

(Specimens.)

W. T. WELLS.

PROCESS OF COATING IRON AND STEEL WITH RUSTLESS OXIDE.

No. 382,447.

Patented May 8, 1888.

Fig 1

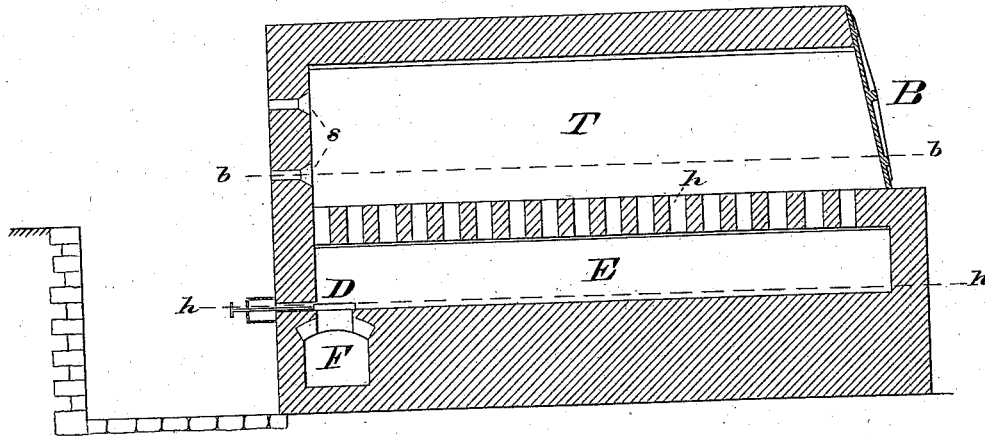
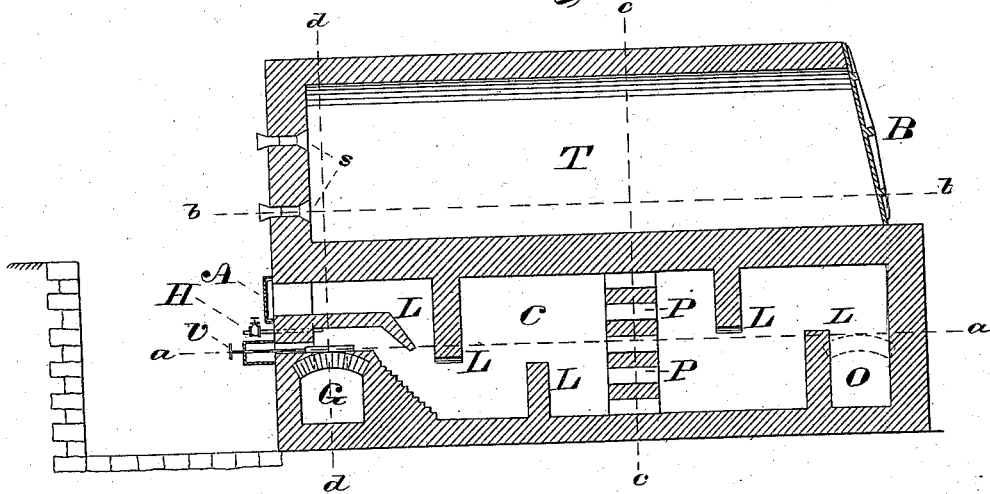


