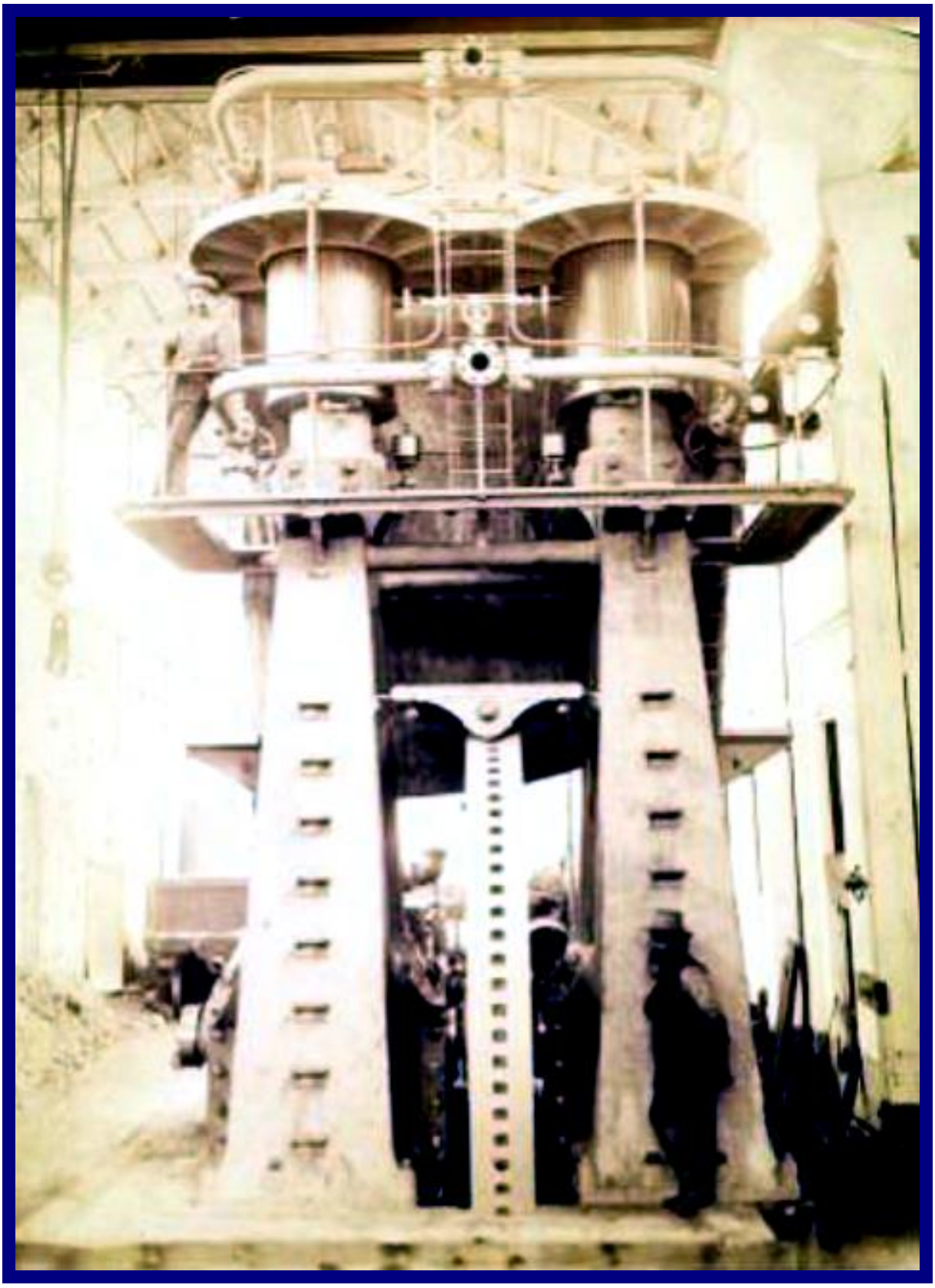
SPECIAL NOTICE.—With our Corliss Engine we contract for fitting up complete the entire Steam Plants, including Steam Boiler, Feed Water Heater, Feed Pumps, Piping, Shafting, and all the appurtenances and belongings peculiar to a first-class job.

SEND FOR SPECIAL PAMPHLET AND LIST OF REFERENCES OF CORLISS ENGINES.

