

# STUART WARREN CRAMER and HIS WORK in AIR CONDITIONING

by Brian Roberts, CIBSE Heritage Group



*Stuart Warren Cramer, 1868-1940*

Stuart Cramer was born on 31 March, 1868, in Thomasville, North Carolina. He studied Naval Engineering at the United States Naval Academy, graduating in 1888. From 1888-1889, he studied Mining Engineering at Columbia University, leaving to become Assayer at the United States Mint in Charlotte, North Carolina.

In 1889 Cramer married Bertha Berry, with whom he had a son, Stuart Jr, and a daughter Katherine. After Bertha's death in 1895 he married her sister Kate, who died within months of their wedding. He married a third time to Rebecca Warren Tinkham, with whom he had a second son, George Bennett.

In 1893, Cramer went to work for Daniel A Tompkins, a leading textile mill engineer, being rapidly promoted to Chief Engineer & Manager of Tompkins' company in Charlotte, which represented the Westinghouse Electric Motor and other textile mill supply companies. After two years, he left and set up in business as an Engineer & Contractor specialising in designing and equipping cotton mills (At this time, there was a region-wide boom in textile production).

In 1905, Cramer worked with Tompkins and Westinghouse to help establish the Duke Power Company which invested in hydro-electric power plants. He encouraged the widespread installation of electric-drive motors in textile mills to replace water power and Corliss steam engines, with the added advantage of providing electric lighting, enabling the mills to run full-time.

From 1905 onwards, Cramer carried out the design and construction of his own textile mills, notably Highland Park No. 3 Mill & Mill Housing. He planned the spinning and weaving mill beside its railway tracks to “facilitate an integrated work flow from unloading the cotton from railroad cars to shipping out the finished gingham. It was one of the first textile mills planned specifically for electric power and had its own generating plant.”

Cramer’s major contribution to the cotton industry was his work on improving spinning efficiency by his innovative invention of a water-spray humidifier to control relative humidity levels, reducing yarn breakage and improving worker comfort levels. He is credited with coining the term *air conditioning* which he introduced in his paper of 1906, *Recent Developments in Air Conditioning*, read before the American Cotton Manufacturers Association. It is believed the term was suggested by the use of the term *conditioning* in the treatment of yarn, cloth or raw materials before manufacture. Cramer also used term in his US Patent of 1907. He wrote *Useful Information for Cotton Manufacturers* in 1906 and 1909. (Cramer discovered independently some of the psychrometric relationships set out in 1911 by Willis Carrier). In 1913, Cramer obtained a further patent for his *Air Conditioning (Humidifying) Apparatus*.

In 1918, Cramer sold his air-conditioning business to the G M Parks Company of Fitchburg, Massachusetts and ceased his interest in air conditioning. The new Parks-Cramer Company was formed with additional offices in Boston and Charlotte and, in 1924, published the classic textbook *Air Conditioning in Textile Mills* based on his work.



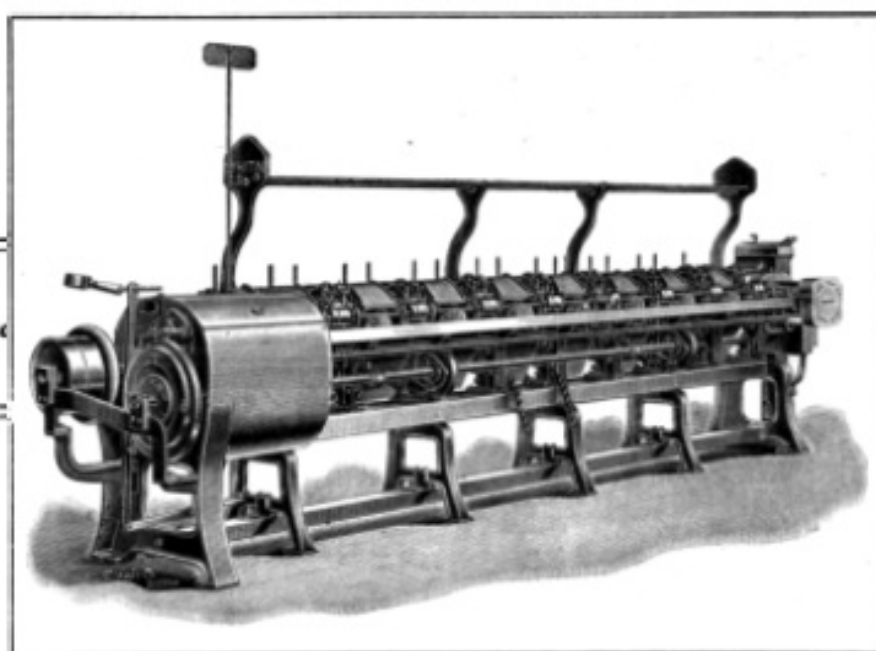
*Ceiling-hung humidifiers in a textile mill*

# THE WHITIN MACHINE WORKS

WHITINSVILLE, MASS.

*BUILDERS OF*

## COTTON MACHINERY



*High-Speed*

*Comber*

CARDS, COMBERS, DRAWING FRAMES, SPIN-  
NING FRAMES, SPOOLERS

TWISTERS, REELS, LONG CHAIN QUILLERS,  
LOOMS

*SOUTHERN AGENT*

**STUART W. CRAMER**

CHARLOTTE, N. C., and ATLANTA, GA.



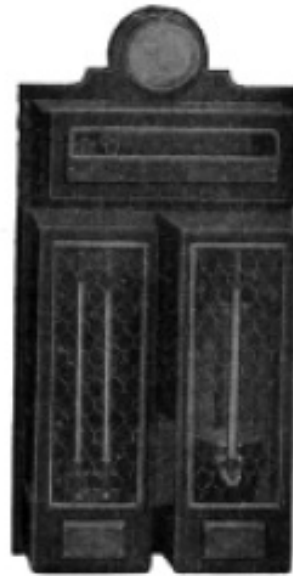
*Carolina cotton mills in 1908*

*(Photographs by Lewis W Hine, from "Children at Work," Vicki Goldberg, Prestel, 1999)*

# Cramer System of Air Conditioning



Cramer "High Duty" Air Conditioner



Cramer Automatic Regulator

## FACTS

In several large mills equipped with humidifiers of other makes, we have entirely reorganized their system, installing our "High Duty" equipment with automatic humidity and temperature control and the average improvement during the succeeding twelve months test is:

- A—Seconds reduced over 50%.*
- B—Production uniform day after day (No big jumps.)*
- C—Actual waste account halved.*
- D—Large saving in "invisible waste."*

**What Would Similar Results Be Worth To You?**

**STUART W. CRAMER**

50 Church St.  
New York

Charlotte, N. C.

Tremont Bldg.  
Boston, Mass.

## WILLIS CARRIER AND TEXTILE MILL AIR CONDITIONING

Cramer had a rival in the design and installation of humidity control systems for the textile industry. It was Willis Carrier, when operating the Carrier Air Conditioning Company of America (a subsidiary of Buffalo Forge) who developed "Apparatus for Treating Air" (US Patent No. 808, 897 of 1906). This was probably the world's first spray-type air conditioning equipment. "It was designed to humidify or dehumidify air, heating water for the first and cooling it for the second." The idea of using spray water for humidifying was readily accepted but the idea of using it to dehumidify was greeted with incredulity. Over the next few years, Carrier developed his equipment and established the "dew point control" method, successfully installing systems in a range of textile mills. In 1915, Carrier, with others, set up the Carrier Engineering Corporation. He developed air conditioning theory and designed new equipment which led to him being known as "The Father of Air Conditioning." His company went on to be a world leader.

### *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 mach-

[Four]

### *Some Silk Mills*

inery, 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.

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

[Five]

# Carrier Engineering Corporation



Humidifying, Dehumidifying, Cooling,  
Drying, Air Washing, Automatic Temperature  
and Humidity Regulation



39 Cortlandt Street, New York

BOSTON, MASS  
176 Federal St.

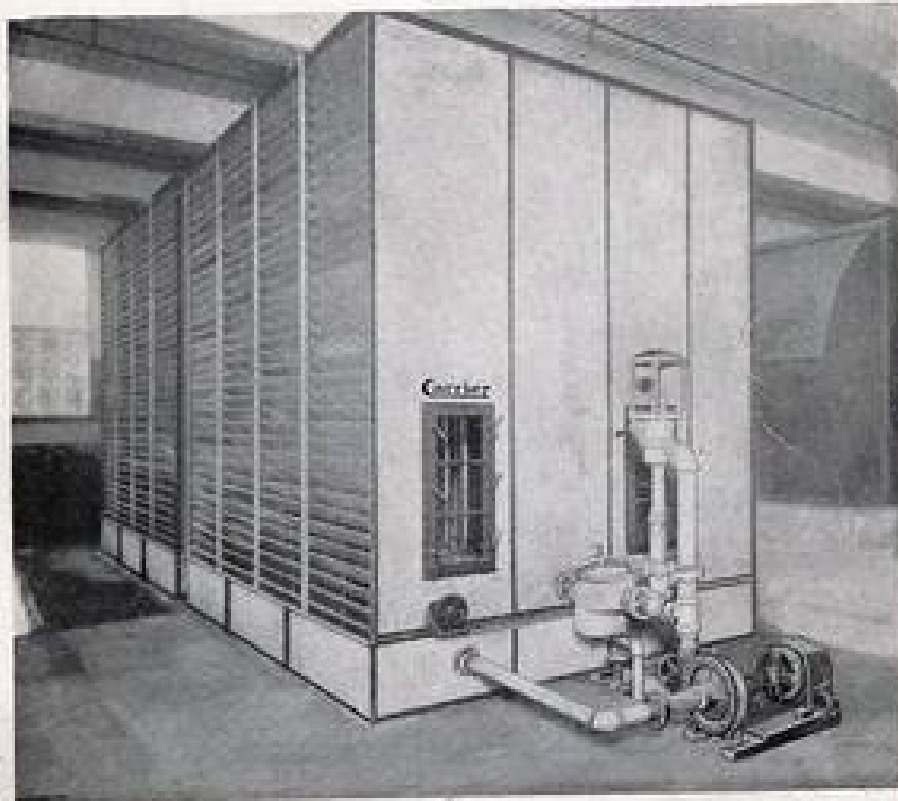
PHILADELPHIA  
Land Title Bldg.

BUFFALO, N. Y.  
Mutual Life Bldg.

CHICAGO, ILL.  
Transportation Bldg.

Bulletin No. 103

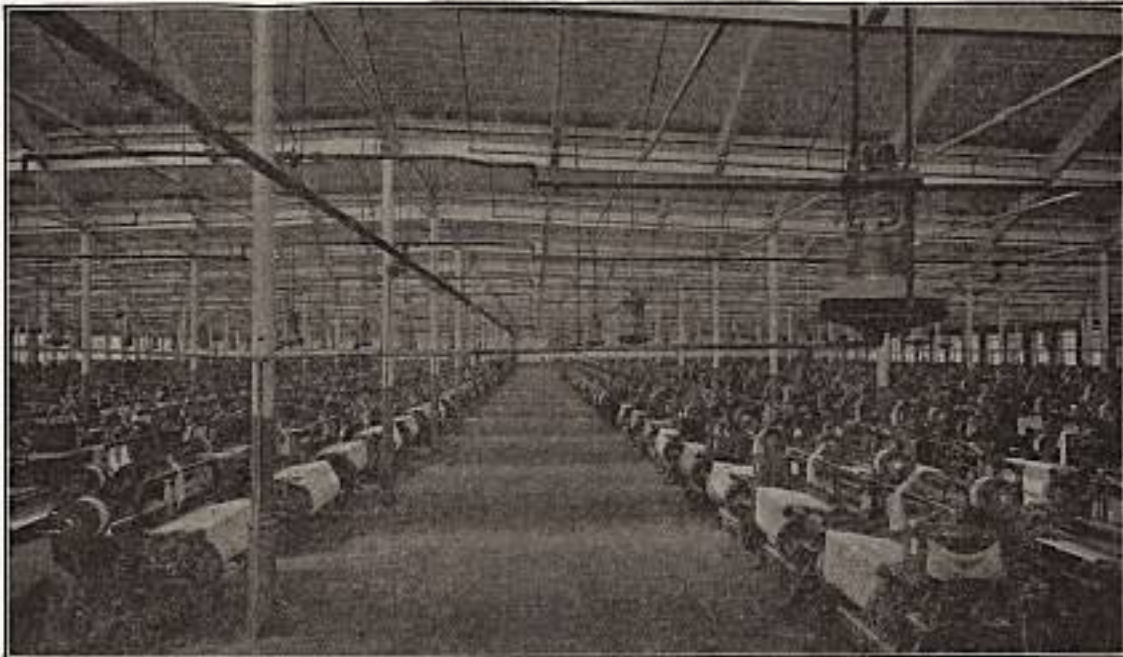
## The Carrier System of Humidifying as applied to textile mills



*Typical Carrier Humidifier with automatic temperature and humidity control. This installation serves the largest alpaca mill in the United States and one in which worsted dress goods and coat linings of the highest quality are made. Farr Alpaca Company, Holyoke, Mass.*

Copyrighted, 1916 by Carrier Engineering Corporation

# Machinery on the Ceiling Would Double Production



HUMIDIFIERS ARE EQUAL TO USING THE CEILING FOR PRODUCTION

**Y**OU place your machinery on the floors of your mill, mostly in response to the application of the laws of gravity.

But if some one would design textile machinery to operate successfully on your ceiling—and you could get operatives that had the faculty of working and walking upside down—this additional equipment would have some effect on your production.

