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K. LOECK ET AL

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FURNACE FOR THE HEAT-TREATMENT OF BILLETS, BLOOMS AND THE LIKE

Filed May 21, 1962

3 Sheets-Sheet 1

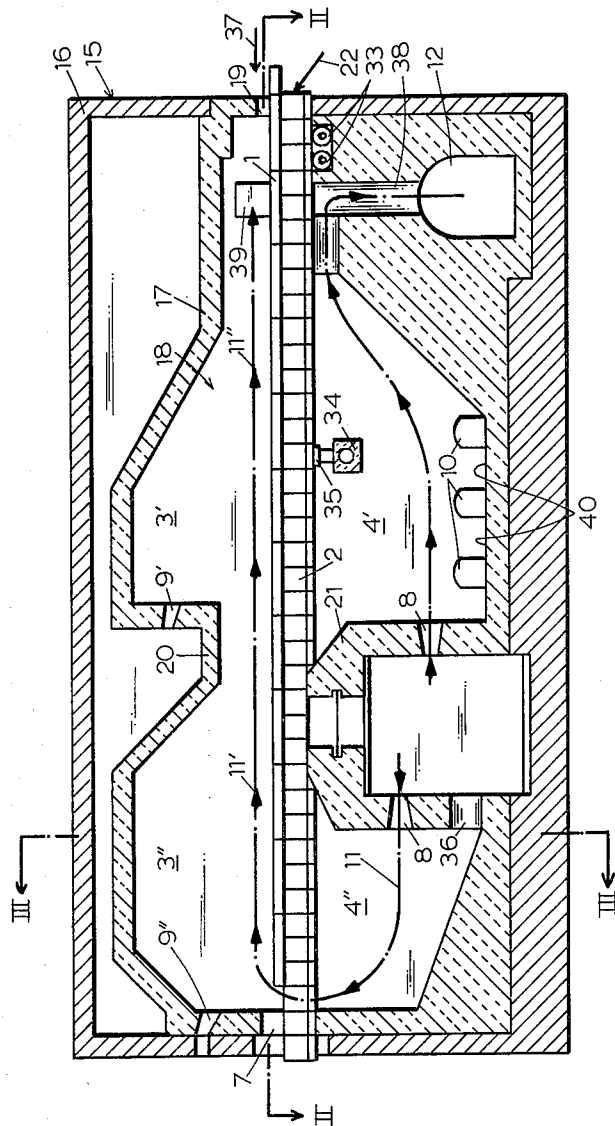


FIG. 1

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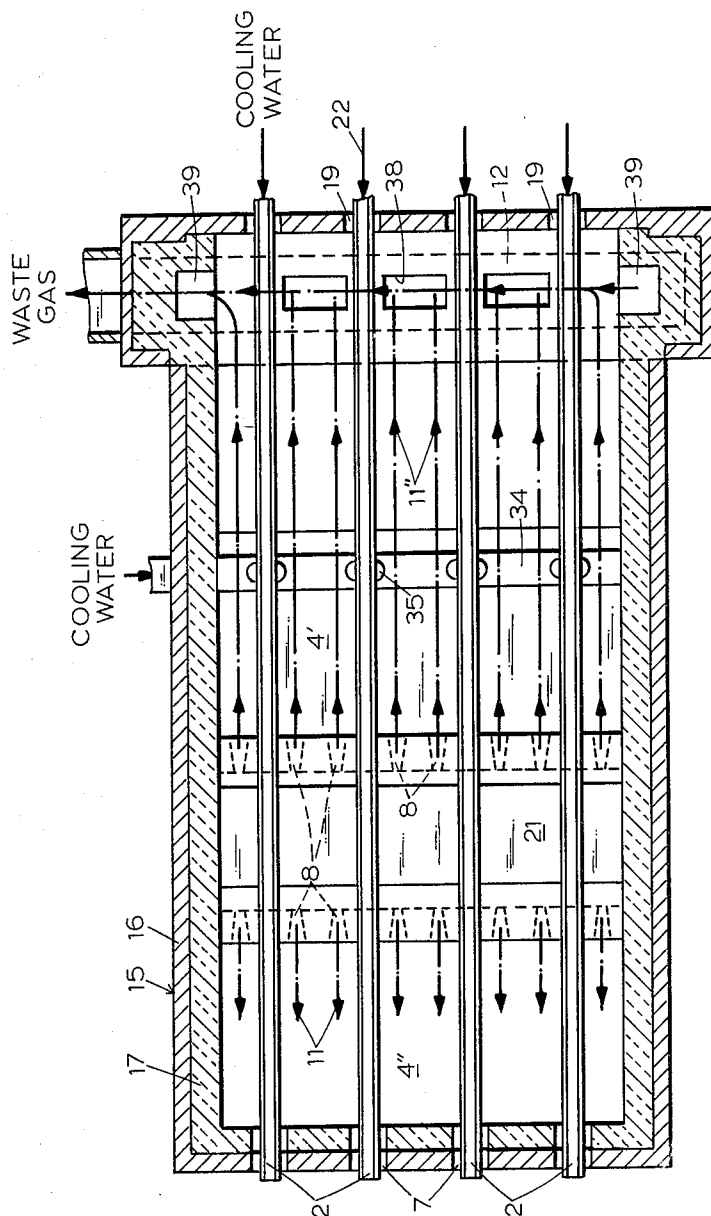


