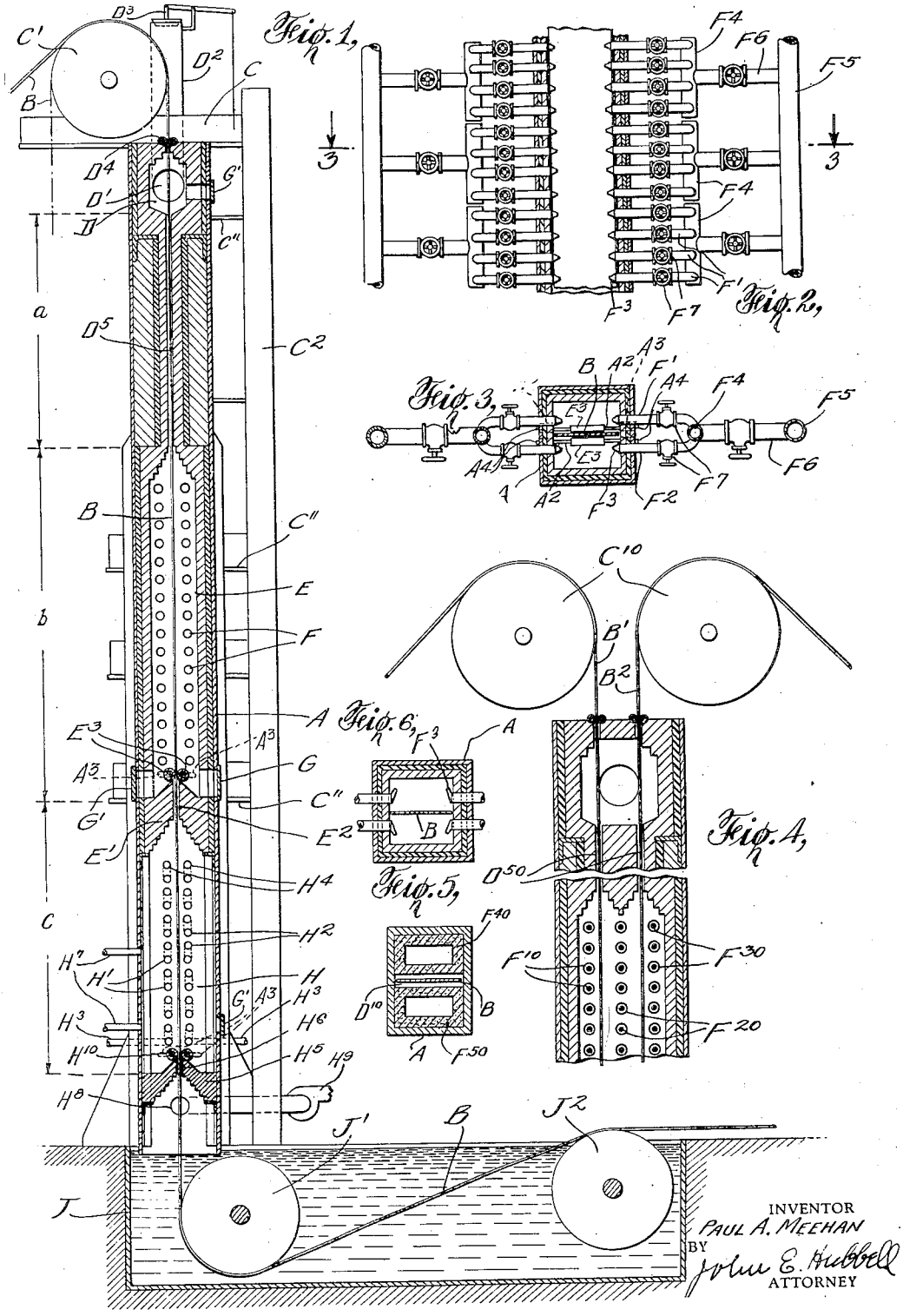
Dec. 6, 1932. P. A. MEEHAN 1,890,065

METHOD AND APPARATUS FOR HEAT TREATING SHEET METAL

Filed June 28, 1927



Patented Dec. 6, 1932 1,890,065

UNITED STATES PATENT OFFICE

PAUL A. MEEHAN, OF CLEVELAND, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO SWINDELL-DRESSLER CORPORATION, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA

METHOD AND APPARATUS FOR HEAT TREATING SHEET METAL

Application filed June 28, 1927. Serial No. 202,014.

