E. SAVAGE.

METALLURGICAL FURNACE.

No. 171,321. Patented Dec. 21, 1875.

Fig. 1

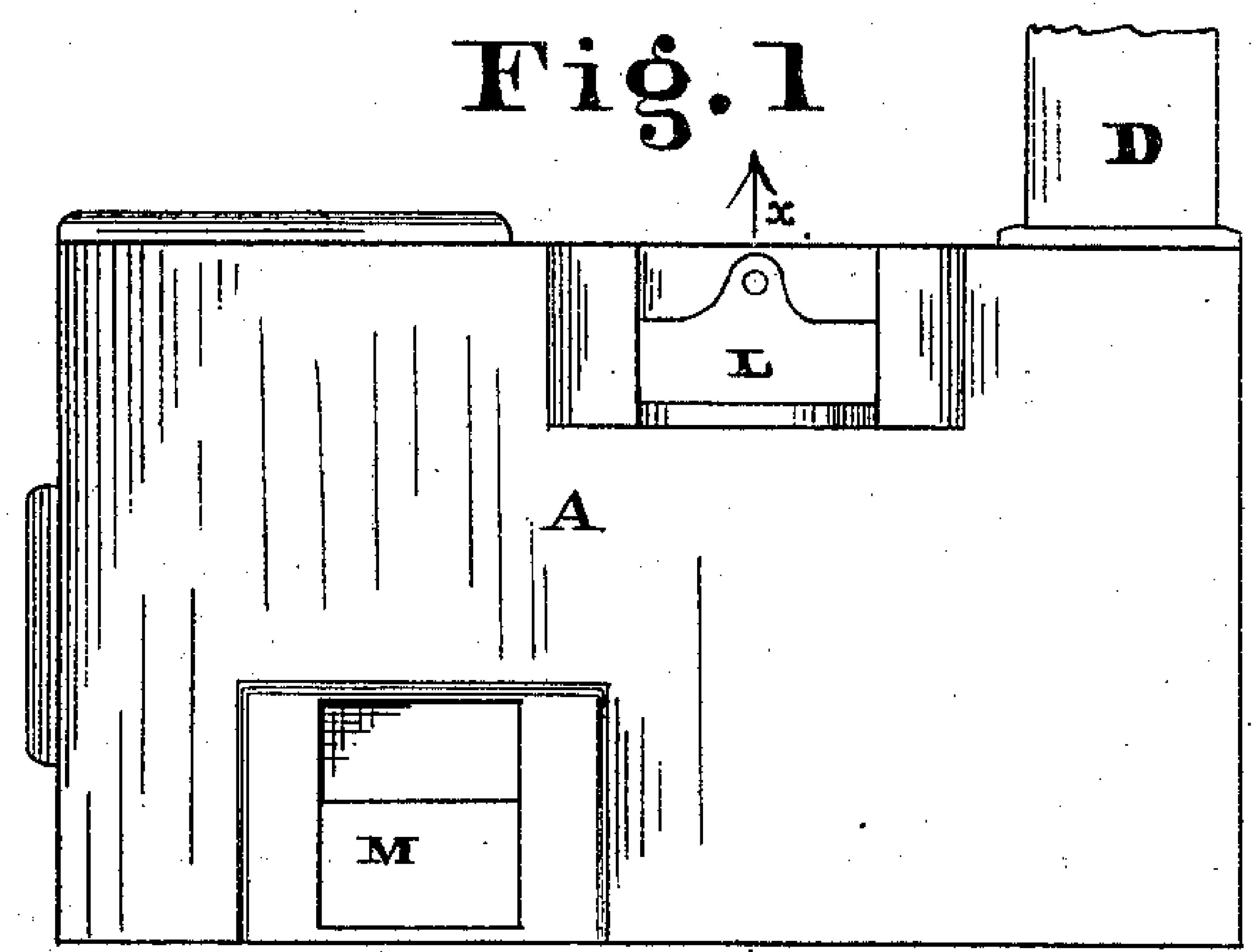


Fig. 2

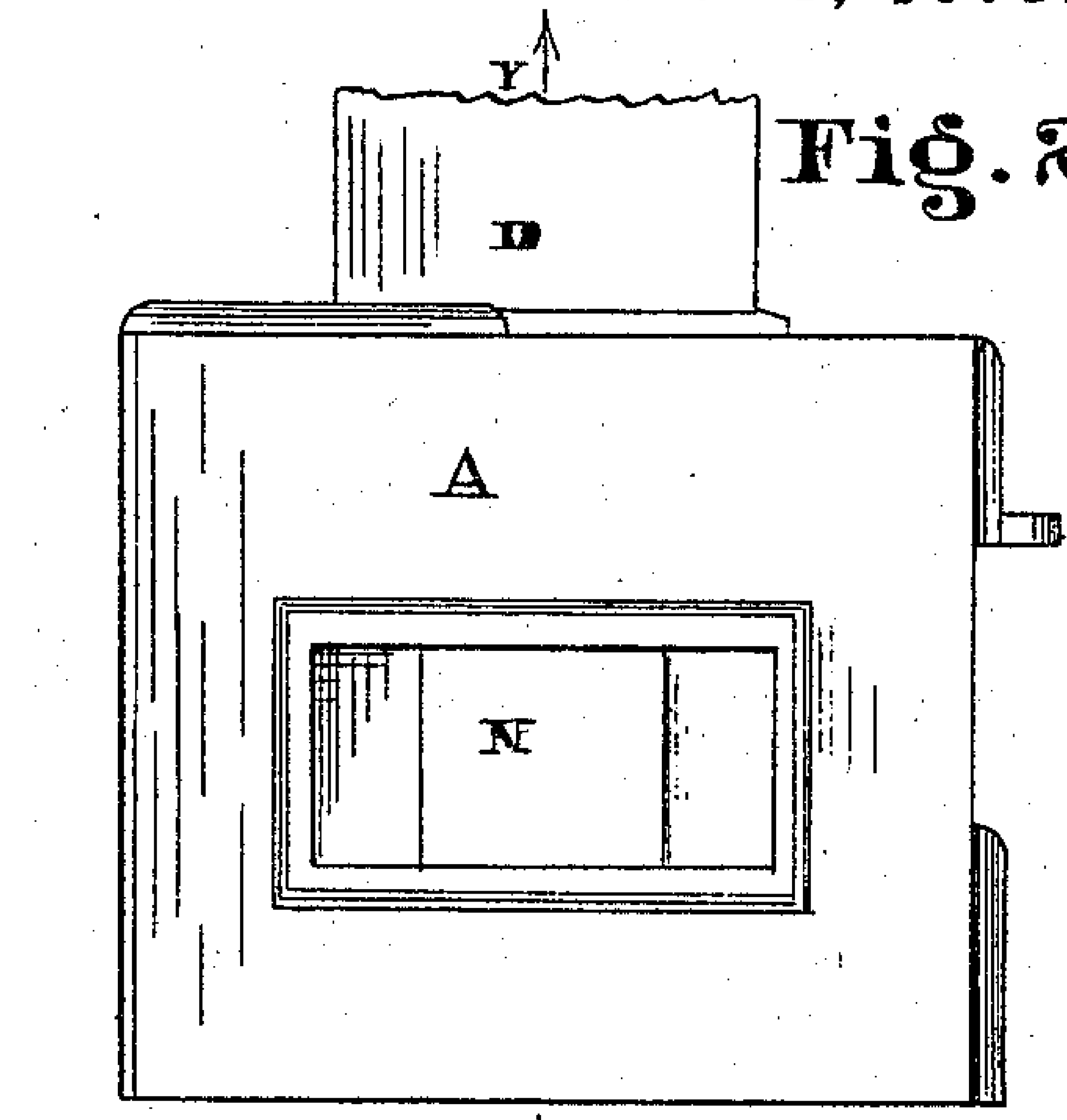


