

(No Model.)

J. F. ALEXANDER.

ART OF MAKING MALLEABLE IRON AND STEEL DIRECTLY FROM CAST IRON.

No. 368,504.

Patented Aug. 16, 1887.

Fig. 1

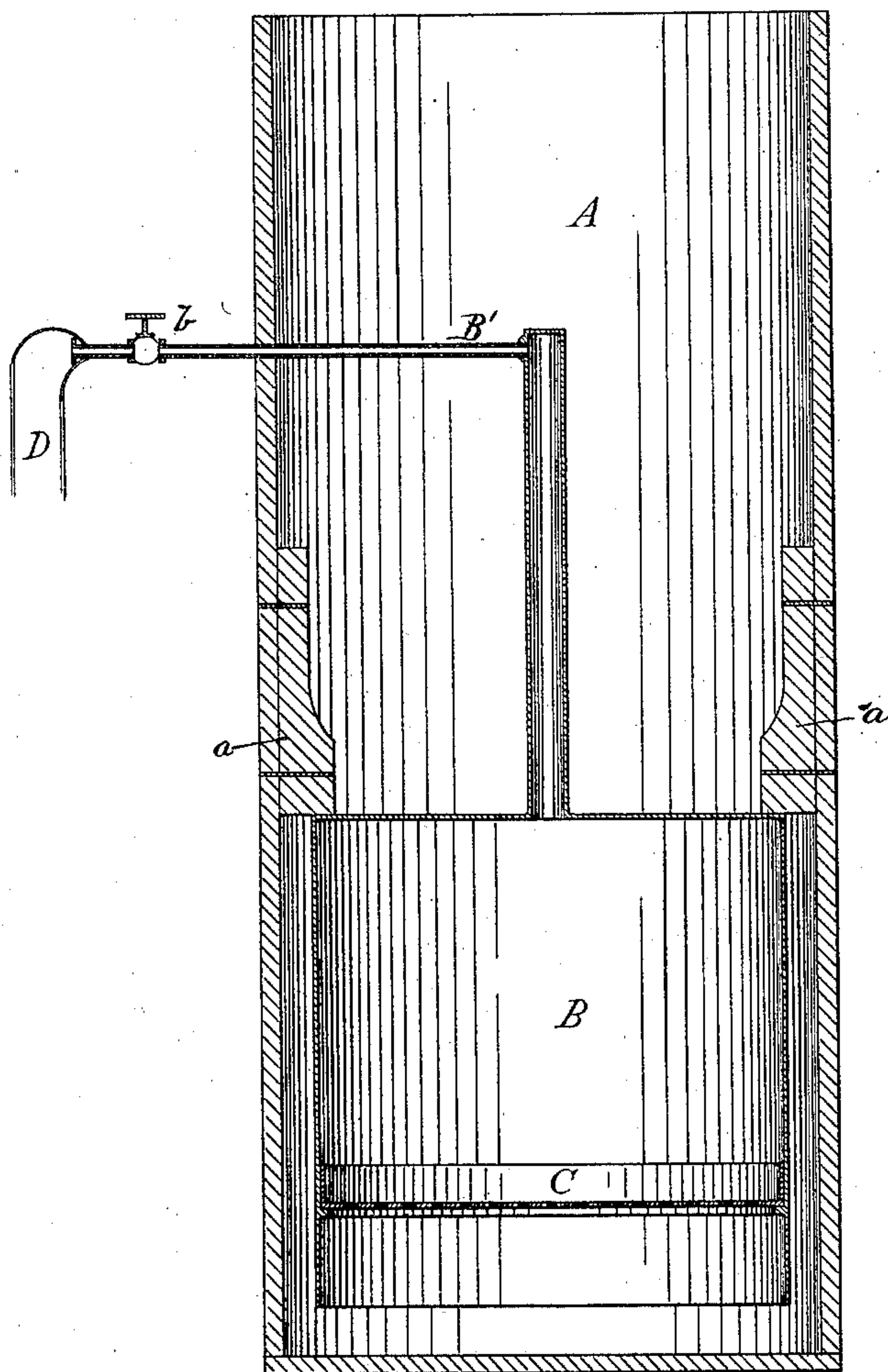
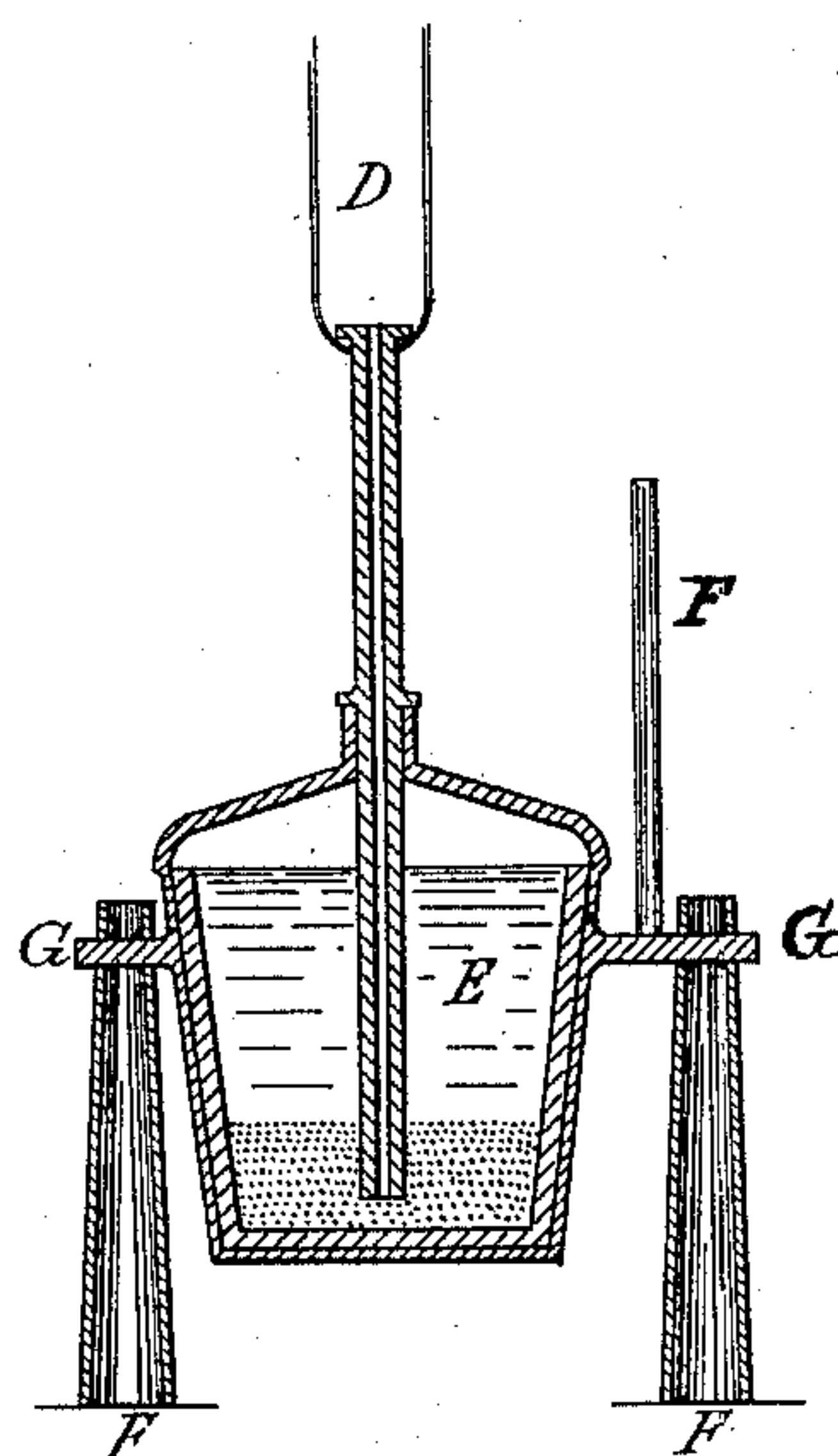


