(No Model.) 2 Sheets—Sheet 1.

# J. KEANE.

## SMOKE CONSUMING FURNACE.

No. 378,096. Patented Feb. 21, 1888.

Fig. 1.

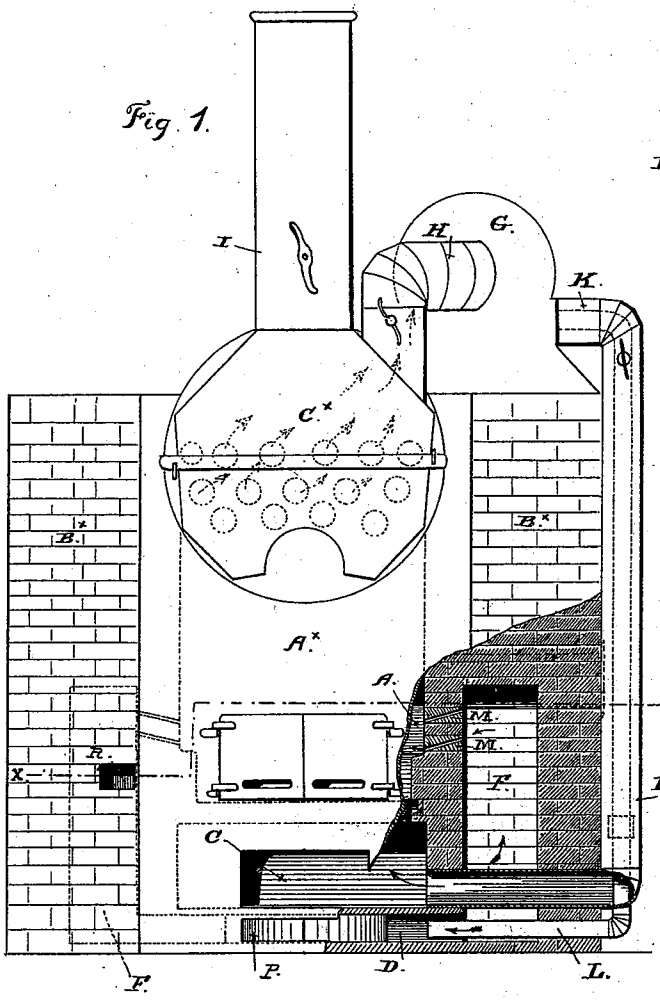



Fig. 2.

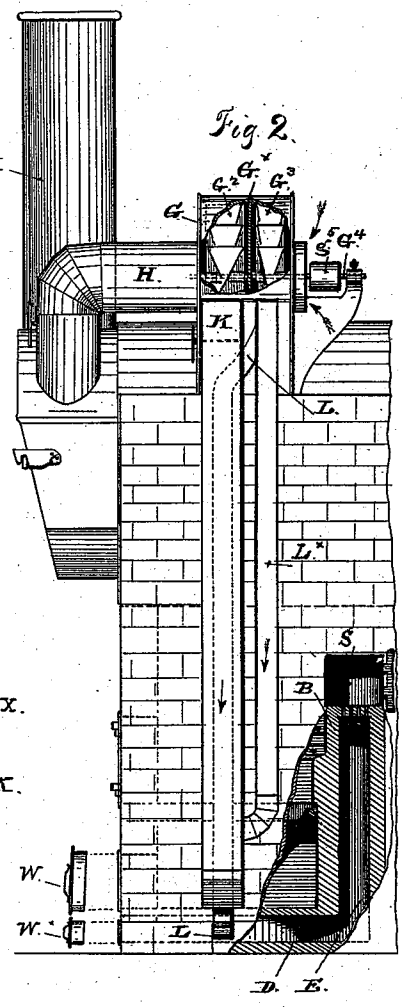
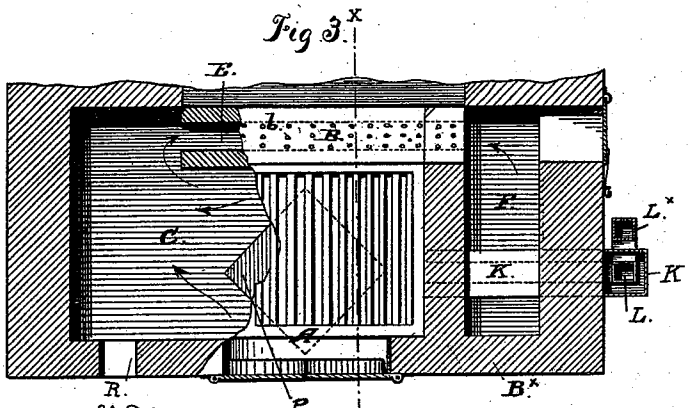



Fig 3.




