

**B F STURTEVANT COMPANY PART-2**  
**Boston, Massachusetts**  
**Extracts from Catalogue of 1899**

# **Centrifugal Fans & Systems**

MECHANICAL DRAFT.



STURTEVANT.

# MECHANICAL

# DRAFT

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## A PRACTICAL TREATISE

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EDITED BY  
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OF THE ENGINEERING STAFF OF THE  
B. F. STURTEVANT CO.

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B. F. STURTEVANT CO.

BOSTON, MASS.

NEW YORK.

PHILADELPHIA.

CHICAGO.

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STURTEVANT ENGINEERING CO.

LONDON.

GLASGOW.

STOCKHOLM.

BERLIN.

MILAN.

AMSTERDAM.





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

## CHAPTER XII.

### **THE STURTEVANT FANS FOR MECHANICAL DRAFT.**

It has been made evident in the preceding chapters that the essential feature of mechanical draft is a fan blower or exhauster. It has been shown that the blowing engine and the positive rotary blast blower are not adaptable, that the steam or compressed-air jet is not economical, and that the disc or propeller form of fan wheel is not suitable for the purpose. The peripheral discharge type of fan therefore stands as the only form which it is desirable to employ for the production of draft. It is the purpose of this chapter to illustrate and describe this type of fan in all of its principal forms as built by this house. It is, however, manifestly impossible to present all of the multitudinous shapes in which these fans are constructed to suit the ever-varying requirements of different plants.

Prominent among the advantages of mechanical draft as displayed in the preceding chapter is that of adaptability, as is most clearly evidenced in this and the succeeding chapter. The steel-plate construction employed in all fans but those of smaller size lends itself most readily to perfect adaptation to the conditions existing in any specific case. The fan may, if absolutely necessary, be small and be operated at high speed, or, as should otherwise be the case, it may be large and run slowly. It may be constructed of steel plate in all sizes, and of cast iron in the different types of the smaller sizes. In the former material it may take almost any shape within the range of possible requirements, while either cast-iron or steel-plate fans are regularly constructed to discharge either horizontally at the top or bottom, or directly upward or downward. The pulley or engine, according as one or the other is employed, may be placed upon either side of the fan; while the engine may, to suit circumstances, be single or double, open or enclosed, with its cylinders above or below the shaft, or may be horizontal and of any required size. Or if desired a direct-connected electric motor may take the place of the engine in all but the largest sizes. The most important of these various arrangements are presented in the succeeding illustrations, while in Chapter XIII. are shown specific applications, in many of which the particular conditions demanded the construction and introduction of the particular forms of fans which there appear.



**Steel-Plate Steam Fan.**— It is always desirable that the means of propulsion for a fan should be as independent as possible of any other source of power; in other words, the motor adopted should be devoted solely to the driving of the fan. In the smaller sizes of fans of the pressure and "Monogram" types, the speed of rotation to produce the required pressure is such that a motor in the form of a steam engine directly connected to the fan shaft would be obliged to operate at too high a speed to remain durable; hence the belted arrangements which have already been shown. In the larger sizes of fans, however, particularly those of steel plate, the speed is such as to make direct connection practicable. A common form of this arrangement is that illustrated in Fig. 23. The fan itself is an exhauster, being identical in form and construction with that shown in Fig. 22, with the exception that the shape of the support is changed and that an engine is substituted for the journal boxes and pulley. This form of engine, which has its cylinder above the shaft, is of the same construction as the regular automatic upright engines built by this Company. The valve is of the balanced piston type, the cylinder is thoroughly lagged, the crank is accurately counter-balanced, and the crank pin is oiled from a stationary sight-feed oiler, attached to the frame of the engine. Large-cylindere

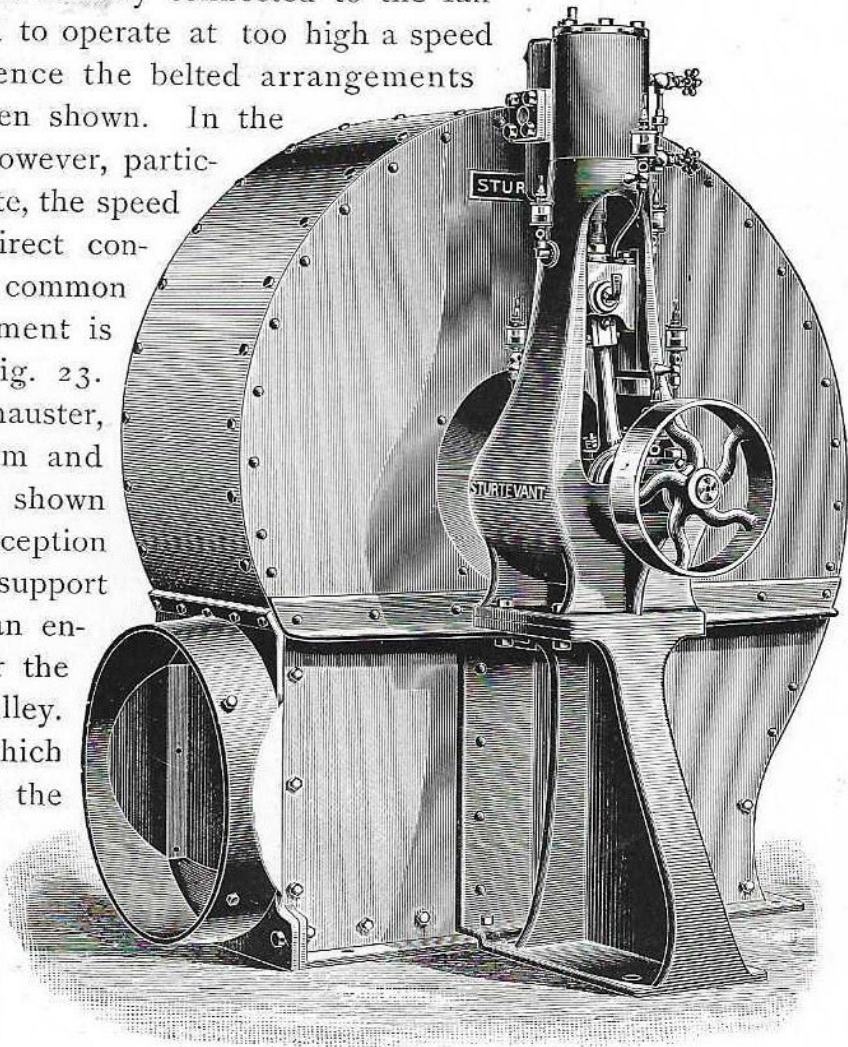


FIG. 23. STEEL-PLATE STEAM FAN WITH ENGINE HAVING CYLINDER ABOVE THE SHAFT.

ed low-pressure engines can be furnished in this type. Evidently this construction readily lends itself to application for mechanical draft, particularly under the induced system; for the wheel is overhung upon the end of the shaft and the inner journal may be water cooled.



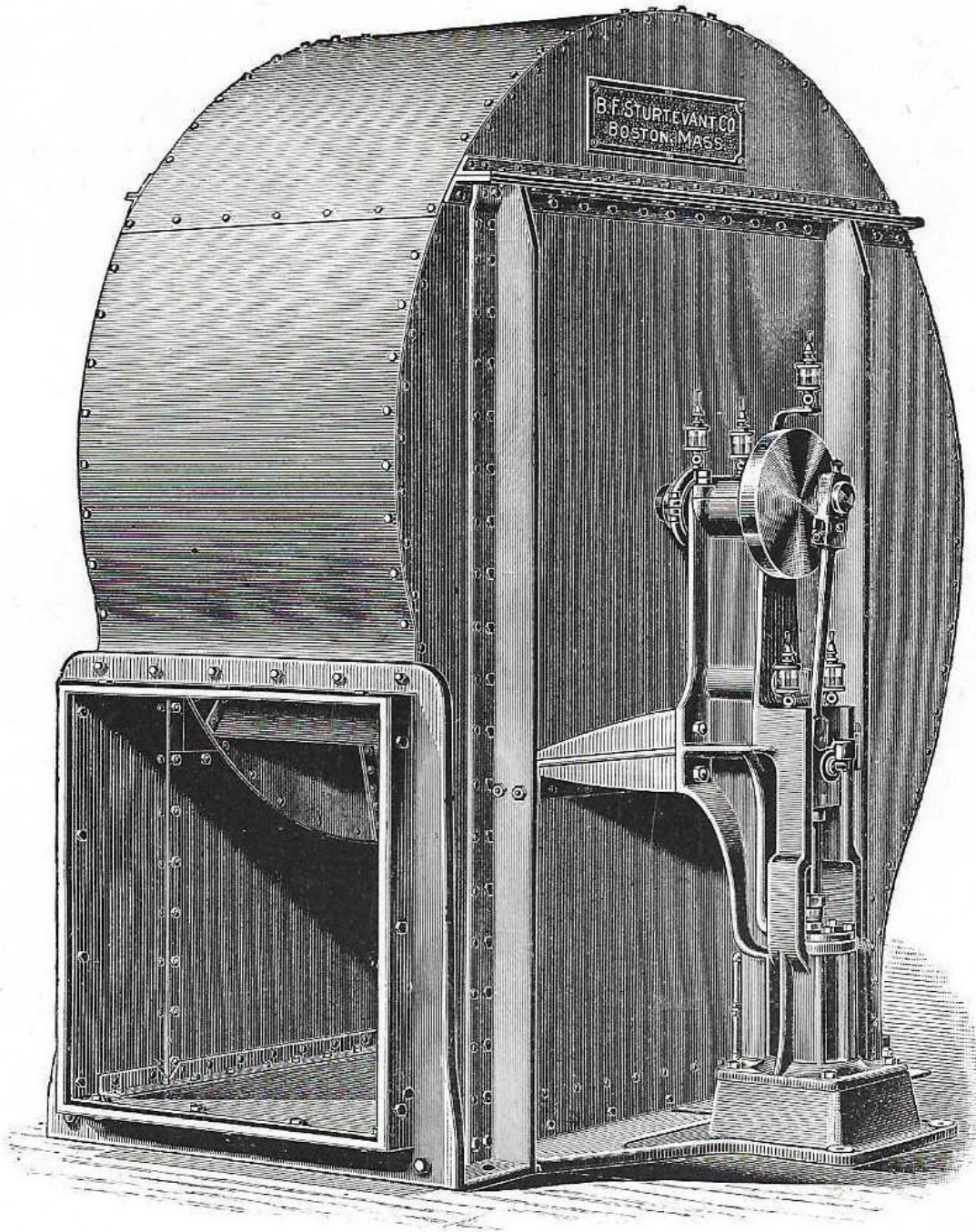


FIG. 24. STEEL-PLATE STEAM FAN WITH ENGINE HAVING CYLINDER BENEATH THE SHAFT.



