BENJAMIN FRANKLIN STURTEVANT AMERICAN FAN ENGINEER

by Brian Roberts, CIBSE Heritage Group

Benjamin Franklin Sturtevant, 1833-1890

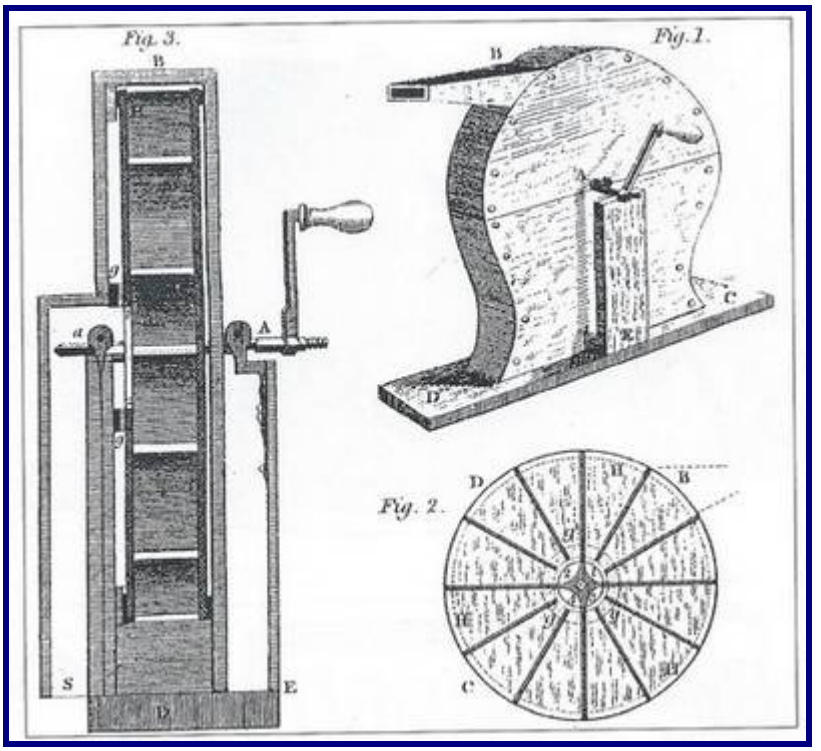
Benjamin Franklin Sturtevant was an American fan engineer and possibly the most important name in ventilation during the second half of the 19th century. He was borne in Norridgewock, Maine, on 18 January, 1833, where he learned the trade of shoemaking and repair before moving to Boston in 1856. Having an inventive mind, in about 1850 Sturtevant built a crude fan to relieve the summer heat. Around 1861 he designed a centrifugal fan to suck dust and leather clippings away from his work area. Soon other shoemakers wanted one, leading Sturtevant to set up a shop on Sudbury Street in Boston where he employed 8 men to build centrifugal fans, creating the centrifugal fan industry in the USA.

FANS AND VENTILATION MACHINES BEFORE STURTEVANT

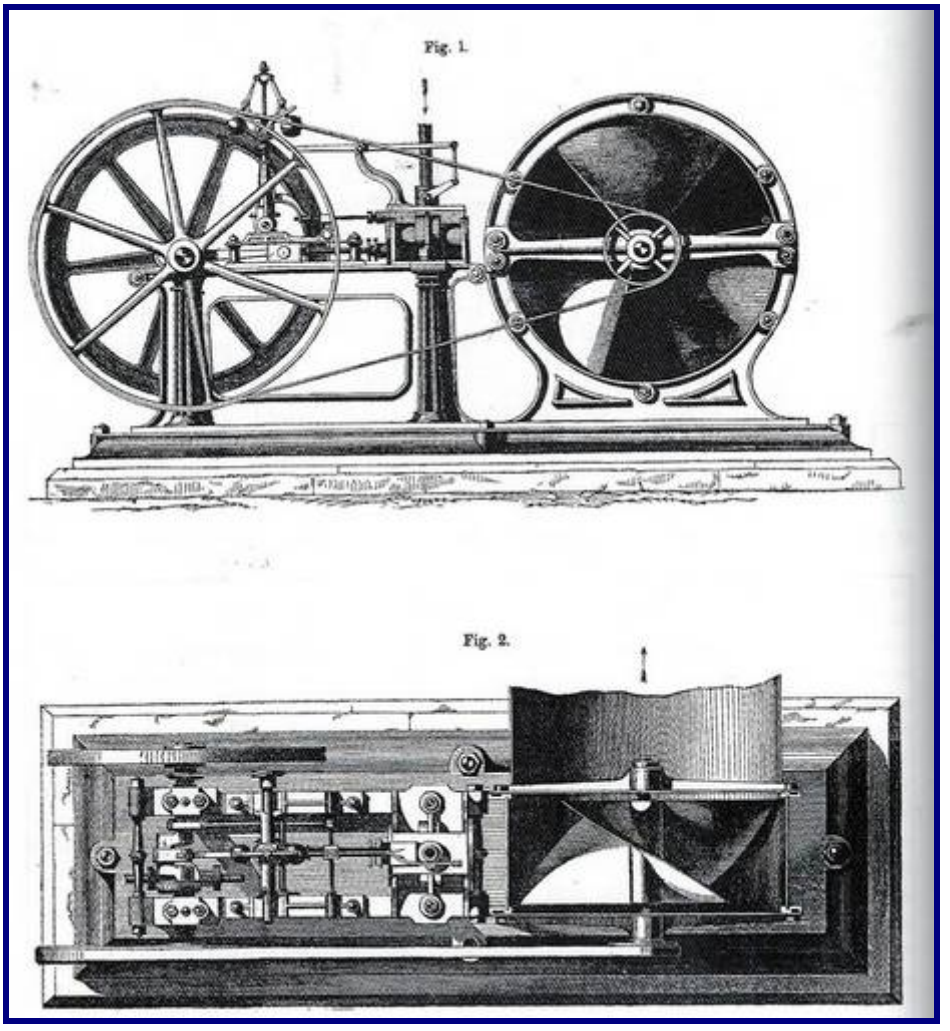
The earliest fans date from the mid-16th century and were used to ventilate mines in Savoy and Bohemia. They were driven by hand or were horse-driven or relied on wind or water power. About 1735, Desaguliers provided a hand-cranked fan, operated by a man called the *ventilator*, for use in the Houses of Parliament. Bellows were used by Triewald (1841) for ventilating ships and by the Rev Stephen Hales (1758) to ventilate hospitals. Barry (c.1847) used a steam jet (ejector pump) for the ventilation of the House of Lords while Arnott used an automatic air pump (driven by water stored at high level) for night-time ventilation of York Hospital.

Curved fan blades were introduced about 1840, but Walker (1850) preferred an air screw driven by a steam engine. Improvements just prior to Sturtevant's fan-making activities include the backward-curved fan of Buckle (1847) and the spiral scroll of Professor Rankine.

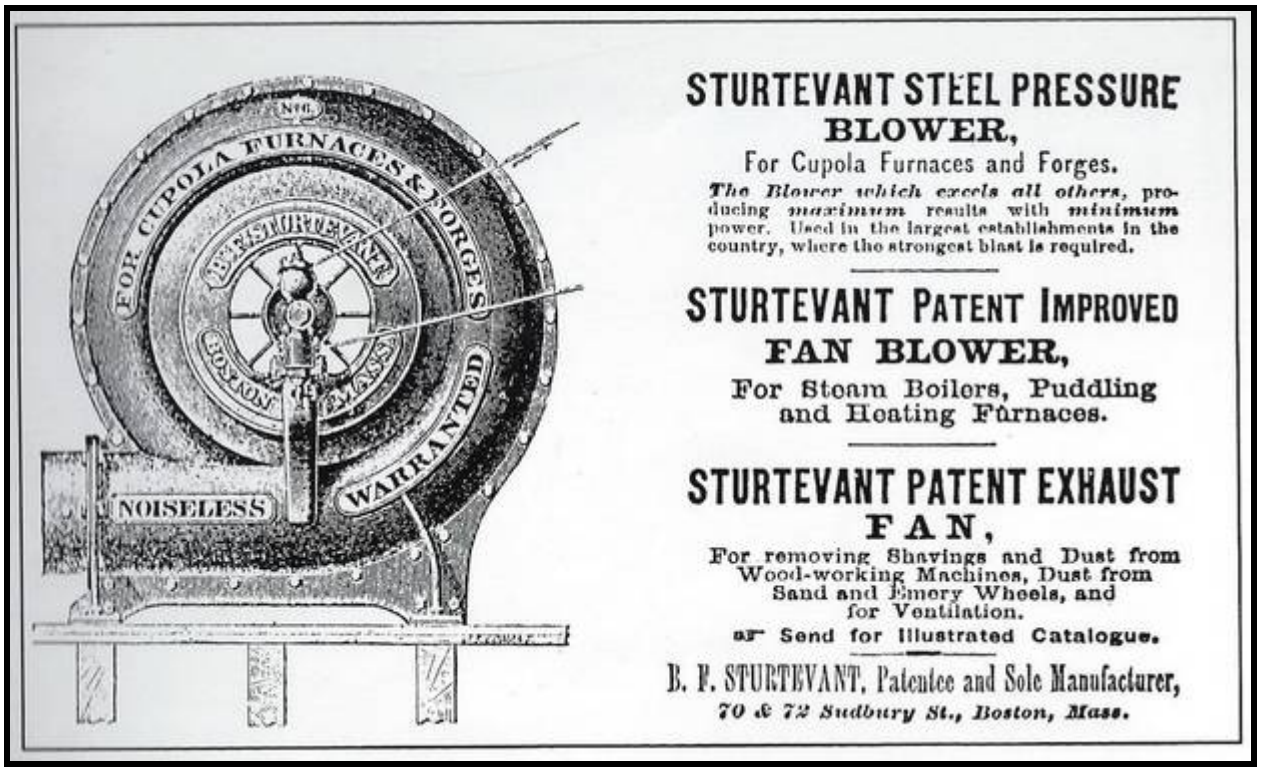
Making fans for mine ventilation, 1556, using fan blades tipped with goose feathers



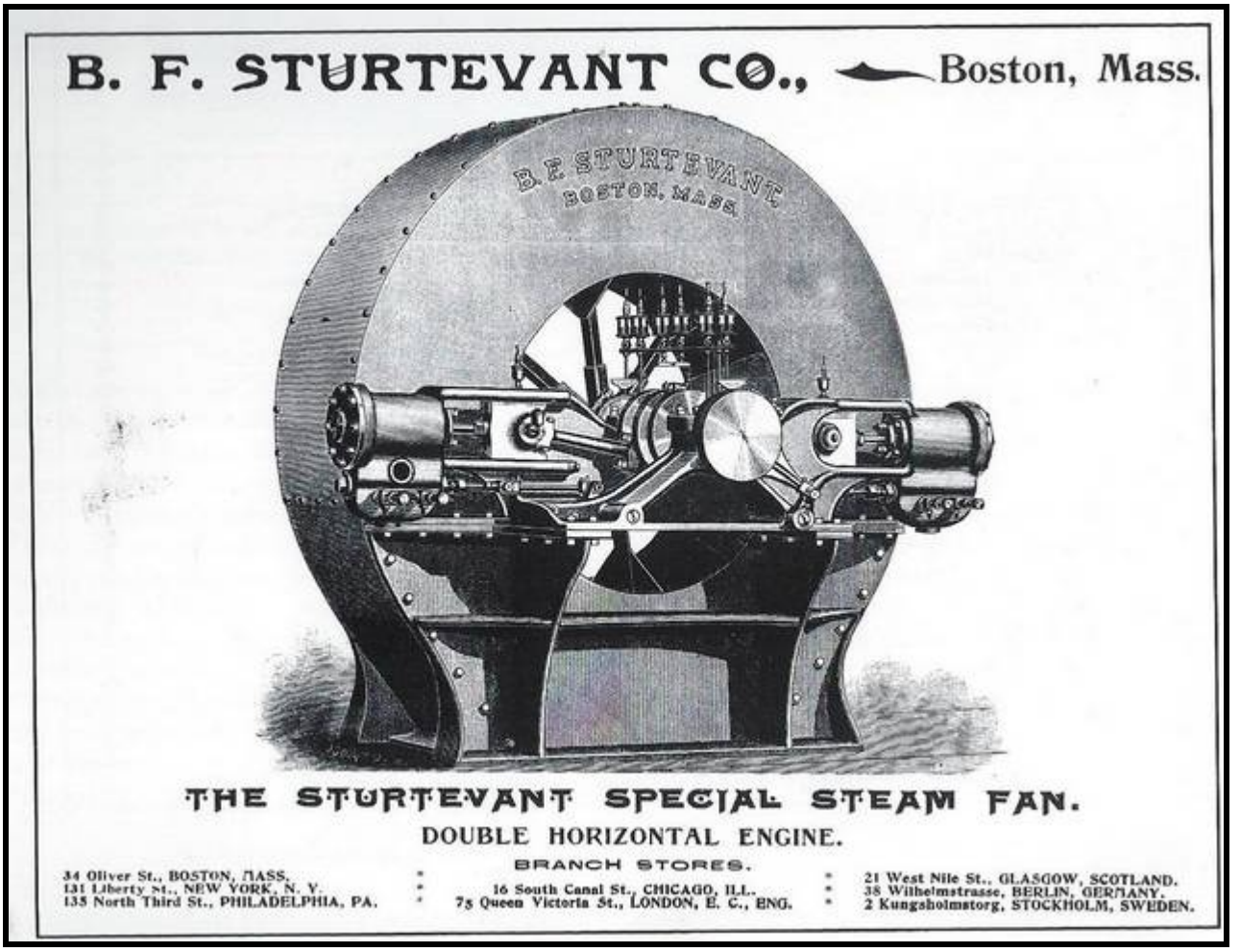
Fanning Wheel of Dr Desaguliers, 1735



Screw fan of 1850 driven from a steam engine



Advertisement of 1872

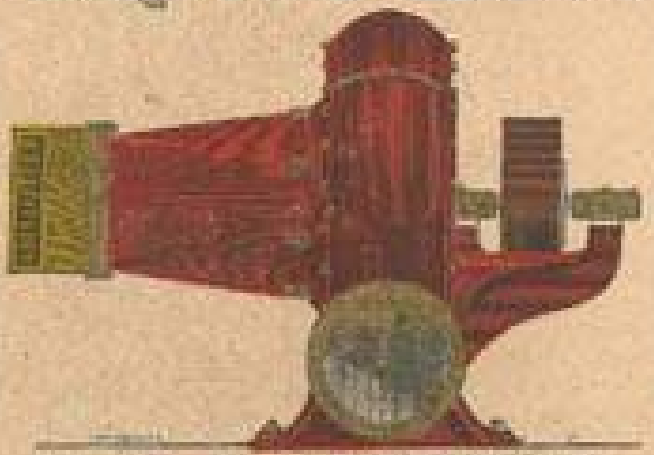


Advertisement of 1895

B. F. STURTEVANT'S

Patent Improved Exhaust Fan.

For removing Shavings from Planing and Moulding Machines, Bevels, and Dust from Sand and Emery Wheels, Sawdust and Gas from Manufacturing Establishments, Steam and Vapor arising from Drying Cylinders and Impurities, Soot from Mill Stacks, offensive odors from Tar Kettles, Dust from Rag and Cotton Pickers, Flax and Rope Machinery, and for ventilation of Coal Mines and all under-ground Apartments or Cellars.



This Fan is already exclusively in use for the purposes mentioned, but I desire to call particular attention to recent improvements, adapting it especially for the removal of

Shavings and Saw-dust.

Illustrated Catalogue sent on application. **B. F. STURTEVANT,** Patentee and Sole Manufacturer,

72 SUDBURY STREET....BOSTON, MASS.

B. F. STURTEVANT'S

Patent Monogram Fan Blower.

FOR

FORGES,

Steam Boilers,

HEATING FURNACES

AND

VENTILATION.

GREAT REDUCTION IN PRICES!

Quality and Capacity Maintained.

I build nine sizes of these Blowers, from No. 000 to No. 6, inclusive; and sell at prices ranging from $10. to $120.

Send for Price List.

Also, for my Illustrated Catalogue.

A Blower for the Times!

To supply this demand, I have, at great expense, made suitable patterns, and fitted up for making this **LOW PRICED** Blower, which I sell at **HALF THE PRICE** of my regular Pressure Blower, of equal capacity.

My Patent Steel Pressure Blower, for Cupola Furnaces and Forges, continues to be the leading Blower in the market, having stood the test in competition with all other blast machines for nine years, during which time ☞ **more than 12,000** have been sold.

I am now making a better Blower for less money than ever before.

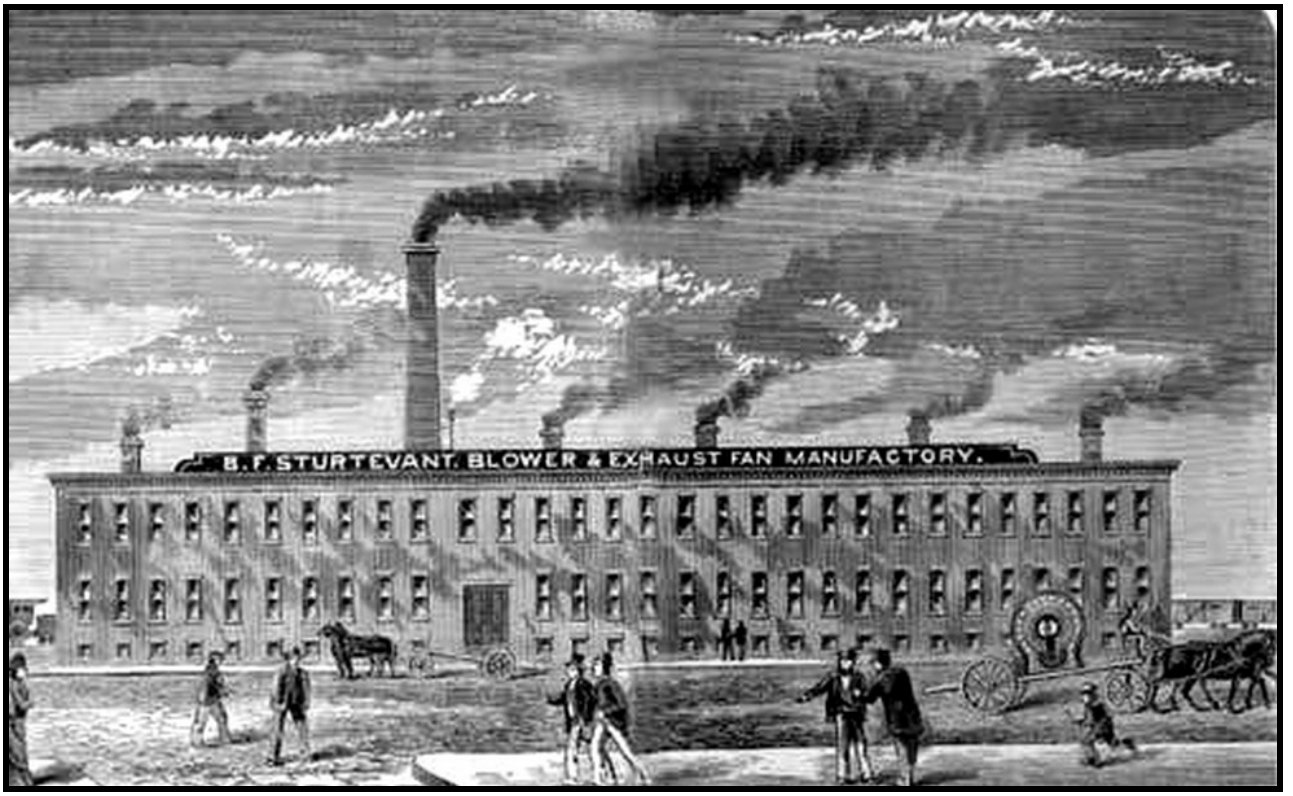
B. F. STURTEVANT, Patentee and Sole Manufacturer,

70 & 72 SUDBURY STREET....BOSTON, MASS.

