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Semenov et al.

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[54] **FURNACE FOR DIRECT NON-OXIDIZING HEATING OF MATERIAL UNDER THERMAL TREATMENT**

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[51] **Int. Cl.** **F27b 9/14,** F27b 3/22

[58] **Field of Search** 432/72, 133, 136, 144, 432/146, 149, 150

[56] **References Cited**

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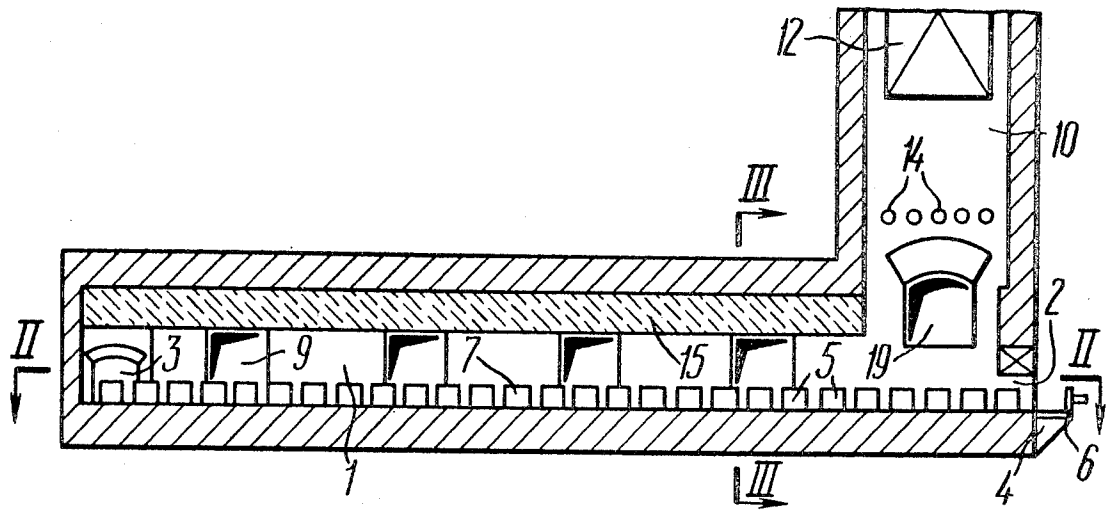
[57] **ABSTRACT**

The present invention relates to the equipment designed for heating metal blanks prior to their hot pressure shaping with a resultant reduction of metal resistance to deformation. The furnace according to the invention is adapted for incomplete burning of fuel with an excess air ratio of 0.3 – 0.5, whereas air to be directed to burning is heated in a recuperator. Burners are evenly located along the elongated working chamber and located across this chamber. The wall of the working chamber located opposite to the burners has gas outflow openings and this wall also serves as a wall of a gas-escape channel located parallel to the working chamber and being in height equal to that of the working chamber.