FIG. 2

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FIG. 3

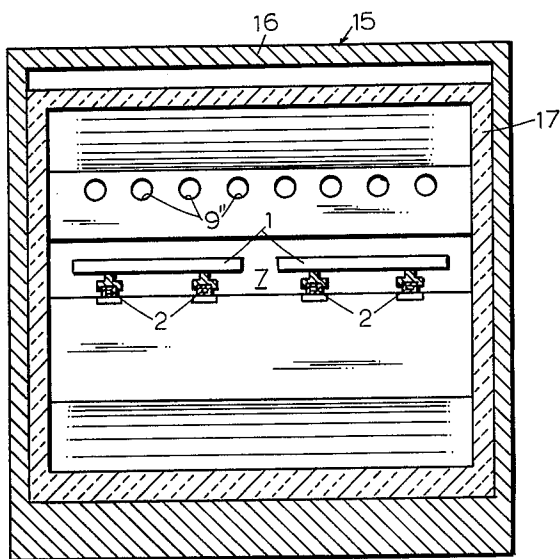


FIG. 4

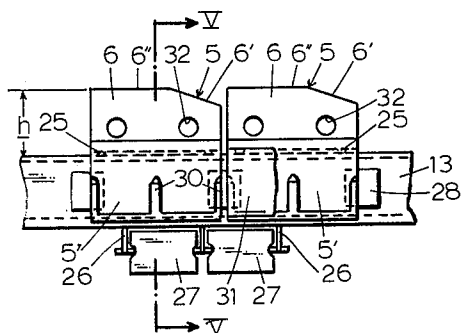
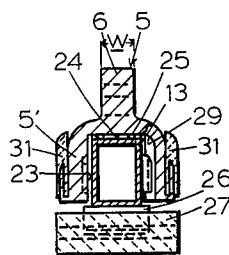


FIG. 5



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## FURNACE FOR THE HEAT-TREATMENT OF BILLETS, BLOOMS AND THE LIKE

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Claims priority, application Germany, May 23, 1961, H 42,673

1 Claim. (Cl. 266—5)

The present invention relates to a furnace for the heat-treatment of metal bodies such as billets, blooms, ingots and the like adapted to be processed in their heated state and, more particularly, to a pusher-type furnace of this character.

Heretofore, pusher-type furnaces for the heating of billets and blooms generally have been formed with a preheating zone, a main-heating zone and an equalizing zone successively arranged along a guide path for the bodies to be heated. The equalizing zone was required to permit temperature equalization within the heated body which often had portions in contact with the guide surfaces whose temperature was substantially below that of the remainder of the body so that so-called "black stripes" were formed. In the temperature-equalization chamber, the heat of the hotter part of the body gradually raised the temperature of the cooler parts. The preheating and main-heating zones of such furnaces generally were provided with water cooled guide rails terminating at a refractory-brick table within the equalizing zone. The disadvantages of this arrangement will become obvious when it is noted that such tables, which may be several meters long, often become encrusted with scale from the heated bodies as the latter are displaced therealong. This encrustation raises the transport surface of the table so that frequent cleaning is often required.

It is an object of the present invention to avoid the disadvantages of hitherto-known furnaces of the character described.

A more particular object of the invention is to provide a furnace for heating billets, blooms, ingots and the like in a continuous process while dispensing with the equalizing chamber of earlier furnaces.