His business expanded rapidly. One report says that in 1866, he provided fans with "wheels 16 feet in diameter" for the US Capitol building (if so these would have been replacements for the originals of 1857). In that year the business had grown to the point where Sturtevant was employing nearly 50 men, all making fans.

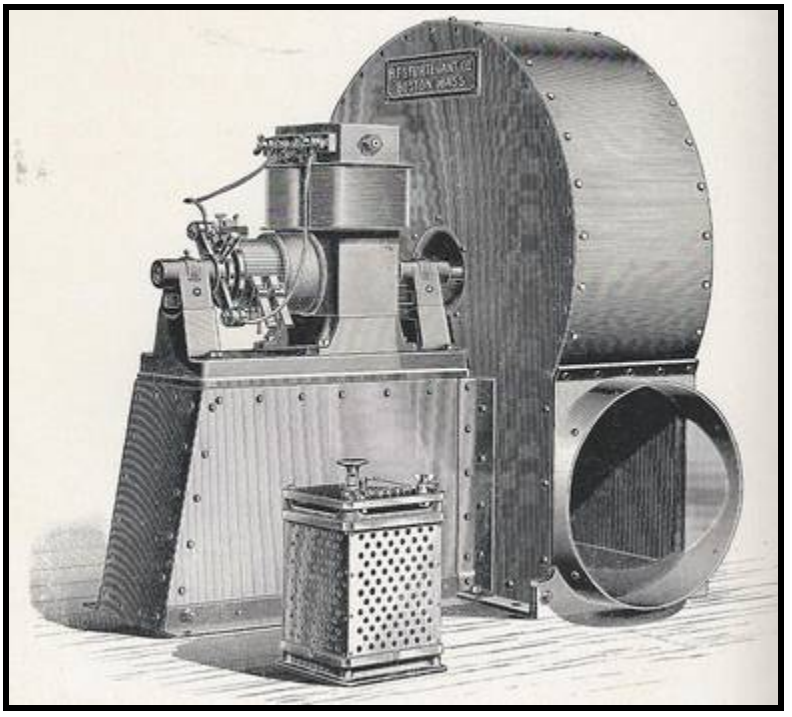
In 1969, Sturtevant entered the so-called modern heating era with the introduction of his "hot blast system." This consisted of a steam engine driving a fan passing a large volume of air through a steel pipe heating coil and distributing it through supply air ductwork to the heated spaces with a building.

As the business grew the company moved to a factory in Jamaica Plain and was now making fans, steam engines, heating coils and drying apparatus while providing complete heating & ventilation systems. Sturtevant went on to expand in New York, Chicago, Philadelphia and then in England and Germany, becoming the largest fan manufacturing company in the world



In 1886, Sturtevant began making mechanical draught fans for marine applications starting with the USS Alliance, the first extensive test on a US warship and the results were said to be sensational.

Benjamin Sturtevant lived at 11 Revere Street in Jamaica Plains until 1889 and then at 60 Elm Street where he died at home on the 17th April, 1890. He had hired Eugene Noble Foss in 1882 and put him in charge of manufacturing. Sturtevant has two daughters, the younger married Foss in 1884, the same year he was appointed Treasurer & General Manager. Upon Sturtevant's death, Foss was elected President of the company.



Sturtevant centrifugal fan with direct-drive electric motor 1899

Sturtevant disk fan 1906

1879

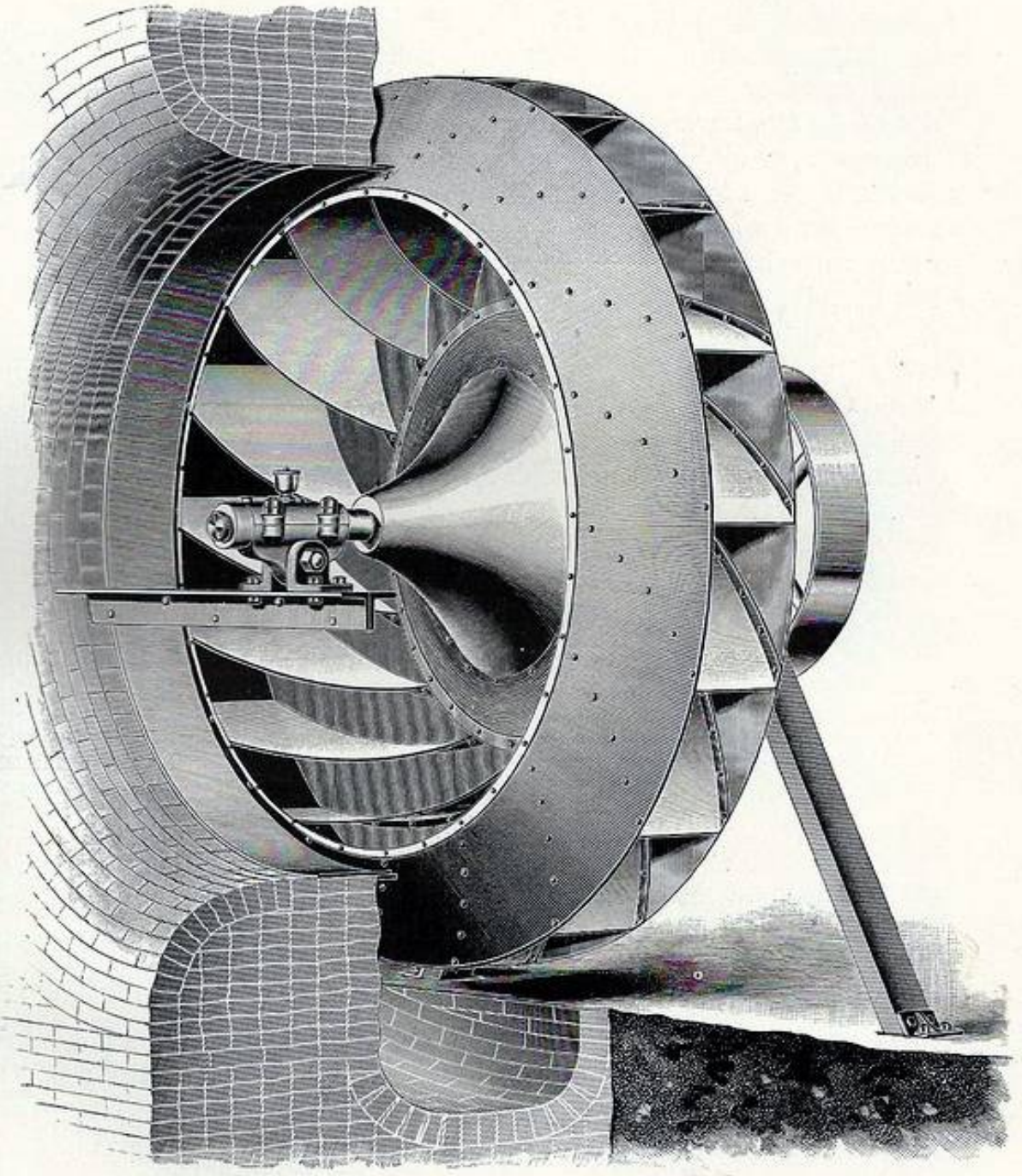


FIG. 18. CONE WHEEL.

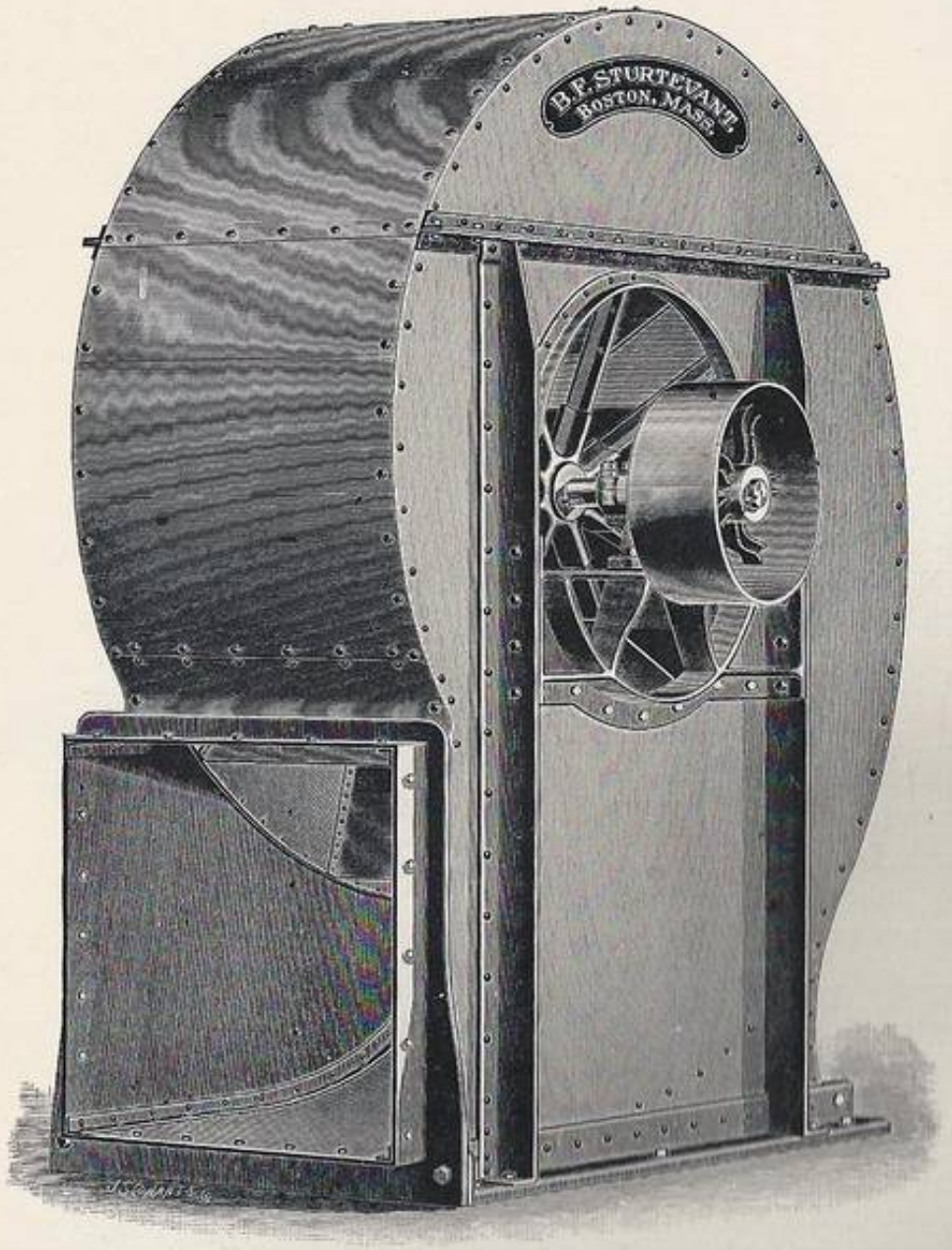


FIG. 21. STEEL PLATE BLOWER,
WITH OVERHUNG PULLEY.

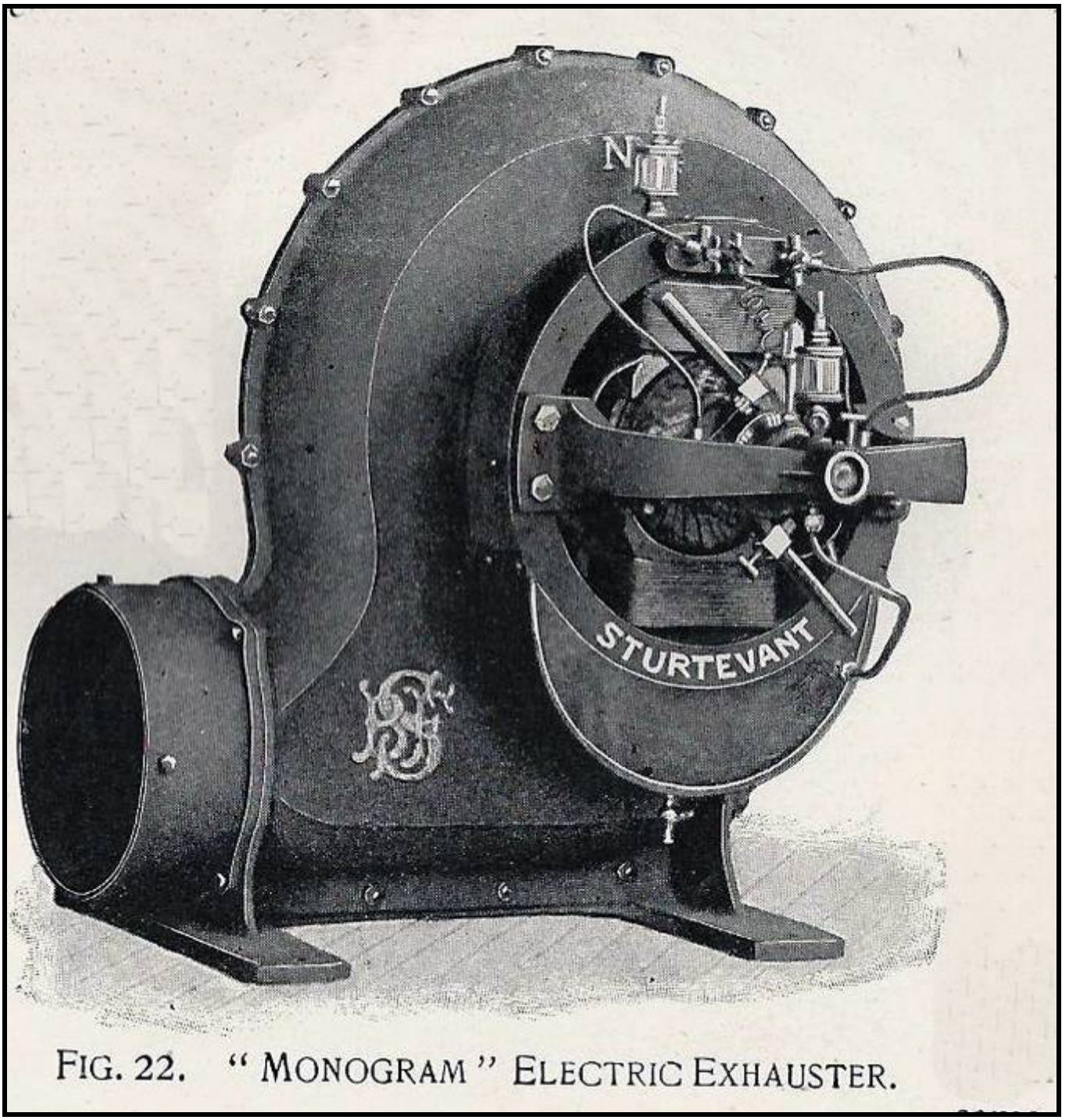


FIG. 22. "MONOGRAM" ELECTRIC EXHAUSTER.

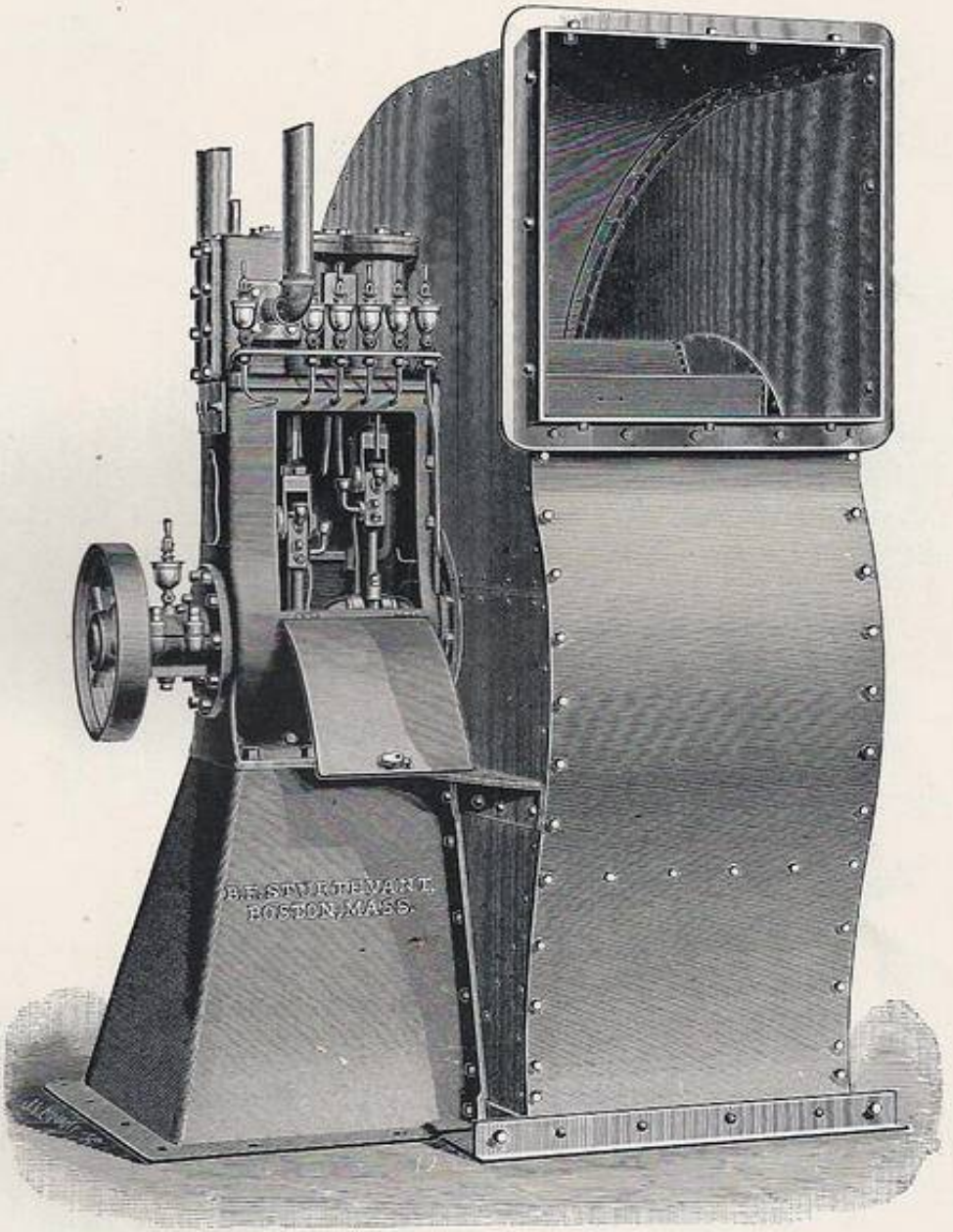


FIG. 26. SPECIAL STEEL PLATE STEAM FAN,
WITH DOUBLE ENCLOSED ENGINE.

