Feb. 10, 1925. 1,525,725

P. D'H. DRESSLER

FURNACE CONSTRUCTION AND OPERATION

Original Filed May 1, 1920

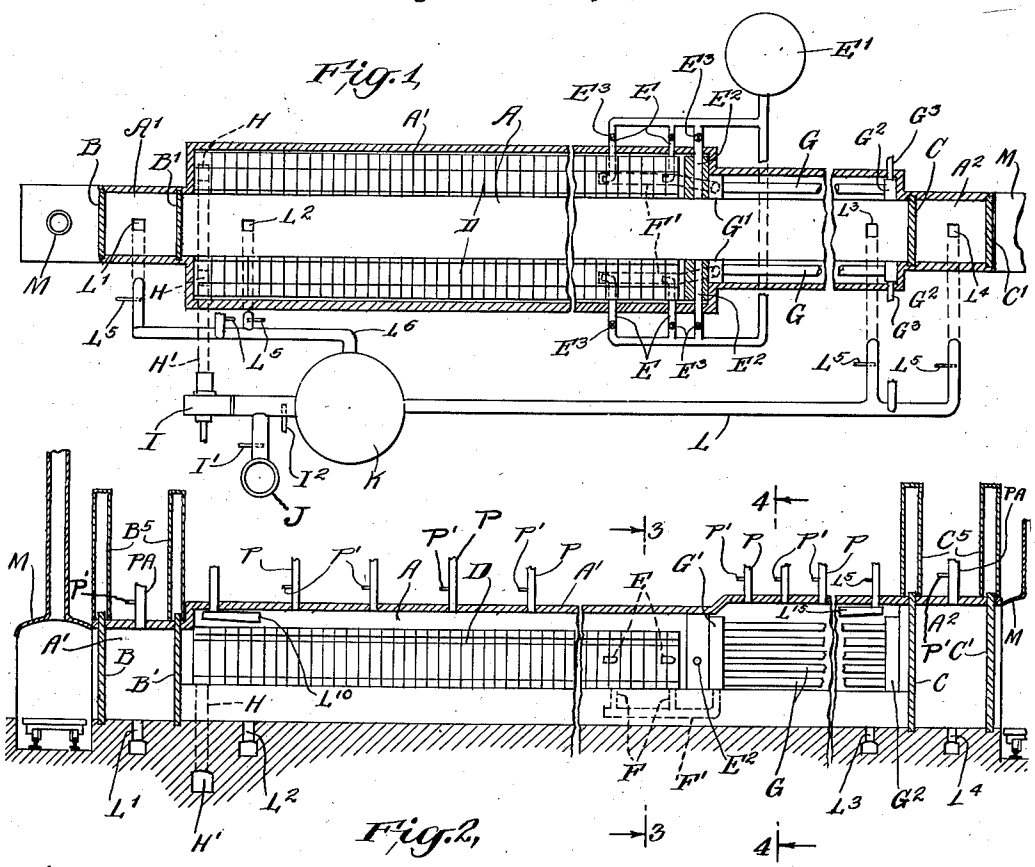


Fig. 1,

Fig. 2,

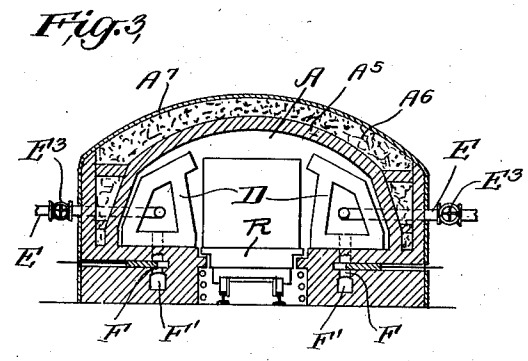


Fig. 3,

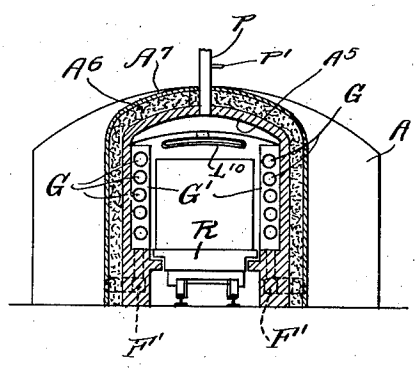


Fig. 4,

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By his Attorney
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Patented Feb. 10, 1925. 1,525,725

UNITED STATES PATENT OFFICE.

