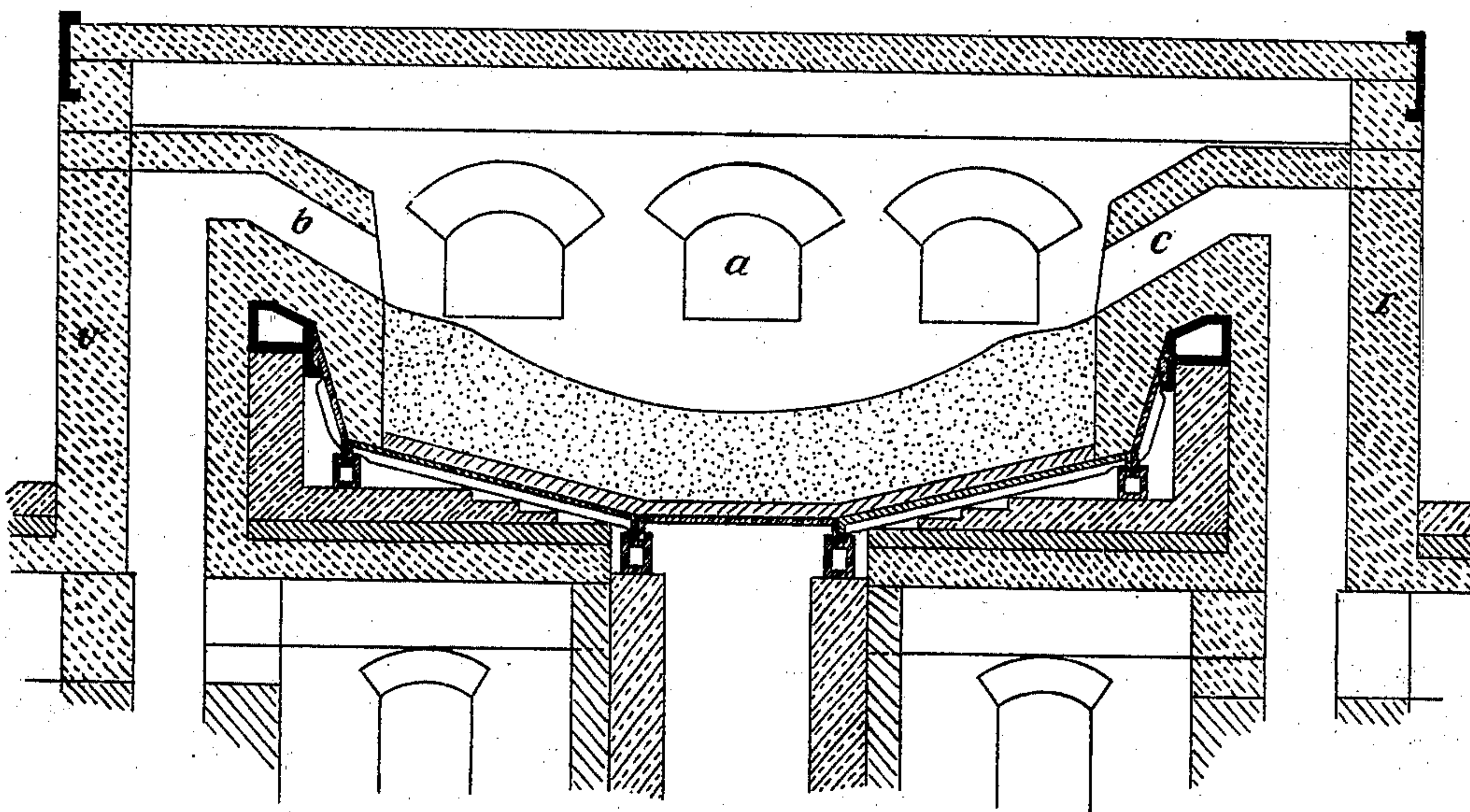


No. 709,563.

Patented Sept. 23, 1902.

O. THIEL.
PROCESS OF PRODUCING IRON.
(Application filed Aug. 19, 1899.)

(No Model.)



Witnesses

H. K. Bonet

[Signature]

Inventor

Otto Thiel

By *[Signature]* *[Signature]*
Attorney

UNITED STATES PATENT OFFICE.

OTTO THIEL, OF KAISERSLAUTERN, GERMANY.

PROCESS OF PRODUCING IRON.

SPECIFICATION forming part of Letters Patent No. 709,563, dated September 23, 1902.

Application filed August 19, 1899. Serial No. 727,848. (No specimens.)

To all whom it may concern:

Be it known that I, OTTO THIEL, a subject of the Emperor of Germany, residing at Kaiserslautern, Germany, have invented certain new and useful Improvements in Processes for the Production of Iron, of which the following is a full, clear, and exact description.

The present invention relates to a process of producing iron directly from the ore.

