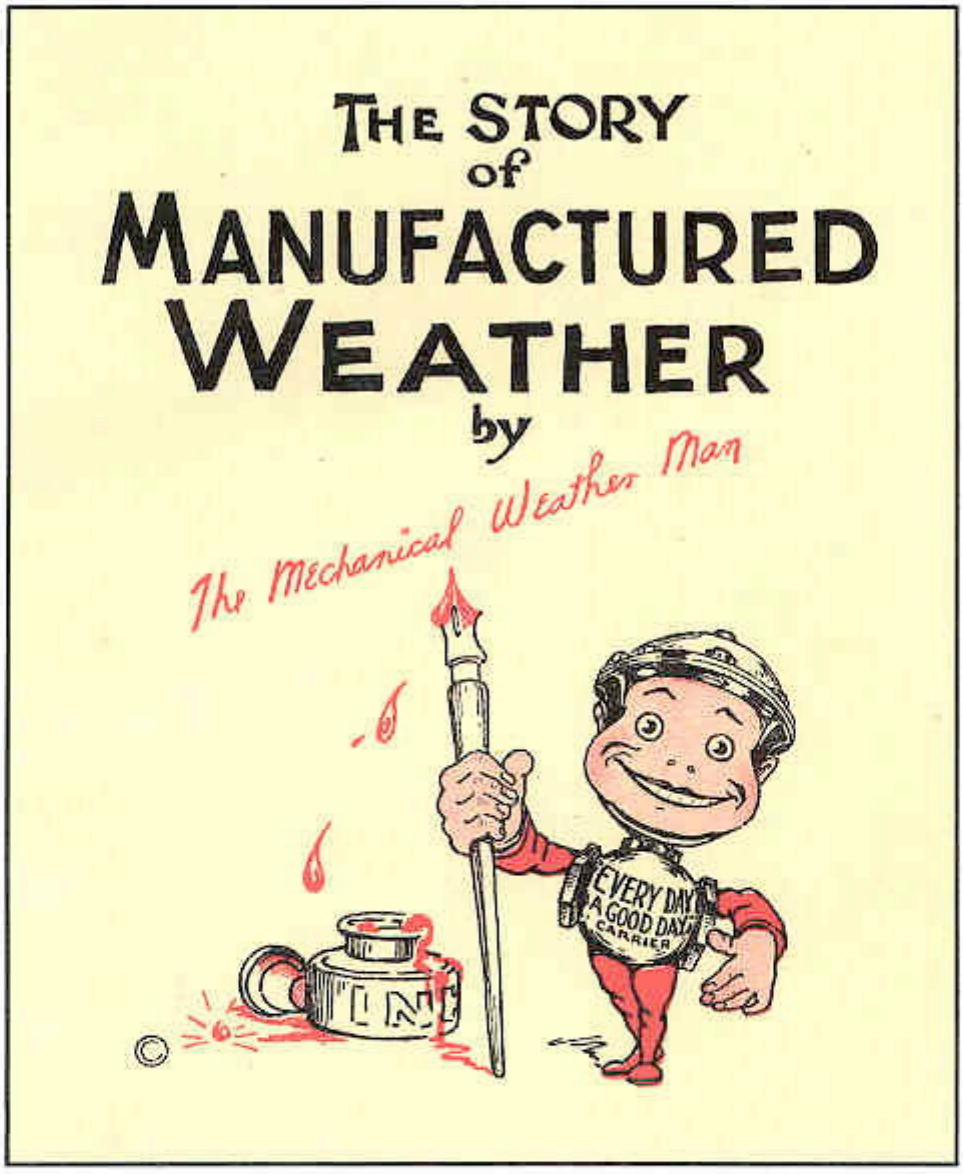


From catalogue of 1919 [6/401].

PART-1

THE AMERICAN CONNECTION
Willis Carrier & Carrier Corporation, USA

1. THE AMERICAN CONNECTION

Dr Willis Haviland Carrier (1876-1950) is universally regarded as the "Father of Air Conditioning." His life and career, and the story of the American Carrier Corporation until his death, has been told in Margaret Ingels' biography [19/FAC] and elsewhere [see Reference List 1].