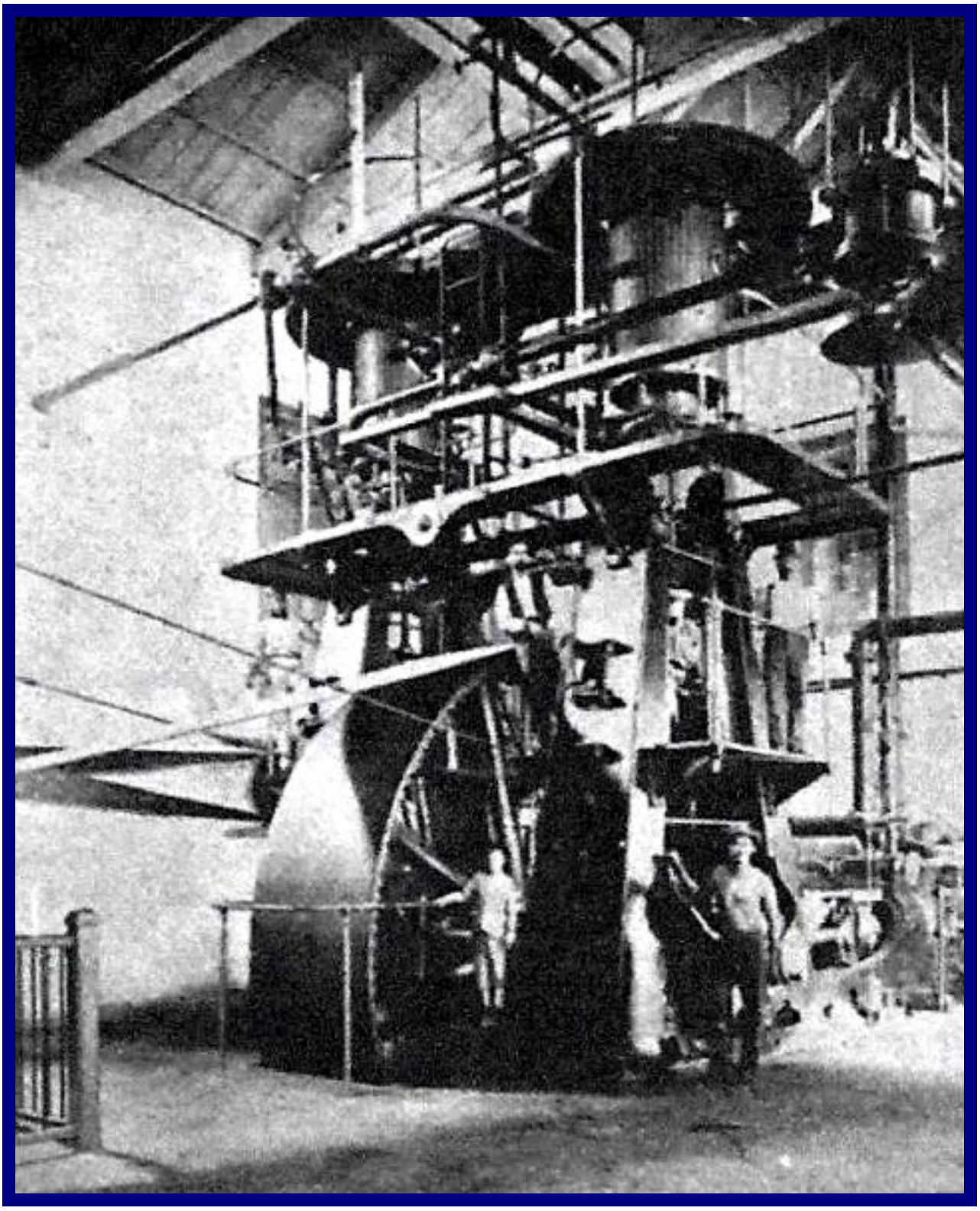


1000 HORSE POWER "EGLIPSE" PLAIN CORLISS ENGINE.

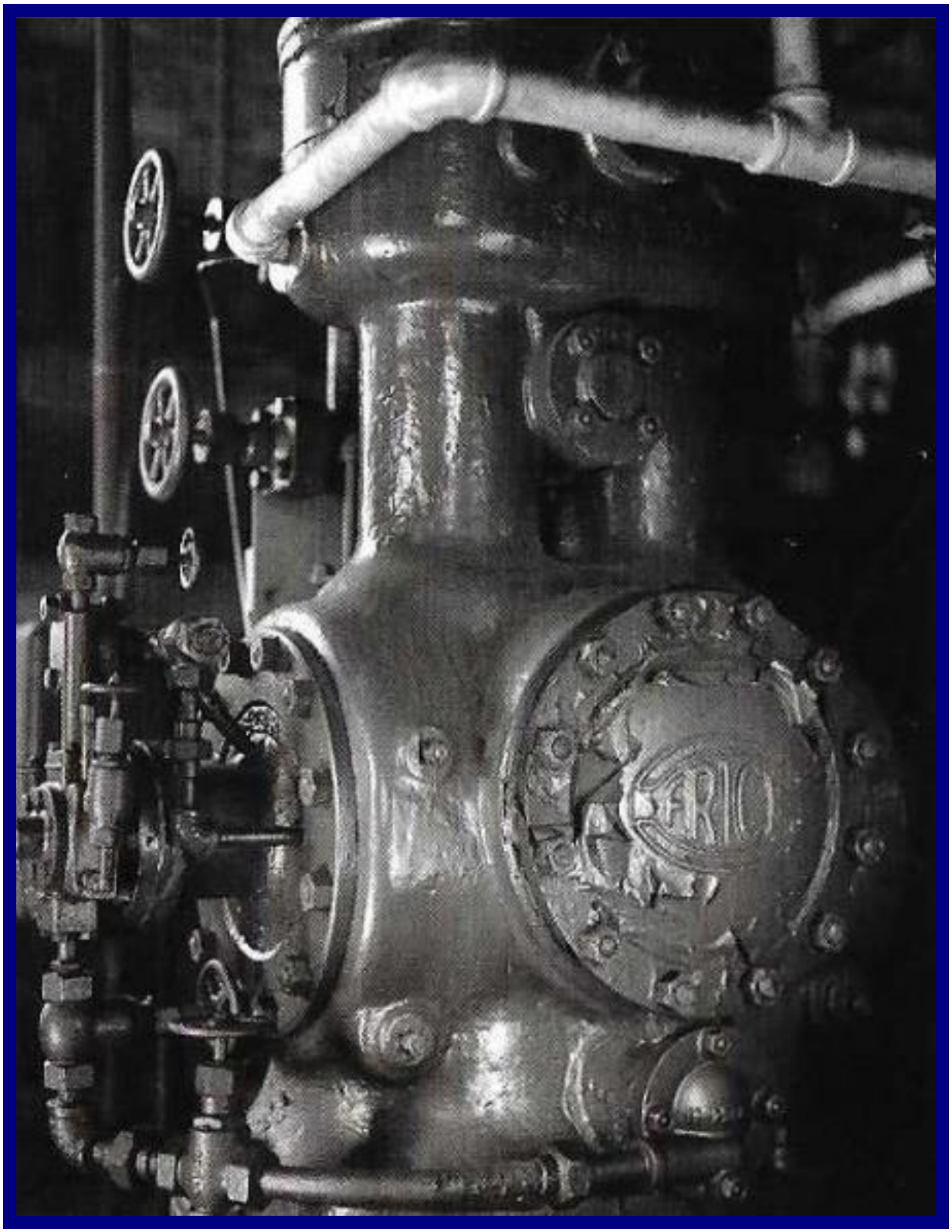
FRICK COMPANY, WAYNESBORO
DETAILS-LOCATION UNKNOWN



FRICK MACHINE HAVANA BREWERY 1892
STEAM ENGINE OR WATER-WHEEL DRIVE



FRICK COMPANY, WAYNESBORO

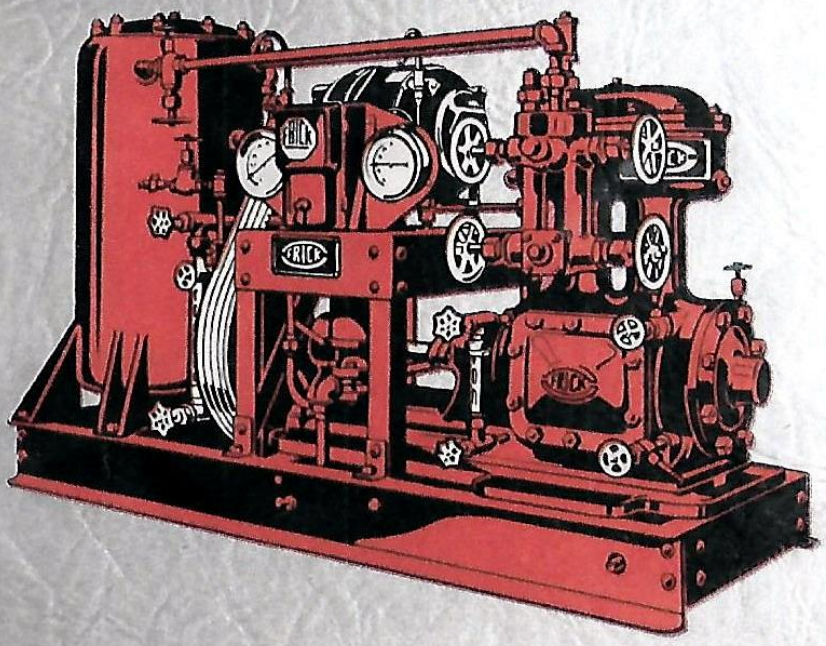


FRICK COMPANY, WAYNESBORO, 1938

ICE AND FROST

Published by

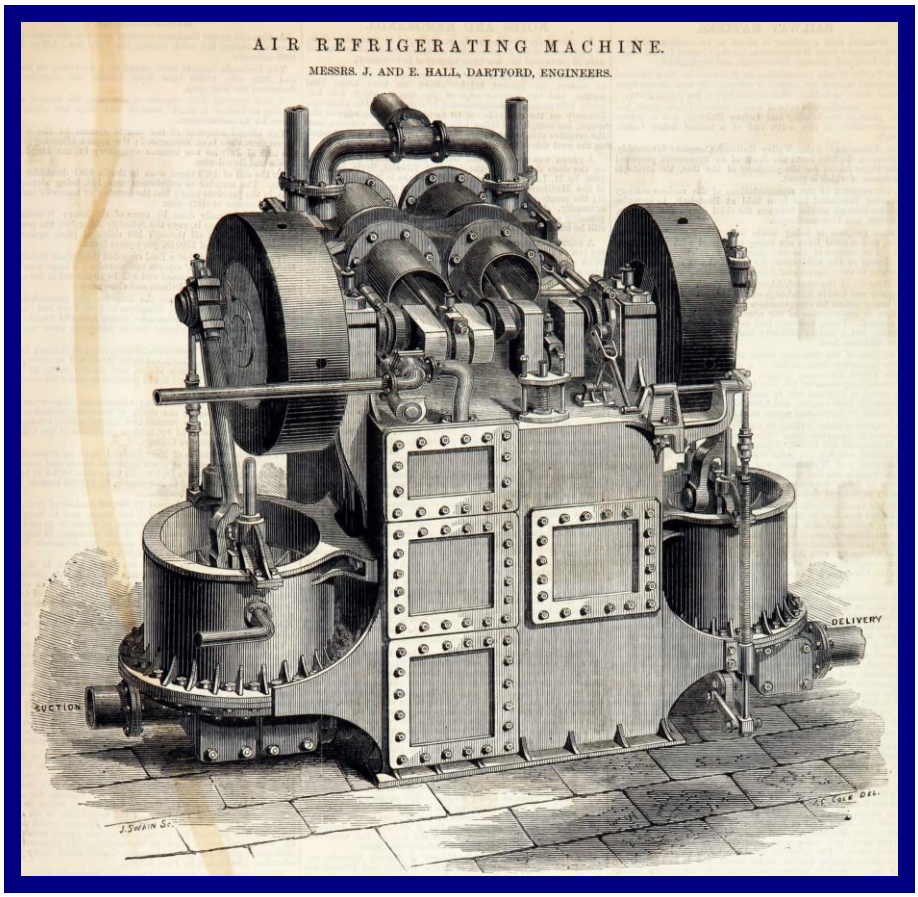
FRICK COMPANY, WAYNESBORO, PENNA.

