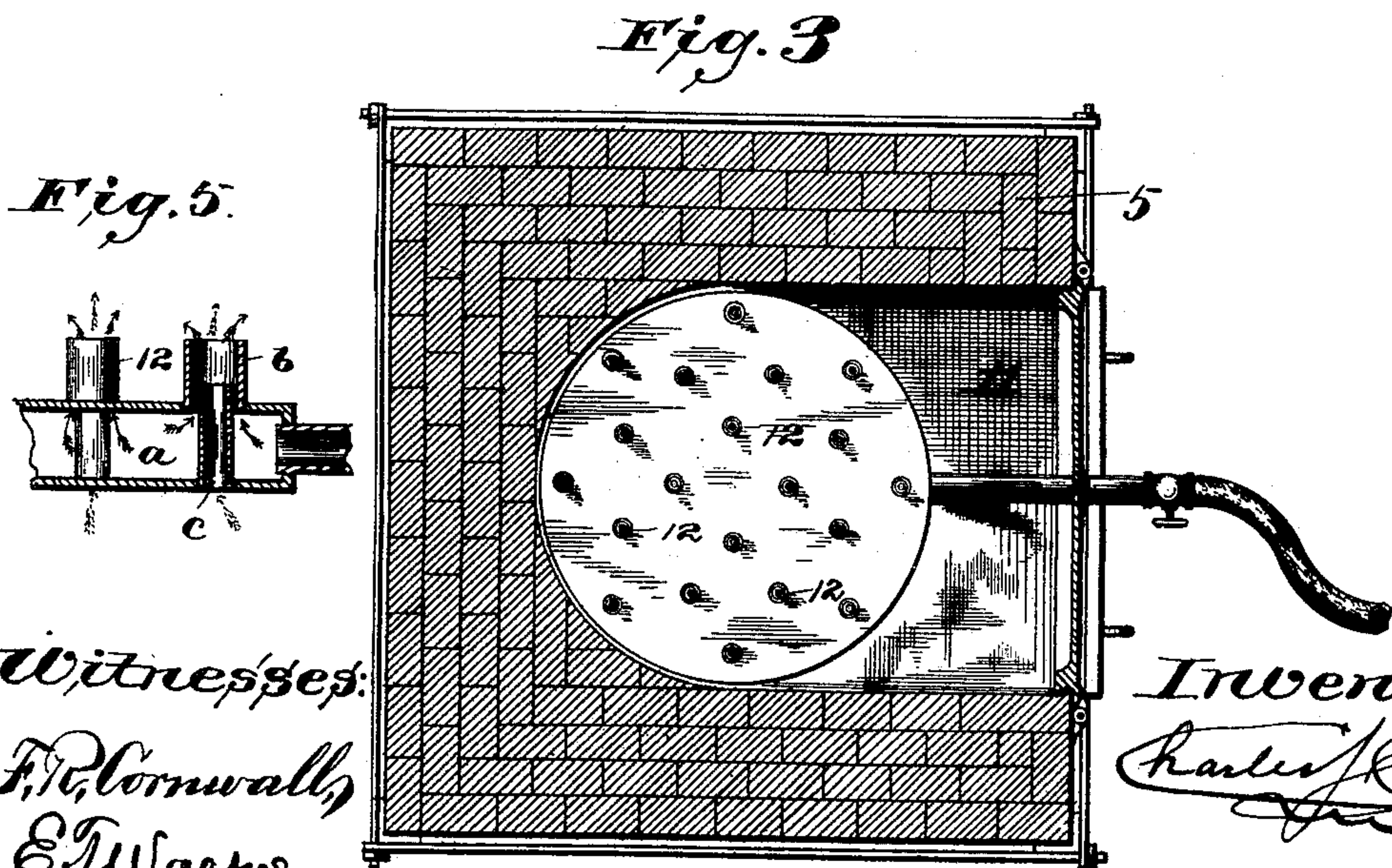