Fig. 3

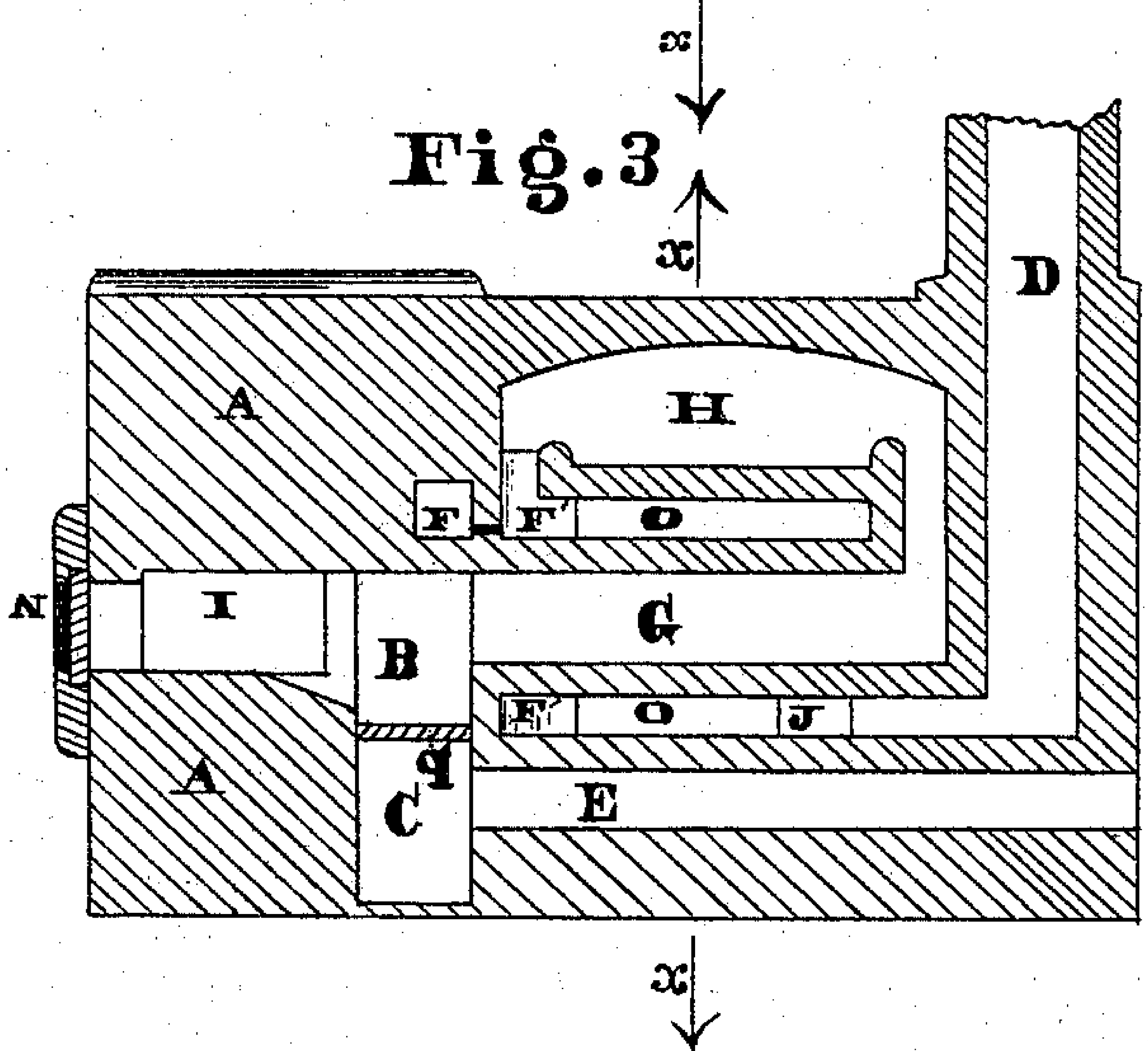


Fig. 4

