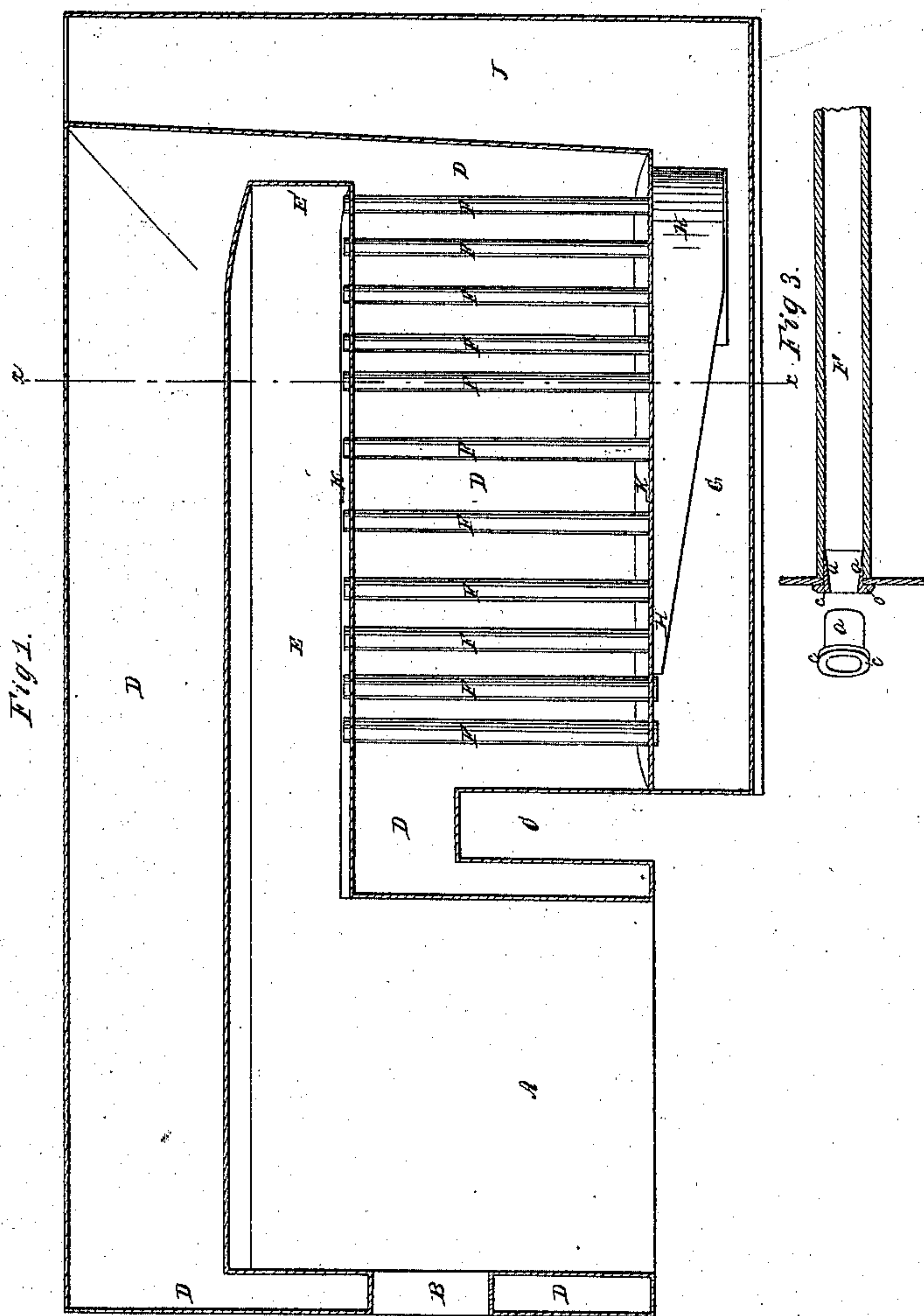
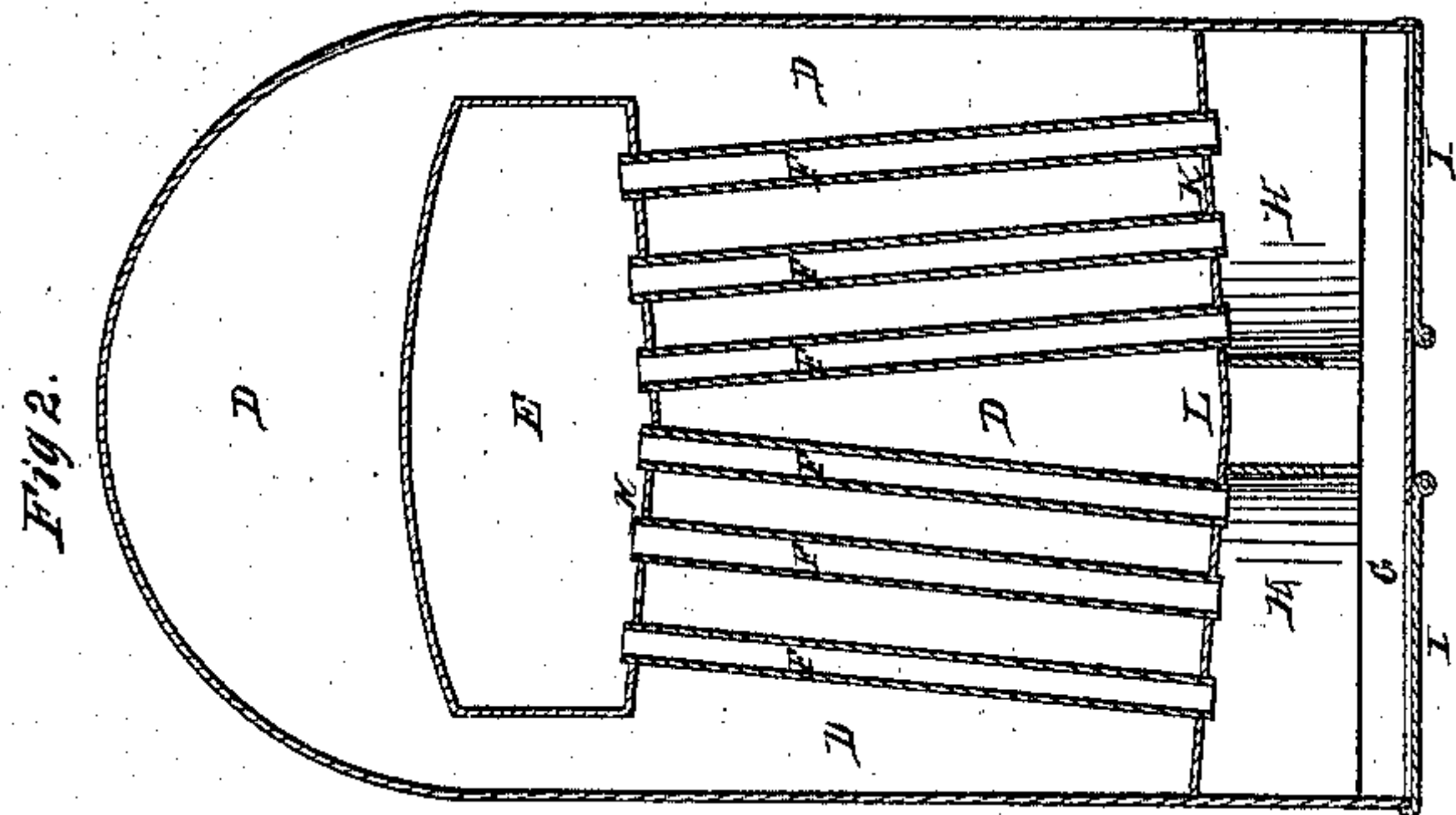