Fig. 2 -



Witnesses

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JOHN F. ALEXANDER, OF WASHINGTON, DISTRICT OF COLUMBIA.

ART OF MAKING MALLEABLE IRON AND STEEL DIRECTLY FROM CAST-IRON.

SPECIFICATION forming part of Letters Patent No. 368,504, dated August 16, 1887.

Application filed April 13, 1887. Serial No. 234,609. (No model.)

To all whom it may concern:

Be it known that I, JOHN F. ALEXANDER, a citizen of the United States, residing at Washington city, in the District of Columbia, have invented a new and useful Improvement in the Art of Making Malleable Iron and Steel Directly from Cast-Iron, of which improvement the following is a specification.

In order to produce malleable iron by my improved process, I pour molten cast-iron into an open vessel lined with a refractory material, which vessel contains a mixture of one part of cryolite (which is, as is well known, a compound of fluoride of aluminum and fluoride of sodium) and two parts, by weight, of sesquioxide of iron. The portions of this fluxing mixture depend upon the amount of silicon contained in the cast-iron. I have found in practice from three to five per cent. of this compound to produce very good results. Hydrogen gas is introduced near the bottom of the vessel and under this mixture under a hydrostatic pressure of about five pounds to the square inch. This gas is ignited before the metal is poured into the vessel, in order to prevent explosive action. The gas unites with the fluorine in the cryolite and forms hydrofluoric acid, which, in turn, attacks the silicon of the iron as it rises through the molten metal and forms a volatile tetrahydrate of silicon, which escapes into the air. The sodium and aluminum of the cryolite unite with the silicon and other impurities of the iron and form a slag, which floats on the surface. The oxygen in the sesquioxide of iron supports combustion underneath the mass of metal and its iron mingles with the cast-iron in the vessel, the entire contents of which are kept at a white heat during the process by the combustion above mentioned.

Should the production of steel from the molten metal above described be desired, instead of pouring the purified metal from the vessel or receiving-ladle, I stop the injection of hydrogen and sprinkle in, with constant stirring, a powder composed, by weight, of four parts of wrought-iron filings, one part of black oxide of manganese, and one-half part of yellow prussiate of potash, amounting in all to about ten per cent., by weight, of the metal under treatment. This compound supplies

carbon sufficient to convert the molten metal into a very fine quality of steel, which can be poured into ingots and then rolled into bars in a well-known way. The compound also supplies sufficient oxygen to maintain the metal at the requisite high temperature. In either case the slag is held back in the usual way when the metal is poured.

The unconsumed hydrogen takes up the phosphorus, sulphur, and carbon of this melted iron, and escapes as phosphureted, sulphureted, and carbureted hydrogen, which burn on the surface of the iron, producing a large volume of white fumes. The cast iron is thus converted into a malleable iron, which can immediately be poured into an ingot-mold and rolled into bars.

The accompanying drawings represent one form of apparatus for practicing my invention, which may, however, be carried out with various well-known forms of apparatus.

Figure 1 represents a vertical central section through the gas-generating apparatus, and Fig. 2 a similar section through the receiving-vessel and gas-supply pipe.

A tank, A, of wood, contains a gasometer, B, of metal, provided with a perforated diaphragm or grating, C, near its bottom. Iron or zinc filings are placed on this grating, and the tank is about half filled with sulphuric acid diluted with water. The contact of the water with the filings rapidly generates hydrogen gas. The gasometer is prevented from rising above a certain level by stops *a* on the inside of the tank A. As the gas is generated in the gasometer B it expels the diluted sulphuric acid and stops the generation. A pipe, B', conducts the hydrogen gas from the gasometer outside of the tank A, where it is provided with a stop-cock, *b*. This pipe leads to the gas-pipe D, of unglazed baked clay, which is shown as passing through the handle of the receiving-vessel E into the molten metal and terminating near the bottom thereof. This vessel is shown as lined with refractory material, such as fire-clay, and as rocking on pivots G and regulated by a handle, F, in a well-known way.

I have described cryolite as one of the preferred ingredients of the fluxing composition upon which the cast-iron is poured; but I have

also obtained good results with fluor-spar, fluoride of aluminum, or fluoride of sodium, fluorine being the essential ingredient. I do not, therefore, limit myself to the use of cryolite
5 alone, but regard the other substances containing fluorine as substantial equivalents.

I am aware that it has heretofore been proposed to treat molten iron in various ways and at different times with all of the substances
10 herein mentioned, (such ways, however, differing essentially from mine,) and I do not, therefore, broadly claim treating molten metal with such substances, but limit my claims in the manner therein specified.

15 Having thus fully described my improved process, what I claim as my invention, and desire to secure by Letters Patent, is—

1. The hereinbefore-described process or improvement in the art of making malleable
20 iron directly from cast-iron, which consists in injecting hydrogen gas under pressure into molten cast-iron in the presence of a com-

pound of sesquioxide of iron and cryolite or equivalent fluoride, in about the proportions specified, to support combustion and eliminate
25 carbon, phosphorus, silicon, sulphur, and other impurities.

2. The hereinbefore-described improvement in the art or process of making steel directly from cast-iron, which consists in
30 injecting hydrogen gas under pressure into molten cast-iron in the presence of a compound of sesquioxide of iron and cryolite or equivalent fluoride, in about the proportions specified, and then adding wrought-iron fil-
35 ings, black oxide of manganese, and yellow prussiate of potash, in about the proportions specified, for the purpose set forth.

In testimony whereof I have hereunto subscribed my name.

JOHN F. ALEXANDER.

Witnesses:

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