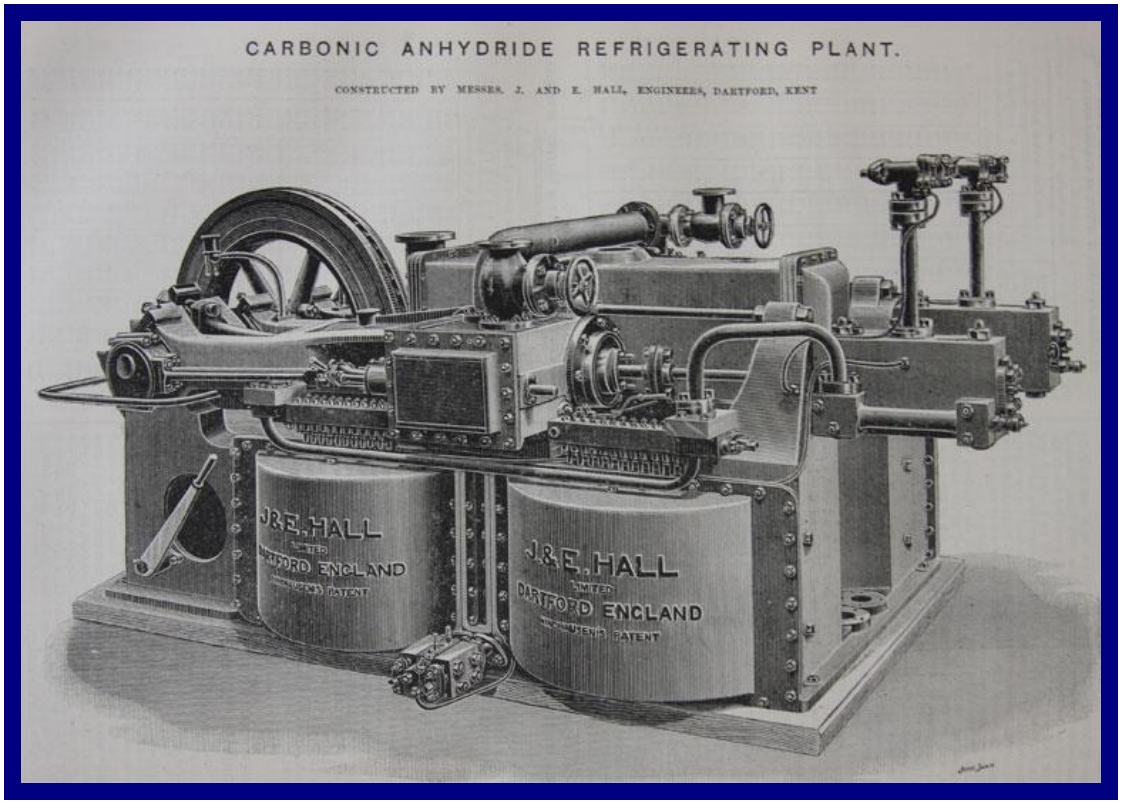


Bulletin
104-H

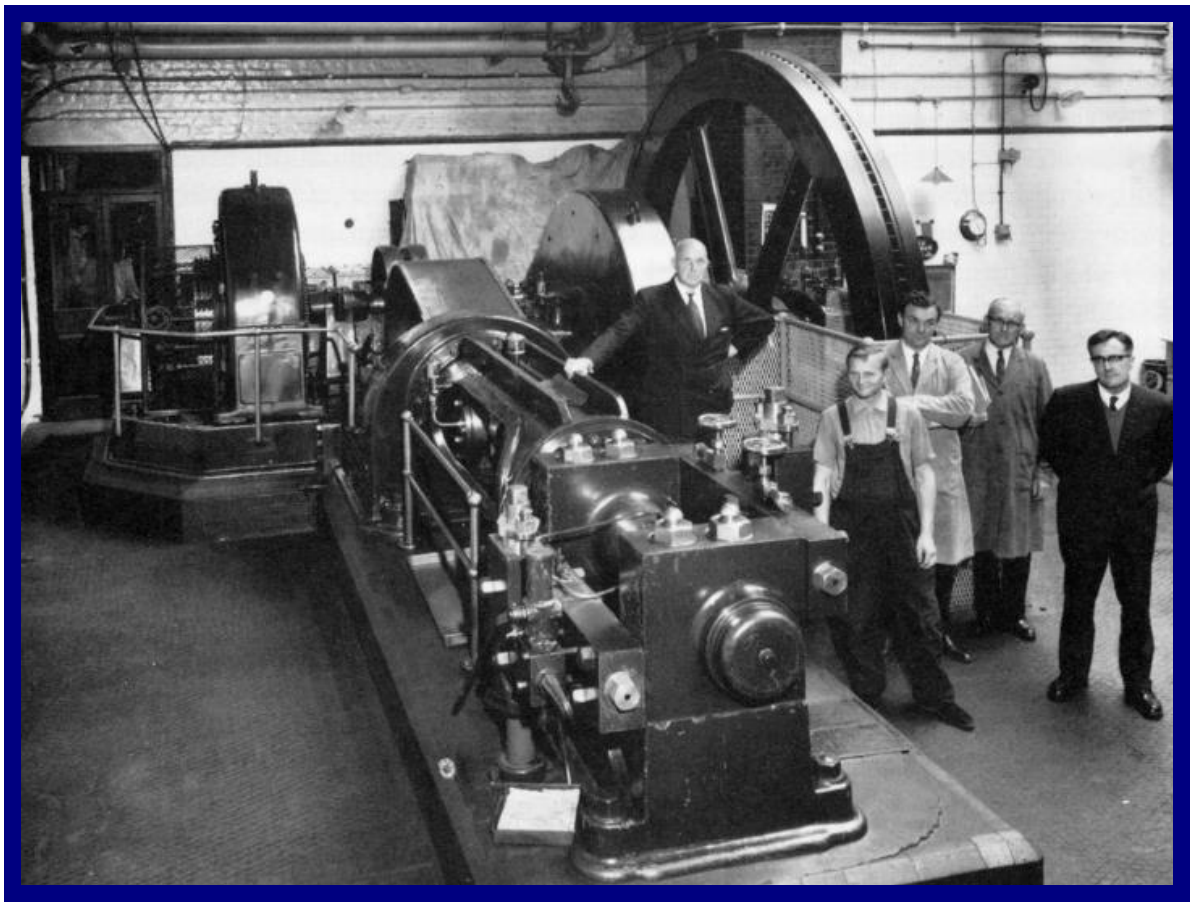
Combined Ammonia
Refrigerating Units

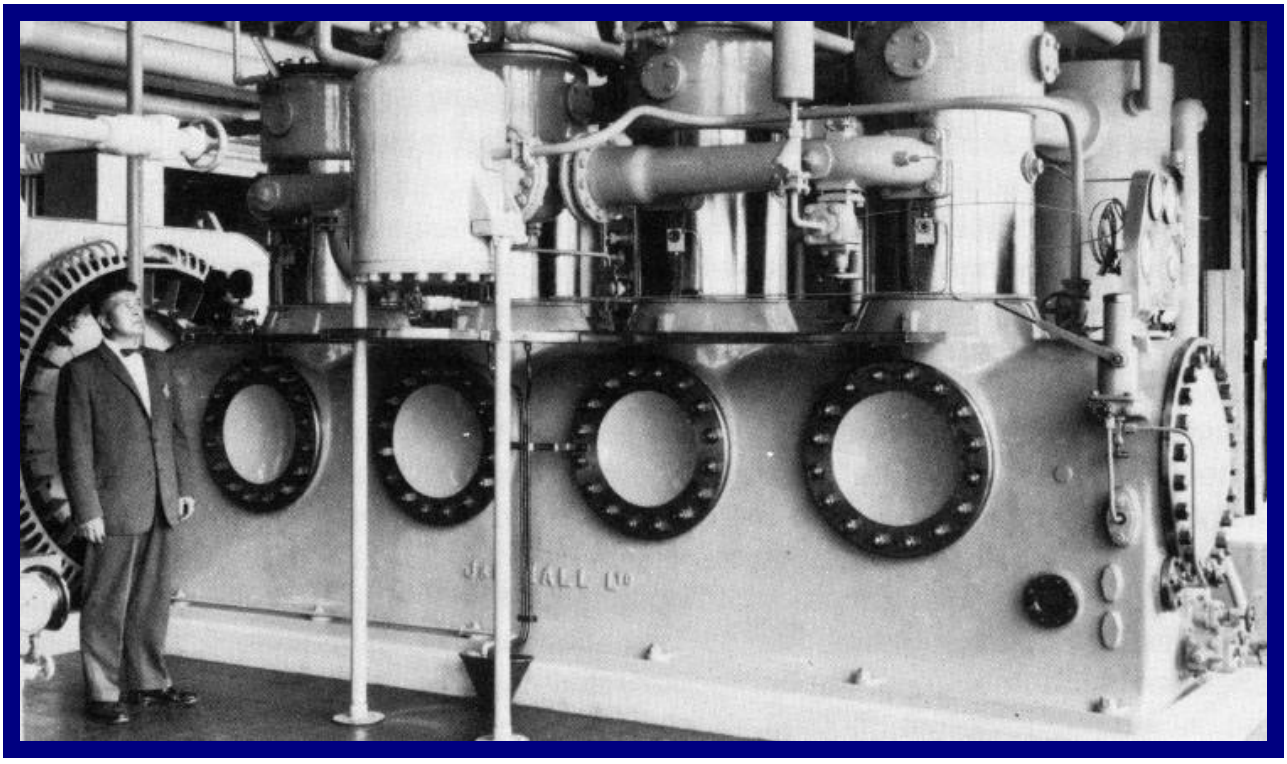
J & E HALL, DARTFORD, KENT 1880,1892





J & E HALL, DARTFORD, KENT 1912,1959





HOLDEN BROS, PHILADELPHIA 1878

D. L. HOLDEN & BROS.,

MANUFACTURERS OF

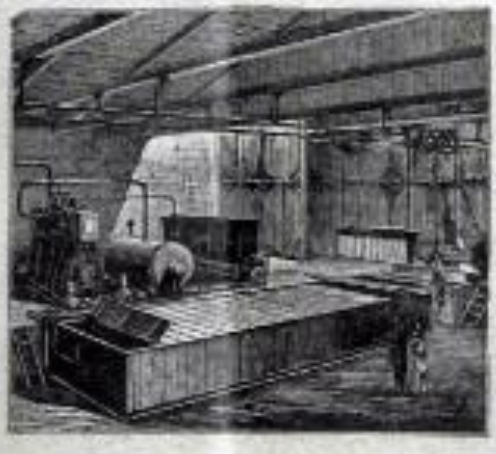
ICE MACHINES,

ALSO

REFRIGERATING MACHINES,

FOR

Breweries, Distilleries, Packeries, Fruit Houses, Steamships, &c.



PENN IRON WORKS,

BEACH AND PALMER STREETS,

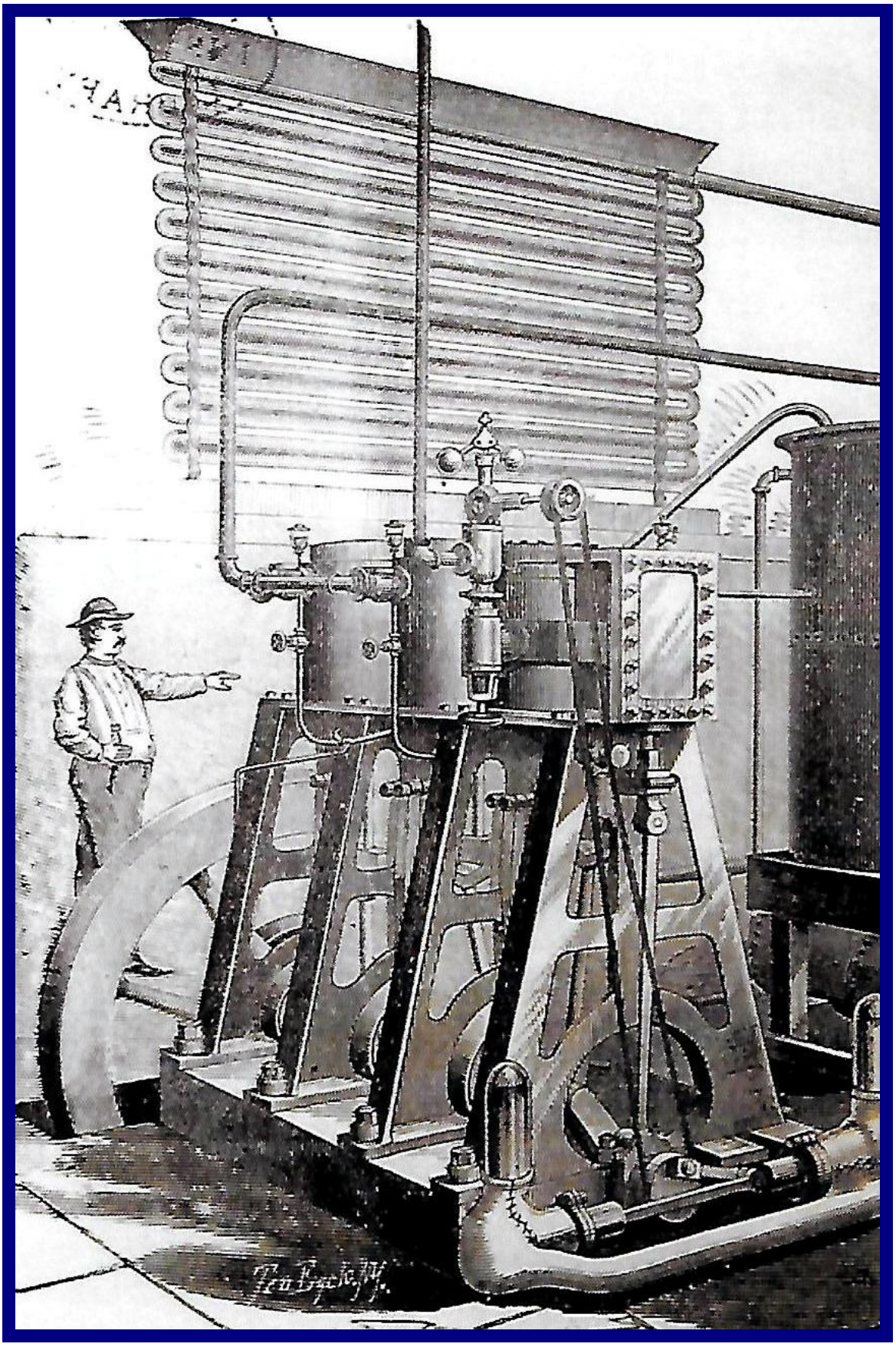
P. O. Box, 1808,

PHILADELPHIA, PA. U. S. A.

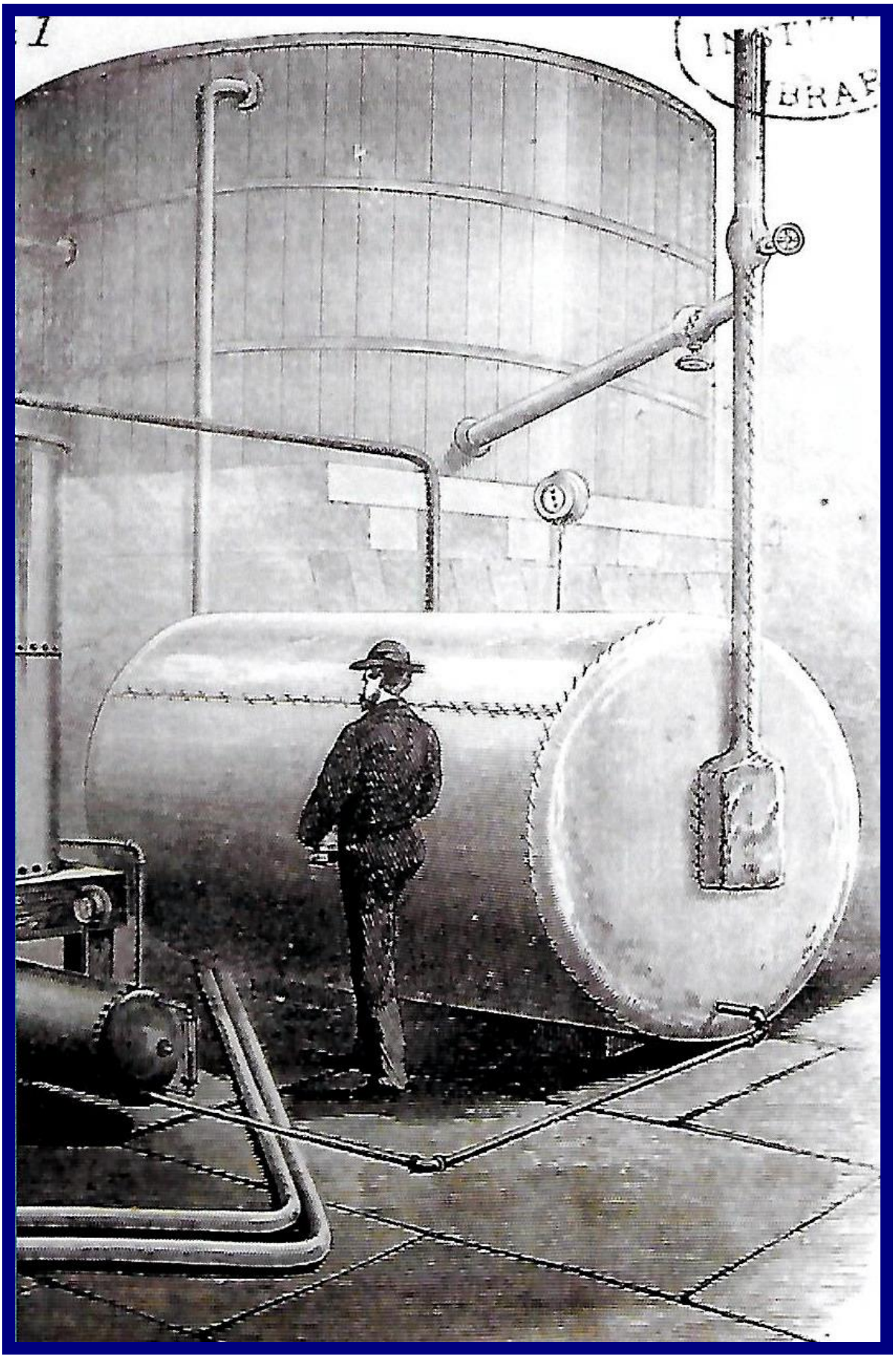
D. L. HOLDEN, E. C. HOLDEN, C. M. HOLDEN.