Wouldn't it?

And also on your profits?

Turbo and Cramer humidifying equipment—scientifically designed for your specific manufacturing problems are the equivalent of just this.

They are just as if you used the ceilings of your plant for additional machinery.

Only.

The operatives still stay on the floor.

Machinery on the ceiling would present quite a problem.

Humidifiers near the ceiling—out of the way—solve problems.

Don't think—just because you have a humidifying equipment—you have gotten all there is out of it. Installations of humidifiers—are engineering problems. We have made much and exhaustive study of the subject—have learned much during the past few years particularly.

If you have not had the benefit of our data as applied to your problem, there is something more in humidifiers for you. Even if you have humidifiers now.

One of our customers installed Cramer humidifiers—he was already equipped as he thought—and saved \$28,000.00 the first year. The humidifiers cost him less than that amount.

Our engineers can determine accurately.

## Parks-Cramer Company

*Engineers & Contractors*  
*Industrial Piping and Air Conditioning*

**Fitchburg**

**Boston**

**Charlotte**



# Air Conditioning *in* Textile Mills

A Handbook on Humidification  
*for*  
Textile Manufacturers  
Engineers and Students

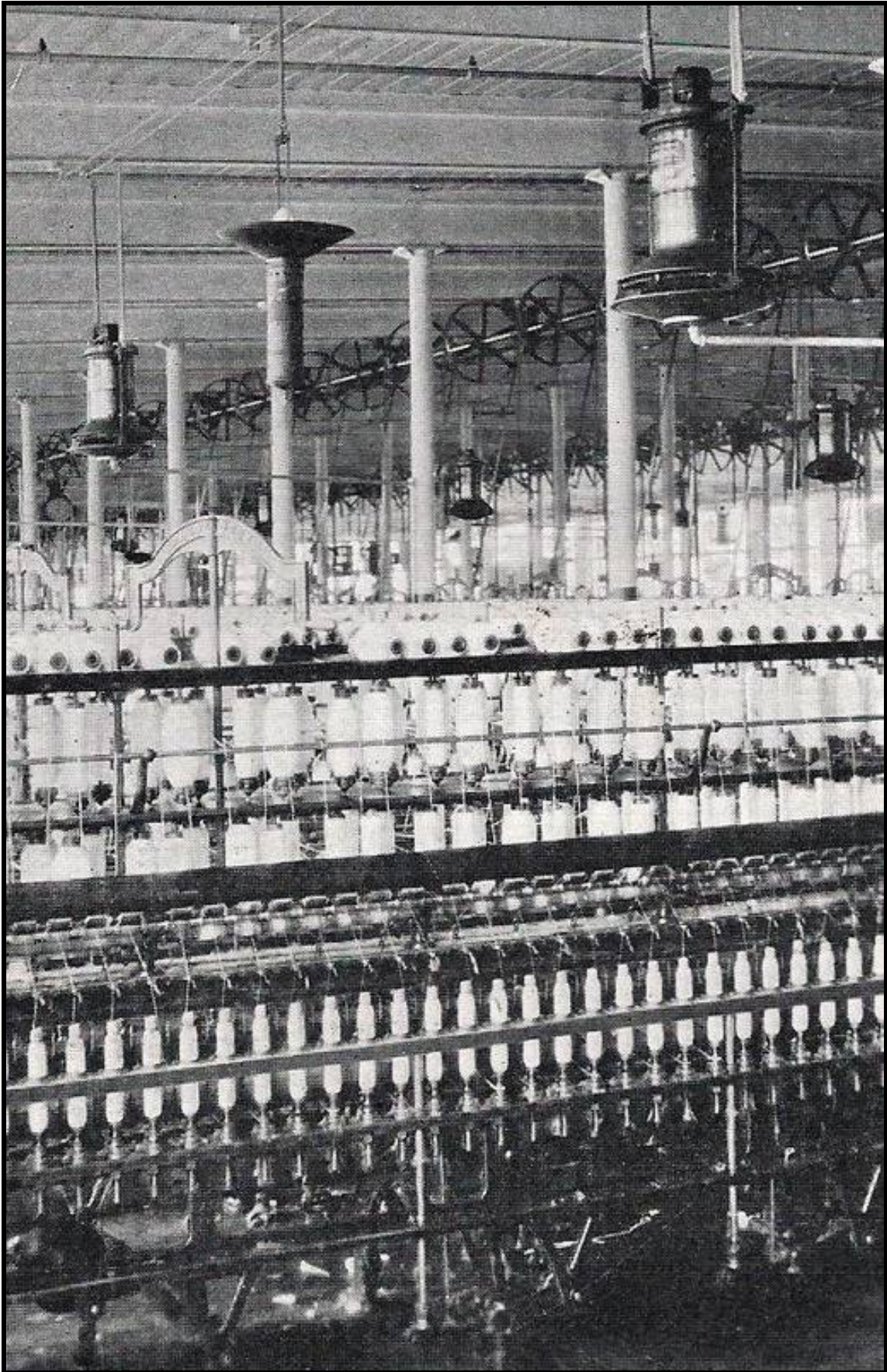
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*Edited by*  
Albert W. Thompson  
Vice-President  
Parks-Cramer Company

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*Price \$5.00*

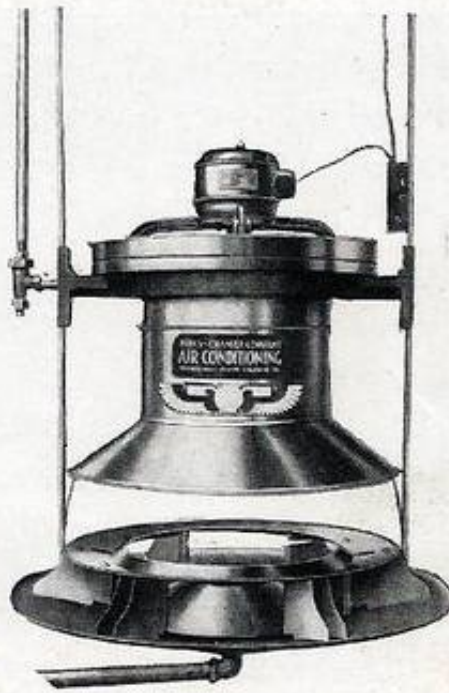
**Parks-Cramer Company**  
*Engineers & Contractors*  
*Industrial Piping and Air Conditioning*  
Fitchburg      Boston      Charlotte



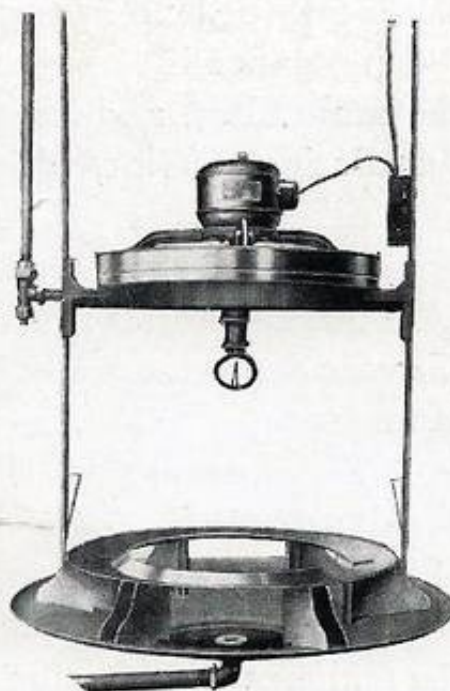
*High level humidifiers in Cotton Ring Spinning Factory, 1924*



Upper casing lowered.



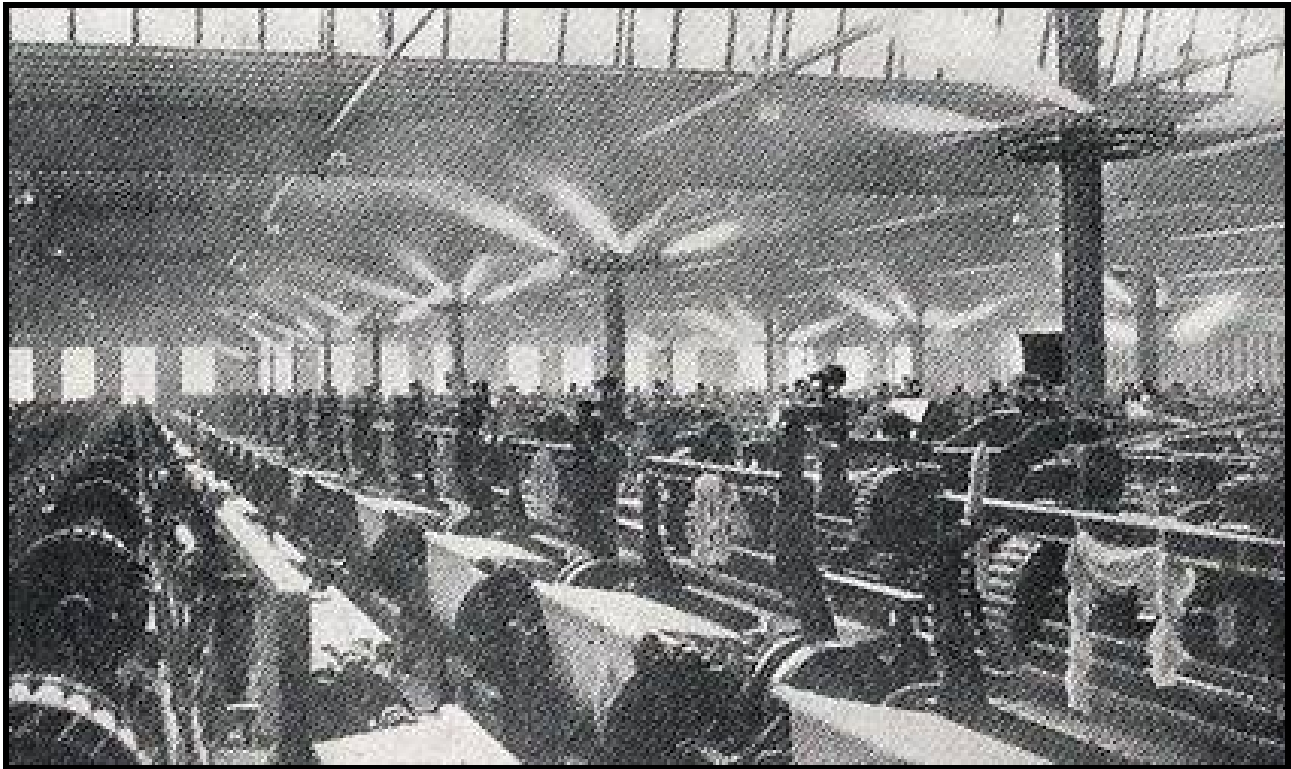
Lower casing raised.