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(No Model.) 2 Sheets—Sheet 2.

# J. KEANE.

## SMOKE CONSUMING FURNACE.

No. 378,096. Patented Feb. 21, 1888.

Fig. 4.

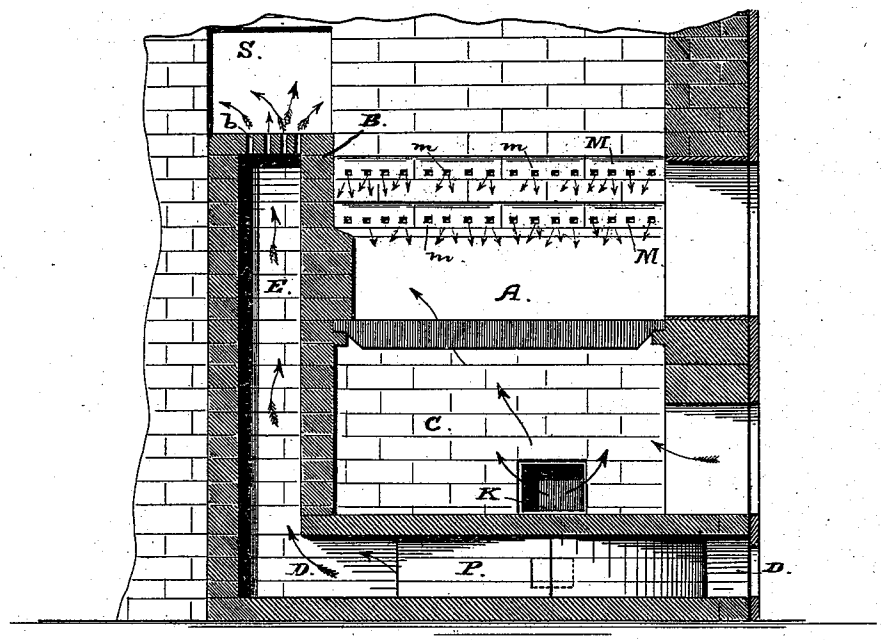



Fig. 5.

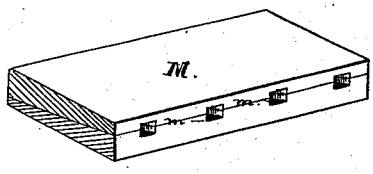



Fig. 6.

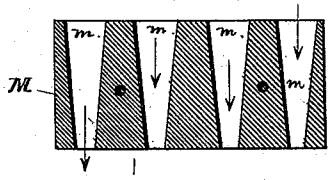



Fig. 7.




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# UNITED STATES PATENT OFFICE.

JOHN KEANE, OF SAN FRANCISCO, CALIFORNIA.

## SMOKE-CONSUMING FURNACE.

SPECIFICATION forming part of Letters Patent No. 378,096, dated February 21, 1888.

Application filed October 6, 1887. Serial No. 251,667. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN KEANE, a citizen of the United States, residing in the city and county of San Francisco, and State of California, have invented certain new and useful Improvements in Smoke-Consuming Furnaces; and I do hereby declare that the following is a full, clear, and exact description of my said invention, reference being had to the accompanying drawings, which form a part of this specification.

My invention relates to improvements in steam-boiler furnaces in which the gases of combustion, after passing through the boiler flues or tubes, are returned to the fire-box and made to pass through the fire in conjunction with a supply of atmospheric air, which is introduced with the smoke and gases in their passage to the fire-box, for the purpose of securing complete combustion of the fuel and those products that pass off and are commonly lost in the smoke-stack.

The object of my said improvements is to remedy certain defects and imperfect features heretofore existing in devices or apparatus of the kind mentioned, and to secure complete combustion of the products from the fuel and the prevention of smoke.

