

UNITED STATES PATENT OFFICE.

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PROCESS FOR REDUCING THE AMOUNT OF CARBON IN CAST-IRON OR ARTICLES CAST FROM IRON.

935,234.

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No Drawing.

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To all whom it may concern:

Be it known that I, WALTER RÜBEL, engineer, a subject of the King of Prussia, German Emperor, and a resident of Vienna, Austria-Hungary, have invented certain new and useful Improvements in a Process for Reducing the Amount of Carbon in Cast-Iron or in Articles Cast from Iron, of which the following is a full, clear, and exact specification.

This invention relates to a process for reducing the amount of carbon in cast-iron or in articles cast from iron.

The manufacture of steel and other qualities of iron poor in carbon can be effected by various processes and, in the largest extent, is to-day effected by the Bessemer process in which the amount of carbon in the iron is diminished by blowing air through the molten iron, whereby a part of the carbon as well as impurities are eliminated by oxidation.

The qualities of iron so obtained are not used for making castings. For this purpose, the Siemens-Martin process is used, particularly for large castings of steel. Small castings, such as carriage fittings, railway-car fittings and the like, are usually produced from ordinary cast-iron by the malleableizing process inasmuch as much carbon as may be is eliminated from the cast-iron by malleableizing the same. This process, however, is not only very expensive, but it also requires a period of at least eight days for finishing such malleableized castings, and this from the very beginning limits the use of such malleableized castings to small quantities.

The present process is to be considered as a substitute for the malleableizing process hitherto used and permits the amount of carbon in crude iron to be reduced in the shortest possible time, to any desired limit. It is possible by this process to get iron of 45 kilograms resistance and 8% tensile strength, and the carbon in this is present in the form of pearlite.

This process can be carried out in a cupola furnace, and the elimination of the excess carbon is effected by the aid of sodium hydroxid. The method is as follows:—Firstly, the requisite quantity of crude iron is melted

in a furnace and, in a retort adjoining it and consisting of firebrick or steel or iron, the requisite quantity of sodium hydroxid is melted. The sodium hydroxid melts at 750° centigrade. When both masses are sufficiently fluid, they are permitted to flow out through suitable gates into an outer hearth common to both. The quantities of iron and sodium hydroxid which enter into reaction with one another are determined by the dimensions of the gates. When the crude iron rich in carbon, containing about 3.5% of carbon, meets the molten sodium hydroxid, double decomposition takes place, in the course of which the sodium hydroxid is transformed into carbonate of sodium, thereby withdrawing the carbon from the iron. In this reaction hydrogen is liberated and is burned. The high degree of heat so generated transforms the carbon still remaining in the iron into pearlite.

The new process is of advantage in that by the simplest means a soft iron is produced containing any desired amount of carbon which is eminently fit for casting and will make castings which will not show any cracks. The sodium hydroxid acts upon the carbon present in the iron in the form of graphite, forming soft iron and sodium carbonate as already mentioned.

The gases produced in the reaction may pass away either to the chimney of the retort and into the open air, or they may be utilized.

The present process for diminishing the amount of carbon in cast iron is applicable not only to crude iron before casting castings therefrom, but is also suitable for effecting the decarburization after the castings are made, which has the additional advantage that the castings do not require to be annealed afterward for the purpose of doing away with internal stresses as is absolutely necessary with castings made from cast-steel. Moreover, if desired, the finished castings may be entirely decarburized.

To carry out the present process with castings having, for example, an average proportion of carbon of 3.5%, they are put into a retort or a muffle containing sodium hydroxid or the hydroxid of some other alkaline metal, say, potassium hydroxid, in such