PHILIP D'H. DRESSLER, OF ZANESVILLE, OHIO, ASSIGNOR TO AMERICAN DRESSLER TUNNEL KILNS, INC., OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

FURNACE CONSTRUCTION AND OPERATION.

Application filed May 1, 1920, Serial No. 378,332. Renewed July 3, 1924.

To all whom it may concern:

Be it known that I, PHILIP D'H. DRESSLER, a subject of the King of Great Britain, and resident of Zanesville, in the county of Muskingum and State of Ohio, have invented certain new and useful Improvements in Furnace Construction and Operation, of which the following is a specification.

A main object of my present invention, and that for which it was primarily devised is to provide an improved method of and apparatus for the annealing, and particularly for the so-called "bright" annealing of metal in a continuous tunnel kiln. In bright annealing it is necessary to guard against the exposure of the metal to an oxidizing atmosphere while the metal is heated to a temperature at which such exposure would result in surface oxidation of the metal. A continuous tunnel kiln has long been recognized as a highly desirable form of furnace in which to anneal metal and various plans have been proposed for maintaining a non-oxidizing atmosphere in such a furnace in order that bright annealing could be carried on without the necessity of packing the articles to be annealed in iron filings or otherwise protecting them against exposure to an oxidizing kiln atmosphere. In particular it has been proposed to fill the kiln chamber with an inert gas such as nitrogen, or with a reducing gas such as carbon monoxide. It is not practical in many cases to keep the kiln chamber filled with a truly inert gas, such as nitrogen, and with the arrangements heretofore proposed for maintaining a reducing gas atmosphere in the kiln chamber, the admission of air to the kiln, which must be opened and closed at its ends from time to time to permit the insertion and removal of the cars carrying the articles to be annealed is very apt to cause dangerous explosions notwithstanding all the precaution that may be taken.

In proceeding in accordance with the present invention I fill the portion of the kiln chamber in which the temperatures are high enough to cause oxidation with an oxidizing atmosphere, with a reducing gas, such as producer gas, and I eliminate all appreciable risk of explosion by filling the end portions of the chamber with a non combustible gas such as carbon dioxide or products of combustion, i. e. carbon dioxide and nitrogen. The carbon dioxide or the like non-combustible gas filling the ends of the chamber, then form barriers between the combustible reducing gas in the central portion of the kiln chamber, and the outside atmosphere. It is, ordinarily necessary of course, to provide doors at the ends of the kiln, to restrict the influx of atmospheric air and the outflow of carbon dioxide. In practice the influx of air into the kiln, when the kiln doors are opened at intervals for short periods, may be substantially minimized by the normal maintenance of a pressure in the kiln chamber slightly above that of the atmosphere. A small inflow of air into the kiln at its ends when the doors are not gas tight, or occurring when the doors are opened for the insertion and removal of the goods will not result in explosions, however, or be otherwise seriously harmful. Such air absorbed in the carbon dioxide or like inert gas barriers and eventually coming into contact with the carbon monoxide or other reducing gas at the temperature of ignition, will not explode but will burn slowly, as a mixture of carbon monoxide, carbon dioxide and oxygen is not explosive where the oxygen percentage is relatively small as compared with the percentages of carbon monoxide and carbon dioxide.

