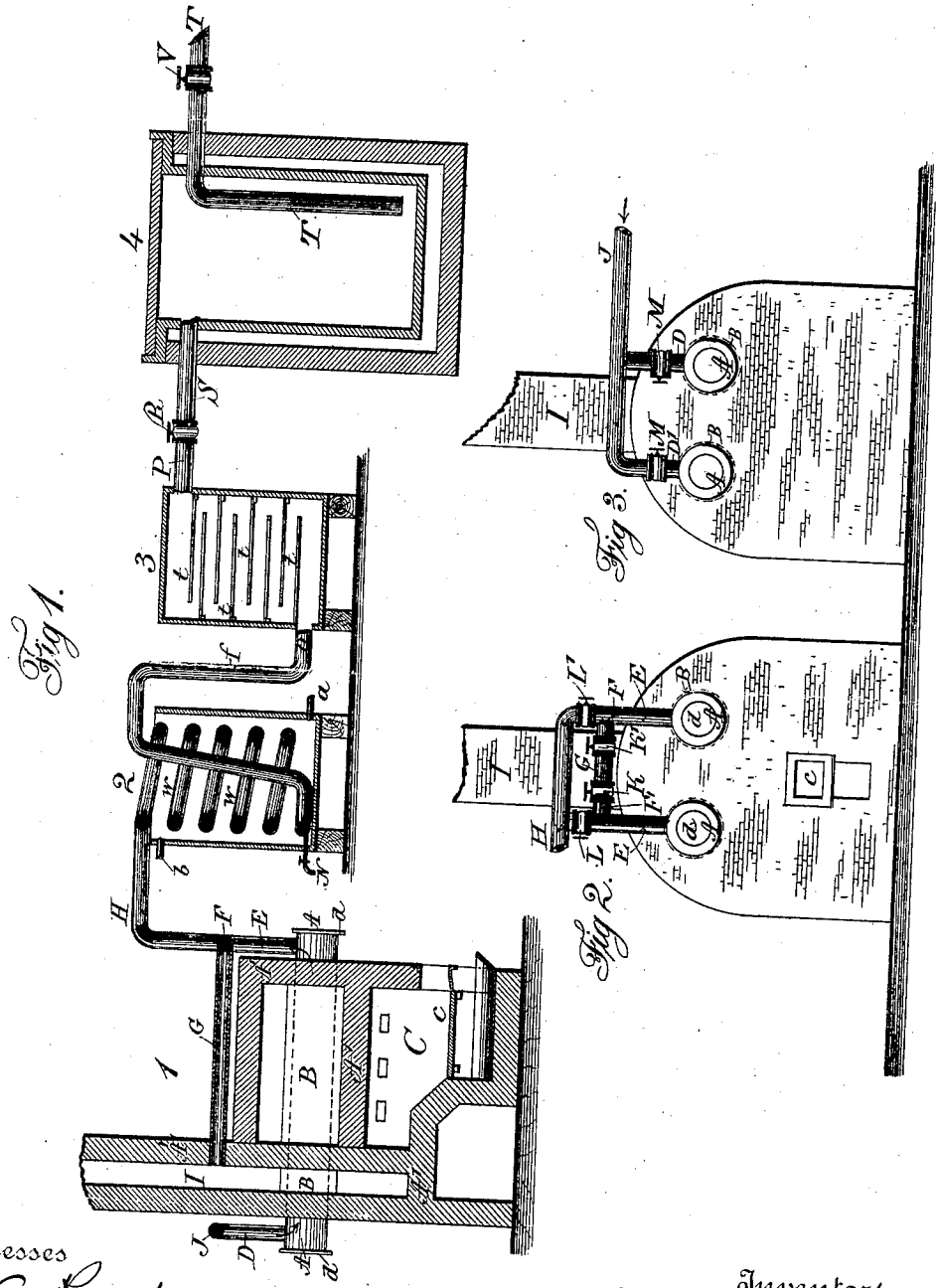
(No Model.)

G. W. CUMMINS & J. H. COLEMAN.

PROCESS OF PREVENTING THE OXIDATION OF METALS WHILE IN A HEATED CONDITION.

No. 409,276. Patented Aug. 20, 1889.



Witnesses
Leo Von Rosenberg
Francis P. Reilly

Inventors
G. W. Cummins
J. H. Coleman
By their Attorney
P. M. Voorhees

UNITED STATES PATENT OFFICE.

GEORGE WYCKOFF CUMMINS AND JAMES HENRY COLEMAN, OF NEW HAVEN, CONNECTICUT.

