2 Sheets-Sheet 1.

G. I. Washburn,

Steam-Boiler Water-Tube.

No. 49,810. Patented Sep. 5, 1865.

Fig. 1.

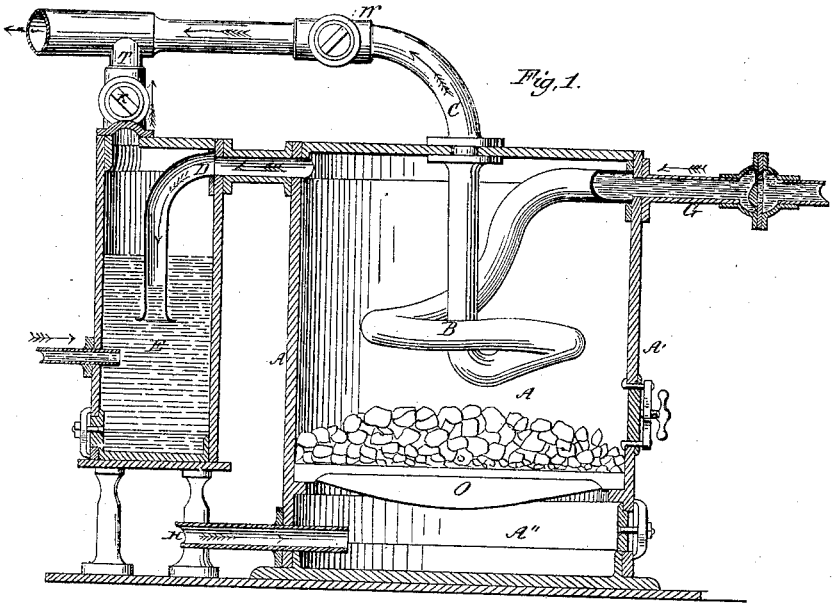
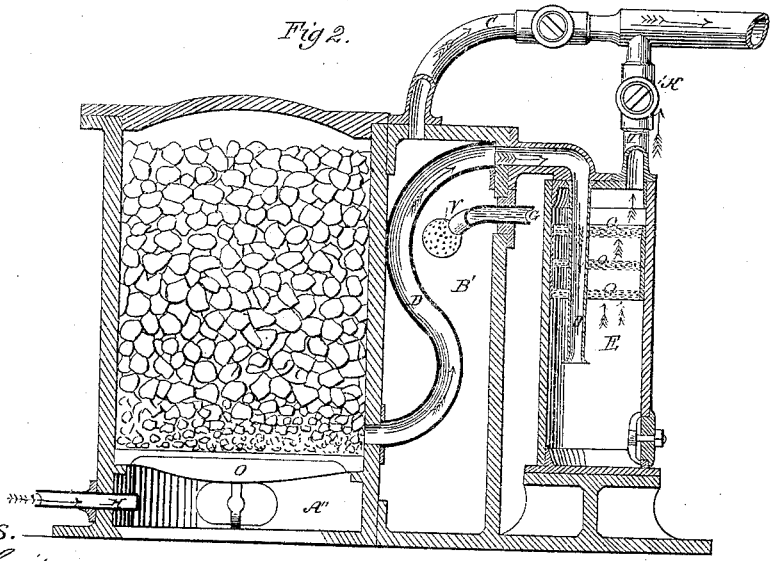


Fig 2.



Witnesses.

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2 Sheets. Sheet 2.

G. I. Washburn,

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Fig 3.

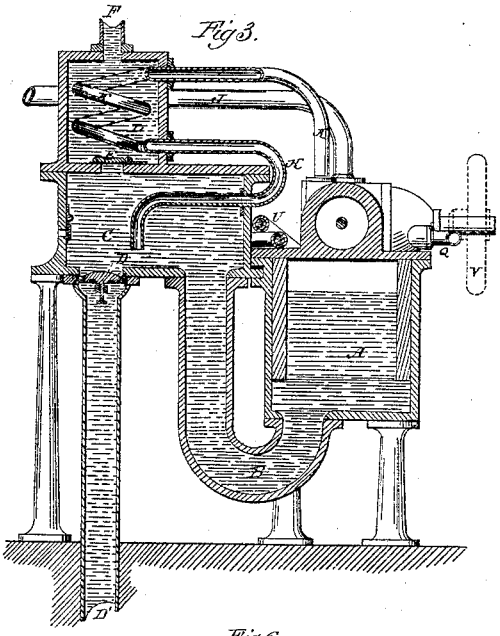


Fig 4.