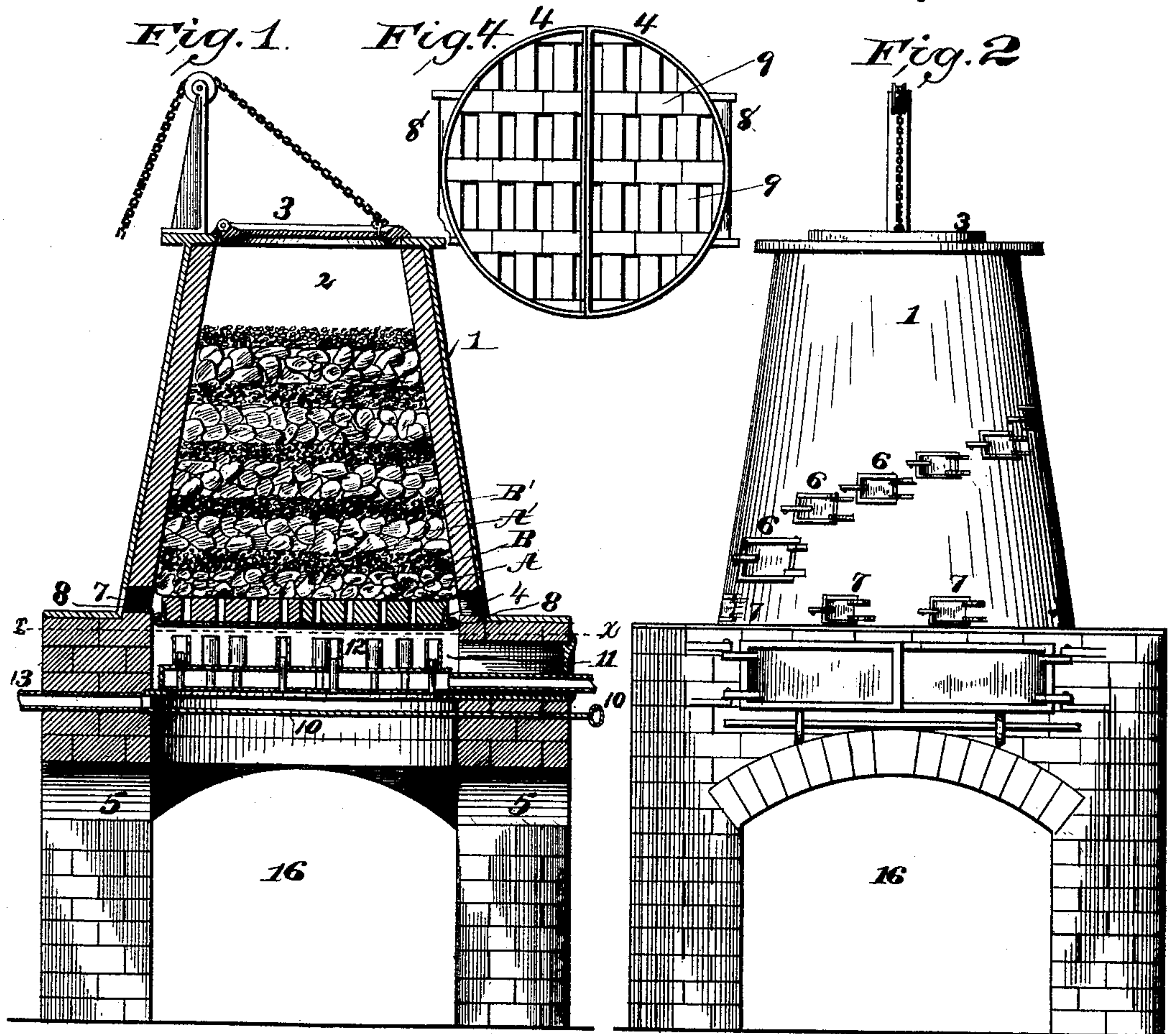


