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METAL HEATING FURNACE APPARATUS

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Fig. 1.

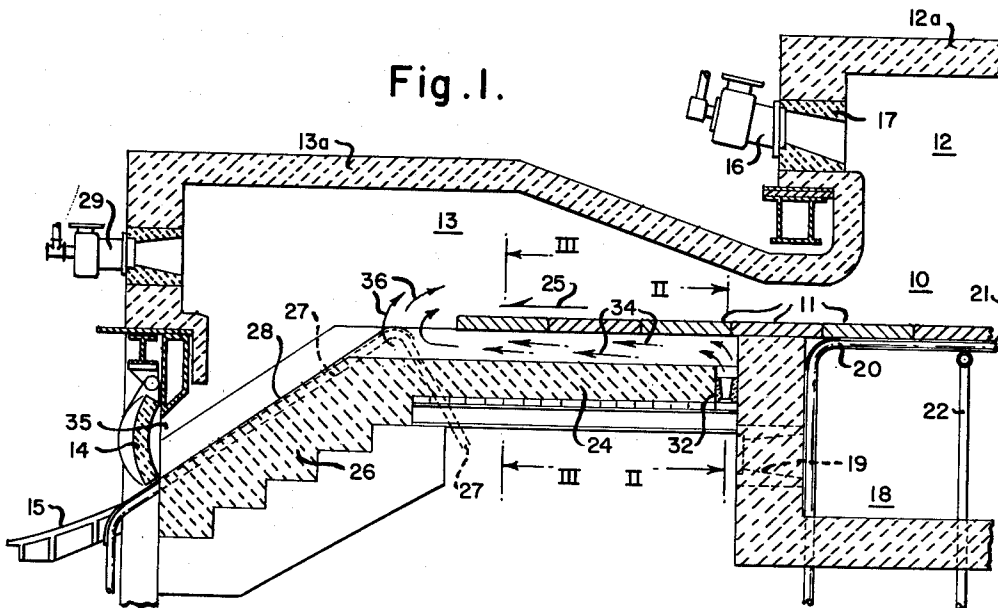


Fig. 2.

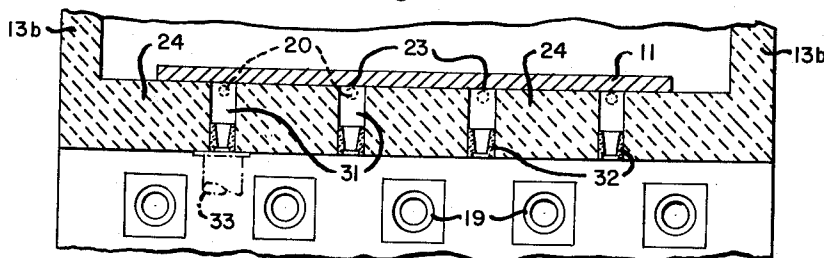


Fig. 3.

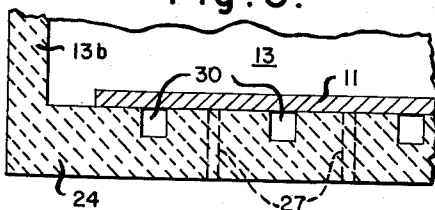


Fig. 4.

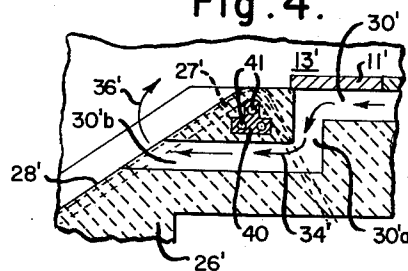
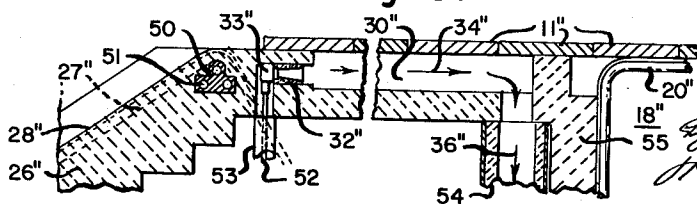


Fig. 5.



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METAL HEATING FURNACE APPARATUS
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This invention relates to a metal heating furnace apparatus and method to remove skid marks on heated pieces of metal work. More particularly, this invention pertains to countervailing means for directly heating the skid mark area of metal work within a furnace to bring it up in temperature so it does not remain in said work.