quantity that the castings are completely covered by the molten hydroxid. The temperature of the retort or muffle is then raised to 1100 to 1150° centigrade and, at this temperature, decarburization proceeds very rapidly. The retort or muffle is provided with a safety valve capable of withstanding a pressure of about two atmospheres. If the gas pressure in the retort exceeds that amount, the valve opens and the gas passes through a cooling coil into a receptacle filled with a solution of ammonia, whereby the sodium liberated in the process is dissolved. The gases not absorbed by the ammonia are carried back to the furnace and serve to heat the same. It is important to obtain a pressure of about two atmospheres, as this promotes the reaction. If, for example, the decarburization is to be carried out to the extent of reducing 3.5% to about 1.5%, then, at the temperatures given, heating for about two hours is required. At the end of this time, a valve provided on the retort or muffle is opened and the excess of sodium hydroxid is run off. Then the retort is permitted to cool gradually and the castings are removed. For the complete decarburization of castings up to about 20 millimeters thickness, about six hours is required. Iron decarburized by the above method has a crystalline lustrous fracture like ingot-iron cast from crucibles. By changing the time and temperatures employed, decarburization may be so regulated that the finished product after annealing is equal to fine casting in steel of corresponding quality.

Compared with known malleableizing processes and other processes of decarburization, the following advantages are obtained by the present process:—

(1) Castings of the most complicated and delicate shapes can be cast free from flaw which, as is known, offers no difficulty with cast-iron, while casting from crucibles in cast-steel or crucible-steel from Siemens-Martin furnaces and the like can only be made, comparatively speaking, in simple forms on account of the stresses and flaws which occur therein. The quality is nevertheless the same as with steel castings.

(2) In order to reduce the amount of carbon in a casting from 3.5% carbon to fine steel with 0.8% carbon only, altogether about ten hours are required. The processes hitherto used in malleableizing require at least seven days.

(3) No alteration of shape in the castings takes place as is the case in malleableizing processes, in which the castings have to be closely packed in oxidizing reagents, as in the present process the castings can freely expand in all directions. This avoids the necessity for again heating the castings to red-heat and adjusting. By the present process, for instance, motor cylinders with very

thin ribs can be produced, while, heretofore, these articles could only be produced from cast-iron, as they could not be cast in steel at all and the alterations in shape occurring in the malleableizing process could not be made good.

(4) The present decarburizing process is also cheaper than any other known process as, on account of its rapidity, it only requires a small quantity of fuel and also does not require large and complicated installations. The cost of the sodium hydroxid employed is fully covered by the sodium and sodium carbonate that are recovered.

The process takes place in the following way:—When the cast-iron is immersed in the sodium hydroxid at red heat, the carbon at the surface of the iron enters into combination with the sodium hydroxid forming sodium carbonate, hydrogen becoming free. As soon as there is a superficial decarburization, which takes place at about 750°, the process almost entirely stops until the temperature is raised to 1050 to 1100°. At this moment, the iron which is still rich in carbon, namely that under the pure superficial layer of iron, commences to soften and carbon travels outward and combines, not with the carboniferous iron, but with the sodium hydroxid. Thus, the process continues and the outer layer of pure iron, which is of increasing thickness:—whose melting point is about 400° higher than that of the carboniferous iron, protects the casting against melting and consequently against alteration of shape. If, for instance, a round rod about 30 millimeters thick is taken out after two hours and broken, it will show on the outside, for about 4 millimeters thick, a clean crystalline iron fracture and then toward the core the richness in carbon increases. If, however, the rod is gradually cooled from 1000°, the carbon is again completely and evenly distributed over all parts.

It may be remarked that cast-iron with combined carbon is easier to decarburize than iron that contains graphite.

In the aforesaid manner, large castings, such as cylinders and machinery frames, may be so far decarburized as to have on the outside a thick tough layer of iron of some 3 to 5 millimeters thickness. This yields the self evident advantage that the pieces will be capable of much greater resistance to fracture and will afford a much better holding surface for screws, nuts and fixings than is the case with hard cast iron.

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

1. The process for diminishing the amount of carbon in cast-iron, which consists in treating the cast-iron at a temperature from 1100 to 1150 degrees C. with molten sodium

hydroxid, whereby the hydroxid acts by diffusion on the carbon.

2. The process for diminishing the amount of carbon in cast-iron, which consists in treating the cast-iron at a temperature from 1100 to 1150 degrees C. with sodium hydroxid at a still higher temperature, whereby the hydroxid acts by diffusion on the carbon.

In witness whereof I have hereunto signed by name this 23rd day of May 1908, in the presence of two subscribing witnesses.

WALTER RÜBEL

Witnesses:

A. FUHRON MALTZAN,
D. D. LANDENEGER.