Willis Carrier was born on a farm in Angola in New York State. After a considerable struggle, he managed to win a scholarship to Cornell University, where he survived financially by taking on an amazing variety of odd jobs. He graduated in 1901 with the Degree of Mechanical Engineering in Electrical Engineering. Although intending to specialise in electrical engineering, he took a job in Buffalo with the Buffalo Forge Company where he worked with Irvine Lyle, whom he later described as "the best salesman he ever knew." The company was engaged in the manufacture of blowers, exhausters and heaters and their application for heating, drying and boiler draught systems. He soon realised that the engineers relied largely on rule-of-thumb calculation methods. Not satisfied with this, Carrier produced a mathematical approach to the selection of boiler fans and a paper "Mechanical Draught" which so impressed the two top executives of the firm (the founder and principal owner, William F Wendt, and his younger brother and operating manager, Henry W Wendt) that he was allowed to set up a research laboratory.

In 1902, Lyle brought Carrier details of the humidity problems being experienced by the Sackett-Wilhelms Lithographing and Publishing Company in Brooklyn. After much experimentation and theoretical work, Carrier designed what has been hailed for nearly a century as the world's first scientifically designed air conditioning plant. [It now appears the installation was not the great success claimed by successive advertising departments, 18/HAC, page 332, note 63, and was removed in 1910]. In fact, a notable, though less well known air conditioning pioneer was Alfred Wolff [CM, entry 211] who designed what was probably the first successful comfort installation for the New York Stock Exchange in 1903; this operated successfully for some 20 years. Also, the development of early industrial humidity control, particularly in the textile mills in the southern states of America, owes much to Stuart W Cramer [CM, entry 105] who is generally credited with coining the term "air conditioning" in 1906.

This is not to denigrate Willis Carrier's enormous contribution to the fledging industry, but Carrier, himself, said in 1929, "No individual or no firm can take credit for all or part of these (air conditioning) developments." What Willis Carrier did so successfully was to develop a complete range of air conditioning design tools, and systems and equipment which still form the basis of modern practice.

The founders of Carrier Engineering Corporation, now Carrier Corporation. They are, standing, from the left, Edmund P. Heckel (Superintendent of Erection), Ernest T. Lyle (Boston Office), and Alfred E. Stacey, Jr. (Western Manager and Engineer). Seated are L. Logan Lewis (Chief Application Engineer), Willis H. Carrier (President, Chief Engineer), J. Irvine Lyle (Treasurer, General Manager) and Edward T. Murphy (Secretary, Manager, Philadelphia District).

The founders of Carrier Engineering Corporation, USA, 26 June 1915 [5/564, 2].

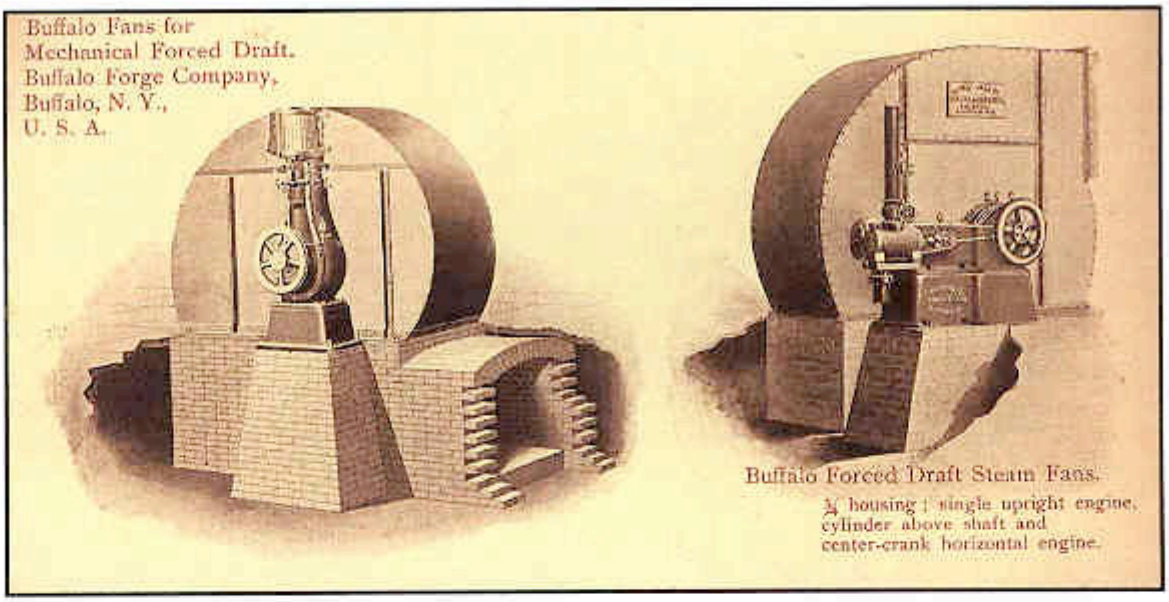
In 1904, Carrier applied for an equipment patent for an "Apparatus for Treating Air" [USP 808897, 2 January 1906]. This was a spray chamber washer, which could heat and humidify the air passing through it when supplied with warm water, or cool and dehumidify when the water was cooled below the dew point temperature of the air passing through it. The concept of removing moisture from an air stream by spraying chilled water into it was greeted with incredulity, even ridicule, but it worked. The washer remained a vital part of an air conditioning system up until the 1940s, and was still finding limited use in the 1960s. The open water circuits had a number of operating and maintenance problems and came to be supplanted by chilled water coils operating in closed circuits.