PHILADELPHIA:
LEHMAN & BOLTON, PRINTERS.
1878.

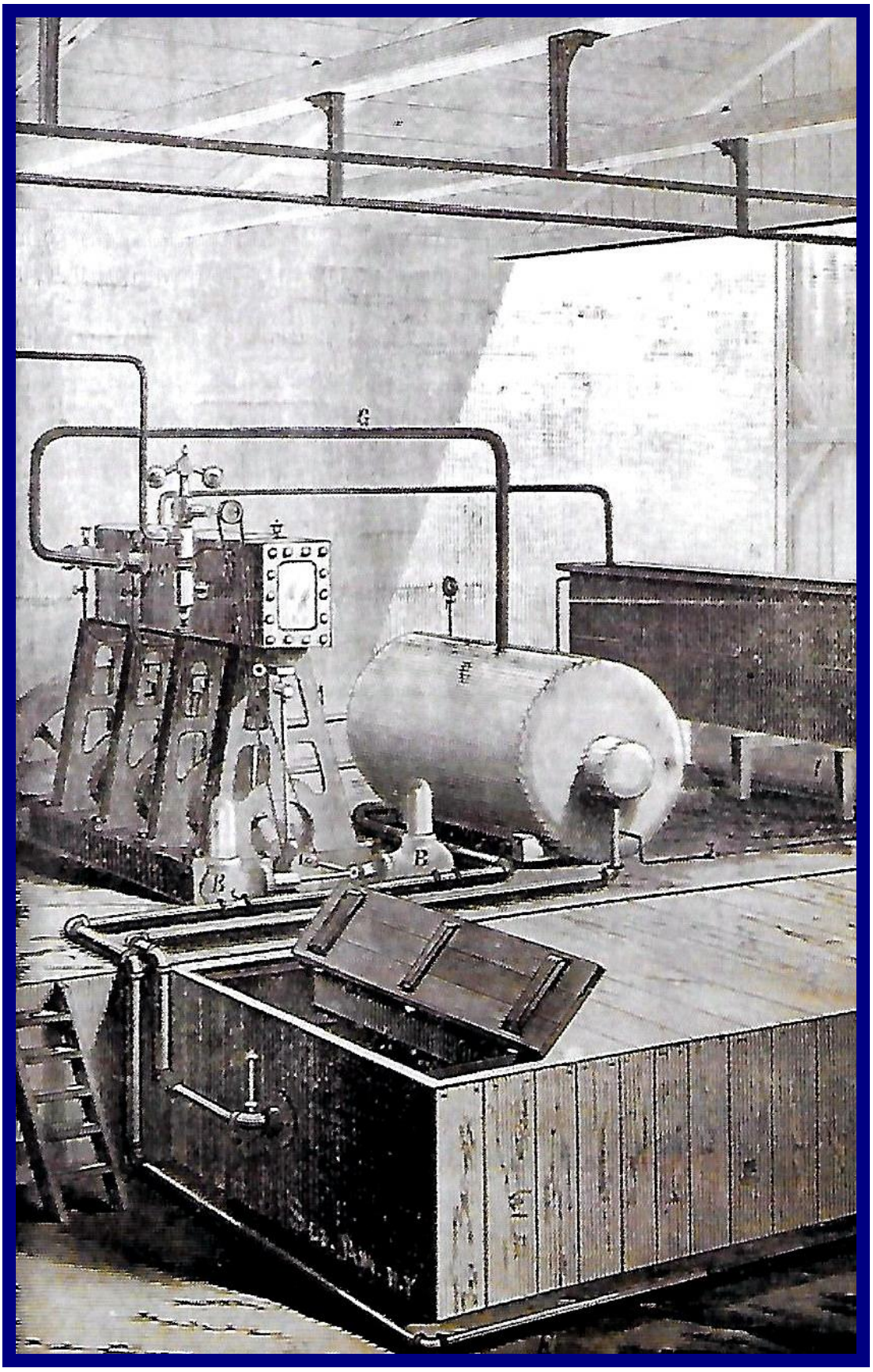
HOLDEN BROS, PHILADELPHIA 1878



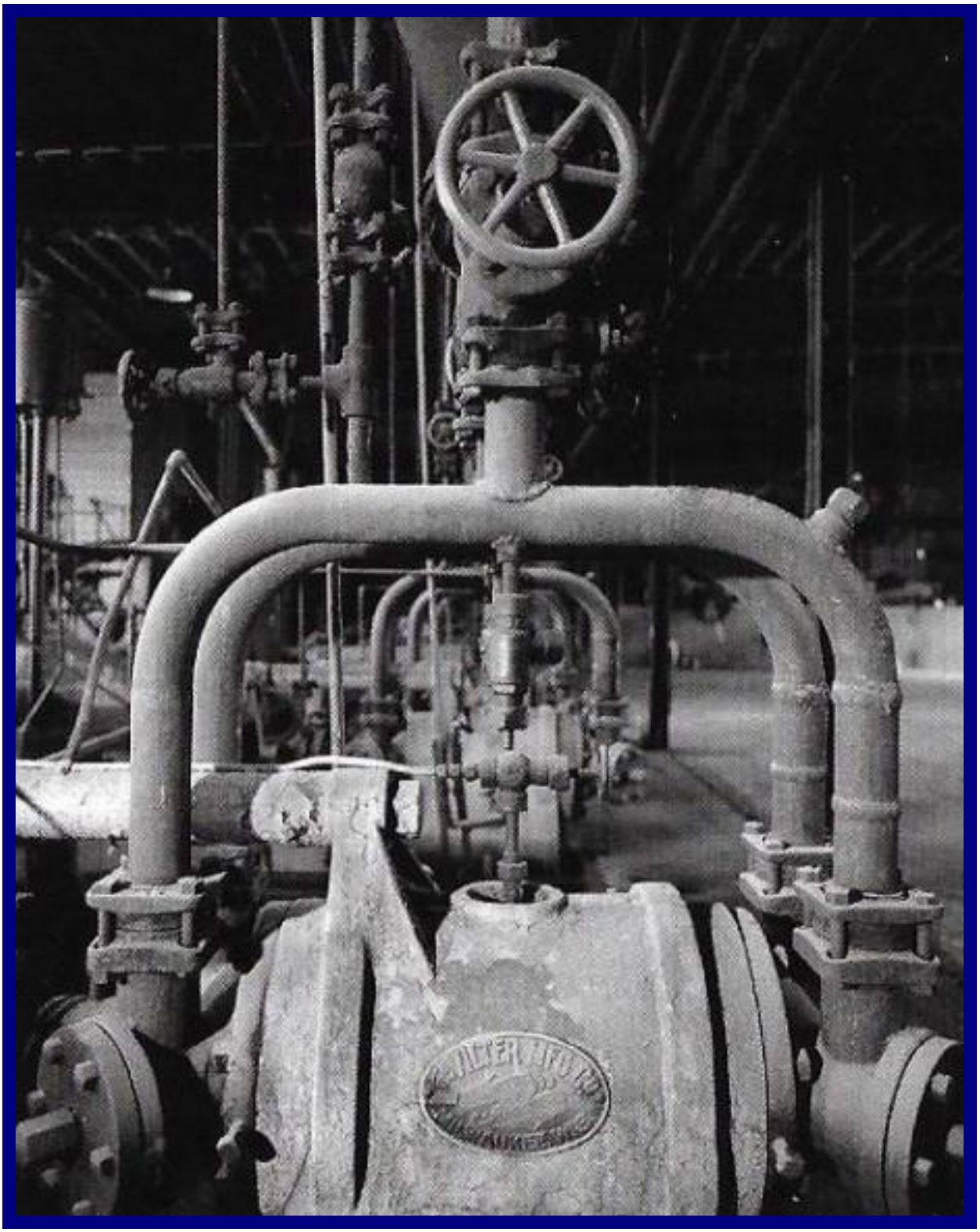
HOLDEN BROS, PHILADELPHIA 1878



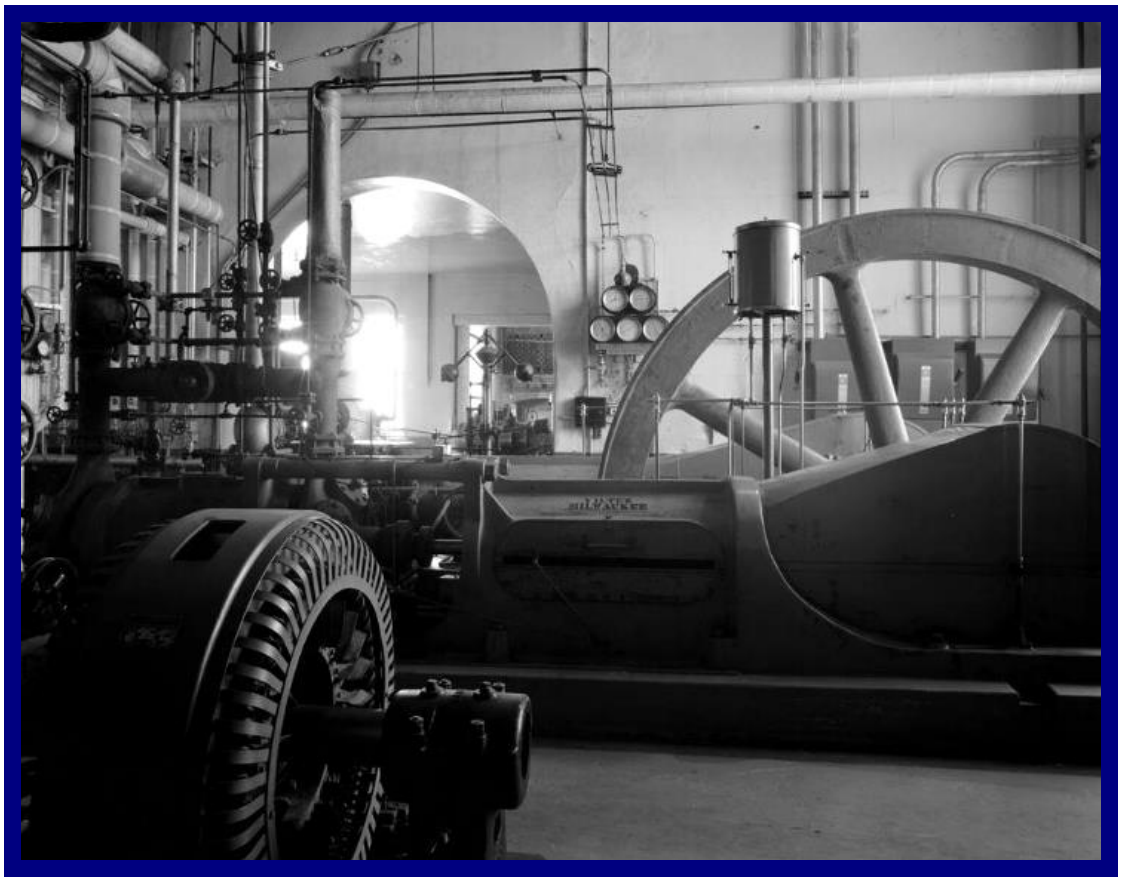
HOLDEN BROS, PHILADELPHIA 1878



