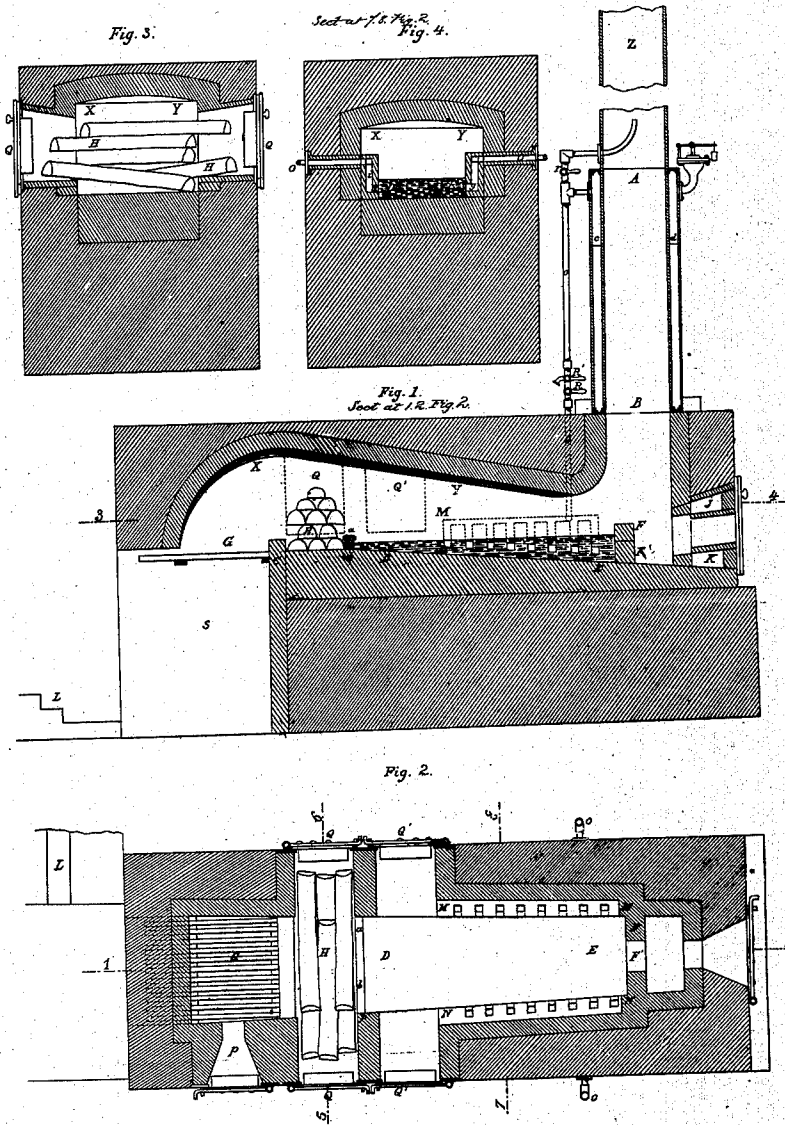


A. G. CAZALAT.
CONVERTING IRON INTO STEEL.

No. 62,113.

Patented Feb. 19, 1897.



United States Patent Office.

ANTOINE GALY CAZALAT, OF PARIS, FRANCE, ONE HALF ASSIGNED TO
JULES DESPECHER, OF SAME PLACE.

Letters Patent No. 62,118, dated February 19, 1867.

IMPROVEMENT IN FURNACES FOR CONVERTING IRON INTO STEEL.

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, ANTOINE GALY CAZALAT, chemist, of No. 18 Rue Gaillon, Paris, have invented certain Improvements in the Conversion of Cast Iron into Cast Steel, Malleable Cast Iron, or Pure Wrought Iron; and I do hereby declare that the following, taken in connection with the drawings which accompany and form part of this specification, is a description of my invention sufficient to enable those skilled in the art to practise it.

This invention consists in modifying in such a manner the ordinary reverberatory furnace that it can be made to decarbonize progressively considerable quantities of cast iron liquefied by heat, which can subsequently, as may be desired, be converted into malleable cast iron, pure wrought iron, ordinary steel, or pure homogeneous cast steel, without air bubbles.

Description of the Improved Furnace.

Figure 1 of the annexed sheet of drawings is a longitudinal elevation in section, through the line 1 2, fig. 2, of my improved furnace.

Figure 2 is a plan in section through the line 3 4, fig. 1.

Figure 3 is an elevation in cross-section through the line 5 6, fig. 2; and

Figure 4 is an elevation in transverse section through the line 7 8, fig. 2.