The form of steam fan illustrated in Fig. 24 is that employed in the larger sizes of full-housing steel-plate steam fans. As is evident, it is specially constructed for this particular use, its cylinder is beneath the shaft, and it possesses but a single bearing, the other bearing for the shaft being regularly placed upon a truss in the inlet upon the opposite side of the fan. When applied for induced draft, the shaft may be extended so that its supporting journal box can be placed outside the inlet connection. Both this bearing and that upon the engine may be chambered and kept cool by a constant circulation of water.

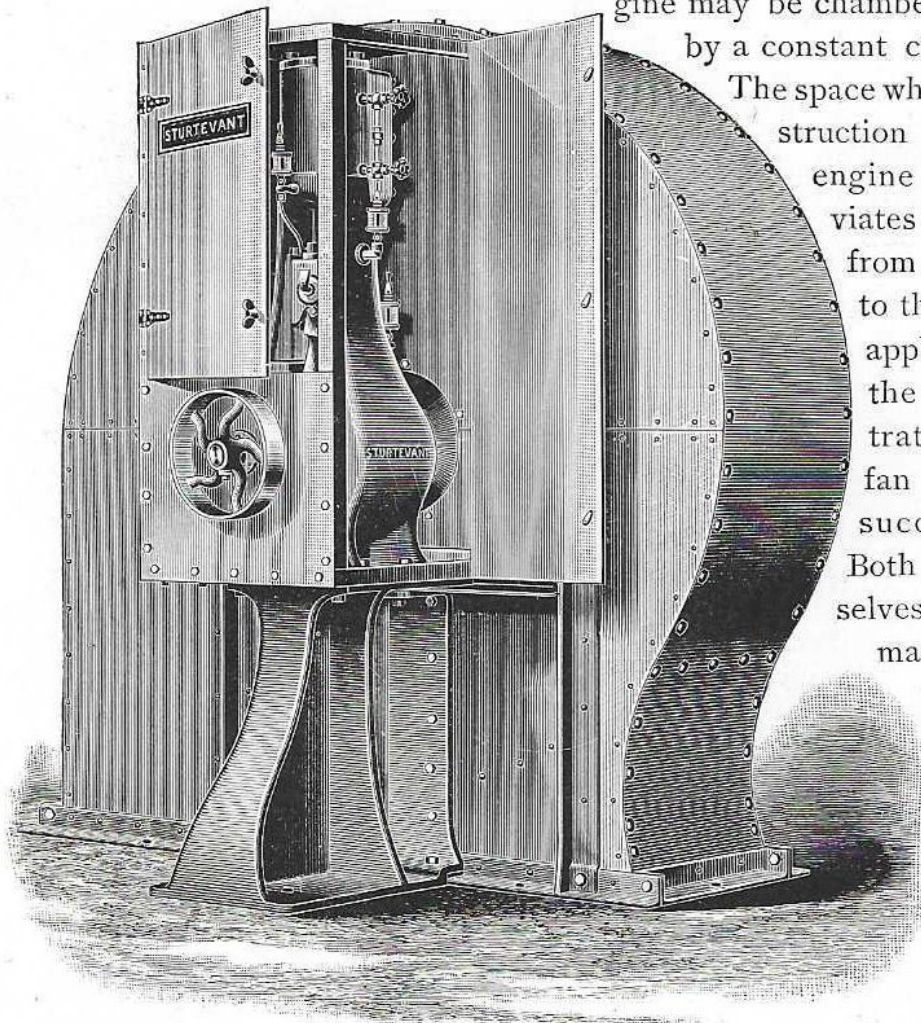


FIG. 25. STEEL-PLATE STEAM FAN WITH ENGINE ENCLOSED.

**Steel-Plate Steam Fan with Engine Enclosed.**—The objection to the presence of an engine in some boiler rooms is usually that of liability to damage from the fine dust which is floating in the atmosphere and constantly tends to work into the bearings with disastrous effect. This objection may be removed by entirely enclosing the engine in a steel-plate casing as shown in Fig. 25. A regular form of double enclosed engine is shown in subsequent cuts.

The space which in the usual construction is left between the engine and the shell obviates any further trouble from direct transmission to the engine. Various applications of this and the previously illustrated form of steam fan will appear in the succeeding chapter. Both forms lend themselves to control by automatic draft regulators, which may be so arranged that as the steam pressure falls the engine speed and consequently the draft pressure and rate of combustion rise and more steam is at once generated.



**Steel-Plate Exhauster with Inlet Connection.**— When an exhaust fan is to be employed for induced draft it is frequently desirable to construct, in connection with and in fact as a part of the fan, an inlet connection in the manner indicated in Fig. 26. As there shown, with the shaft extended through the connection and supported by an outside journal box, the arrangement is particularly adaptable to any type of fan, whether steam or pulley, such as is shown in Figs. 19 and 24, in both of which the shaft is ordinarily supported by a bearing in the inlet. Naturally the external bearings would be provided with cooling

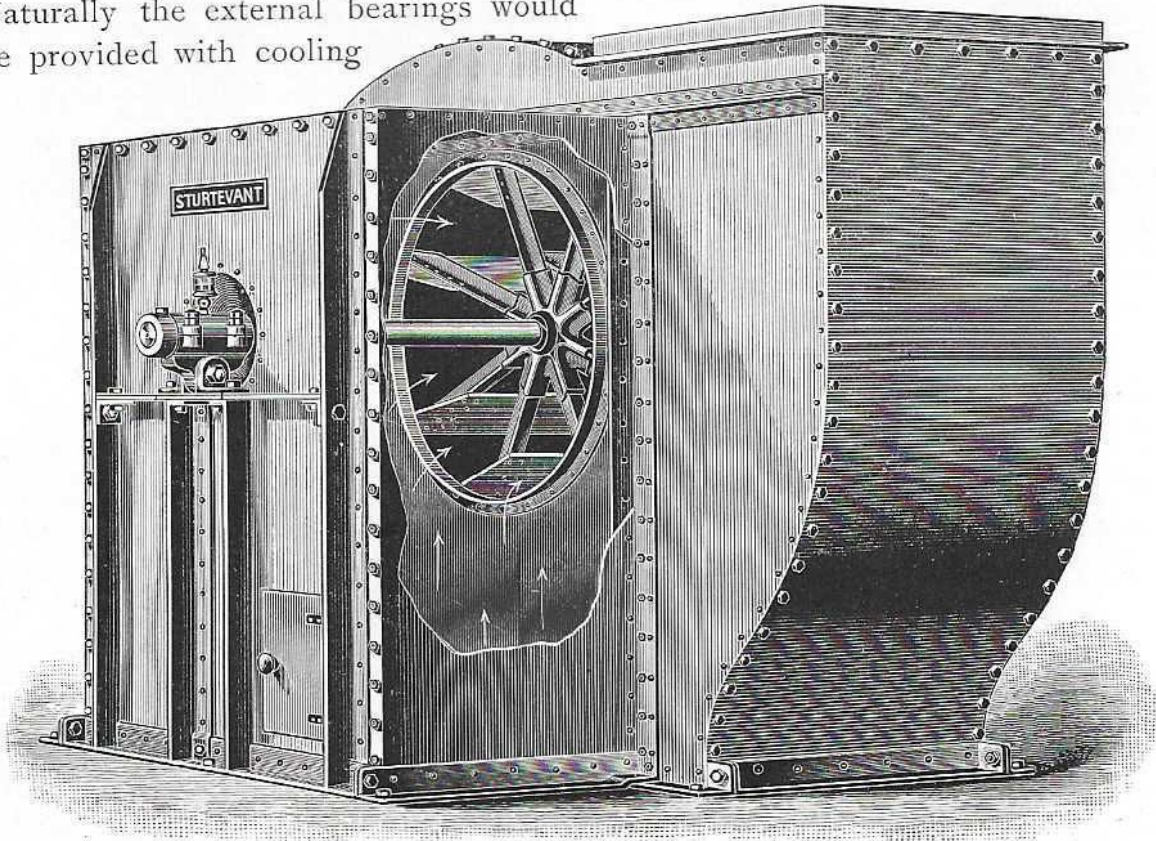


FIG. 26. STEEL-PLATE EXHAUSTER WITH INLET CONNECTION.

devices if hot air or gas is to be handled, and therefore thereby rendered perfectly serviceable even under these somewhat trying conditions.