The present invention relates to furnaces wherein a strip of metal in the form of wire strands or an elongated web of sheet metal is subjected to a continuous heat treating process. The object of my invention is to provide an improved method of and apparatus for continuously heat treating metal in such a form. The apparatus of my invention is especially adapted for operation as a wire or sheet metal annealing furnace and is characterized by the construction of the furnace in such a manner as to permit a vertical passage therethrough of the material to be heat treated.

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 drawing and descriptive matter in which I have illustrated and described preferred embodiments of the invention.

Of the drawing:

Fig. 1 is an elevation in section of a preferred form of my invention;

Fig. 2 is an enlarged side view of a portion of the apparatus shown in Fig. 1;

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

Fig. 4 is a sectional elevation of a portion of a modified form of my invention;

Fig. 5 is a section through the heating zone illustrating a modified form of heating means; and

Fig. 6 is a section through the heating zone illustrating another form and arrangement of heating elements.

In the drawing I have illustrated a furnace structure A wherein a continuous web or strip of sheet metal B is subjected to annealing treatments and which may be regarded as comprising a vertical series of treatment zones including a low temperature or preliminary heating zone *a*, a high temperature or soaking zone *b* and a cooling zone *c*. In the construction shown, the furnace A is substantially rectangular in cross section and arranged to permit the free passage of the strip of sheet metal B from the top to the bottom of the furnace. At the top of the furnace is a platform C on which is mounted for rotation a large size drum, roll or pulley C′ on the periphery of which the strip B of sheet metal is supported and passed to the furnace preheating zone *a*. At the top of the preheating zone is arranged a chamber D, the opposite sides of which are arranged with outlets D′ to a stack D^2 provided with a draft regulating valve D^3. At the top of the chamber D are arranged a pair of centering rollers D^4 between which the strip of metal to be heat treated is passed downward and which prevent the heating gases from escaping through the top of the passage. A vertical rectangularly shaped passage D^5 extends from the bottom of the chamber D to the top of the high temperature heating chamber E of the heating zone *b*.

The heating zone *b* comprises the vertical heating chamber E wherein two series F', F^2 of vertically spaced burners F are located in burner openings in opposite sides of the heating chamber. The burner openings for each set of burners are spaced horizontally from the openings of the adjoining series so that the burning mixture from each burner is discharged between the side wall and the descending strip of sheet metal. Each burner F comprises a cylindrical pipe element having a tapered nozzle F^3 at the inner end thereof and connected at its outer end through a valve F^7 to a group main F^4 into which the burners in that section of the heating chamber are connected. As shown in Fig. 2 each group main F^4 has four burner elements of each series on one side of the heating chamber connected thereto and is in turn connected to a gas main F^5 by a valved connection F^6. At vertically spaced points in the furnace side walls are openings G opening to the interior of the furnace at various sides thereof and to which access is had by platforms C″ secured to the furnace wall and connected to an elevator shaft C^2. These openings G may be used for inspection or cleaning operation and are especially useful for the insertion of suitable tools by which the material to be treated may be initially threaded through the guide rolls. The

openings are closed at their outer ends by closure devices G'. The bottom of the heating chamber is formed by an inverted V-shaped wall portion E' having a vertical rectangular shaped passage E^2 through the apex thereof. At the upper end of the passage is mounted a pair of adjustable guide rollers E^3 formed of heat resistant material for the strip of sheet metal B.

The wall portion E' forms the top of a vertical cooling chamber H in the cooling zone *c*. The cooling chamber comprises two horizontally spaced series of cooling elements H' and H^2, each series comprising vertically spaced horizontal elements each of which is connected at its opposite ends to the adjacent upper and lower cooling elements, respectively. A cooling medium, such as water, is introduced into each series of elements through an inlet pipe H^3 at the bottom of each series and passes out at the top of the series through outlet pipe H^4.

At the bottom of the cooling chamber H is arranged an inclined bottom wall H^5 similar in construction to the wall E' and provided with a restricted passage H^6 through the central portion thereof. At the upper end of the restricted passage is arranged a pair of adjustable rollers H^{10} between which the strip or web of sheet metal is guided. Each roller of the guide roller pairs E^3 and H^{10} is rotatable on a shaft A^2, which extends parallel to the strip B and with each end projecting through a horizontal slot A^3 formed in the adjacent side wall of the furnace A. Each shaft is normally fixed in a predetermined position in the corresponding slots by any suitable holding means A^4. Each pair of rollers can be moved towards or away from each other by loosening the holding means, varying the position of the shaft ends in the corresponding slots, and again tightening the holding means. The cooling chamber is also provided at vertically spaced points in the side walls thereof with inlet pipes H^7 through which reducing gases are introduced into the cooling chamber. The lower portion of the furnace below the bottom wall of the cooling chamber is provided with a pair of outlet pipes H^8 in opposite side walls of the furnace and connected at their outer ends to a fan H^9, so that any gases formed in the section of the furnace below the cooling chamber will be drawn off by the fan.