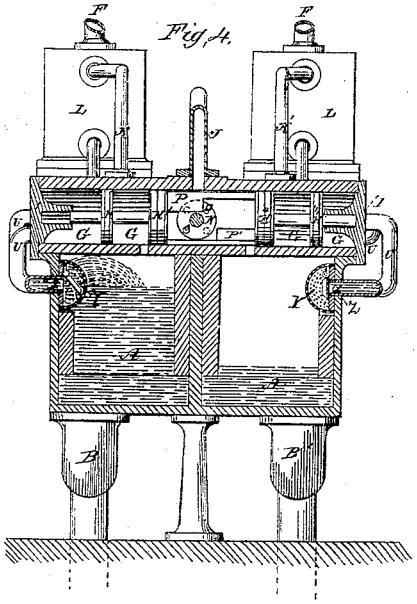


Fig 6.

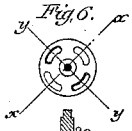
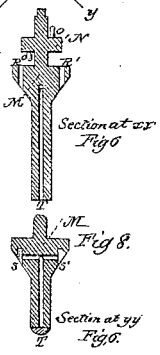


Fig 7.



Elevation of Valve Seat

Fig 9.

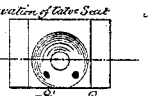
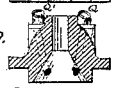


Fig 10.



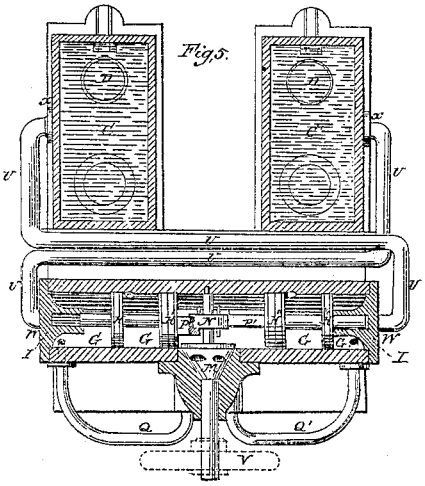
Section of Valve Seat

Section at xx Fig 6

Fig 8.

Section at yy Fig 8.

Fig 5.



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UNITED STATES PATENT OFFICE.

GEORGE I. WASHBURN, OF WORCESTER, MASSACHUSETTS.

IMPROVEMENT IN STEAM-GENERATORS.

Specification forming part of Letters Patent No. **49,810**, dated September 5, 1865.

To all whom it may concern:

Be it known that I, GEORGE I. WASHBURN, of the city and county of Worcester, and State of Massachusetts, have made new and useful Improvements in Steam-Boilers and Utilizing the Heat of the Furnace; and I do hereby declare the following to be a clear and exact description of the same, reference being had to the accompanying drawings, which are made part of this specification, and in which my improvements are represented by two vertical sectional views.

I construct a furnace capable of withstanding great internal pressure, within which I place the fuel, forcing in air to maintain the combustion of the fuel. I cause the volatile products of combustion, together with all the dirt, dust, or other matters which may pass out of the furnace with these gases, to pass through a separate chamber, made of equal strength with the furnace, and which I term the "cleanser," and during the passage through this cleanser all these extraneous matters which would be injurious to the machinery, are removed from the gases by the action of water-spray or other device and retained in the cleanser, from which they are removed from time to time, as desirable. I also generate steam within this furnace either by means of a boiler, which may be a convoluted pipe or a vessel of suitable form, or by injecting water into the furnace, dispensing with a boiler; or I may inject air into the furnace-space above the fire for the purpose of utilizing the heat by its expansion of the said air.

The heated and cleansed gases are conveyed from the cleanser to any suitable engine through a passage controlled by a stop cock or valve, by means of which any desired pressure may be maintained in the furnace.