Carrier also developed methods to try and calculate air conditioning loads more accurately and developed psychrometric data, publishing his first psychrometric chart in Buffalo Forge Catalogue No. 97 in 1906. These were important breakthroughs in the design process. They enabled proposals submitted by him through Buffalo Forge to prospective clients to include a guarantee of system performance, specifying the internal conditions of temperature and humidity that would be maintained under stated external summer and winter conditions. At that time many competitors did no more than guarantee the volume of air that the system fans would deliver, without any mention of the results to be achieved. Also in 1906, Carrier invented his "Dew-Point Control" [USP 854,270, 21 May 1907].

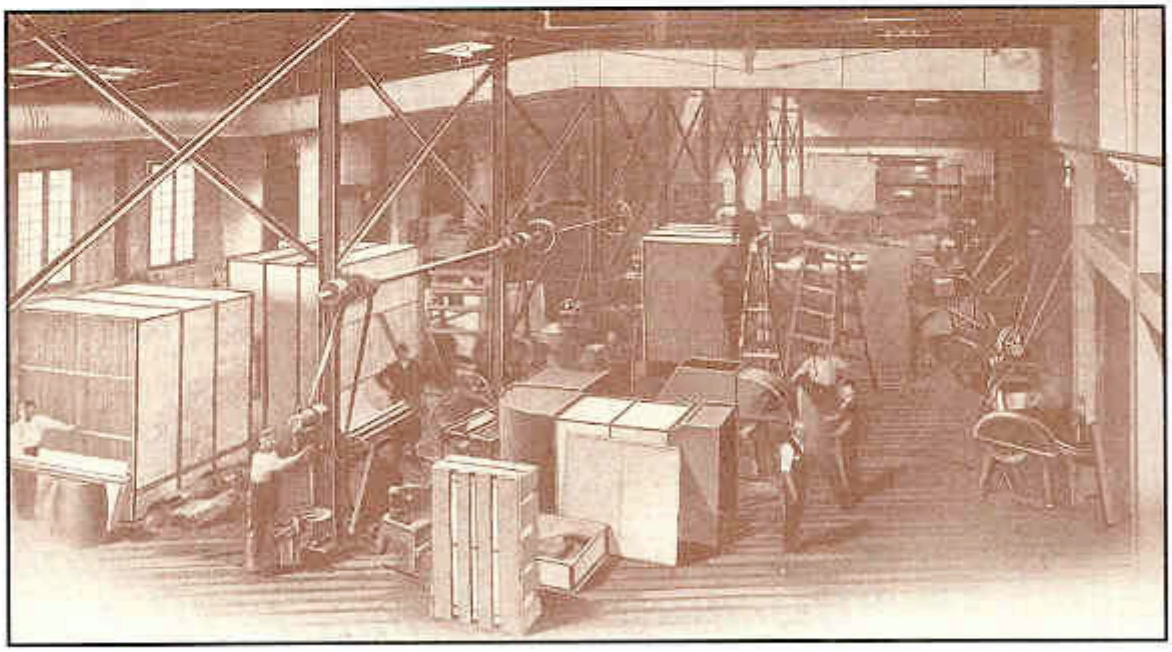
The air conditioning operations of Carrier, Lyle and his colleagues proved so successful that the Wendt brothers set up a wholly owned subsidiary, operational by 1908, called Carrier Air Conditioning of America (CAC). Willis Carrier continued to develop his ideas on air conditioning. He improved the spray-washer. In 1911, he invented a dew point thermostat and a differential hygrostat. The same year, he presented to ASME one of his most important technical papers, "Rational Psychrometric Formulae" [2/468]. The business thrived and was particular active in the provision of air conditioning for textile mills.