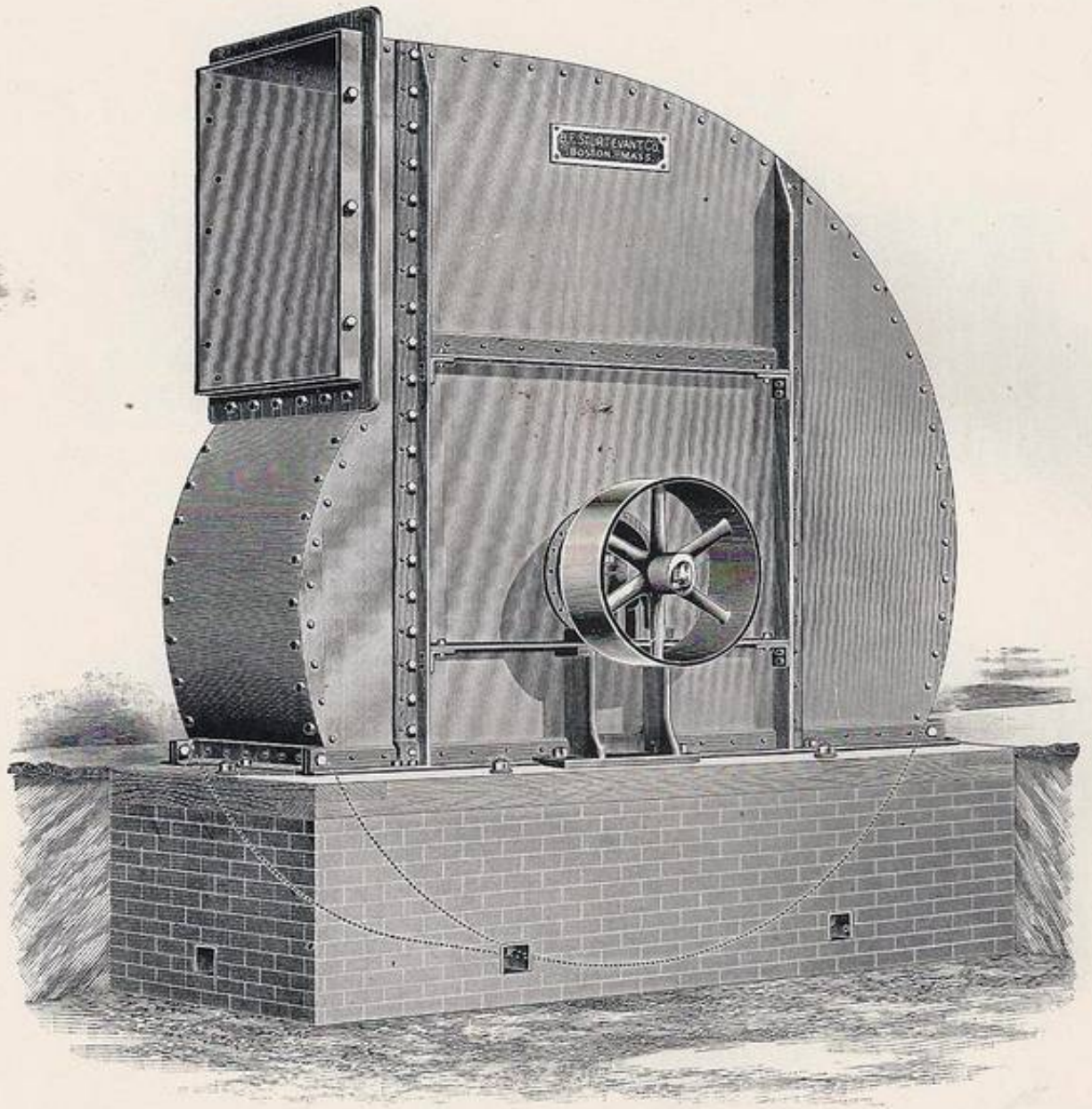


FIG. 35. STEEL PLATE PULLEY FAN,
WITH THREE-QUARTER HOUSING.

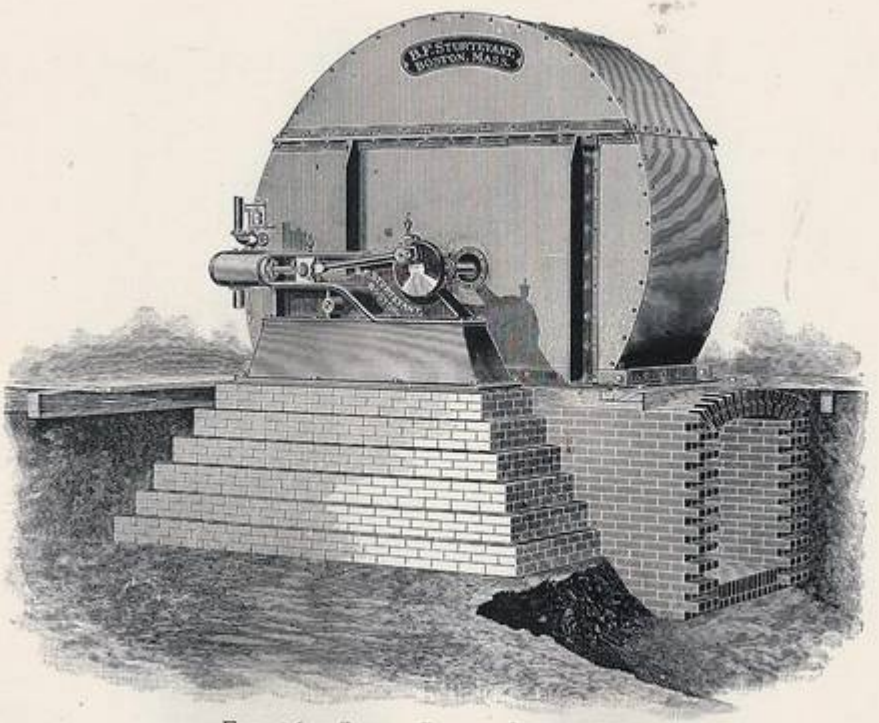


FIG. 36. STEEL PLATE STEAM FAN,
WITH THREE-QUARTER HOUSING.

VENTILATION AND HEATING

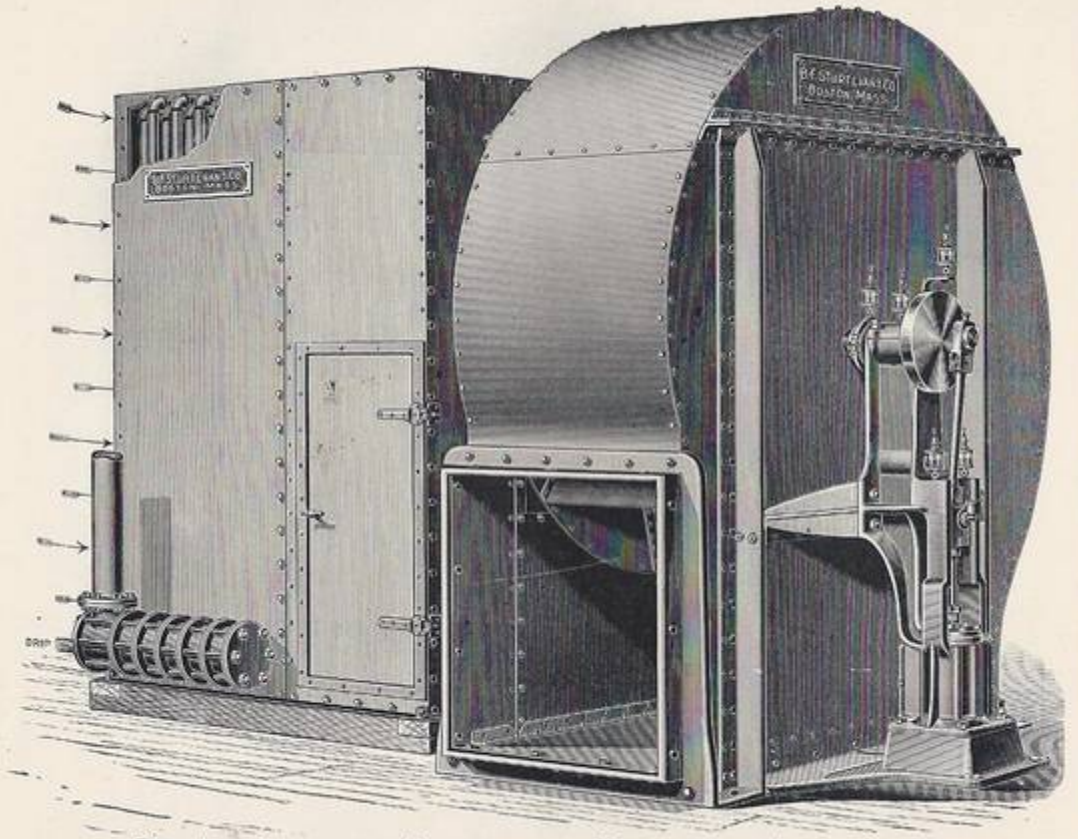


FIG. 49. STANDARD HEATING AND VENTILATING APPARATUS.

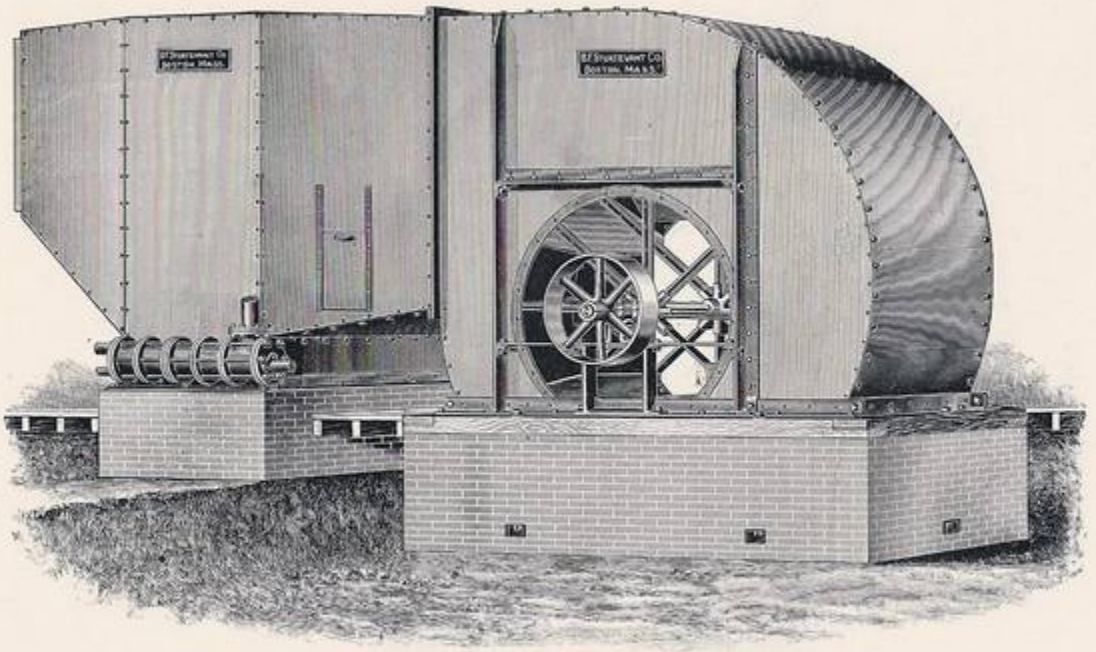


FIG. 52. HEATING AND VENTILATING APPARATUS,
ARRANGED TO BLOW THROUGH, WITH THREE-QUARTER HOUSING PULLEY FAN.

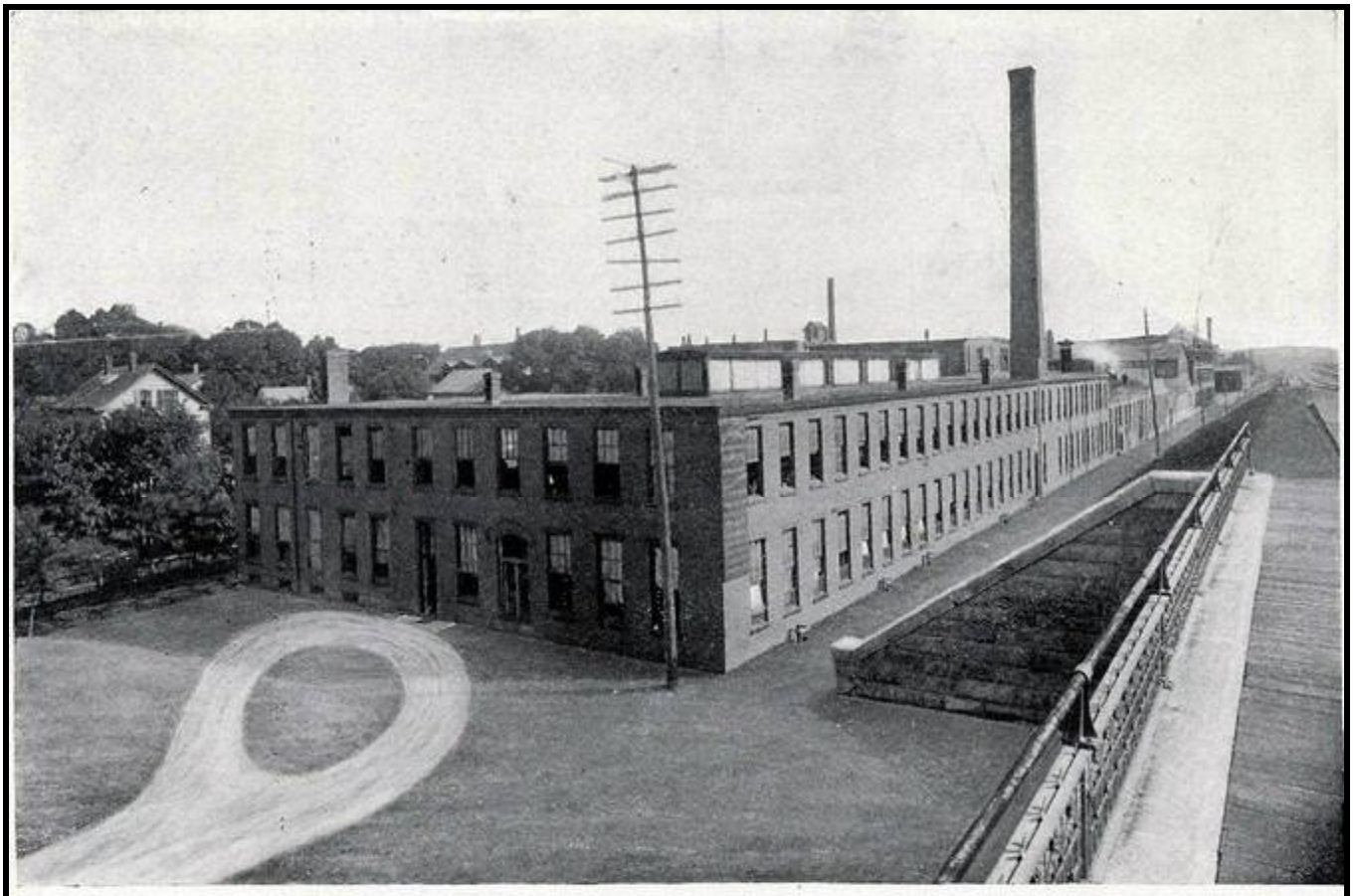


FIG. 49. VIEW OF B. F. STURTEVANT CO.'S WORKS, JAMAICA PLAIN, MASS., SHOWING RELATIVE SIZES OF CHIMNEY AND INDUCED-DRAFT PLANT STACK.

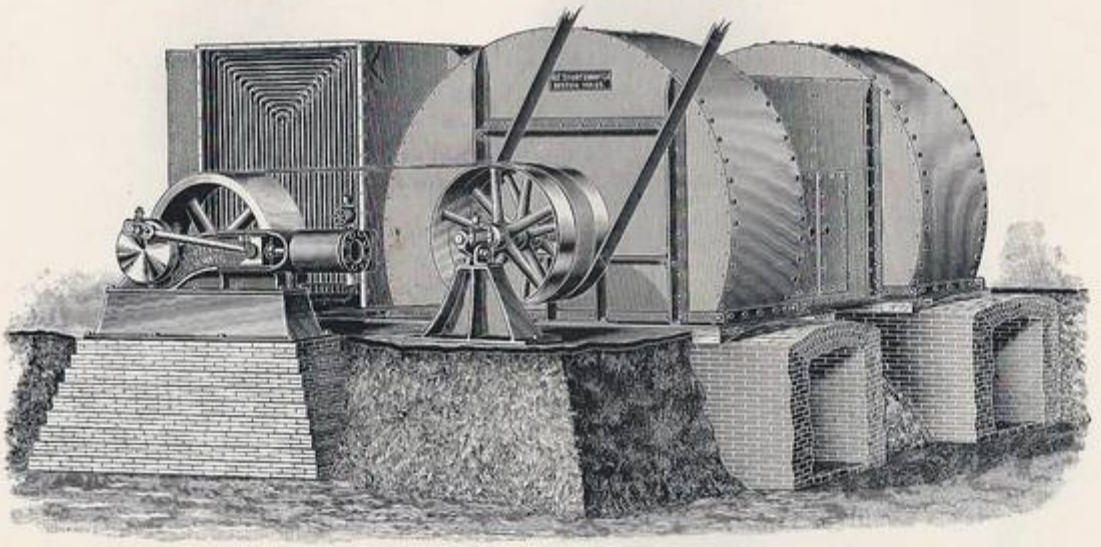


FIG. 53. DUPLEX HEATING AND VENTILATING APPARATUS,
WITH THREE-PULLEY RIG.