A submerged tank J is constructed at the base of the furnace structure with the lower part of the furnace arranged to project slightly therein. The tank is filled with a liquid cooling medium which forms a liquid seal for the bottom of the furnace chamber. Mounted in the tank are a pair of rotatable drums or pulleys J' and J^2, the drum J' being located with one part of its peripheral portion in line with the opposite portion of the periphery of the drum C' at the top of the furnace so that the strip of sheet metal will pass downward through the furnace without contacting with any of the parts thereof except the guide rolls D^4, E^3 and H^{10} and around the drum J' to the drum J^2 from which it passes to the pickling baths (not shown).

In the operation of the furnace described, a continuous strip of sheet metal B, which may be formed by spot welding strips rolled from billets, is passed downward through the preheating zone *a* where it is heated by the gases arising from the high temperature heating zone *b*. The heat transference in this section is very high due to the close contact of the gases in the restricted passage D^5 with the descending sheet metal. The strip then passes through the heating zone *b* wherein it is heated to the desired temperature. By controlling the burner valves, the final temperature to which the strip is heated may be closely regulated. The burner provisions are of the premixing type, wherein the air and gas are already mixed before issuing from the burner nozzles. It is desirable that the burners be so regulated that a reducing atmosphere be maintained within the heating chamber E, since in annealing operations the metal sheets or strands of wire being heat treated should not be exposed to oxidizing conditions when the metal is at the high temperatures to which it is ordinarily heated. A slight pressure is maintained within the heating chamber E to prevent any upward movement of the atmosphere in the cooling chamber H into the heating chamber.

The strip of sheet metal then passes downward between the guide rolls E^3 through the vertical passages into the cooling chamber H, where due to the direction of flow of the cooling medium through the pipe elements H' and H^2 being opposite to the direction of travel of the strip of metal, the metal is slowly cooled in its downward passage and passes through the passage H^6 into the tank J. The restricted passage E^2 at the upper end of the cooling chamber tends to further prevent any upward movement of the cooling atmosphere. The introduction of reducing gases through the inlet pipes H^7 tends to build up a small pressure in the cooling chamber which would keep the metal from being oxidized during its passage through the cooling chamber. Any leakage of the cooling chamber atmosphere downward through the passage H^6 would be drawn off by the fan H^9 and any leakage up through the passage E^2 would pass off with the combustion gases.

The strip of metal passing through the tank J is still at a temperature sufficient to generate a quantity of steam which collects in the portion of the furnace below the wall H^5 and which is prevented from passing upwardly through the restricted passage H^6 by the action of the fan H^9. The final stage of

cooling takes place in the tank J and the metal strip is then passed to the usual pickling apparatus.

My invention is characterized by the vertical type of furnace construction which is especially adapted for annealing metal in an elongated form, as a continuous strip of metal may be passed from the top of the furnace to the bottom without contacting with any of the parts which would scratch the surface of the metal, a disadvantage occurring in horizontal annealing furnaces, and is further characterized by the gravity circulation of the gases in the heating and cooling zones as the hot gases in the heating chamber naturally tend to rise and flow upward through the preheating zone to the stack while the colder gases in the cooling chamber tend to remain in that position. The combustion conditions in the heating zone may be so regulated that a slight pressure in that zone will be sufficient to prevent any movement of the gases into or from the heating chamber to the cooling chamber. A further advantage of my invention is that less ground space is occupied by a vertical furnace than by existing types of horizontal annealing furnaces. The furnace illustrated is capable of handling strips of sheet metal up to a maximum width of 24″ and is especially adapted for the annealing of automobile fender stock, which is approximately 18″ in width.

Various modifications of the type of furnace construction shown in Figs. 1–3 may be made, one of which is illustrated in Fig. 4, wherein parallel webs or strips of sheet metal B' and B^2 are passed downward simultaneously over corresponding drums C^{10}. In this modified construction the heating chamber is provided with three vertical series of burner elements F^{10}, F^{20}, F^{30} in openings in opposite sides of the heating chamber, the burner series being horizontally spaced so that each strip of metal will be evenly heated on all sides. As shown the furnace is constructed with a duplicate set of restricted passages D^{50} similar to the passage D^5 shown in Fig. 2, through which the strips are separately passed.

