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2,130,756

HEAT TREATMENT OF METALS

Filed Oct. 6, 1936

2 Sheets-Sheet 1

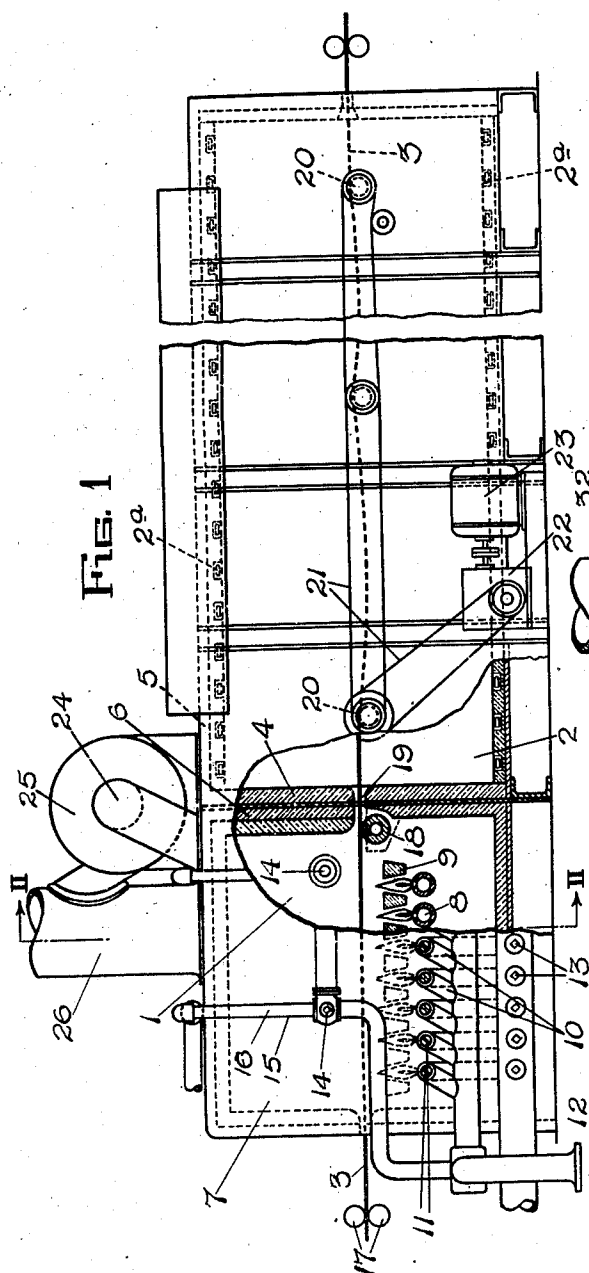


FIG. 1

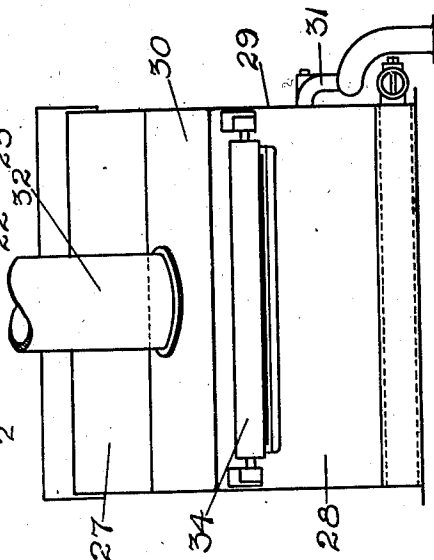


FIG. 4

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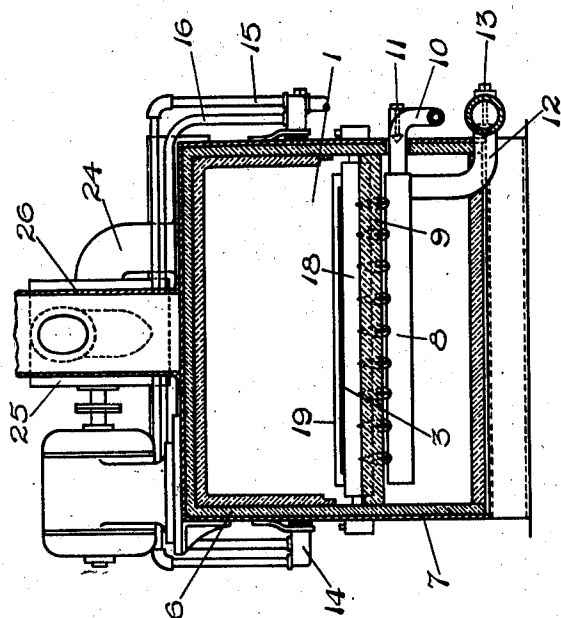