The accompanying drawing illustrates a vertical sectional view of a Martin furnace for carrying out my process.

In an apparatus provided with a gas-generator furnace—as, for instance, a Martin furnace, as represented in the accompanying drawing—with openings *a a*, adapted to be tightly closed and constructed of as solid or impermeable masonry as possible and the air and gas chambers of which can be securely closed, *b* indicates a suitable gas-inlet, and *c c* are the gas-outlets, all arranged as shown and in a manner well known to this style of furnace. The inlet *b* is placed at such an angle that the issuing gas is obliged to pass downward and over the furnace. The gas-outlets *c c* are of such cross-sections that their total area is equal to or preferably a little in excess of the cross-sectional area of the inlet. Both outlets are connected by means of short connections with tubes, through which the gases resulting from the reduction, as well as the injected gas, the temperature of which has become partly lowered, are carried away for further treatment. Part of it will serve to supply heat for the purpose of heating the heat-reservoir, in which the gas to be introduced into the furnace is to be brought to the required temperature. Both in the inlet and outlet tubes valves are arranged for the purpose of regulating the pressure in the furnace-chamber, inasmuch as there always ought to be a slight excess of pressure to prevent air passing inward should there be any leakage or irregularity in the surrounding masonry.

The process is carried out as follows: Suppose the above-described Martin furnace is at full heat—as, for instance, after the tapping of the metal. The furnace is at once charged with about two-thirds of the flux and full heat applied. The application of said full heat is then suspended, and now the charge,

consisting of a mixture of ore, carbon, and the remaining portion of the flux, all broken to the size of nuts, is introduced as rapidly as possible. The quantity of gas evolved might become excessive; but this is prevented by withdrawing the flue slides or dampers. The furnace being thus charged, the doors are tightly closed. An equalization of temperature takes place between that of the charge and the temperature of the surrounding masonry, during which time carbonic-oxid gas is evolved, which has the effect of reducing some of the ore. This process, however, will soon slacken, and the temperature in the furnace-chamber will grow less. At this moment the highly-heated gas is admitted, raising the temperature and rendering the process of reduction so energetic and rapid that the whole charge will be reduced in from two to three hours. It is within the power of the workers to carry the process of reduction as far as may be required, continuing it until eventually the iron becomes carbonized. As a rule, however, the reduction is not quite carried through. As soon as the required degree has been reached the gas is shut off and molten iron is run into the furnace. The furnace is closed again and the hot gas readmitted until all the reduced iron has been dissolved in and taken up by the molten metal, so that the possibility of the reduced iron reoxidizing is prevented. After this the gas is completely shut off and gas-regenerator firing instituted, the remainder of the process closely following the lines of the Martin process. In this manner it is possible to get fifty per cent. or more of iron from a full charge directly from the ore, according to the quality of the ore. Ores with a greater quantity of slagging impurities are somewhat differently treated, inasmuch as after the reduction of the ore and the dissolution in molten iron the slag is entirely melted and the mass tapped into a second furnace, care being taken to retain the slag on the way to the second furnace, in which then the remaining operation is carried out.

It has been stated above that the reduction of the ore should not be completed entirely, and for this reason that when the molten metal is run in a strong reaction sets in, which has been found to powerfully aid the slagging

and the dissolving power of the molten metal. To know to what extent reduction has taken place, it is only necessary from time to time to take samples of the outcoming gas and
5 compare them with the constitution of the ingoing gas, by which means it will be possible to form a sufficiently accurate estimate.

The advantages and novelty of the invention as compared with others of a somewhat
10 similar character are that in apparatus provided with a gas-regenerator furnace, first, the reduction of ores is carried out in a manner whereby the heat required for the reduction of the ore is not produced by the gas-
15 regenerator furnace, but by the introduction of a highly-heated current of reducing-gas, which is produced independently of the said gas - regenerator furnace; second, the reduced ore is not placed in a bath of molten
20 cast-iron, but, on the contrary, molten cast-iron is poured on the reduced ore, effecting a complete dissolution by providing a constant current of a highly-heated reducing-gas, whereby reoxidation is prevented; third, that
25 the gas-regenerator furnace becomes absolutely independent of the process of reduc-

tion, so that its action can be effectively employed without any regard to the latter.

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

In the manufacture of iron, heating a regenerative furnace by the introduction of heated reducing-gas, adding part of the flux
35 to be employed and heating same, shutting off the gas-supply and adding the charge of ore, carbon and the remainder of the flux, readmitting the gas and then cutting it off to allow of an equalization of the temperature
40 of the apparatus, then readmitting the gas until the desired degree of reduction is obtained and afterward adding molten iron to take up the reduced iron substantially as described.

In witness whereof I have hereunto set my
45 hand in presence of two witnesses.

OTTO THIEL.

Witnesses:

J. ADRIAN,
JULIUS BASS.