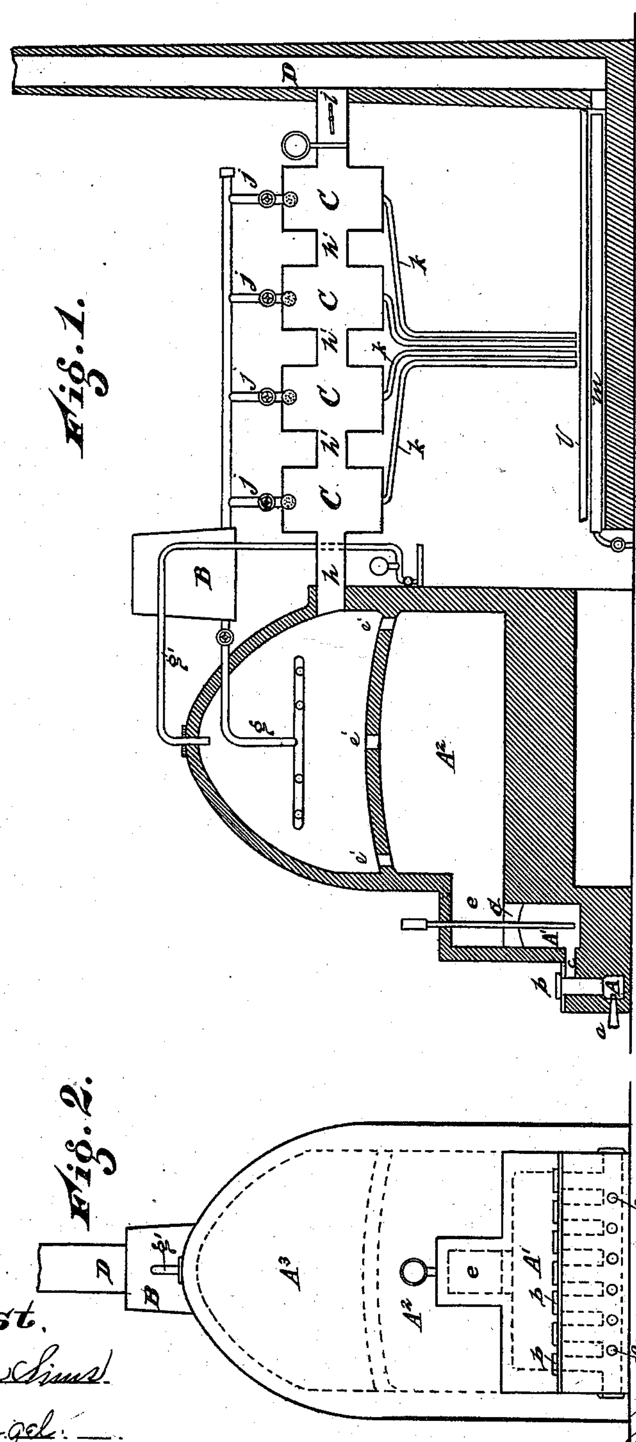
(No Model.) 2 Sheets—Sheet 1.

F. J. SEYMOUR.

FURNACE FOR REDUCING ALUMINUM.

No. 382,196. Patented May 1, 1888.



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(No Model.) 2 Sheets—Sheet 2.

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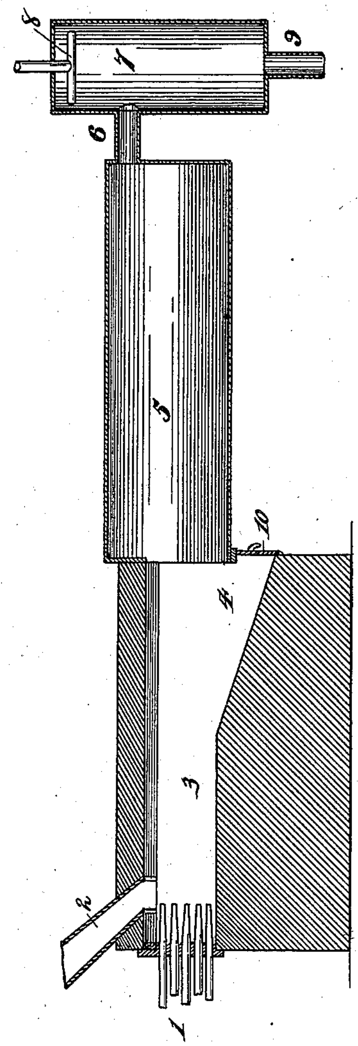
Fig. 3.



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UNITED STATES PATENT OFFICE.

FREDERICK J. SEYMOUR, OF FINDLAY, OHIO.

FURNACE FOR REDUCING ALUMINUM.

SPECIFICATION forming part of Letters Patent No. 382,196, dated May 1, 1888.