Other means may be provided for heating the strip in the preheating zone *a* and heating zone *b* such as electrical resistors on either side of the sheet metal or, as shown in section in Fig. 5, vertical combustion chambers F^{40} and F^{50} through which the heating gases pass and which extend through the heating and preheating zones. The combustion chambers are arranged with their adjacent sides spaced apart to provide a narrow passage D^{10}, like the passage D^5, through which the metal strip B may be passed. In such constructions, the proper furnace atmosphere may be introduced into the bottom of the passage to provide reducing conditions therein so that there will be no oxidation of the sheet metal during the annealing operations.

A further modified form of heating means is illustrated in Fig. 6 wherein the burner nozzles F^3 are so arranged that the ignited mixtures are discharged against the side walls of the heating chamber which are parallel with the material being heated. In this construction the material is mainly heated by radiation from the side walls of the heating chamber.

While in accordance with the provisions of the statutes, I have illustrated and described the best form of embodiment 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 the apparatus disclosed without departing from the spirit of my invention as set forth in the appended claims and that in some cases certain features of my invention may be used 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 sheet metal of a substantial width which comprises passing a continuous strip of the metal downwardly through a series of heating chambers out of contact with the apparatus therein and in which the metallic strip is progressively heated to a high temperature by radiation and convection, slowly cooling said strip during its passage through a cooling chamber, maintaining said strip in a reducing atmosphere while in said heating and cooling chambers, and subjecting the strip while in an unoxidized condition to a final cooling action by passing it through a bath of cooling liquid.

2. The method of annealing sheet metal of a substantial width which comprises passing a continuous strip of the metal vertically downward through a low temperature preheating zone in which heat is transferred to the metal by convection, a high temperature heating zone in which heat is transferred to the metal partly by convection and partly by radiation and wherein a reducing atmosphere is maintained, and a cooling zone through which a cooling fluid is passed in a direction opposite to the travel of the metal strip, and regulating the combustion conditions in said heating zone to prevent the circulation of gases between said heating and cooling zones.

3. A vertical furnace for subjecting a continuous strip of sheet metal to heat treatment comprising a vertically elongated heating chamber, heating means arranged in said chamber at opposite sides of said strip, means for moving said strip downwardly through said chamber, and guiding means at one level in said chamber at opposite sides of said strip maintaining said strip out of contact with

said heating means while passing through said chamber.

4. A furnace for subjecting a continuous strip of sheet metal to heat treatment comprising a vertically elongated heating chamber, guiding means for causing the strip of sheet metal to move vertically through said chamber and means for causing heating gases to move through said chamber in a direction opposite to the movement of said metal strip.

5. A furnace adapted for heat treating a continuous strip of sheet metal of a substantial width and comprising a vertically elongated preheating chamber, a vertically elongated heating chamber in vertical alignment with said preheating chamber and connected thereto, a vertically elongated cooling chamber in vertical alignment with said heating chamber, and means for passing a continuous strip of metal vertically through said chambers.

6. A vertical annealing furnace comprising a preheating chamber, means connected to the upper end thereof for effecting an upward heating gas flow therethrough, a vertically elongated heating chamber having its upper end connected to said preheating chamber, means for passing a continuous strip of metal vertically downward through said chambers, heating means in said heating chamber at opposite sides of said strip of metal, and means preventing contact between said strip and heating means.

7. An annealing furnace comprising a preheating chamber, a heating chamber, said preheating chamber being connected to said heating chamber and arranged to receive heating gases therefrom, means for passing a strip of metal vertically through said chambers and means for withdrawing the heating gases from the top of said preheating chamber.

8. An annealing furnace comprising a preheating chamber, a heating chamber and a cooling chamber, means for passing a continuous strip of sheet metal through said chambers, means for withdrawing heating gases from said heating chamber through said preheating chamber, means in said heating chamber for simultaneously heating both sides of said metal strip, means for maintaining a reducing atmosphere in said heating chamber, means in said cooling chamber for simultaneously cooling both sides of said metal strip, and heat resistant guide means at vertically spaced points in said furnace by which said metal strip is prevented from contacting with the walls of said chambers.

9. The method of annealing a continuous strip of metal which comprises passing the strip vertically downward successively through a preheating zone, a high temperature heating zone and a cooling zone, progressively heating said strip while passing through the preheating and high temperature zones by passing heating gases from said high temperature zone into intimate contact with said strip while passing through said preheating zone and supplying heat to said strip while passing through said high temperature zone by radiation and convection, slowly cooling said strip while passing through said cooling zone, and regulating the pressure conditions in said high temperature zone to prevent the passage of gas from said cooling zone into said high temperature and preheating zones.

Signed at Cleveland, in the county of Cuyahoga, and State of Ohio, this 25th day of June, A. D. 1927.

PAUL A. MEEHAN.