(No Model.)

C. J. EAMES.  
REDUCING STACK.

No. 407,000.

Patented July 16, 1889.



Witnesses:  
J. R. Cornwall,  
E. J. Warner

Inventor:  
Charles Eames



# UNITED STATES PATENT OFFICE.

CHARLES J. EAMES, OF NEW YORK, N. Y.

## REDUCING-STACK.

SPECIFICATION forming part of Letters Patent No. 407,000, dated July 16, 1889.

Application filed January 19, 1889. Serial No. 296,840. (No model.)

*To all whom it may concern:*

Be it known that I, CHARLES J. EAMES, a citizen of the United States, residing at New York city, in the State of New York, have invented certain new and useful Improvements in Reducing-Stacks for the Reduction of Iron and other Ores; and I hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, wherein—

Figure 1 is a vertical central section of a reducing-stack embodying my invention. Fig. 2 is an elevation of the reducing-stack. Fig. 3 is a horizontal section on the line *x x*, Fig. 1, showing the gas-burner and its chamber. Fig. 4 is a detached top or plan view of the drop-grate. Fig. 5 is a detail view of a portion of the burner.

Like symbols refer to like parts wherever they occur.

My present invention relates to the construction of stacks for the deoxidation or reduction of iron and other ores by such methods as utilize carbonic oxide or equivalent gases as the heat-conveying medium, and which bring the heated gases in direct contact with the material operated on.

It has for its object the production of an inexpensive stack which can be operated with either solid or gaseous fuel, or both, if desired, can be easily repaired, can be operated by unskilled labor, and whose output will equal, if not exceed, that of more expensive plants. While of value for the reduction of ores generally, it is particularly adapted for the reduction of iron ore where the strata processes (described by me in several applications of even date herewith) are followed.

To this end the main features of the present invention may be broadly stated as follows: First, in a stack for reducing ores, said stack having a damper at the top, a dumping-grate to discharge the contents of the stack, a closed chamber beneath the stack provided with means for controlling the draft through the grate and for cutting off said draft, and a series of air-ports at the base of the stack for maintaining low combustion above the grate; second, a reducing-stack closed below by a drop-grate, beneath which is a slide for forming a burner-chamber, within which

chamber is arranged a removable gas-burner or gas-supply; third, a reducing-stack provided at its base with a drop-grate the upper surface of which is lined with fire-brick, which forms a checker-work heat-storer; and, finally, there are other minor features of invention, all of which will hereinafter more fully appear.

I will now proceed to describe my invention more specifically, so that others skilled in the art to which it appertains may apply the same.

In the drawings, 1 indicates a tapering shell of plate or boiler iron or other suitable material, suitable proportions for which will be three feet diameter at the top, five feet diameter at the bottom, and five feet high, though any other desired proportions may be selected by the constructor, provided the stack is given sufficient taper to make it discharge freely when the grate is dropped.

In the walls of the stack 1 are a series of doors 6, arranged at different heights and preferably in step form, as shown in Fig. 2, which doors serve for introducing and spreading the charge or successive layers of the ore and carbon or reducing agents.

Encircling the base of the stack 1 are a series of air-ports 7, which may be closed by plugs of fire-brick or by doors, as shown in the drawings. These ports serve to admit air to support low combustion. This shell 1 is lined with fire-brick 2, provided above with a suitable damper 3 and below with a drop-grate 4. It is supported on suitable arches 5 of brick-work to obtain a pit 16, to receive the charge after treatment, and the arches should be of sufficient height to allow the workmen free access for removing the charge and resetting the grate 4.

The grate 4 is preferably a two-part drop-grate hinged at the sides, as shown at 8 8, and having its upper surface lined or faced with fire-bricks 9 9, (see Fig. 4,) which form a checker-work, which will become and remain highly heated. It will be noted that the grate 4 is in reality only a shell or frame for holding the checker-work 9 9.