While my present invention was primarily devised for, and is especially adapted for use in annealing, the method of, and means for separating one active atmosphere from another by an interposed barrier of inert gas is useful for other purposes.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, and the advantages possessed by it reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described the construction and contemplated mode of operation of a muffle heated tunnel kiln with provisions for maintaining barriers composed of products of combustion in the end portions of the kiln chamber while the central portion of the kiln chamber is filled with producer gas or other reducing gas.

Of the drawings:

Fig. 1 is a somewhat diagrammatic plan;

Fig. 2 is an elevation in section;

Fig. 3 is a section on the line 3—3 of Fig. 2; and

Fig. 4 is a section on the line 4—4 of Fig. 2.

In the drawings I have illustrated the use of my invention in connection with a continuous tunnel kiln A which, in its general arrangement, is of the well known Dressler type.

The kiln A comprises an elongated kiln chamber with an antechamber A^1 at its entrance end, and an exit chamber A^2 at its exit end. Doors B and B^1 are provided at the opposite ends of the antechamber A^1, and similar doors C and C^1 at the opposite ends of the exit chamber. The heating zone of the kiln chamber is laterally enlarged to provide space at the opposite sides of the goods pathway for the combustion chambers D which as shown, are of the type disclosed in the patent to Conrad Dressler #1170428. Combustible gas is supplied to each combustion chamber at one or more points through inlets E of which two for each combustion chamber are shown. Air to support combustion is supplied by air inlets F, one adjacent each gas inlet E. This air is preheated by its passage through heat absorbing pipe G in the cooling zone of the kiln. These pipes are connected at their ends to headers G^1 and G^2. The headers G^1 are connected by conduits F^1 to the inlets F, while the heads G^2, which are adjacent the exit door C, receive air from the atmosphere or from a supply fan not shown through inlets G^3. The combustion chambers are provided, adjacent the entrance end of the kiln, with outlets H for products of combustion. The outlets H are connected by a conduit H^1 to the inlet of a fan I which has its delivery end connected to a stack J and to a gas holder K by separated valved connections I^1 and I^2 respectively.

The gas holder K is connected by piping L to an inlet L^4 opening to the exit chamber A^2 and to inlets L^3 and L^{10} opening to the exit chamber A^2 and inlets L^3 and L^{10} opening to the kiln chamber adjacent its exit end. Piping L^6 connects the gas holder K to an inlet L^1 opening to the antechamber A^1 and to inlets L^2 and L^{10} opening to the kiln chamber adjacent its entrance end. As shown the inlets L^2 and L^3 open at the bottom of the kiln chamber while the inlets L^{10} and L^{15} are each arranged to discharge a filmlike jet along the roof of the kiln chamber toward the opposite end of the chamber from that at which the inlet is located. The purpose of the special construction disclosed of the inlets L^{10} and L^{15} is to neutralize the normal convection current circulation flow along the roof of the kiln chamber from the center toward the ends of the kiln as set forth in my prior Patent No. 1,369,330 granted February 22, 1921. A separate controlling valve L^5 regulates the discharge from the gas holder through each of the inlets L^1, L^2, L^3, L^4, L^{10} and L^{15}.

Gas is supplied to each combustion chamber inlet E, from a suitable source as a gas producer E^1. This source also supplies producer gas to the interior of the kiln through conduits E^2 shown as opening to the kiln chamber at points adjacent the center of the length of the kiln. A separate regulating valve E^3 is shown for each of the inlets E and E^2.

The kiln chamber is provided with a plurality of gas outlets P through its roof, each provided with a regulating valve P^1. The outlets P are shown as distributed along both the heating and cooling zones of the kiln. Outlets PA with regulating dampers P^1 are provided for the antechamber and exit chamber. At the ends of the kilns are provided hoods M with roof outlets for carrying away products of combustion escaping from the chambers A^1 and A^2 when the doors B and C^1 are opened. The outlets P, PA, and hoods M may each comprise a stack of sufficient height for direct discharge into the atmosphere, or they may be connected by suitable piping to one or more separate stacks.