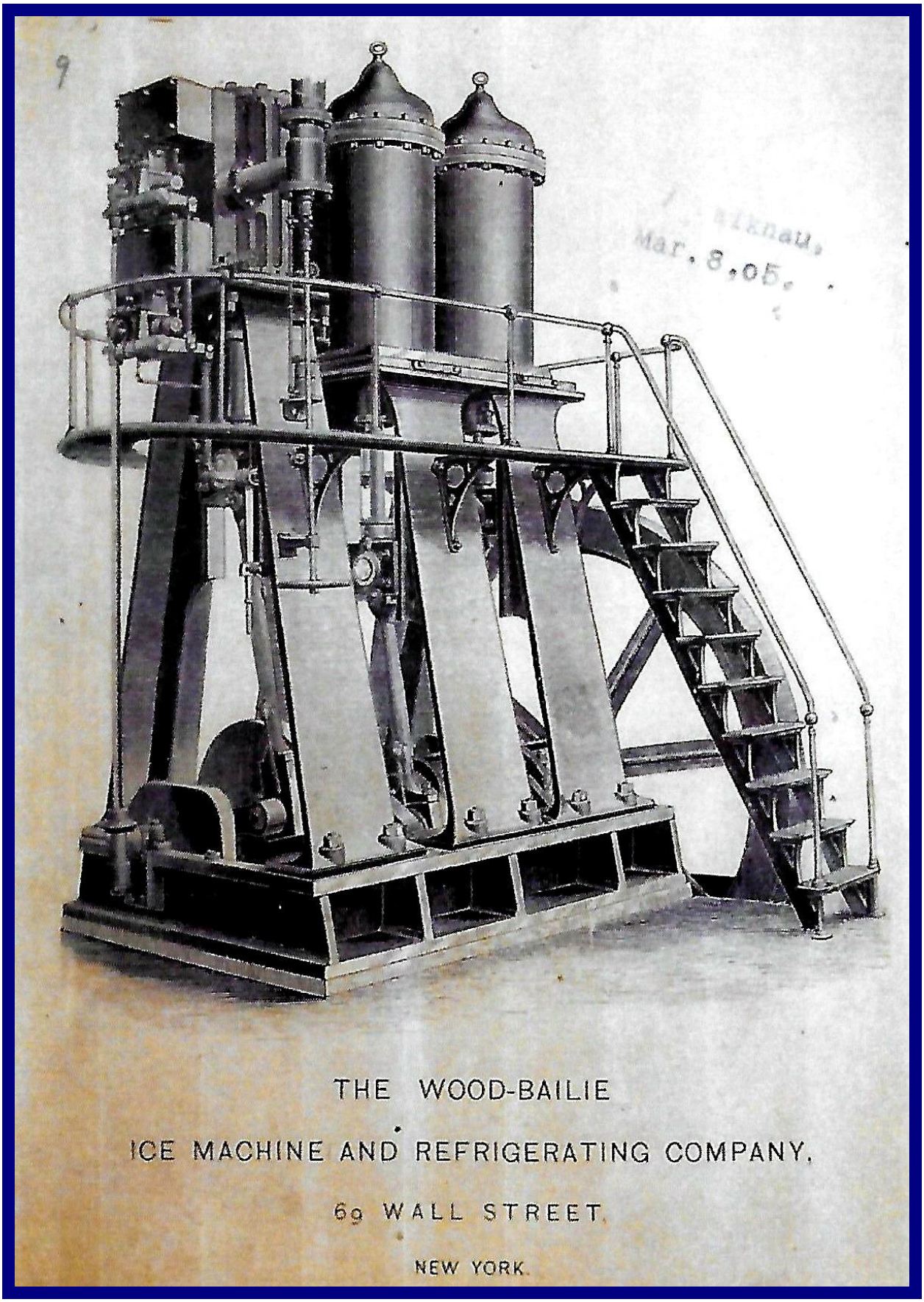
VILTER MANUFACTURING, MILWAUKEE



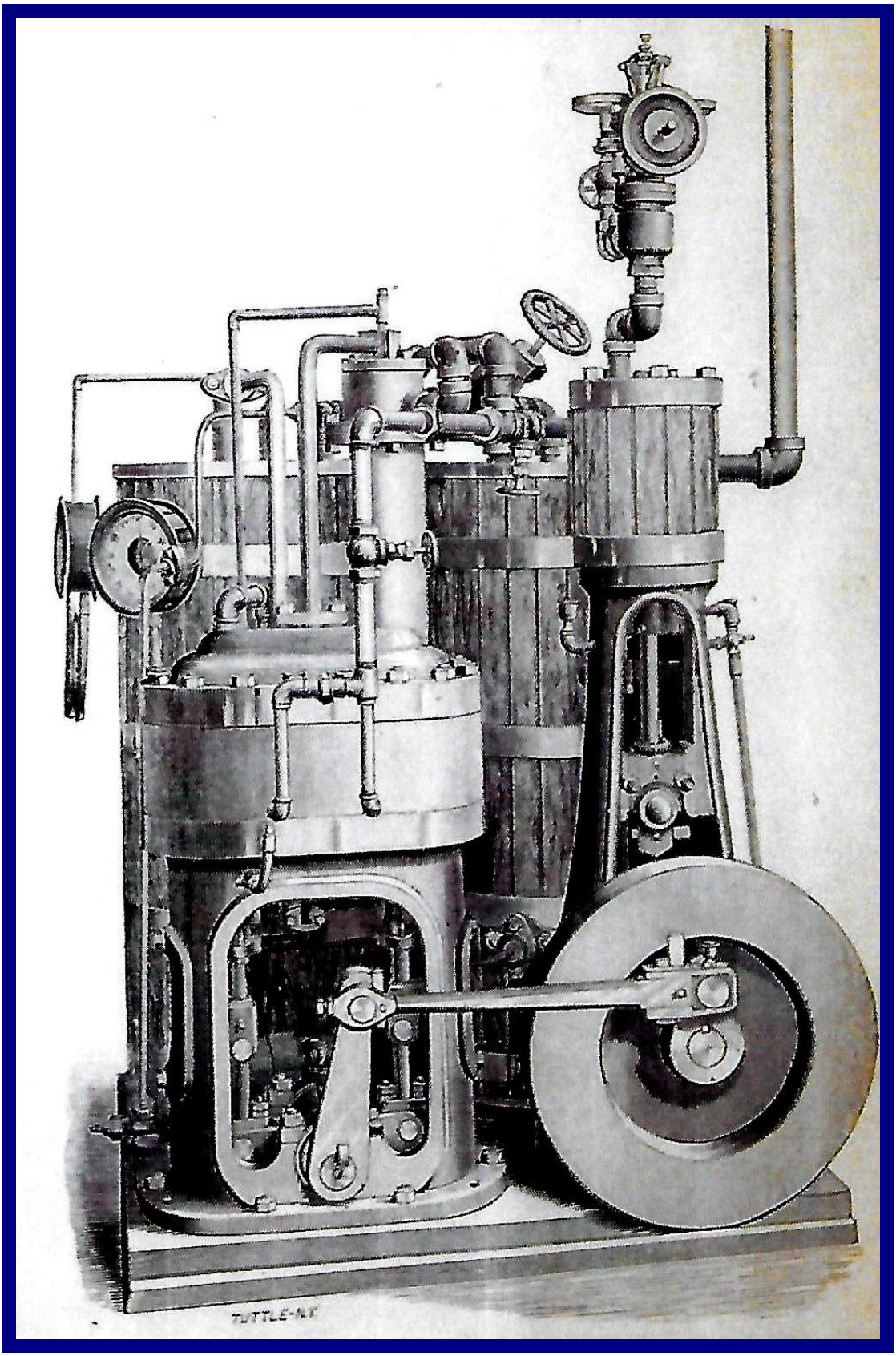
VILTER MANUFACTURING, MILWAUKEE



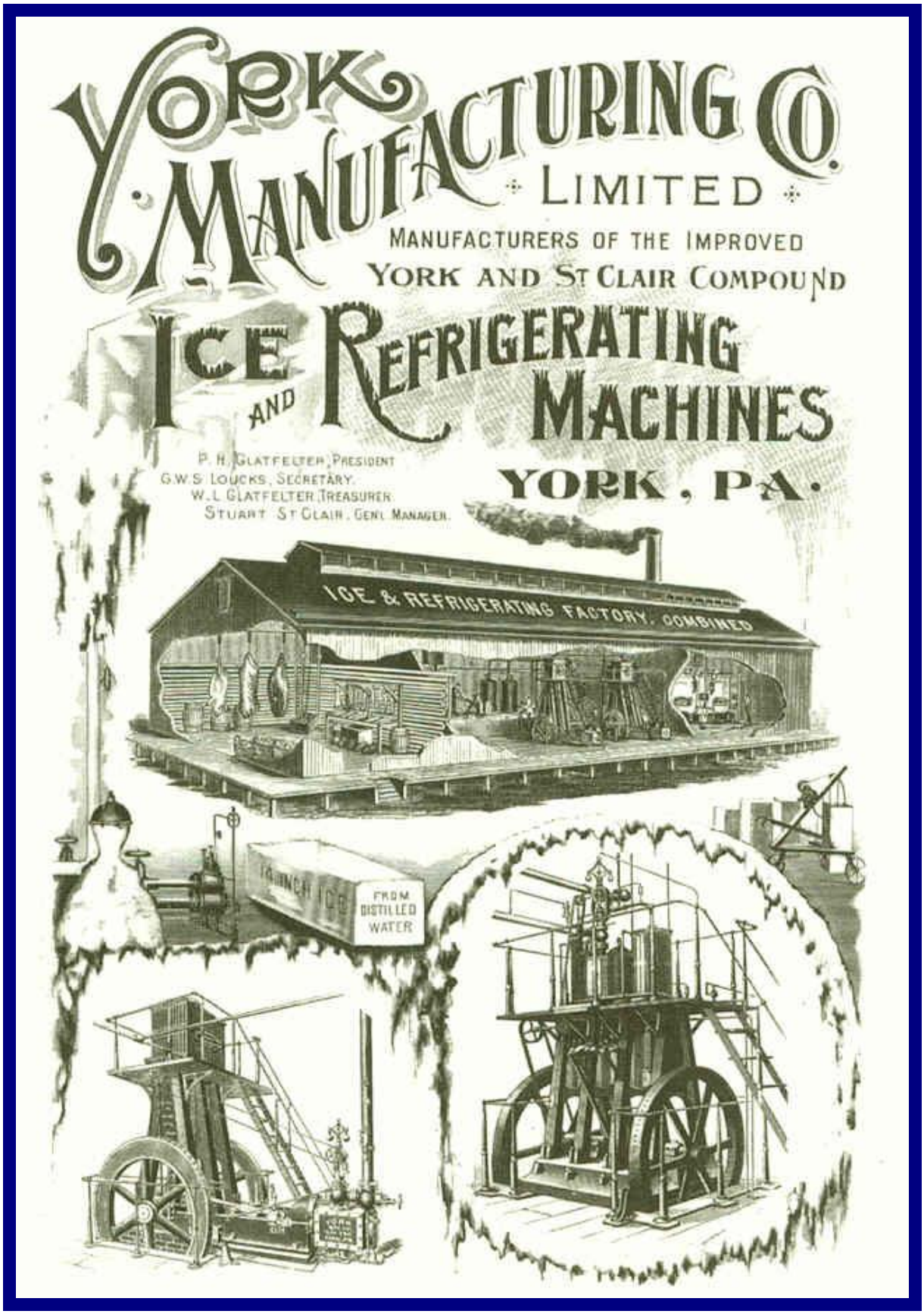
WOOD-BAILIE, NEW YORK 1890



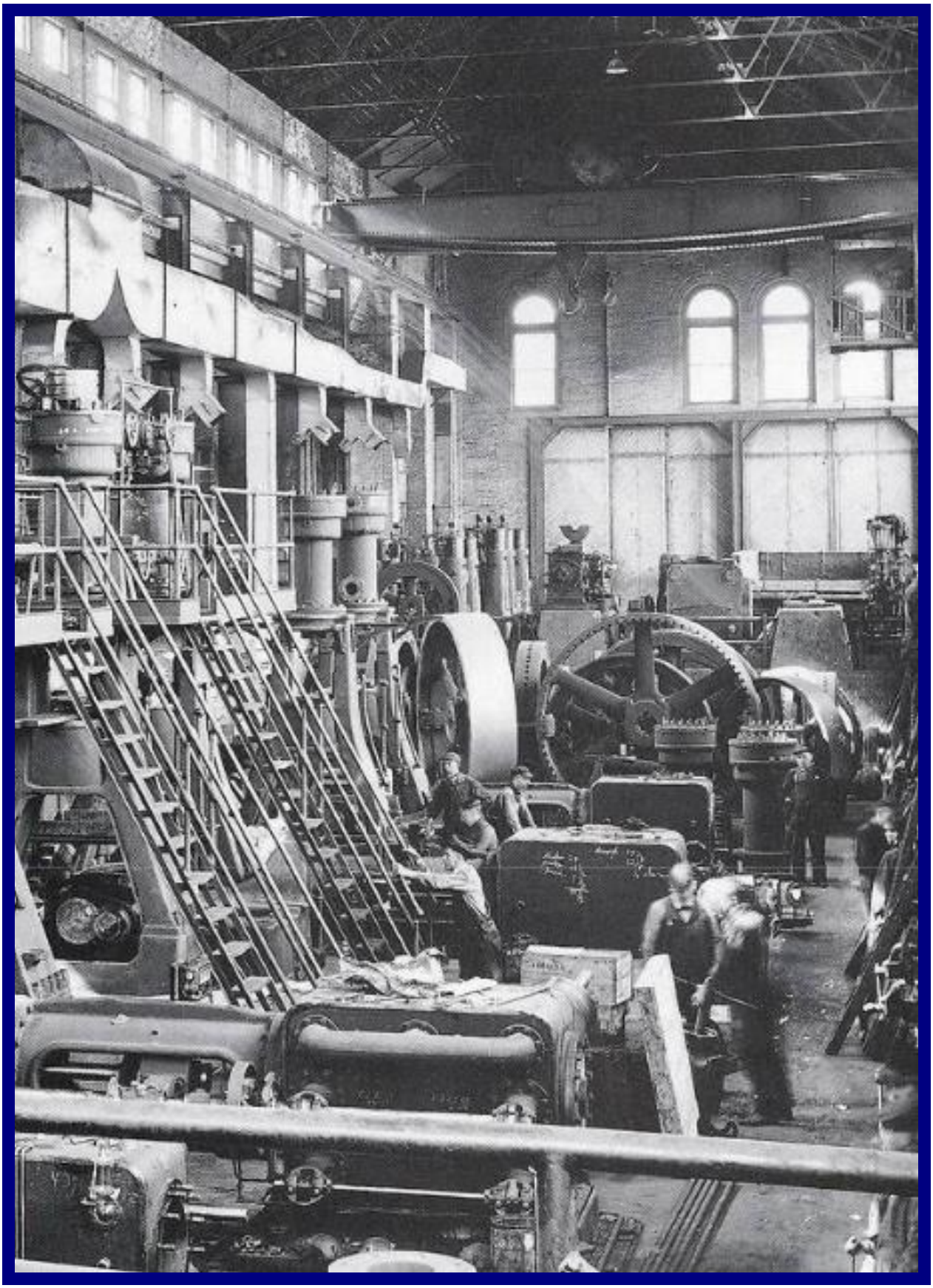
WOOD-BAILIE, NEW YORK 1890