However, the advent of the 1914 war in Europe led the Wendt brothers to rethink their business strategy. They decided to close CAC and concentrate on manufacturing. Risking all, Willis Carrier with six other engineers, set up the Carrier Engineering Corporation on 26 June 1915. The other founders were Irvine Lyle and his brother Ernest, Edward Murphy, Logan Lewis, Alfred Stacey and Edmund Heckel.

As the new company took on various air conditioning projects, Willis Carrier recognised the inadequacy of existing refrigeration machines. The story of how he turned the idea of the centrifugal compressor into a practical machine for chilling water is summarised elsewhere in this book [under "Refrigeration in Part-3]. The theory behind this and his search for a suitable refrigerant may be found in his own technical papers [13/453, 465 & 903-A2] while a fuller history has been written by his colleagues, Logan Lewis [13/459] and Walter Grant [900-A2]. The centrifugal water chiller, which he introduced in 1922, was to change the face of comfort air conditioning.



Extract from Mechanical Forced Draft, booklet of Buffalo Forge Company c.1899 [3/316, 4]



Air Washer under construction in the workshops of the Buffalo Forge Company.
From a 1913 catalogue of Carrier Air Conditioning Company of America [3/R81, 2].
(This particular catalogue is rubber stamped "Buffalo Forge Company, Caxton House. Westminster, London")

Some Silk Mills

IN no class of textile mills does the question of a proper temperature and humidity deserve and probably receive more attention than in the silk industry.

The reason is very apparent, as silk is one of the most hygroscopic of fibres, and changes in temperature and humidity greatly affect its manipulation and manufacture.

A few years ago, and only a very few, too, the best of the mill managers felt that they had done all that was necessary when they bought almost any kind of a humidifying system. They had bettered their conditions without a doubt, for even the earlier types of humidifiers were an improvement on nature. Of late, however, the more progressive of these men have been very critical in passing judgment, and have demanded something more than the mere moistening of the atmosphere of the mill.

Among their demands have been that there be provided some means for ventilation, cooling of the mill, and automatic regulation of both temperature and humidity.

Nearly all the foremost mill engineers in this country today are advocating adequate ventilation as an economical consideration as well as humanitarian.

The artificial cooling of mills was unnecessary until mills became filled with high speed machinery, using a large amount of power, with the resultant rise in temperatures.

Humidity and temperature are too closely allied for the former to be successfully treated without considering the latter.

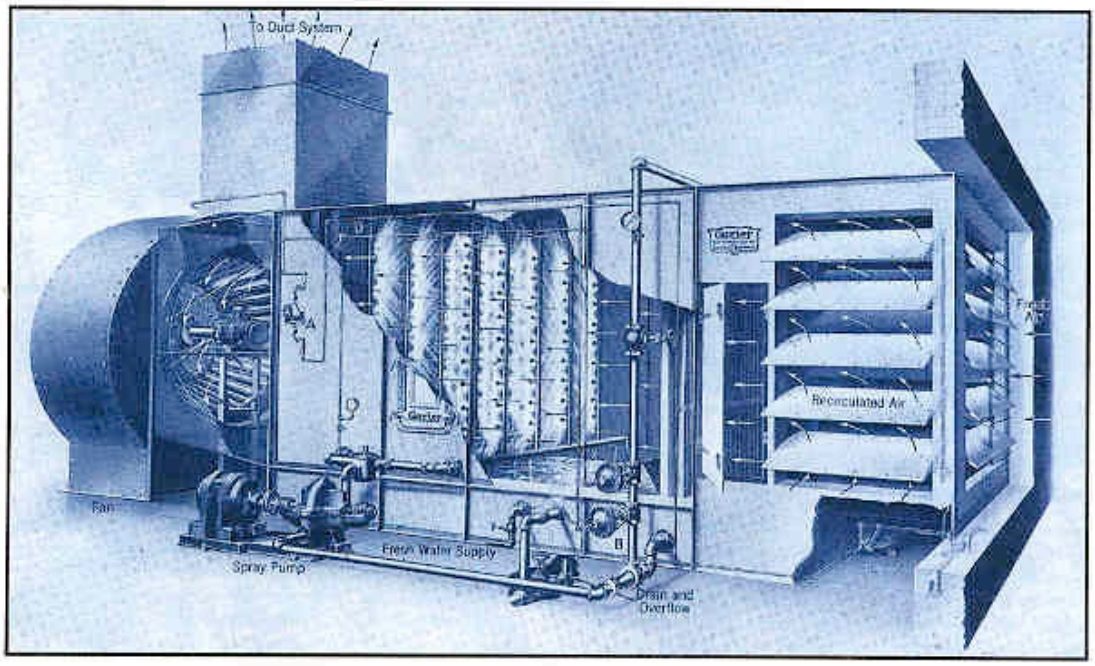
The automatic regulation of the relative humidity and temperature has proven to be a big step toward a uniform production as well as an increased production. With an atmosphere maintained uniformly at the point best suited to the operation at hand, few adjustments in the machines are required, and usually they can be operated at increased speed.

