H. M. PIERCE.

Steam-Boiler Furnace.

No. 217,143. Patented July 1, 1879.

Fig. 1.

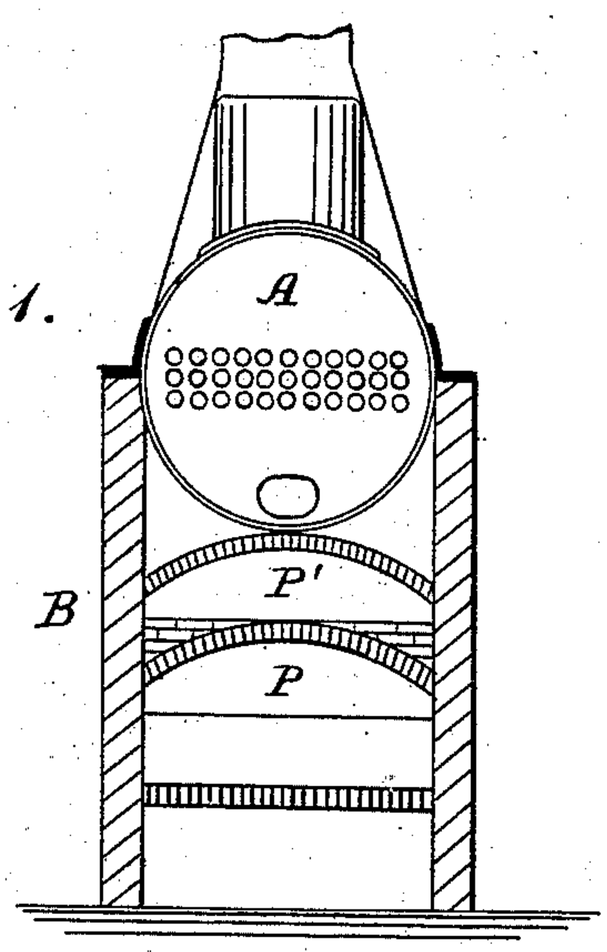


Fig. 2.