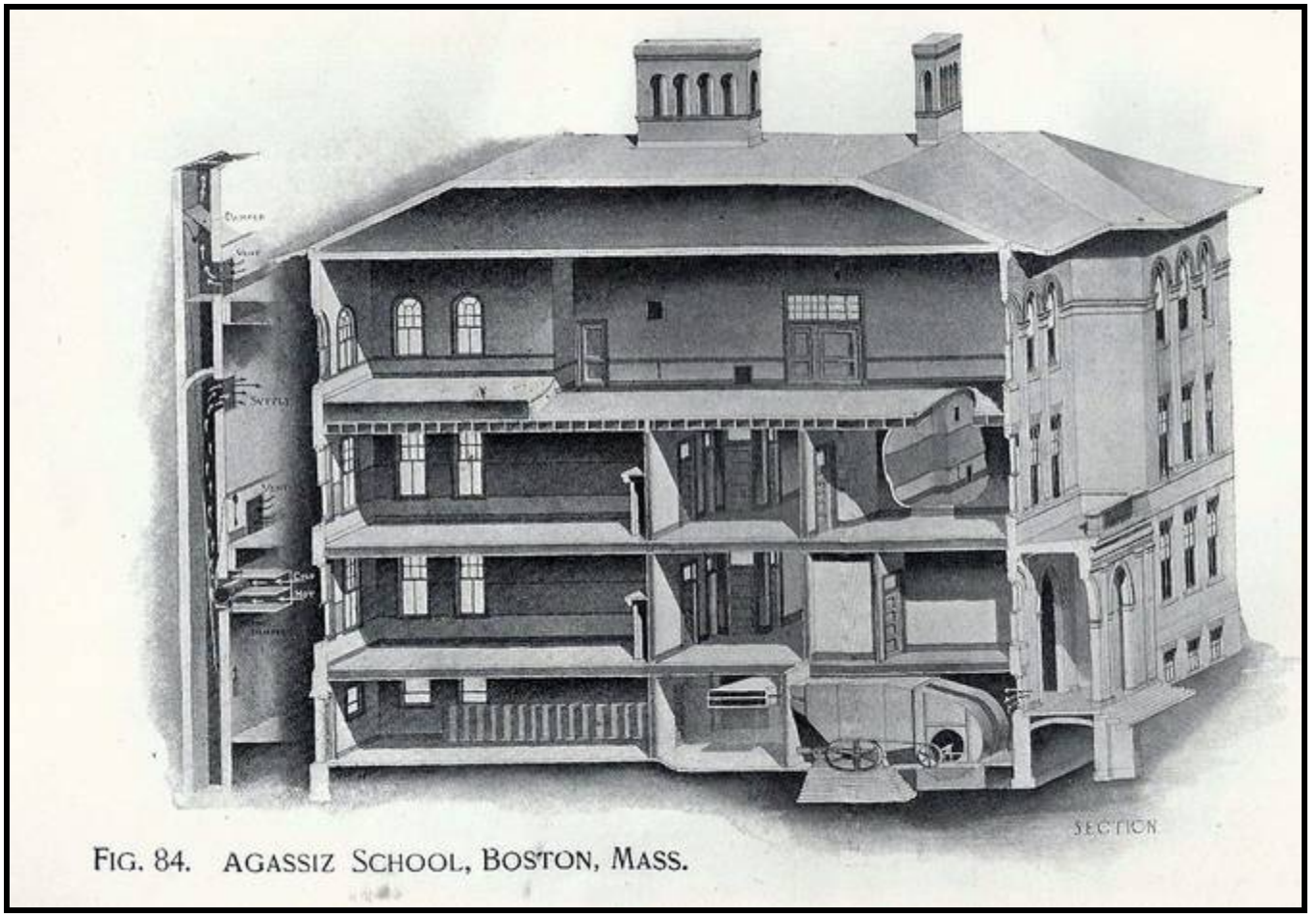


FIG. 84. AGASSIZ SCHOOL, BOSTON, MASS.

An early Dual-Duct system

VENTILATION AND HEATING

PRISONS.

The requirements of a building designed for the imprisonment of criminals are peculiar to itself. In the most advanced construction such a building includes, as its most important feature, the cell room or rooms variously arranged according to the ideas of those in authority, but, under all conditions, containing a series of small rooms for the separate confinement of the occupants.

Owing to the character of the inmates, it is obviously desirable that the heating and ventilating system should provide no advantageous opportunity for escape, while the occupation of the cells, during at least one-half of the twenty-four hours, requires that the maximum of air supply per occupant shall be provided. The separation of the prisoners, however, is such that the supply of air necessary to accomplish the heating under ordinary conditions is sufficient to meet all requirements per capita for the purposes of ventilation.

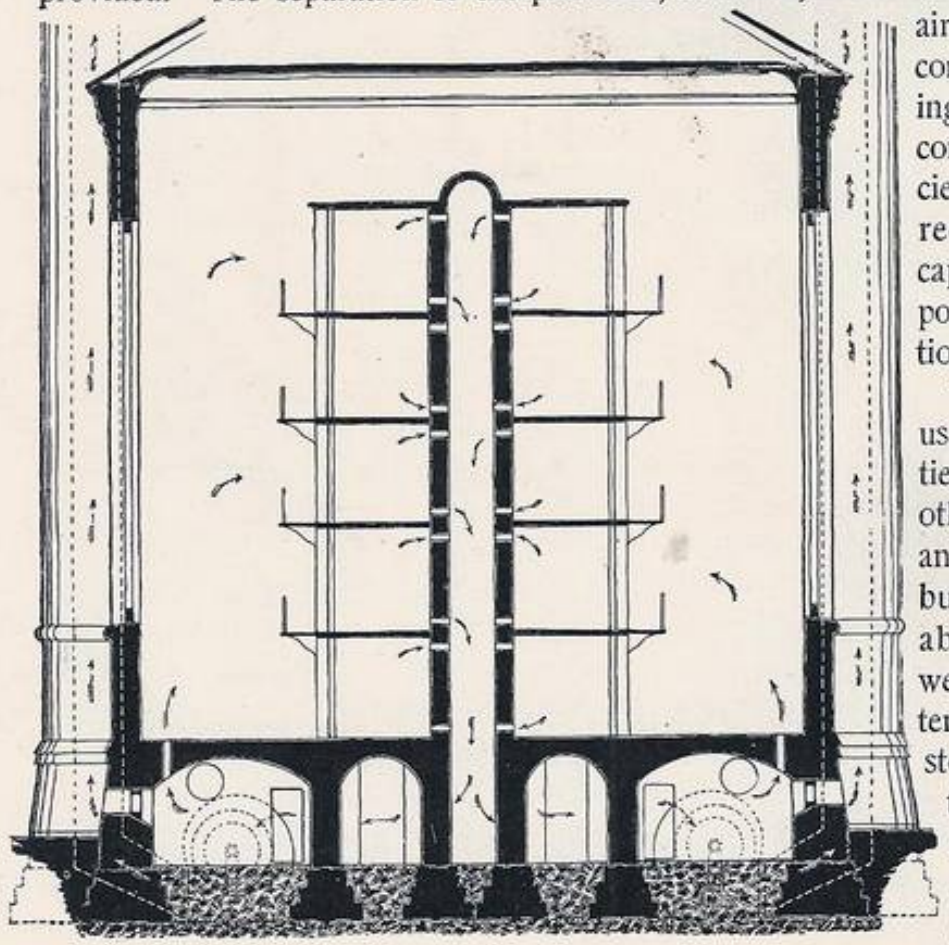


FIG. 77. SECTIONAL ELEVATION.

The cells are usually arranged in tiers, one above the other, either within an outer shell or building, or else abutting upon a well or corridor extending up several stories. To secure the requisite constant change of air, it must be evident, therefore, that mechanical means should be employed, and that both plenum and exhaust fans should be introduced to secure the necessary equaiity in distribution.

"BOSTON STORE," PROVIDENCE, R. I. This building, which is owned by the Callender, McAuslan & Troup Co., is devoted to the purposes of a wholesale and retail dry-goods and department store and serves as a most excellent example of a class of which a considerable number have been equipped with the Sturtevant System in the large cities of the country. Fig. 72 presents a clear conception

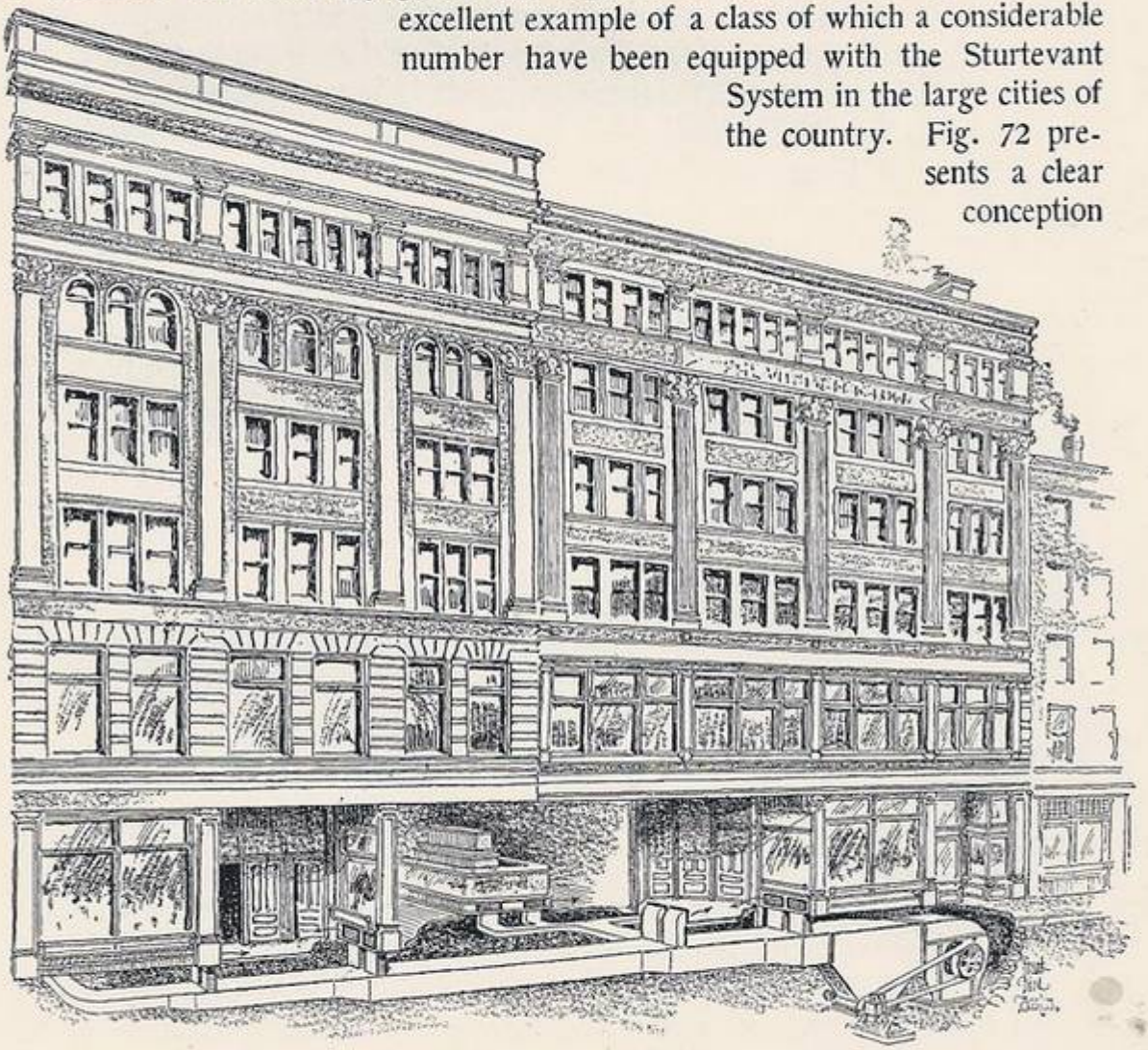


FIG 72. "BOSTON STORE," PROVIDENCE, R. I.

of its character and appearance as well as of the location of the apparatus and the general method of application. In the case of a retail store, the constant passing of the customers in and out makes it extremely difficult to maintain the portion near the entrance at even a moderately comfortable temperature. This problem was presented in connection with the application to the store here illustrated, and in fact its successful solution was the primary result sought in the introduction of the system. Under the conditions of direct heating, the attempt is usually

TESTING SYSTEMS OF VENTILATION AND HEATING.

The actual efficiency of any system of ventilation and heating cannot be ascertained by mere casual inspection, but only by careful, intelligent and extensive experiment. Trustworthy results can only be obtained by the use of special instruments designed for such investigations. Among the most important for this purpose are those here presented.

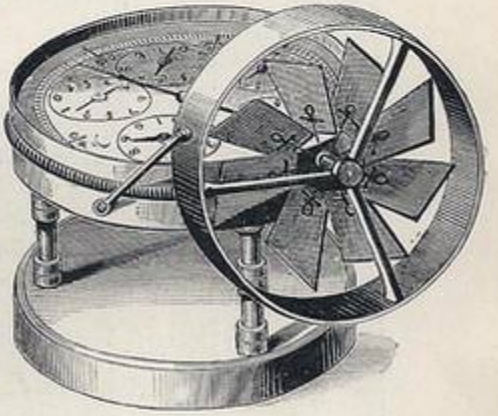


FIG. 100. ANEMOMETER.

Good thermometers, of the usual construction, are generally sufficiently accurate for observing the ordinary temperature of air, but for noting the temperature of steam, or of highly-heated air, the form shown in Fig. 99 is very convenient. The thermometer tube is enclosed in a tubular brass case, the lower end of which is provided with a screw of standard size and thread, by means of which it may be securely inserted in any T or flange. The tube projects well down below the threaded portion, and is guarded by a small pipe attached to the bottom of the case, which allows free circulation around the bulb of the thermometer. The glass may be graduated to read between any given temperatures. For instance, if the thermometer is to be employed exclusively for ascertaining the ordinary temperature of steam, its range need not be greater than between the points 200° to 350°.

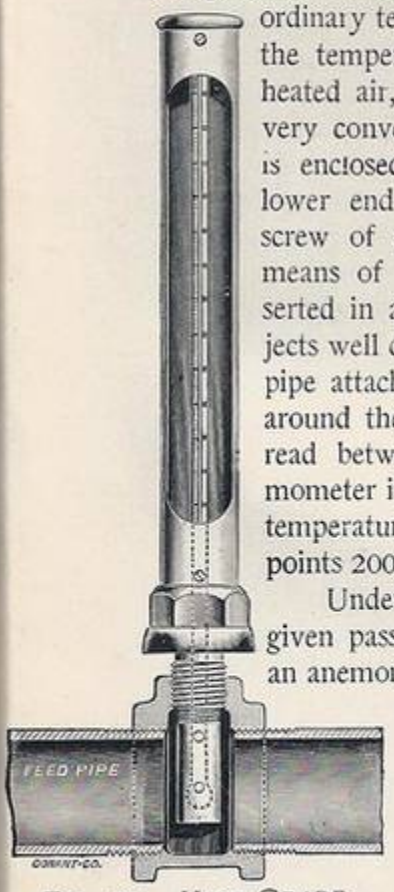


FIG. 99. HIGH-GRADE THERMOMETER.

Under ordinary conditions the volume of air flowing through a given passage or orifice may be most readily determined by means of an anemometer. This instrument, of the form illustrated in Fig. 100, consists of a light and delicately constructed fan wheel whose motion is transmitted to a practically frictionless system of gearing within the attached case. The movement of this system of gearing is rendered evident by the hands and graduated circles upon the dial. The velocity of the air, in feet per minute, is indicated thereon, the series indicating 100, 1,000, 10,000, 100,000, 1,000,000 and 10,000,000

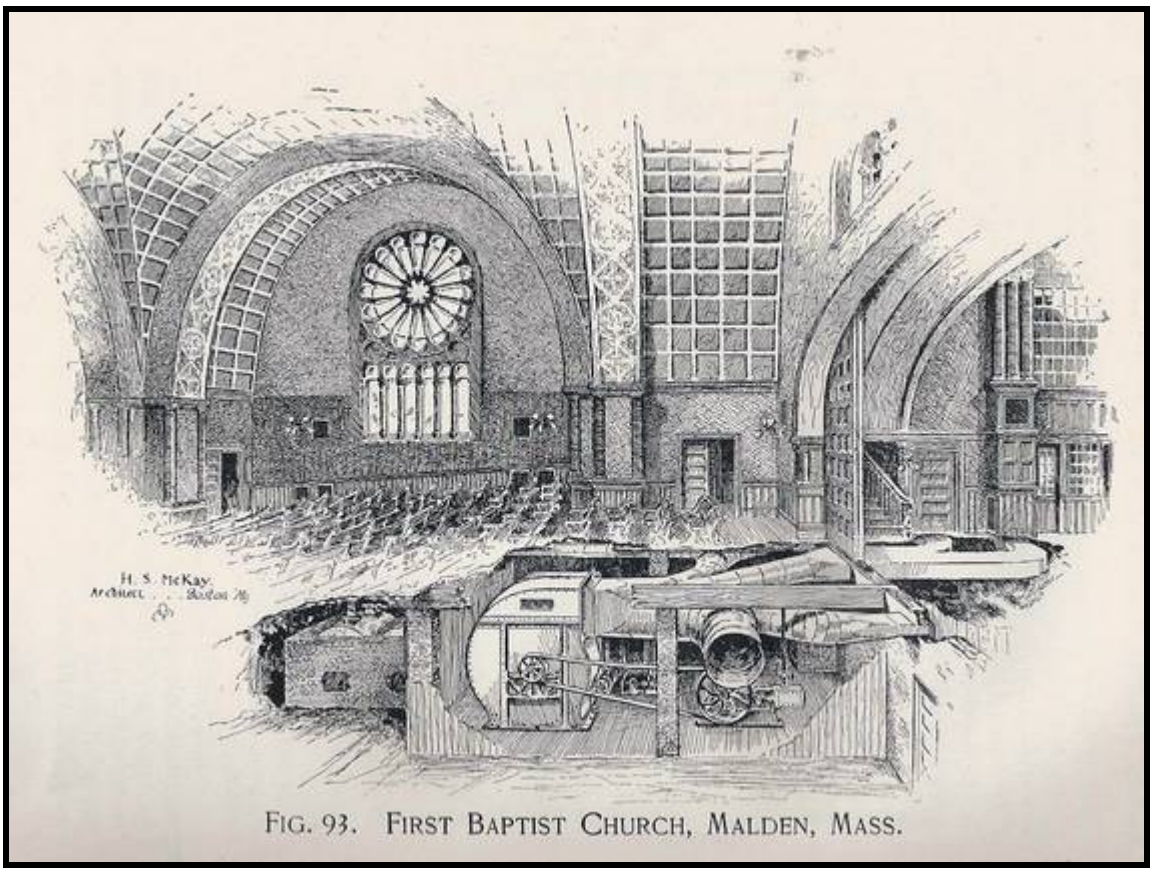


FIG. 93. FIRST BAPTIST CHURCH, MALDEN, MASS.