In case I use a steam-boiler, as it is located within this furnace, and is under an external pressure through the means of the valve K, which is within control, the strength required in the boiler will be only that requisite to withstand the difference between the internal and external pressure. As this difference may be reduced at will to any extent, the thickness of the boiler may be reduced to its minimum, and be determined by other considerations than its power of resisting pressure. The consequence of this comparative thinness is that the transmission of heat from the furnace to the contained water is greatly facilitated. Another consequence is that I can use highly-conducting and comparatively unoxidizable material—such as copper—for the boiler, which would not be practicable under other circumstances, owing to its inferior tensile strength when heated.

The form of boiler which I prefer is shown in Figure 1, where the convoluted pipe B, which contains a small quantity of water, serves as a generator of steam, and may be considered as an instantaneous generator.

A is the furnace, with walls A′ of any requisite thickness and strength. O are the grate-bars, and A″ the ash-pit. The air is forced in to support combustion through the pipe H, and B is the inclosed boiler, suspended from the roof of the furnace and communicating by steam-pipe C with the engine. The supply-pipe G, which is a continuation of the boiler B, is connected with a suitable force-pump.

The heated gases and volatile products of combustion, together with all the dirt, dust, and other matters which may pass out of the furnace with these gases, are carried by pipe D into the cleanser E, and the gases, having been separated from the dirt, either by being passed beneath the surface of the water, as in Fig. 1, or through a porous diaphragm, as in Fig. 2, proceed through pipe T to the engine.

The pipe T and steam-pipe C are controlled by valves K and W, respectively, by means of which the pressure in the boiler and in the furnace is controlled at will.

Fig. 2 represents a base-burning furnace, whose walls form a part of or are entirely inclosed within the strong walls A′, Fig. 1, of the chamber A above spoken of. The usual advantages are derived from the use of this kind of furnace, and the volatile results of combustion are conveyed by a pipe through the inclosing-chamber B′ into the cleanser, in which they are separated from their accompanying dirt, dust, &c., by passing through the porous diaphragms Q, which may be wet or dry and of any effective construction.

The chamber A′, which surrounds the base-burning furnace, is heated by the latter, and is used to an instantaneous generator by injecting a spray of water, or otherwise affords the means of heating injected air or other fluid, which is introduced through the sprinkler or

pipe V. This heated fluid, whatever it may be, is added to or used separately from the heated product of combustion above spoken of.

Whatever heat may be imparted to the contents of the cleanser by the heated gases which pass through it is utilized in the engine by means of the steam caused thereby.

In some cases I dispense with the cleanser and retain the pressure in the furnace for the sake of the thin boiler. I then locate a back-pressure or suitable safety-valve in the pipe D, for the purpose of maintaining the requisite pressure within the furnace A. In such cases I may inject into the boiler water, gases, or air, to be expanded by the heat of the furnace acting through the thin boiler and used as a motive power.

The products of combustion and the expanded contents of the boiler B may be conducted to different engines.

The heat which radiates from the outside of the furnace may be utilized by a water-jacket.

The boiler may be dispensed with and all the steam that is used be generated in the cleanser E.

The consumption of the fuel under pressure results in a more perfect combustion of the fuel, and under given circumstances of space and time more heat can be generated than under the ordinary mode of construction and operation.

The total expansive effect derived from the combustion minus the heat radiated from the surface of the apparatus is worked through the engine.

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

1. In apparatus so constructed as to use the volatile results of combustion in combination with the steam under equal pressures, the cleanser E, which is distinct from the boiler, and within which the said volatile products are cleansed.

2. In apparatus so constructed as to use the volatile results of combustion in combination with the steam under equal pressures, the cleanser E, Fig. 1, within which steam is generated by the heat of the said volatile products which pass through and are cleansed therein.

3. In apparatus so constructed as to use the volatile products of combustion in combination with the steam under equal pressures, the generator placed inside of the furnace.

To the above specification of my improvement in furnace and boiler I have signed my hand this 25th day March, 1865.

GEO. I. WASHBURN.

Witnesses:
EDWARD H. KNIGHT,
CHARLES D. SMITH.