As here represented the inlet connection is of steel plate, with angle-iron corner frames and additional bracing of heavy angle iron. It is provided with a door to permit of access to the interior of the connection and of the fan for the removal of soot and dust. Although shown with open bottom for the admission of air or gas, it may as readily be constructed so that the supply can be taken from above or through either side. The bottom connection is especially desirable if the fan is to be placed above the boilers and the gas taken from a flue beneath.



**Special Steel-Plate Steam Fans.**—The types of independent fans which have thus far been presented are those of regular form. But, in the adaptation of fans for mechanical draft, many special forms are required, particularly for application on shipboard. These are generally provided with independent engines, in each case directly connected to the fan shaft. Great variety in the character, form and proportions of these engines is necessary to make them readily adaptable; as a consequence, the differences between most of the fans, the illustrations of which here follow, lie fully as much in the engines, by means of which they are driven, as in the fans themselves.

The smallest and simplest by this Company is shown in Fig. 27. The general construction of the shell is the same as that of the regular steel-plate exhausters. The engine is self contained, upon its extended base, and is designed for operation in a confined space. This size and type is particularly adapted for forced-draft production on small steam yachts where the available area is limited. The engine is of the double-cylindrical type, and is mounted on a foundation of channel beams. The fan casing is constructed of steel plate, and is provided with a sight-glass for the oil level. The fan wheel is of the regular type, and is mounted on a shaft which is supported by bearings. The fan is driven by a single engine, and is capable of running at high speed for a long period. The fan is particularly adapted for this location because of its compactness, its perfect balance, its ability to run at high speed for a long period and its enclosure from dust and dirt.

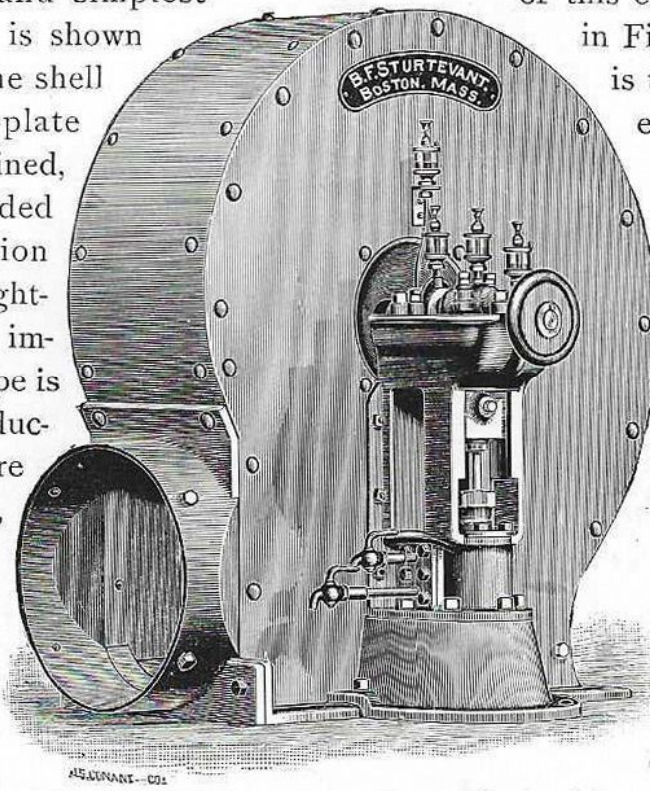


FIG. 27. SPECIAL STEEL-PLATE STEAM FAN, WITH SINGLE ENGINE.

of this class manufactured in Fig. 27. The general is the same as that of exhausters. The engine carries the fan wheel shaft, and is designed for operation at high speed. It is provided with feed oilers and is supported by bearings. The fan is particularly adapted for this location because of its compactness, its perfect balance, its ability to run at high speed for a long period and its enclosure from dust and dirt.

tion of the fan and of channel beams the shell of the interior support, thus bringing the top of the fan casing close up to the deck. Owing to the limited space in the steam yacht *Sapphire*, for which this was designed, the outlet was formed in the side of the casing, the air being deflected thereto by a curved plate within the casing. From this outlet a pipe leads to the boiler ashpit. Evidently this arrangement occupies the minimum of space. The engine is of the double-cylindrical type subsequently illustrated in Fig. 32. It is particularly adapted for this location because of its compactness, its perfect balance, its ability to run at high speed for a long period and its enclosure from dust and dirt.



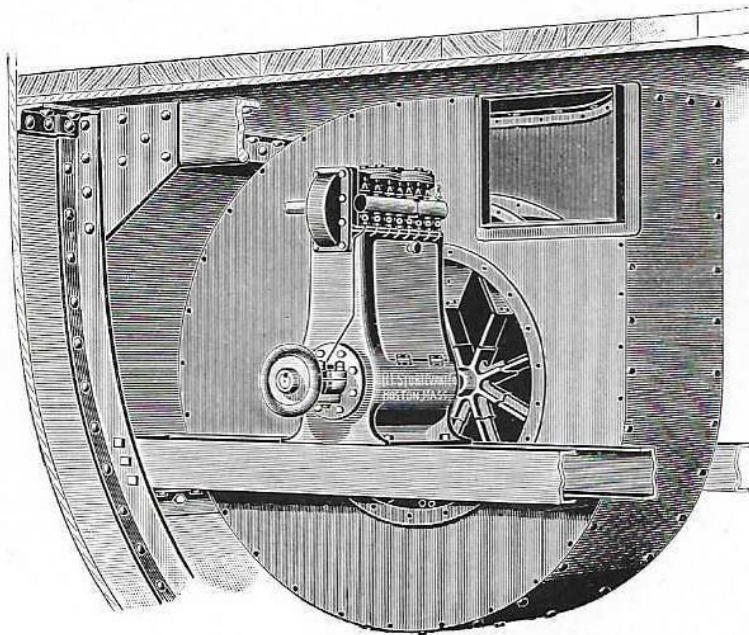


FIG. 28. SPECIAL STEEL-PLATE STEAM FAN WITH  
DOUBLE ENCLOSED ENGINE.

It is sometimes the case that an upright engine of the type just described will, if of adequate power, require a greater height than the conditions will admit. This difficulty may in some cases be avoided by using an engine of the same type with the cylinders below the shaft, as shown in a succeeding illustration; but when neither form is admissible resort must be had to a special type of horizontal engine. This was the condition which held in the design of the special fan shown in Fig. 29,

which represents one of several fans constructed for U. S. S. Monadnock.

The engine is self-contained, having two bearings; and the fan wheel is supported on the end of the shaft.

The crank and connecting mechanism are entirely enclosed, preventing the throwing of oil and the admission of dust. By the combined effect of the cast-iron bracket and the angle-iron sling, the engine is held rigidly in its place. Being carried close up to the deck, the fan being in fact fitted in between the deck beams, the least possible head room is occupied. Evidently such a fan can be arranged to deliver in any given direction or entirely around the circumference, as might be desirable in a closed fire room. Other forms for use in marine work are presented in the next chapter.

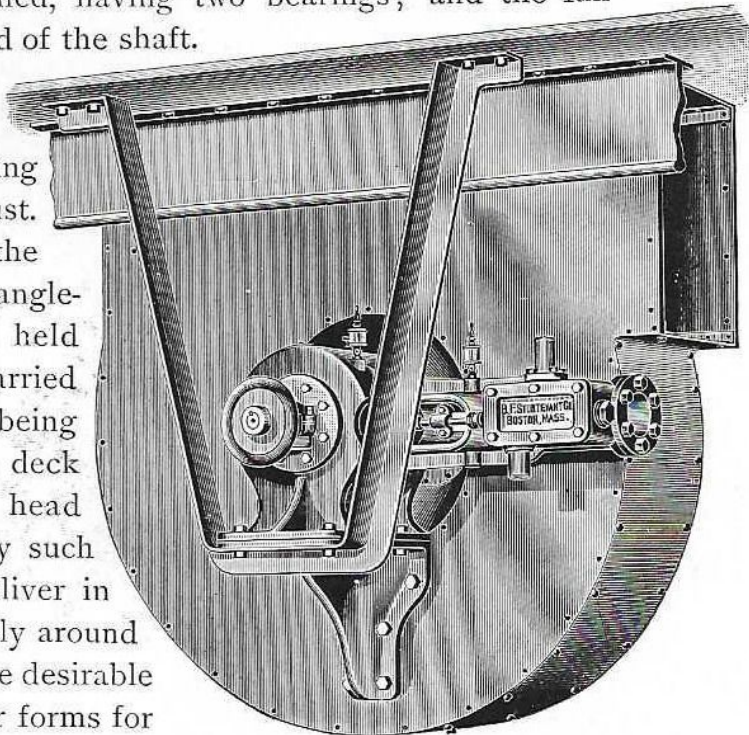


FIG. 29. SPECIAL STEEL-PLATE STEAM  
FAN WITH HORIZONTAL ENGINE.