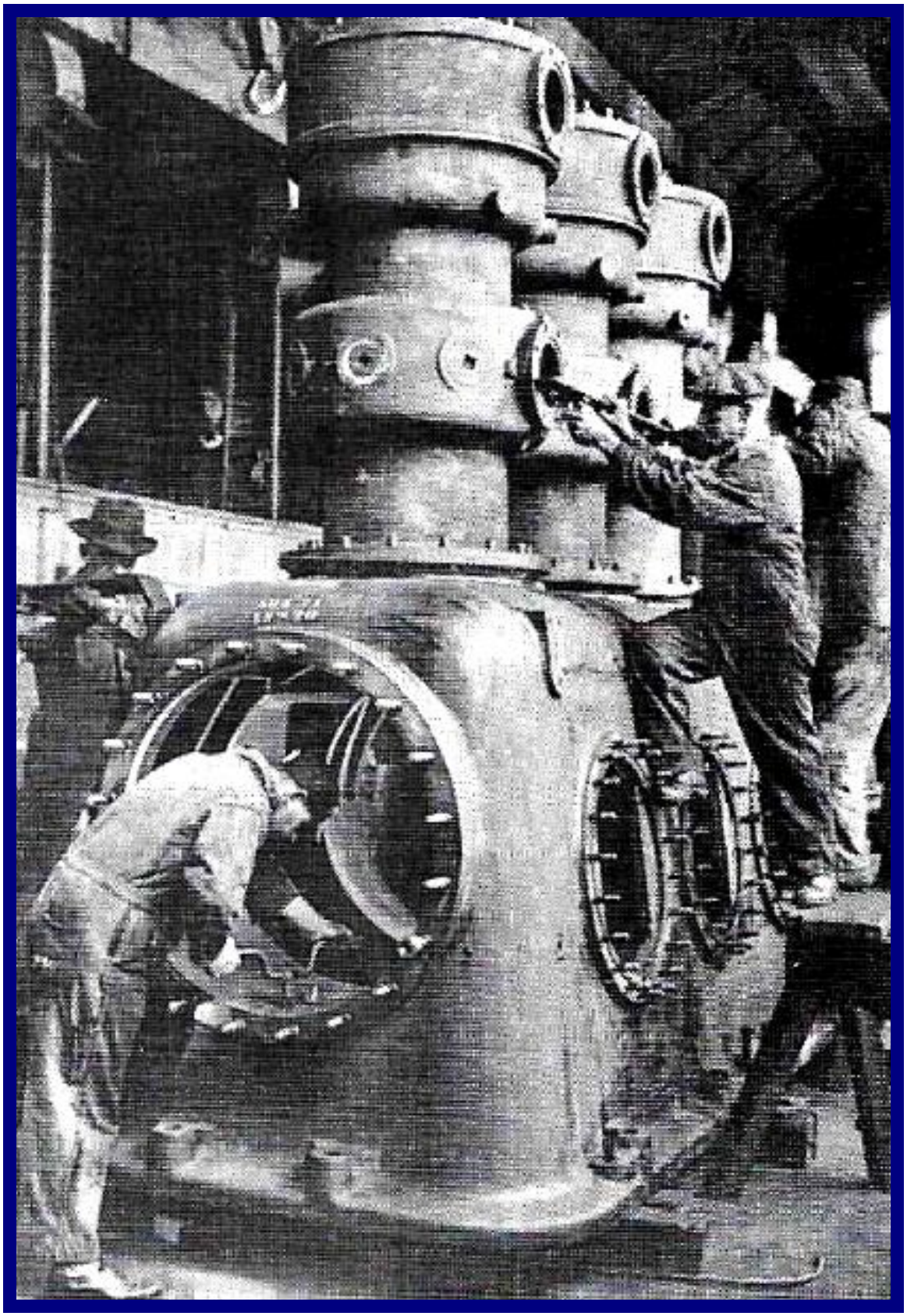
YORK MANUFACTURING, YORK, PA. 1891



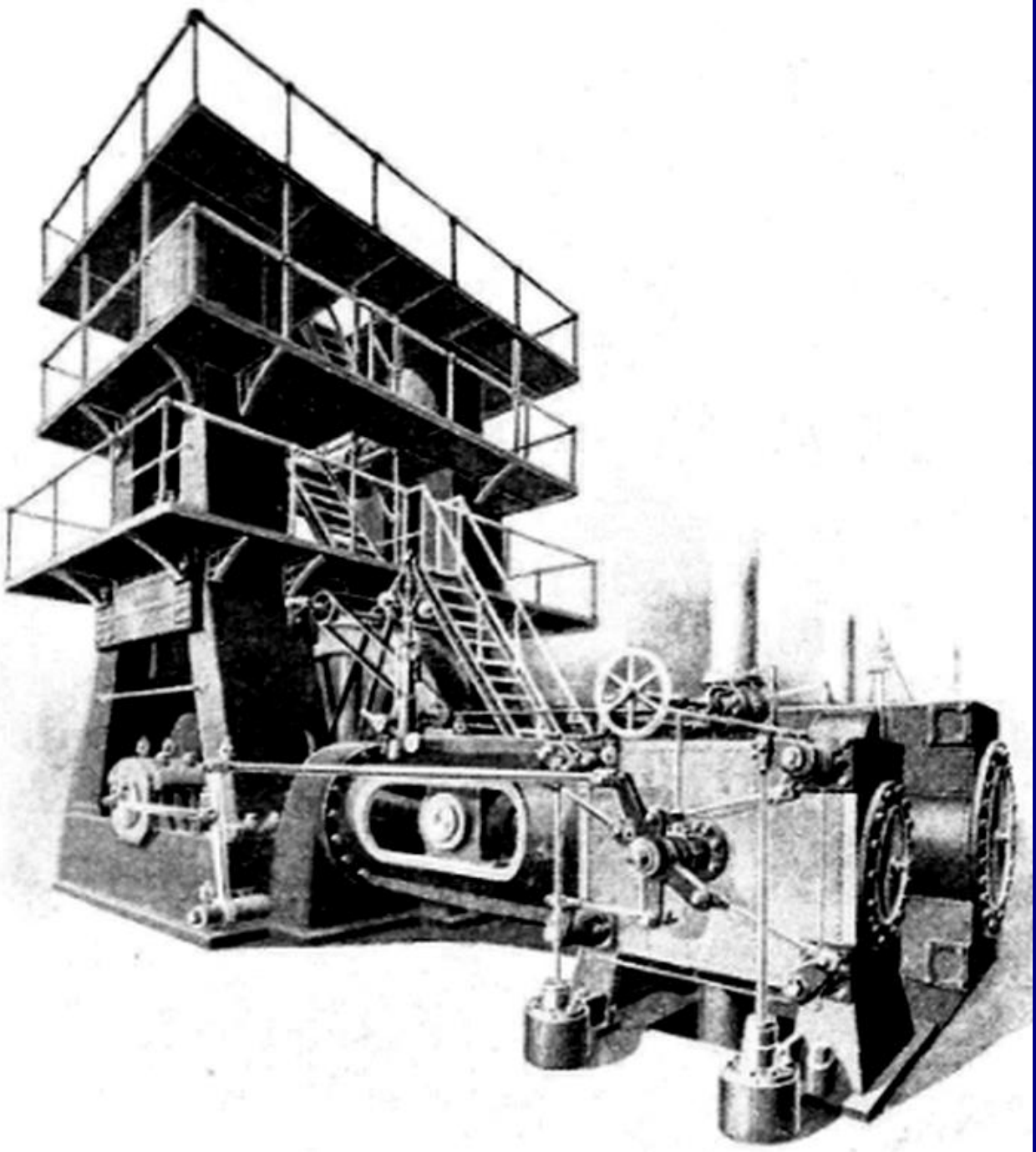
YORK MANUFACTURING FACTORY



YORK MANUFACTURING ICE MACHINE



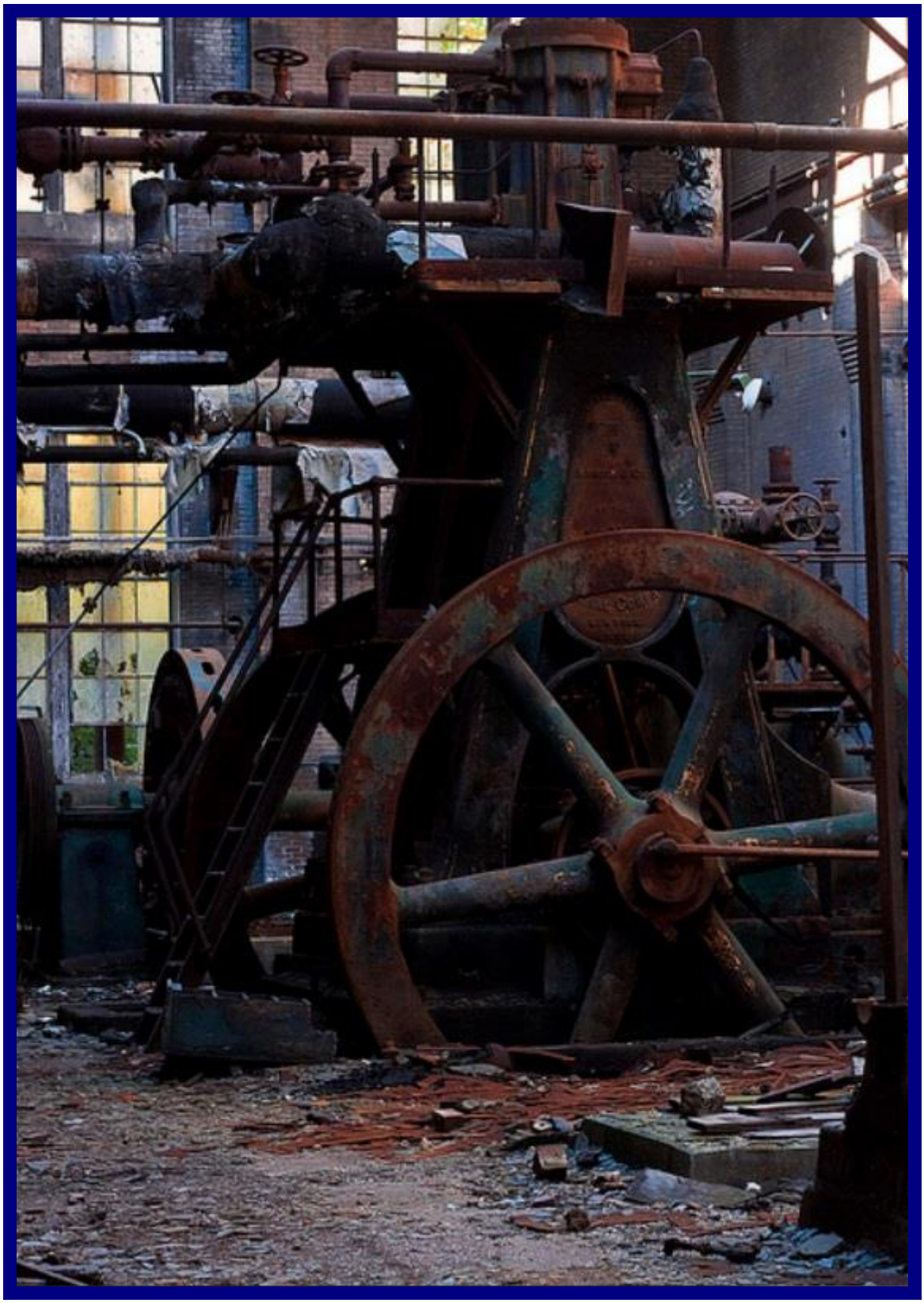
YORK MFG MAMMOTH 400 TR



YORK MFG. CO.'S MAMMOTH MACHINE, 400 TONS REFRIGERATING CAPACITY.

