

E. Kendall,

Steam-Boiler Water-Tube.

No 23,030.

Patented Feb. 22, 1859.

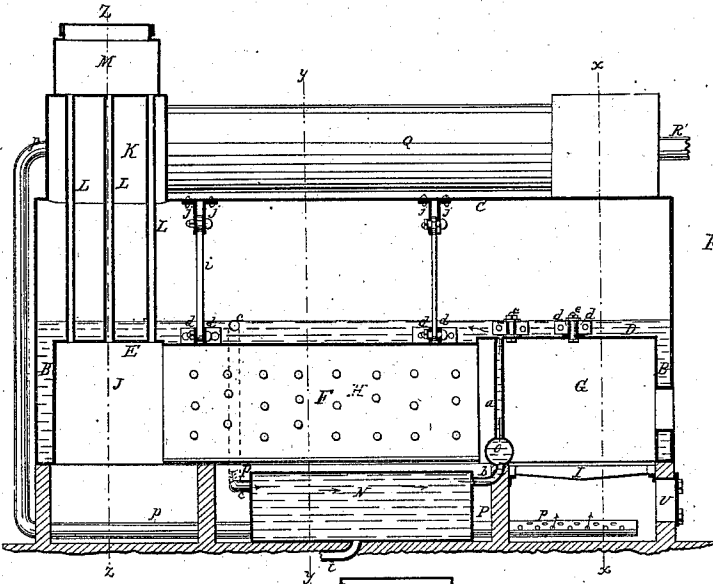


Fig. 1.

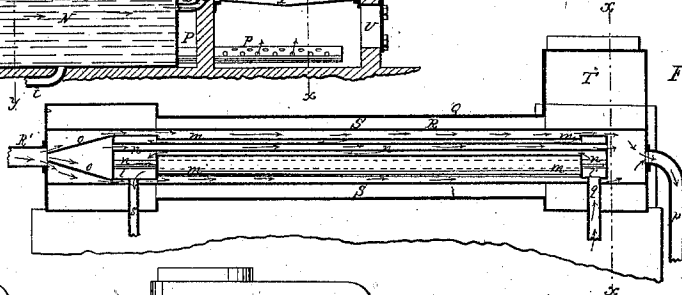


Fig. 4.

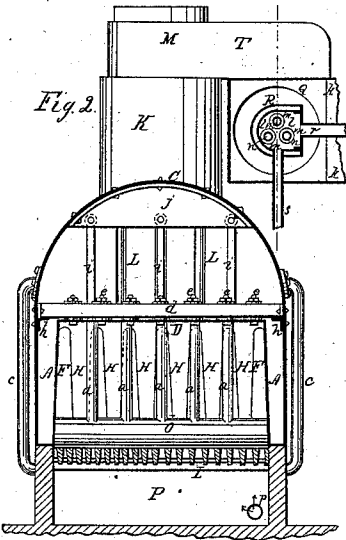


Fig. 2.

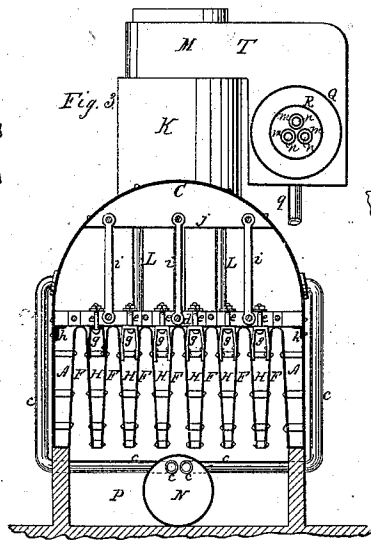


Fig. 3.

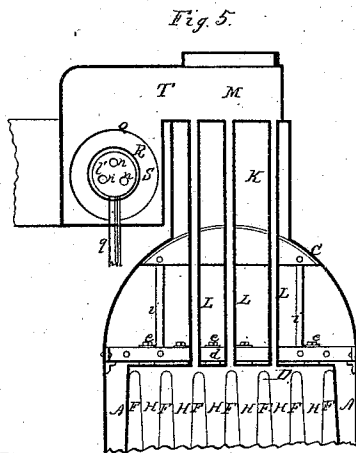


Fig. 5.