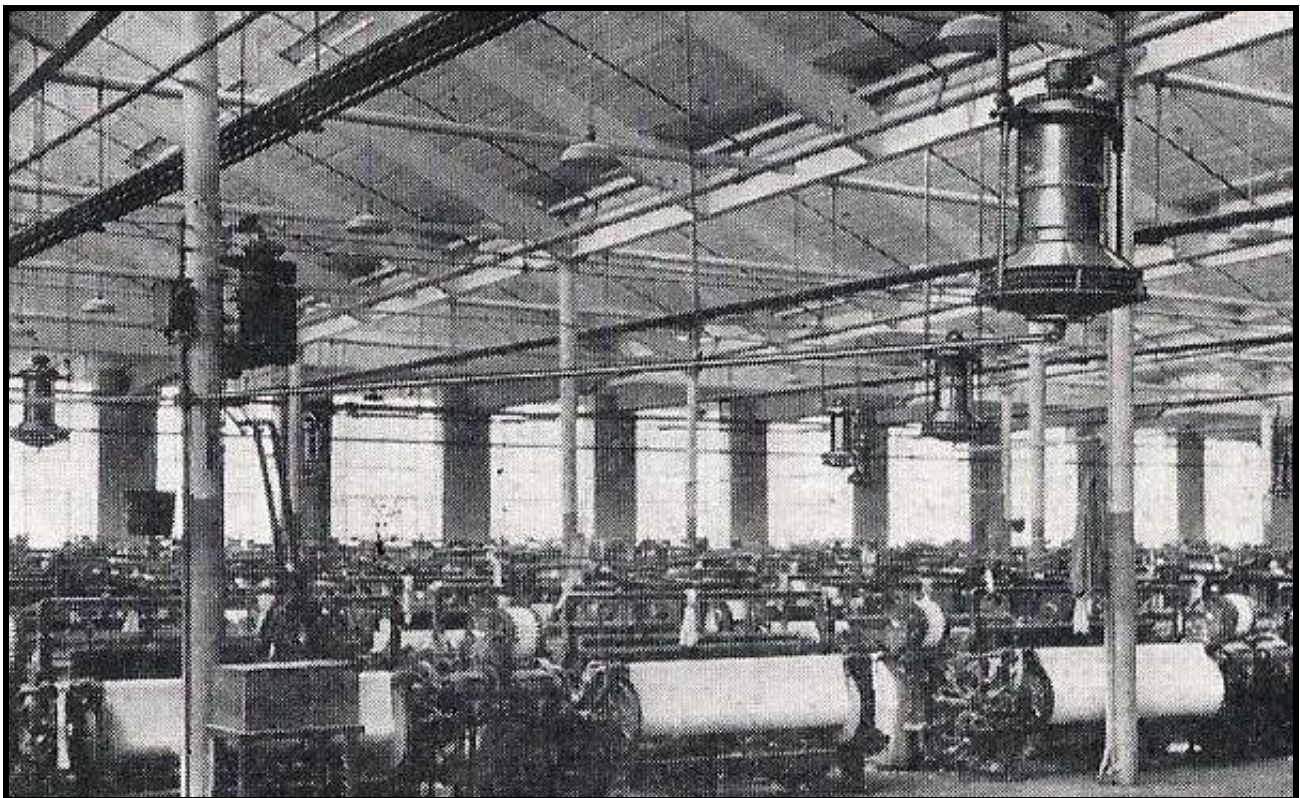
High Duty Humidifier—showing accessibility for cleaning



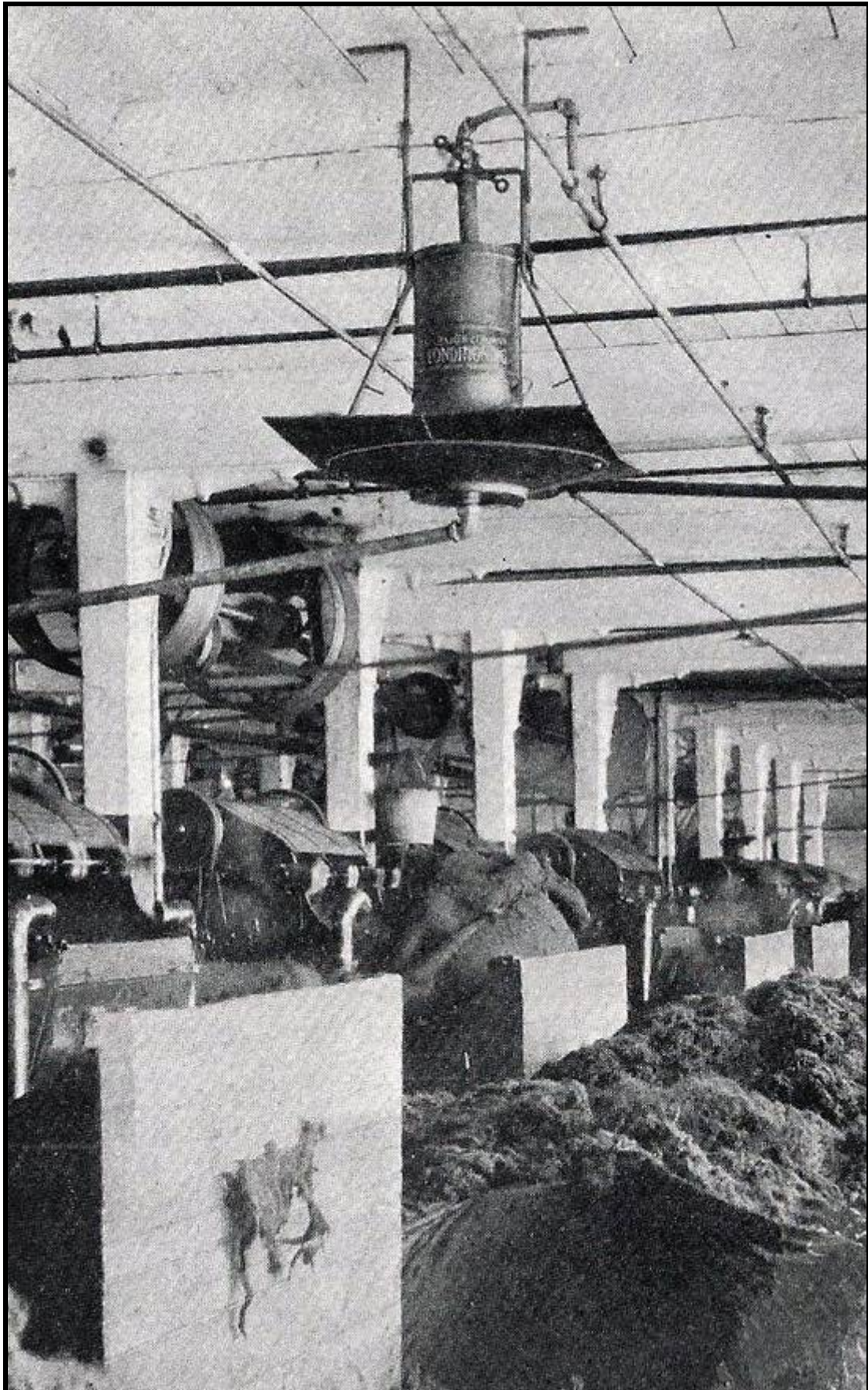
*Humidifiers used in Cotton Drawing Process*



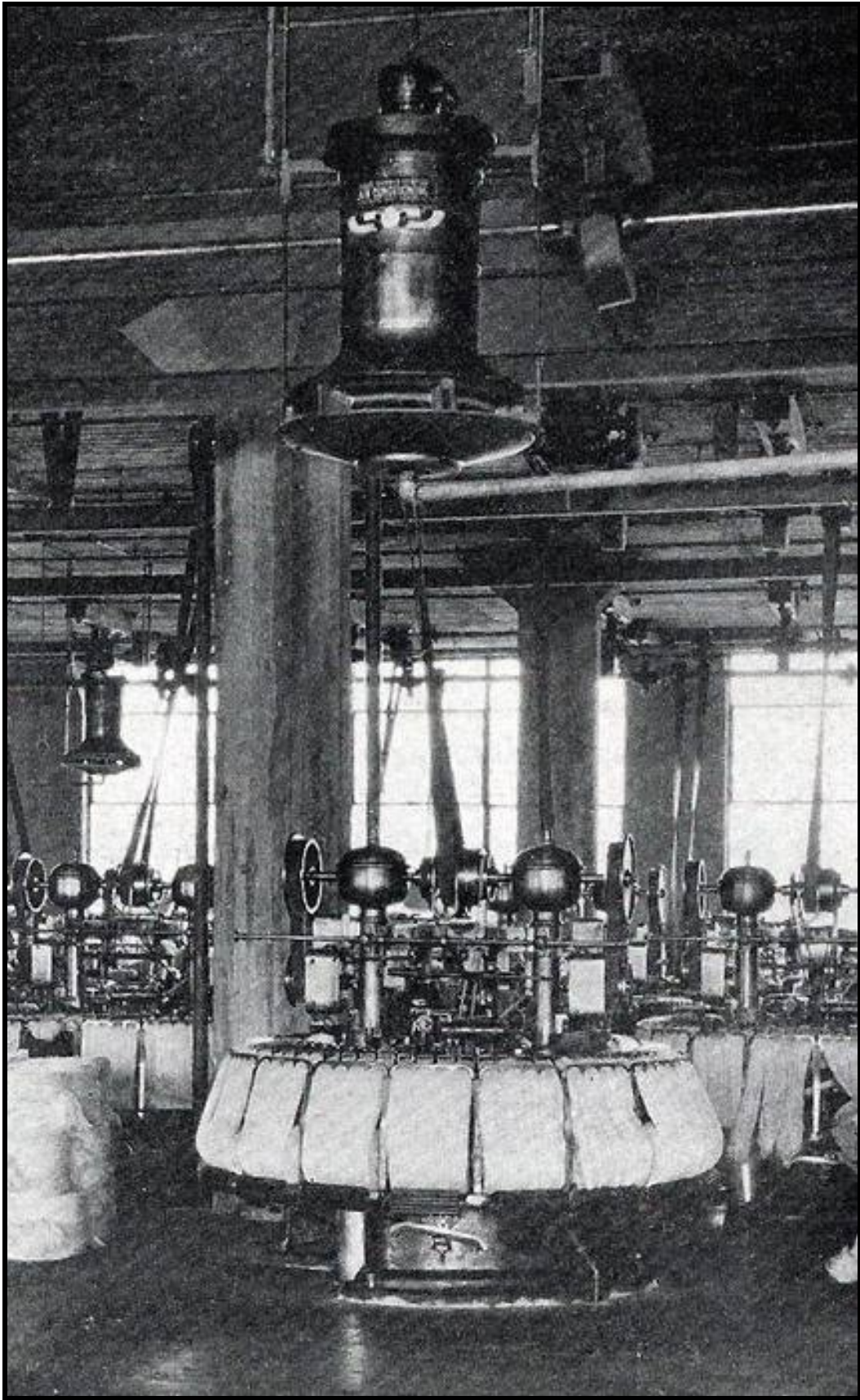
*Turbo Humidifiers (Ring Construction) used for Cotton Weaving*