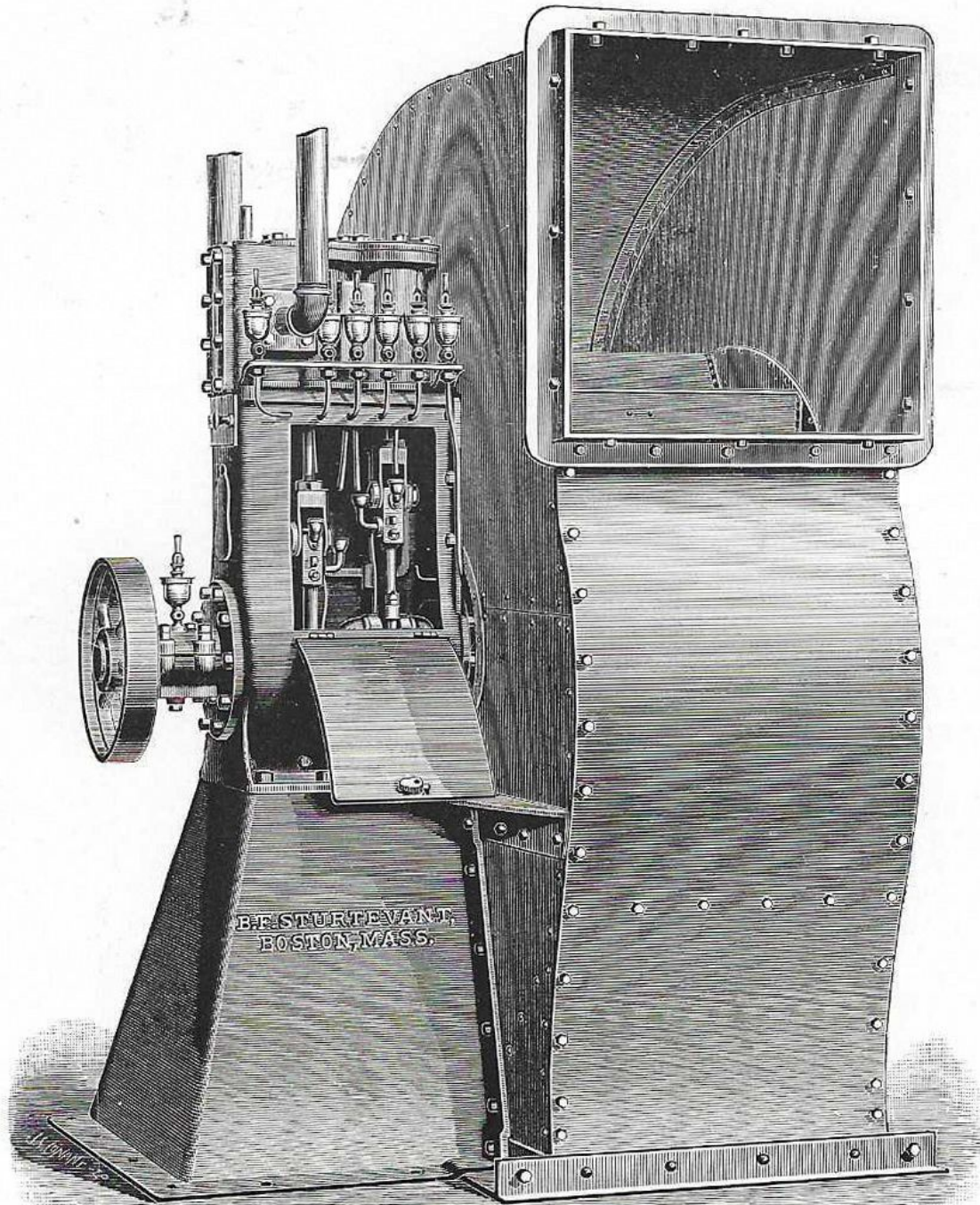


FIG. 30. SPECIAL STEEL-PLATE STEAM FAN WITH DOUBLE ENCLOSED ENGINE.



Still another form of the steel-plate steam fan with a double enclosed upright engine is shown in Fig. 30. This has a top horizontal discharge, and is applicable for either forced or induced draft. The engine is supported upon a substantial cast-iron base and carries the fan wheel upon its extended shaft. The hand wheel upon the outer end of the shaft is provided for starting the engine off the centre, when necessary. Large numbers of fans of this general type, but with the point of discharge to suit the conditions, have been furnished for the production of draft.

A pair of down-discharge fans is shown in Fig. 31, the combination with the engine forming a duplex steam fan, in which both fans are operated in unison by the same engine. A wheel is carried on each

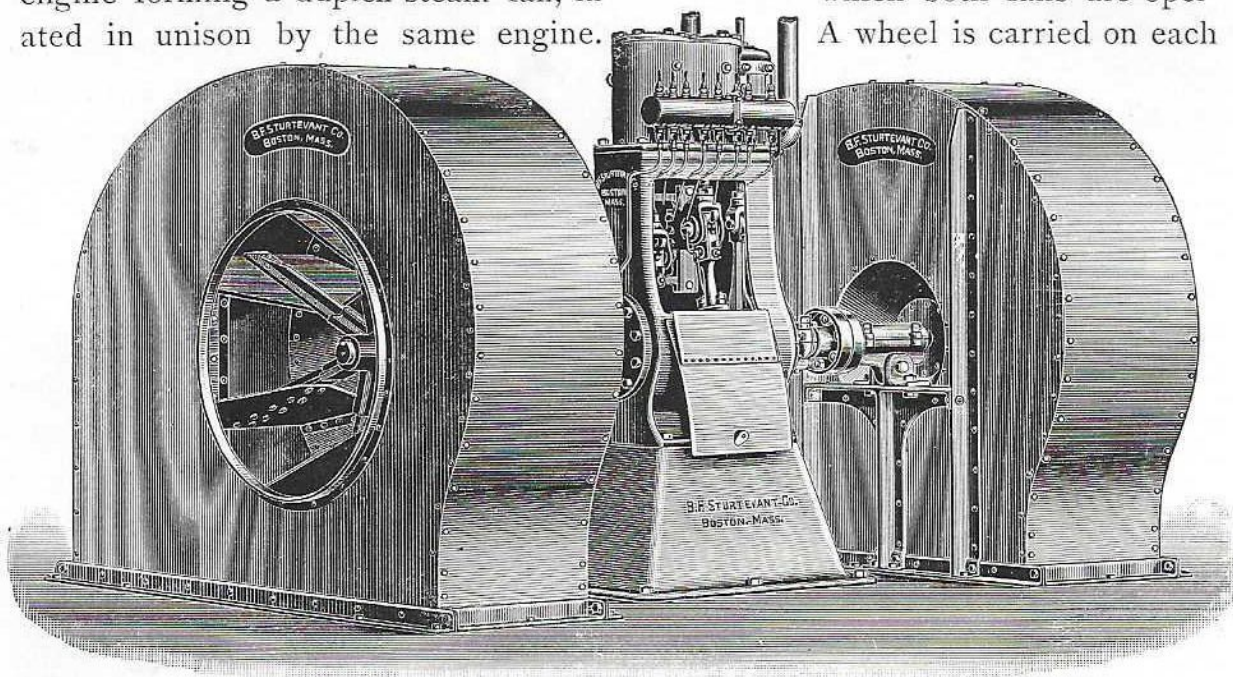


FIG. 31. SPECIAL DUPLEX STEEL-PLATE STEAM FAN WITH DOUBLE ENCLOSED ENGINE.

end of the shaft, which is provided with couplings between the engine bearings and those upon the fans, so that the engine can be entirely removed without disturbing the fans. By the arrangement for down discharge these fans may be placed above the boilers and the air delivered directly downward to them. If it be a stationary plant, a duct would connect each outlet to the boiler ashpits, but if used in the marine service either the closed ashpit or closed fire-room system of supply could be adopted. In the latter case the air would simply be delivered through openings in the deck corresponding to the outlets of the fans and thence discharged directly downward into the boiler rooms. The duplex feature reduces the height which it would be necessary to provide for a single fan of the same capacity.