Witnesses;
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EDWARD KENDALL, OF CAMBRIDGEPORT, MASSACHUSETTS.

IMPROVEMENT IN STEAM-BOILERS.

Specification forming part of Letters Patent No. 23,030, dated February 22, 1859.

To all whom it may concern:

Be it known that I, EDWARD KENDALL, of Cambridgeport, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Steam-Boilers; and I do hereby declare that the following is a full, clear and exact description of the same, reference being had to the annexed drawings, forming part of this specification, in which—

Figure 1 is a central longitudinal vertical section of a boiler with my improvements. Fig. 2 is a transverse vertical section of the same in the plane indicated by the line $x x$ of Fig. 1. Fig. 3 is a transverse vertical section of the same in the plane indicated by the line $y y$ of Fig. 1. Fig. 4 is a longitudinal vertical section of the apparatus for heating the air to supply the furnace by the escaping products of combustion and the exhaust-steam. Fig. 5 is a transverse vertical section of the upper part of the boiler in the plane indicated by the line $z z$ of Figs. 1 and 4.

Similar letters of reference indicate corresponding parts in all the figures.

This invention consists in certain arrangements of water-spaces, flues, and heating-surfaces, whereby several important advantages are obtained, as will be hereinafter specified.

It also consists in a certain arrangement of passages for the air, the escaping gaseous products of combustion, and the exhaust-steam in a heater for heating air to supply the furnace.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction and operation.

The outer shell of the boiler is so constructed as to form hollow upright side and end water-walls A A B B, combining with an arched top C, a crown-sheet D, and a tube-sheet E, the said crown-sheet covering the fire-box and the said tube-sheet being horizontal and about on a level with the crown-sheet, but arranged at the rear or opposite end of the boiler. Between the crown-sheet and tube-sheet are arranged a series of alternating interposed upright flues F F and suspended water-spaces H H, of a depth equal to the height of the hollow side and end water-walls, the said flues being open at the bottom and said water-spaces being open at

the top, as shown at Fig. 3. The fire-box G occupies the space between said water-walls A A, extending from the front of the boiler backward nearly to the flues F F and water-spaces H H. The fire-grate I is nearly on a level with the bottom of said flues and water-spaces. The space J, between the side walls A A, behind the flues F F and water-spaces H H, constitutes a smoke-box. A steam-drum K is situated directly over the smoke-box J, and an upper smoke-box M is arranged above the steam-drum with communicating tube-flues L L passing through the steam-drum to superheat or dry the steam therein. The upper smoke-box may communicate directly with the chimney when no heater is used for the air to supply the furnace; but I connect it with the heater, so that all the products of combustion may pass through the latter without entering the chimney.

The water-spaces H H and crown-sheet are supported by means of bars $d d$, which are riveted together in pairs, with washers between them of sufficient thickness to hold them at a proper distance apart to permit the passage between them of the rivets or bolts $e e$, which attach the crown-sheet, and the stirrups $g g$, Fig. 3, which connect the water-spaces H H. The bars $d d$ are flanged at their ends and riveted to the sides of the shell, and their ends are further supported by flanged plates $h h$, riveted to the shell underneath them. The said bars are further supported by rods $i i$, connecting them with flanges $j j$, riveted to the top of the shell.

The air-heater is constructed as follows: A long cylinder or box Q contains an inner cylinder R, extending the whole length thereof, so as to form an annular chamber S between them. This chamber S is connected at one end by a passage T with the upper smoke-box and at the other end with the chimney. This chimney is not shown; but the outlet to the chimney is represented at $k k$ in Fig. 2. Inside and near the ends of the cylinder R there are arranged two boxes $l l'$, connected by tubes $m m$, through which pass other tubes $n n$, which also pass through the ends of said boxes $l l'$ into the cylinder R. Attached to the front box l there is a hollow cone o , Fig. 4, which serves to separate the cold air which