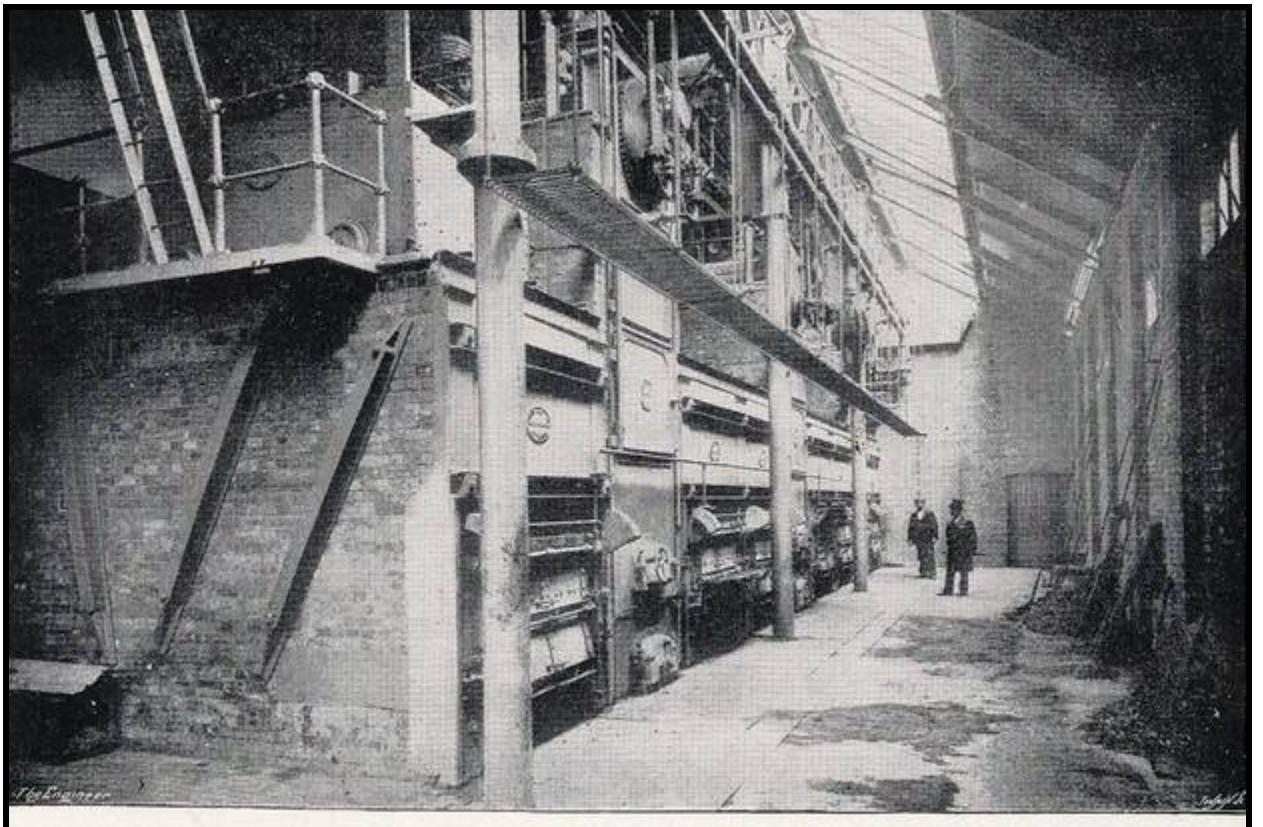
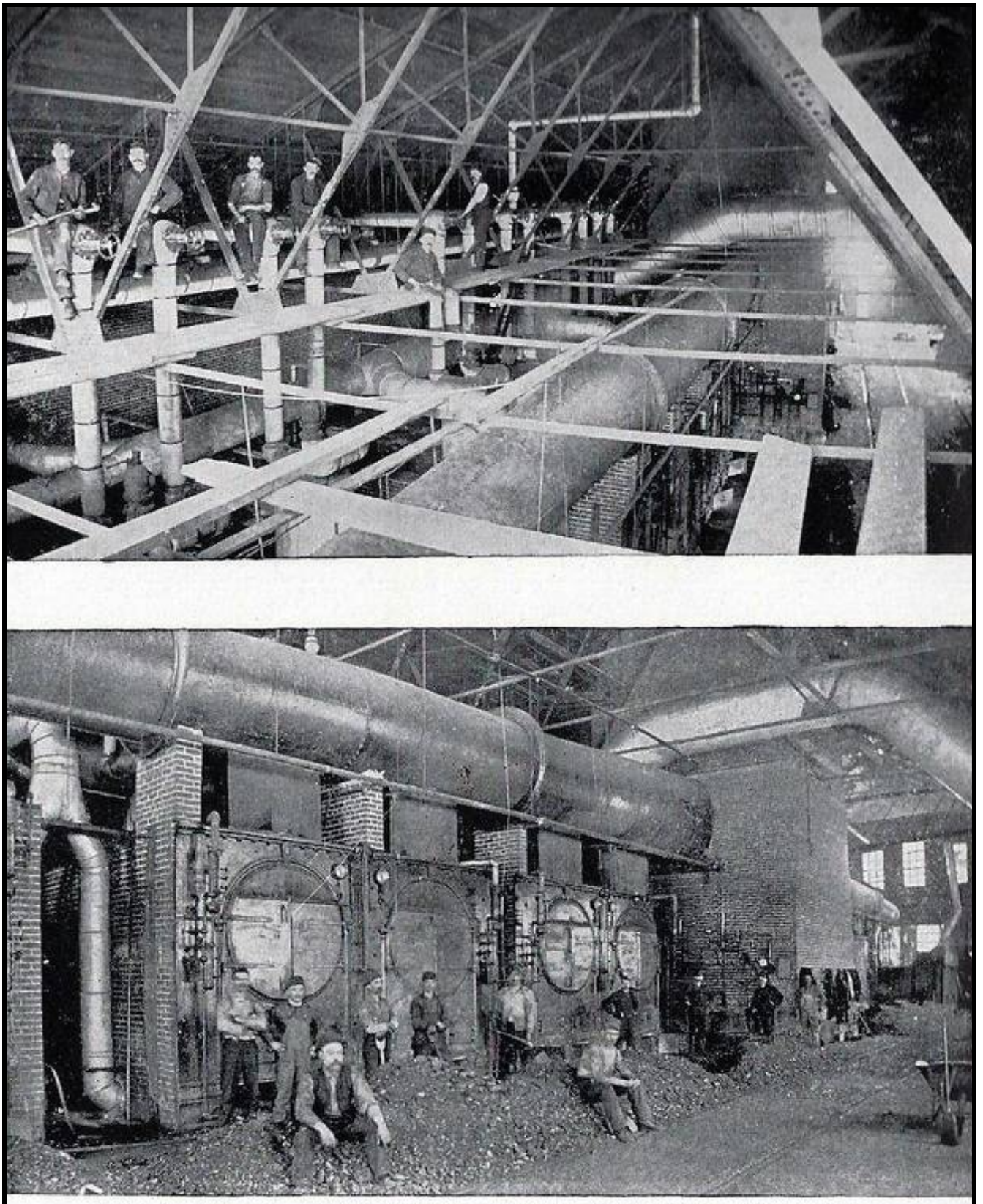


FIG. 76. DUST DESTRUCTORS AT SHOREDITCH, LONDON, ENG.



FIGS. 79 AND 80. FORCED-DRAFT PLANT AT GLENS FALLS PAPER MILL, FORT EDWARD, N. Y.

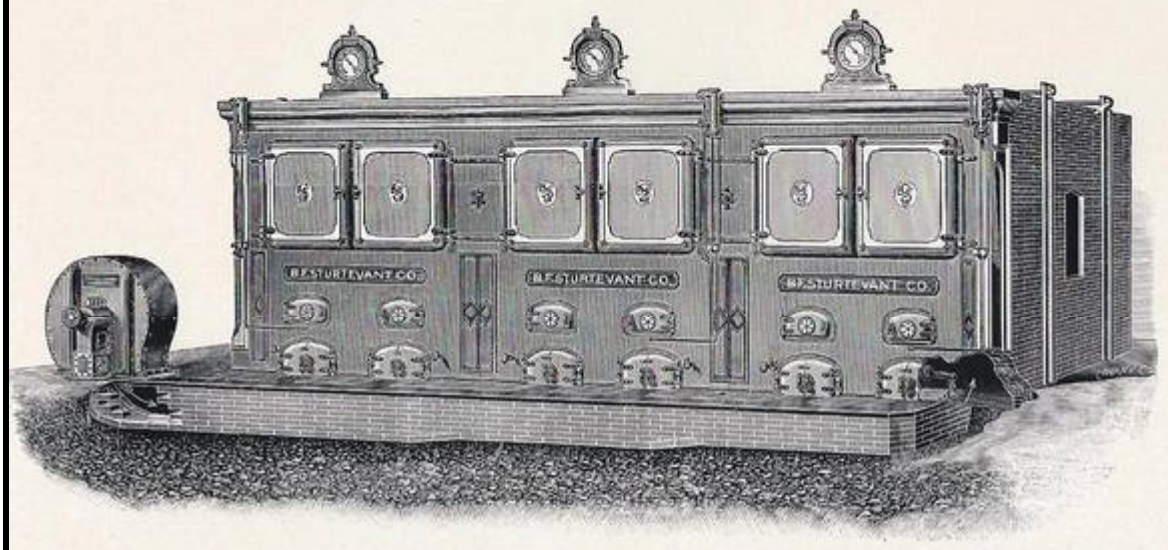


FIG. 45. TYPICAL ARRANGEMENT OF THE STURTEVANT STEAM FAN FOR THE PRODUCTION OF UNDER-GRATE FORCED DRAFT.

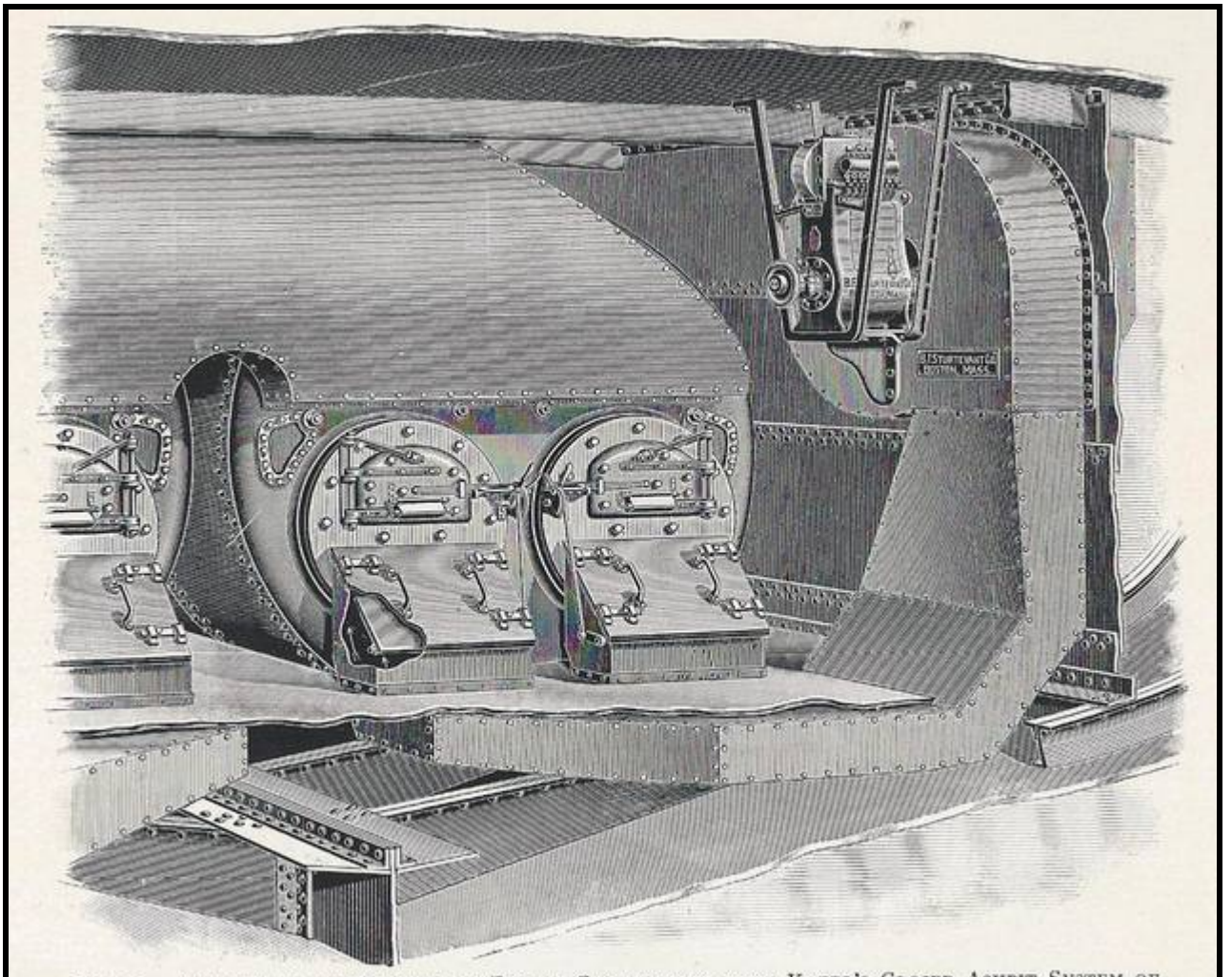


FIG. 55. APPLICATION OF STURTEVANT FAN IN CONJUNCTION WITH KAFER'S CLOSED ASHPIT SYSTEM OF FORCED DRAFT.

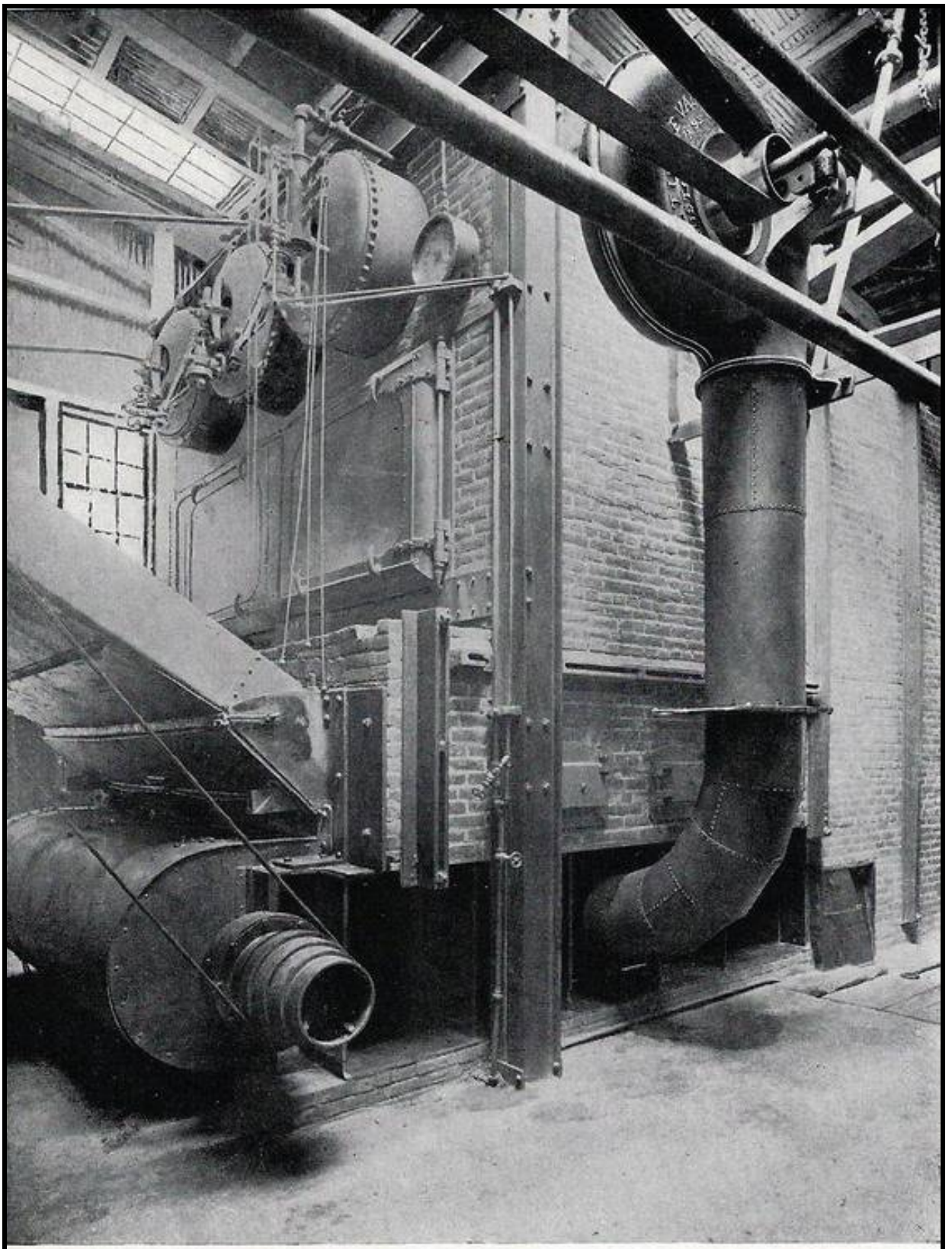
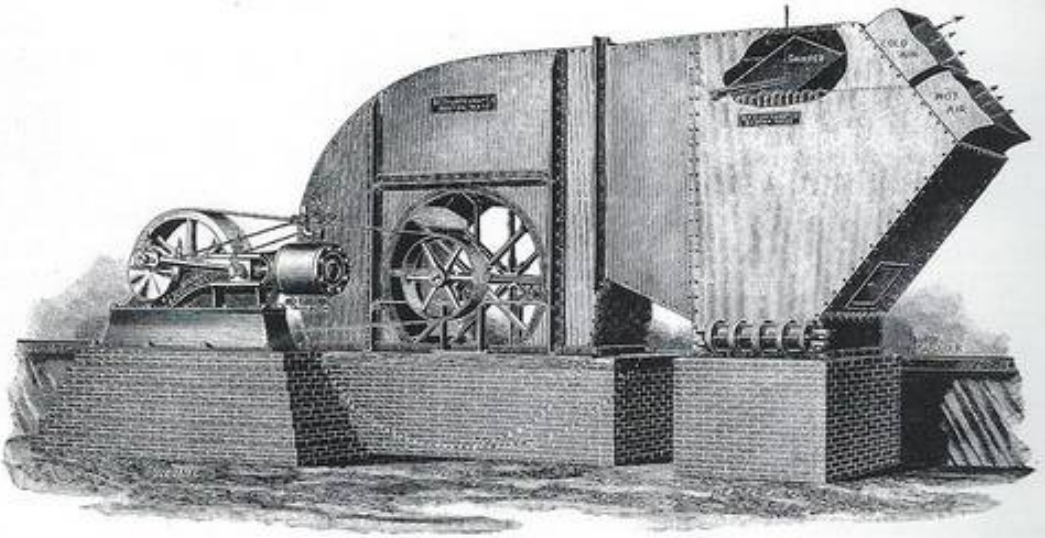


FIG. 64. ARRANGEMENT OF COXE MECHANICAL STOKER AND STURTEVANT FAN AT THE DERINGER COLLIERY OF THE CROSS CREEK COAL COMPANY, DERINGER, PA.

The Sturtevant System

OF HEATING AND VENTILATION

By a Forced Circulation of Warm Air is applicable to all classes of buildings



The Sturtevant System Is Superior to Direct Heating

BECAUSE

- The apparatus is centralized and under one man's control.
- There is no steam piping scattered around the building.
- Consequently no danger of freezing or of damage from leaky joints, valves, or aircocks.
- The heater is specially adapted to the use of exhaust steam.
- Heating can be accomplished with great rapidity.
- Building can be cooled and ventilated in summer.
- Humidity can be regulated.

BECAUSE

- Ample and positive ventilation is provided.
- Quantity and quality of air are under absolute control.
- Constant temperature can be maintained and air volume varied when "hot and cold system" is used.
- The heating surface is inclosed in a fireproof casing.
- The air-ducts are fireproof.
- There is no tendency to noise.
- Operation is independent of wind and weather.