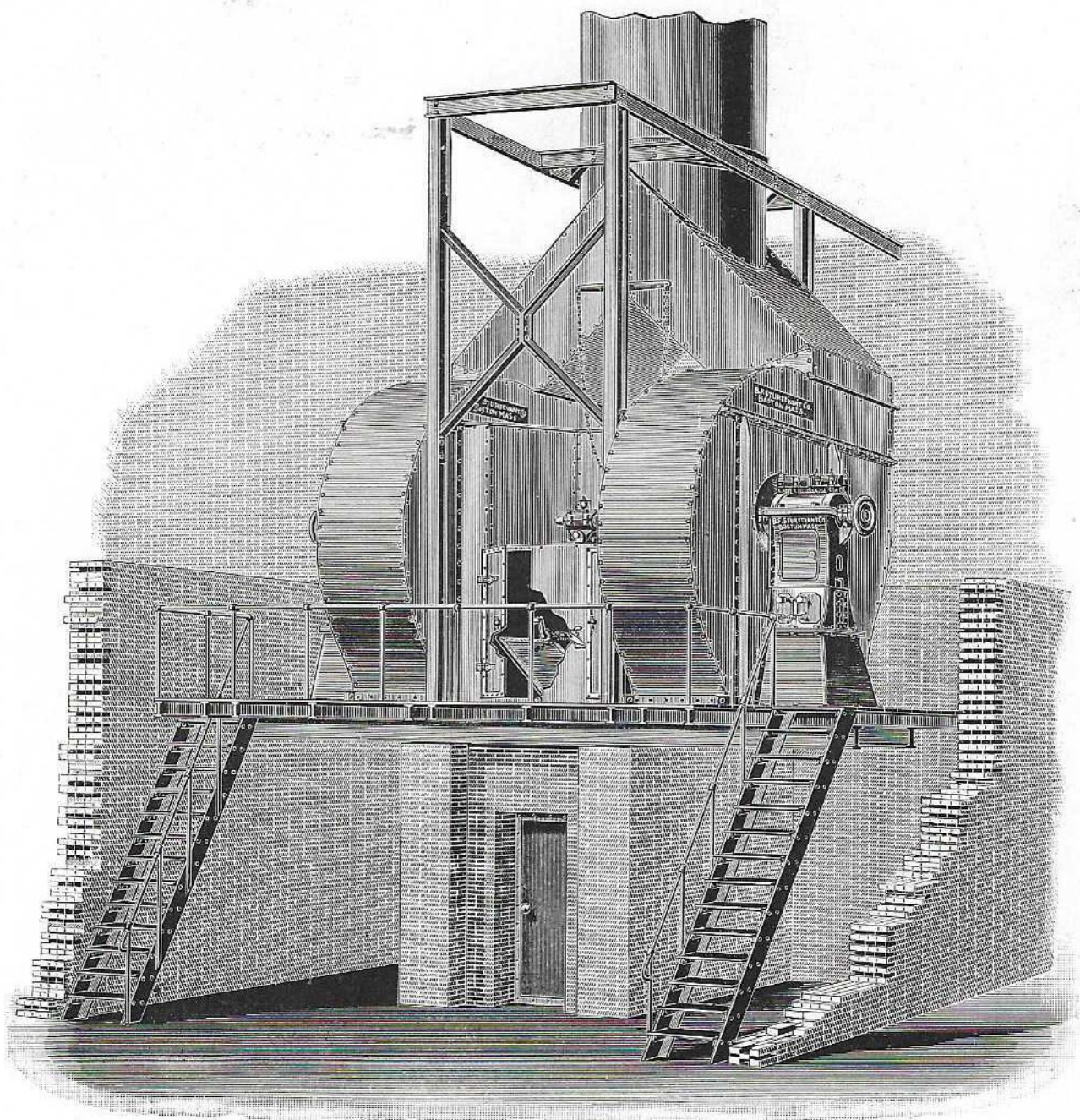


FIG. 34. SPECIAL DUPLEX STEEL-PLATE STEAM FAN APPLIED FOR INDUCED DRAFT.



**Special Duplex Steel-Plate Steam Fan.**— Two fans provided with engines of the type just described and set up in proper manner to form a duplex fan are shown in Fig. 34, which represents the arrangement designed for and installed at the Holyoke Street Railway Co.'s power house at Holyoke, Mass., for the production of draft by the induced system. The flue gases enter the brick chamber

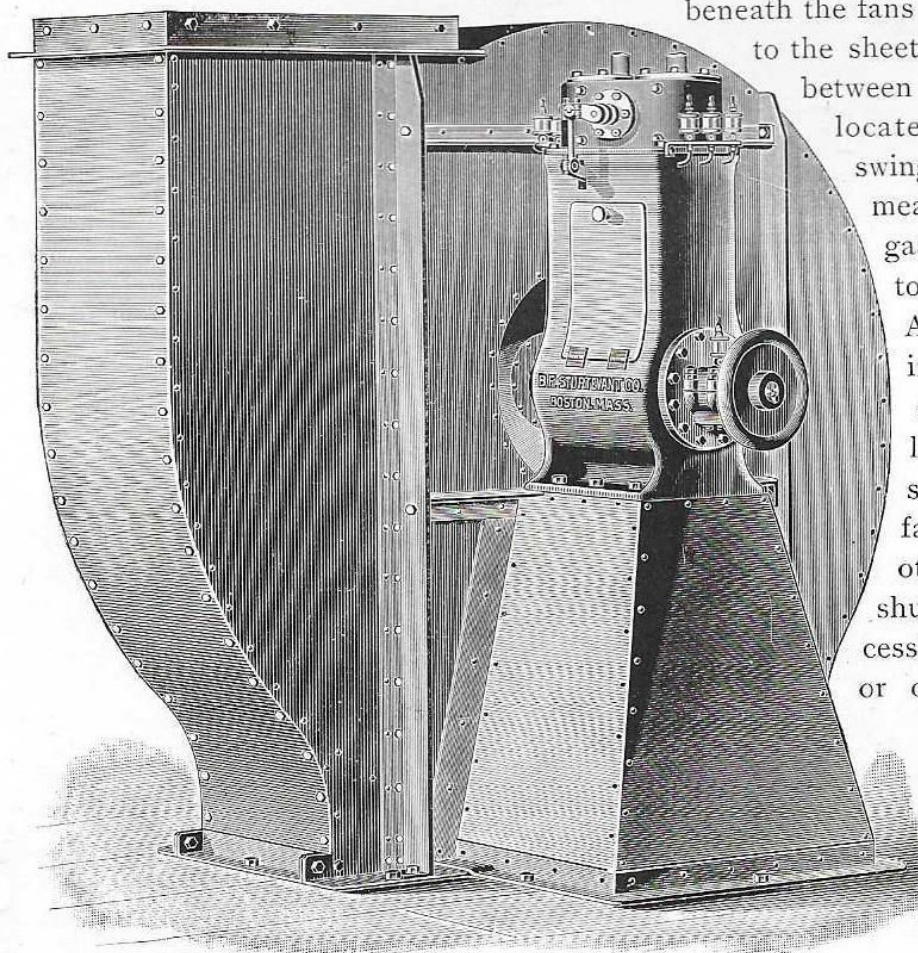


FIG. 35. SPECIAL STEEL-PLATE STEAM FAN WITH UPRIGHT COMPOUND ENGINE.

**Special Steel-Plate Steam Fan with Upright Compound Engine.**— The fan illustrated in Fig. 35 differs from those previously shown, in that it is provided with a special type of compound engine. This engine, because of its simplicity and economical performance, is of value where the exhaust steam cannot be utilized and high efficiency is important. A single oscillating valve performs the functions of the two valves necessary in the ordinary types, and with half the complication of moving parts.

beneath the fans and thence pass to the sheet-iron connection between them. Here is located, as shown, a swinging damper, by means of which the gases may be made to enter either fan. Another damper, in the connection above the fans, likewise operates so that when one fan is in use the other is entirely shut off and is accessible for cleaning or other purposes. Either fan is capable of producing the maximum draft that is required by the entire plant. One fan may thus serve as a relay.



**Special Steel-Plate Steam Fan with Double Open-Type Engine.**— Another type of double upright engine, not enclosed, and therefore suitable only for cleanly locations, is illustrated in Fig. 36. The relative size of this steam fan can be judged by the fact that the engine cylinders are 9 inches in diameter by 5½ inches stroke. For absolute rigidity, the engine was, in the plant from which this illustration was taken, set upon a special brick foundation. This renders its support entirely independent of the fan and removes all strain therefrom.

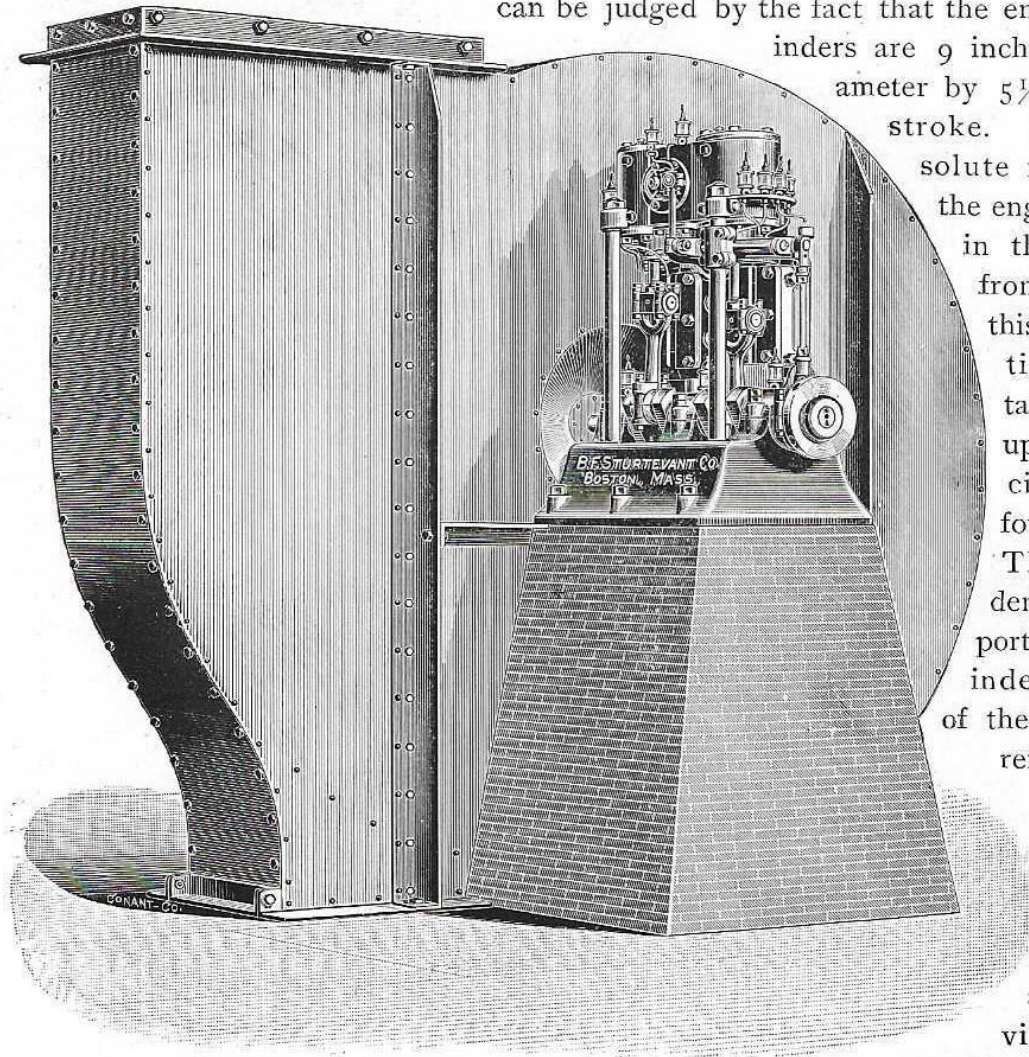


FIG. 36. SPECIAL STEEL-PLATE STEAM FAN WITH DOUBLE OPEN-TYPE ENGINE.