The present invention contemplates the employment of water-cooled support rails extending within an elongated furnace chamber substantially between its inlet and outlet openings to convey the metal bodies through this chamber, the rails each comprising an elongated support member and a row of blocks mounted thereon and having substantially aligned surfaces adapted to receive the bodies pushed therealong. A furnace of this type, which is capable of heating such bodies without the formation of the aforementioned "black stripes," may comprise an upper and a lower compartment, between which the support rails extend, provided with burner means for producing a stream of hot gas in contacting relationship with the bodies transported along the rails. The latter are, advantageously, transversely spaced to permit the gases to contact both the upper and lower sides of the bodies. Thus, while the rails may consist of tubular members having an upper surface in direct contact with the under surface of the body and provided with insulating material about its periphery, I prefer to employ the tubular support member merely to carry blocks of heat-conductive material which are interposed between the members and the bodies.

According to a more particular feature of the invention, the blocks are supported on the water-cooled tubular member with at least partial peripheral clearance so that a

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gas-cushion (e.g. of air) is provided between the cooled members and the heat-conductive blocks. The latter may be partly insulated but are preferably provided with an uninsulated upstanding flange which is generally at the temperature of the gases in the furnace so that there is substantially no conduction of heat away from the bodies by the blocks. Accordingly, the formation of "black stripes" is avoided. The support members may be carried by transversely extending beams, which also are water-cooled, via the intermediary of upright hollow posts or pillars through which cooling fluid is circulated. While the present invention contemplates the formation of protuberances of limited surface area on the support members and/or the blocks in order to maintain the latter in loose relationship with respect to the former and to maintain the clearance between them, other means for producing the air gaps mentioned above may be employed (e.g. the forced flow of air between the members and the blocks).

According to another aspect of this invention, the upper and lower compartments of the furnace are generally subdivided into a preheating zone disposed adjacent the inlet opening and a main-heating zone disposed adjacent the outlet opening and extending substantially up to the latter. The support rails also extend to the outlet opening and may, in fact, project therethrough. Thus, the use of an equalizing table or hearth is completely avoided.

The blocks, according to the invention, are of generally inverted-Y configuration and have their arms embracing the support member, thereby forming a channel adapted to receive it with at least partial clearance. The substantially coplanar upstanding flanges of the blocks each have a beveled edge facing the inlet opening and adapted to cam the bodies upwardly upon their displacement along the carrying surfaces formed by the flanges so as to prevent entrainment of the blocks by the bodies. Moreover, the blocks and their supporting members are provided with complementary formations limiting relative longitudinal displacement so that the entire rail including the support member and its blocks may be removed as a unit from the furnace. In the usual manner, a lifting device may be provided at the outlet opening of the furnace for withdrawing the heated bodies and disposing them upon an inclined slide leading to the rolling mill. It is also possible to provide lateral chutes or guide channels at the outlet end of the furnace whereby the bodies may be pushed into these chutes for conveyance to the rolling mill or other processing installation.

The above and other objects, features and advantages of the present invention will become more readily apparent from the following description, reference being made to the accompanying drawing in which:

FIG. 1 is a longitudinal cross-sectional view schematically illustrating a furnace according to the invention;

FIG. 2 is a cross-sectional view taken along the line II—II of FIG. 1, with omission of the metallic bodies to be heated;

FIG. 3 is a cross-sectional view taken along the line III—III of FIG. 1;

FIG. 4 is an enlarged elevational view, partly broken away, of the support rails; and

FIG. 5 is a cross-sectional view taken generally along the line V—V of FIG. 4.

The drawing shows a pusher-type furnace 15 comprising a main housing 16 surrounding a refractory structure 17 forming an elongated furnace chamber generally designated 18. Furnace chamber 18 is provided at one axial end with an inlet opening 19 and, longitudinally remote therefrom, an outlet opening 7. These openings are spanned by a plurality of transversely spaced guide and supporting rails 2 which also subdivide cham-

ber 18 into upper and lower compartments. Partitions 20, 21 intermediate the openings further subdivide these compartments into preheating zones 3', 4' and main heating zones 3'', 4'', respectively. The preheating zones 3', 4' are adjacent the inlet opening while the main heating zones 3'', 4'' extend to the outlet opening without the intermediary of an equalizing zone of the type previously required.

The guide rails 2 comprise longitudinally extending central supporting members 13 which are tubular and of generally prismatic configuration (see FIGS. 4 and 5). A source of cooling fluid schematically shown as an arrow 22 supplies the tubular members 13 with cooling fluid. The tubular members carry respective rows of blocks 5 of heat-resistant but non-insulating character. These blocks 5 are of inverted-Y transverse cross-section and have arms 5' embracing with peripheral clearance the respective support member 13; the arms 5' form a channel 23 receiving the member. The roof 24 of this channel is formed with protuberances 25 of limited surface area in contact with the upper surface of member 13 for maintaining a gas cushion between the latter and the blocks 5.