The walls A^5 of the kiln are formed of masonry as usual and are covered with kieselguhr A^6 which serves both as heat insulation and to prevent leakage through the kiln walls. As a further and more positive protection against leakage the kiln may be encased in sheet metal A^7. The doors, B, B^1, C and C^1 should be made as nearly gas tight as is readily feasible. For this purpose casing B^5 and C^5 are provided to receive the doors when in their elevated open positions.

In the contemplated mode of operation of the apparatus disclosed the cars R carrying the articles to be annealed are passed slowly through the kiln chamber, and as they pass through the latter they are gradually brought up to the annealing temperature by the heat generated in the combustion chambers D. In their passage through the exit end portion of the kiln chamber the articles are cooled down to a temperature at which they can safely be withdrawn from the kiln by the cooling system comprising the heat absorbing pipes G. Heat is generated in the combustion chambers by the combustion of the air and fuel admitted to the latter. A reducing gas atmosphere is maintained in the highly heated central portion of the kiln by the constant, though slow, influx of combustible gas into the chamber through the gas inlets E^2. An inert gas atmosphere is maintained in the end portions of the kiln and in the gas locks formed by the ante and exit chambers A^1 and A^2, by supplying

products of combustion thereof withdrawn from the combustion chambers. These products are cooled before being passed back into the kiln as a result of heat radiation from the gas holder K and the exposed portions of the conduit system through which the products of combustion pass from the combustion chambers back to the end portions of the kiln chamber and gas locks. The tendency of the products of combustion and the combustible gas to mix in the kiln chamber by diffusion, and as a result of convection current circulation longitudinal of the kiln chamber, is substantially neutralized by constantly withdrawing gases from the kiln chamber through the outlets P. This withdrawal of gas neutralizes the natural tendency of the atmospheres in the different kiln chamber zones to mix, partly by modifying the natural longitudinal convection current circulation kiln and partly by eliminating partially mixed gases which are replaced by the separately supplied unmixed gases. The withdrawal of gases from the kiln chamber may advantageously be restricted by closing some and opening other dampers P^1 wholly, or largely, to points adjacent the desired planes of division between the combustible gas atmosphere in the central portion of the kiln chamber and the inert gas atmosphere in the end portions of the kiln chamber. The proper location of these division planes or zones will depend somewhat on the temperatures employed, but considerable variations in location will ordinarily be possible because the products of combustion will not exert any appreciable oxidizing effect on the articles being annealed except at temperatures appreciably above those found in an annealing furnace of the character described at points in the kiln chamber at all close to the ends thereof. Carbon dioxide, the principal oxidizing agent in the products of combustion, will not oxidize iron except at temperatures many degrees above those at which dry air will produce oxidation.

The kiln chamber and cars may be shaped and arranged according to well known principles, so as to minimize longitudinal flow in the kiln chamber. Advantageously the pressure in the kiln chamber is maintained slightly above the pressure of the atmosphere, to thereby prevent influx of air into the kiln when the doors at its ends are opened, and so that leakage, if any, through the walls to kiln chamber will be out of the kiln chamber and not into the latter. This will result in some escape of products of combustion into the external atmosphere when the outer doors of the entrance and exit chambers are opened, but this is not particularly objectionable, in view of the nonpoisonous character of the products of combustion, and this escape of products of combustion is a matter of negligible importance when the hoods or other means are employed for quickly removing the products of combustion thus escaping from the ends of the kiln chamber. Air entering the chambers A^1 and A^2 when the doors B and C^1 are opened may be expelled through the outlets PA after these doors are closed and before the doors B^1 and C are opened, by products of combustion admitted to the chambers A^1 and A^2.