FIG. 2

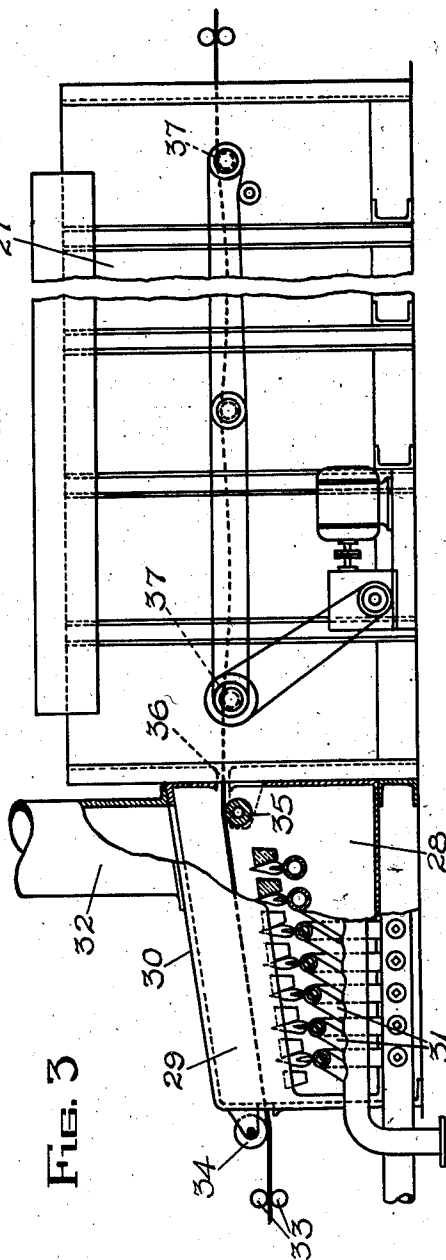


FIG. 3

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UNITED STATES PATENT OFFICE

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HEAT TREATMENT OF METALS

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7 Claims. (Cl. 13—2)

This invention relates to an improved method and apparatus for heat treating metals and in particular to a continuous annealing or other heat treating process in which the metal is passed through a heated furnace.

At the present time continuous annealing of metal strip, sheet or wire, is usually carried out in furnaces which are heated by gaseous or liquid fuel or by radiation from electrical resistance elements. For satisfactory annealing it is often necessary not only to raise the metal to the annealing temperature, but also to maintain it at this temperature for a given period of time. Although metal strip or the like can be heated up rapidly and economically in gas fired furnaces, difficulty is often experienced in controlling accurately the final annealing temperature. With electrically heated resistance furnaces, on the other hand, this difficulty is overcome, since accurate thermal control is possible and the metal is heated in a uniformly radiating chamber. The capital cost of such furnaces, however, is high. Moreover, the maximum economic furnace temperature which can be attained by radiant heat supplied by electrical resistance elements is about 850° C. so that the metal is not heated as rapidly as possible. Consequently the metal has to be passed through the furnace relatively slowly, with the result that the output of the furnace is restricted.

The object of the present invention is to provide a method and apparatus for the continuous annealing or heat treating of metals which will be free from the disadvantages referred to in the preceding paragraph.

According to the method of the invention, the metal strip, sheet, wire or the like, is pre-heated by passing it through a pre-heating zone, where it is rapidly heated by the combustion in said zone of a suitable fuel, e. g., gas or oil, whereby its temperature is raised substantially to that required for the intended heat treatment, the pre-heated metal then being passed through an annealing or heat treating zone which is heated by electric heating elements whereby the metal is maintained at the required temperature by radiant heat. The arrangement is preferably such that the gaseous products of combustion in the pre-heating zone are led away so that a minimum of combustion gas enters the annealing zone. The invention also comprises apparatus for carrying out the above method.

Two forms of apparatus suitable for carrying out the invention are illustrated in the accompanying drawings, in which—

Figure 1 is a longitudinal side elevation, partly in section, of a combined gas-fired and electric annealing furnace suitable for carrying out the method of this invention.

Figure 2 is a cross-sectional elevation on the line 2—2 of Figure 1.

Figure 3 is a longitudinal side elevation, partly in section, of a modified form of furnace.

Figure 4 is an end elevation, looking from the left, of the furnace shown in Figure 3.

Referring to Figures 1 and 2 of the drawings, the numeral 1 designates a gas-fired pre-heating chamber adjacent to an annealing chamber 2, which is heated by electrical resistance elements 2^a of any suitable known type. The annealing chamber 2, which may be about 20 feet long, is provided with a refractory lining 4 encased within a steel casing 5, and the pre-heating chamber 1, which is relatively short, has a refractory lining 6 encased within a steel casing 7.

Rows of gas burners 8 are provided in the pre-heating chamber, below and in close proximity to the metal strip 3 which passes continuously through the furnace. Refractory bars 9 are arranged between neighbouring rows of burners, as shown, and these bars, when they become heated, serve to provide a more even distribution of heat. Gas is supplied to the burners by means of pipes 10 having regulating valves 11. The combustion air is supplied through pipes 12 having regulating valves 13. The air may be pre-heated and/or supplied under pressure, if desired. In order that radiant heat from the upper walls of the preheating chamber may be employed, auxiliary gas burners 14 positioned in the side walls of the preheating chamber are provided. These burners are supplied with gas and air by means of pipes 15 and 16 respectively.