MASSIVE: MAKE- LOCATION UNKNOWN

MASSIVE: FRICK-DE LA VERGNE 1903
ARMOUR MEAT PACKING, ST LOUIS, MO.



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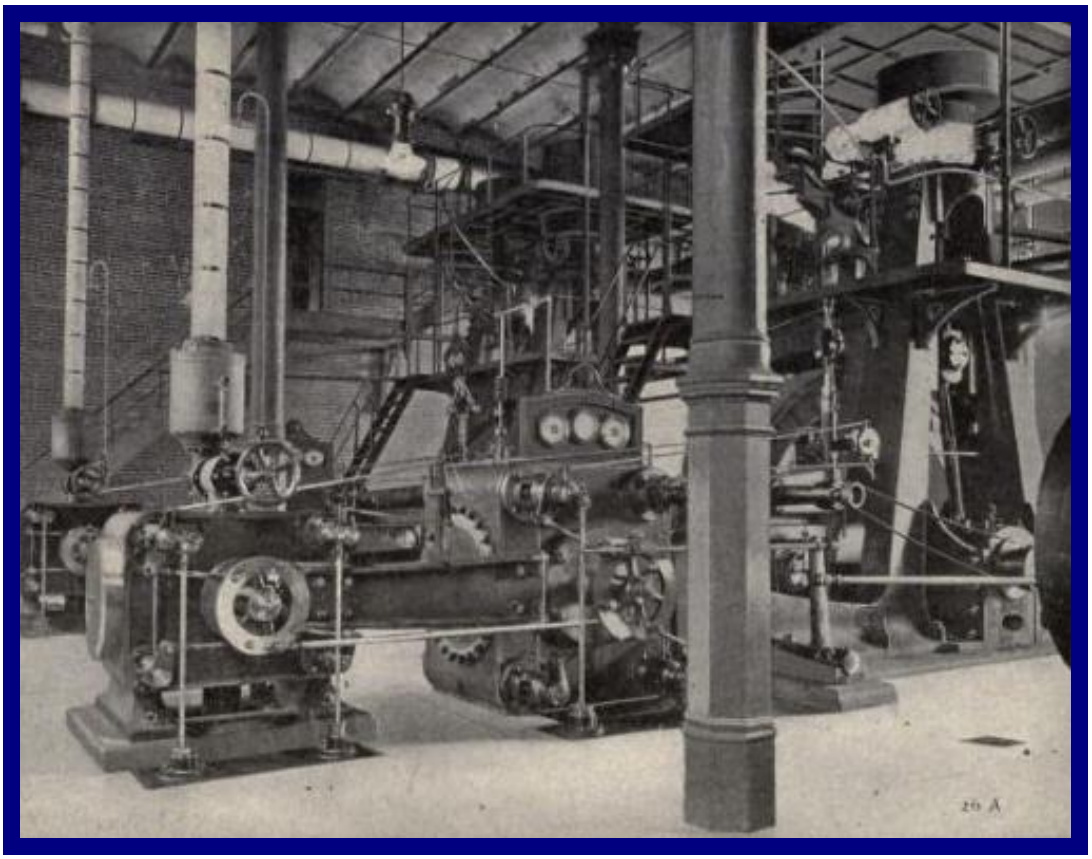
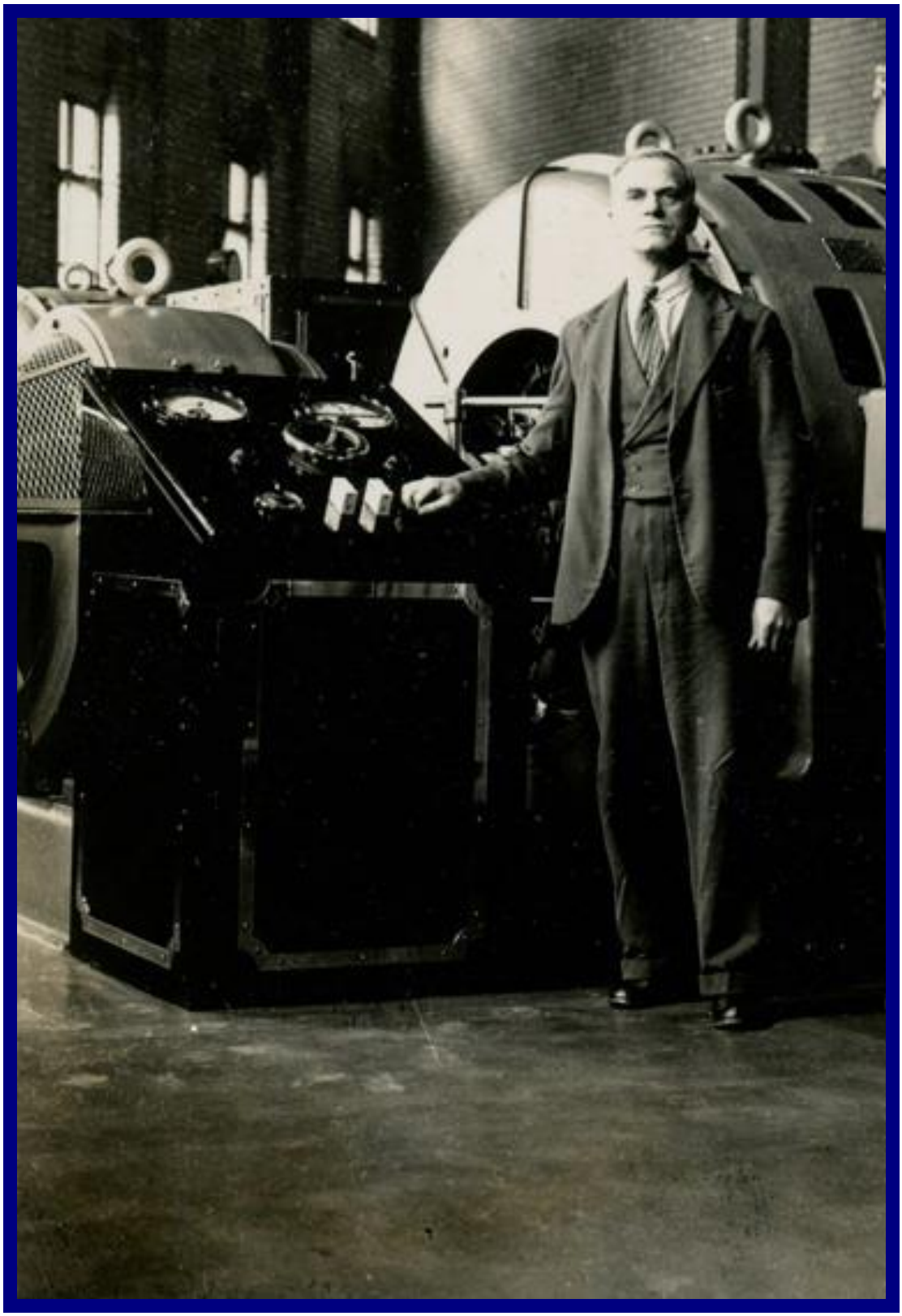
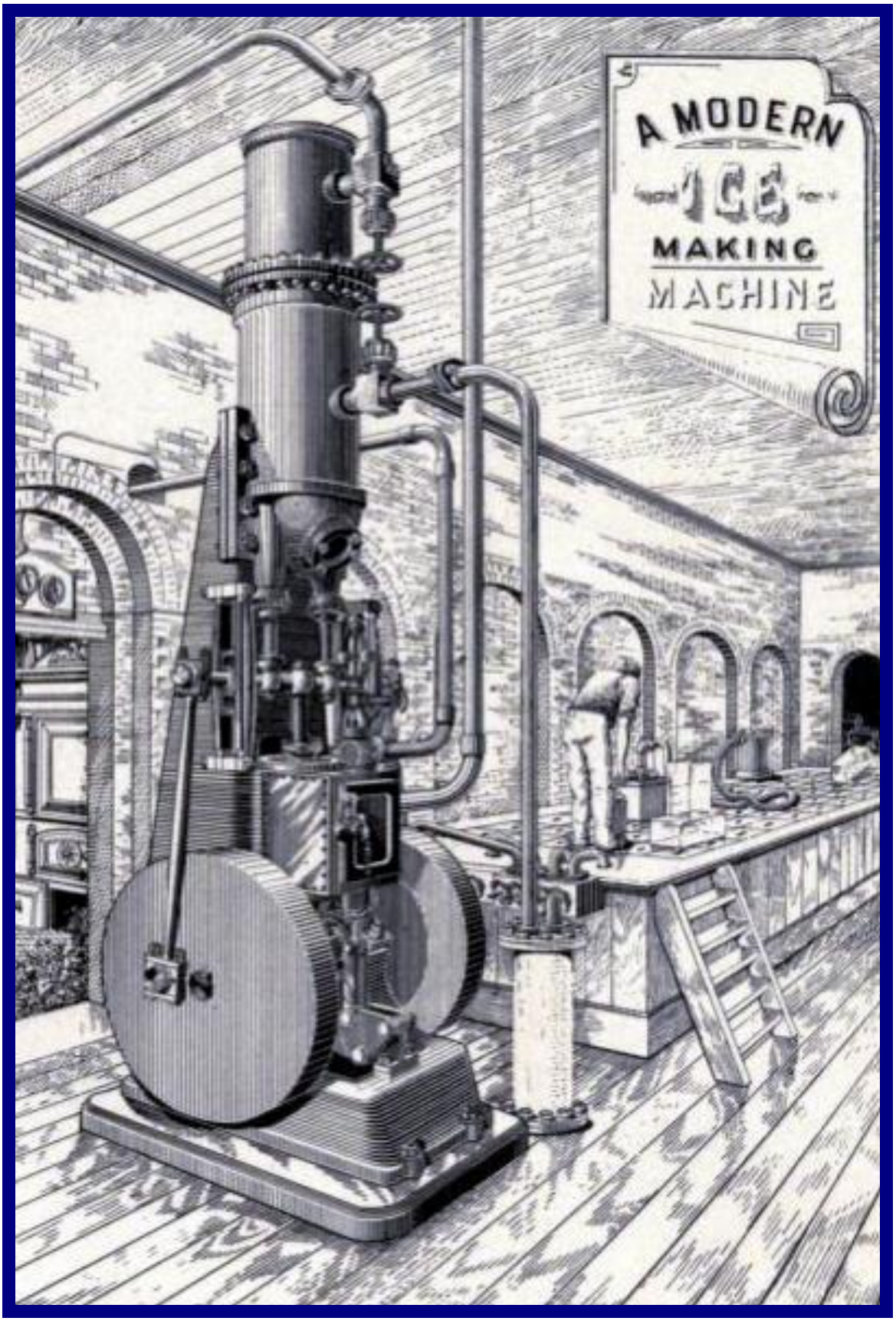


