

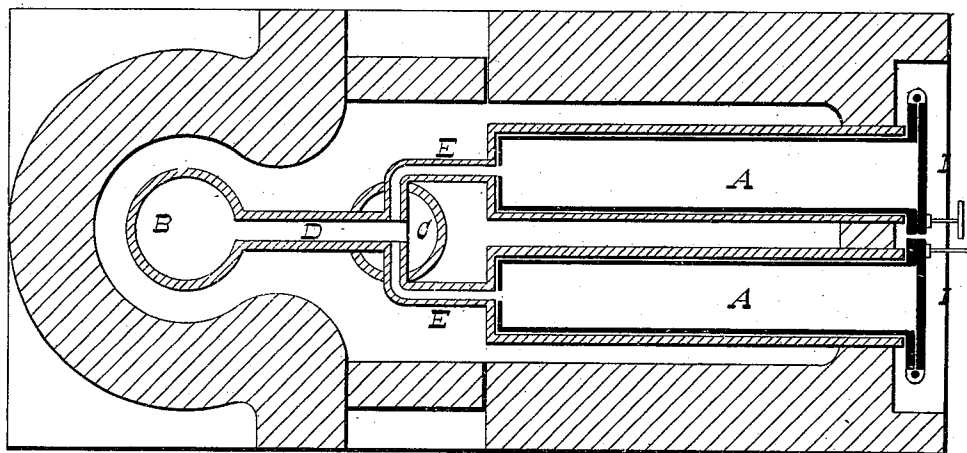
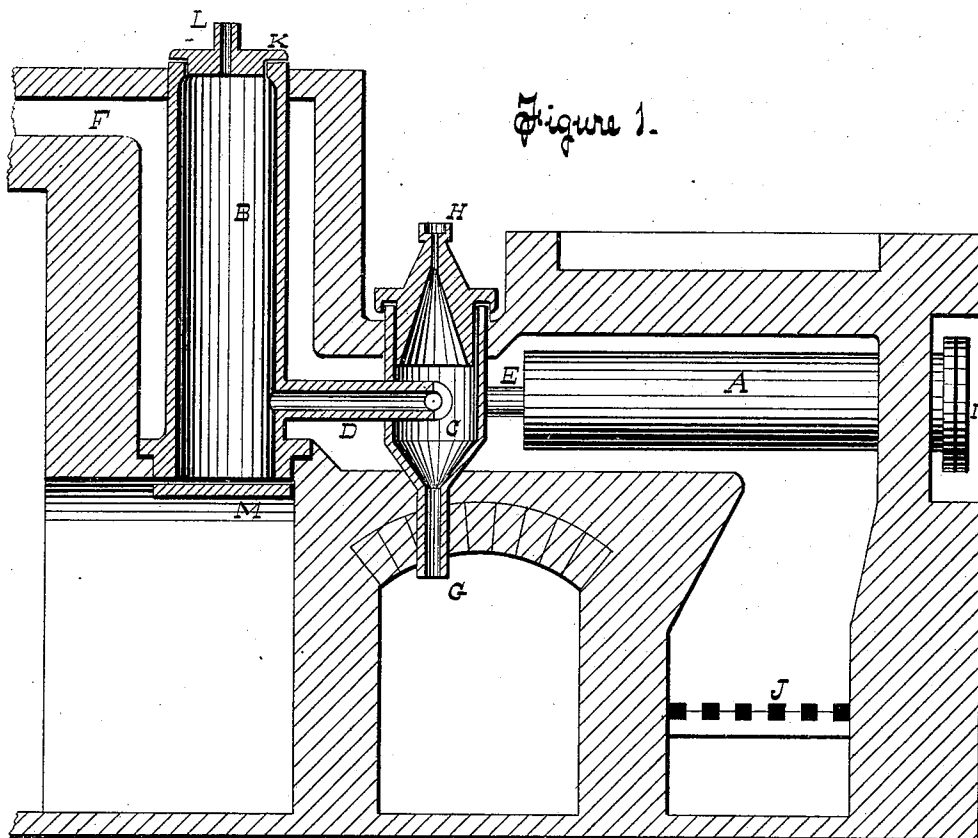
(No Model.)

W. FRISHMUTH.

PROCESS OF EXTRACTING THE METAL ALUMINIUM.

No. 308,152.

Patented Nov. 18, 1884.



Witnesses

Emerson Foote
Francis B. Crocker.

Figure 2.

Inventor

William Frishmuth.
by J. M. Blanchard.
Attorney.

UNITED STATES PATENT OFFICE.

WILLIAM FRISHMUTH, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO HIMSELF, GEORGE R. BLANCHARD, AND EMERSON FOOTE, BOTH OF NEW YORK, N. Y.

PROCESS OF EXTRACTING THE METAL ALUMINIUM.