The wheel, as in previous fans described, is overhung upon the end of the engine shaft, which is of large diameter and supported in three bearings within the base of the engine. The greatest care has been given to the continuous and effectual oiling of this engine, with the result that in numerous installations on transatlantic steamers it makes the passage without a stop. It is extremely compact, requiring the minimum of floor space for a given output, and is, therefore, especially valuable for use where but little space is available.



**Special Cast-Iron Steam Fan with Double Horizontal Engine.**—A somewhat unique form is presented in Fig. 37, which is from a photograph of one of the fans furnished for the U. S. S. Puritan. The side pieces of the shell are of cast iron, the rim being of heavy steel plate and the entire bottom of the casing being open for the delivery of the air directly downward. Support brackets cast the shell is zontal en-cranks

livery of the air directly ported upon projecting on to one side of a double hori-gine with its set opposite so that the reciprocating parts

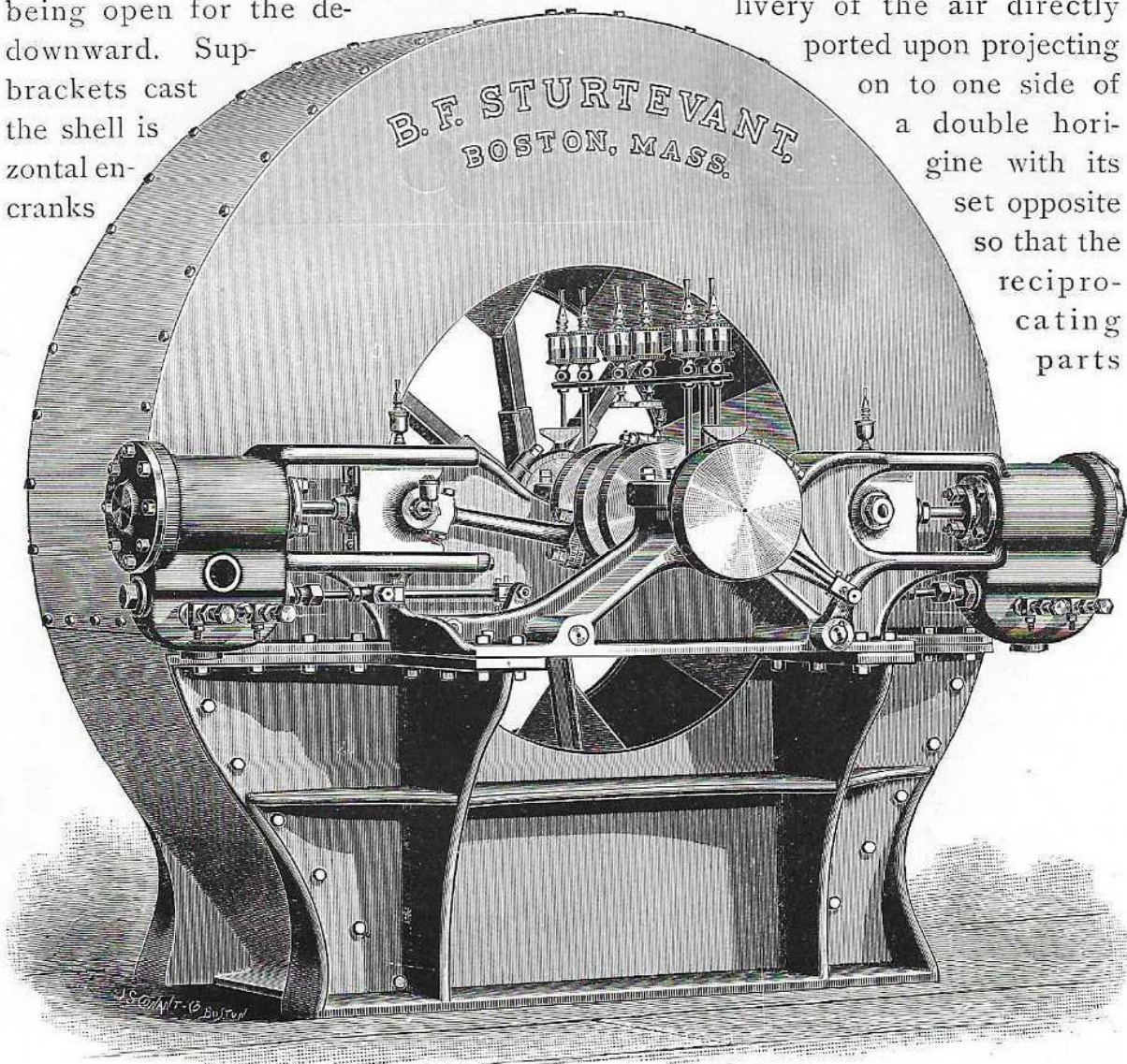


FIG. 37. SPECIAL CAST-IRON STEAM FAN WITH DOUBLE HORIZONTAL ENGINE.

are balanced. High rotative speed is thus made possible without objectionable vibration of the engine. The engine, in fact, consists of two engines, so constructed that either may be removed without disturbing the other. The valves, which are of the piston type, are actuated by eccentrics, transmitting the motion by means of rockers. A thorough system of sight-feed oilers, wipers and catch cups is provided, as is clearly shown.



**Steel-Plate Steam Fan with Three-Quarter Housing.** — All the fans previously described have been of the full-housing type. Under certain conditions, such as a lack of available height or the desire to discharge into an underground duct, a fan having a portion of its scroll constructed in the brick foundation is both economical and convenient. The standard type of three-

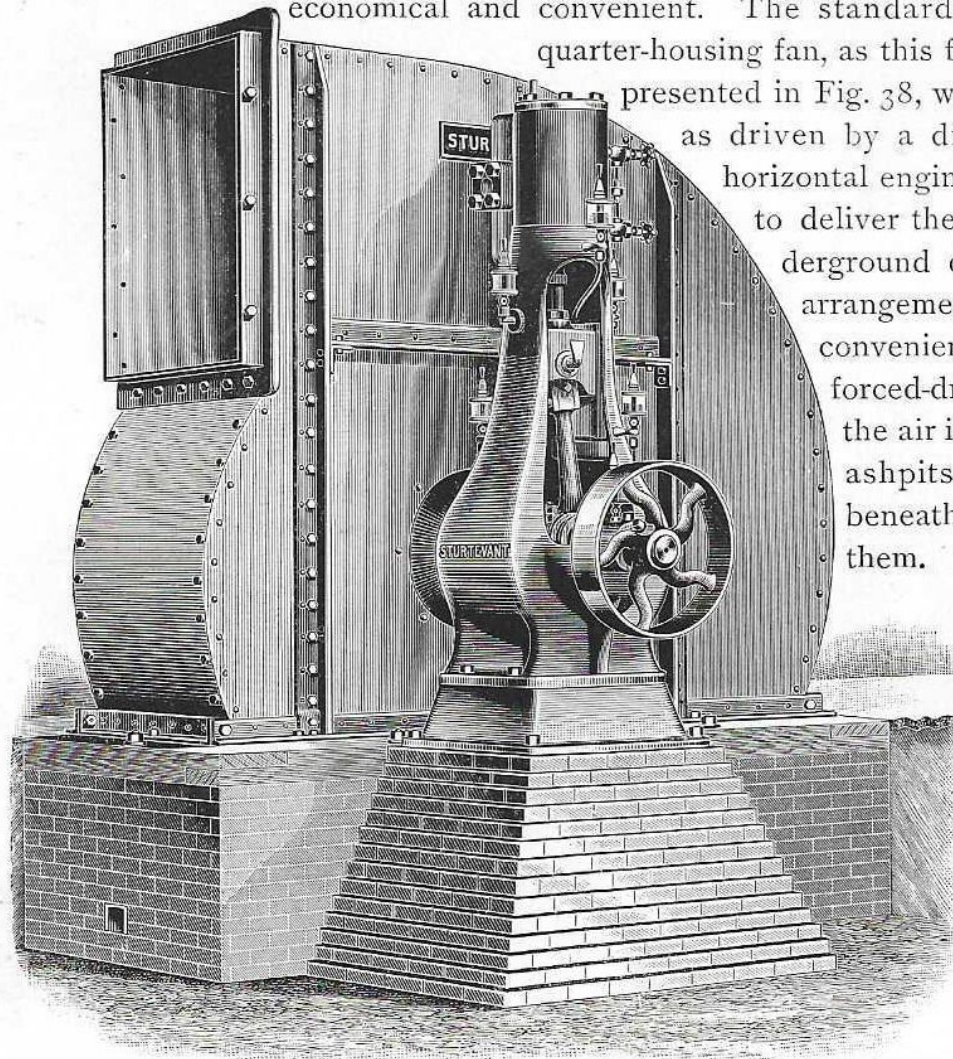


FIG. 39. STEEL-PLATE STEAM FAN WITH THREE-QUARTER HOUSING AND SINGLE UPRIGHT ENGINE.

quarter-housing fan, as this form is called, is presented in Fig. 38, where it is shown as driven by a direct-connected horizontal engine, and arranged to deliver the air into an underground duct. Such an arrangement is of especial convenience for a large forced-draft plant, where the air is forced into the ashpits from a duct beneath or in front of them. For an induced-draft plant the arrangement shown in Fig. 39 is well adapted. The curve of the fan scroll is continued within the brick foundation and the air or gas is discharged horizontally at the top, whence it may be readily conducted to a chimney. The engine is of the single upright variety already illustrated in connection with the full-housing fans. It carries the fan wheel upon its extended shaft, and is rigidly supported on a substantial brick foundation bonded into the fan foundation. The absence of a bearing in the inlet leaves it entirely unobstructed for the passage of air or gases, the condition desirable for induced draft adoption.