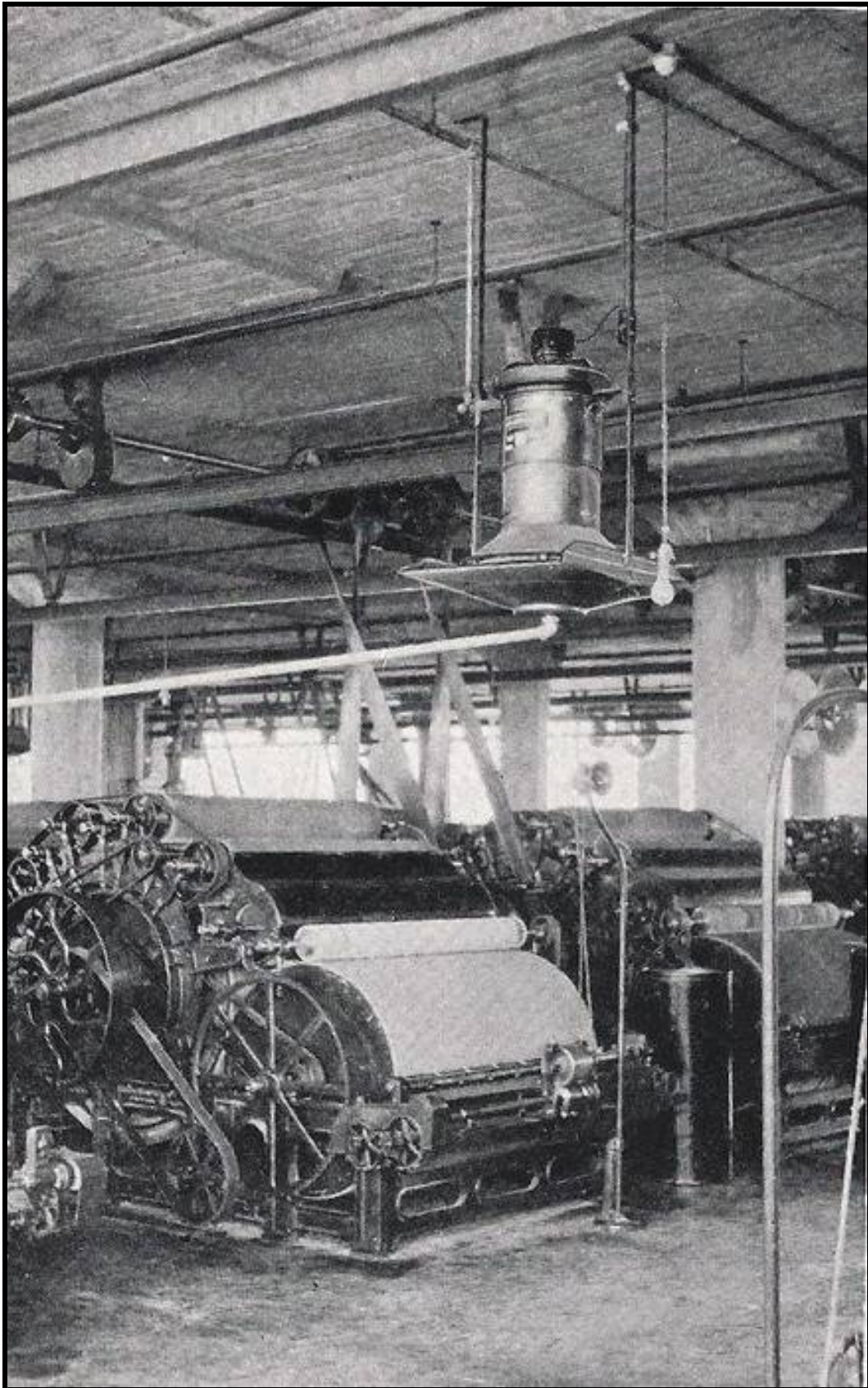
*High Duty Humidifiers and Automatic Regulators in use for Cotton Weaving*