SPECIFICATION forming part of Letters Patent No. 308,152, dated November 18, 1884.

Application filed December 5, 1883. (No model.) Patented in England October 16, 1883, No. 4,930.

To all whom it may concern:

Be it known that I, WILLIAM FRISHMUTH, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented or discovered certain new and useful improvements in process of extracting the metal aluminium from alumina, corundum, bauxite, clay, and other ores and compounds of the metal; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to use or practice the same.

Heretofore the practiced method of obtaining metallic aluminium—as described, for instance, in Watts' Dictionary of Chemistry, Vol. I, page 150—has been to treat the chloride of the metal with metallic sodium as a reducing agent; but the great trouble in handling metallic sodium and the high cost of that metal have made this process for producing aluminium very difficult and expensive, the price of aluminium being up to the present time as high as that of silver.

I have already invented several processes whereby the difficulties and expense attending the use of metallic sodium are gotten rid of. These inventions are described and claimed in Letters Patent Nos. 282,621 and 282,622, (process for extracting aluminium,) granted to me August 7, 1883, and in an application filed by me in the Patent Office August 6, 1883, Serial No. 105,763. In the first of these I set forth the use of sodium vapor produced by heating a mixture of a sodium salt and carbon or other reducing agent in a suitable retort or furnace, said vapor passing over into a second retort, where it acts upon chloride of aluminium or the double chloride of aluminium and sodium mixed with carbonaceous material and heated to a high temperature. The second patent differs from the first in the substitution of fluoride of aluminium, or the double fluoride of aluminium and sodium instead of the chloride or double chloride. The process set forth in the third application is an improvement upon the two former in so far as the necessity for mixing carbonaceous material with the aluminous material is obviated and the process thus simplified.

My present invention differs materially from the process heretofore generally employed for obtaining aluminium, (as given in Watts' Dictionary, &c.) It also differs from other processes practiced or described up to the present time, and is an improvement upon my previous inventions.

It consists in simultaneously generating sodium vapor and a volatile compound of aluminium in two separate vessels or retorts, and in mingling the vapors thus obtained in a third vessel, wherein they react upon each other, producing metallic aluminium, which is precipitated upon the bottom of the vessel. A form of furnace which I have found to work very well is shown in plan and vertical section in the accompanying drawing; and it consists of three retorts, A A and B, and a receiver, C, set in brick-work. The pair of retorts A A are for the production of the sodium vapor. They are made of iron, preferably wrought, and are placed horizontally side by side immediately over the fire, which is upon the grate J. The ends I I of these retorts are provided with doors, through which the mixture to produce the sodium vapor is charged and the residue withdrawn after it is worked out. These doors are fitted with clamps, &c., so that they may be closed perfectly tight. From the other ends of these retorts two tubes, E E, lead into the receiver C. The receiver C is a vertical cup shape vessel made of fire-clay, and having a cover, H, through which there is a small sight-hole. The bottom of C is in the form of an inverted cone, and from the apex of the cone a pipe, G, leads directly downward. B is the vertical retort in which the chloride of aluminium vapor is generated. It is made of fire-clay, and has a cover, K, through which passes a tube, L. The cover K is removable to allow of the charging of the aluminous material. The bottom plate, M, is arranged also that it may be withdrawn. B is connected by a tube, D, to the receiver C. The products of combustion of the fire first heat the two retorts A A, then the receiver C, and finally the retort B. Thence they pass to the chimney through the flue F.

In practicing my newly-described process

the aluminous material may be converted into any of the volatile compounds of aluminium; but I prefer to convert it into the form of the double chloride of aluminium and sodium, and in describing in detail how my invention is carried out I shall describe the process in which this double chloride is used. To this end I take the aluminous material, which may be alumina, corundum, bauxite, or other suitable aluminous substance, and calcine it. Of this calcined mass I take, say, one hundred pounds, and grind it to a fine powder, and mix it with about fifty pounds of chloride of sodium and about the same amount of carbonaceous material. For this last purpose I have found that equal parts of starch and powdered charcoal, or oil and powdered charcoal, give good results. To the mixture of aluminous and carbonaceous materials, with chloride of sodium, is added sufficient water to bring the same to a pasty condition. It is then made into cakes or balls and dried. The dried cakes or balls are then put into a suitable retort, wherein they are heated to redness, and at the same time a stream of chlorine gas is passed through the retort, so as to penetrate all through the material contained in it. The action of chlorine upon the aluminous material in the presence of chloride of sodium results in the formation of the double chloride of aluminium and sodium. The simple chloride of aluminium might be made and used instead of the double chloride by not mixing the chloride of sodium with the aluminous material; but I prefer to use the double chloride. This double chloride vaporizes as fast as produced, and passes over through a tube into a properly constructed vessel, chamber, or receiver. Sodium vapor also enters this same chamber through a second tube, said sodium vapor being generated by heating a mixture of carbonate of soda or other suitable compound of sodium with charcoal or other reducing agent in another retort similar to that in which the double chloride is produced, the proportion of carbonate of soda or its equivalent to charcoal or its equivalent being two of the former to one of the latter, by weight. The two vapors—the sodium vapor and the double chloride of aluminium and sodium vapor—meeting in the chamber react upon one another, forming metallic aluminium and chloride of sodium. The metal falls to the bottom of the chamber and collects there in the form of globules. The chloride of sodium condenses, and also collects upon the bottom, and it serves as a slag to protect the globules, and as a flux to unite them. If desired, additional flux—such as chloride of potassium, cryolite, &c.—may be put into the chamber. The globules of metal may be removed from the bottom of the chamber from time to time and melted together in large crucibles and cast into ingots. It is well to have more than one retort for generating the double chloride vapor, for in this way the flow of the two vapors may be made continuous, one or more retorts being always kept work-

