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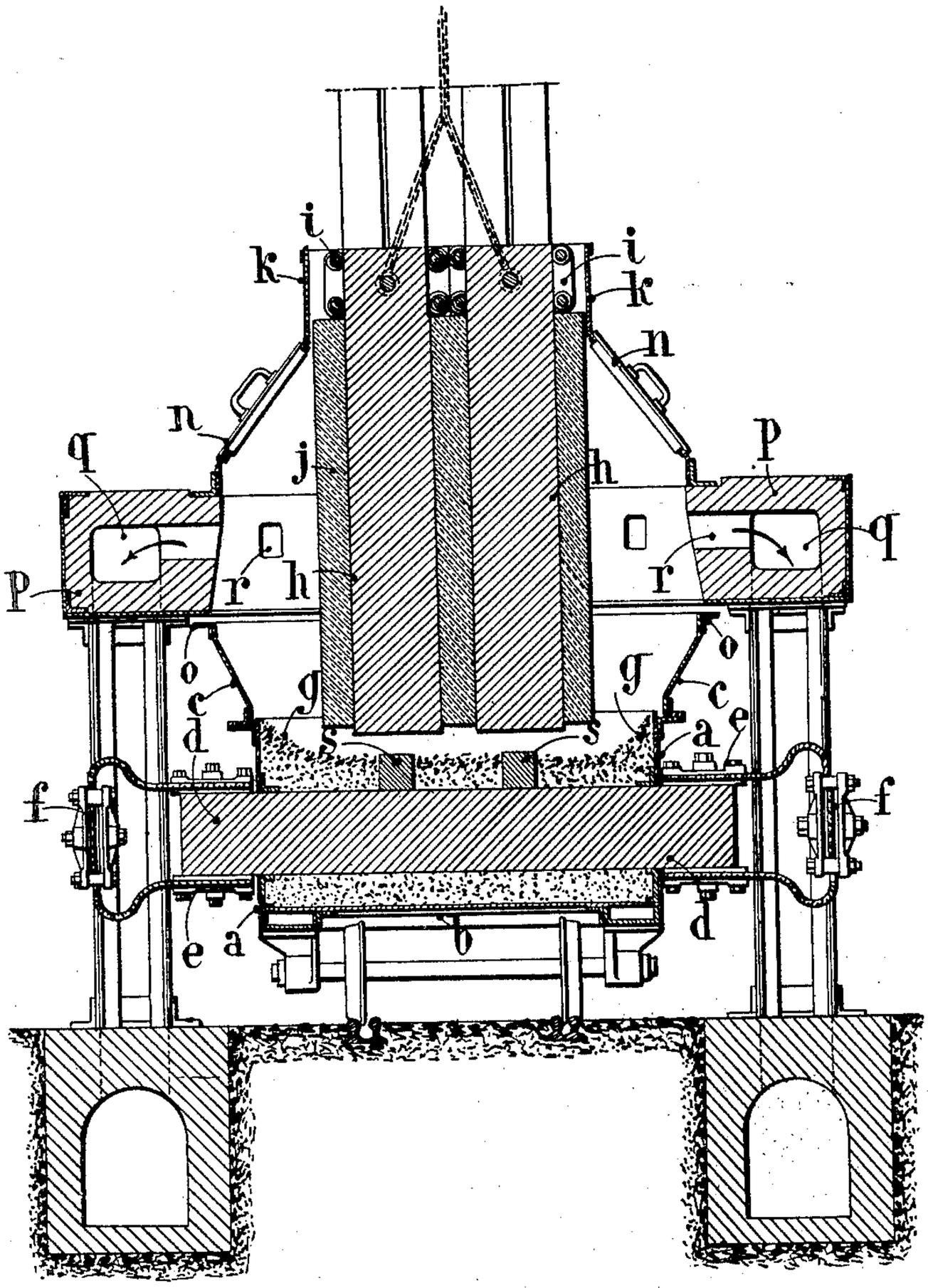
A. SIMON.

MANUFACTURE OF IRON, MANGANESE, AND ALLOYS OF THESE METALS BY AID OF ELECTRICITY.

(Application filed Feb. 27, 1901.)

(No Model.)



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MANUFACTURE OF IRON, MANGANESE, AND ALLOYS OF THESE METALS BY AID OF ELECTRICITY.

SPECIFICATION forming part of Letters Patent No. 704,393, dated July 8, 1902.

Application filed February 27, 1901. Serial No. 49,120. (No specimens.)

To all whom it may concern:

Be it known that I, ALBERT SIMON, engineer, a citizen of the French Republic, residing at Bordeaux, department of Gironde, France, (whose post-office address is 9 Allées de Tourny, in the said city,) have invented certain new and useful Improvements in the Manufacture of Iron, Manganese, and Alloys of these Metals by Aid of Electricity, of which the following is a specification.

This invention relates to the manufacture of iron, manganese, and alloys of these metals, and has for its principal object a new process intended to render practicable the use of electric furnaces for obtaining the said products on a commercial scale. Attempts hitherto made to obtain such products in the electric furnace by reduction of the ores in the presence of carbon have not proved satisfactory, owing principally to the considerable loss of metal owing to the readiness of the manganese to volatilize.