MASSIVE: GRIMSBY ICE FACTORY
J & E HALL REFRIGERATION c.1930
REPLACED ORIGINAL LINDE COMPESORS

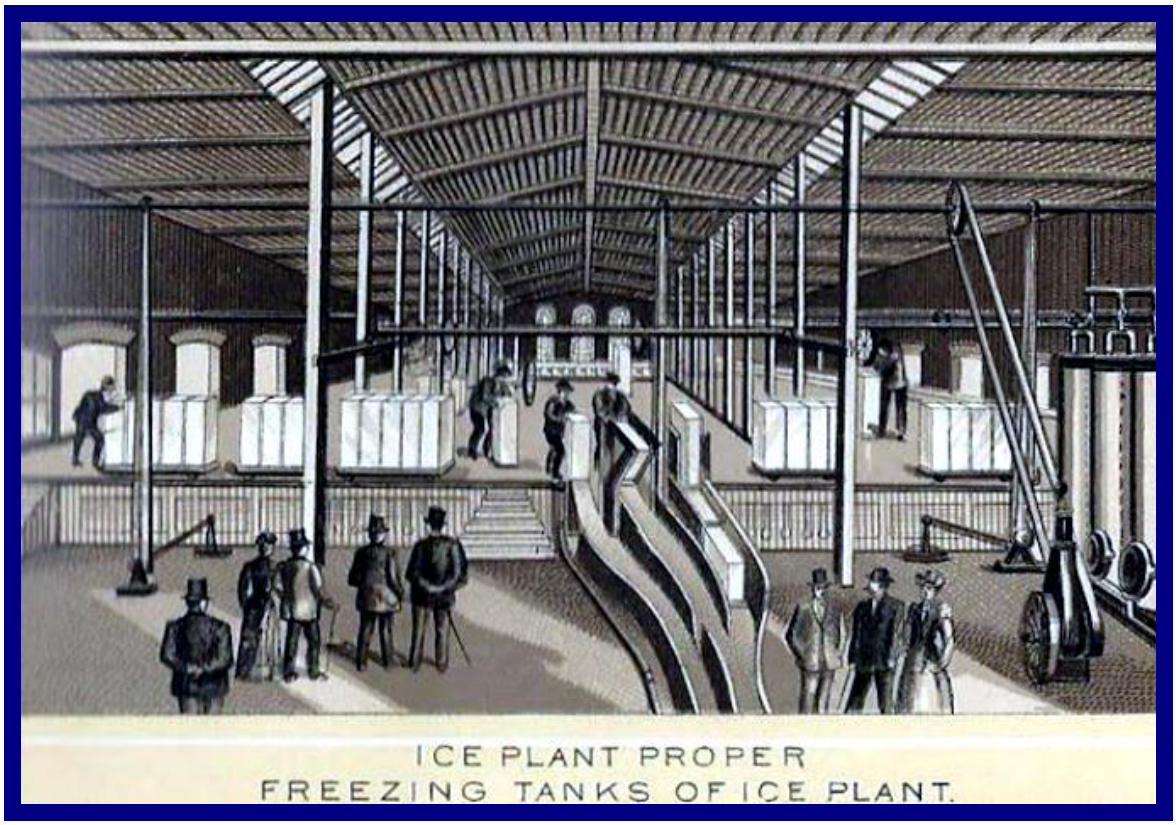


MASSIVE: MAKE-LOCATION UNKNOWN

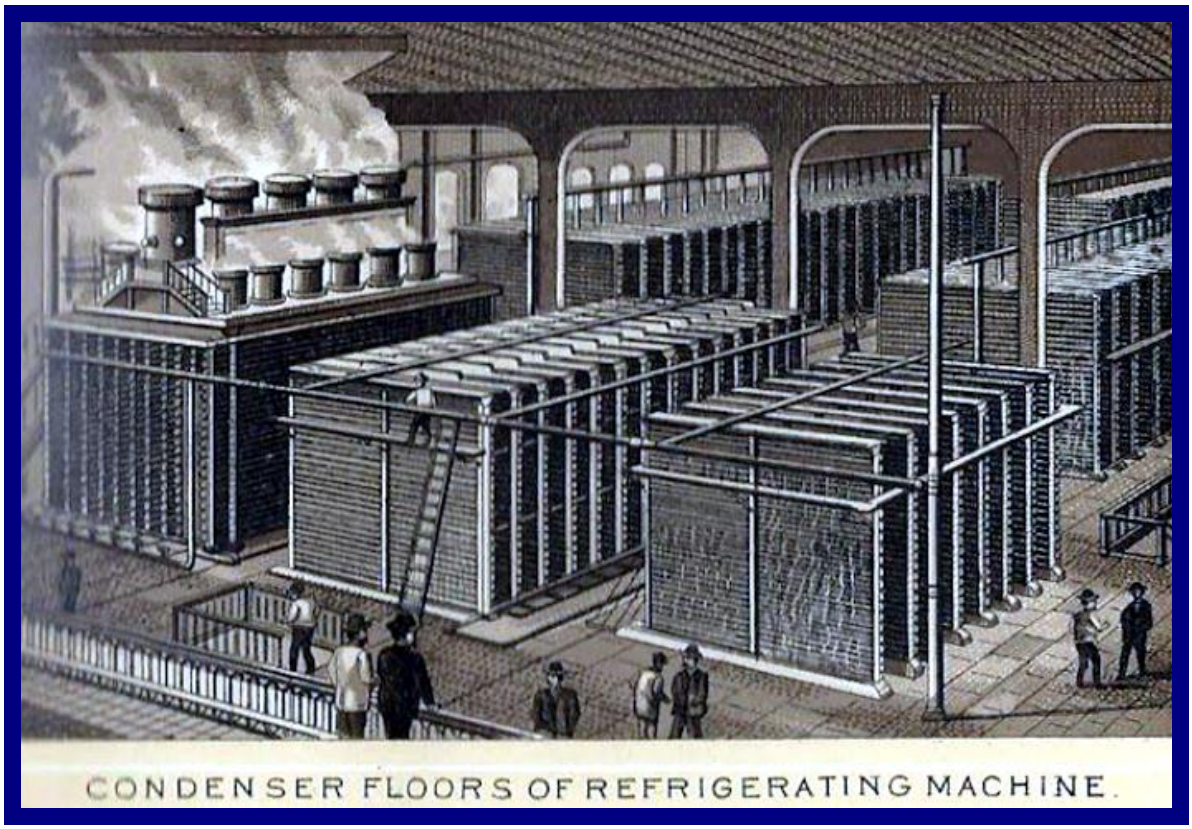
MASSIVE: AUSTRALIA



MASSIVE: LEMP BREWERY, ST LOUIS



ICE PLANT PROPER
FREEZING TANKS OF ICE PLANT.



CONDENSER FLOORS OF REFRIGERATING MACHINE.