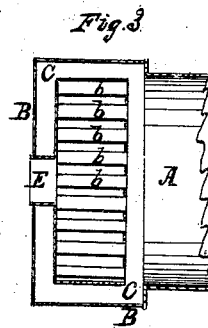
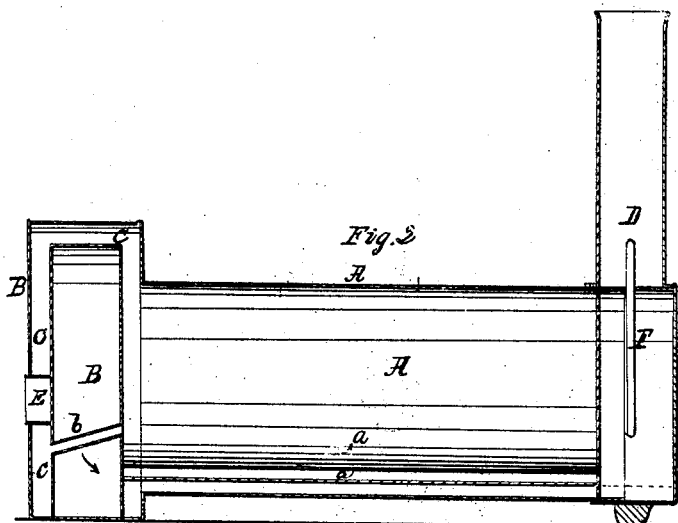
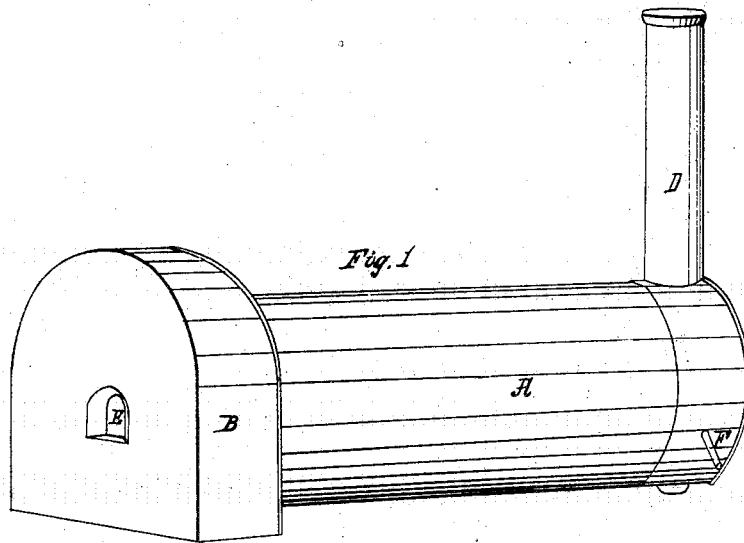


*C. Crawford,*  
*Furnace-Grate Bar.*  
*N<sup>o</sup> 49,728.      Patented Sep. 5, 1865.*



*Witnesses.*

*W. H. Burrage.*  
*A. W. McClelland*

*Inventor*

*Clay Crawford*

# UNITED STATES PATENT OFFICE.

CLAY CRAWFORD, OF EAST CLEVELAND, OHIO.

## IMPROVEMENT IN STEAM-GENERATORS.

Specification forming part of Letters Patent No. 49,728, dated September 5, 1865.

*To all whom it may concern:*

Be it known that I, CLAY CRAWFORD, of East Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Steam-Generators; and I do hereby declare that the following is a full and complete description of the construction and operation of the same, reference being had to the accompanying drawings, making a part of this specification, in which—

Figure 1 is a perspective view of the steam-generator. Figure 2 is a longitudinal section. Fig. 3 is a view across the fire-place.

Like letters of reference refer to like parts in the several views.

My improvement relates to arranging the flues in the lower part of the boiler, below the grate-pipes, and also to inclining said pipes in the fire-box, for the purpose of causing a current of water to pass continually through the grate-pipes, and producing a more perfect combination of the fuel and economical operation of steam.

A represents the boiler; B, the fire-place, the internal structure of which is shown in Figs. 2 and 3. Around the fire-place is a chamber, C, for containing water, and in the fire-box are grate-pipes *b*, inclined upward from the front, as shown in Fig. 2, or they can be inclined in the other direction. These pipes form the grate of the fire-box, and communicate with the chamber C on one side and the boiler on the other. From the fire-box, underneath the grate-pipes, through the lower part of the boiler, extend flues *a*, for conveying the non-combustible gases into the chimney D and to generating steam in the boiler. The upper flues enter the fire-box below the grate-pipes, as shown in Fig. 2, being in a line or a little above the lowest end of the pipes, below which there can be any desired number of flues for generating steam.

F is an exhaust-pipe in the rear end of the

boiler, as seen in Figs. 1 and 2, for the ordinary use.

E is the opening into the fire-place.

The object of having the grate-pipes or tubular bars *b* inclined either way across the fire-box instead of horizontal is to cause a current of water to run continually through the pipes, which is not so readily done when the pipes are horizontal. In this way the grate-pipes are prevented from burning out so rapidly, the fresh water passing continually through them, the water being admitted into the lower part of the boiler in the ordinary manner. The draft from the fire-box is down around the pipes *b*, through the flues *a* in the lower part of the boiler, entering the flues from the grate in the direction of the arrow, being a downward draft or current through the coals on the grate and around the pipes. The principle involved in this downward draft is that the gas to produce combustion distills down through the fuel until it comes in contact with the lower stratum of burning coals and becomes sufficiently heated to ignite, so that the smoke and all combustible gases produced by ignition go through the fire and are consumed, instead of passing off as waste products of combustion in the ordinary way, being utilized, as specified.

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

1. So arranging the tubular grate-bars *b* in relation to the flues *a* and fire-place B and draft that the products of combustion in said fire-place will pass down from the top around the grate-pipes in accordance with the direction of the draft, substantially as and for the purpose set forth.

2. The grate-pipes and flues, when arranged in relation to each other and the boiler, substantially as and for the purpose set forth.

Witnesses: CLAY CRAWFORD.

W. H. BURRIDGE,  
A. W. McCLELLAN