Z is the circular chimney, formed of boiler plate, and surrounded at its base with an outer concentric shell, B A, which constitutes a boiler for generating steam. L are steps leading to the ash-pit situated below the fire-bars C, which are fed with coal through the opening P, and the latter is closed, after charging, by a door lined with fire-brick. The doors Q Q are for the purpose of charging pigs of spathic pig iron, H, between the bridge C and the cross-stop P'. The extremities of said pigs are maintained in an inclined position above the working surface of the furnace, as shown in figs. 2 and 3. A second and more considerable charge of ordinary cast iron is introduced through the doors Q' Q', near the middle of the bed, where they are maintained and arranged, as shown in fig. 3. When the fire is lighted on the grate G, the flame reflected by the arch X Y passes through and heats both these charges, whilst the waste heat that escapes through the chimney B A evaporates the water in its outer casing. The spathic iron melts first and accumulates in the upper reservoir, between the bridge C and the cross-wall, which is inclined towards the hole, p', temporarily stopped with sand or clay. Shortly after the mass of ordinary pig iron melts also, and falls in a liquid state on the working-bed, where it is retained by the fire-brick wall F. In this state it is purified and decarbonized in the following manner: I insert in each side of the furnace a fire-clay tube, O' O', and in connection with each of such tubes a fire-clay plate, M and N, perforated by one horizontal passage, to which are connected a series of perpendicular passages, t t, opening laterally in the liquid metal. The steam from the boiler B A is admitted through the cock R into these passages by the pipe O, and enters the liquid metal through the lateral openings x y, and becoming highly superheated by this contact, it undergoes decomposition. Its oxygen oxidizes the iron and gradually consumes the carbon therein contained, whilst the corresponding hydrogen purifies the steel by destroying the sulphur and other metalloids which render it brittle. After having injected the steam alternately in each of the conduits M and N, during seven or eight minutes each time, the decarbonized metal must be examined. To that end the steam is shut off and a ladle full of iron extracted. This is converted into an ingot or struck on an anvil. If it flies to pieces under the hammer it is a proof that it is still too much carbonized for steel. It can therefore be used as malleable cast iron. The cock R' is for the purpose of blowing off water which has condensed in the pipe O.

Malleable Cast Iron.

Castings made of this metal are rendered less brittle in the ordinary manner, by the oxide of iron treatment. In this case, however, as they will be decarbonized in a great measure, a less amount of fuel and of ore is required. This part of the process consists in heating them in cast-iron vases arranged in layers covered with sand and oxidulated with iron.

Liquid Oxide of Iron.

When it is desired to convert the metal containing still an excess of carbon into purified liquid cast iron,

the action of the steam, admitted through the cock R, is continued until it is completely decarbonized, which effect can be easily ascertained before running into the moulds.

Ordinary Steel.

To obtain ordinary steel, a certain amount of carbon must be reincorporated in the metal. For this purpose the sand plug p^1 is drawn out, and the liquid spathic specular iron contained in the upper reservoir flows into the lower one, whereby the carbon it contains is distributed to the mass of oxide of iron. Whilst this action is taking place steam is admitted for a few seconds on both sides of the furnace. The metal can then be run out fit for converting into rails of heterogeneous or "Bessomer" steel.

Continuous Process for the Manufacture of Steel.

After having run the charge, and before the furnace has lost any of its internal heat, two new charges of cast iron can be made through the door Q Q, Q' Q', and the sand or clay plugs refitted. In this manner nearly all the fuel required to heat the furnace for each separate operation is economized.

Continuous Process for Manufacturing Cast or Homogeneous Steel.

In order to convert ordinary steel into cast or homogeneous steel, the metal must be maintained in a quiet state of fusion and at a very high temperature. To this end the steam-cock R must be closed and the one r opened. The rush of steam up the chimney Z has the effect of augmenting the draught, thereby increasing the combustion. The proper chemical reaction then takes place, the oxygen abandoning the metal to consume the free carbon, which has the effect of rendering cast steel formed in large masses of as good a quality as when remelted in small crucibles. As the liquid metal is not in any way deteriorated by remaining for a considerable time in a quiet state of fusion and in a highly heated furnace, successive trials of the same can be made until it has acquired the property of being forged and hardening like the best cast steel; then the metal should be run out by withdrawing the plugs F' and K.

Process for Casting Steel under High Pressure.

It is well known that cast steel run into moulds is subject to blister and is otherwise porous, which defect reduces considerably its toughness. In order to give to this metal its requisite tenacity it is subsequently reheated and then rolled or hammered. As many articles, such as cannon, cannot be treated in this manner, I have devised to submit them to a high pressure whilst still in a liquid state enclosed in their sand moulds maintained in iron flasks. For this purpose, immediately after running a cannon, I cover hermetically the head by a metallic cap, by means of bolts or other devices attached to the flask. This cap is fitted in its centre with a vertical pipe, and provided with a cock at its lower extremity, whilst its upper extremity is closed by a washer pressed by a bolt in such a manner as to act as a safety valve. Before attaching the cap, at, supposing one inch from the surface of the liquid metal, I introduce in the vertical pipe, and between the cock and the washer, a charge of about one-quarter of an ounce of gunpowder, in the proportion of eighty parts saltpetre and twenty charcoal, with no sulphur. On opening the cock this powder falls on the metal, ignites, and engenders about one-third of a cubic foot of gas at 1400° centigrade. These gases exert on the liquid metal a pressure which is transmitted throughout the entire mass, thereby condensing the same and expelling the blisters. The effect thus produced is equivalent to the pressure of a head of liquid metal ninety feet high, admitting that the capacity between the cap and the surface of the metal contains thirty cubic inches. By making the flasks sufficiently strong the charges of powder may be varied, so as to produce by its ignition a uniform and general pressure, which is preferable to the partial, irregular, and momentary action of a hammer.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The arrangement of parts, as above specified, applied on either side of the furnace for introducing steam into or through the molten metal.
2. The upper reservoir of cast iron, as above described, for the purpose of restoring to the purified iron the requisite amount of carbon for converting the same into ordinary steel.
3. The conversion of ordinary steel into homogeneous steel by maintaining the liquid metal in a quiet state of fusion, and at a high temperature by injecting steam in the chimney; and
4. The means indicated of submitting steel cast in moulds to high gaseous pressure, whereby the blisters are expelled and the metal close-grained and condensed.

Witnesses:

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D. H. BRANDON.

GALY CAZALAT.