Application filed April 25, 1887. Renewed March 24, 1888. Serial No. 268,324. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK J. SEYMOUR, a resident of Findlay, in the county of Hancock and State of Ohio, have invented certain new and useful Improvements in Furnaces for Reducing Aluminum, of which the following is a specification.

My invention relates to an improvement for obtaining oxides of aluminum, of which the following is a specification, reference being had to the accompanying drawings.

The process herein described relates to the treatment of kaolin or other aluminous ore or earth in its natural condition by heat, making use of such fluxes as may be used to advantage in its reduction and concentration, and delivering it in the condition of an oxide from which metallic aluminum might be obtained, and which is always suitable for use in the manufacture of alloys of aluminum with other metals.

The accompanying drawings illustrate apparatus proper for the reduction of such oxides.

Figure 1 represents a longitudinal vertical section of the apparatus, and Fig. 2 represents an end view of the same. Fig. 3 represents a modification of the furnace shown in Figs. 1 and 2.

The reduction chamber or furnace A represented in this apparatus is represented as heated by gas supplied through burners *a a*, constructed on the blow-pipe principle. Each furnace may have six pipes for gas and thirteen pipes for air. The gas delivered through the burners into the furnace is under a pressure of one and one-half pound to the square inch. The air is delivered into the furnace under about the same pressure. The gas and air first come into contact at the point where combustion first takes place, and the force by which each is impelled carries the consuming gases and heat directly upon the ores under treatment. Both gas and air have their independent chamber and valves, and the proportion of each as delivered into the furnace is such as to make combustion perfect, and both are under complete control of the operator. The result of this arrangement insures an intense heat exactly upon the point in the furnace desirable to reach.

The reduction-chamber A of this furnace may be eighteen inches square and fifteen feet long, provided at its ends with openings having removable covers, for the purpose of raking out the débris after the mineral has been expelled from the ores, and is also provided at intervals extending along its entire length at its side surface with openings to admit the projection of the pipes or burners to a proper distance inside the outer wall of the furnace. Each burner, having its independent supply of gas and air and once adjusted, will run continuously for an indefinite length of time without changing the degree of heat attained in the furnace-chamber. The furnace is also provided at its upper side or floor, *b*, with adjustable openings at intervals for the admission of crucibles or ores for concentration, and also provided with appliances for lifting crucibles from the reduction-chamber when desirable to do so. Each of the openings, as before noticed, communicates directly with the reduction-chamber A below, and each is provided with a separate flue, *c*, and all communicate with a common heating-chamber, A′, which lies above and parallel with the reduction-chamber and is a part of the furnace construction, as described above. This heating-chamber A′ is thirty inches wide and thirty-six inches high and fifteen feet long, constructed so thoroughly as to be able to sustain as great heat as the reduction-chamber A below. The mineral vapors expelled from the ores and carried by the blast and natural draft into this heating-chamber A′ here become homogeneous and uniformly sublimated. This result is desirable, as the ores are fed into the reduction-chamber A below at somewhat irregular intervals. This heating-chamber A′ is provided at the top and center with single outlet *d*, which communicates by means of a flue, *e*, with a brick chamber, A^2. This chamber A^2 is fifteen feet in diameter and eight and one-half feet high. Its purposes are to reduce the heat and mineral vapors and to allow the vapors carrying the oxide of the minerals to become more homogeneous and better fitted for treatment by the reagents for precipitation, which are to follow. This chamber A^2 is provided with outlets *e′* at intervals through its arched top, which becomes the floor of a third chamber, A^3, with which it connects and communicates. This chamber A^3 is of brick and thoroughly built, and is fifteen feet in diameter and ten and one-half feet high and cone-shaped. The heat and vapor coming from the chamber A^2 below through the arched floor are met in this chamber A^3 by a spray of a weak solution of carbonate of potash from a tank, B, through a pipe, *g*, with a number of branches, through which the said solution is forced in a spray produced by any known or suitable means. Another pipe, *g'*, communicates with the said chamber A^3 at the top for the double purpose of introducing the hydrates of ammonia or other reagents among the contained vapors and for attaching a pressure-gage. This cone-shaped chamber A^3 is also provided with an outlet-pipe, *h*, somewhat below the center of its altitude, twenty inches in diameter, which connects with a series of thin copper cylinders, C C, of six-feet diameter and five feet in length. These copper cylinders are placed at intervals about six feet apart, and connections made with each by a continuation, *h'*, of the twenty-inch pipe *h*. This pipe *h'* extends beyond the copper cylinders and into a chimney, D, for the escape of superfluous material, if desired. The outlet-pipe *h'*, near the chimney, is provided with a damper, *i*, or means for shutting off or checking the escape of any material that would be desirable to save, thus enabling the operator to hold in check the product continually coming from the reduction-furnace and to operate the whole process on the retort or distillation principle.

