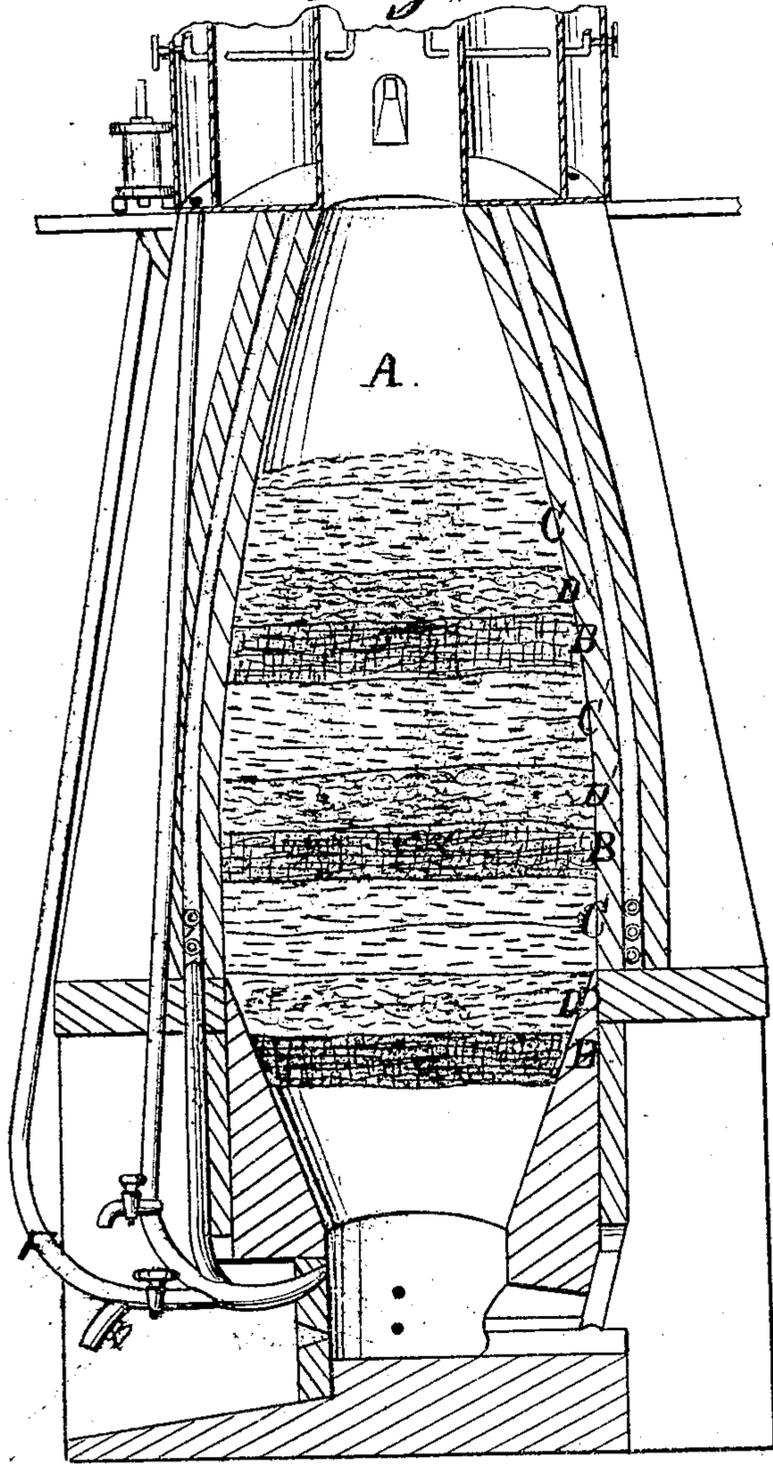


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*Impts in making Iron*  
*Fig. 1.*

PATENTED  
DEC 3 1867



*Witnesses*  
*James P. McLean*  
*Wm. Wright*

*O. W. Duckworth*  
*Inventor.*

# United States Patent Office.

DAVID W. HENDRICKSON, OF NEW YORK, N. Y.

*Letters Patent No. 71,754, dated December 3, 1867.*

## IMPROVEMENT IN THE MANUFACTURE OF IRON.

*The Schedule referred to in these Letters Patent and making part of the same.*

### TO ALL WHOM IT MAY CONCERN:

Be it known that I, DAVID W. HENDRICKSON, of the city, county, and State of New York, have invented a new and useful Improvement in the Smelting or Manufacturing of Iron, suitable for converting or making into steel by the Bessemer process, direct from the furnace; and I hereby declare the following to be a full and exact description thereof, reference being had to the accompanying drawings, which are lettered to correspond with and form a part of the specification.