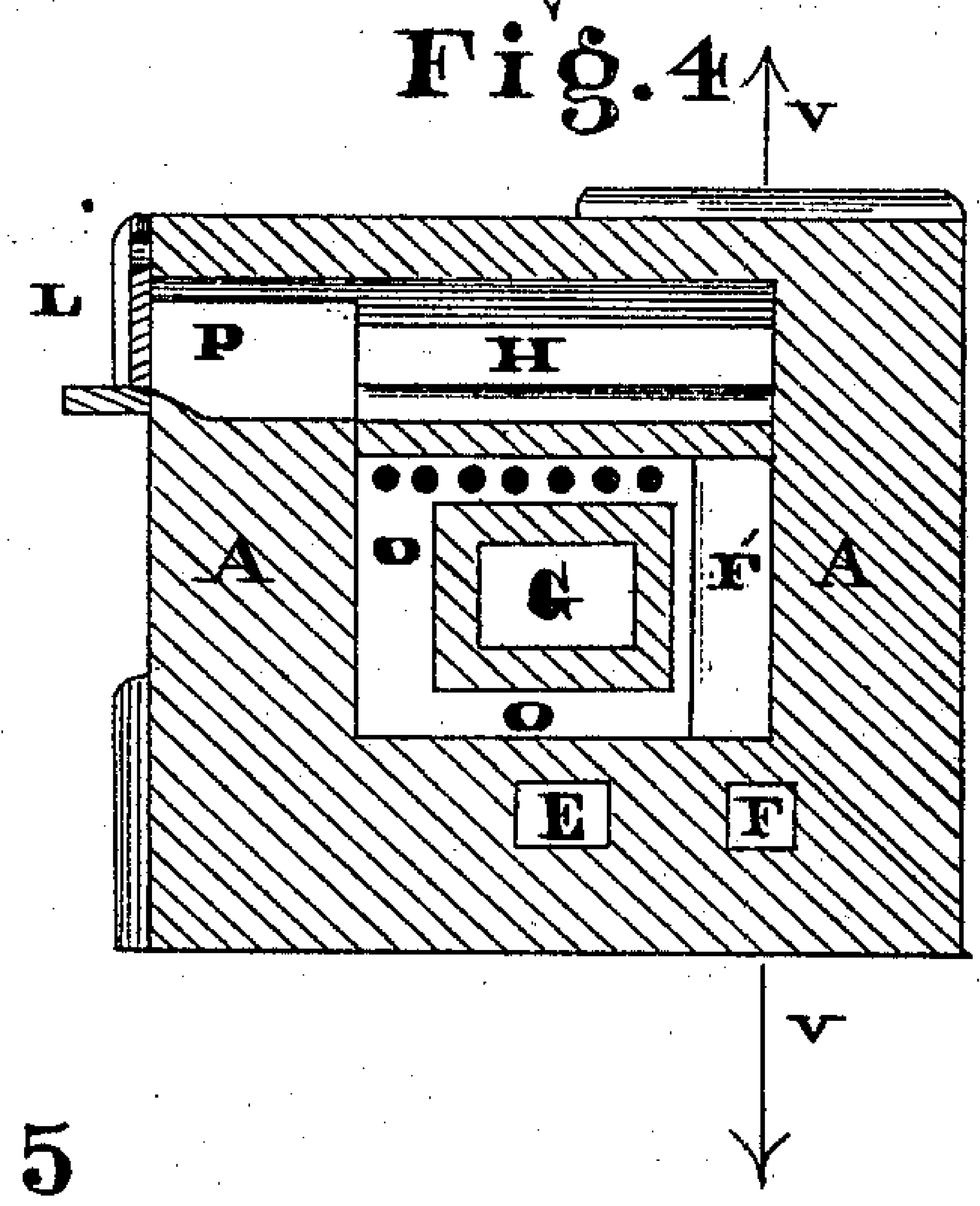
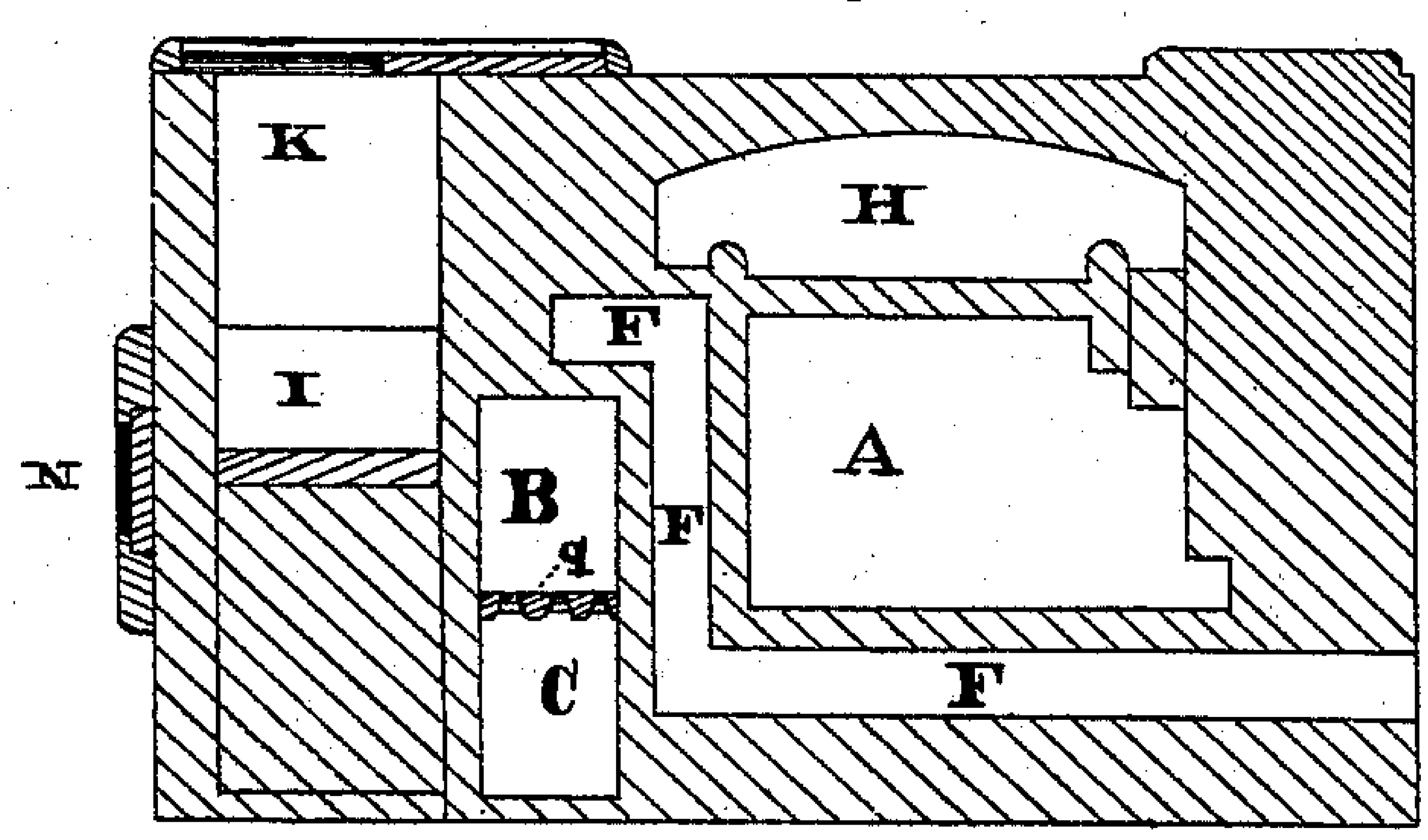


Fig. 5



Attest

A. S. Hutchinson

James Moore

Inventor

Elliot Savage

By Geo. J. Murk

his Attorney.