This invention is based on the practical carrying into effect of the following observations: The lower oxids of manganese are soluble in fused fluorid of calcium. This solution can be used as the electrolyte, and it will yield metallic manganese at the cathode under the action of a continuous electric current suitable to produce simultaneously the electrolytic decomposition and thermic action necessary for melting the mixture and keeping it in a sufficiently fluid condition. If the composition of the electrolyte be such that its point of fusion be not sensibly greater than that of the manganese (1,300° to 1,400° centigrade) and if this composition be kept about constant by regulated additions of oxid of manganese, the formation of the metallic bath will be continuous and the temperature moderate enough to enable the metal to be drawn off, while avoiding volatilization and the losses it entails. By the employment of the method set forth hereinafter the reduction of the silicates contained in the ore the same retains only a small quantity of silicon, and it will be evident that the silicon which results from the reduction of the silicates by the action of the electric current combines with the fluorin to form a gaseous fluorid. It is well known that the affinity or tendency of silicon combining with fluorin is very high. It will then be readily understood that the silicon which has been, as to say, absorbed by the fluorin will be set free and, as before stated, the metal only retains a small quantity of the silicon.

According to this invention the electrolytic treatment can be employed alone or combined with the reduction by carbon. In the first case, say, when the electrolytic method is alone resorted to the normal voltage varies from seven to eight volts for a current intensity of five to six amperes per square centimeter. The silicon reduced under the action of the current combines with the free fluorin to form a gaseous fluorid, which is set free, so that the metal only retains but small quantities of silicon. When the electrolytic treatment is combined with the reduction by the carbon, the silicon reduced, owing to the presence of the carbon in the bath, combines, as aforesaid, with the free fluorin to form a gaseous fluorid, which is set free, so that the metal only retains a small quantity of silicon. In this case of simultaneous employment of electrolysis and reduction by carbon the normal voltage may be greatly increased, even to as high as eighteen or twenty volts.

For the practical carrying out of the process an electric furnace may be used of the kind described in my application for United States Patent, Serial No. 49,119, dated February 27, 1901, of which the accompanying drawing is a sectional view. This furnace consists, essentially, of a crucible or hearth *a*, of a fireproof material of any suitable composition, mounted on a carriage *b* and provided with raised sides *c*. The cathode is formed of horizontal carbons *d*, arranged on the base of the hearth or crucible, the casing of which they traverse, and they are connected to the main circuit *f* by means of flexible connections pressed against the carbons by plates *e*. These carbons *d* are embedded in a layer *g* of crushed ferromanganese, the upper level of which rises about to three-fourths of the height of the casing *a*. The purpose of this layer of crushed ferromanganese is to form a conductive mass with the bath of molten metal, as will be more clearly explained below. The upper electrode or anode is formed of four (or more) electric carbons *h*, which are of dimensions proportionate to the power of the fur-

nace and which can be moved vertically by means of levers or the like. The carbons which form the upper electrode *h* are inclosed in a casing or envelop *j* of crushed slag compressed with tar and resin. The manganese contained in this slag is monoxid, so it cannot promote the oxidation of the carbons. This form of this electrode is that of a rectangular prism sliding in a frame *k*, provided on its four sides with charging-openings *n*. The raised sides *c* carry brackets *o* at their upper ends placed under the brickwork *p*, so as to securely close the interior of the furnace. A channel *q* is provided in the brickwork *p*, the said channel communicating by means of openings *r* with the interior of the furnace and also with a dust-chamber, into which the gases arising from the reduction process pass, together with the metallic dust and vapors. Two small blocks of carbon are arranged at *s s*, which blocks extend just above the top of the layer of crushed ferromanganese *g* and serve to prime the furnace, for without these the current could not pass at a low temperature through the said layer of crushed ferromanganese, which then offers too considerable resistance.

The operation is the following: After the upper electrodes *h* have been placed in contact with the carbon blocks *s* a mixture of flour-spar and carbon is gradually introduced through the openings *n*, the constituents being in proportions suited to the voltage at which the furnace is working. The strength or intensity of the electric current in the said carbon blocks *s* being very high by reason of their reduced section, a very high temperature is developed around the said carbon blocks *s*, and thus rapidly melts the mixture which has been fed into the furnace, and thus a bath is formed which gradually penetrates the resisting layer *g*, which becomes more conductive. A temperature is thus gradually produced which finally reaches a normal and invariable degree corresponding to the minimum of volatilization of the metal, if the proper strength or intensity of electric current be provided. A current, for example, of, say, forty to fifty watts per square centimeter of the sectional area of the upper electrode enables this result to be obtained. As the work of the furnace proceeds the metal accumulates on the hearth *g*, where it remains in a fluid condition by reason of the superficial resistance of the layer and its low thermic conductibility. When the bath of metal has reached the desired height, it is drawn off in the usual manner. The present method also allows the obtainment of rich ferromanganese or other alloys of metals. For this purpose there is only to be introduced into the fuel mixture a suitable proportion of an oxid of the metal which is to enter in the composition of the alloy.

Having now particularly described and ascertained the nature of my invention and in what manner the same may be performed, I declare that what I claim is—

A process of manufacturing iron, manganese and the alloys of such metals, consisting in adding to the material to be treated carbon, and an electrolyte consisting of fluorid of calcium, in sufficient quantity to dissolve the material and then subjecting the mass to the action of a continuous electric current to cause the electrolytic decomposition and the keeping of the material in a fluid condition, substantially as described and for the purpose set forth.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

ALBERT SIMON.

Witnesses:
JAMES L. CHASSEREAU,
GABRIEL FAURE.