There is only one system of Air Conditioning that does Humidifying, Cooling, Heating, Ventilating, and Automatically Controls the temperature and humidity, and that is the CARRIER SYSTEM—the guaranteed system.

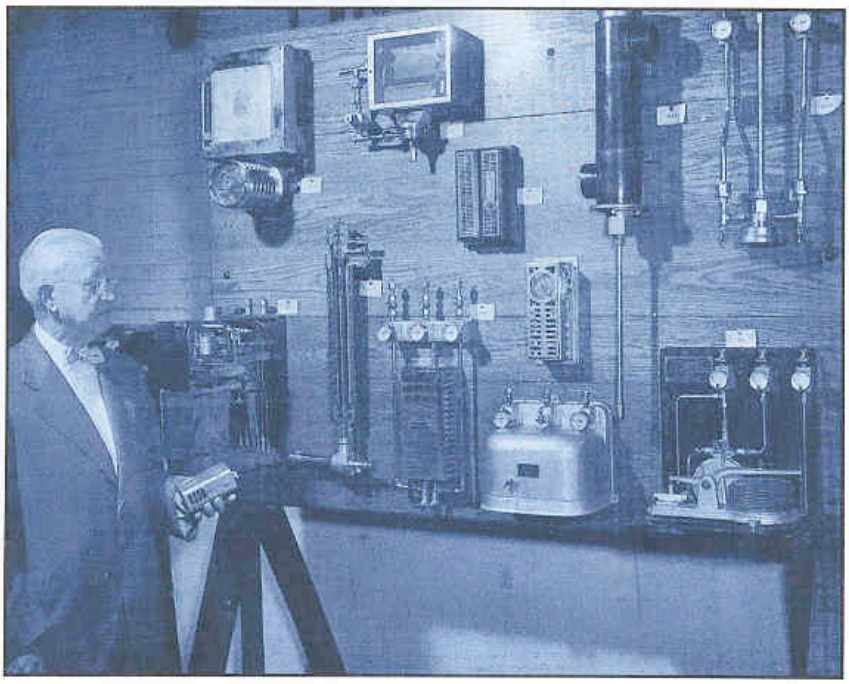
THE CARRIER AIR CONDITIONING CO. not only sell you apparatus, but also results, which are what count. Write for complete catalog, or if you desire, an engineer who is a specialist on Air Conditioning will be sent to tell you more about the System, the results and methods.