enters the front end of the cylinder R by a pipe R' from a blowing apparatus and cause a portion of the same to pass outside of the boxes *l l'* and tubes *m m*, and the remainder to pass through the tubes *n n* to the rear end of the cylinder R, whence it passes by a pipe *p*, which conveys it to the ash-pit and delivers it thereinto, through numerous perforations, in small streams. The rear box *l'* receives the exhaust-steam through a pipe *q*, and all of the said steam passes through the tubes *n n* to the box *l*, from whence all that is not condensed escapes by a pipe *r* to the chimney, while any water condensing in the boxes *l l'* and tubes *n n* is collected and escapes by a pipe *s*. The cold air, it will be understood, enters the heater at the coolest end, and what passes outside of the tubes *m* derives heat partly from the exhaust-steam escaping through the tubes and partly from the gaseous products of combustion, the whole of which pass through the annular chamber S, while what passes through the tubes *n n* derives heat from the steam by which they are surrounded. The air thus passing, as indicated by the arrows in Fig. 4, from the coolest to the hottest part of the heater, or in the opposite direction to the steam and products of combustion, and passing over a very large heating-surface absorbs a very great portion of the heat from the steam and gaseous products of combustion, and is caused to enter the ash-pit at such a temperature that its oxygen combines readily with the carbon of the fuel and produces very perfect combustion. The ash-pit is provided with a door U; but this is only opened till sufficient steam is generated to start the blower.

At the back of the fire-box there is a hollow cylinder O, which is arranged to constitute a fire-bridge, and which is at the same time a water-space, said cylinder being closed at its ends, but having communication with the space above the crown-sheet by a series of vertical tubes *a a*, and also communicating by one or more pipes *b* with a larger cylinder N, arranged in the pit P, that is formed in the boiler-setting below the flues F F and water-spaces H H. This cylinder N is connected with the boiler above the flues F F and just below the water-line by two pipes *c c*, which are at the opposite end to *b*.

Fire having been started with the ash-pit door U open and steam enough having been raised to drive the blower, the ash-pit door is then closed and the operation of the boiler is as follows: The fire being supplied with air which has been heated by being forced by the blower through the heater, the gaseous products of combustion pass from the fire-box over the hollow bridge O and between the tubes *a a* into and through the flues F to the smoke-box J, and thence up the tubes L L to the smoke-box M, and thence

through the heater, as before described, passing on their way over the extensive heating-surfaces of the water-spaces H H and walls A A and effecting a very rapid generation of steam. A rapid generation of steam also takes place in the cylinder O and tubes *a a*, and the steam passing upward produces an upward circulation of water from the cylinder N through the pipe *b* to supply its place, accompanied by a downward circulation from the boiler through the pipes C C to the cylinder. The water passing from the boiler down the pipes *c c*, being taken from the surface where the impurities rise in the form of scum, carries the scum with it down into the cylinder N, and as in this cylinder, owing to its having no heat applied under its bottom, there is no ebullition, but only a very gentle circulation from the end where the water enters by the pipes *c c* to the end where it leaves by the pipe or pipes *b*, the impurities sink to the bottom of said cylinder, whence they may be from time to time blown out through a pipe *t*.

Among the advantages possessed by this boiler the following most important ones may be enumerated: First, its very extensive heating-surface; second, the short distance the steam has to rise, combined with the absence of all obstructions to its rise, and the very extensive area of the surface of water presented; third, its having the most intense heat presented or applied to it near the top of the water; fourth, the absence of liability to burn out, resulting from the conveyance of all sedimentary matter away from the parts exposed to the heat; fifth, its having its flues so constructed (open at bottom) that no dust or cinders can collect in them, all such matters falling within them descending into the pit P; sixth, perfect access is obtained to every part of the inner surface of the boiler for cleaning.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The arrangement of the water-walls A A B B, the suspended water-spaces F F, flues H H, fire-box G, lower and upper smoke-boxes J M, and tubes L L, within the shell of the boiler, substantially as herein set forth.

2. In combination with the above-described arrangement of water-spaces and heating-surfaces, the arrangement of the hollow fire-bridge O, the pipes *a a* and *b*, the cylinder N, and pipes *c c*, the whole operating substantially as herein set forth.

3. The arrangement of the passages for the gaseous products of combustion, the exhaust-steam, and the air in the air-heater, substantially as and for the purpose herein set forth.

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Witnesses:

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