The invention consists in the construction, arrangement, and combination of parts, substantially as will be hereinafter described and claimed.

Referring to the accompanying drawings, Figure 1 is a front view of a stationary boiler-furnace broken away to show a portion of the interior construction. Fig. 2 is a side elevation taken from the right-hand side of Fig. 1. Fig. 3 is a horizontal section taken through the brick-work setting and below the boiler at about the line *x x*, Fig. 1, the floor of the ash-pit being broken away to show the chamber and the hollow space in the bridge-wall, which is a vertical extension of said chamber to the top of bridge-wall. Fig. 4 is a vertical section, taken longitudinally on line *x x* of Fig. 3, through the fire-box, the bridge-wall, ash-pit, and air-chamber below it. Figs. 5, 6, and 7 are detail views showing the construction of the cast-iron plates and air-passages through them, which are set into the brick-work of the fire-box along the sides to form inclined and flaring apertures through the brick-work.

A represents the fire-box, B the bridge-wall, and C the ash-pit, of a boiler-furnace.

$A^{\times}$ is the front plate of the boiler; $B^{\times}$, the brick-work setting; $C^{\times}$, the boiler-breeching.

D is a space or chamber extending under the ash-pit, preferably for its full area, and back to the bridge-wall, whence it terminates in or connects directly with a hollow space, E, within the bridge-wall. At the sides also this air-space runs into air chambers or spaces F, that are formed in the brick-work setting and carried up above the grate-surface in the fire-box to the height at least of the bridge-wall at the back.

The brick-work and front of the boiler at one side are broken away in Fig. 1 to show this chamber and the space under the ash-pit connecting with it. The mouth of the ash-pit and the opening in the front of the space D below the pit are closed by doors or plates W $W^{\times}$ after the fire is started and the fuel is well kindled. In the top of the bridge-wall are numerous air-apertures, through which air from the chamber below is delivered in jets or smalls streams directly upward.

At G, Figs. 1 and 2, is shown a double fan, mounted, for convenience, on the top of the boiler and driven by a belt or otherwise from any suitable power at hand. This fan is of peculiar construction in being divided into two spaces by a partition, $G^{\times}$, and having two fans, $G^2$ and $G^3$, mounted on a single shaft, $G^4$, by which they are driven in the same direction by one pulley, $g^5$. The central inlet-opening at one compartment of the fan is connected by the pipe H directly with the boiler-breeching and the discharge-apertures in the case, and on the same side of the dividing-partition is connected to a pipe or conductor, K, which is carried down the side of the brick-work setting to a point about on a level with the ash-pit floor, and is thence taken through the brick-work and into the ash-pit, where it terminates just below the bottom of the grate. This side of the fan, acting by suction directly on the space within the breeching, is made to draw the hot air and gases and other products from the ends of the boiler tubes or flues and

to force such products into the ash-pit and up through the burning fuel, while the compartment in the fan on the opposite side of the partition is caused to take in atmospheric air through the central inlet surrounding the shaft and to deliver it both into the air-chamber F F and into the pipe K, to mingle with and to increase the amount of oxygen in the matter passing down through this conductor into the ash-pit.

The pipe L from the discharge-opening in the fan-case conducts the air into the air-chamber in the one case, and the branch pipe $L^{\times}$, terminating in the pipe K, carries and delivers a portion of this air from the fan into the gases and products drawn off from the breeching in the other case. The temperature of this air may be raised in both cases by carrying one pipe within the other, as shown in Figs. 1, 2, and 3. The sides and walls of the air-chamber under the ash-pit will of course contribute considerably toward heating the air forced in by the fan $G^3$, and especially when the front opening of the chamber is closed.

In the walls of the air-chambers F on the sides of the fire-box are air-passages *m*, composed of cast-iron plates that are arranged in rows from the front back to the bridge-wall to deliver air in jets or streams laterally across the fire-space at different levels. These passages are formed on both sides of the furnace, and are set with a downward inclination to discharge the air against the fuel and flames. They are also made of gradually-contracted area from the inner to the outer or discharge ends, in order to spread the air-jets at the point of discharge. In forming these air-passages and apertures I cast a plate, M, in two halves, about the size of a brick in width, with a number of inclined passages, as shown in Figs. 4, 5, and 6, and then in laying the brick-work I set in a course one of these plates along the inner walls of the setting that forms the sides of the fire-box. The passages are gradually contracted in area from the higher or outer end to the lower or inner end. The plates are made of cast-iron, in halves or two parts, as shown, and when laid are set just back of the face of the brick-work, with the courses above and beneath overhanging the ends of the plates, in order to protect these ends that are presented to the fire. It is not my intention, however, to claim herein the construction shown in Figs. 5, 6, and 7, and the same is hereby disclaimed.