8 Claims, 3 Drawing Figures



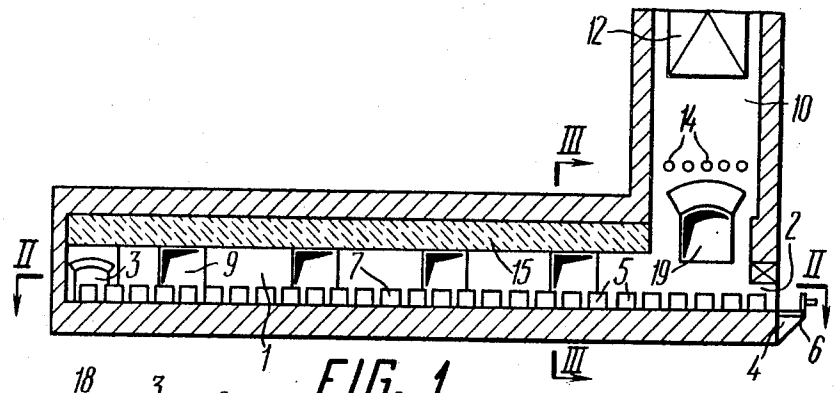


FIG. 1

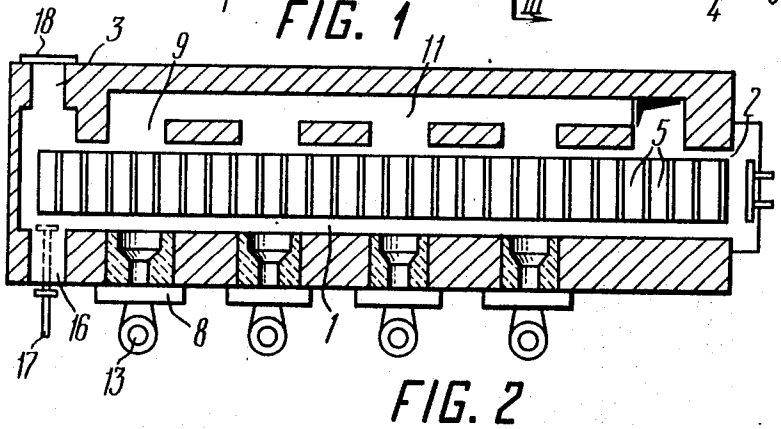


FIG. 2

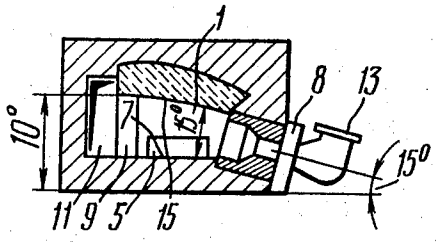


FIG. 3

FURNACE FOR DIRECT NON-OXIDIZING HEATING OF MATERIAL UNDER THERMAL TREATMENT

BACKGROUND OF THE INVENTION

The present invention relates to a furnace for direct non-oxidizing heating of material, in particular steel, being under thermal treatment. In such furnace, combustion products evolved as a result of incomplete burning of fuel, essentially gas, and possessing no oxidizing properties are forwarded directly to the material under thermal treatment.

The invention may be most efficiently utilized for heating metal blanks to high temperature at which the resistance of deformation of metal is substantially reduced.

PROBLEMS OF THE PRIOR ART

One of the main problems encountered in designing and operating furnaces for non-oxidizing heating lies in the necessity to ensure a reasonable combination of the high heating temperature, economic fuel burning and a limiting of the oxidizing phase in combustion products.

Such furnaces, as a rule, incorporate an elongated working chamber having a charging opening at one end and a discharging opening at a remote end. A burner adapted for incomplete burning of fuel, a rule of initial burning, is located at that end of the working chamber which has the discharging opening. Positioned between discharging and charging openings, near the former, are nozzles in the crown of the furnace to deliver air for secondary burning of combustion products brought from the above mentioned burner.

To reduce or prevent ingress of secondary combustion products, containing oxidizing components to the high temperature zone, where oxidizing reaction is most vigorous, the crown is made rather complex in configuration with maximum height at a place where said nozzles are positioned. This height is at least twice as much as the mean height of the working chamber. Besides, complex measures must be taken to coordinate velocities of initial and secondary combustion product flows. Problems are involved when determining the position of the nozzles for fuel supply to secondary combustion so as to have no turbulence of flows in the working chamber (cf., e.g., laid-open description of the invention to a F.R.G. Application No. 1,116,255, Cl. 18*c*, 8/90 of 1958).

Should a necessity arise to increase the throughout of the furnace when both charging and discharging openings have to be opened more frequently, gas flow will turbulate unavoidably while the material under treatment will oxidize. In addition, location of burning devices at two points of the working chamber far apart from each other will of necessity cause great heat losses due to the absorbtion of heat by the furnace lining.

SUMMARY OF THE INVENTION

The principal object of the invention is to increase temperature in the working chamber while preventing contact of air from penetrating into the furnace with material under thermal treatment, in a furnace adapted for continuous charging and discharging of said material.

This object is achieved due to the provision of a furnace equipped with devices for initial and secondary

burning of fuel and having an elongated working chamber with charging and discharging openings, wherein according to the invention, the devices for initial burning of fuel are uniformly located along one of the long walls of the working chamber, while the other long wall of the working chamber has gas outflow openings and this wall also serves as a wall for a gas-escape channel located parallel to the working chamber and being in height equal to that of the working chamber.

With this embodiment of the furnace, air unavoidably penetrating through charging and discharging openings will be carried by the flows of combustion products towards gas outflow openings which are only a very short distance away from devices for initial burning of fuel whereas its mixing at a high velocity of combustion product flows is possible only at the periphery of a flame torch.