CARRIER AIR CONDITIONING COMPANY OF AMERICA
NO. 39 CORTLANDT STREET, NEW YORK

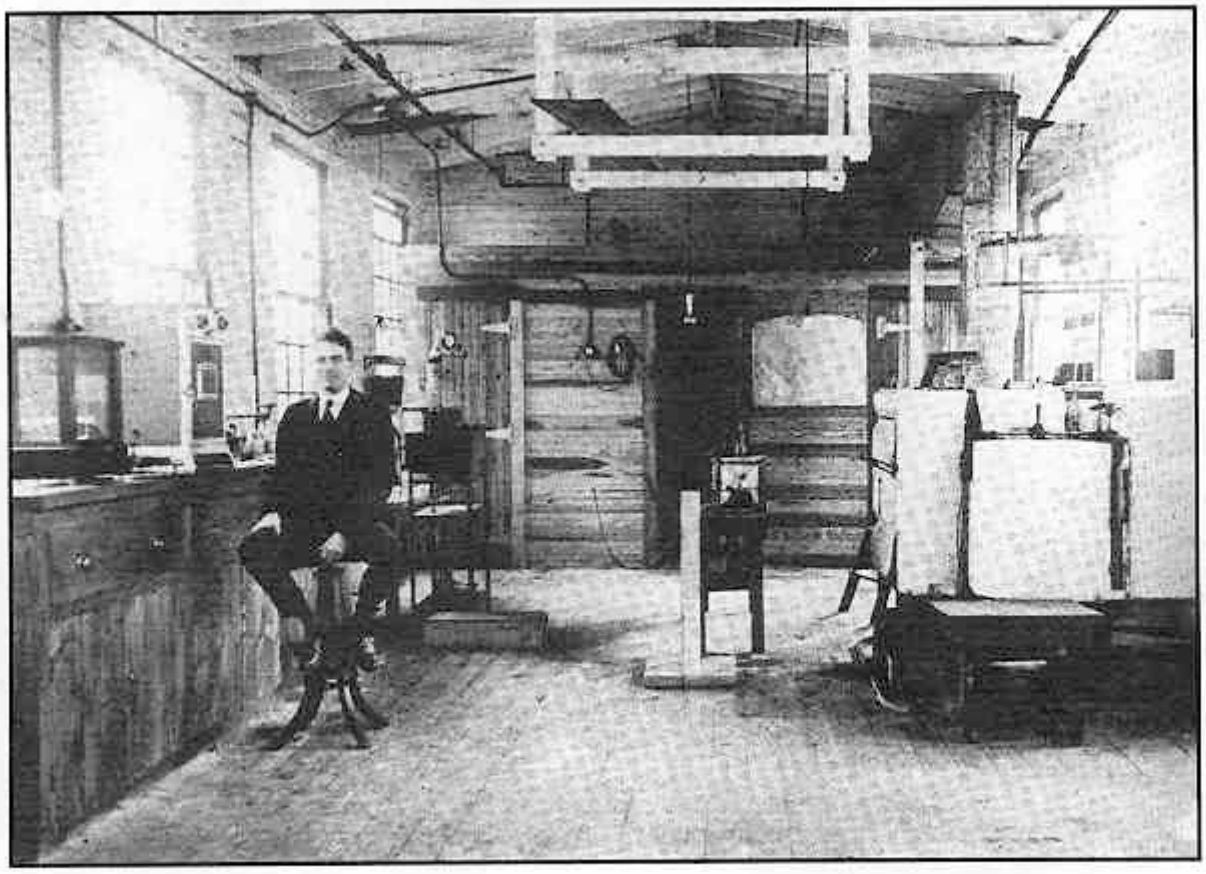
Extract from a booklet "Some Silk Mills," Carrier Engineering Company of America, 1910 [3/315, 4 & 5]