The strip 3 is passed through tensioning rollers 17 before entering the preheating chamber and passes over a roller 18 of heat-resisting material before entering the annealing chamber through an aperture 19 in the dividing wall between the two chambers. The strip is conveyed through the furnace by means of a series of rollers 20 located in the annealing chambers, which rollers are driven simultaneously by a chain drive 21 coupled to a reduction gear 22 and electric motor 23.

A flue 24, communicating with an induced draft fan 25 and a chimney 26, is provided at one end of the gas fired chamber for the purpose of conducting away the gaseous products of combustion, and the aperture 19 through which the strip enters the electric furnace is made as small

as possible so that a minimum of combustion gases enters the annealing zone.

The temperature of the gases in the preheating zone is considerably higher than that required for annealing purposes, so that the strip is rapidly heated. The speed of travel of the strip through the furnace and the degree of heating is so regulated that the strip is raised to the correct annealing temperature as it passes through the preheating zone. In the case of brass strip this temperature may be about 630° C.

Figures 3 and 4 of the drawings indicate how the invention can be applied to the conversion of an existing continuous electric annealing furnace 27 by the addition of a preheating chamber 28 which is arranged at the front end of the electric furnace. The pre-heating chamber here comprises a simple sheet steel casing 29 having an inclined roof portion 30. The heat is applied in this case solely by means of a row of gas burners 31 arranged beneath the strip. The gas and air supplied to the burners are regulated in the manner previously described and the products of combustion are conducted away from the preheating chamber by means of a chimney 32 affixed to the roof portion 30.

The metal strip, after passing through tensioning rolls 33, is guided through the preheating chamber by means of guide rollers 34 and 35 and enters the electric annealing furnace by the opening 36. The driven rollers 37 in the electric furnace 27 serve to convey the strip through the furnace.

In some cases, instead of conducting away the gaseous products of combustion by means of a chimney or flue in the preheating chamber these gaseous products may be passed through the annealing or heat treating zone before being discharged to the atmosphere.

By heat treating metals in accordance with the invention not only is the capital cost of the plant required for a given output very substantially decreased, but a saving in production costs is obtained, since a very high temperature gradient can be employed when raising the metal to the desired annealing temperature and this rapid heating can be carried out with greater economy by combustion than by electrical means.

By way of comparison it may be mentioned that in the case of an electrically heated furnace 20 feet long, even when the front entry zones of the furnace are at a temperature of about 850° C., annealing of brass strip 0.030 inch thick can only be carried out at a speed not exceeding about six feet per minute, whereas, when the strip is treated in accordance with this invention the annealing operation can be carried out at a speed of nine feet per minute, thus increasing the output of the furnace by 50%.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that I do not limit myself to

the specific embodiments thereof except as defined in the appended claims.

I claim:

1. Apparatus for the heat treatment of metal comprising a preheating chamber having an inlet for the metal to be heat treated and a juxtaposed annealing chamber having an outlet for the heat treated metal and communicating with said preheating chamber by a narrow opening adapted for the passage of said metal, means for conveying said metal through the preheating chamber and annealing chamber in succession, combustion means for heating said metal during its passage through said preheating chamber, and electrical means for heating said annealing chamber.

2. Apparatus as set forth in claim 1, in which said combustion means comprise a plurality of burners.

3. Apparatus for the heat treatment of metal comprising a preheating chamber having an inlet for the metal to be heat treated and a juxtaposed annealing chamber having an outlet for the heat treated metal and communicating with said preheating chamber by a narrow opening adapted for the passage of said metal, means for conveying said metal through the preheating chamber and annealing chamber in succession, a plurality of rows of gas jets arranged in said preheating chamber and adapted to heat said metal during its passage therethrough, gas and air regulating valves for each of said rows, said valves being located outside said preheating chamber, an outlet for combustion gases from said preheating chamber, and electrical means for heating said annealing chamber.

4. Apparatus as set forth in claim 3, in which a plurality of refractory bars are arranged between neighbouring rows of said gas jets.

5. Apparatus as set forth in claim 3, in which additional gas jets are provided in the preheating chamber, said additional gas jets being adapted to heat the upper part of said chamber.

6. Apparatus for the heat treatment of metal comprising a refractory-lined preheating chamber having an inlet for the metal to be heat treated and a juxtaposed refractory-lined annealing chamber having an outlet for the heat treated metal and communicating with said preheating chamber by a narrow opening adapted for the passage of said metal, means for conveying said metal through the preheating chamber and annealing chamber in succession, combustion means for heating said metal during its passage through said preheating chamber, and electrical heating means located adjacent the refractory lining of said annealing chamber.

7. Apparatus as set forth in claim 6, in which said combustion means comprise a plurality of gas burners arranged substantially in one plane and extending over the greater part of the cross-section of said preheating chamber.

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