In order that the public may fully understand the nature of my invention, and those skilled in the manufacture of iron be enabled to use the same, I will describe it as follows, to wit:

My improvement consists in placing zinc or manganese, or both, in the natural metallic state, or as an oxide, or as in the Franklinite ores of New Jersey, United States, or as combined in any zinc or zinciferous oxides or ores, in the furnace, to be used with magnetic, brown, or red hematites, bog or specular iron ores, with any suitable flux, and with anthracite or bituminous coal, brown lignite, peat, or charcoal, as a fuel, in combination with a compound blast of superheated steam and hot or cold air, to be commingled in the tuyere-chamber or chambers, and discharged through the same tuyere or tuyeres into the bottom of the ore-chamber of the furnace.

#### *Mode of Operation.*

In supplying or charging the furnace, Figure 1, letter A, I first place the zinc or manganese, or both, or Franklinite ores, over the fuel, B, and immediately under the iron ore C, and then charge the furnace in the usual manner with fuel, B', flux and Franklinite D', iron ore C, and so continue the charges in rotation, using from ten (10) to thirty (30) per cent. of Franklinite or zinciferous ores for a mixture or flux, as the quality of the iron or ores to be smelted may demand. When the furnace is fully heated, I then admit the compound blast of superheated steam and air, hot or cold, through the tuyere or tuyeres F, into the said furnace, whereby the iron is made to part with its deleterious gases, which, by the presence of the zinc in a volatile oxide state, are carried off through the top of the furnace to the open air, with the heat and carbonic acid gas.

The usual forms of furnaces may be used with a fair prospect of success; but I prefer my own improvements in furnaces, as allowed on the 28th day of May, 1867, as the compound blast, and the commingling of the lighter gases in the same tuyeres, as set forth in my arrangement of tuyeres, particularly constructed for the compound blast.

In smelting, I particularly desire to use the Franklinite ores of New Jersey, United States, as found at Sterling and Hamburg, and those of Altenberg, near Aix-la-Chapelle, in Europe, which ores contain from fifteen (15) to twenty (20) per cent. of oxide of zinc, ten (10) to twenty (20) per cent. of manganese, forty (40) to fifty (50) per cent. of iron, and ten (10) to twenty (20) per cent. of pure lime. I consider this particular ore the most suitable and powerful agent, either as a flux or a mixture, for improving, purifying, and carrying off and separating all iron ores from sulphur and phosphoric acid, when used in combination with the compound blast of superheated steam and air, either in the blast or cupola-furnace, when preparing the iron to be used for making steel by the Bessemer process, or other purposes.

When the Franklinite ore is used I would avoid using the common limestone for flux, as there is sufficient lime in the spar, combined with the ore, to create enough slag in the furnace to make the said furnace work smoothly and well, and cause a saving of fuel; besides, most of the common limestone in ordinary use contains a percentage of phosphoric acid, which is one of the most injurious acids to be found in iron for making Bessemer steel, or where great strength is required. The combination of the Franklinite and the compound blast of superheated steam and air, will make a stronger, tougher, and generally a better iron, with twice the tensile strength, for all merchantable purposes, of any iron now known to commerce.

The zinc, in its volatile state, will purify the ores and metallic iron. The manganese is an essential ingredient in the manufacture of good steel, and I believe the compound blast of superheated steam and air will create and keep up a more powerful and intense heat than any other agent now in practical use, forming, as it were, a compound oxyhydrogen blow-pipe, causing the ores to melt more rapidly, preventing the mineralizing of the sulphur and phosphoric acid with the molten iron, also creating a saving of fifty (50) per cent. of fuel for

one ton of anthracite coal, or one and one-quarter ( $1\frac{1}{4}$ ) ton of prepared peat, with Franklinite as a flux, will make one ton of pig-iron, and by the same blast and flux in the cupola-furnace, one hundred (100) pounds of anthracite coal will melt one ton of scrap or pig-iron.

I am aware that zinc and Franklinite ores have been used for purifying iron and iron ores, and that manganese has been used in the preparation of iron for steel purposes, and that steam and water have been used in combination with the same; but I am not aware that a compound blast of superheated steam and air has been used in combination with the above ores and iron ores suitable for and adapted to the Bessemer process of making steel.

*Claim.*

Therefore, what I claim as my invention, and desire to secure by Letters Patent of the United States of America, is—

The use of zinc or zinciferous ores, manganese, or the Franklinite ores, as a flux or a mixture in iron-furnaces, in combination with the compound blast of superheated steam and air for manufacturing iron suitable for the Bessemer process of and for manufacturing steel and other purposes, substantially in the manner and for the purpose herein set forth, and shown in the accompanying drawings.

In testimony whereof, I hereunto subscribe my name, in presence of three witnesses.

D. W. HENDRICKSON.

Witnesses:

SARAH E. HENDRICKSON,

J. P. McLEAN,

WM. WRIGHT.