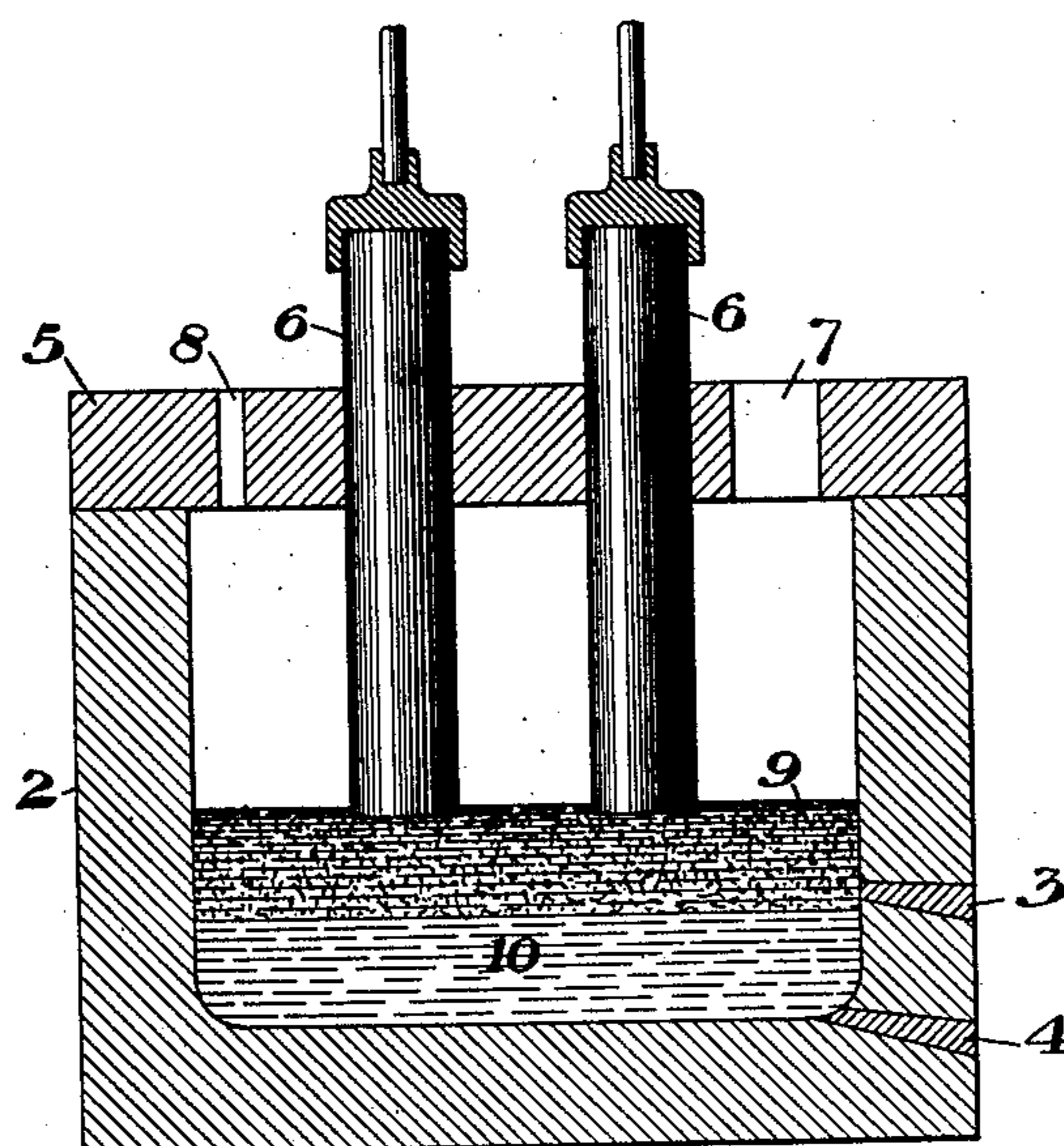


No. 842,273.

PATENTED JAN. 29, 1907.

F. J. TONE.  
PROCESS OF REDUCING COMPOUNDS.  
APPLICATION FILED DEC. 16, 1905.



WITNESSES

Warren W. Swartz  
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INVENTOR

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his atty

# UNITED STATES PATENT OFFICE.

FRANK J. TONE, OF NIAGARA FALLS, NEW YORK.

## PROCESS OF REDUCING COMPOUNDS.

No. 842,273.

Specification of Letters Patent.

Patented Jan. 29, 1907.

Application filed December 16, 1905. Serial No. 292,038.

*To all whom it may concern:*

Be it known that I, FRANK J. TONE, of Niagara Falls, Niagara county, New York, have invented a new and useful Process for  
5 Reducing Compounds, of which the following is a full, clear, and exact description, reference being had to the accompanying drawing, forming part of this specification, in which the figure is a vertical section showing  
10 one form of electric furnace for carrying out my improved process.