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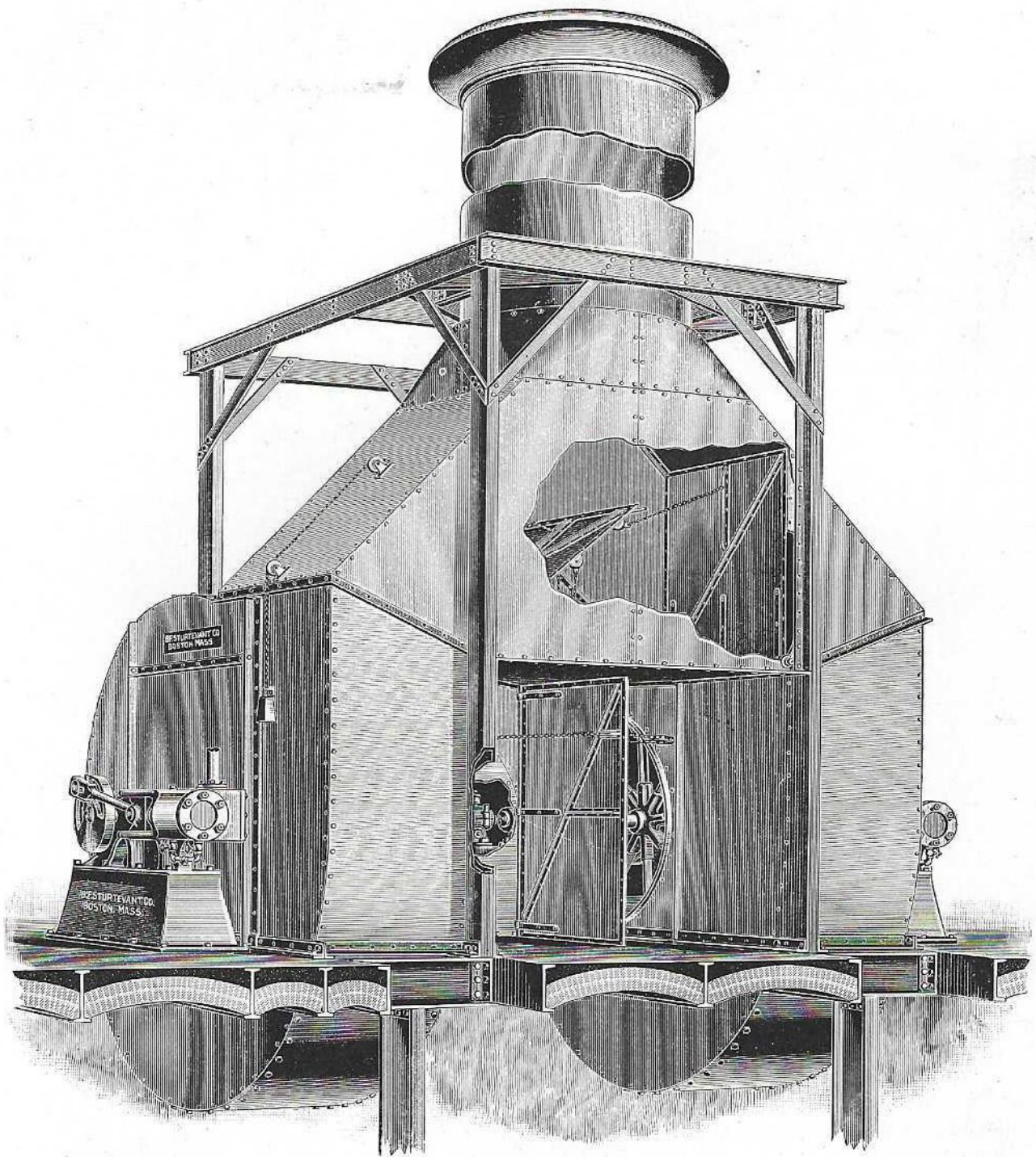


FIG. 42. SPECIAL DUPLEX STEEL-PLATE STEAM FAN, THREE-QUARTER-HOUSING TYPE, WITH STEEL-PLATE BOTTOM AND HORIZONTAL ENGINES.



**Electric Fan, Steel-Plate Pattern.** — For comparatively large plants where an electric fan is employed the pattern presented in Fig. 44 is well adapted. The shell is of the same steel-plate construction as the steel-plate exhauster already

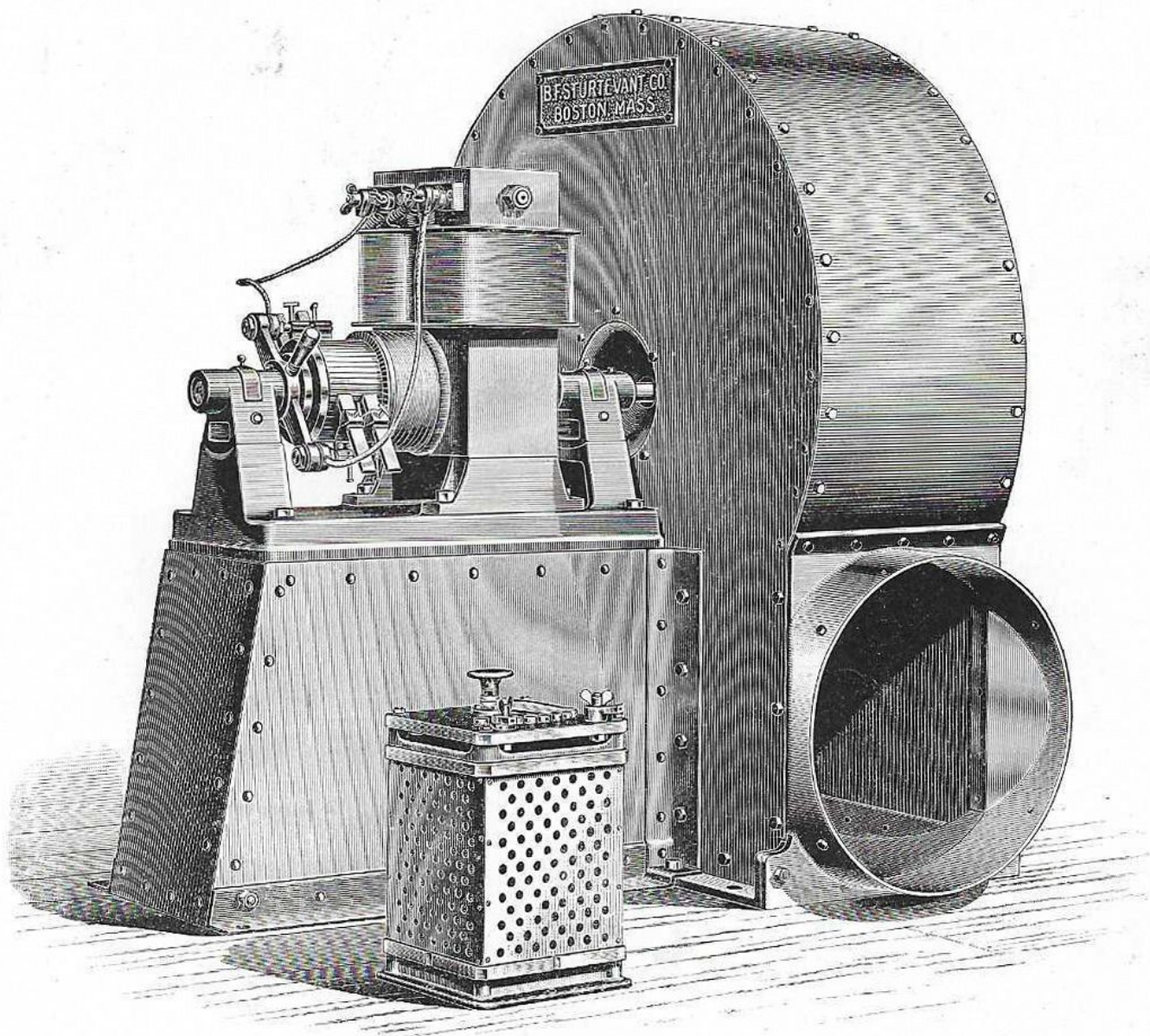
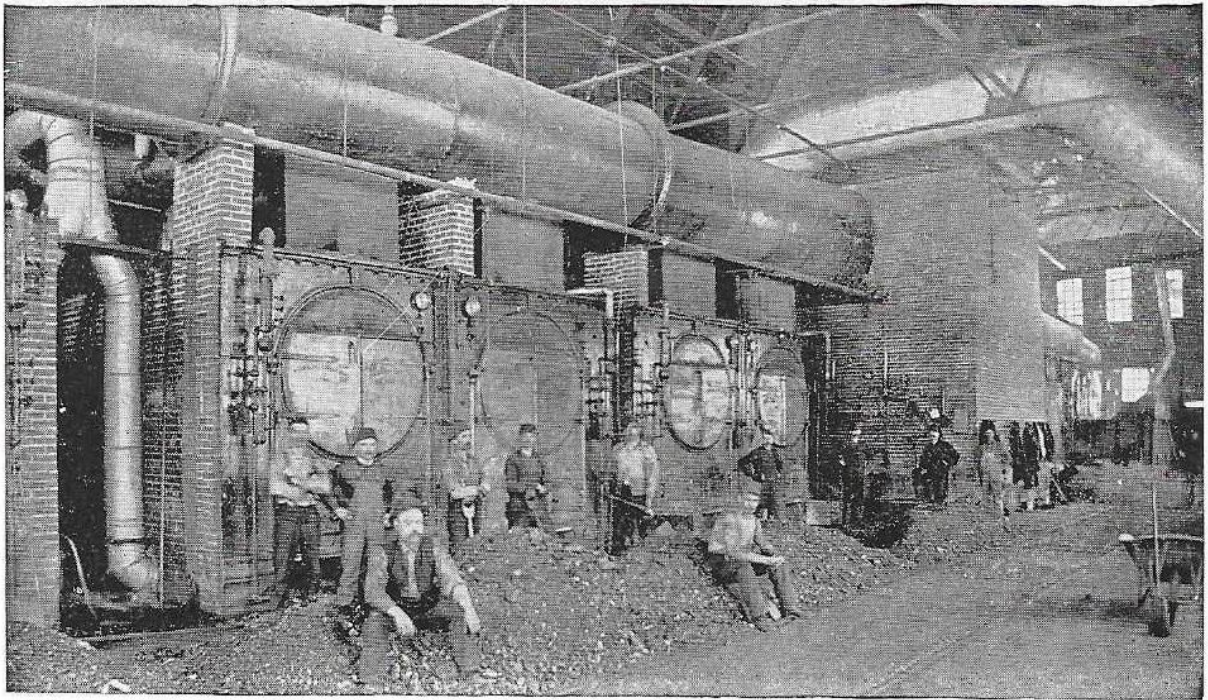
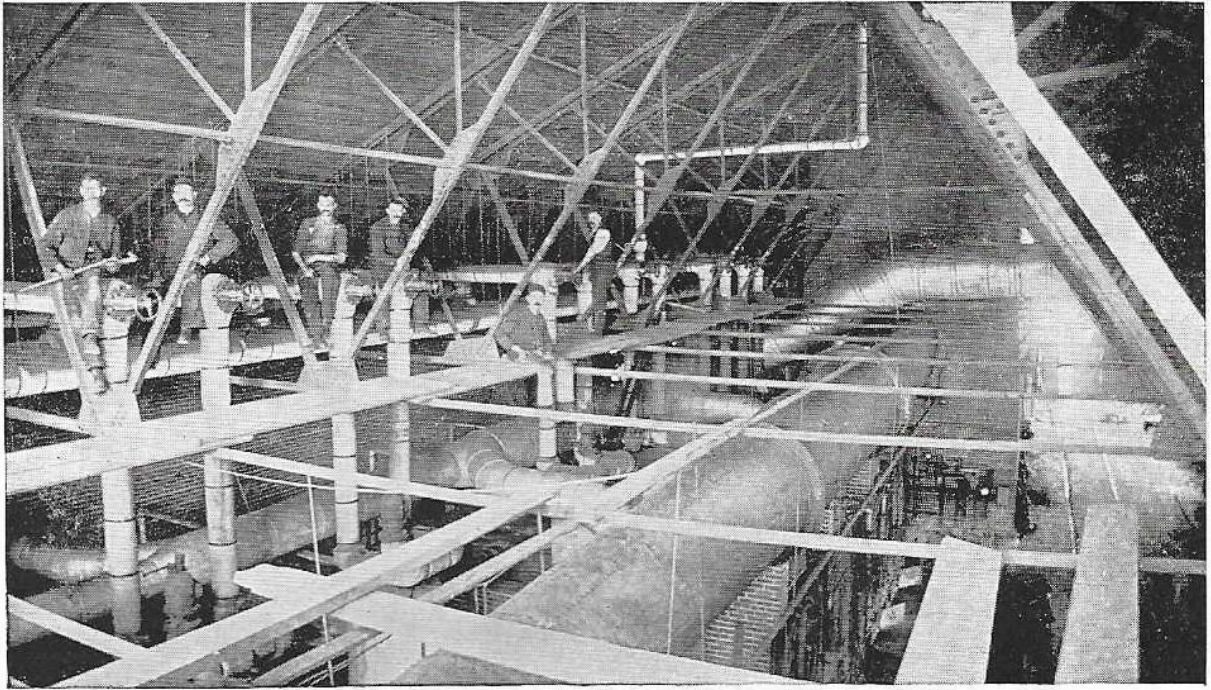