Fig 2



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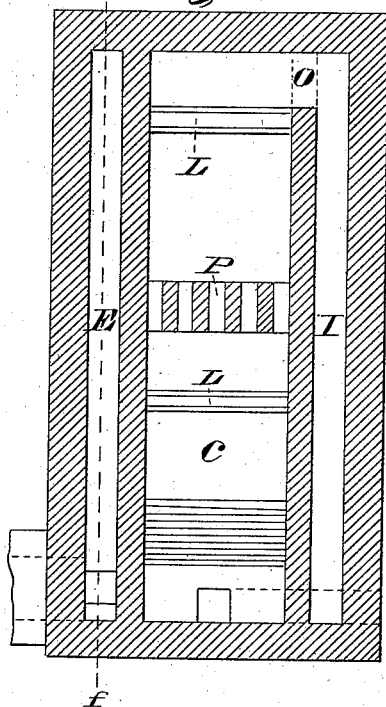
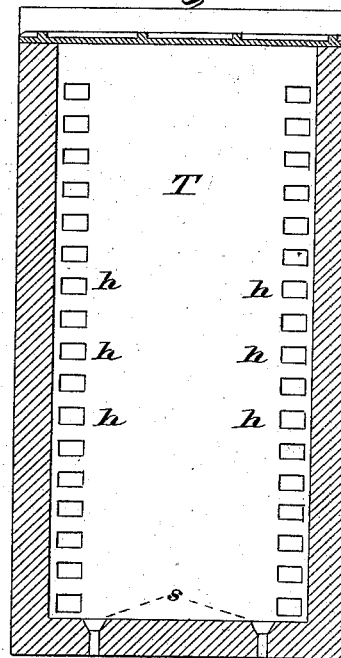
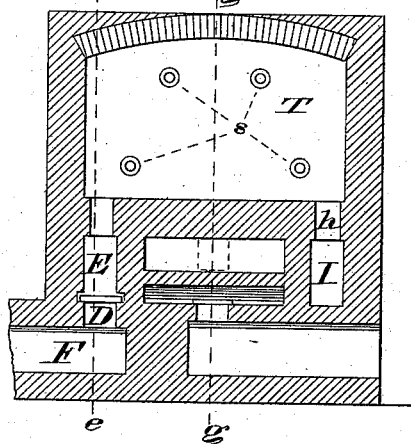
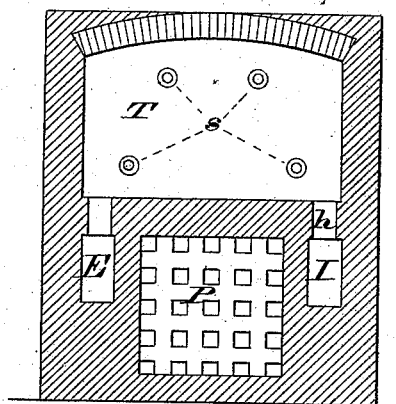
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Fig 3*Fig 4**Fig 5**Fig 6*

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UNITED STATES PATENT OFFICE.

WILLIAM T. WELLS, OF HACKENSACK, NEW JERSEY.

PROCESS OF COATING IRON AND STEEL WITH RUSTLESS OXIDE.

SPECIFICATION forming part of Letters Patent No. 382,447, dated May 8, 1888.

Application filed November 18, 1887. Serial No. 255,513. (Specimens.)

To all whom it may concern:

Be it known that I, WILLIAM T. WELLS, a citizen of the United States, residing in Hackensack, in the county of Bergen and State of New Jersey, have invented a certain new and useful Improvement in Process of Coating Iron and Steel Surfaces with Rustless Oxide; and I hereby declare the following to be a full, clear, and exact description of the same, such as will enable others skilled in the art to practice the invention, reference being had to the accompanying drawings, which form a part hereof.

The invention relates to the protection of iron and steel surfaces by the production of a rustless coating thereon, and has for its object the more economical, reliable, and effectual production of such a coating than is possible by any process heretofore devised; and it consists of the improved process herein described and claimed.

Heretofore superheated steam and carbon dioxide have severally been employed in processes to produce a rustless surface on iron and steel articles, but the processes have been unsuccessful when attempted to be used on a large commercial scale, and at best the results have been uncertain and unsatisfactory.

In the process employing superheated steam, (known as the "Barff process," and described in Letters Patent of the United States, No. 182,148, dated September 12, 1876,) the articles of iron or steel that it is desired to provide with a rustless coating are placed in a muffle or chamber constructed so as to be closed or partly closed. External heat is then applied to the muffle or chamber until the iron or steel has acquired a temperature sufficiently elevated to cause the decomposition of steam, which is then injected into the muffle or chamber until the protective coating has been produced; or, instead of applying external heat to the muffle or chamber, the steam itself is superheated, and is relied upon to sufficiently heat the iron or steel to cause the action to take place, and the protective coating to be formed. The latter of these two processes is imperfect in its operation, and unreliable, and is not possible of application in an ordinary muffle, but requires expensive steam-tight chambers for the operation. The former process is expensive in the great loss of

heat entailed by the external heating of the muffle, and is imperfect in its results. The steam in the ordinary muffle under the high external heat of the process seems to be a too vigorous oxidizer of the iron or steel, and efforts to control the process and make it reliable and certain in its results have met with little success.