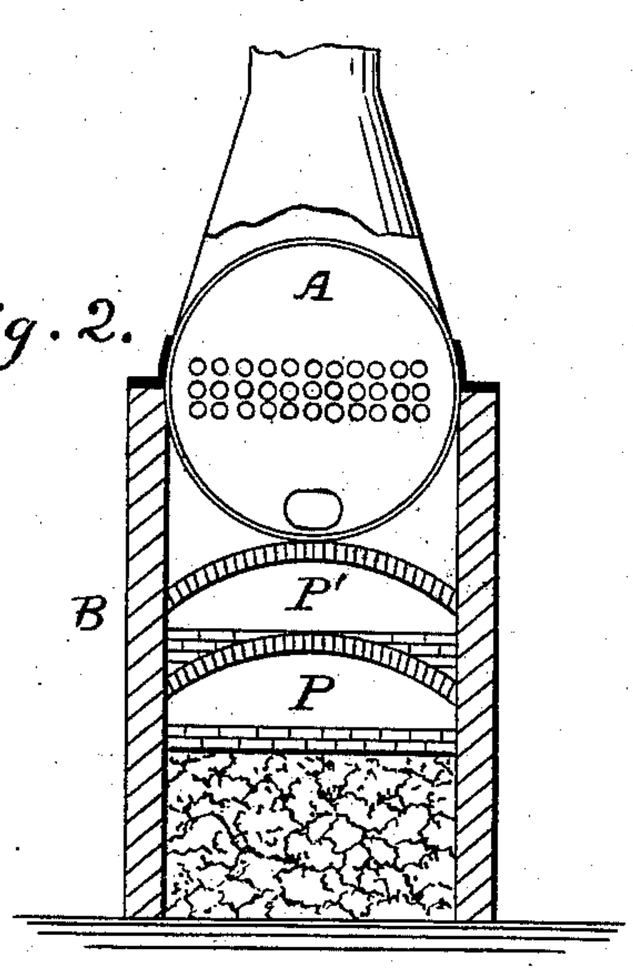
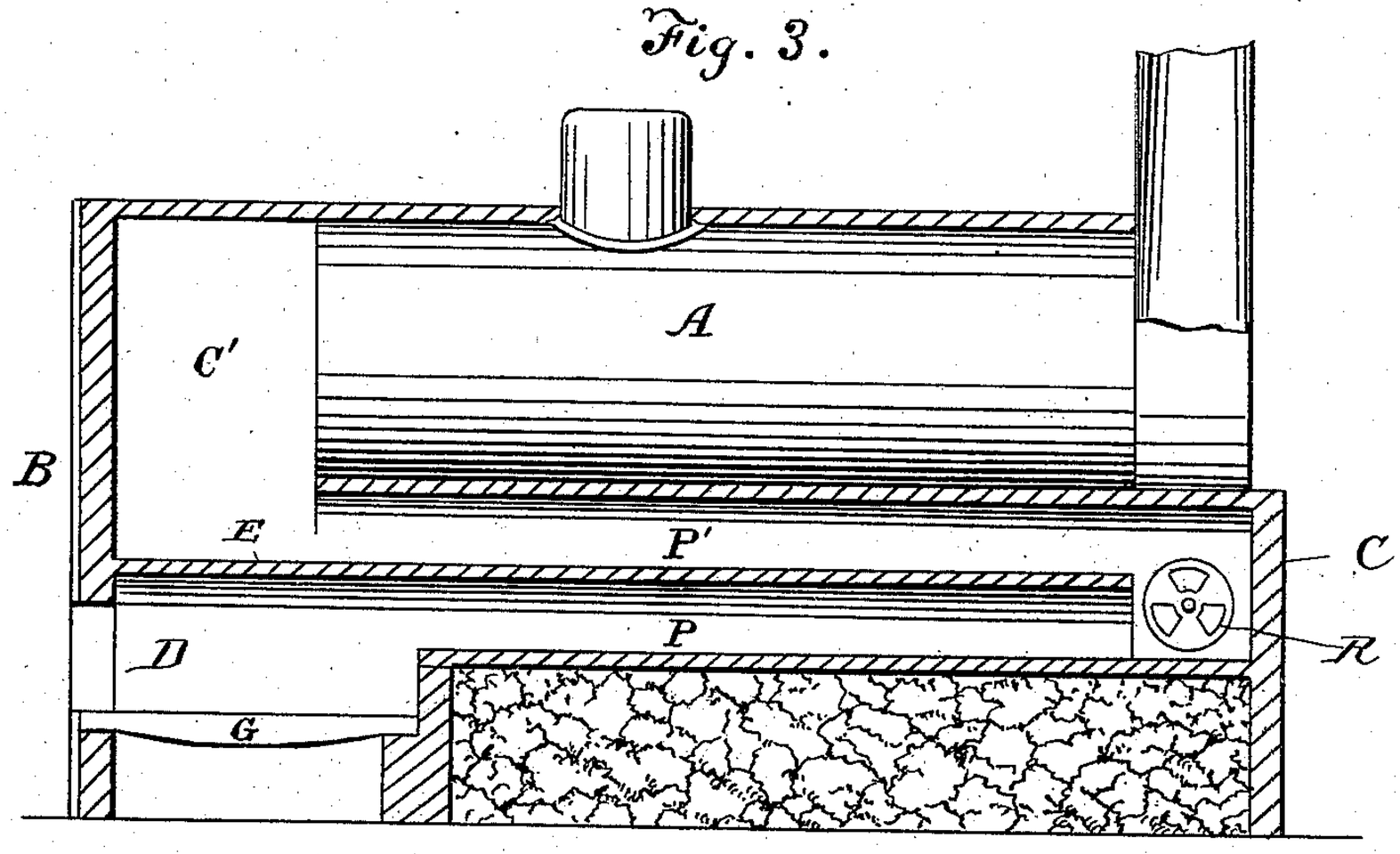


Fig. 3.



Witnesses:

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UNITED STATES PATENT OFFICE.

HENRY M. PIERCE, OF GRAND RAPIDS, MICHIGAN.

IMPROVEMENT IN STEAM-BOILER FURNACES.

Specification forming part of Letters Patent No. **217,143**, dated July 1, 1879; application filed June 3, 1879.

To all whom it may concern:

Be it known that I, HENRY M. PIERCE, of the city of Grand Rapids, in the county of Kent and State of Michigan, have invented certain new and useful Improvements in Furnaces for Steam-Boilers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

The object of this invention is, first, to secure perfect combustion of fuel in the furnace, and to apply the results of such combustion to the boiler.

The invention consists in so constructing and arranging a furnace that the whole volume of the gases from the fuel on the grate shall continue long enough in their passage and be kept hot enough to burn until entire combustion is effected. I supply air to said products of combustion at suitable points in the path of said products between the grate and the boiler, and before any portion of the flame and hot gases has fallen to a temperature below the point of ignition, in such quantities as are required to effect complete combustion.

It further consists in a certain arrangement of passages for said products or hot gases from the grate to the boiler, so that said passages are returned or doubled upon themselves in such a manner as to secure an increase of space and time for combustion without increasing the radiating-surface; also, in the provision of a combustion-chamber under the boiler of a furnace, said chamber being divided by a longitudinal horizontal diaphragm, to form an upper and a lower flame-flue, having a return-chamber at the end of the fire-flue, to which air is admitted, and a combustion-chamber adjoining the boiler and over the fire-place, being separated therefrom by the said diaphragm.