*H. Boardman,*  
*Steam-Boiler Fire-Tube.*  
*N<sup>o</sup> 12,665.* *Patented Apr. 10, 1855.*





# UNITED STATES PATENT OFFICE.

HORACE BOARDMAN, OF PLATTSBURG, NEW YORK.

## IMPROVEMENT IN STEAM-BOILERS.

Specification forming part of Letters Patent No. 12,665, dated April 10, 1855.

*To all whom it may concern:*

Be it known that I, HORACE BOARDMAN, of Plattsburg, in the county of Clinton and State of New York, have invented certain new and useful Improvements in Steam-Boilers for Locomotives, &c.; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, making a part thereof, in which—

Figure 1 represents a central longitudinal and vertical section through the boiler. Fig. 2 represents a vertical transverse section looking to the right of the red line *xx* of Fig. 1. Fig. 3 represents a modified form of the method of contracting or graduating the openings in the tops of the vertical tubes or flues.

Similar letters where they occur in the several figures denote like parts.

In boilers where vertical flues or tubes are used the tendency of the flame and heated products of combustion is to pass over the first flues of the series nearest to the fire-box or furnace, and not to descend them until checked near the end of the boiler. This disseminates the burning products unequally through the flues, the first of the series not receiving their equitable proportion of heat, while the others are receiving too much.

The object of my invention is to overcome this irregular transit of the heated products of combustion and to equalize it throughout the entire series of tubes or flues; and the nature of my invention consists, first, in graduating the openings in the tops of the vertical tubes or flues, which may be done by gradually diminishing the diameters of the tubes from those nearest the fire-box or furnace to those most remote from it, so that greater flue-space shall be presented to the heat and flame at the points where its greatest tendency is to pass over the tubes and lesser flue-space where its tendency to descend is greatest; or it may be done by dropping thimbles with graduated openings in them into the tops of the tubes whose diameters are uniform throughout, said thimbles being provided with flanges to prevent them from dropping down into the tubes and to hold them in their places; and, secondly, in connecting with the graduated flues or tubes a semi-division plate or

plates in the chamber in the bottom of the boiler, which plates are so shaped as to present greater facilities of egress to the flame and heated products from the tubes nearest the furnace and restrain them more in those more remote from it; and, thirdly, in inclining the tubes both ways from the center laterally, and also inclining the flue-sheets in which they are riveted in the same directions, so as to form a space central between the tubes in which the sediment may deposit and from which it may be removed readily, and for the further purpose of having the flue-sheets normal to the line of tubes to facilitate their being properly riveted therein.