*Humidifier in Woollen Card Room*

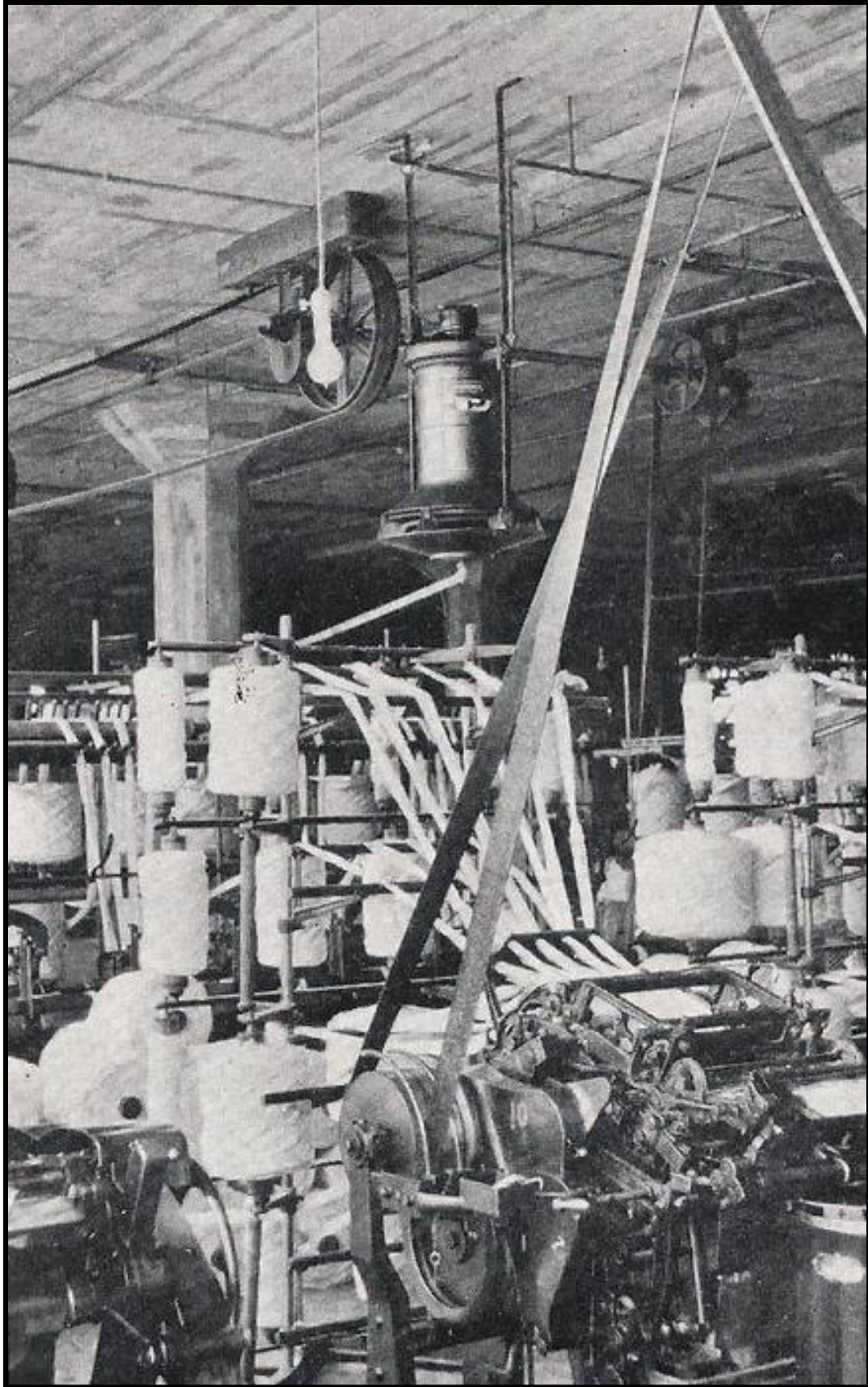


*Humidifier serving Noble Comb Machines (Bradford System)*

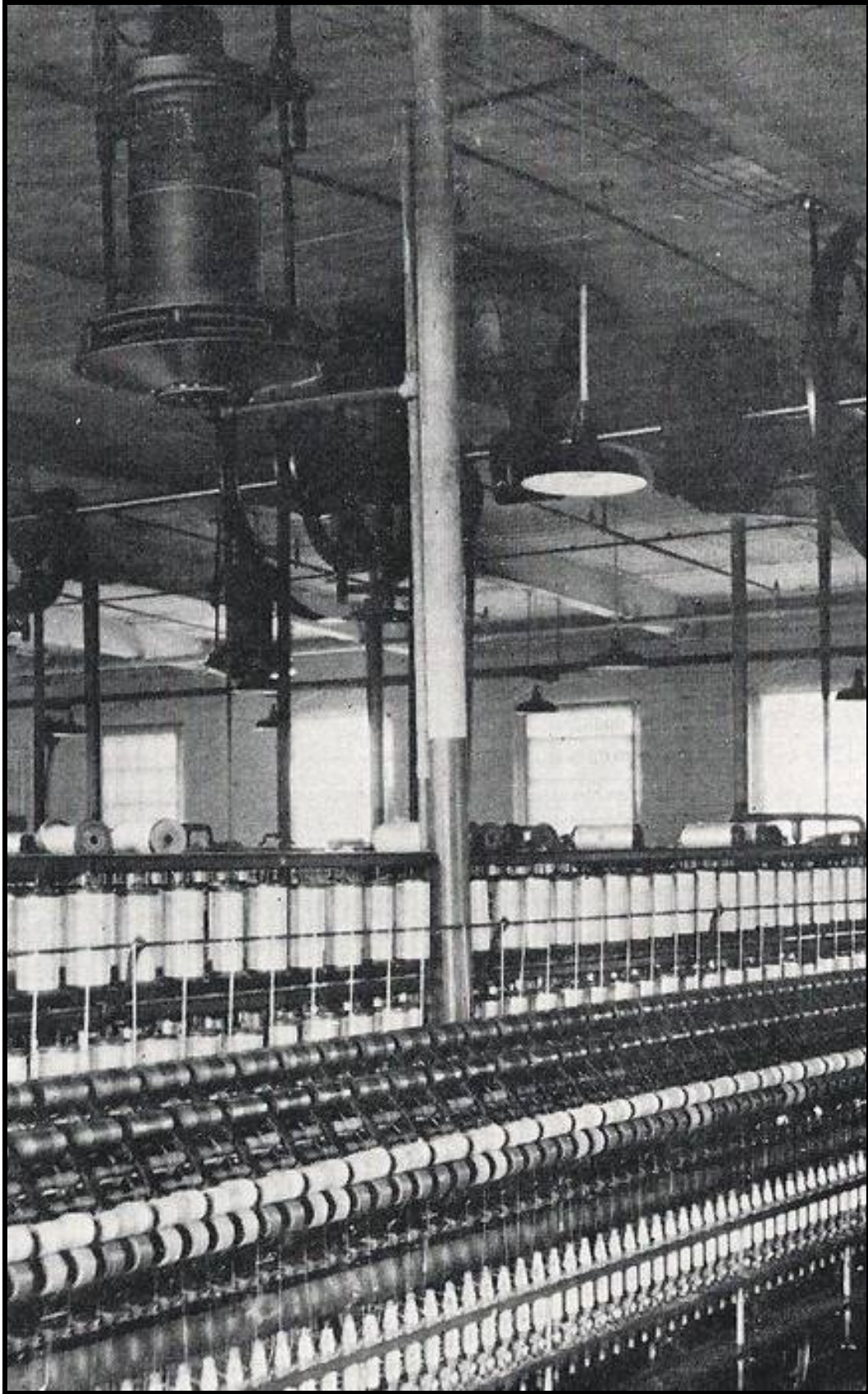


*Humidifier used during Worsted Carding (French System)*





*Humidifier used during Worsted Combing (French System)*



*Humidifier in use for the so-called Porcupine Drawing (French System)*

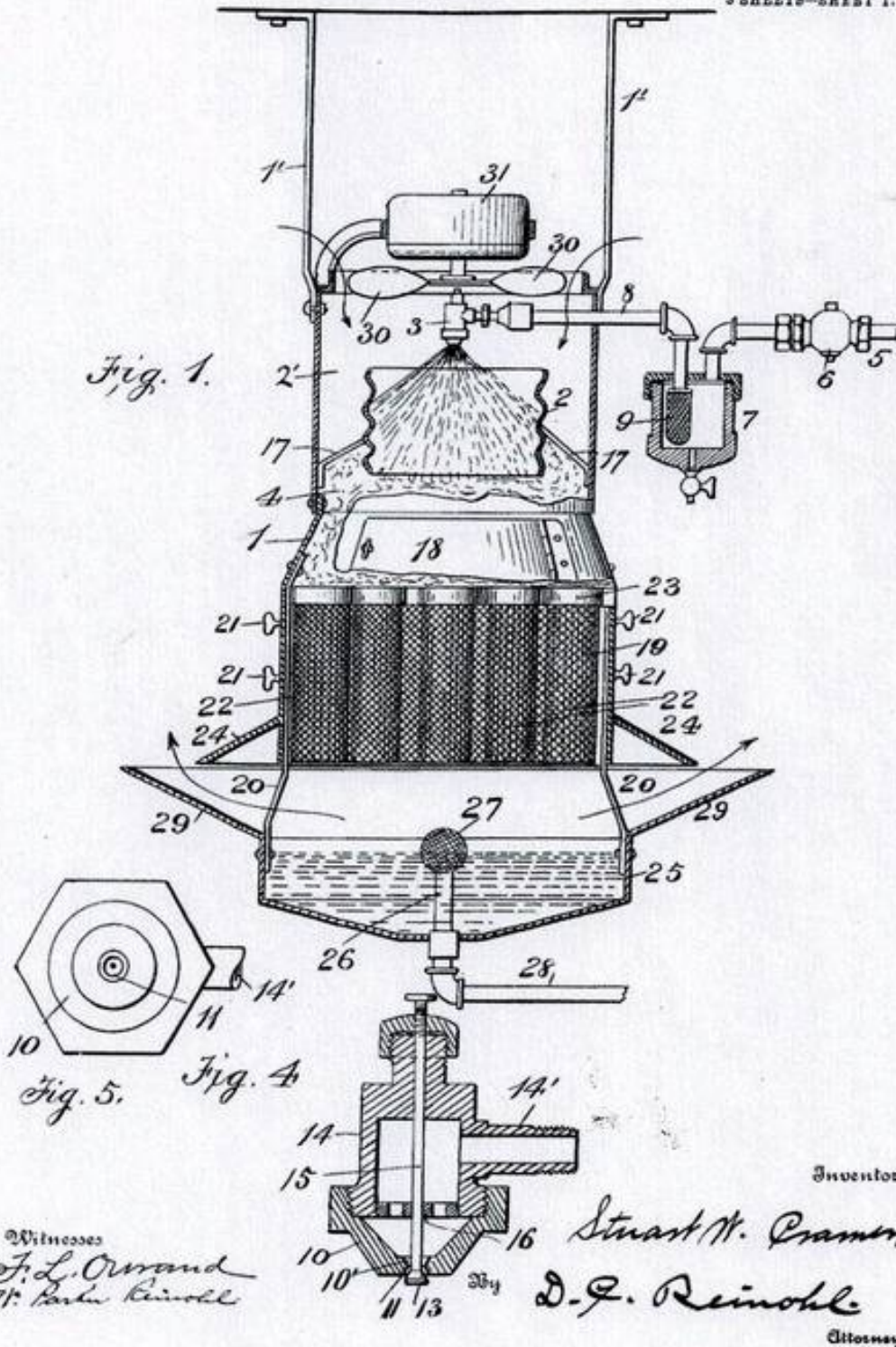
**APPENDIX I: CRAMER'S PATENTS FOR HUMIDIFYING & AIR CONDITIONING APPARATUS**

No. 852,823.

PATENTED MAY 7, 1907.

**S. W. CRAMER.**  
**HUMIDIFYING AND AIR CONDITIONING APPARATUS.**  
 APPLICATION FILED APR. 18, 1906.

3 SHEETS—SHEET 1.



Witnesses  
*J. L. Orvand*  
*W. Parker Reinold*

Inventor  
*Stuart W. Cramer.*  
*D. G. Reinold*  
 Attorney

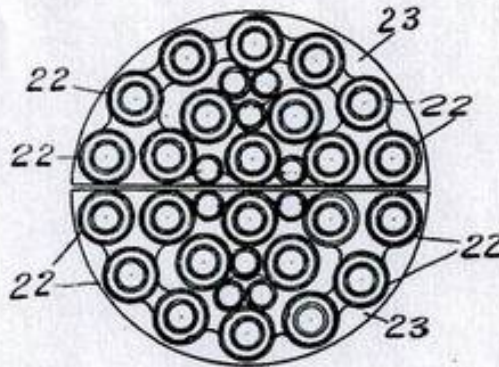
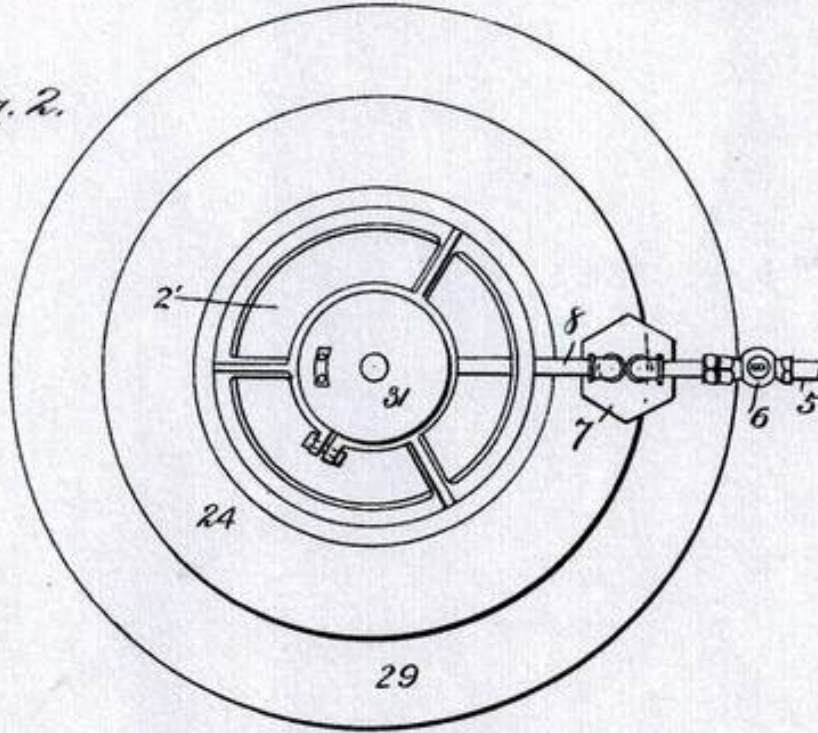
No. 852,823.

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S. W. CRAMER.  
HUMIDIFYING AND AIR CONDITIONING APPARATUS.  
APPLICATION FILED APR. 18, 1906.

3 SHEETS—SHEET 2.

*Fig. 2.*



*Fig. 3.*

Witnesses  
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*W. Carter Reinold*

Inventor  
*Stuart W. Cramer*  
By *D. E. Reinold*  
Attorney

No. 852,823.

PATENTED MAY 7, 1907.

S. W. CRAMER.  
HUMIDIFYING AND AIR CONDITIONING APPARATUS.  
APPLICATION FILED APR. 18, 1906.

3 SHEETS—SHEET 3.

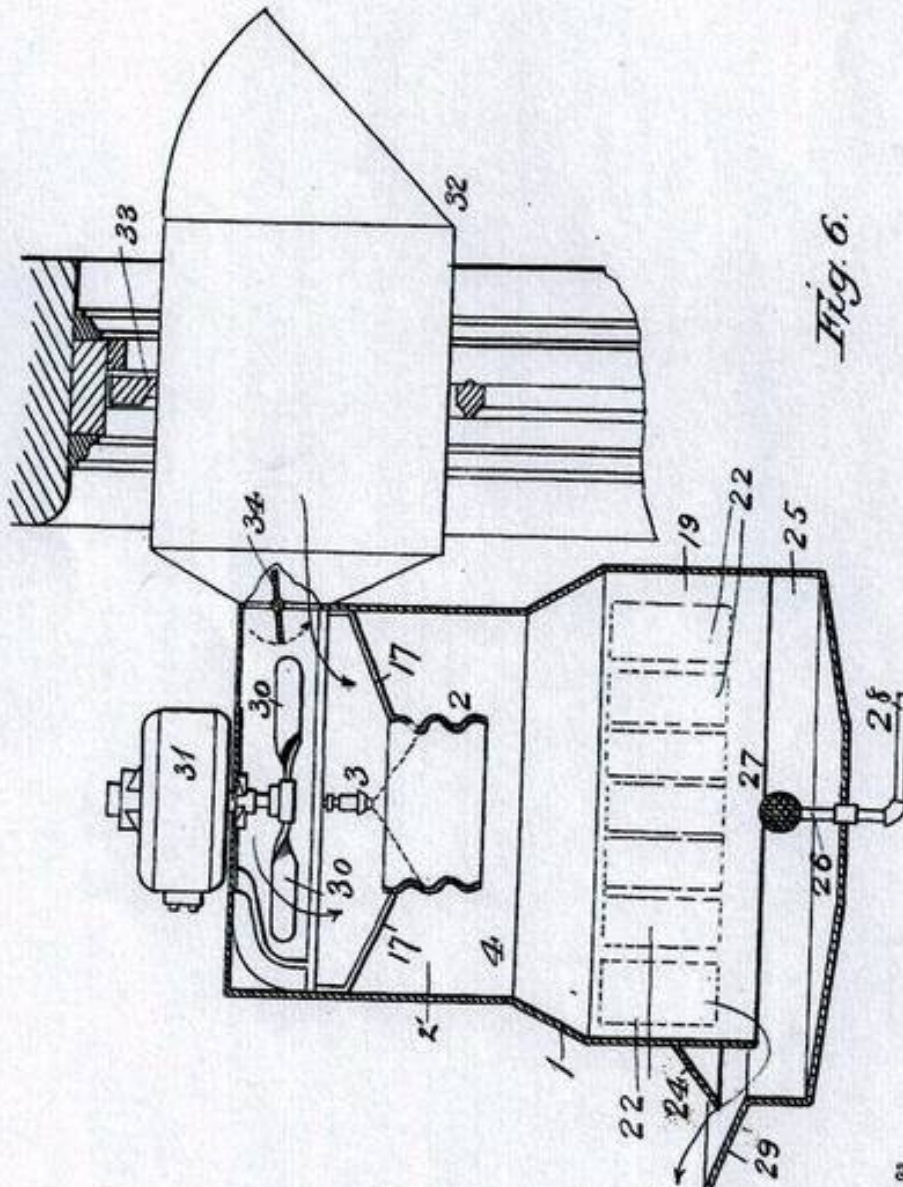


Fig. 6.

Witnesses  
F. L. Curran  
T. Parker Rindell

Inventor  
Stuart W. Cramer.

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Attorney

# UNITED STATES PATENT OFFICE.

STUART W. CRAMER, OF CHARLOTTE, NORTH CAROLINA.

## HUMIDIFYING AND AIR-CONDITIONING APPARATUS.

No. 852,823.

Specification of Letters Patent.

Patented May 7, 1907.

Application filed April 18, 1906. Serial No. 312,453.

*To all whom it may concern:*

Be it known that I, STUART W. CRAMER, a citizen of the United States, residing at Charlotte, in the county of Mecklenburg and State of North Carolina, have invented certain new and useful Improvements in Humidifying and Air-Conditioning Apparatus; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to humidifying and air conditioning apparatus for textile and other factories, is designed for use in systems of automatic regulation of the humidity and temperature in such factories, disclosed in my Patent No. 811,383, dated January 30th, 1906 and No. 813,083, dated February 20th, 1906, and the invention consists in certain improvements in construction, which will be fully disclosed in the following specification and claims.

This apparatus is designed for placing along the wall between the windows in a room in a factory, mill, or other building, taking air from the outside, and by a system of dampers also from the inside in varying proportions, as may be desired. The incoming air is thus treated or uniformly conditioned so that its introduction into the room does not disarrange or disturb the conditions that the whole object of the apparatus seeks to establish.