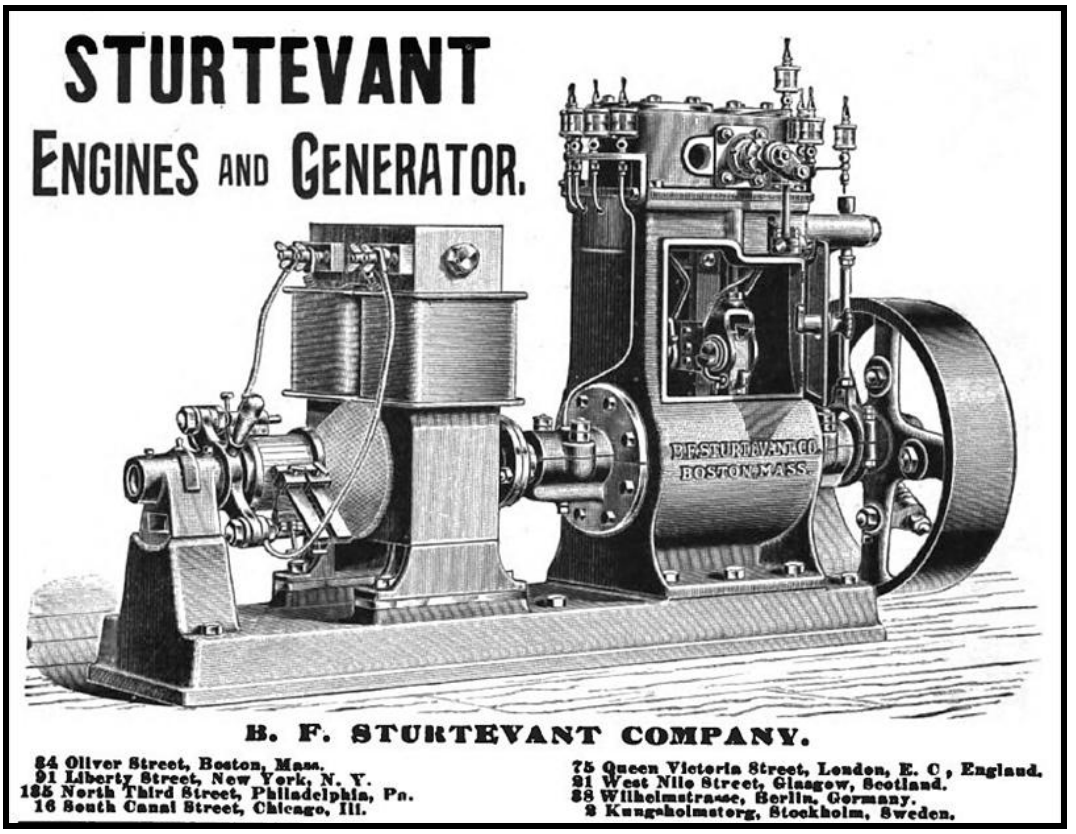
Send for Catalogue No. 112, describing the system in detail

B. F. Sturtevant Company, Boston, Mass.

NEW YORK: 131 Liberty St. | PHILADELPHIA: 135 No. Third St. | CHICAGO: 16 So. Canal St. | LONDON: 75 Queen Victoria St.

118

Advertisement of 1907



1896

In the early 1900's, Foss moved the main manufacturing operations to Hyde Park, near Boston. Around 1910, the Sturtevant company ventured into aviation, both aircraft and engines. This ultimately proved unsuccessful though it made a material contribution to the brief America World War I effort during 1917-18.

The Hyde Park Factory, early 1900's

Sturtevant's Hyde Park Manufacturing Plant, early 1900's
(Assembling aircraft wings in the lower photo)

In 1927, the company introduced Fan Inlet Vane Control. In the 1940's the Sturtevant Company was acquired by Westinghouse and later sold to the Howden Fan Company. In the UK, in 1965, Sturtevant Engineering (then an air conditioning contracting company) was taken over by Drake & Gorham Scull.

Sturtevant House, London, c.1965

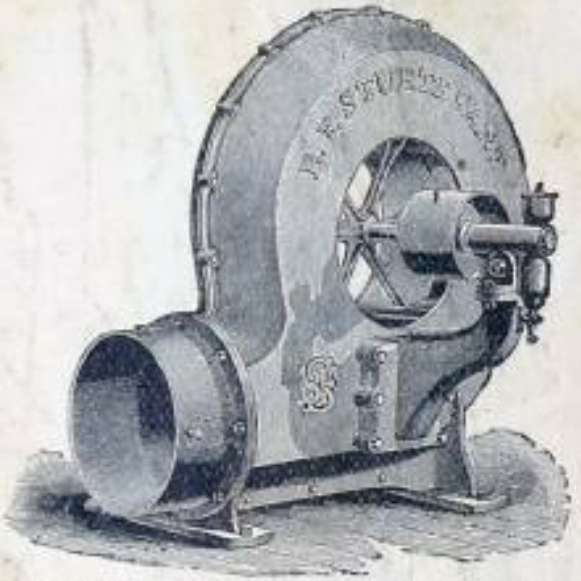
APPENDIX I: STURTEVANT ENGINEERING UK ADVERTISEMENTS

STURTEVANT FANS.

OVER 100,000 IN USE.

SPECIAL TYPES ADAPTED TO ALL KINDS OF WORK.

A LARGE STOCK OF ALL PATTERNS READY FOR IMMEDIATE DELIVERY.



Right Hand, Bottom Horizontal Discharge

MONOGRAM TYPE.

THE STURTEVANT SYSTEM OF MECHANICAL VENTILATION.

The Sturtevant Apparatus for Drying all kinds of Materials.

STURTEVANT ENGINEERING CO.,

75, QUEEN VICTORIA STREET, LONDON.
21, WEST NILE STREET, GLASGOW

STURTEVANT BLOWERS AND EXHAUSTING FANS

FOR ALL PURPOSES.

PRESSURE BLOWER.

BLOWERS are used for blowing Cupola Furnaces and Forges, Heating and Puddling Furnaces, Forced Draught, &c.

EXHAUSTERS for removing Smoke, Dust, and Noxious Fumes; Stive from Mill Stones and Purifiers; Shavings from Planing Machines; Saw-dust from Circular Saws; and for Elevating and Conveying Cotton, Cotton Seed, Hulls, Tea, Wool, and other Fibrous Materials.

CATALOGUES AND PRICES ON APPLICATION.

A LARGE STOCK ALWAYS READY FOR IMMEDIATE DELIVERY.

THE STURTEVANT SYSTEM

FOR

HEATING AND VENTILATING

Steamships, Factories, Schools, Hotels, Churches, Public Buildings, &c., by means of a forced circulation of large volumes of

Pure, Warm Air.

This Apparatus is also unsurpassed for Drying Lumber, Tea, Tobacco, Chemicals, Cotton, Wool, Hemp, and all kinds of Fibrous Materials.

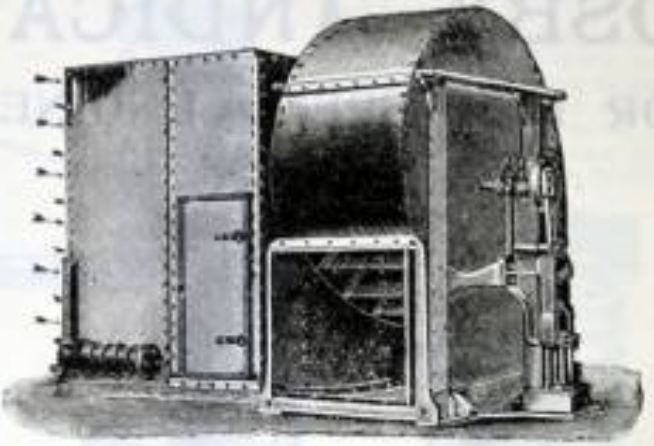
SEND FOR SPECIAL CATALOGUES ON HEATING AND VENTILATION, & DRYING.

STURTEVANT ENGINEERING CO.,

FORMERLY STURTEVANT BLOWER CO.,

75, QUEEN VICTORIA STREET, LONDON, E.C.

STURTEVANT



WARMING, VENTILATING, AND DRYING APPARATUS.

Sturtevant Engineering Co,

MANUFACTURERS OF

BLOWING AND EXHAUSTING FANS

OF VARIOUS TYPES FOR ALL PURPOSES.

SPECIAL FANS FOR MECHANICAL DRAUGHT.

75 QUEEN VICTORIA STREET, LONDON, E.C.

GLASGOW, BERLIN, STOCKHOLM, MILAN.

SPECIFY

STURTEVANT

INCREASE IN STEAMING CAPACITY,

STURTEVANT

INDUCED DRAUGHT FAN

FOR BOILERS

Ask for Catalogue "P.U. 1071."

STURTEVANT ENGINEERING CO., LTD.

147, Queen Victoria Street, LONDON.

Paris. Berlin. Amsterdam.

APPENDIX II: B F STURTEVANT PATENTS

Sheet 1 3 Sheets.

B. F. Sturtevant.

Blower.

No. 86469. Patented Feb. 2. 1869.

Fig. 1.

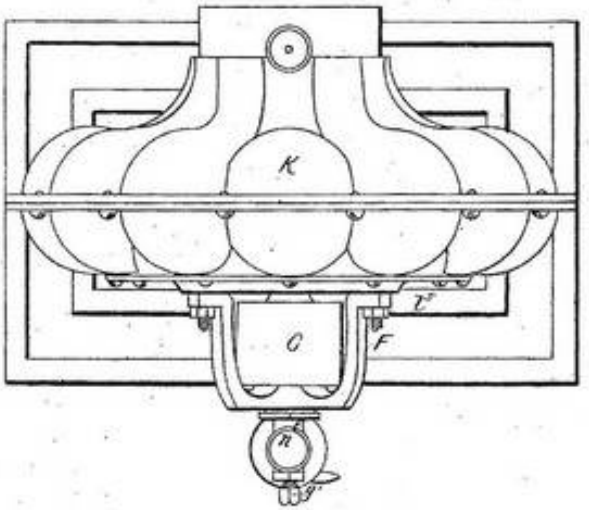
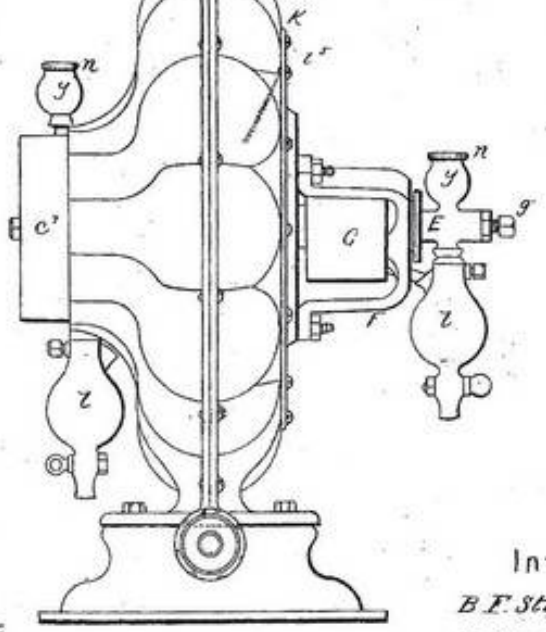


Fig. 4.



Witnesses.

S. N. Piper.

J. B. Snow.

Inventor.

B. F. Sturtevant.

by his attorney.

R. H. Eddy

B. F. Sturtevant.

Pressure Blower.

No. 92489. Patented July 13. 1869.

Fig. 1.

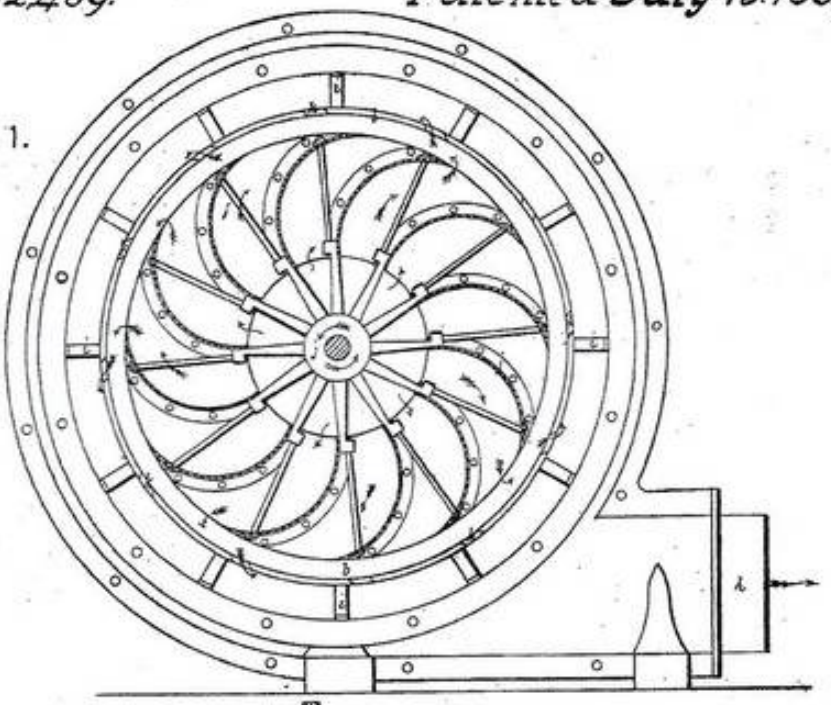
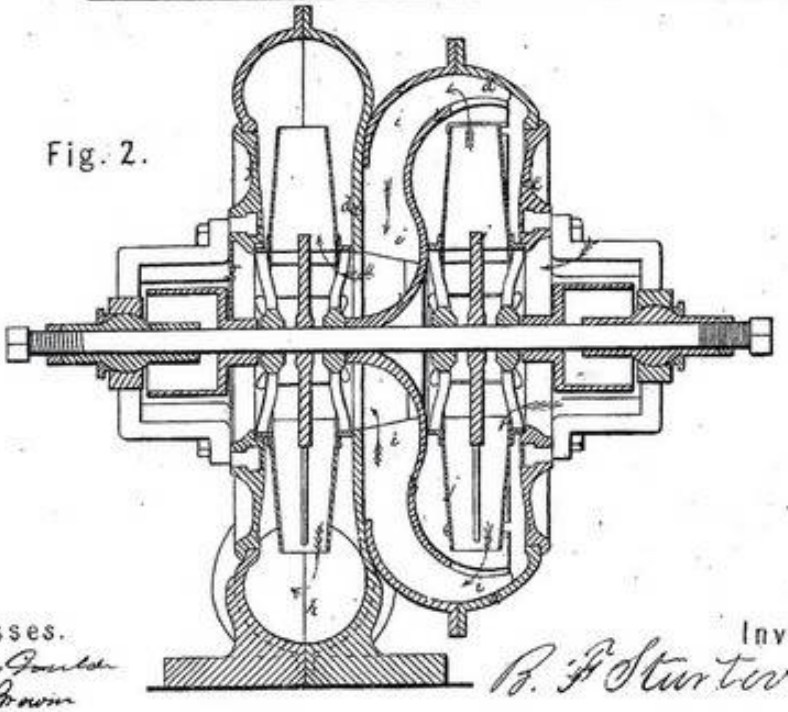


Fig. 2.



Witnesses.

Frank Gould

C. Warren Brown

Inventor.

B. F. Sturtevant

Fig. 1.

№ 92490

PATENTED
JUL 13 1869

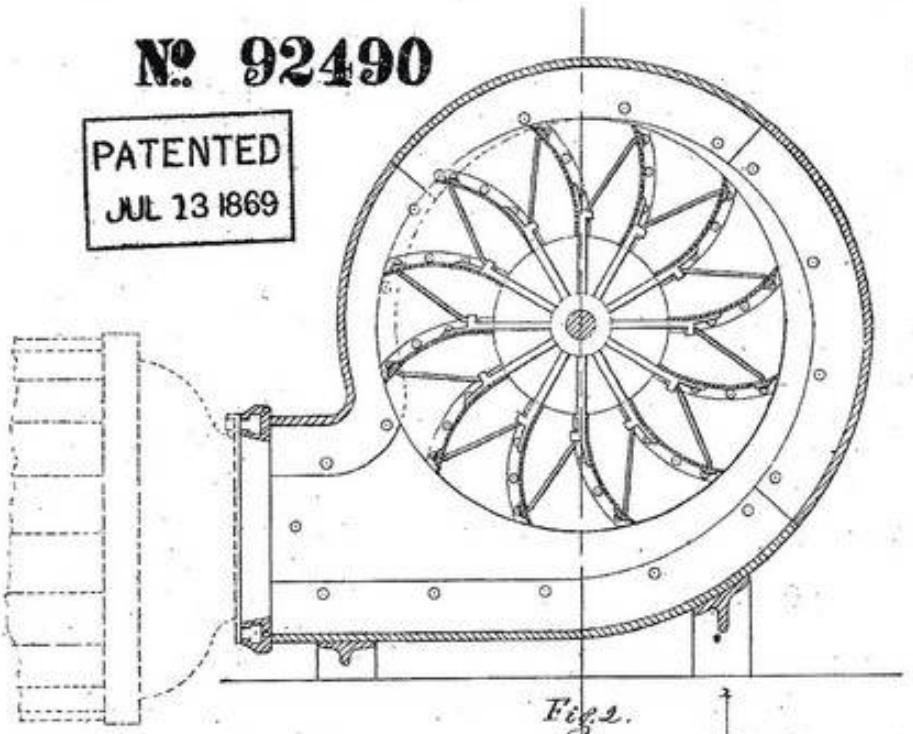
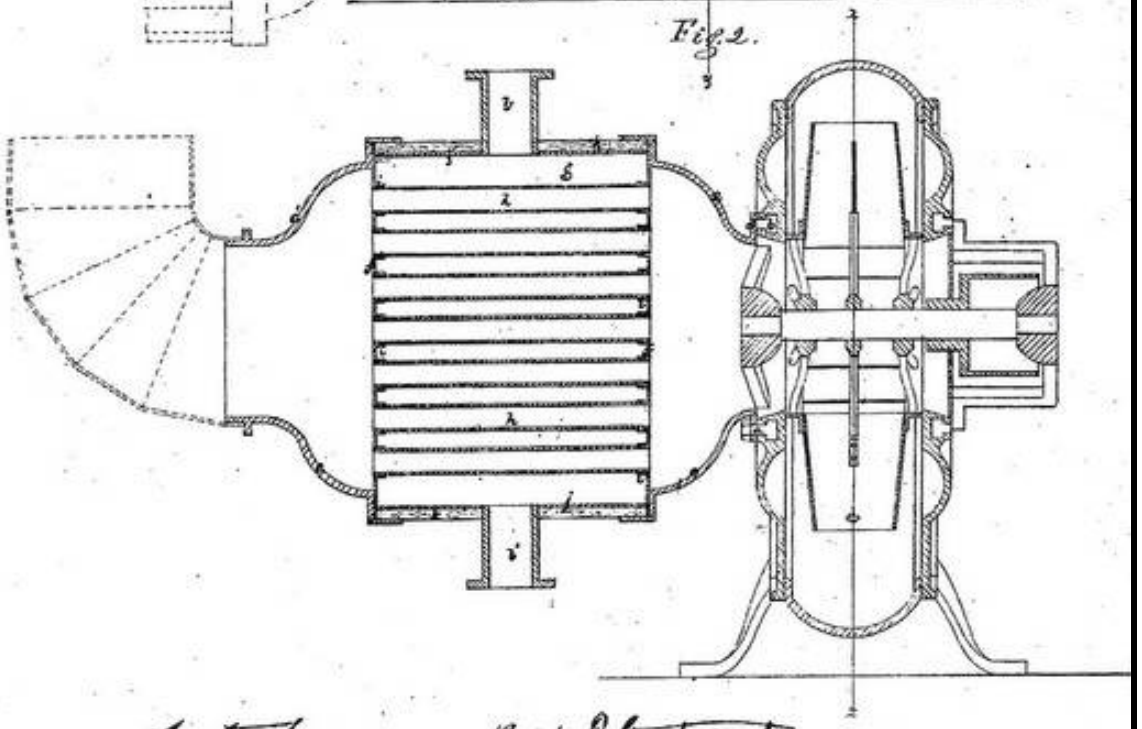


Fig 2.



Witnesses
Francis Gaub
C. Warren Brown.

Benj. F. Sturtevant

B. F. Sturtevant,

Hot Air Furnace

No. 95,849. Patented Oct. 12. 1869.

Fig. 1.