In the process of employing carbon dioxide, (known as the "Bower process," and described in Letters Patent of the United States, No. 234,524, dated November 16, 1880,) the articles of iron or steel are placed in a retort which is subjected to the action of external heat, and carbon dioxide (CO_2) is passed directly in, among, and over the articles under treatment. The operation which takes place is understood to be as follows: The carbon dioxide, in presence of the iron or steel at the high temperature, parts with one atom of oxygen, which it gives up to the iron or steel, forming an oxide or oxides of iron, and then passes off as carbon monoxide, (CO), the oxide or oxides of iron formed being the protective coating desired. Several modifications of the method of heating up the iron or steel articles have been suggested, and of the particular method of bringing the heated iron or steel and the carbon dioxide into effective contact; but the results of the process have not been satisfactory. Parts of a charge are found to be greatly oxidized and parts too little oxidized, and the process seems to be one impossible to precisely and successfully control with large charges such as must be operated upon, and in ordinary furnaces such as must be used in order to make the process at all available commercially. It has also been suggested to uniformly oxidize the charge in excess at first by burning carbon monoxide with an excess of air in and around the charge, producing red oxide or sesquioxide of iron on its surfaces, and then to deoxidize partially by passing carbon monoxide without any admixture of air over the still heated charge, reducing the red oxide to black or magnetic oxide, the rustless coating desired; but the same irregularity of result on different parts of the charge attends this method, and greater care and attention and time in applying the process add nothing to the certainty and reliability of the result.

The present invention is of a new process

for the production of a rustless coating upon iron or steel, and it is devised and adapted to economically and reliably produce such coating in an even and impenetrable layer all over the surfaces of the charge and every part thereof, and to be equally effective in its application to large and to small charges, and in ordinary furnaces, avoiding at once the expensive retorts and special muffles of the old processes and the blistering and overoxidizing incident to those processes as well as their general irregularity of result.

In practicing the invention I place the charge, which may be of any size, in an ordinary muffle or heating-chamber, and I heat up the charge gradually and thoroughly through several hours in any desired way, and preferably cleanse and otherwise prepare it, as hereinafter described. I then inject into said heating-chamber a mixture of steam and carbon monoxide, so that the atmosphere in contact with the heated charge shall, as far as practicable, consist of steam and carbon monoxide. I then close the chimney damper or dampers of said heating-chamber, and leave the mixture of steam and carbon monoxide to act upon the heated charge for several hours—varying with the size of the charge, &c., generally about five hours—taking pains to permit the escape of the hydrogen generated thereby. The charge, when allowed to cool, will be found to be of a uniform color all over its surfaces wherever the mixture of steam and carbon monoxide has been in contact with it in its heated condition, and the coating will be found to be an even and impenetrable and continuous coating of rustless oxide of iron. The chemical operations that proceed in this new process, so far as they are at present understood by me, seem to be as follows: The mixture of steam and carbon monoxide in contact with the heated surface of the iron or steel oxidizes the metallic iron and the lower oxides, raising all to the rustless oxide, and it simultaneously reduces the higher oxides to the same uniform rustless oxide, and the mixture also partially scales off or otherwise removes the higher or red oxide in the shape of a fine red dust of oxide of iron, which is generally found settled on the drag or charging plate of the heating-chamber, the unitary effect being to produce over the previously heterogeneous surfaces of the iron or steel a homogeneous layer or coating of rustless oxide, even and continuous over the entire surfaces of the iron or steel and integral with the mass of the metal. In this operation the steam of the mixture appears to be the active agent in producing the oxidizing results; but in such operation it is limited and controlled by the presence and action of the carbon monoxide of the mixture. In the general operation, also, the carbon monoxide appears to be the active agent in producing the deoxidizing effects; but in such operation it is limited and controlled by the presence and action of the steam. The carbon monoxide also appears to

operate to burn up or consume the free oxygen of the steam and the oxygen of the air that may leak into the chamber during the progress of the operation—a leakage which is unavoidable in practice—which air, with its free oxygen, would otherwise attack the heated iron of the charge and raise it in spots to a red oxide. The elements of the charge in contact with each other and operating together, and operating under much heat, work together to produce the unitary result described. The simultaneous and conjoint operation of the steam and carbon monoxide in contact with the heated surface of the iron or steel charge, whatever the previous condition of the surface, effects the complete conversion of that surface into the black or magnetic oxide, and to a depth and with a character continuous, tenacious, and integral with the internal mass or body of the iron or steel, which causes it to form an impenetrable rustless coating and to act as a complete protection of the entire mass or charge from injury by rust.