It is a well-known fact that ventilating textile factory buildings by opening windows or doors, is not only injurious from a manufacturing standpoint interfering with the proper running of the work, but also positively disarranges and disturbs the normal uniform conditions of the fibers of the material which are required for the most favorable conditions to manufacturing. It is also a well known fact that air containing lint, dust, and other impurities when blown or conducted past wetted surfaces, or sheets of water, will not readily part with its impurities. The surface tension of the water operates in antagonism to air cleansing, at least so far as relieving it of any dry foreign matter is concerned. In my apparatus therefore, when the air is first drawn into the apparatus by a fan, I provide for a thorough dousing or wetting of the air by a strong spray or cloud of vapor; in the second place, realizing that water directly discharged into

the atmosphere in however finely an atomized condition, is not a benefit, but, on the contrary, an objection until it is evaporated, and realizing furthermore, the practical impossibility of evaporating fine particles of water when discharged or blown into the atmosphere, especially after a moderate percentage of humidity has been attained, I next provide for removing all of the coarse particles of water, including the fine spray and vapor, from the air, that it may issue from the apparatus colorless and free from even a fog-like appearance, but thoroughly cleansed from all solid impurities. Furthermore, just before the air issues from the apparatus, it impinges directly and normally upon the surface of a body of water, that will catch or arrest any coarse foreign matter that may have escaped being deposited upon the wet surfaces to which reference has already been made.

In my present apparatus I provide first a casing in which to treat the air; a fan for drawing in and forcing through the casing a current of air either from without the building or from within the building itself, or a mixture of both inside and outside air; a spray chamber in which the air is driven through a dense cloud of fine spray and vapor; a collecting, condensing and evaporating chamber, in which wetted woven fabrics of an absorbent and evaporative nature, geometrically or otherwise arranged to the best advantage, are kept moist by the spray deposited on them by the current of air as it comes to them direct from the spray chamber. Said woven fabrics presenting surfaces upon which deleterious and foreign matter in suspension in the air are readily deposited by their having been wetted in the spray chamber; and finally, an open basin of water at the bottom of the casing, upon which water the air must impinge before it can issue radially from the casing, thus collecting the last traces of any coarse particles of lint, fly, sweepings, etc., that may have been too heavy to remain on the fabrics in the collecting chamber above, but which in their heavy and wetted condition are readily caught in the basin of water instead of being allowed to skip out (as a stone is glanced or ricocheted on a pool or water) with the air in the casing, which has heretofore been the case in apparatus of this type.

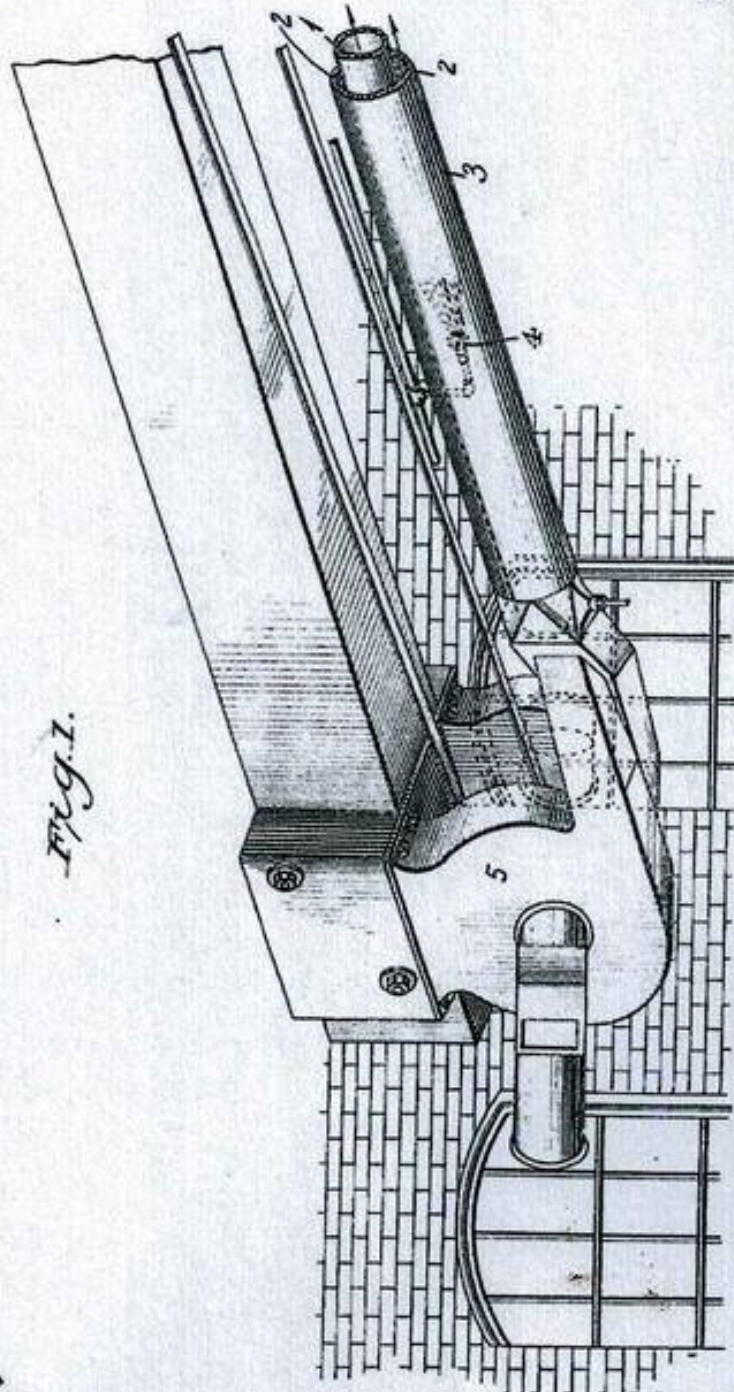
The invention will be fully disclosed in the following specification and claims.

S. W. CRAMER.  
AIR CONDITIONING APPARATUS.  
APPLICATION FILED JAN. 11, 1910.

1,073,475.

Patented Sept. 16, 1913.

3 SHEETS—SHEET 1.



*Fig. 1.*

Witnesses  
*J. L. Ormrod*  
*W. Parker Kinosh*

Inventor

*Stewart W. Cramer*

By

*D. C. Reinhold*

Attorney

S. W. CRAMER.  
AIR CONDITIONING APPARATUS.  
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3 SHEETS-SHEET 2.

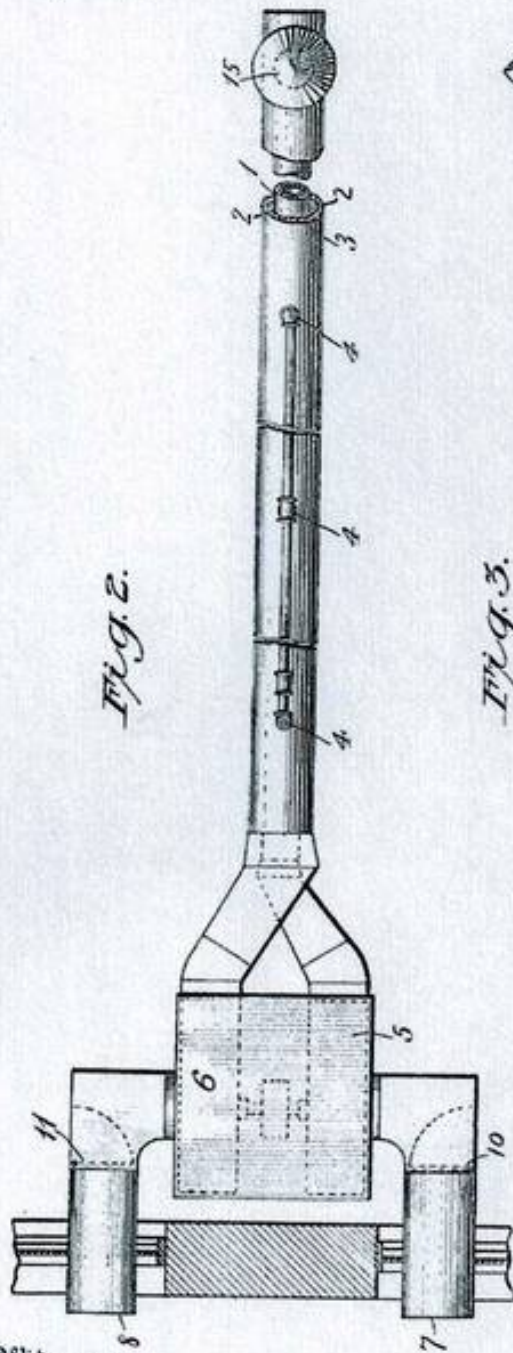
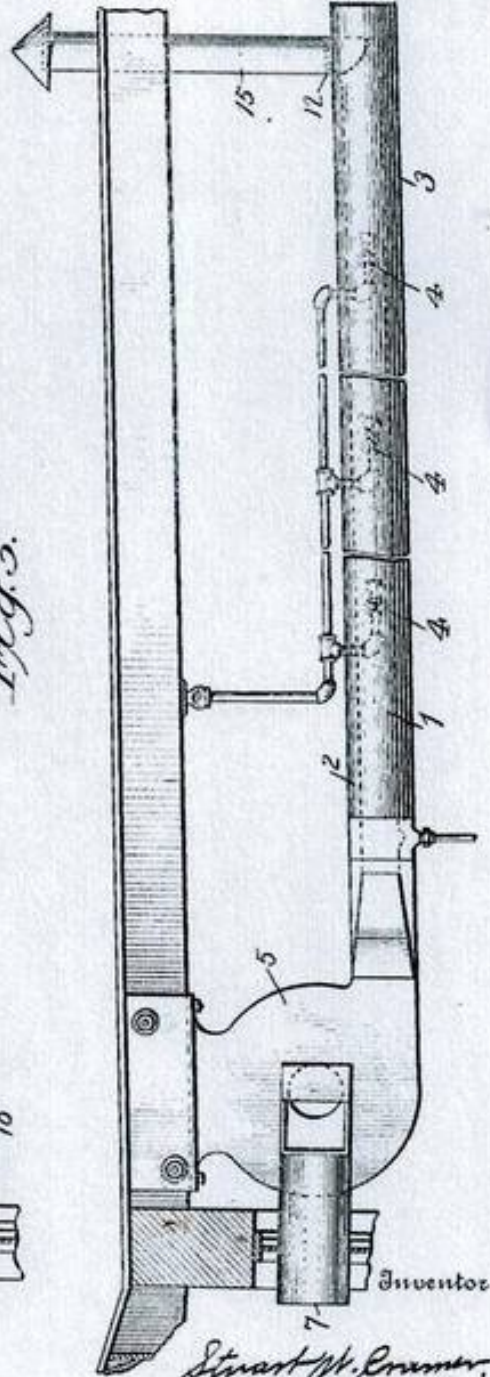


FIG. 2.

FIG. 3.



Witnesses  
J. L. Curand  
W. Paul Reimold

By

Inventor  
Stuart W. Cramer.  
D. C. Reimold  
Attorney

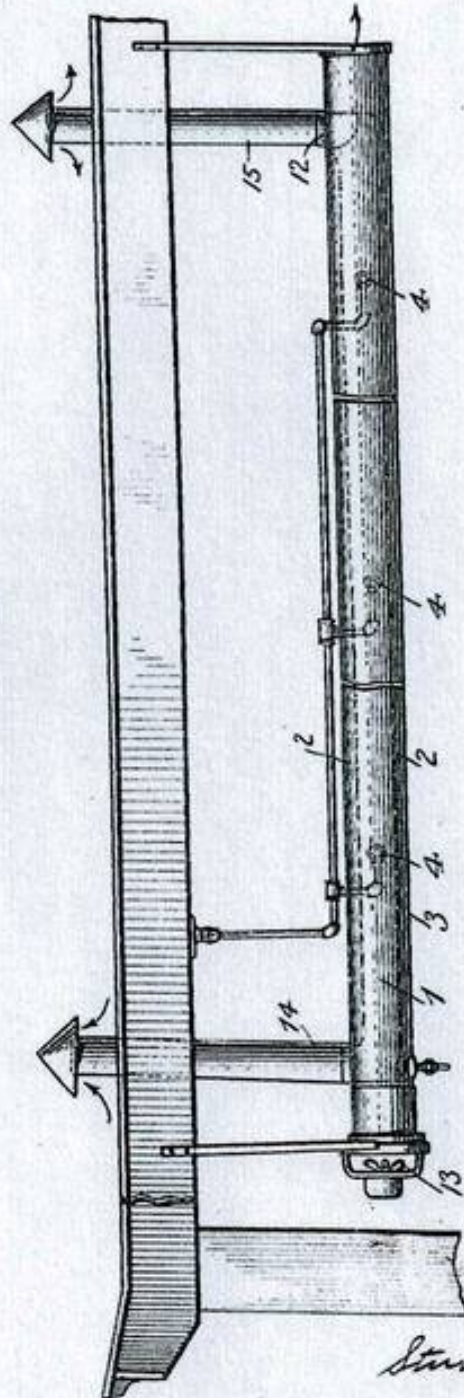


S. W. CRAMER.  
AIR CONDITIONING APPARATUS.  
APPLICATION FILED JAN. 11, 1910.

1,073,475.