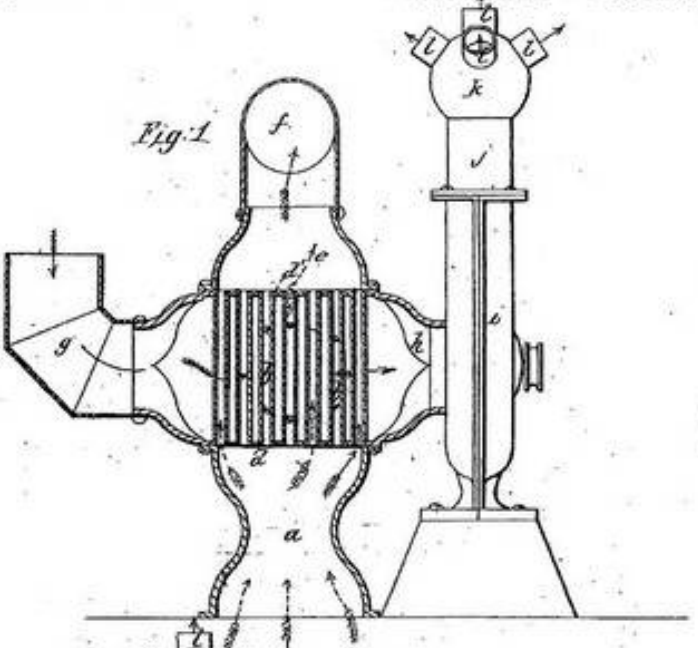
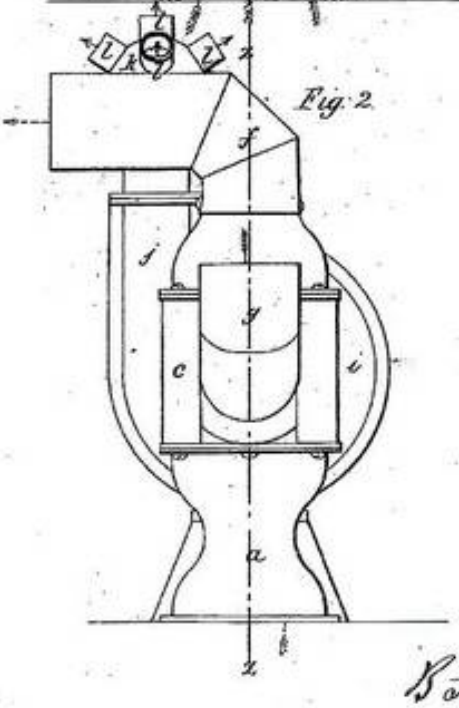


Fig. 2.



Witnesses;
W. B. Lively
Frank Gould

Inventor;
B. F. Sturtevant

B. F. STURTEVANT.

COMPOUND AIR HEATER AND STEAM CONDENSER.

No. 100,241. Patented Feb. 22, 1870.

Fig. 1.

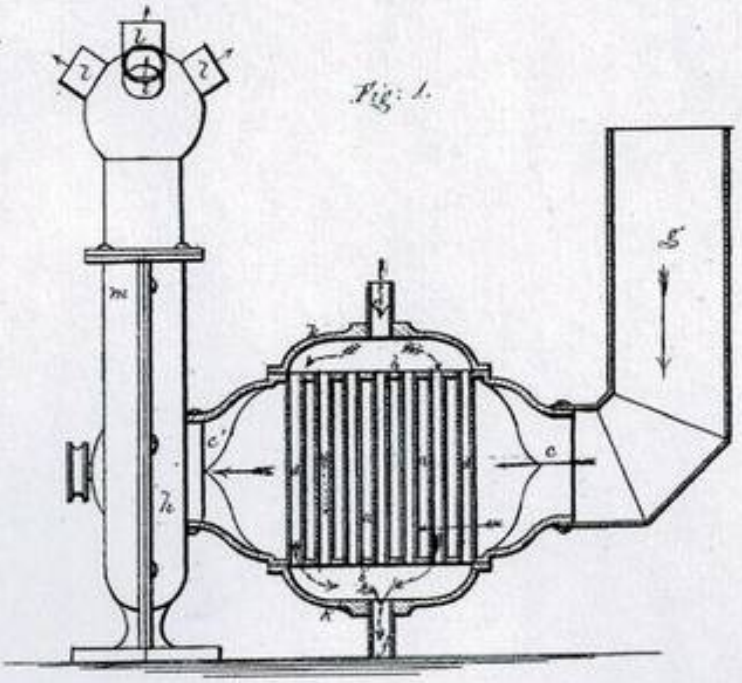
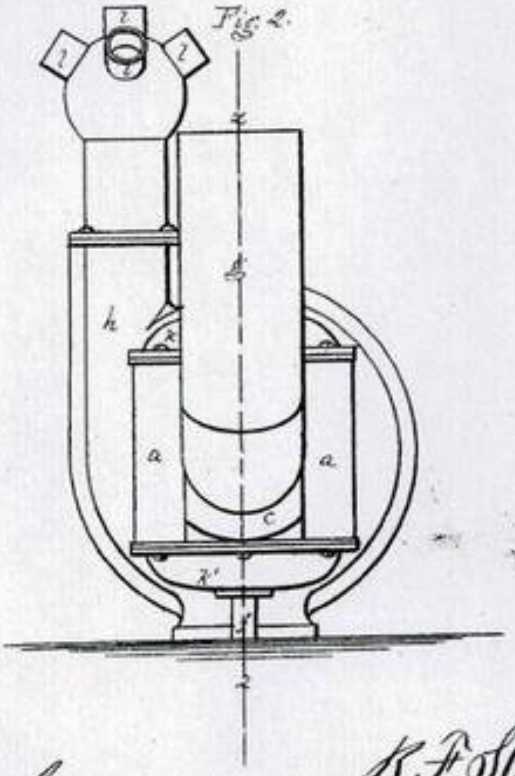


Fig. 2.



Witnesses: J. B. Crosby, C. Warren Brown

B. F. Sturtevant

United States Patent Office.

B. F. STURTEVANT, OF JAMAICA PLAIN, MASSACHUSETTS.

Letters Patent No. 100,241, *dated February* 22, 1870.

IMPROVEMENT IN COMPOUND AIR-HEATERS AND STEAM-CONDENSERS.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that I, B F. STURTEVANT, of Jamaica Plain, in the county of Norfolk, and State of Massachusetts, have invented an Improvement in Air-Surface Condensers; and I do hereby declare that the following, taken in connection with the drawings which accompany and form part of this specification, is a description of my invention sufficient to enable those skilled in the art to practice it.

In that class of apparatus in which air moved rapidly under the action of a rotary blower is used to condense steam, it is necessary that the metal used to separate the air and steam-currents should be made very thin, in order to conduct heat rapidly, and it is further necessary, to give sufficient strength to the metal, that it should be used in the form of small tubes, through which the steam passes, the air surrounding and passing along the outside of the tubes.

To produce the best results, it may be desirable that the tubes should be arranged in a vertical or inclined position, instead of in a horizontal position, as shown in my patent for blast-apparatus, dated July 13, 1869, numbered 92,490, and in my patent for a compound air-heater and condenser, of even date herewith, so that the water of condensation will drain rapidly from them, and not remain therein as it will in horizontal tubes, lessening materially the effective conducting-surface of the tubes with which the steam is in contact.

My invention consists in the combination of a rotary blower with a condenser made with vertical or inclined tubes, through which steam is made to pass, the tubes being inclosed in a case, and the top and bottom ends of the tubes opening out of and emptying into chambers separate from the air-space in which the tubes are contained, one of said chambers receiving the steam from a conducting-pipe, and the other or bottom chamber receiving the water of condensation and the uncondensed steam, which then flow off through a suitable conducting-pipe, when the blower is arranged to force or to draw air rapidly through the air-space surrounding the tubes, the operation causing the steam to condense by giving up its heat to the air, which heated air may be impelled by the blower to any location for any desired purpose.

The drawings represent, in Figure 1, a vertical sectional elevation of my improved air-surface condenser, the section being taken in the plane of the line *z z*, Figure 2.

a denotes the condenser-case, made with tube-heads *b* and air-entering and delivery nozzles *c c'*.

Tubes *d* are secured in the tube-heads *b* either in a vertical or in an inclined position, with their open ends communicating with spaces made by the covering-bonnets *k k'*.

The inlet-steam pipe *e* enters the space under bonnet *k*, and the outlet-pipe *f* proceeds from the space above bonnet *k'*, the direction of the currents of steam and the water of condensation being shown by the dotted arrows seen in the sectional part of fig. 1.

To the nozzle *c*, an air-inlet pipe, *g*, is attached, and the suction-entrance of the blower *h* is attached to the other nozzle *c'*, so that the action of the blower will obviously be to draw air through pipe *g*, and cause it to pass around the outside of the tubes *d*, through nozzle *c'*, to and through the series of delivery or distributing-pipes, *l*, attached to the blower-outlet *m*.

The steam, in passing through the tubes *d*, is condensed against the tube-surfaces, which are cooled by abstraction of heat into and by the air-current caused by the operation of the blower, and the water of condensation flows down the tubes as rapidly as it is formed, and without accumulation therein, and is conducted off through pipe *f*.

It will be apparent that the blower may be arranged to force air through the space containing tubes *d*, instead of drawing it through, in which case the delivery-pipes *l* would be attached to one of the nozzles *c* or *c'*, the outlet of the blower being then attached to the other nozzle, and the air-inlet pipe to the suction-entrance of the blower.

I claim the combination and arrangement of a rotary blower and compound heater and cooler, having vertical or nearly vertical tubes for the steam, and transverse passages for the air, all substantially as shown and described.

B. F. STURTEVANT.

Witnesses:
J. B. CROSBY,
FRANCIS GOULD.

3 Sheets—Sheet 1.

B. F. STURTEVANT.

HEATING AND VENTILATING APPARATUS.

No. 100,211. Patented Feb. 22, 1870.

Fig. 1.

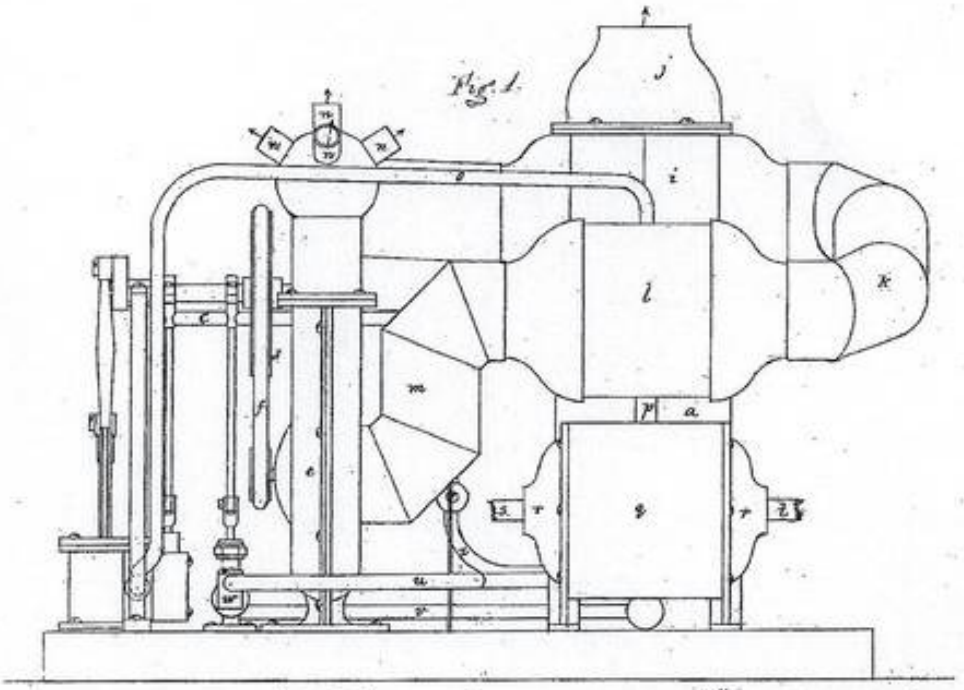
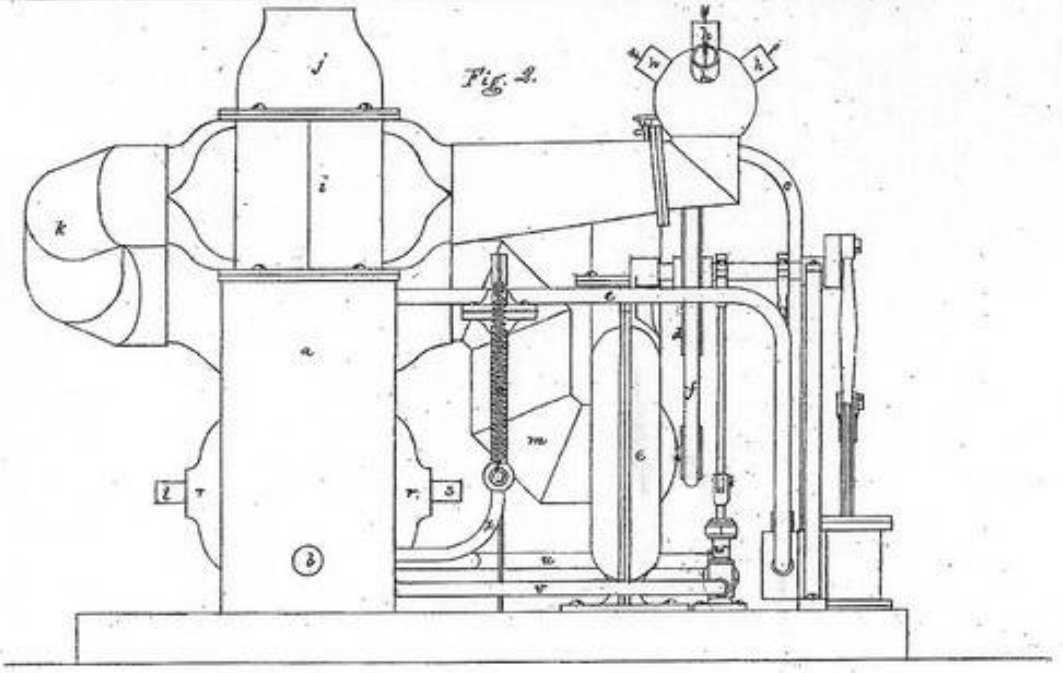


Fig. 2.



Witnesses: W. Brady, C. Barnes Brown

B. F. Sturtevant

3 Sheets—Sheet 2.

B. F. STURTEVANT.

HEATING AND VENTILATING APPARATUS.

No. 100,211. Patented Feb. 22, 1870.

Fig. 3.

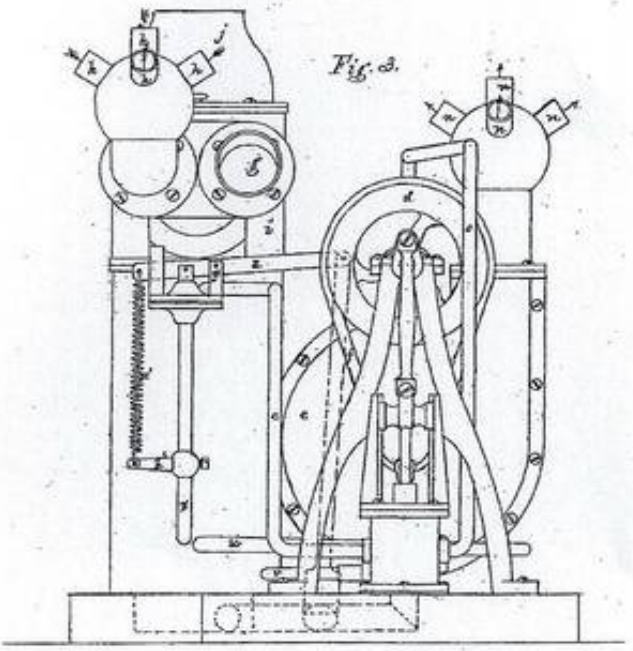
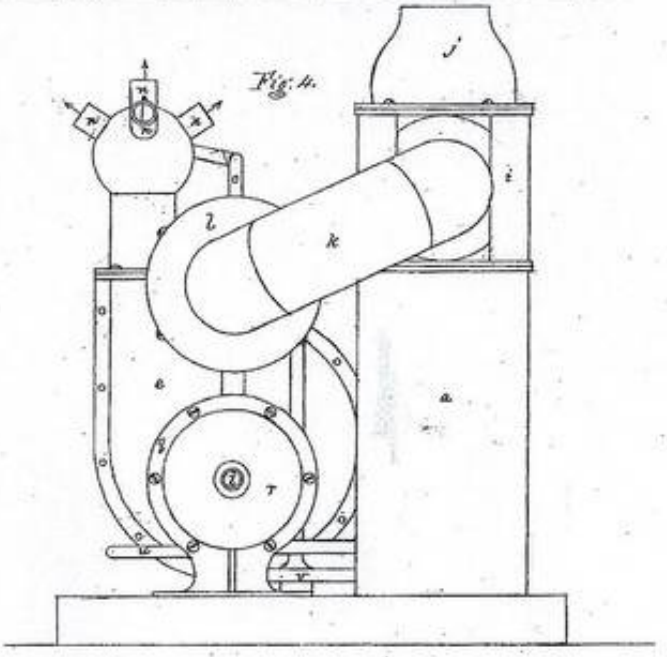


Fig. 4.



Witnesses: { W. B. Shockley. C. Warren Brown

B. F. Sturtevant

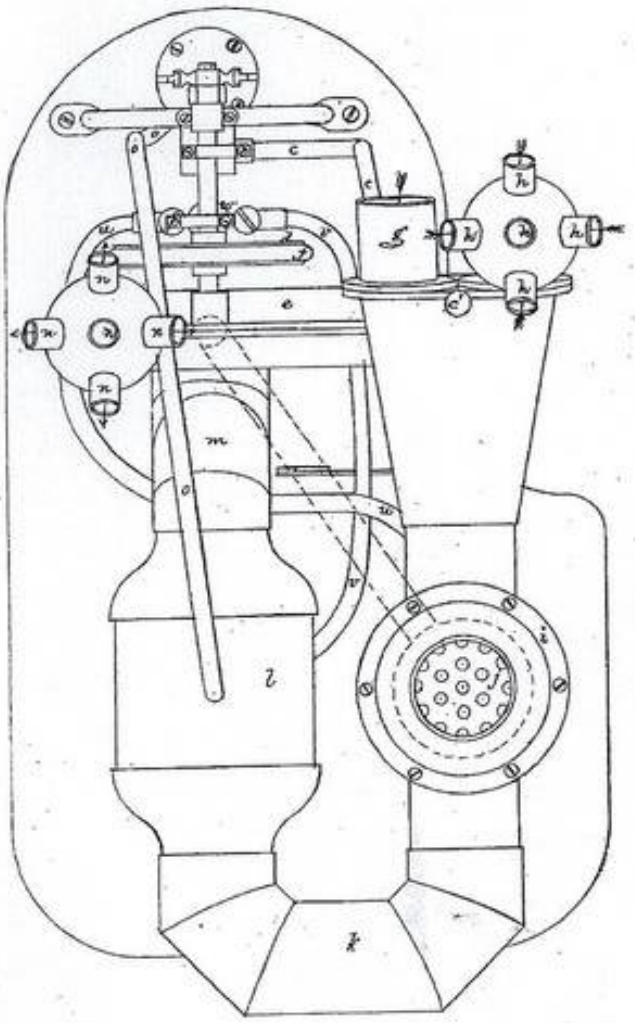
3 Sheets—Sheet 3.