UNITED STATES PATENT OFFICE.

ELLIOT SAVAGE, OF WEST MERIDEN, CONNECTICUT.

IMPROVEMENT IN METALLURGICAL FURNACES.

Specification forming part of Letters Patent No. **171,321**, dated December 21, 1875; application filed September 18, 1875.

To all whom it may concern:

Be it known that I, ELLIOT SAVAGE, of West Meriden, in the county of New Haven and State of Connecticut, have invented a new and useful Improvement in Metallurgical Furnaces, fully set forth in the following specification, reference being had to the accompanying drawings.

The objects of this invention are, first, to prevent the oxidation of the metal in the smelting-chamber when brought to a high temperature by supplying said chamber with the reducing-gases at the requisite degree of heat to smelt the metal without producing complete combustion in the chamber; and, second, to prevent the waste of fuel by supplying the reducing-gases after leaving the smelting-chamber with a fresh supply of oxygen, to produce complete combustion, and utilize the heat thus produced to heat the reducing-gases to the proper temperature before entering the smelting-chamber.

It is well known that in the ordinary process of combustion oxygen and carbon can be made to combine in two definite proportions, forming carbonic oxide (CO) or carbonic acid (CO_2); carbonic oxide being formed when carbon is burned in a limited supply of oxygen; carbonic acid being the result of the perfect combustion of carbon; carbonic oxide containing one atom of carbon and one atom of oxygen; carbonic acid being composed of one atom of carbon and two atoms of oxygen. When one pound of carbon is combined in the process of combustion with one and one-third pound of oxygen the total amount of heat developed is four thousand four hundred British thermal units, the product being two and two-thirds pounds of carbonic oxide, which can be combined by combustion with one and one-third pound of oxygen, and by so doing develop heat amounting to ten thousand and one hundred thermal units. When one pound of carbon is combined in the same manner with two and two-thirds pounds of oxygen, the amount of heat developed is fourteen thousand and five hundred thermal units, and the product of combustion is three and two-thirds pounds of carbonic acid (CO_2). The burning of carbon as it takes place in the combustion-chambers of ordinary furnaces is always complete at first, provided the layer of coal from which the carbon is obtained is not so thick and the supply of air so small but that oxygen in sufficient quantity can get direct access to all the solid carbon—that is to say, one pound of carbon combines with two and two-thirds pounds of oxygen, and makes, as stated above, three and two-thirds pounds of carbonic acid, and thus carbon, which is solid immediately before the combustion, passes during the combustion into the gaseous state, forming with the oxygen carbonic-acid gas, and producing fourteen thousand and five hundred thermal units per pound of carbon consumed, and under these conditions the process terminates; but when part of the solid carbon in the furnace is not supplied directly with oxygen, being first heated and then dissolved into the gaseous state by the hot carbonic-acid gas, which has already been formed in it, the product is carbonic-oxide gas, three and two-thirds pounds of carbonic-acid gas being capable of dissolving one pound of carbon, and thus making four and two-thirds pounds of carbonic-oxide gas. The volatilizing of this second pound of carbon causes a loss of heat amounting to five thousand and seven hundred thermal units, which being taken fron the fourteen thousand and five hundred thermal units produced by the perfect combustion of one pound of carbon, there remain eight thousand and eight hundred thermal units. Should the process stop here the waste of fuel is very great; but if the four and two-thirds pounds of carbonic-oxide gas is mixed with a sufficient quantity of fresh air of proper temperature it will burn with a blue flame, and the product will be seven and one-third pounds of carbonic-acid gas, the amount of heat developed in the process amounting to twenty thousand and two hundred thermal units. Adding to this the eight thousand and eight hundred thermal units above, we have twenty-nine thousand thermal units as the result of the perfect combustion of two pounds of carbon.