PROCESS OF PREVENTING THE OXIDATION OF METALS WHILE IN A HEATED CONDITION.

SPECIFICATION forming part of Letters Patent No. 409,276, dated August 20, 1889.

Application filed July 14, 1888. Serial No. 279,990. (No model.)

To all whom it may concern:

Be it known that we, GEORGE WYCKOFF CUMMINS and JAMES HENRY COLEMAN, of New Haven, in the county of New Haven and State of Connecticut, have invented a new and useful Process of Preventing the Oxidation of Iron or Steel while in a Heated Condition, notably while undergoing such heating as is usual in annealing operations, which invention is fully set forth and illustrated in the following specification and accompanying drawings.

The object of this invention is sufficiently disclosed by the above-made statement of its purpose, and the invention will therefore now be described in detail, and then particularly set forth in the claim.

An apparatus or plant suitable for carrying out this invention is illustrated in the accompanying drawings, in which—

Figure 1 shows in sectional side elevation a view of the entire plant. Fig. 2 shows in front elevation a generator or furnace, forming part of Fig. 1. Fig. 3 is a rear elevation of said generator or furnace.

In said figures the several parts are indicated by numbers and letters of reference, as follows:

1 indicates a gas-generator; 2, a cooler; 3, a desiccator, and 4 an annealing pot or chamber. The cooler and annealing-pot may be cylindrical in exterior shape, if preferred, and the desiccator preferably square or rectangular.

The several parts above named may be described as follows:

The furnace or generator 1 consists of cast-iron retorts A, two or more in number, protected by fire-brick B, set within ordinary brick-work A′, such as is used for the setting of coal-gas retorts. The retorts A are heated by a furnace or furnaces C, provided with grates *c* and appropriate flues, as in furnaces for the generation of coal-gas. The retorts A are each closed by doors *d* at each end and provided at one end with an inlet-pipe D and at the other end with an outlet-pipe E, each of which outlets delivers into one common outlet-pipe H. The pipe F connects the two pipes E, and from the pipe F the pipe G leads to the escape-flue or chimney I. Valves K, L, and M govern the flow of the gas as desired, the special office of which valves will be hereinafter more particularly described.

The cooler 2 may be made with a worm *w*, as shown in the drawings, for the gas to pass through, like any common "still" or condenser, any moisture condensed within said worm from the gas being drawn off through the cock N, the cooling-water entering at *a* and leaving at *b*, or vice versa. A gas-holder of any common and well-known form—such as is used for storing common illuminating-gas—may be, if desired, located between the cooler 2 and the desiccator 3. The size of this holder will be determined by the quantity of gas desired to be stored. The smaller its size, however, the less costly the construction and materials of the holder will be.

The desiccator 3 consists of a closed box or chamber containing trays or shelves *t*, on which is placed fused calcium chloride. Said trays are so arranged that the gas entering at *o* must pass over a considerable surface of said chloride before emerging at P. Instead of calcium chloride, pumice-stone moistened with concentrated sulphuric acid may be substituted. This substituted desiccating material has the advantage that the pumice-stone does not need removal or renewal, for so long as supplied with the acid it is a rapid and thorough desiccator. The acid is readily renewed without opening the desiccator by permitting it to trickle or fall in drops on the pumice-stone, through suitable pipes or orifices in the walls of the desiccator, over the pumice-stone.

Of course it is understood that iron or steel, when heated to redness, readily absorbs oxygen at its surface from atmospheric air or any other source from which it can obtain oxygen, the surface of the metal thereby becoming rough and covered with scales of oxide. The endeavor therefore, under such circumstances, in the treatment of metals is to exclude, as far as possible, from the presence of the hot metal all sources or media whence it can absorb oxygen. Even in annealing heretofore, while the annealing-vessels were closed air-tight the residual atmosphere present always exercised deleterious influence upon the metal being annealed.

This invention excludes the atmosphere and substitutes therefor an artificial atmosphere, which entirely surrounds the metal from before it is heated until it has been cooled, or through the annealing process of both heating and again cooling. The artificial atmosphere or gas used by us for this purpose may be said to be a mixture of nitrogen, carbonic oxide, and carbonic acid (N CO CO_2) entirely freed from the vapor of water. Without confining ourselves to these proportions, it may be stated that the gas may consist of about sixty-eight per cent. of nitrogen, about twenty-seven to thirty-three per cent. of carbonic oxide, and from a trace to about four per cent. of carbonic acid.