B. F. STURTEVANT.

HEATING AND VENTILATING APPARATUS.

No. 100,211. Patented Feb. 22, 1870.

Fig. 5



B F Sturtevant

Witnesses { W. B. Crosby
E. Warren Brown

United States Patent Office.

B. F. STURTEVANT, OF JAMAICA PLAIN, MASSACHUSETTS.

Letters Patent No. 100,211, *dated February* 22, 1870.

HEATING AND VENTILATING APPARATUS.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that I, B. F. STURTEVANT, of Jamaica Plain, in the county of Norfolk, and State of Massachusetts, have invented an Improved Heating and Ventilating Apparatus; and I do hereby declare that the following, taken in connection with the drawings which accompany and form part of this specification, is a description of my invention sufficient to enable those skilled in the art to practice it.

In this invention I make use of fuel to generate steam, to operate through a suitable steam engine to produce motion, which is utilized in moving air which absorbs the heat escaping in the volatile products of combustion and in the exhaust steam, and which conveys the caloric so absorbed to any desired location, the power developed by the combustion of the fuel being also employed to the extent necessary to return the water of condensation to the boiler, to be again evaporated and used as before.

In some cases I use a part of the force generated by the combustion of fuel to heat water for domestic or manufacturing purposes, and also to raise it from one level to a higher one.

The drawings show, in Figures 1 and 2, two opposite elevations of an apparatus embodying my invention.

In figures 3 and 4, two opposite end elevations; and

In Figure 5, a plan of said apparatus.

The boiler may be of any known type; that shown in the drawings at *a* is designed to be of the vertical multitubular variety, having its fire door at *b*. The steam generated in the boiler is conveyed to any suitable engine by a pipe, *c*, the engine shown in the drawings being of the direct-action vertical variety, with its fly and driving-wheel *d* above the cylinder.

The engine is made to put in motion any kind of an air motor, the kind shown in the drawings being one of my well-known centrifugal or rotary blowers *e*, the shaft of which is rotated by a belt, *f*, from the wheel *d*.

The arrangement of the blower as shown in the drawings is such, that when in operation, it draws or sucks air through the inlet *g*, or through the series of inlets *h*, through the case *i*, (which surrounds a series of flues through which the volatile products of combustion pass off through the outlet *j* to a chimney or other escape duct,) through pipe *k*, to and through a series of pipes contained in case *l*, through pipe *m*, to the blower inlet, and thence they are forced by the fan-wheel in the blower through any one or all of the distributing-pipes *n*.

The exhaust steam from the engine passes through the pipe *o* into the case *l*, around the tubes therein, through which the air passes to the fan, and is condensed by the absorption of its heat by the air, the water of condensation flowing from case *l* through pipe *p* into a similar case, *q*, and around tubes therein, the ends of which enter spaces between the tube sheets of case *q* and bonnets *r*, to each of which are connected pipes, one of which, *s*, leads to an elevated reservoir for water, and the other of which, *t*, leads from said reservoir in such a manner that a circulation of water will be established by the ascent of the water heated in the pipes contained in case *q*, by the hot water of condensation from case *l*, and by the descent of cold water from the reservoir.

From the lowest part of case *q* the condensed water and what steam may be left uncondensed are drawn off through pipe *u* by pump *w*, worked by the engine by which the water is returned through pipe *v* to the boiler, to be again converted into steam, to again act as before described.

The combustion of fuel in the boiler is urged by a current of air taken from the blower through suitable ducts, and discharged into the ash-pit below the grate, said duct being shown in dotted lines in figs. 3 and 5.

The area of the passage through the duct supplying air to promote combustion is controlled by a valve worked by an apparatus that closes the valve more or less as the pressure of steam increases, and opens the valve as the pressure of steam diminishes. Said apparatus consists of a pipe, *x*, connected with the water in the boiler, preferably where the water is coolest.

The upper part of this pipe is enlarged, and contains a diaphragm, which operates a lever, *z*, pivoted at *y*, the long arm of the lever being connected to the valve which controls the passage by which air is supplied to the fuel. The short arm of the lever is coupled to a spring, *a'*, one end of which is attached to an arm, *b'*, which is made adjustable on pipe *x*, so that the degree of tension of the spring may be regulated at will to control the amount of air to be supplied to the fuel.

It will be seen that as the pressure in the boiler increases, the short arm of the lever will be raised by the diaphragm, which will extend spring *a'*, and will lower the long arm of lever *z*, which will cause the long arm of lever *z* to lower the valve thereto attached and will shut off more or less of the supply of air which urges combustion, which, of course will result in checking the fire and the generation of steam. As the pressure of steam diminishes, the contraction of spring *a'* will cause the air-valve to open, which will result in intensifying combustion and in increasing the generation of the steam.

By turning the handle *c'*, fig. 5, a valve is worked to shut off from case *i* the supply of air from the inlets *g* or *h*. The inlet *g* is used when pure fresh air is needed, and the inlets *h* lead from the spaces supplied with heated air from the outlets *n*.

Suppose the boiler sufficiently filled with water, and steam generated therein by consumption of fuel in the

furnace to a pressure sufficient to work the engine and blower connected therewith, then the air will begin to flow through inlet *g* or inlets *h*, according to the position of the valve controlled by the handle *c'*, and the heat of the escaping volatile products of combustion will be transferred to the passing current of air, which on its passage will also absorb the heat of the steam exhausted from the engine, and will pass with the air forced out from the outlets *n* to be applied for warming and ventilating, or for any other useful purpose, a part of the air acted on by the blower passing to urge combustion of the fuel, and the water resulting from condensation of the steam passing back to the boiler, so that all the attention needed for the apparatus is to keep it properly supplied from time to time with fuel, and to keep the frictional surfaces lubricated and the packings from leaking.

It will be obvious that the position or arrangement of the blower may be changed so as to force the air into the case *i*, and all parts beyond, instead of drawing it through said case and the case *l*, as before described, and it will also be obvious that the case *l*, instead of being supplied with horizontal air-pipes as described, may be supplied with vertical steam pipes, and then the air will pass around said pipes and within the case. And in the water-heater the hot water and uncondensed steam may be made to pass through vertical pipes instead of around horizontal pipes.

In some heating apparatus one boiler supplies steam radiators with steam, which, as it condenses, flows back into the boiler by gravity, without the intervention of a pump, and also an engine, which works a blower to force air over the radiators to be heated and conveyed to the space to be warmed; but in such cases the exhaust from the engine escapes to waste, and the water which is carried off by the steam has to be supplied by additional water.

In my invention, on the contrary, I use no direct steam for heating, but do use all the exhaust steam, which, when it has parted with its heat, is returned to the boiler by a pump, so that I use the same water again and again, and would have to supply no additional water if it were possible to prevent all leakage at joints, stuffing-boxes, &c.

In my invention, also, I reclaim and utilize as much as possible of the heat escaping in the volatile products of combustion, and supply any deficiency of draught by a positive blast from a blower.

To obtain the minimum of heat and the maximum of ventilation, and the maximum of heat and minimum of ventilation, the valve controlled by the handle *c'* and the adjustment of spring *a'* are to be varied to suit the requirements of the case.

To vary the speed of the engine, a valve may be placed in the pipe which supplies the steam to the cylinder, or a cut-off, which may be adjusted to any desired point, may be applied to the engine.

Under some circumstances the engine of this apparatus will be worked under a heavy back pressure; for example, if it is desired to give intense heat to the air currents set in motion, then the engine and blower should be run slowly, and fuel supplied to generate steam of high pressure in the boiler. The air supplied by the condenser will then not suffice to condense the exhaust steam rapidly, and the exhaust steam will accumulate in the condensing apparatus till its pressure equals a large fraction of the pressure in the boiler, the exhaust steam under said circumstances heating the air currents about as they are usually heated by steam taken directly from the boiler.

I claim—

For producing and heating currents of air, the combination of a boiler, engine, blower, exhaust-steam-condensing apparatus, (operating to condense by the air set in motion by the blower,) and pump, or other suitable device for returning the condensed water to the boiler.

Also, in combination with the elements first claimed, an apparatus for extracting and utilizing the heat escaping in the volatile products of combustion.

Also, in combination with the elements first claimed, the series of distributing-pipes *n*, leading from the blower.

Also, in combination with the elements first claimed, the series of collecting or return pipes *h* leading to the blower.

Also, the combination of one or more return pipes *h*, and one or more delivery-pipes *n*, with a cold-air inlet-pipe, *g*, and a valve or equivalent device for regulating the proportion of fresh air to be heated and circulated.

Also, the arrangement of the water heater between the condenser and the pump, substantially as and for the purpose described.

B. F. STURTEVANT.

Witnesses:
J. B. CROSBY,
C. WARREN BROWN.

BIBLIOGRAPHY

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------ *B F Sturtevant*, US Patent Office Records

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1994 *Heat & Cold: Mastering the Great Indoors***,** Barry Donaldson & Bernard Nagengast, ASHRAE

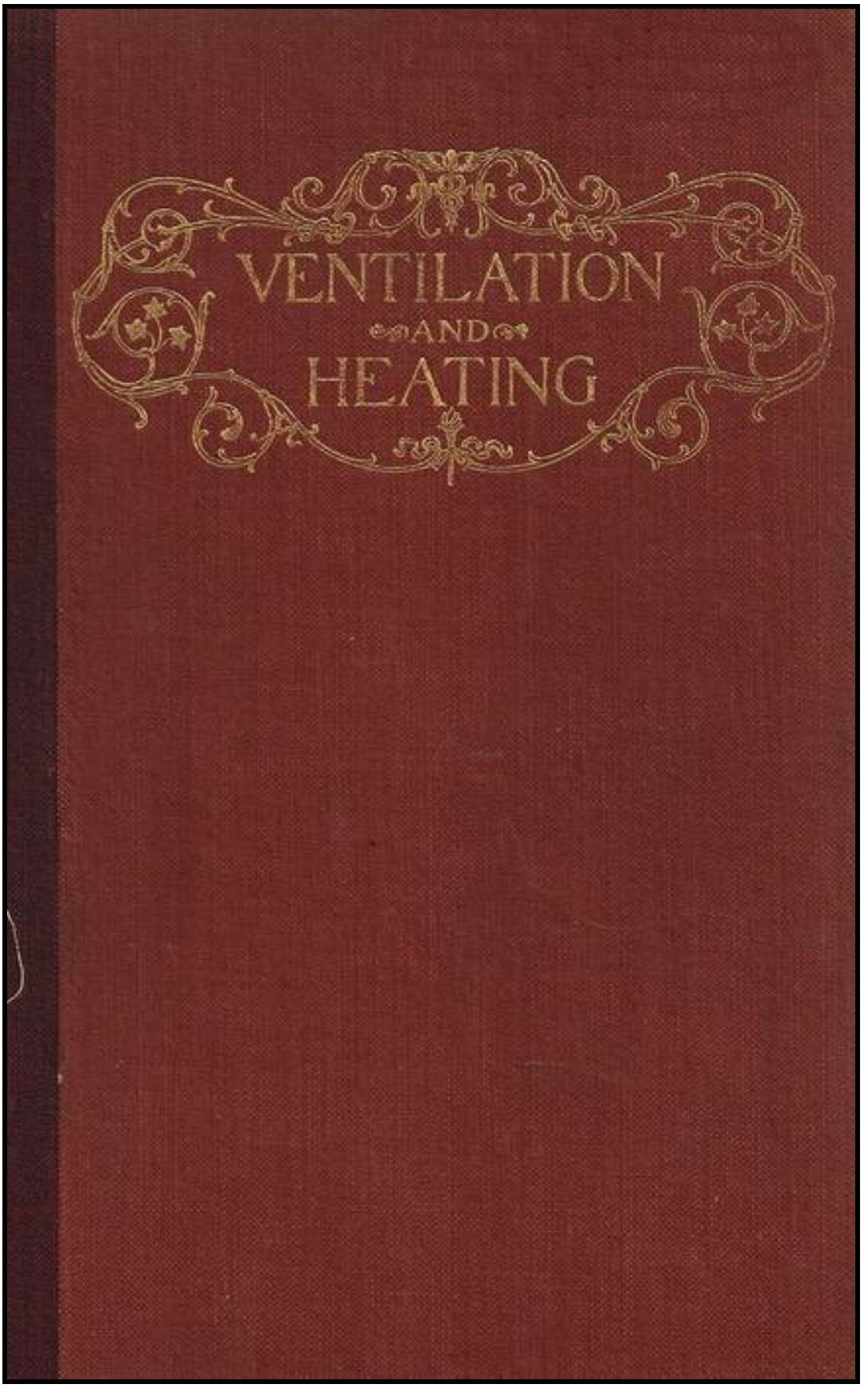
2000 *The Comfort Makers*, Brian Roberts, ASHRAE

2005 *Jamaica Plain Historical Society*

http:// www.sturtevantfan.com/BFS.html

http://www.gracesguide.co.uk/Sturtevant-Engineering-Co

POSTSCRIPT: FURTHER READING

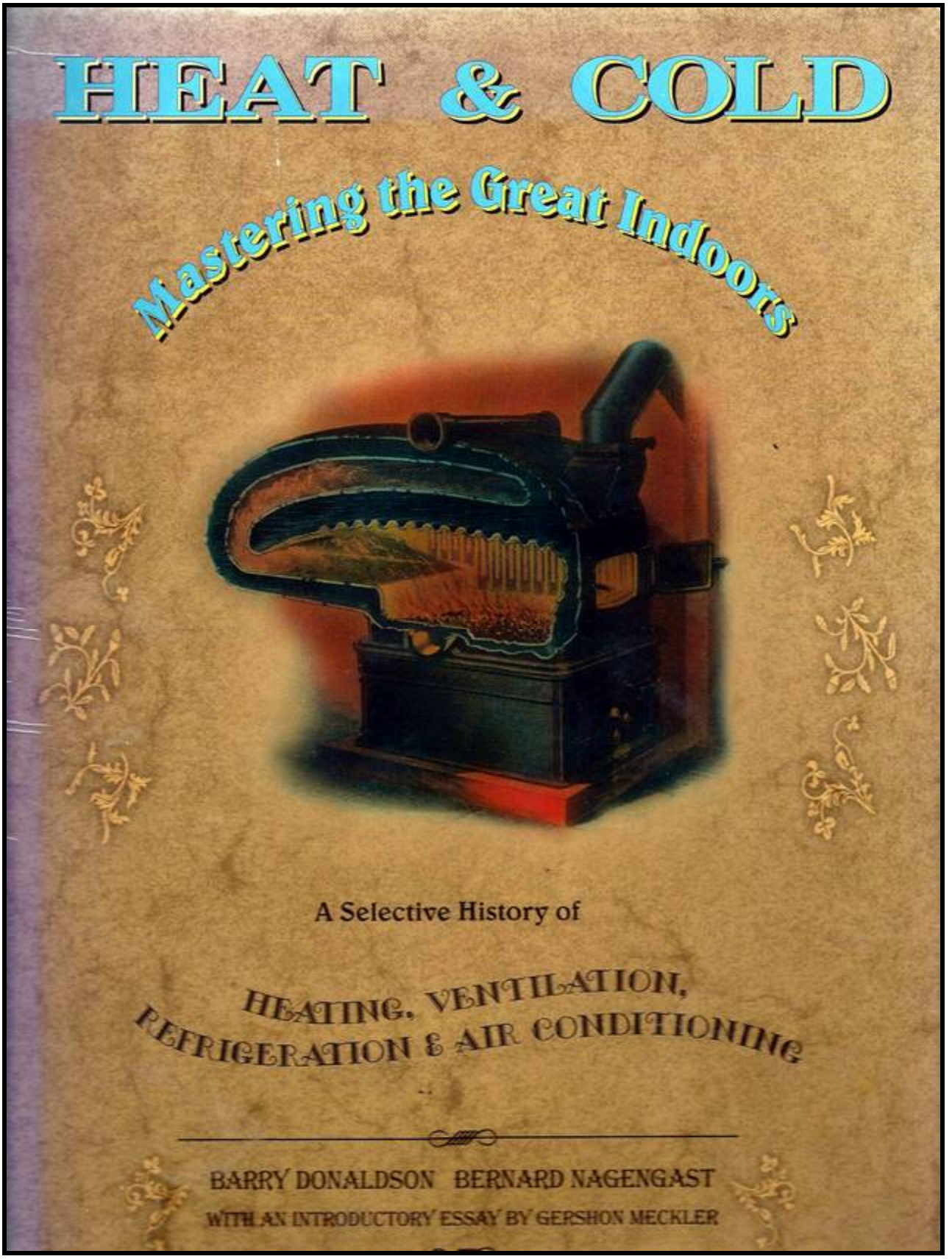


1906

MECHANICAL DRAFT.

STURTEVANT.

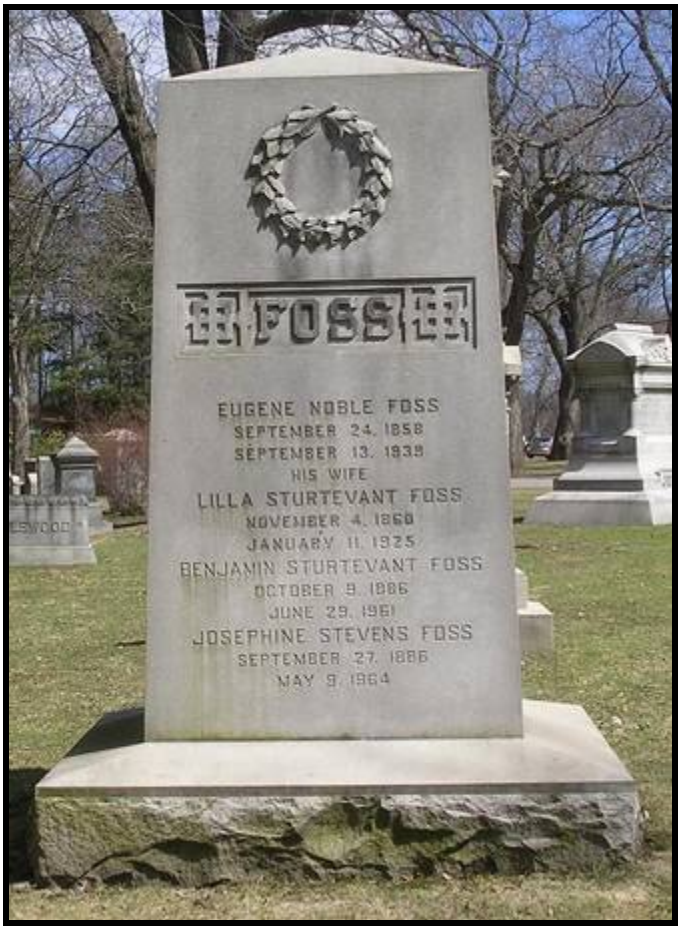
1899


HEAT & COLD
Mastering the Great Indoors
A Selective History of
HEATING, VENTILATION,
REFRIGERATION & AIR CONDITIONING
BARRY DONALDSON BERNARD NAGENGAST
WITH AN INTRODUCTORY ESSAY BY GERSHON MECKLER

1994

EPILOGUE

There is little information on the death of Benjamin Franklin Sturtevant and his final resting place. One report says he died in 1890 and that "the Sturtevant and Foss families are buried in adjacent plots in Jamaica Plains Forest Hills Cemetery."



Commemorative Gravestone of Eugene Noble Foss and Lilla Sturtevant Foss (Benjamin's Daughter)

Entrance to Forest Hills Cemetery