

UNITED STATES PATENT OFFICE.

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TREATMENT OF TITANIFEROUS IRON ORES.

995,576.

Specification of Letters Patent.

Patented June 20, 1911.

No Drawing.

Application filed December 10, 1907. Serial No. 405,878.

To all whom it may concern:

Be it known that I, ALF SINDING-LARSEN, a subject of the King of Norway, residing at Christiania, Norway, have invented certain
5 new and useful Improvements in the Treatment of Titaniferous Iron Ores; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art
10 to which it appertains to make and use the same.

My invention relates to the treatment of titaniferous iron ores and consists in a combined process, whereby I obtain from titaniferous iron ore valuable products at so low
15 costs that a remunerative industry may be established thereon.

It is a well known fact that titaniferous iron ore has not heretofore been in high repute, firstly because said ore is stubborn and gives refractory slags, and secondly because
20 titanic acid, which in most titaniferous ores constitutes one of the principal component parts, and which if the process is to be remunerative, must also yield a salable product, has not hitherto been so largely utilized that any considerable quantities thereof
25 could be sold, and thirdly, because the content of titanium in the iron produced, has proved to have a bad influence on the iron—most likely on account of its being instrumental to the absorption of nitrogen.

My process which is performed in two principal operations, has, in short, for its
35 object to produce from titaniferous iron ore an iron free from titanium and nitrogen, and also to produce titanium nitrogen compounds. The iron or steel produced in accordance with the said process will be largely possessed of the properties required
40 in a first class iron, and the titanic nitrid obtained as a by-product may be used either unmixed or with the addition of other substances, as a nitrogen fertilizer, or may form the fundamental material for the production
45 of other nitrogen compounds, which will materially tend to render the process economically profitable.

The different steps of the process are as follows:

(1) The titaniferous iron ore is subjected to reduction in an electric furnace, either:
55 (a) in one operation to obtain an iron alloy containing much titanium, or (b) in two operations, the iron being first reduced using a basic slag bath, whereby the titanic acid

goes into the slag, forming titanates, which are thereupon reduced separately for titanium.

(2. a) If the process (1. a) is employed, the titanic iron thus obtained is submitted to treatment with nitrogen in a converter or the like. The titanic nitrid obtained thereby is discharged as a product, while the iron thus freed of the greater part of the titanium contained in it is submitted, in the same or some other converter, to a treatment with a current of superheated steam. By this treatment the titanium-nitrogen compounds—the titanium nitrogen-carbon compounds, the iron-nitrogen compounds, and, it may be, the iron-nitrogen-carbon compounds, contained in the iron, will be decomposed, the resulting product being an iron entirely free from titanium and nitrogen. (If it is then desired to submit the iron to usual bessemerizing with a blast of air in order to oxidize impurities such as sulfur, silicon, etc., this may, as a matter of course, be done in the same converter, if such converter has beforehand been adapted, or lined for the purpose).

(b) On the other hand, if the process (1. b) is made use of, the iron is at once treated with steam in the converter, while the titanium separately obtained, (it may be in the form of an alloy more easily fusible,) is submitted to nitrogen-treatment in a special converter, thereby obtaining the same products as by the method described under (2. a), an iron free from nitrogen and titanium, and titanic nitrid. The gaseous nitrogen compounds (ammonia, cyanogen, etc.) obtained by the steam bessemerizing, if produced in any large quantities, may, of course, be absorbed and utilized.

The titanic nitrid, obtained as a by-product by this process may, as already mentioned, be utilized directly as a fertilizer; it should then be in the form of a powder and there may, to facilitate its sale, be added to it other fertilizers, such as for instance, phosphates of lime or nitrates, etc. The titanic nitrid may also form the elementary material for the production of nitrous gases and by way of the latter for nitric acid and all compounds derived therefrom, treating it with higher, easily reducible oxids thereby obtaining nitrogen oxids, titanic acid and the reduction product of the higher oxid employed.

As the titanic acid and the titanium itself

have very high melting points it is advantageous, when reducing the titanic acid separately, to add to the charge some other material such as copper, lead or the like, with which the titanium forms a more easily fusible alloy or an oxid of such a metal. If it is desired to obtain the titanium perfectly pure, a volatile metal such as lead for example or an oxid of such metal is added to the charge. After the reduction process this additional metal is then removed from the titanium by distillation.

The converters for the operation described above may be electrically heated being in that case constructed as electric induction- or resistance-furnaces.

I believe to have by the method described above invented a process by which titaniferous iron ore is enabled not only to obtain the same but even a higher value than the iron ores commonly used, and which will enable an extensive metallurgic and chemical industry to be based on it.

I claim:—

1. The method of treating titaniferous iron ore, comprising reducing the ore to crude metal, then transforming nearly all of the titanium into titanic nitrid by treating it with nitrogen, separating metal and slag and subsequently submitting the iron, still containing some titanium residue, to bessemerizing with superheated steam, in order to obtain an iron free from titanium and nitrogen.

2. The method of treating titaniferous iron ore, comprising reducing the ore in an electric furnace and transforming the titanium obtained to an easily fusible alloy, then transforming nearly all of said titanium into titanic nitrid by treating the alloy with nitrogen, submitting the resulting titanium-carrying iron to bessemerizing with superheated steam to remove the titanium residue in order to obtain an iron free from titanium and nitrogen.

3. The method of treating titaniferous iron ore, consisting in reducing the ore, submitting the titanium iron alloy obtained by the reduction to a treatment with nitrogen, and the iron resulting therefrom to a bessemerizing with superheated steam.

4. The method of treating titaniferous

iron ore, which comprises reducing the ore to crude metal in a basic furnace, separating metal and slag, and bessemerizing the metal with steam to remove the titanium.

5. The method of treating titaniferous iron ore, which comprises reducing the ore to crude metal, then transforming nearly all the titanium into titanic nitrid by treating it with nitrogen, and subsequently bessemerizing the iron with superheated steam to cause the remaining titanium residue to pass into the slag and separating the metal and slag.

6. The method of treating titaniferous iron ore, which comprises reducing the ore to crude metal, transforming nearly all of the titanium into titanic nitrid by treating it with nitrogen, bessemerizing the iron with superheated steam to cause the remaining titanium to enter the slag, separating metal and slag, and absorbing the nitrogen compounds formed during the bessemerizing in a suitable absorbent.

7. The method of treating titaniferous iron ore, which comprises reducing the ore to crude metal, then transforming nearly all of the titanium into titanic nitrid by treating it with air and causing the titanium nitrid to enter the slag, and subsequently bessemerizing the iron with superheated steam to cause any remaining titanium to pass into the slag and separating metal and slag.

8. The method of treating titaniferous iron ore, which comprises reducing the ore to crude metal, transforming nearly all of the titanium into titanic nitrid by treating it with air, bessemerizing the iron with superheated steam to cause the remaining titanium to enter the slag, separating the metal and slag and absorbing the nitrogen compounds formed during the bessemerizing in a suitable absorbent.

In testimony that I claim the foregoing as my invention, I have signed my name in presence of two subscribing witnesses.

ALF SINDING-LARSEN.

Witnesses:

HENRY BORDEWICH,
AUG. OLSEN.