In the heating or heat treating of metal work such as slabs, billets, plates, bars, ingots and other shapes of steel and other metals, numbers of furnaces for that purpose support the work on longitudinally extending rails within the furnace. One conventional way of advancing such work through the furnace is by pushing each entering piece of work into the entry end of the furnace causing it to engage and push forward the line of workpieces up ahead which are already undergoing heating, the foremost piece in such line being discharged contemporaneously with and by the entry of a fresh workpiece. Generally, such furnaces have a plurality of longitudinally spaced zones for heating control of the work respectively in such zones at a particular time. At the end of the heating zones, there is usually provided a soaking section having a hearth along which the workpieces move while they soak to mitigate temperature differentials, e.g., between surface and center or edges and center. However, colder longitudinally extending skid marks remain even though some differential temperature amelioration therein takes place in the course of the soaking and conveying of the heated workpiece after it leaves the furnace. Such colder skid mark streaks are detrimental, particularly with relatively heavier sections, or high capacity rolling and forging practices, or rolling to precise thin gauge, such as such workpieces may undergo following such heating or heat treatment.

My invention comprehends apparatus and method whereby such skid marks are eliminated as a practical matter by applying heat substantially directly thereto within the furnace. Thereby, any tendency to overheat the remainder of the workpiece or any resort to special skid rail structure practices to attempt to correct the skid mark problem, are avoided. Advantages of a practice of my invention include the production of workpieces that are more uniformly of the predetermined temperature desired for the further processing of the workpiece following its heating. Other objects, features and advantages of this invention will be apparent from the following description and the accompanying drawings, which are illustrative only, in which

FIGURE 1 is a view in longitudinal cross section of the rear portion of a metal heating furnace embodying one form of my invention;

FIGURE 2 is a partial view in section taken along line II—II of FIGURE 1;

FIGURE 3 is a view in section taken along line III—III of FIGURE 1;

FIGURE 4 is a partial view in longitudinal cross section of the rear portion of a metal heating furnace embodying another form of my invention; and

FIGURE 5 is a similar view of a still further form of my invention.

Referring to FIGURES 1 to 3 of the drawings, there is shown therein a heating furnace 10 through which slabs 11 of metal, such as steel, are pushed for heating in one or more conventional zones 12 extending to the

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front of the furnace. Slabs 11 are moved intermittently and preferably are in a position such as that shown during a dwell interval, the rearmost slab 11 having been pushed over onto the slide and discharged due to gravity by the push which immediately preceded such dwell. Soaking of the work in a soaking zone 13 occurs before they are discharged through a discharge door 14 under which each heated and soaked slab slides onto an apron 15 adjacent equipment (not shown) such as a roller table, conveyor or manipulator for transferring the discharged heated slab 11 to the next operation to be performed thereon. The zones 12 are provided with a roof 12a and soaking zone 13 has a roof portion 13a and side walls 13b. In the illustrated embodiment, the heating zone shown at 12 has an upper compartment which is raised to desired temperature by a direct-firing fluid fuel burner 16 firing through the port in a port block 17 inserted in the end wall of the upper compartment. Similarly, a lower compartment 18 in the heating section of the furnace may be directly heated through the side walls, or by a burner in the end wall coacting with a port block 19 therein.

As the slabs 11, or other metal work, move forward through the furnace, they are supported upon longitudinally extending support rails 20 in the form of tubes through which water or other coolant is circulated to inhibit deterioration of the supports. Further, to prevent wearing through of the tubular cooled supports, one or more skid strips 21 are preferably welded to the upper portion of the tubular support so that the slabs 11 rest directly upon such skid strips. Such skid strips extend through the insulation usually provided around the tubular metal portion of the supporting rails 20 to protect such rails against the intense thermal head temperature in the respective heating zone compartments in furnace 10.

The longitudinally extending skid rails 20 are transversely spaced as shown in FIGURE 2 and receive transverse support from cross supports 22 fastened to the underside of the skid rails 20 at longitudinally spaced intervals. The cross supports 22 preferably are tubular metal members also through which a coolant such as water is circulated through the interior thereof and are covered with protective insulation to withstand the temperatures to which such supports are exposed and minimize loss of heat by the workpieces, as is also the case with rails 20.

Despite such efforts to minimize loss of heat by the workpieces 11 to the rails 20, longitudinally extending skid marks or streaks 23 result and represent longitudinally extending transversely spaced cooler portions of the workpiece. The temperature disparity of such cooler portions are abated somewhat in conventional furnaces as the workpieces soak when passing over the usual solid hearth in the soaking zone at the discharge end thereof. However, sufficient skid mark streaking remains in conventional practices in the heated workpieces discharged to cause difficulty in the further processing thereof.