With the devices for initial burning of fuel located substantially close to each other, flame torches of separate devices merge into a large single continuous flame which fills the entire working chamber, thus significantly reducing the surface area where mixing is possible for air penetrating into the working chamber with combustion products. Heating temperature in the furnace by obvious reasons is also substantially increased.

This effect displays best when gas outflow openings are positioned strictly opposite to the devices for primary burning and also when the distance between the hearth and the crown of the working chamber does not exceed the cross-sectional dimension of the flame torch produced by the device for initial burning of fuel this results in relatively smaller dimensions for the working chamber which is conducive to still higher heating temperature.

In a preferred embodiment of the invention, it is feasible that the crown be located at a 10° -15° angle in relation to the hearth. With this layout of the furnace lining, the flame would fill the working chamber over its entire cross section.

It is expedient that devices for initial burning of fuel be inclined in relation to the hearth of the working chamber at the same angle as the furnace crown is inclined. This wall make possible heating of the crown to such an extent where it is enabled to radiate energy taken by the upper portion of material under thermal treatment being displaced on the hearth.

For the sake of greater economy, installed beyond the working chamber is a chamber for secondary burning of fuel — for burning products effluant from the gas-escape channel. Heat products from the secondary burning is utilized by a recuperator adapted for heating air to be used in the initial burning of fuel.

In order to preclude penetration of air from the charging opening to the location zone of devices for initial burning of fuel, it is reasonable that the working chamber section adjacent to said opening communicate with the secondary burning chamber which should be positioned above the working chamber. With this embodiment of the furnace, the air penetrating to the furnace from the discharging opening is conveyed to the secondary burning chamber, while heat by way of radiation will preliminary heat the material under thermal treament brought into the furnace.

An important advantage of the present invention is that with a relatively high heating temperature the loss of metal due to scale (oxidizing) formation is not in excess of 0.4% by weight.

In order to make the present invention more readily understood a specific embodiment thereof will now be described with reference to the accompanying drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal section of a furnace according to the invention;

FIG. 2 is a section along line II — II of FIG. 1; and

FIG. 3 is a section along line III — III of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A furnace (FIGS. 1, 2, 3) is in plan of an elongated rectangular shape. A working chamber 1 lies along the furnace and is provided with a single charging opening 2 at the front end thereof located along the working chamber 1 and a single discharging opening 3 at the rear end thereof located across the working chamber 1. Mounted beneath the charging opening 2 is a bracket 4 for carrying material under thermal treatment — metal blanks 5 subject to heating. Mounted adjacent to the bracket 4 on a fixed base (not shown in the drawings) is a pusher mechanism 6 to displace blanks 5 from the bracket 4 to a hearth 7 of the working chamber 1 and furnace, along this hearth, towards the discharging opening 3. Openings formed in the long side wall of the working chamber (facing the viewer; see FIG. 2) incorporate devices for initial burning of fuel — burners 8 uniformly located along the working chamber 1 except at its forward portion at the charging opening 2.

A gas outflow opening 9 is formed in the opposite long side wall of the working chamber 1 for each burner 8. The gas outflow openings 9 communicate with a secondary burning chamber 10 (FIG. 1) through the agency of a gas-escape channel 11 (FIG. 2) whose one wall is formed by the long side wall of the working chamber 1 having the gas outflow openings 9. The height of the gas-escape channel 11 (FIG. 3) is equal to that of the working chamber 1.

Installed above the secondary burning chamber 10 is a recuperator 12 for heating primary air delivered to burners 8 through ports 13. Final burning of gas coming from the gas-escape channel 11 is effected in the chamber 10. Provided in the lower portion of this chamber 10 are devices for secondary burning of fuel — tuyeres 14 to deliver secondary air needed for complete burning of combustible components of gas. The secondary burning chamber 10, at its lower portion, communicates with that portion of the working chamber 1 which is adjacent to the charging opening 2.