The best method which I have discovered of carrying out the invention is as follows: It being understood that the various steps which I now describe as preceding the process heretofore described are preparatory steps preferred to be carried out by me in embodying my invention and tending to perfect the ultimate result produced, but to which I do not wish my broad invention to be limited.

I first place the charge of iron or steel articles of, say, twelve thousand pounds weight in an ordinary muffle or heating-chamber, and then I heat up the charge gradually through a period of twelve hours, more or less, varying with the size of the charge, &c. It is important not to heat any part of the charge so hot as to blister it, and yet every part of the charge must be raised to the dull-red heat required. I prefer to use the gas made by the well-known Siemens producer for the purpose of thus gradually heating the charge, and to admit air in limited quantities into the chamber along with the gas coming from the producer, just enough to consume the latter and to give a small flame in the chamber. During this operation the dampers will be open, permitting escape of the products of combustion to the chimney. The heating should be gradual, whereby blistering of the parts of the charge will be avoided, and whereby the whole charge will be evenly and equally heated, and should be so controlled that the charge will reach its maximum of heat at about the end of twelve hours. For a smaller charge a shorter period of time is required. The surface of the charge may be, by this particular method of gradual heating, somewhat oxidized, both to a red and a black oxide; but the effect is irregular and patchy where it does appear at all, and is not of any importance in our general process. At the end of the heating step of the process I turn off the gas from the Siemens producer, and also the air, and I introduce steam into the

hot chamber containing the heated charge, and after the steam has blown the remnants of the gas out of the chamber I close the dampers of the same and leave the steam turned on for some thirty minutes or thereabout. This is merely a cleaning step, the steam operating to clean the surface of the charge and free it from scale and foreign substance, and thereby prepare it for the steps of the process that follow. The charge is very hot during this cleaning step, and the steam seems to operate to scale off and remove mechanically or otherwise a part of the red oxide from the surface of the charge, if any be present. At the completion of this cleaning step of the process I turn off the steam from the chamber and introduce carbon monoxide; and when the atmosphere of the chamber is cleared of the steam thereby I close the dampers again, and submit the charge in its very hot condition to the action of the carbon monoxide alone for an hour and a half, more or less.

The operation of the carbon monoxide is to partly remove the red oxide or sesquioxide of iron that may have existed upon the surface of the charge or been produced thereon by the earlier steps of the process, leaving in its place magnetic oxide or lower oxides, or even metallic iron, these black parts of the surface being intermixed with irregular patches of red oxide, but of fine microscopic texture, and all substantially integral with the body or mass of the metal of the charge, the rough and scaly separable portions of the oxide on the surface having disappeared as the result of the last two above-described steps of the process. The charge is thus prepared in the best manner known to me for the final and essential step of the process. I now turn on the steam and leave the carbon monoxide turned on and the chimney-dampers of the chamber closed, and for five hours, more or less, I submit the charge to the operation of the mingled steam and carbon monoxide, as heretofore described. The heat of the charge at the beginning of the operation should be a dull-red heat, and air should be excluded as far as practicable. The steam need be under little or no pressure, and may or may not be superheated before being introduced into the chamber. This last or fourth step is the essential step of the process, and is the one in which is produced the effective rustless coating of black or magnetic oxide that is sought.

The first three or preparatory steps described above conduce to the ultimate production of a more perfect and homogeneous protective coating, and may be employed, one or all of them, in conjunction with the final step of the process, as described, or that single and essential step may be employed alone.

I employ any ordinary muffle or heating chamber of the usual construction, and do not require any special appliances to make it—for instance, absolutely air-tight or steam-tight, or capable of standing high pressure, &c.—as my

process is adapted to proceed successfully without the use of elaborate or costly apparatus.