FIG. 44. ELECTRIC FAN, STEEL-PLATE PATTERN.

shown in Fig. 22. The motor shown is of the independent bi-polar type, but in large sizes a multi-polar machine is employed. For small sizes the circular form shown in the preceding illustration is also adaptable. This type lends itself to a great variety of arrangements.





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



Crane & Breed Manufacturing Company, Cincinnati, Ohio. — One type of under-feed mechanical stoker used in connection with a Sturtevant fan has already been described. In Fig. 81 is shown a plant equipped with the American Stokers. A No. 5 Sturtevant "Monogram" blower, driven by a 4 x 4 Sturtevant upright engine, serves to supply the requisite air under the pressure which is necessary with this type of stoker, the general form and construction of which is shown in Fig. 82. <sup>1</sup> "Immediately beneath the coal hopper, and communicating with it, is

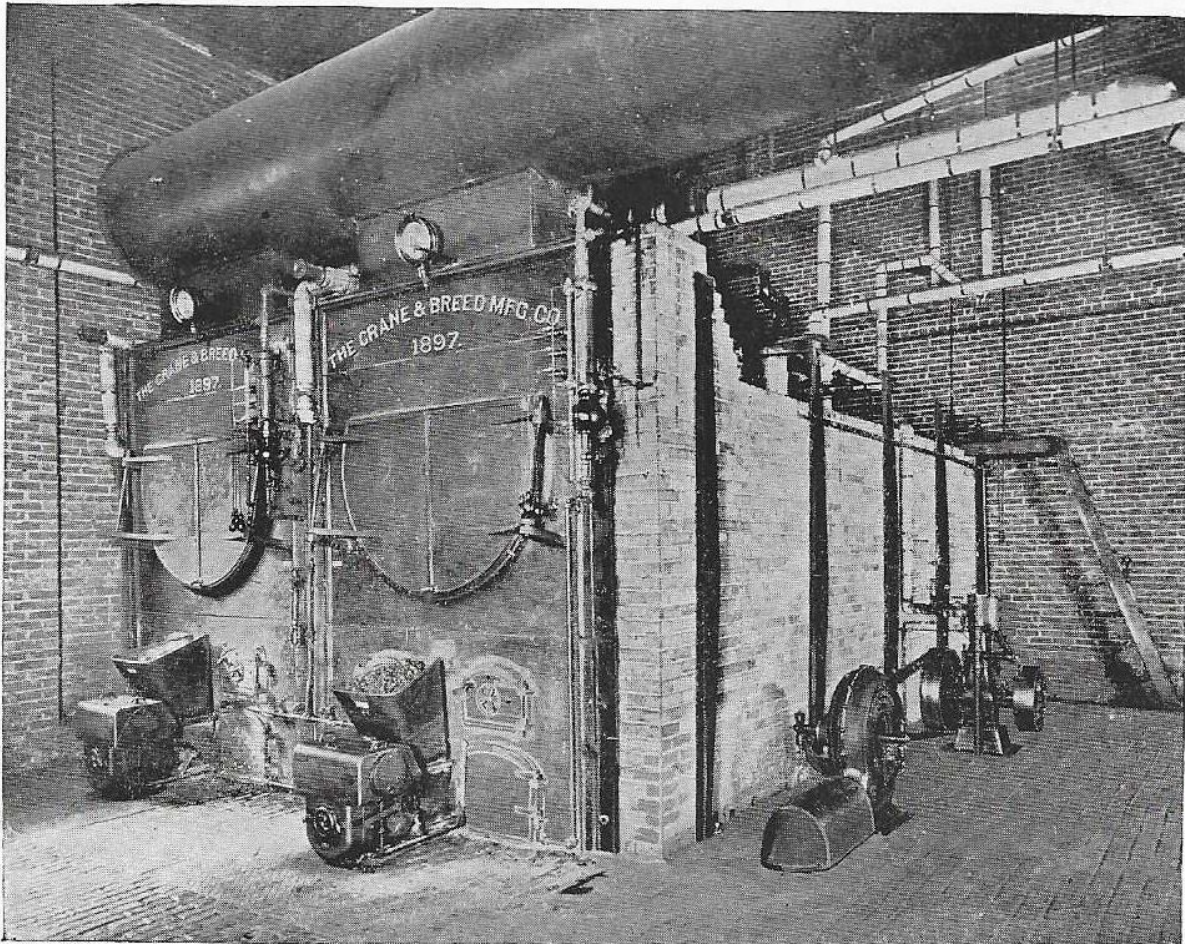


FIG. 81. ARRANGEMENT OF AMERICAN STOKERS AND STURTEVANT FAN AT CRANE & BREED MANUFACTURING COMPANY, CINCINNATI, OHIO.

the conveyer, this in turn communicating with the magazine in direct line with it. A screw conveyer or worm is located in the conveyer chamber, and extends nearly the entire length of the magazine. Immediately beneath the conveyer chamber is located the wind-box, having an opening beneath the hopper. At this point is connected the piping for air blast. The other end of the wind-box

<sup>1</sup> The American Stoker. Catalogue, 16 pp. American Stoker Co., Dayton, Ohio.