Patented Sept. 16, 1913.

3 SHEETS-SHEET 3.



*Fig. 4.*

Witnesses  
*J. L. Cuykend*  
*W. Curtis Reinold*

Inventor

*Stuart W. Cramer*

By

*D. C. Reinold*  
Attorney

USEFUL INFORMATION  
FOR  
COTTON MANUFACTURERS.

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Compiled and Issued

by

STUART W. CRAMER,

Mill Architect and Engineer.

Contractor for

Cotton Mill Machinery  
and Equipment.

Providence, R. I.

Charlotte, N. C.

Atlanta, Ga.

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SECOND EDITION.  
(Complete in Four Volumes.)

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VOLUME IV.

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1909.

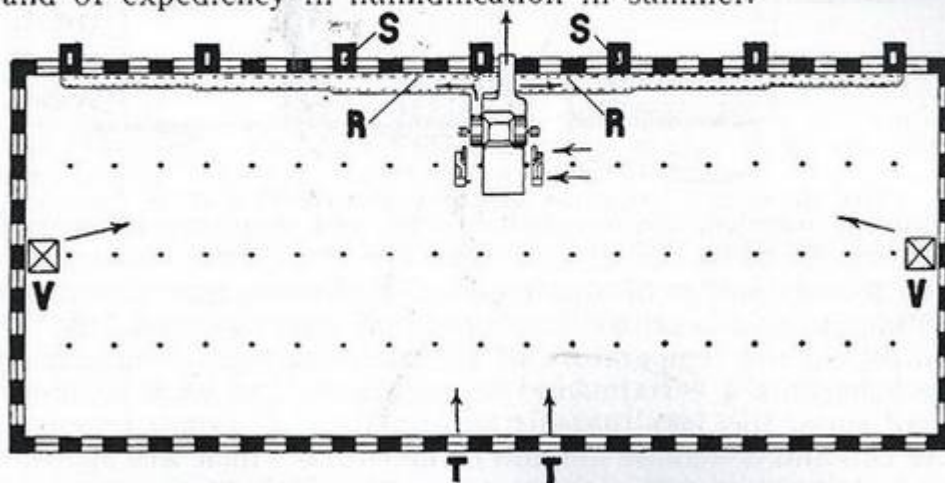
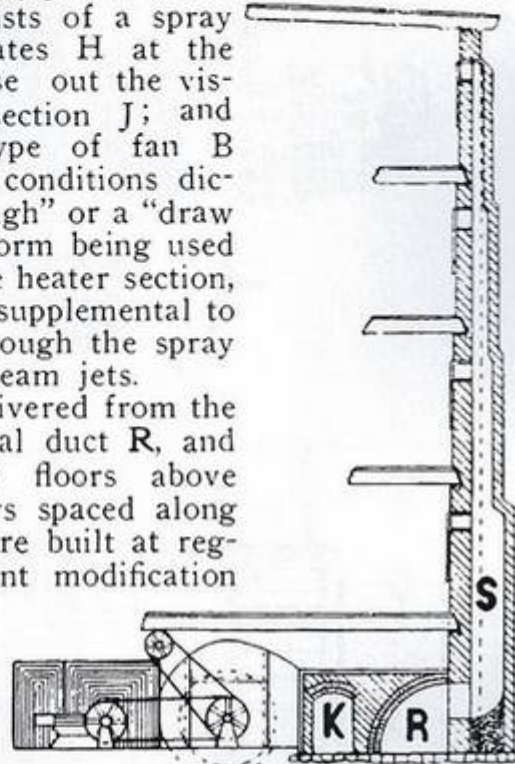
**Cramer Air Conditioners, Central Station Type.**

The central station type of apparatus is a development of the old and well known "Blower" or "Fan and Heater" system of heating and ventilating. (See pages 379-403 inclusive, Vol. II.)

In the old form, it consists of a spray chamber F with baffle plates H at the discharge end to condense out the visible moisture; a heater section J; and a blower or exhauster type of fan B according to whether local conditions dictate the use of a "blow through" or a "draw through" outfit, the latter form being used in preference. In lieu of the heater section, or in conjunction with and supplemental to it, the water circulating through the spray nozzles can be heated by steam jets.

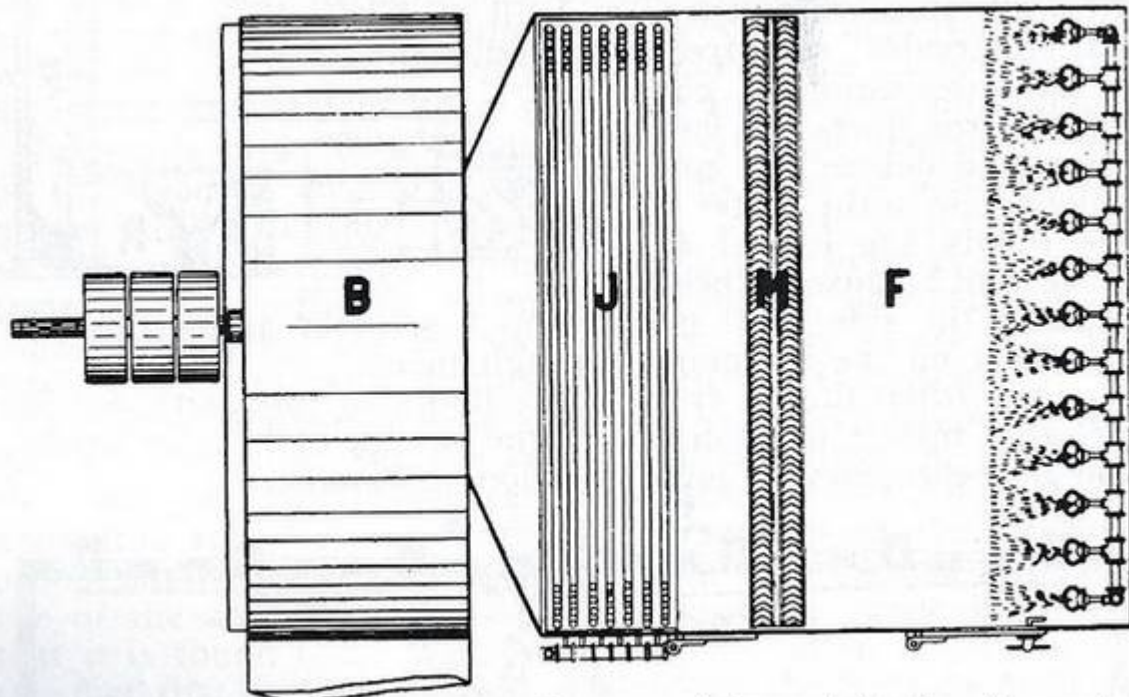
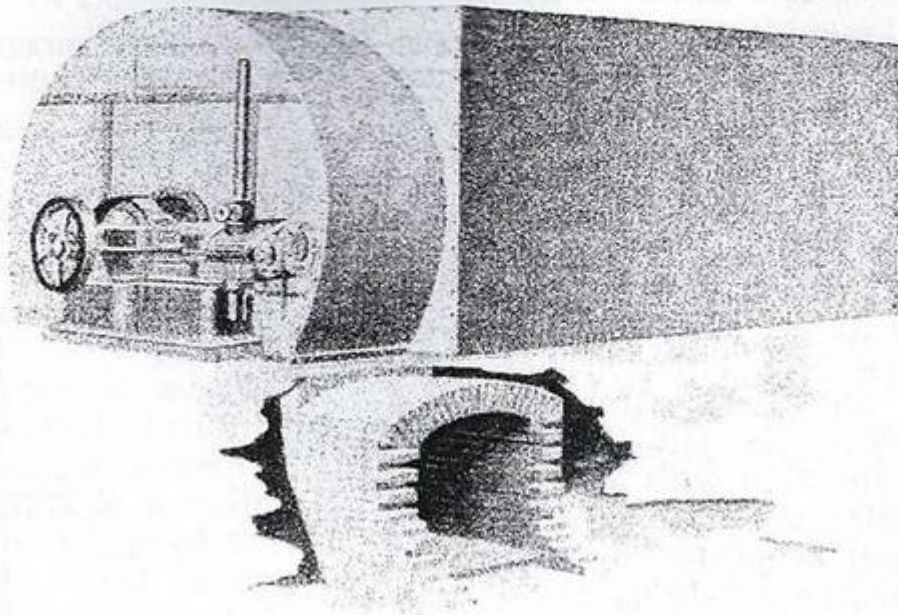
The conditioned air is delivered from the apparatus into a longitudinal duct R, and thence distributed to the floors above through flues S, in pilasters spaced along the walls into which they are built at regular intervals; one frequent modification is the substitution of galvanized iron ducts and flues erected to deliver the conditioned air in the center of the rooms, the logical arrangement because the brick ducts in the side walls get so hot in summer as to considerably heat up the air going through them.

Air is often drawn from upper floors to mix with outside air, as a matter of economy in the saving of heat in winter, and of expediency in humidification in summer.



(In the above plan, showing the lower floor of a mill equipped with a Central Station type of apparatus, air comes down through the elevators VV and is mixed with the outside air entering through windows TT, fitted with automatically controlled dampers.)