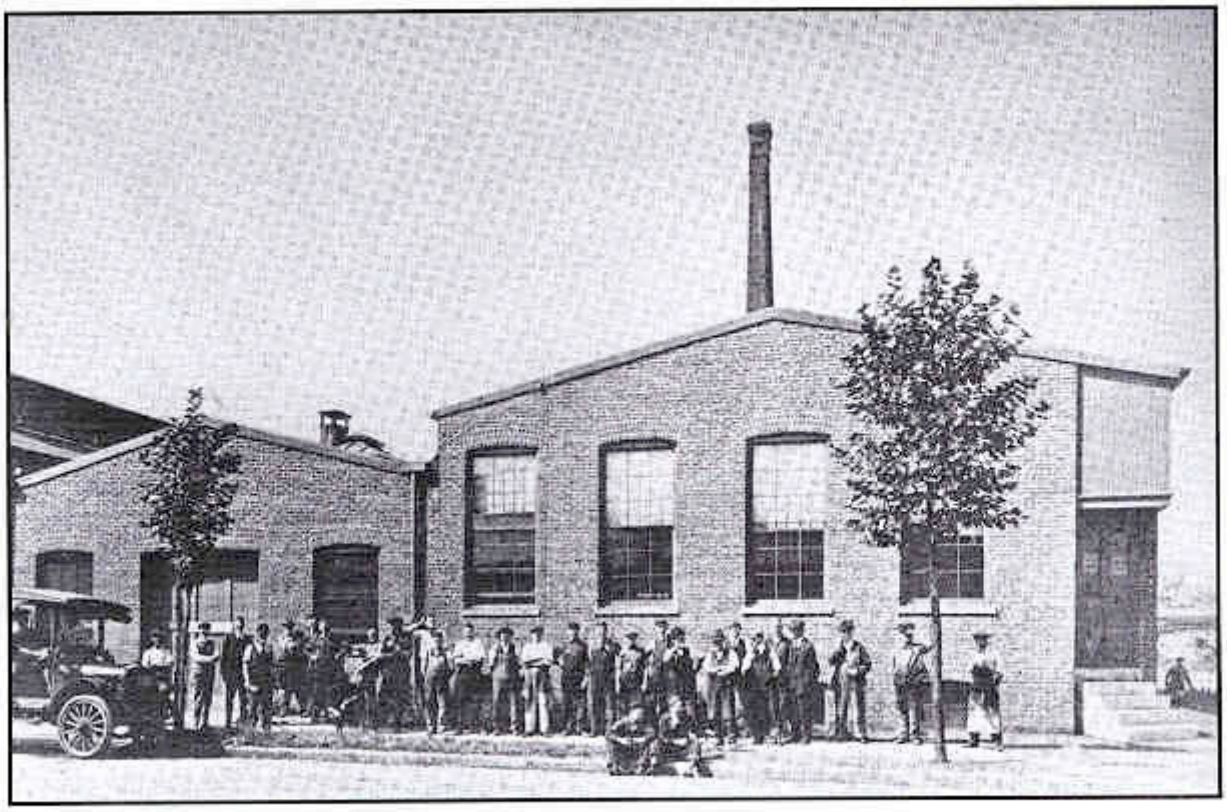
Early Carrier Engineering Spray Washer Central Station System, c.1915 [4/564, 6]



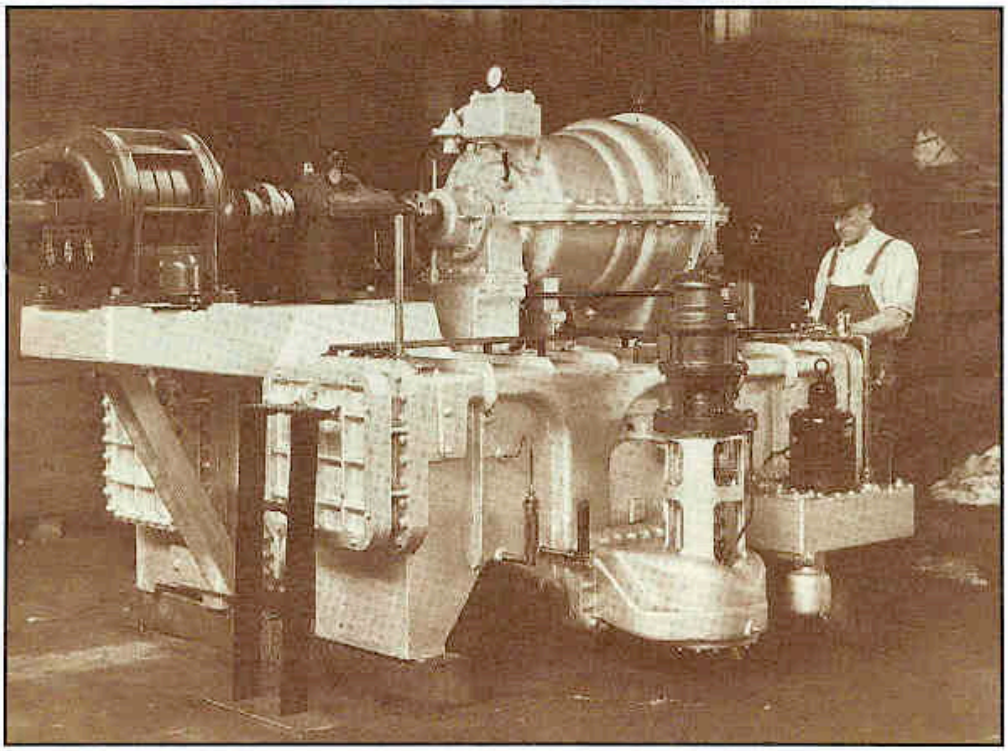
Early Carrier automatic humidity control instruments.
(The onlooker is not Willis Carrier) [4/564, 4]
Originally the instrument at lower left sold for $750; by 1950 it cost around $50.