My invention relates to the use of electric furnaces in forming silicids of metals, in reducing silicon compounds, and in reducing  
15 ores of metals.

While the process is especially applicable to and advantageous in the reduction of silicious ores and the forming of silicids and alloys of silicon, at the same time it is also  
20 applicable to the reducing of ores generally and to the making of alloys of silicon either from ores, metals, or metal compounds. The specific compounds to be reduced or combined which I describe herein are selected  
25 as types of my process, and the invention is not limited thereto.

If in the manufacture of silicids, such as the silicids of manganese, a charge of silica, oxid of manganese, and carbon is heated in  
30 an electric-arc furnace of the type commonly employed for such purposes, an alloy or compound of silicon and manganese is obtained; but the loss of both silicon and manganese by vaporization is great, and such method is  
35 therefore objectionable. I have discovered that this loss can be largely prevented by using an electric furnace with a fused bath comprising the ore, compound, or metal, with a reducing agent and solvent or flux,  
40 such as lime or fluor-spar. This bath is interposed as a resistance-conductor between the terminals of the electric furnace, and thereby the reduction is accomplished with little or no volatilization or loss of metallic  
45 product.

In carrying out my improved process for the obtaining of manganese silicid as an example of the process I may use the crucible 2, (shown in the figure,) which is made of  
50 suitable refractory material and may be provided with two tap-holes. The upper tap-hole 3 is used for removing the slag and the lower tap-hole 4 for drawing off the product. The cover 5 is provided with holes  
55 through which extend the two electrodes 6 6, having the usual connections for electric cur-

rent. The cover or roof is also preferably provided with a charging-hole 7, which may or may not be provided with a cover, and a gas outlet or vent 8.

When manganese and silicon are to be combined, the charge is preferably made up of manganese ore, such as manganese dioxid, and silica, carbon, and lime. For this mixture I have found the following proportions  
60 to give successful results: thirty-eight parts of silica, twenty-four parts of manganese and dioxid, twenty-one parts of carbon, and seventeen parts of lime. This charge being introduced into the crucible is heated by the  
65 electric current and melted to form a fused bath. The lower ends of the electrodes 6 6 are immersed in this bath, through which the circuit is completed. The heat generated by the resistance which the bath offers to the  
70 passage of the current is sufficient to accomplish the reaction, and the metal or alloy settles in the bottom of the receptacle as the layer marked 10, the slag overlying the metal, as shown at 9. The metal may then be  
75 tapped off, as desired, through the lower or metal tap-hole.

If metallic silicon is to be produced, the silicious ore, with a suitable reducing agent and flux, is introduced into the furnace, as  
80 above described, and treated in the same manner.

In the manufacture of the silicids or silicon compounds the metal itself may be used instead of its oxid or other ore. For example, a  
85 silicid of iron and manganese may be obtained by using a charge of ferromanganese, silica, carbon, and flux.

The advantages of my invention result from the saving in product, since there is  
90 little or no loss from vaporization or otherwise during the reduction.

Various changes may be made in the form and arrangement of the furnace, the ores, metals, reducing agents, and fluxes, as well  
100 as in the proportions, without departing from my invention.

I claim—

1. The method of reducing silicon compounds, consisting in forming a fused bath of  
105 the compound, together with a reducing agent and a flux, interposing the fused bath as a resistance-conductor between electrodes, and reducing the compound; substantially as described.

2. The process of forming silicids, consisting in forming a fused bath containing a  
110

silicon compound, metalliferous material, a reducing agent and a flux, interposing such bath as a resistance-conductor between the electrodes of an electrical furnace, passing  
5 sufficient current through the bath to reduce the compounds and form a silicid, and collecting the silicid; substantially as described.

3. The process of making manganese silicids, which consists in interposing as a re-  
10 sistence-conductor between the electrodes of an electric furnace a fused bath composed of a silicon compound, manganese ore, a reducing agent and a flux, passing sufficient current through said bath to reduce the silicon  
15 and manganese compounds to form a manganese silicid, and collecting said silicid; substantially as described.

4. The process of making silicid of manganese and iron, which consists in interposing  
20 as a resistance-conductor between the electrodes of an electric furnace a fused bath composed of a silicon compound, ferroman-

ganese, a reducing agent and a flux, passing sufficient current through said bath to reduce the silicon compound and cause it to unite  
25 with the ferromanganese, thereby forming a silicid of iron and manganese, and collecting said silicid; substantially as described.

5. The method of reducing silicon compounds, consisting in forming a fused bath of  
30 a mixture of the compound with a reducing agent and a flux, interposing the fused bath as a resistance-conductor between electrodes, passing sufficient current through the bath to reduce the compound and form a silicid  
35 without substantial volatilization, and collecting said silicid; substantially as described.

In testimony whereof I have hereunto set my hand.

FRANK J. TONE.

Witnesses:

JOHN MILLER,  
H. M. CORWIN.