Extending across the arch or base, which supports the stack 1, is a slide (or slides) 10, which, when the stack is in operation, (reduc-



ing the ore,) is pushed in to form a chamber 11, in which is located a gas-supply pipe and burner 12, and into the chamber 11 so formed a blast-pipe 13 delivers, so that an air-blast can be used whenever desired. By withdrawing slide 10 a natural draft for the stack can be obtained when desired. However, the blast is only used in cases of emergency to prevent scaffolding of the material, or sometimes to urge the fire before the material to be treated has been charged into the stack.

The natural draft is the one most commonly used to urge the fire in the preliminary heating of the furnace.

During the reducing operations the air-ports 7 at the base of stack 1 supply all the air which under ordinary circumstances is either requisite or admissible.

12 indicates a removable burner which, when in use, is introduced into chamber 11 through side doors 14, (see Fig. 2,) and through which doors it can be withdrawn previous to discharging the reduced charge into pit 16. This burner 12 is preferably made up of a series of Bunsen burners of the general character shown in Fig. 5, wherein *a* indicates the gas-box, *b* the gas-jet, and *c* a central air-tube, the full-line arrow indicating the course of the gas and the dotted-line arrow that of the air.

A reducing-stack having substantially the features of construction hereinbefore pointed out can be used for reducing ores of any character, wherein the passage of heated or heat-conveying neutral gases through the material operated on is practiced or is admissible; and the gases can be generated either in the lower stratum or fuel-bed or can be supplied from an external source through burner 12, (or other pipe,) and either oxidized in chamber 11 or in the checker-work 9 9.

When working with solid fuels to generate the carbonic oxide in the stack, a bed-layer A, of coke or any other suitable carbon, of considerable thickness, is placed on grate 4 and checker-work 9 9, and by means of suitable kindling and a blast or the natural draft brought to incandescence. When incandescent, a stratum or layer B of the ore to be reduced, mingled with the reducing agent, (the whole in the form of a granular mass,) is placed on the carbonaceous layer A and leveled off through the appropriate door 6. Upon the stratum B of ore to be treated is placed a second layer A' of carbon, and on that a sec-

ond layer B' of the ore to be treated, mixed with the reducing agent, the successive layers being leveled and their depth regulated through the appropriate doors. Thus the alternate layers A B are continued until the stack is filled to within a few inches of the top, when the treatment of the charge can be commenced.

The carbonic oxide for treating the ore can, as before specified, be generated by low combustion in the lower carbonaceous layer A by the admission of air in limited quantity through ports 7 7 at the base of the stack; or gaseous fuel can be admitted through pipes 12, and (after the first or preliminary heating of the stack and bed A) low combustion induced therein above grate 4 in checker-work 9 9 by admitting a limited amount of air through ports 7 7.

Having thus set forth the nature and advantages of my invention, what I claim, and desire to secure by Letters Patent, is—

1. A stack for reducing ores, having a damper at its top, a drop-grate at its bottom, a slide below the drop-grate, and a series of air-ports at its base just above the plane of the grate, substantially as and for the purposes specified.

2. A stack for reducing ores, having a dumping-grate at its base, a series of air-ports encircling the stack at its base, a slide arranged below said grate and forming a closed chamber beneath the grate, and a series of charging-doors arranged on successive levels, substantially as and for the purposes specified.

3. A reducing-stack having at its base a drop-grate provided with a facing or checker-work of fire-brick, substantially as and for the purposes specified.

4. The combination, with a reducing-stack having a drop-grate, of a detachable or sliding gas-burner arranged below the grate, substantially as and for the purposes specified.

5. The combination, with a reducing-stack having a drop-grate, of a removable or sliding burner arranged below the grate and a removable slide arranged below the burner, substantially as and for the purposes specified.

In testimony whereof I affix my signature, in presence of two witnesses, this 19th day of January, 1889.

CHARLES J. EAMES.

Witnesses:

E. T. WALKER,

F. R. CORNWALL.