It is well known to metallurgists that carbonic oxide in its action upon metals and metallic oxides is a reducing-gas, and that metals are not readily oxidized, even when exposed to it at a high temperature. It is also known that when metals which have an affinity for oxygen are exposed to the action of carbonic-acid gas at a high temperature they are rapidly oxidized, and thus burned up and wasted.

In the furnaces in common use for manufacturing wrought-iron, the atmosphere of the heating-chamber is usually kept in such a state as to prevent the oxidation of the iron while it is being heated. This is accomplished by supplying the combustion-chamber of the furnace with a large amount of carbon, which, of necessity, must be burned in a limited supply of air, which results in a large waste of fuel.

The method by which I prevent this waste will be understood by the following description of my improved metallurgical furnace.

In the drawing, Figure 1 is a side elevation, and Fig. 2 an end view, of the furnace. Fig. 3 is a central vertical section of the furnace, taken through line *y y*, Fig. 2. Fig. 4 is a vertical cross-section through line *x x*, Figs. 1 and 3, and Fig. 5 is a longitudinal vertical section through *v v*, Fig. 4.

A is the walls or mason-work. B is the first combustion-chamber; C, the ash-pit; D, the uptake. E is a flue through which air is conducted to the ash-pit. F is the flue, and F′ its walls for conducting air to the second combustion-chamber O. G is the flue in which the reducing-gases are heated, and through which they are conducted to the smelting-chamber H. I is the inclined dead-plate of the fuel-chamber, down which the fuel passes to the first combustion-chamber B. J is a support for the wall of flue G. K is the fuel-chamber or coal-box. L is the door of the smelting-chamber; P, the entrance to the same. M is the door of the ash-pit; N, the door or stoking-hole of the combustion-chamber B. O is the second combustion-chamber (completely surrounding flue G,) in which the gases after leaving the smelting-chamber H, and taking a fresh supply of oxygen through perforations leading from flue F, are completely consumed.

The mode of operation is as follows: Fire being kindled in first combustion-chamber B, and box K being filled with coal, air is forced through flue E into ash-pit C, and up through grate-bars *q′*. Complete combustion is produced immediately above the grate-bars. The result of this complete combustion, (CO_2,) passing up through the incandescent fuel receives from the fuel being coked on dead-plate I another portion of carbon, forming carbonic oxide, this reducing-gas passing through flue G into smelting-chamber H, and from there into chamber O, receiving, after leaving chamber H, a fresh supply of air through the perforations leading from flue F, the perfect combustion of the fuel is accomplished. The heat thus generated by this second combustion is communicated to the walls of chamber O and the flue G, the gases then passing out into the air through the up-take D. When a sufficiently high temperature has been attained for the purpose desired, the combustion can be retarded by regulating the supply of air through the air-passages E and F, and thus a great saving of fuel accomplished, and a strictly reducing gas introduced into and maintained in the smelting-chamber, while the oxidizing-flame is confined entirely to the chamber O.

For the purpose of completely preventing any air entering the chamber H, the passage from said chamber is made smaller than the entering-passage to it, thus causing and maintaining an outward pressure in the chamber H.

I claim—

1. The combination, substantially as hereinbefore set forth, of the flue for conducting the heated gases from the first combustion-chamber to the smelting-chamber, and the second combustion-chamber for heating said flue.

2. The combination, substantially as hereinbefore set forth, of the flue for conducting the heated gases from the first combustion-chamber, the second combustion-chamber for heating said flue, and the smelting-chamber intervening said flue and second combustion-chamber.

3. The combination, substantially as hereinbefore set forth, of the flue for conducting the heated gases from the first combustion-chamber into the smelting-chamber, and the second combustion-chamber for heating said flue with a flue for admitting air into said second combustion-chamber.

ELLIOT SAVAGE.

Witnesses:

JAMES MOORE,

DR. I. E. NOYES.