The underside of members 13 carries channel struts 26 which secure refractory bricks 27 to this underside in order to insulate it. The lateral surfaces of members 13 are provided with outwardly extending formations 28 receivable in recesses 29 in the inner surface of arms 5' to limit relative longitudinal displacement of the blocks and the members. The flanks of arms 5' are provided with a plurality of longitudinally spaced pins 30 adapted to engage plates 31 of refractory, heat-insulating material.

The heat-conductive upwardly extending flanges 6 of the blocks 5 of each row are substantially coplanar and have beveled corners 6' facing the inlet opening to cam oncoming bodies 1 (e.g. steel blooms or billets) upwardly onto the flat carrying surface of each flange. The carrying surfaces 6'' operate in a substantially horizontal plane. Advantageously, the flange has a height  $h$  ranging between substantially 150 and 400 mm., and a transverse width  $w$  ranging between substantially 50 and 150 mm. The flanges 6 are also provided with bores 32 to facilitate their handling when the entire rail 2 is removed from the furnace 16. The rails 2 thus may be removed upon rolls 33 along the supporting surfaces of the furnace to permit the ready withdrawal of the rails along with these blocks 6, which may then be lifted from their supporting member 13 and replaced if necessary because of encrustation etc. The rails may also be supported within the furnace by water-cooled thermally insulated tubes 34 via hollow pillars 35 through which water is also circulated.

Partition 21 is formed with a chamber 36 admitting the heating fluid (e.g. hot gas or a burning gas mixture) through a plurality of transverse apertures or burners 8 into the lower compartment 4', 4'' of the furnace chamber into contact with the outsides of the bodies 1. A portion of the hot gas streams counter-current to the direction of displacement 37 of the bodies 1 as indicated by the arrows 11', 11'' while another portion of the gas stream flows in the direction of displacement (arrow 11). A plurality of burners 9', 9'' in the upper compartment 3', 3'' provide part of the heating fluid for the upper surfaces of bodies 1, another portion of the fluid arriving from the lower compartments via gaps between the bodies. The cooled gases are removed from the furnace chamber via upright ducts 38 communicating with the lower compartment 4' and leading to an exhaust-gas conduit 12. A pair of lateral ducts 39 also leading to this conduit removes the cooled gases from the upper compartment 3', 3''. Doors 10 are provided in the preheating zone 4' of the lower compartment for the removal

of scale which tends to accumulate on the floor 40 thereof.

This arrangement permits the heating of billets, blooms, ingots and the like without the formation of "black stripes" indicative of cool regions along those portions of the bodies contacted by the support rails, since the flanges 6, directly in contact with the bodies, are substantially at the furnace temperature and are insulated from the water-cooled support member by the air cushions. The rails 2 thus can extend to or through the outlet opening 7 inasmuch as no equalizing hearth is required. Consequently, a saving in material and labor as well as increased heating efficiency is obtained.

The invention described and illustrated is believed to admit of many modifications within the ability of persons skilled in the art, all such modifications being deemed included within the spirit and scope of the appended claim.

What is claimed is:

A pusher-type furnace for the heat-treatment of bodies, comprising a housing forming an elongated substantially horizontal furnace chamber and provided with an inlet opening and an outlet opening at opposite longitudinal ends of said housing; partition means in said chamber forming a succession of compartments therein commencing at said inlet opening and terminating at said outlet opening; a plurality of transversely spaced elongated rails longitudinally extending within said chamber through all of said compartments from said inlet opening to said outlet opening; and heating means in said chamber for passing a hot gas through all of said compartments above and below bodies resting upon said rails a terminal one of said compartments at said outlet opening having chambers above and below said rails and exposing said bodies to said hot gas as they move along said rails through said terminal compartment until said bodies pass through said outlet opening; said rails each comprising an elongated tubular support member, a row of heat-resistant but thermally conductive blocks of generally inverted-Y transverse cross-section fixedly mounted on said support member against longitudinal displacement relative thereto and having substantially aligned surfaces to receive said bodies, the arms of the inverted Y forming a channel adapted to receive the respective support member with at least partial peripheral clearance and thereby forming respective gas cushions between said blocks and said members, said blocks being further provided with protuberances extending into said channels in limited contact with said members, and heat-insulating means along an underface of each support member and on at least the outer flanks of each of said arms of the inverted-Y-shaped blocks, and roller means for removably mounting said rails in said housing whereby said support members with their respective blocks are concurrently withdrawable from said chamber.

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