Alfred E Stacey Jr in the Newark Laboratory, c.1919 [4/467, 8]



The early Carrier Engineering Corporation Research Laboratory & Shop, Newark, NJ, 1919 [4/467, 8]



An early Carrier centrifugal refrigerating machine, [4/564, 8].

The Rivoli movie theatre, New York, "Cooled by Refrigeration," 1925 [4/467, 6].

The other event that was to enable Carrier Corporation to expand from their industrial air conditioning base was the recognition of the enormous potential in the comfort market, particularly in the movie theatre business.

At this time, only a handful of buildings had comfort systems. The cooling of cinemas in the USA was pioneered by Frederick Wittenmeier of Chicago from 1917[19/ACA, chapter 4]. His systems used carbon-dioxide refrigeration and took no account of humidity control. He used an upwards system of air distribution which generally overcooled the audience. Logan Lewis of Carrier Corporation changed this with his 1922 installation for Grauman's Metropolitan in Los Angeles, using a system of downwards air distribution with return air bypass [4/564]. The first cinemas to use the new centrifugal, in 1924, were the Palace in Dallas and the Texan and Iris (which shared a machine) in Houston. In New York, the Rivoli was upgraded to air conditioning in 1925, employing the centrifugal chiller [19/FAC], an installation which impressed Adolph Zukor, the head of Paramount Pictures. [It turned out that the air conditioning of movie theatres was the one thing that was later to enable the company to survive the Depression.]

These events were all to prove significant to the success of Carrier Engineering Company (CEC) when it was established in London in 1921.

Willis Carrier went on continue his contributions to the company which bears his name and to the industry at large. He served as Presidents of both ASRE (1927) and ASHVE (1931). Around 1929, he developed the Carrier "Weathermaster" induction unit system. He helped to develop CEC and other Carrier business interests around the world. He contributed over 100 technical and discussion papers to the profession and wrote two textbooks, which became industry standards: "Fan Engineering" (Buffalo Forge), 1914 and "Modern Air Conditioning, Heating and Ventilating" (with Rialto Cherne & Walter Grant), 1940 [the latter became a standard reference in the UK during the 1950s & 60s where it was simply referred to as "Carrier, Cherne & Grant"]. Willis Carrier received many honours: John Scott Medal (1932), F Paul Anderson Medal (ASHVE, 1932), the ASME Medal (1934) and the first Frank P Brown Medal of the Franklin Institute (1941). In 1947, he had the unusual distinction of being one of three Americans invited to address the centenary celebration in London of the Institution of Mechanical Engineers [1/552]. In 1994, Willis Carrier, the Father of Air Conditioning, was inducted in the ASHRAE Hall of Fame.

A POEM by Dr ALBERT KLEIN
IN TRIBUTE TO WILLIS HAVILAND CARRIER

Bad Teinach, Germany
14 February 1947

Seventy years have passed away
Since a cold November day,
Came to life a black-haired boy,
Loud and lusty was his cry.

Willis Haviland he was named,
He became well-known and famed,
As the man who made, I say:
"Every day a perfect day."

But before he could do that-
In young years he grew not fat,
For he had no easy start,
Had to work long hours and hard.

School and college he passed, swift,
Nobody gave him a lift,
But his indomitable will
Drove him upwards the steep hill.

So he made his later way,
Worked and studied night and day,
Till he drew his famous chart
That gave air conditioning its start.

Out of his inventive mind
Fans and washers he designed
Autoregulation too
From imagination grew.

Centrifugal compressors came
Through his work to widest fame,
He made, I state, short and tart:
Air conditioning an art.

He wrote books about the air
And its technique and with rare
Knowledge, intuition told
Of its problems manifold.

How to cool it, how to heat,
Whether fast or slow the speed,
Where the pressure high, where low,
Whether strong or soft the blow.

Whether air was much too dry
Or humidity too high-
"Health and comfort through good air"
Was his watchword everywhere.

All the places where man slaves,
Suffers from cold and heat waves,
Cold air, hot air, dusty, mean
He made warm or cool and clean.

But not only he improved
Air where workers sat or moved,
Theatres, movies with great care
He gave well conditioned air.

Thus, not only USA-
Europe, Asia, Africa
Soon called Willis Carrie(e)r:
"Air conditioning's pioneer."

He brought help to all mankind,
Lessening the daily grind;
May he long live, healthy, strong
Many, many years to come.

[1/487a]

Dr Willis Haviland Carrier
1876-1950 *[1/552]*