STUART W. CRAMER

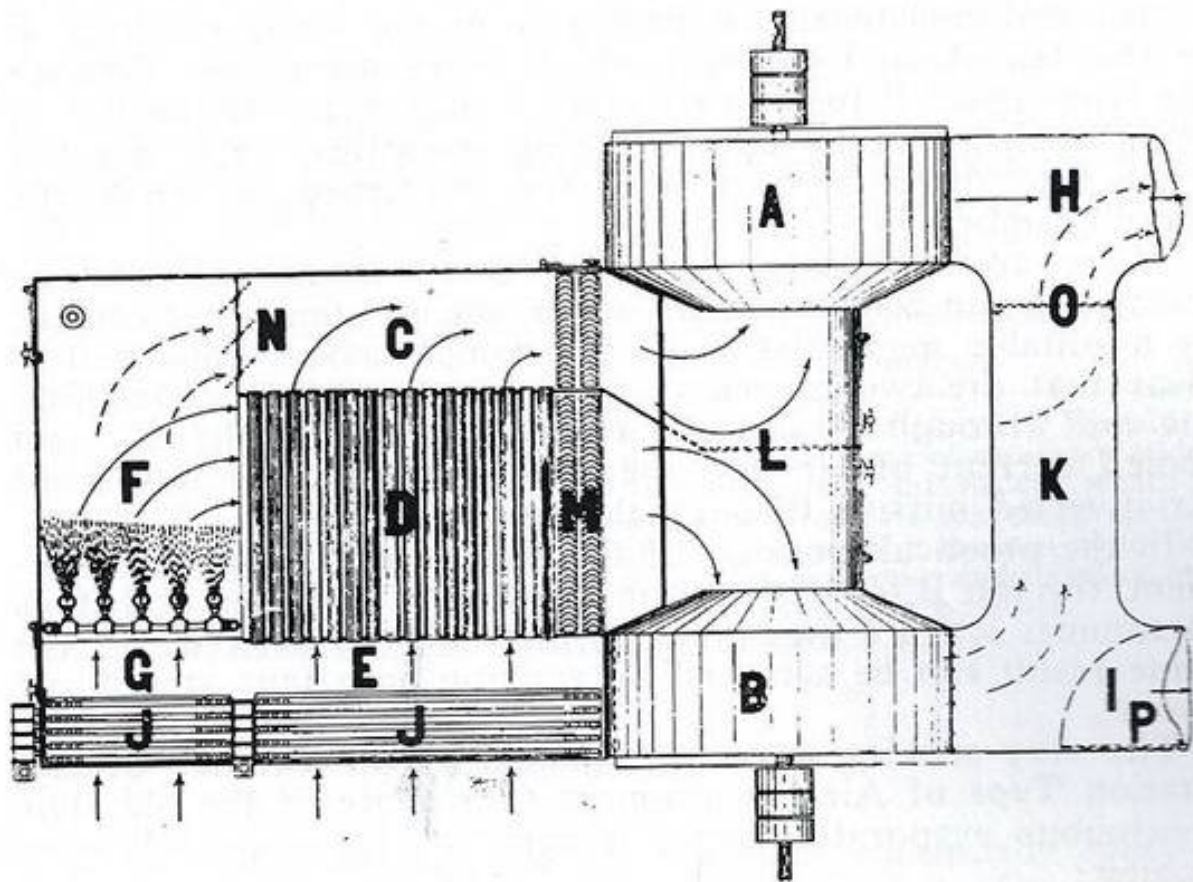
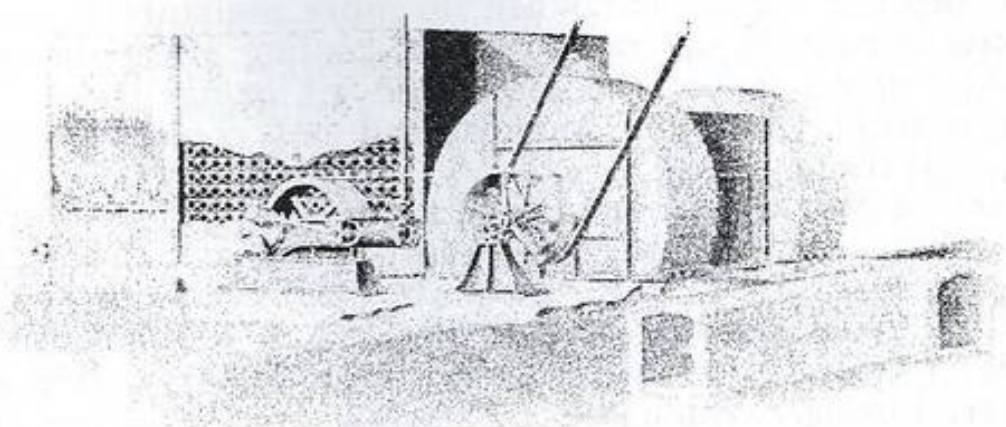


(The above cuts show the old type of Central Station Apparatus heretofore installed, the lower view illustrating in plan, its construction and operation,—described on the preceding page.)

Providence, R. I.

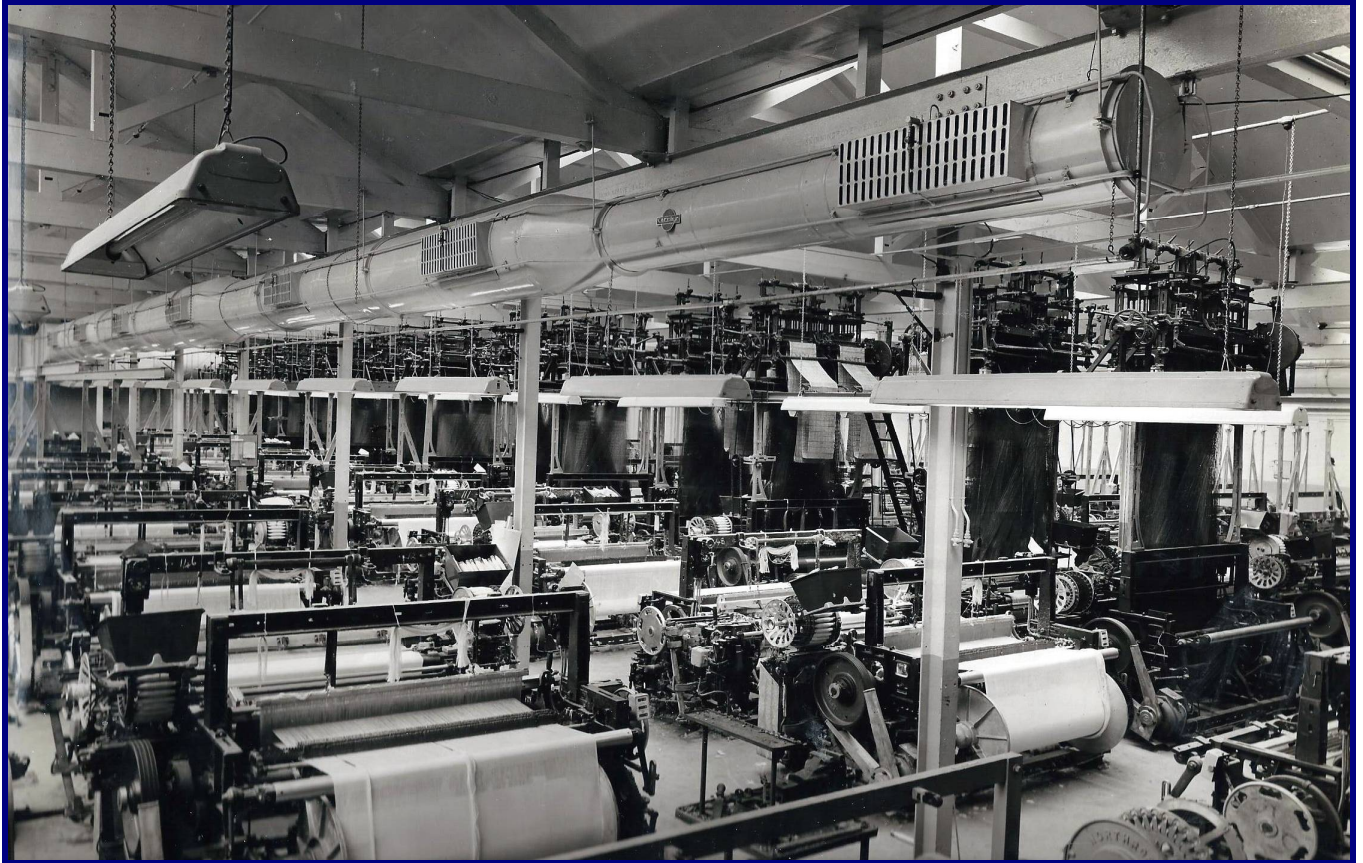
Charlotte, N. C.

Atlanta, Ga.



(The above cuts show the Cramer Improved Type of Central Station Apparatus, the lower view illustrating in plan its general construction and operation,—described on page 1416.)

**APPENDIX III: A COMPARISON: UK TEXTILE MILL AIR CONDITIONING  
BY CARRIER ENGINEERING COMPANY LTD, c.1950**



*Gartside Rhodes No.1 Mill, Middleton, Lancashire*



*English Spinning Cotton Company, Stanhill Ring Mill, Accrington, Lancashire*



*Weaving Shed, Sladon Wood No.2 Mill, Rock Nook*



*Weaving Shed, Gartside & Company, Waterside Mill*

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*Stuart Warren Cramer*



**POSTSCRIPT: FURTHER READING**

**USEFUL INFORMATION  
FOR  
COTTON MANUFACTURERS.**

—  
Compiled and Issued

by

**STUART W. CRAMER,**  
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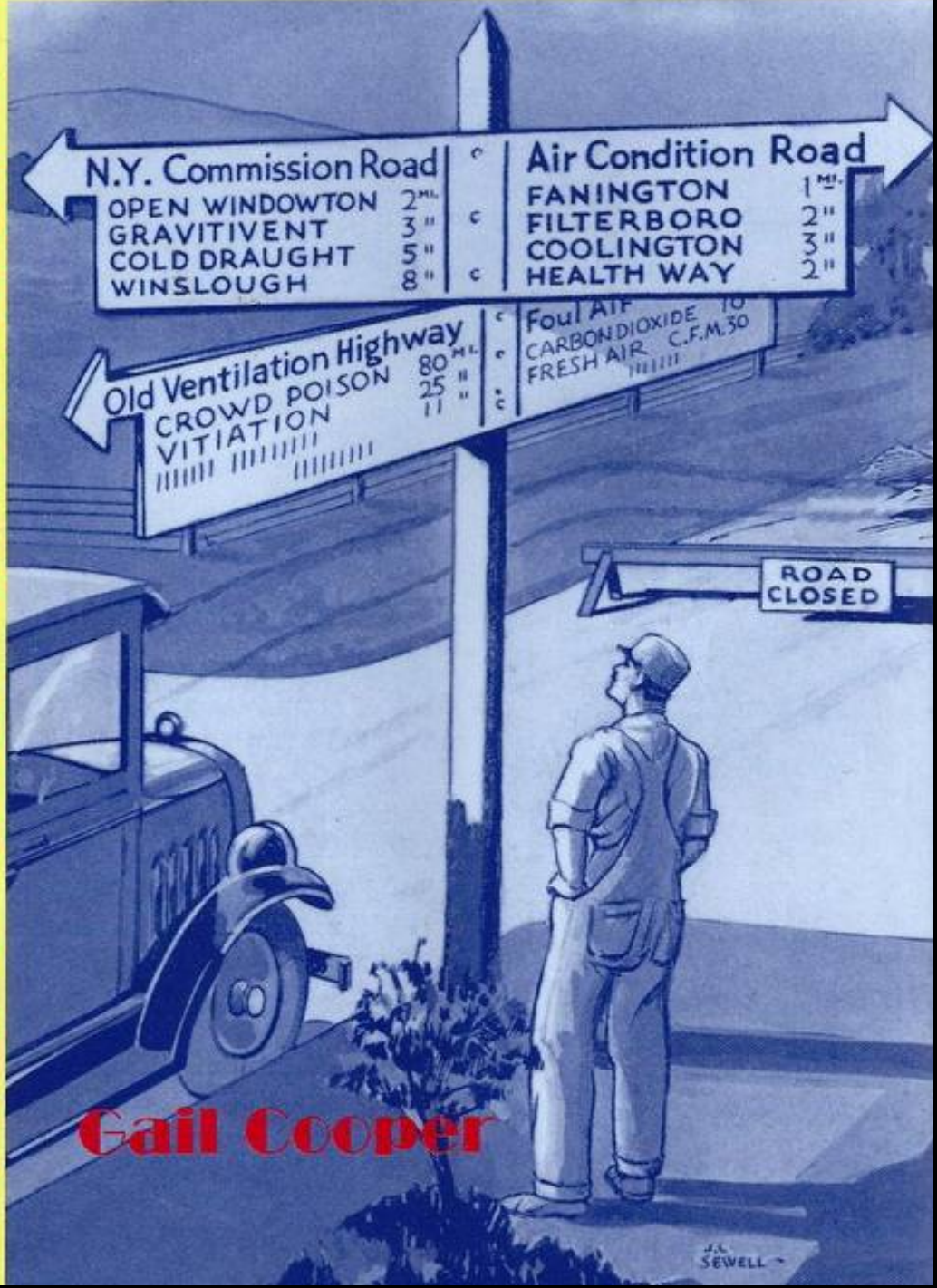
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## EPILOGUE



*Marker at Gaston, North Carolina*

In 1929, Stuart Cramer was awarded an Honorary Doctor of Science Degree by the present North Carolina State University. He died on 2<sup>nd</sup> July, 1940, at the age of 72 and was buried in Charlotte's Elmwood Cemetery. In 1962, Parks-Cramer published a revised, simplified book *Textile Air Conditioning*.