I do not limit myself to the employment of any particular kind of apparatus. The following is a description, however, of what I consider the best means or apparatus for carrying out the invention, the accompanying drawings forming a part of this specification.

Figures 1 and 2 are vertical longitudinal sections of the furnace, which is an ordinary furnace of masonry, about five feet high, fifteen feet long, and six feet wide. Figs. 3 and 4 are horizontal sections of the furnace. Figs. 5 and 6 are transverse vertical sections of the furnace. The section shown in Fig. 1 is made on the line *ff* of Fig. 3 and on the line *ee* of Fig. 5. Fig. 2 is a section on the line *gg* of Fig. 5. Fig. 3 is a section on the line *hh* of Fig. 1 and on the line *aa* of Fig. 2. Fig. 4 is a section on the line *bb* of Figs. 1 and 2. Fig. 5 is a section on the line *dd* of Fig. 2. Fig. 6 is a section on the line *cc* of Fig. 2.

The respective parts are shown in the several figures as follows, the same letters representing the same parts.

V is a gas-valve. A is an air-valve. G is a gas-flue. H is a steam-valve. C is a combustion-chamber. O is an opening into the port-chamber. I is a port-chamber. *hh* are port-holes. T is a heating-chamber. E is the escape-valve. D is the chimney-damper. F is the chimney-flue. P is a checker-work in the combustion-chamber. *sss* are sight-holes in the back of the heating-chamber. *LL* are curtains of masonry.

When the articles are to be treated for the production of a rustless oxide upon their surface, they are placed in the heating-chamber T by being drawn in upon a drag through the doors B. The charge is then heated up gradually and thoroughly through a period of from ten to twelve hours, varying with the size of the charge, and preferably by the admission of gas from a Siemens producer, admitted through the gas-flue G by opening the valve V, a small quantity of air being admitted for the purpose of combustion by opening the valve A, during which operation the damper D is open, permitting escape of the products of combustion to the chimney. The gas entering through V commingles with the air passing through A at the extremity of the curtain L, and is aided in its commingling by the checker-work P in the combustion-chamber; and the burning gas, passing through O, enters the port-chamber I, from which, through the port-holes *hh*, it passes up, around through, and over the charge in T, and thence through the port-holes *hh* into the escape-flue E to the chimney-flue F. When the charge has been sufficiently heated so as to show through the sight-holes a dull-red heat, the valves V and A are closed and steam from any convenient generator is admitted through the valve H, and after the remnants of the gas have been displaced from the chamber the damper D is closed and the steam is forced in

for a period of thirty minutes or thereabout. This step is found to clean the surface and prepare it for the steps that follow. I then close the valve H, open the damper D, and open the valve V, and when the atmosphere of the chamber is cleared of the steam I close the damper D and submit the charge to the action of the gas free from air for upward of an hour and a half. I now open the valve H, and for five hours or thereabout submit the charge to the operation of the mingled steam and carbon monoxide, excluding the air as far as practicable.

I do not in the present application claim the special apparatus herein shown and described.

I am aware that various processes for protecting iron and steel surfaces have been patented that employ steam and a hydrocarbon vapor, or other vapor having an excess of carbon, the two being applied either alternately or simultaneously, as, for example, in the patents to J. P. Gill, Nos. 283,999, 284,000, and 284,001, dated August 28, 1883, and to W. D. Wood, No. 252,166, dated January 10, 1882; but such processes proceed by and have their

utility in the carbides or carburets of iron that are produced in the body or mass of the iron or steel, near the surface of the same, and are therefore wholly distinct from my process in operation and results, and I do not lay any claim to them.

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

1. The process, substantially as described, of protecting iron and steel articles from rust, which consists in subjecting such articles at a high temperature to the action of mingled steam and carbon monoxide.

2. The process, substantially as described, of protecting iron and steel articles from rust, which consists in subjecting such articles at a high temperature to the action of steam, then subjecting them to the action of carbon monoxide, and then subjecting them to the action of mingled steam and carbon monoxide.

WM. T. WELLS.

Witnesses:

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FREDERIC T. COOPER.