Though, the burners 8 are spaced along the working chamber 1, they are disposed sufficiently close to each other to form a single continuous flame comparable to flame torches produced by single burners. A crown 15 of the working chamber 1 is spaced away from the hearth 7 over a distance not exceeding the cross-sectional dimension of the flame produced by the burner 8. Moreover, the crown 15 is inclined at a gradually altered angle within the range of 10° – 15° (larger limit refers to a crown section adjacent to the side wall with burners 8) in relation to the hearth 7, so as with the relatively small cross-sectional dimension of the working chamber, the spray could fill the chamber over its entire cross section, this materially reduces the surface where mixing of air with combustion products is probable. With this arrangement, the overall dimensions of the working chamber 1 are so reduced that the heating temperature may be sufficiently high.

It is possible that at the peripheral burners 8 air penetrating through the charging opening 2 and the discharging opening 3 interferes partly with an outside surface of the flame, however, due to a very small distance between burners 8 and gas outflow openings 9 and positioning these openings strictly opposite to burners 8, air is given no time to come into contact with blanks 5 and branched via the gas-escape channel 11 to the secondary burning chamber 10.

The burners 8 are inclined in relation to the hearth 7 at the same angle of 15° as the portion of the crown 15 adjacent to the long side wall with the burners 8 (see FIG. 3). Therefore, a part of any combustion products is directed to the crown 15 to be heated and to return a part of heat in radiant energy to the upper portions of the blanks 5 being continuously displaced along the hearth 7.

Secondary burning in the chamber 10 is effected to air delivered from tuyeres 14, and also, to that air which flows through the charging opening 2. As a result, air penetrating into the working chamber 1 fails to enter the high-temperature heating zone with the burners 8 located therein.

Positioning the secondary burning chamber 10 above the section of working chamber 1 adjacent to the charging opening 2 permits utilization of radiant energy released in the chamber 10 to afford preliminary heating of the blanks 5. Heat released in the chamber 10 is also utilized by a the recuperator 12 installed above this chamber, the recuparator 12 heats air delivered to burners 8.

The long side wall of the working chamber in which openings are provided for the burners 8 also has an opening 16 (FIG. 2) located opposite to the discharging opening 3. The opening 16 houses a pusher mechanism 17 adapted to push the blanks 5, heated to a required temperature, out of the furnace through the discharging opening 3.

In the course of heating blanks 5, and when the pusher mechanism 17 runs idle, the discharging opening 3 is closed by a gate 18.

For inspection and repair of the furnace, provision is made for an opening 19 (FIG. 1) located below tuyeres 14 for secondary air delivery.

What we claim is:

1. A furnace for directing non-oxidized heating of material under thermal treatment, comprising an elongated working chamber formed by elongated opposed side walls and relatively short end walls, a hearth, a crown above the hearth, and having an opening for charging said material under thermal treatment onto said hearth and an opening for discharging said material from said hearth;

means for primary burning of fuel spaced along one of said side walls and directly across said elongated working chamber toward the other opposed side wall; gas outflow openings in the other opposed side wall in substantially opposed relation to the means for primary burning of fuel;

a gas-escape channel located behind and parallel to said other opposed side wall of the elongated work chamber and communicating with the gas outflow openings, said gas outflow openings being of a height substantially equal to the height of said chamber;

a second chamber communicating with said gas-escape channel for secondary burning of combustion products received from the gas outflow opening through the gas-escape channel; and means for secondary burning of combustion products in the second chamber.

2. A furnace as of claim **1,** in which said gas outflow openings are in direct alignment with said means for primary burning of fuel.

3. A furnace as of claim **1,** in which said hearth and crown of said elongated working chamber, are located at a distance from each other not exceeding the cross-sectional dimension of a torch flame produced by said means for initial burning of fuel.

4. A furnace as of claim **3,** in which said crown of said elongated working chamber is located at an angle of 10° – 15° relative to said hearth of this chamber.

5. A furnace as of claim **4,** in which said means for primary burning of fuel is inclined to said hearth of said elongated working chamber at the same angle as said crown of this chamber.

6. A furnace as of claim **1,** in which said second chamber for secondary burning of combustion products is located beyond said elongated working chamber.

7. A furnace as of claim **6,** comprising a recuperator installed above said second chamber for secondary burning and is adapted for heating air directed to said means for initial burning of fuel.

8. A furnace as of claim **6,** in which said second chamber for secondary burning is located above a section of said elongated working chamber adjacent to said opening for charging said material under thermal treatment, and communicates with said section.

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