The gas, as prepared in the process below described, is non-inflammable and non-explosive, and is entirely inert as to any action upon iron or steel at any temperature, but a perfect preventive of oxidation, while the metal is excluded from the air by its presence.

The method of manufacturing the gas necessary for conducting the operation of treating the metal therewith, and the process of so treating the metal, will now be described.

When the retort A has been heated to incandescence by the furnace C, the former is filled with charcoal or coke, which, as soon as it becomes sufficiently heated, evolves a gas somewhat of the nature of ordinary coal-gas, but as such gas had nearly all been previously removed from the charcoal or coke in the production of the same the evolution of such gas is of short duration. This preliminary gas product is inflammable and not at all suited to the purposes of the invention. On the contrary, it is injurious to the metal to be treated. Said gas is therefore permitted to escape through the pipes G and F or F′, provided with the valves K K′ and L L′. When the evolution of said gas ceases, a current or blast of air is introduced at J through the pipe or pipes D and valve or valves M from any suitable blower (not shown) and forced through the mass of incandescent charcoal or coke. This blast is permitted for a short time to escape into the atmosphere through the pipe G and flue or chimney I. When all watery and hydrocarbon vapors have been thus expelled from the charcoal or coke, the gas then evolved by the blast of air may be regarded as consisting, essentially, of nitrogen, carbonic oxide, and carbonic acid, the first and last gases being considerably in excess of the carbonic oxide. This mixture of gases, though possibly retaining a trace of watery vapor, is ready and fit to be passed from the generator 1 to the cooler 2 and thence through the desiccator 3. In its passage through this latter vessel the last trace of watery vapor is removed from the gas, and it is then in suitable condition to be passed into the annealing chamber or pot, or it may be first stored in a gas-holder such as above described until needed for use in the annealing process.

In the practical conduct of the operation only one of the retorts A need be used at the same time for the production of the blast-gas. Immediately upon ceasing to use the gas from one retort and commencing to use it from the other the charge of charcoal or coke is renewed in the first retort and allowed to become heated until the charge in the second retort is about half exhausted by the air-blast. By this time the charge in the first retort has reached the condition of freedom, more or less complete, from watery and hydrocarbon vapors previously described, and the blast of air is again passed through the first retort, when the second retort is recharged and the same round of operations continuously carried on at will.

By such mode of operation a constant production and supply of suitable blast-gas is secured.

The annealing chambers, boxes, or pots are kept filled with the gas under a steady pressure while the same are both being heated and while being permitted to cool, the gas entering through pipe S and valve R and leaving through pipe T and valve V. Upon the removal therefrom of the articles subjected to such gas in the annealing process no change whatever will be observed to have been produced in bright iron due to its exposure to such gas. The air is forced through the retorts by displacement rather than exhausted therefrom, because any leakage that may occur must be outward and not inward; for if the leakage were inward the admixture of external air that would in such manner take place would change essentially and deteriorate the properties of the gas.

Even were the blast-gas absolutely free from watery vapor when leaving the retorts, the interposition of the cooler is necessary; for if the blast-gas were permitted while hot to enter the cold annealing-vessels and while the metal therein was surrounded with cold air the admixture of the hot gas with such cold air would create a medium surrounding the metal that would oxidize the metal. As it is necessary to start the operation only when the annealing-vessel is cold and to keep up the blast of gas until the annealing is complete, by which time the annealing-vessel has cooled down considerably, though not necessarily enough for a fresh start, the further cooling of such a vessel may be hastened somewhat, if desired, by passing the cold gas through it before starting a new annealing operation.

Oxidizable metals treated by this process are specially well suited to be plated with non-oxidizable metals (or galvanized) by reason of the bright, smooth, and clean surface they possess, entirely free from the roughness and foreign element of oxidation.

We do not confine ourselves to the apparatus or plant herein described for generating and applying the gases named, as it is evident that the apparatus may be greatly varied without changing the process or the product.

Having thus fully described our said process as of our invention, we claim—

The hereinbefore-described process of treating metals to prevent their oxidation while in a heated state, consisting in subjecting such metals to an atmosphere composed of nitrogen and carbonic oxide, with or without carbonic acid, the carbonic oxide being in sufficient excess to overcome any tendency of the carbonic acid, if present, to oxidize the metal, substantially as set forth.

G. WYCKOFF CUMMINS.
J. HENRY COLEMAN.

Witnesses:
FRANCIS P. REILLY,
ALFRED S. BROWN.