ing while the others are being charged. These retorts, as well as the chamber in which the vapors are brought together, may all be placed in one furnace and heated by the same fire. In that case the retorts would receive the first heat of the fire and the chamber would be heated by the products of combustion after leaving the retorts.

I have described what I have found by experiment to be the best way of carrying out my invention; but I desire it to be understood that I do not confine myself to the use of the double chloride of aluminium and sodium. The given aluminous material, alumina, bauxite, &c., might be converted into any other compound of aluminium capable of being vaporized—as, for example, the double chloride of aluminium and potassium, the simple chloride of aluminium, the fluoride of aluminium, or the double fluoride of aluminium and sodium or potassium, &c. It is also evident that potassium vapor could be employed in place of sodium vapor.

As above described, the vapor of the double chloride of aluminium and sodium passes directly from the retort in which it is generated into the vessel wherein the reaction takes place, and the same is true of the sodium vapor, and herein lies the essential feature of my invention—*i. e.*, that the two substances which react upon each other in the vapor form are in the nascent state. They have just been generated by the chemical reaction of suitable materials in contradistinction to having been produced by vaporizing the substances themselves previously made by separate processes.

I am aware that one Knowles, in English Patent No. 1,742 of 1857, describes a process by which metallic aluminium can be produced by subjecting chloride of aluminium to the action of cyanide of sodium as a reducing agent, and said Knowles states that the two substances may be combined either in the melted or vaporized states. It is obvious that he intends taking the two solid substances already made by separate processes, and then melting them or vaporizing them as a convenient way to combine them. This differs from my process for the reasons set forth in the preceding paragraph.

My invention, broadly stated, consists in combining the aluminous material to be reduced and the reducing agent both in vapor form in a proper chamber, said vapors being generated in two separate retorts or in two separate sets of retorts; but my invention does not consist in using any particular aluminous material, or any particular volatile compound of aluminium, or in any particular way of making such volatile compound.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The process of producing metallic aluminium, which consists in simultaneously generating sodium vapor and a volatile com-

pound of aluminium in two separate vessels or retorts, and in mingling the vapors thus obtained in the nascent state in a third vessel, wherein they react upon each other, substantially as described.

5 2. The process of producing metallic aluminium, which consists in mingling, in a chamber or receiver sodium vapor and a compound of aluminium, also in vapor form, said sodium
10 vapor being obtained in the nascent state by heating in a separate vessel or retort a mixture of a sodium compound with charcoal or other reducing agent, and said aluminous vapor being simultaneously produced in the nascent
15 state in another vessel or retort from aluminous material.

3. The process of producing metallic aluminium, which consists in simultaneously generating sodium vapor and the chloride or
20 fluoride of aluminium, also in vapor form, in two separate vessels or retorts, and in mingling the two vapors thus obtained in the nascent state in a third vessel, wherein they react upon each other, substantially as described.

25 4. The process of producing metallic aluminium, which consists in simultaneously gen-

erating sodium vapor and the double chloride of aluminium and sodium, also in vapor form, in two separate vessels or retorts, and in mingling the two vapors thus obtained in the nascent state in a third vessel, wherein they react
30 upon each other, substantially as described.

5. The process of extracting metallic aluminium from its ores or compounds, which consists in converting such aluminous material
35 into the form of vapor by heating it in a vessel or retort with chloride of sodium and at the same time subjecting it to the action of a stream of chlorine gas, and in mingling in a chamber or receiver the vapor of the double chloride
40 of aluminium and sodium thus obtained with sodium vapor simultaneously generated in another vessel or retort by heating a mixture of carbonate of soda and carbon, substantially as described.

Signed and witnessed this 18th day of September, 1883.

WILLIAM FRISHMUTH.

Witnesses:

EMERSON FOOTE,
CLEAVELAND FOOTE.