In the present state of the art referred to I deem the practice defective in two essential particulars—namely, as to temperature and as to space, and consequently as to time. Fuel is burned for the production of steam in chambers, one side of which, as in ordinary horizontal boilers, is formed by a water-surface of the boiler; or, as in case of locomotive-boilers, the top and all four of the sides are formed by water-surfaces of the boiler; or, as in case of an internally-fired boiler with a water-grate, all of the inclosing-walls of the combustion-chamber are water-surfaces of the boiler.

Such construction is deemed to cause an injurious premature cooling of the distillatory results of combustion.

If a lump of coal is laid upon a clear fire, the first result is distillation or reduction of the fuel from a solid to a vapor; second, ignition and complete oxidization of such vapor; third, optical disappearance of all the elements of the lump of coal except the incombustible matters remaining in the form of ash.

If a piece of cold iron be placed quite near the burning lump of coal, the combustion of the vapors touching the cold iron will be arrested, and the carbon contained in such vapor, instead of being burned, will be deposited upon the iron in the form of soot, or will pass up from the iron unconsumed in the form of a black smoke. Hence the vapors arising from the fuel on the grate may, in a common boiler-furnace, either burn or be cooled, and take the form of soot, which greatly impairs the efficiency of the boiler, or pass off in visible smoke, which is fuel thrown away.

The usual heat of fire is about 1,000°, the heat necessary for ignition being about 800°. At a lower temperature combustion ceases. Steam at sixty pounds pressure has a temperature of about 295°; at one hundred pounds, 332°. Hence the temperature of the water-surfaces of ordinary steam-boilers is from 400° to 500°, at least, below that necessary for ignition; consequently smoke is formed, and either deposited in the form of soot or carried out of the chimney.

As to space, authorities give the bulk of the results of combustion of one pound of bituminous coal as one thousand seven hundred and twenty-five cubic feet. In case of a grate measuring five feet by six feet, the fire-box being five feet in depth, the burning of coal being at the rate of twelve pounds to a foot of grate per hour, which is an ordinary instance, the consumption of coal is six pounds per minute, the volume of products ten thousand

three hundred and fifty cubic feet per minute, and the fire-box is consequently filled seventy times per minute.

Although combustion under very favorable circumstances is rapid, I believe the cubic contents of the fire-box or combustion-chamber in the above case is not more than one-tenth of that which is necessary for the perfect and economical combustion of the fuel commonly burned therein.

To remedy the defects above referred to in the existing practice in the use of fuel for the production of steam, I propose, first, to protect the vapors rising from the fuel from all cooling-surfaces, so far as practicable, until after combustion is complete; secondly, to secure ample space and time for that thorough admixture of elements necessary for the chemical combustion of the bulky vapors inseparably connected with the process of combustion; and, thirdly, to apply the vapors arising from combustion to the boiler only after combustion is complete.

In the accompanying drawings, in which my invention is shown in one form, Figure 1 is a front elevation of a boiler with my improved furnace having the fire-front removed. Fig. 2 is a rear elevation of the same having the rear wall removed; and Fig. 3 is a side view of a boiler in position in my improved furnace, the latter being shown in vertical longitudinal section.

A designates the boiler in position in the furnace B. D indicates the fire-box, and G the grate. A passage, P, surrounded by brick walls, leads to the combustion-chamber C, the latter being supplied with air by means of the register R, to facilitate and complete combustion. In the chamber C the course of the products of combustion is changed, and the volume goes in the opposite direction, through the upper passage, P′, to the front of the boiler. The lengths and areas of the passages P and P′ and chamber C are such as to afford ample space and time for complete combustion, so that when the chamber C′, communicating directly with the front of the boiler, is reached, only the products of perfect combustion remain.

E indicates a diaphragm or partition separating the passages P and P′, and also separating the chamber C′ from the fire-place.

Certain advantages, as economy of space and diminution of radiating-surfaces, render the arrangement shown desirable, and this particular form constitutes one part of my invention.

I do not, however, confine myself to the precise form of construction herein shown to produce the desired result, my invention consisting mainly in surrounding the grate and the volatilized fuel with non-conducting surfaces, in connection with means for supplying air until complete combustion is effected, and then applying the result to the boiler.

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

1. As an improvement in furnaces, the combustion-chamber under the boiler, divided by a longitudinal horizontal diaphragm, forming an upper and lower flame-flue, and a return-chamber at the end of the fire-flue, to which air is admitted, and a combustion-chamber immediately over the fire-chamber and above said diaphragm, whereby the combustion of all the gases is made complete and utilized, substantially as herein described.

2. In a boiler-furnace, the grate G, passage P, chamber C, with means for supplying air, the passage P′, and the chamber C′, communicating with the boiler, for the purposes set forth.

In testimony that I claim the foregoing I have hereunto set my hand this 21st day of May, 1879.

HENRY M. PIERCE.

Witnesses:
F. H. PRAY,
W. A. SHINKMAN.