To enable others skilled in the art to make and use my invention, I will proceed to describe the same with reference to the drawings.

A represents the fire-box or furnace, and B the door, through which the fuel is fed into it.

C is an open space in the boiler between the fire-box and the descending flues to allow the boiler to set over the axle of the driving-wheels of the locomotive.

D is the water-space in the boiler, and E a chamber, which I call a "combustion-chamber," extending from the fire-box to near the front of the boiler.

The tendency of the flame and heated products of combustion is to pass to the extreme end, E, of the combustion-chamber, instead of descending the flues F, and for more of the heat to pass through the flues or tubes at the end E' than at the other end. To regulate this transit of the heat through the tubes F and equalize the heat throughout the boiler, I gradually diminish in size the tubes F, placing the larger ones nearest the fire and the smallest ones most remote from it, so as to have more flue-space at one end than at the other, and thus draw the flame and heat through those tubes over which its tendency to pass is the greatest and restrain its passage through those in which the greater quantity of heat tends to pass, and thus equalize the passage of the heated products throughout the extent of the combustion-chamber E.

This method of gradually diminishing the size of the tubes may be practiced in the construction of new boilers, or the tops only of



the tubes may be thus gradually diminished in size, leaving the main part of them of uniform size; but to apply the remedy to boilers already constructed I propose to use a series of cast-iron thimbles, *a*, Fig. 3, provided with flanges *c*. The body or stem of these thimbles in their outer diameters may be of the same size of the caliber of the tubes or flues, and the openings only in said thimbles may be graduated. These thimbles may be dropped into the upper ends of the tubes, their flanges catching over the tops of the tubes, and thus holding themselves in position, while the flanges serve as a shield or protection against the action of the fire on the riveted joint of the flue and flue-sheet. They likewise prevent the tubes from clogging, as they are larger below the opening than at it, and allow everything that enters to pass through. Thus a boiler already constructed may be provided with graduated openings in the tops of its vertical tubes, although the tubes themselves may be of uniform caliber.

Below the flues *F* is a chamber, *G*, in which two semi-partition or division plates, *H*, are arranged. These plates *H* underneath the tubes of smallest diameter extend down nearly two-thirds of the height of the chamber, and run back, inclining upward, until they reach near the tubes of largest caliber, where they terminate. This is for the purpose of facilitating the egress of the heated products from the larger tubes and to check it through the smaller ones; or, in other words, to aid in drawing the heated products through the tubes, over which their tendency is to pass, and to restrain their passage through the tubes to which they tend the greatest, and thus both the ingress and egress of the heated products to and through the tubes are in a great measure regulated and equalized.

*I I* are two doors arranged in the bottom of the chamber *G*, opening downward, for the purpose of cleaning out said chamber or for removing or repairing the flues. The heated products, after passing through the chamber *G*, pass up and out through the space *J* or into the chimney.

The flue-sheets *K K* incline upward both ways from the center of the boiler, as seen in Fig. 2, so as to stand at right angles to the tubes *F*, which are inclined. This inclination of the tubes and flue-sheets are, first, to allow a central space, *L*, between the flues, into which the sediment may deposit and from which it may be removed readily; and, secondly, for the purpose of fairly riveting the tubes into the tube or flue sheets. If the flue-sheets were horizontal and the tubes inclined, or if the tubes were vertical and the flue-sheets inclined, they could not be well secured one to the other, because in either case the ends of the tubes must be inclined to meet the sheets, and if the tubes are not square at their ends such ends cannot be turned out to be riveted, as there would not be any support on the lower side of the tube for the tool which is first driven into the tube to turn the riveting-flange on it. It is therefore necessary in perfect riveting that the sheets and tubes should stand at right angles to each other.

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

1. The graduating of the openings in the flues or tubes in the manner and for the purpose set forth.

2. In connection with the flues or tubes, the semi-division flue-plates *H* in the chamber *G*, for regulating and equalizing the egress of the heated products through said tubes, as set forth.

3. The inclination of the tubes and tube-sheets for the double purpose of preserving a space between the tubes for the sediment to collect in and from which it can be readily removed, and for preserving a square surface between the tops of the tubes and said sheets, so that they can be fairly riveted, as set forth.

H. BOARDMAN.

Witnesses:

A. B. STOUGHTON,  
THOMAS UPPERMAN.