The furnace embodiment of my invention illustrated herein provides for the removal of such skid marks by providing means therefor in soaking zone 13 as shown in the drawings. Therein, a solid refractory hearth 24 supports slabs 11 moving in the direction of arrow 25 while soaking and having their skid marks removed until such slabs are pushed onto the transverse refractory slide slope 26 in which tubular cooled slide bars 27 are partially embedded. Such tubular slide bars may each be provided with a wear strip 28 extending through the protective lagging of the slide bars. Such slide bars are longitudinally extending and transversely spaced, but displaced relative to the rails 20, and furnish a smooth slideway for each slab to be guided onto apron 15 as the weight of each

slab pushes up door 14 sufficiently to allow it to move outside the furnace. Temperature control in the soaking zone may, if desired, be regulated with the aid of a direct-fired burner 29 positioned in the end wall of that zone.

Soaking hearth 24 is divided by longitudinally extending transversely spaced channels 30 each having a firing port 31 at the forward end thereof. A burner port block 32 is provided in each firing port 31 with a direct-fired burner 33 therefor to supply fuel and combustion air for burning and movement of heating gases through the ports 31 and channels 30 as indicated by the arrows 34. The heating gases leave the channels 30 at the left-hand end thereof in FIGURE 1 as indicated by arrow 36 and join any other gases in traveling to a stack flue preferably located toward the front of the furnace. Pneumatic means may be provided, if desired, to blow any scale deposit periodically out of the channels 30 toward the exit end thereof.

The channels 30 and ports 31 are in longitudinal alignment with the skid rails 20. Consequently, the passage of slabs 11 over the top of the channels 30 closes such tops and subjects such colder skid mark streaks to heating and elimination while soaking temperature equalization goes on in each workpiece 11 proper while it moves through the soaking zone 13 toward a discharge opening 35 covered by door 14. The firing rate of the burners 33 is subject to regulation in known ways to select the desired heating effect for such skid mark removal. The consequence is that slabs 11 discharged onto apron 15 by means of this invention will be relatively uniformly heated, soaked and free of skid marks.

In the modification shown in FIGURE 4, the construction and functioning are the same as in the preceding embodiment except that the upper bend of the slide bars 27' is supported by a cross beam 40 having cooling tubes 41 extending therethrough. Hence, channels 30' are staggered at 30'a and continued horizontally at 30'b to vent the skid mark heating gases flowing in the direction of arrow 34'. The corresponding parts in the FIGURE 4 embodiment are provided with the same reference numerals as in the case of such parts in FIGURES 1 to 3, inclusive, with the addition of a prime accent thereto.

In the FIGURE 5 embodiment, parts corresponding generally in construction and functioning to those set forth in the embodiment in FIGURES 1 to 3 are provided with the same reference numerals with the addition of a double prime accent respectively. The FIGURE 5 embodiment is provided with a cross beam 50 and cooling tubes 51 therefor which operate in the manner of the members 40-41. In the FIGURE 5 embodiment, the channels 30'' receive a combustible mixture from the respective burners 33'' at the rear ends of the channels 30'', respective fuel and air streams being supplied through the pipes 52 and 53 to such burners. Combusting gases flow forwardly as indicated by arrow 34'' and exit downwardly into a pipe re-

fractory lined pipe 54 leading to a stack or collecting main through, if desired, an eductor. Or, the channels 30'' may be continued through the rear wall 55 of compartment 18'' with the discharge ends of the channels 30'' being offset to discharge intermediate the insulated skid rails 20''.

Various other changes may be made in details of the illustrated embodiments, and other embodiments provided, without departing from the spirit of my invention or the scope of the appended claims.

I claim:

1. A furnace for removing skid marks from metal workpieces being heated, comprising, a heating zone in said furnace having longitudinally extending fluid-cooled supporting rails therein for said workpieces, said rails causing longitudinally extending transversely spaced skid marks on the underside of said workpieces, a horizontal soaking zone succeeding said heating zone, a hearth in said soaking zone onto and over which said workpieces move after leaving said heating zone and rails, said hearth having longitudinally extending transversely spaced heating channels in individual correspondence to and longitudinal alignment with said rails in said heating zone, said channels being immediately below the surface of said hearth and open along substantially the whole length of the tops thereof directly against skid marks on workpieces passing over and on said hearth, said channels further being substantially free of cross connection to one another at least at the level of said hearth, whereby heating gases supplied to the ends of said channels respectively flow therethrough and directly heat and remove skid marks overlying said channels, and independent direct-firing regulatable burner means positioned in said soaking zone to regulate the flow of heating gases supplied to said channels thereby respectively.

2. A furnace as set forth in claim 1 having a slide discharge for said workpieces at the end of said soaking hearth, and transversely spaced slide support means in said slide discharge laterally displaced from alignment with said rails and channels.

3. A furnace as set forth in claim 2, having a support cross member for the upper end of said slide support means below the level of said hearth and cooling means for said support cross member.

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