The copper cylinders or condensers C C are each provided at their extreme upper diameter with inlet-pipes *j j*, which project inside the cylinder, and to which are attached perforated bulbs or sprayers for the purpose of filling the inside of the copper cylinders with water in a mist or spray, carrying a reagent to make complete the precipitation of mineral carried in the heat and vapors coming continually from the reduction-furnace A.

This system of reduction and these appliances enable the operator to bring the heated and sublimated oxides that are liberated from the ores by the reduction-furnace through a series of cooling and condensing chambers, and by these means bring their temperature down to nearly the normal condition of the atmosphere, and include the opportunity to make complete precipitation of the mineral carried in the ores under treatment. The copper condensing-cylinders are also provided at the extreme point of their lower diameter with outlet-pipes *k k*, through which are carried automatically the flow of water and condensed mineral down into vaporizing and drying pans *b*. These pans are twenty feet long, five feet wide, and five inches deep.

The flow of water and oxide coming from the condensing-cylinders into the vaporizing-pans comes directly over and into contact with heat supplied by gas-burners *m* under the pans *b*, and at such degree as will vaporize the water from the mineral which is continually coming from the condensing-cylinder about as rapidly as will keep the vaporizing-pans from overflowing. This enables the operator to make his runs of the furnace of such length as to result in economy in the gathering of matters which are evolved from the reducing-chamber A and converted into a dry oxide. This process may be rapid or slow, according to the degree of heat applied at the reduction-furnace and to the amount of cooling material and reagents through which the liberated mineral vapors are compelled to come in contact in their transmission through the various stages of cooling and precipitating. This process will deliver the oxide nearly chemically pure and in such condition as to be readily absorbed by metals in a molten condition—notably iron, steel, copper, tin, zinc—making an alloy with those metals and greatly increasing their good qualities. The features of using these oxides as alloys are made the subject-matter of an application filed of even date herewith, and styled "Case 5," and numbered 235,963. In describing the furnace shown on Sheet 1 I have given dimensions simply to illustrate the proper proportions of the parts. I do not wish to confine myself to any particular form or proportion, except where such form or proportion is specifically named as a feature of the claims.

To illustrate the variations in form which may be made, I have shown one modification on Sheet 2 which operates on the same principle as the furnace already described.

1 represents a set of burners; 2, a feeding-chute; 3, the combustion and vaporizing chamber; 4, a slow-cooling flue; and 5, a cooling or condensing cylinder, preferably made of copper for more rapidly cooling the vapors of aluminum and zinc carried along through the same.

6 represents a flue connecting condenser 5 with condenser 7.

8 represents a spraying-pipe for introducing water or other cooling medium into the condenser and mingling the same with the metallic vapors, so as to rapidly condense and deposit the same.

9 represents a conduit for carrying out condensed material.

10 represents a door or opening into the flue 4 for allowing the removal of slag.

If water is used to precipitate the vapors in condenser 7, it is of course expelled from the oxides by evaporation to dryness below, of course, the melting-point of zinc.

In constructing a furnace it is desirable to have the cooling, after the vapors leave the reducing-chamber, sufficiently slow so that the silicon may be deposited by condensation at a point above which the metal vapors will condense, and a considerable length of flue or slow-cooling chamber is required to make a perfect separation of these vapors.

Either of the above-described furnaces, with their condensing-chambers, may be used in the reduction of alumina and its separation by zinc from other elements with which it is naturally associated by a continuous process which is at once cheap and efficient.

It will be readily understood that this process of vaporization is simpler and more rapid by reason of the direct contact of the metal with the incandescent products of combustion at a degree of heat high enough to vaporize the charges; but this direct contact of the products of combustion with the charge is not indispensable, as of course radiant heat will do the work, though not so economically. I do not, therefore, limit myself exclusively to such a construction of the furnace, except in clauses of claim where this direct contact is made a feature of invention.

I claim—

1. The combination of the reducing-chamber provided with means for supplying air, gas, and ores, the gas and vapor exit flue leading from the same, the heating-chamber for the blending and expansion of gases, an exit-flue leading from said chamber, the cooling-chamber, and the superposed chamber provided with a spraying device communicating with said cooling-chamber, all combined substantially as and for the purpose specified.

2. The combination of the reducing-chamber provided with means for supplying air, gas, and ores, the gas and vapor exit flue leading from the same into a chamber for the blending and expansion of gases, the said chamber, an exit-flue leading from said chamber, the cooling-chamber, the spraying-chamber communicating with said cooling-chamber, and a condenser provided with spraying device, all combined substantially as and for the purpose specified.

3. The combination of the reducing-chamber provided with means for supplying air, gas, and ores, the gas and vapor exit flue leading from the same, the heating-chamber, an exit-flue leading from said chamber, the cooling-chamber, the superposed chamber provided with spraying device, the condenser provided with spraying device, and discharge-pipes and evaporating-pan.

In testimony whereof I have hereunto set my hand.

FREDERICK J. SEYMOUR.

Witnesses:
JAS. A. BOPE,
E. E. WOOD.