The opening S is made in the boiler-setting at the side and in line with the top of the bridge-wall to afford facilities for cleaning off the perforated top. This opening is made on a level with the top of the bridge-wall, and is closed by a door.

The lozenge-shaped bulk-head or partition seen at P, Figs. 3 and 4, is set in the middle of the air-chamber under the ash-pit for the purpose of spreading the incoming currents and bodies of air and directing them against the sides of the chamber, for equal distribution. Both the colder air admitted from the outside through the front opening and the air forced in by the pipe L are acted on by this partition, which presents its angles to each inlet.

The pipes H and K and the smoke-stack are furnished with dampers for regulating the combustion, as well as for controlling the operation of the apparatus. In this construction the natural draft of the furnace is available at any time by shutting off the pipes H and K and throwing open the smoke-stack; and thus at the time of starting the fires before the fan can be set in motion the natural draft is not restricted and an abundant supply of air under the grate can always be obtained through the ash-pit opening, and also through the air-chamber below it. At such times, also, this chamber will supply air above the fire through suitable bridge-wall apertures and the inlets *m* in the sides of the fire-box, as the draft in the furnace will produce circulation through these passages to some extent and draw air from the side chamber F. An abundant supply from the outside into the chambers can be assured by having openings R in the front of the brick-work, as shown in Figs. 1 and 3. After the fan is started the smoke stack damper is shut, and the ash-pit and air-chamber openings being closed, the draft and circulation of air to run the furnace takes place continuously through the pipes K L $L^{\times}$, the fire-box, and boiler-tubes into the breeching, from which the pipe H draws off the gases and such imperfectly-consumed matter as may pass over the bridge-wall.

Having thus fully described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The combination, with a steam-boiler furnace, of the double suction-blower G, the exhaust-pipe H, leading directly from the boiler-breeching to the blower, the conductor K, leading from the pressure side of the blower down to and terminating in the ash-pit, the air-chambers D E F F, said chambers E F F provided with apertures delivering into the fire-box, the air-pipes L $L^{\times}$, and a damper in smoke-stack, all connected and arranged as described, for operation as set forth.

2. In a smoke-preventing apparatus for boilers, an air-chamber, D, under the ash-pit, opening into the atmosphere, with upright extensions into the bridge-wall and at the sides of the fire-chamber, and with apertures therefrom delivering through the top of the bridge-wall and across the fire-space, in combination with a suction-blower having connection directly with the boiler-breeching, the conductor K, leading from its pressure side into the ash-pit, and a suction-blower adapted to take air from the outside and to deliver it into the conductor K and the air-chamber below the ash-pit.

3. In a smoke-preventing apparatus for steam-boilers, the double suction-blower G, exhaust-pipe H, adapted to draw directly from

the boiler-breeching, conductors K L $L^{\times}$, and air-chambers D E F, all constructed, arranged, and operating substantially as described.

4. A boiler-furnace having an air-chamber under the ash-pit and separate therefrom, with chambers E and F, provided with apertures *d*, in combination with means, consisting of a suction-blower, constructed and arranged substantially as described, whereby air is drawn from the outside atmosphere and is forced under pressure into said air-chambers and through its apertures into the fire-chamber, for operation as set forth.

5. In a steam-boiler furnace, the combination of an air-chamber under the ash-pit and separate therefrom, with chambers E F, provided with apertures, a boiler-breeching having a smoke-stack with a damper and exhaust-outlet and pipe H, a suction-blower having a conductor, as K, from the pressure side delivering under the grate-surface of the furnace, and a fresh-air pipe adapted to deliver air into said conductor K from a pressure-blower, all constructed, arranged, and combined for joint operation substantially as specified.

In testimony that I claim the foregoing I have hereunto set my hand and seal.

JOHN KEANE. [L. S.]

Witnesses:
CHAS. E. KELLY,
C. W. M. SMITH.