While in accordance with the provisions of the statutes I have illustrated and described the best form of my invention now known to me it will be apparent to those skilled in the art that changes may be made in the form of apparatus and mode of operation disclosed in detail without departing from the spirit of my invention as set forth in the appended claims, and that certain features of my invention may sometimes be employed to advantage without a corresponding use of other features.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. The method of annealing metal articles which consists in moving the articles through an elongated kiln chamber, cooling an exit end portion of the chamber and heating another portion thereof as required to first heat up and then cool the articles in their passage through the chamber, maintaining a reducing gas atmosphere in a central high temperature portion of the kiln chamber and maintaining an inert gas atmosphere in each end portion of the kiln.

2. The improvement in the method of treating articles in a continuous muffle heated kiln which consists in maintaining a reducing gas atmosphere in a hot central portion of the kiln and maintaining an inert gas atmosphere in each end of the kiln chamber.

3. The method of annealing metal articles which consists in moving the articles through an elongated kiln chamber. cooling exit end portion of the chamber and heating other portions thereof as required to first heat up and then cool the articles in their passage through the chamber, maintaining a reducing gas atmosphere in a central high temperature portion of the kiln chamber and maintaining an inert atmosphere formed by products of combustion in each end portion of the kiln.

4. The improvement in the method of treating articles in a continuous muffle heated kiln which consists in maintaining a reducing gas atmosphere in a hot central portion of the kiln and maintaining an inert atmosphere containing carbon dioxide in each end of the kiln chamber.

5. The method of safely maintaining a highly heated combustible gas atmosphere in a central portion of a continuous kiln

which consists in passing combustible gas slowly into said central portion of the kiln and passing an inert gas into the end portions of the kiln, and withdrawing gases from the kiln at points between each end and the central portion thereof.

6. In a muffle heated continuous furnace the combination comprising an elongated furnace chamber provided with cooling conduits adjacent its exit end and with muffle heated means for other portions of the chamber, the improvement which consists in means for supplying a reducing gas to a central portion of the chamber and for supplying an inert gas to the end portions of the chamber and means for withdrawing gases from the furnace chamber at points between each end and the central portion thereof.

7. A continuous furnace comprising in combination, an elongated furnace chamber with double doors constituting a gas lock at each end of the chamber, means for passing the articles to be treated through the chamber, means for cooling an exit portion of the chamber, muffle heating means for heating other portions of the kiln chamber, means for supplying a reducing gas to the central portion of the kiln chamber, means for passing an inert gas into said gas locks, and into the adjacent end portions of the kiln and gas outlets opening to the kiln chamber at points between its center and ends.

8. A furnace comprising in combination an elongated furnace chamber, means for passing articles to be treated through the chamber, a conduit cooling system for the exit end portion of the chamber, muffle heating means, with fuel and air inlets thereto, for heating other portions of the kiln chamber, means for passing a combustible gas into a central portion of the kiln chamber, and means for passing products of combustion from said muffle heating means into the end portions of said kiln chamber.

9. A continuous furnace comprising in combination, an elongated furnace chamber, means for passing the articles to be treated through the chamber, means for cooling the exit end portion of the chamber; muffle heating means for heating other portions of the kiln chamber, means for supplying a reducing gas to the central portion of the kiln chamber, means for passing an inert gas into the end portions of the kiln and regulable gas outlets opening to the kiln chamber at distributed points between its center and ends.

10. A furnace comprising in combination, an elongated furnace chamber, means for passing articles to be treated through the chamber, a conduit cooling system for the exit end portion of the chamber, muffle heating means with fuel and air inlets thereto for heating other portions of the kiln chamber, means for passing a combustible gas into the central portion of the kiln chamber, means for withdrawing products of combustion from said combustion chambers, cooling said products and passing them into the furnace chamber at the ends of the latter, and gas outlets opening from the furnace chamber at points between the center and ends thereof.

Signed at Detroit, in the county of Wayne and State of Michigan, this 26th day of April, A. D. 1920.

PHILIP D'H. DRESSLER.