HIGH TEMPERATURE FURNACE CONVEYOR SYSTEM

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This invention relates to a conveyor system for continuously moving work to be heat treated through a high temperature furnace and is particularly concerned with such a system wherein the conveyor belt is not exposed to the heating zone of the furnace.

These furnaces are used for heat treating work such as ceramics, cermet, refractory metals and like high temperature materials.

The invention is concerned with furnaces of the very high temperature type wherein the work to be heat treated is continuously moved through the heating zone. The temperatures within the heating zone may rise to as high as 1800°F. These furnaces are mainly constructed of materials capable of withstanding high temperatures, but deterioration of the conveyor belts has been encountered where these belts are subjected time and again to the high heat treat temperatures. These conveyors are usually made of stainless steel, Inconel or some other alloy designed for high temperature resistance, but where the conveyor carrying the work passes repeatedly directly along the furnace hearth it has been found that this soon results in oxidation of the metal of the conveyor and consequent failure, thereby causing the furnace to be shut down for considerable periods and requiring expensive parts and labor.

In the present invention the work to be heat treated is brought into the furnace by the conveyor belt, removed therefrom while passing through the high temperature heating zone as the conveyor itself bypasses that zone, and then is redeposited on the conveyor belt as it leaves the furnace, and it is a major object of the invention to provide a novel apparatus for achieving this object.

It is another object of the invention to provide a novel high temperature furnace assembly wherein work to be heat treated is brought to the heating zone of the furnace on an endless conveyor that delivers the work to the furnace hearth and then is deflected to run outside the heating zone, but thereafter within the furnace casing, to again receive the work emerging from the zone and remove it from the furnace, the work being pushed through the heating zone by force derived from the moving conveyor.

A further object of the invention is to provide a novel high temperature furnace wherein trays for containing the articles to be heat treated are brought on the conveyor in succession into the heating zone of the furnace and pushed therethrough by drive means such as lugs on the conveyor abutting the entering tray.

Another object of the invention is to provide a novel high temperature furnace wherein the heating zone is surrounded by a casing closed except for work entrance and exit openings, the interior of the casing being maintained at a reducing or neutral atmosphere, and the work is brought in through the entrance opening on an endless conveyor that pushes it onto the furnace hearth and then bypasses the hearth to receive the treated work and carry it out through the casing exit opening, the work moving through the furnace by successive units being pushed in tandem along the hearth surface.

A further object of the invention is a novel tray structure for moving work through a high temperature furnace, the tray having end projections for maintaining a definite longitudinal spacing with respect to the adjacent tray in a row being pushed through the furnace, and to permit entry and withdrawal of driving lugs on a conveyor outside the heating zone of the furnace.

Further objects of the invention will appear as the description proceeds in connection with the appended claims and the annexed drawings wherein:

FIGURE 1 is a side elevation in section showing the invention according to a preferred embodiment; and
FIGURE 2 is a fragmentary top view showing the manner of pushing the articles through the furnace.

A high temperature electric furnace shown at 10 includes an enclosing casing 11 that has a front extension 12, a rear extension 13, end walls 14 and 15 and a bottom wall 16.

The casing is a continuous enclosure having only a front furnace entrance opening 17 and aligned therewith a rear furnace exit opening 18.

Internally the furnace has a relatively smooth smooth hearth floor 19, which may be a grating for slidably supporting articles passing therethrough between the entrance and exit openings.

Mounted within the furnace casing 12 on parallel axes are conveyor belt sprockets 21, 22, 23, and 24, at least one of which is rotated by suitable power means (not shown). An endless conveyor belt 25 passes over these sprockets and is continuously moved by them in the direction of the arrows in FIGURE 1.

Sprocket 21 is located adjacent and just within the entrance opening 17 so that the entering horizontal belt flight 26, which is suitably supported by means not shown, passes tangentially over the top of sprocket 21.

As shown in FIGURE 2 suitable stationary side guides 27 may flank the belt to comprise part of the conveyor means, and these may be duplicated at the exit side of the furnace.

Belt 25 passes downwardly around sprocket 22 and then horizontally within the casing to sprocket 23 at the same level. Then belt 25 turns up to pass over sprocket 24, disposed at the same level as sprocket 21, to leave the casing through exit opening 18 in a suitably supported horizontal flight 28 in substantial longitudinal alignment with flight 26.

At the entrance end, the furnace has a horizontal apron 31 that extends substantially to sprocket 21 and a similar apron 32 extends substantially to sprocket 24, and the top surfaces of hearth 19, aprons 31 and 32 and belt flights 26 and 28 lie in substantially the same horizontal plane. Aprons 31 and 32 are effective hearth extensions.

The ends of belt flights 26 and 28 are connected to complete the endless belt 25 by a portion preferably passing above or below casing 12, but such is not shown in the drawing. The belt 25 is provided with a plurality of drive lugs 30 on its upper surface.

The work comprising articles to be heat treated is mounted in separate shallow trays 33 which are of special configuration in that each has a pair of rearwardly projecting side arms 34 which in the assembly space longitudinally successive trays 33 sufficiently to enable proper drive engagement and effort of the conveyor 25 with the trays as will appear. Lugs 30 on the belt 25 are spaced a greater distance than the length of a tray 33. Trays 33 are made of molybdenum or some other very highly resistant metal or alloy.

FIGURE 1 shows at the left a tray 33 on flight 26 positively engaged by a lug 30 and moving along ways 27 toward the furnace entrance opening 17. This continues until the tray has become deposited on apron 31 (this being shown by the second tray from the left in FIGURE 1) and the driving lug 30 passes over sprocket 21 and then downwardly out of contact with the tray.
The next tray 33, similarly positively driven by its lug 30 now advances to abut the arms 34 at the rear end of the preceding tray and pushes the leading tray toward the furnace interior.

It will be seen from FIGURE 2 that each lug 30 is wide enough and shaped to squarely engage the flat rear side of the tray over a large area so that directional control is attained and the trays are pushed in straight line relation through the furnace.

Each tray 33 entering the furnace will thus push several trays ahead of it through the furnace. At the exit opening, see the right side of FIGURE 1, each lug 30 on entering flight 28 will extend up into the space between tray arms 34 and resume a positive drive connection with the tray for moving it out of the casing through opening 18.

From the foregoing it will be seen that the furnace has only two openings of minimum size sufficient for the introduction and withdrawal of the work. The entire interior of casing 11 particularly the heating zone 20 is maintained at a reducing or inert atmosphere, and the conveyor belt, although it enters and exits from the same casing openings as the work, travels through a reducing or inert atmosphere space 40 while bypassing the hearth so as to be protected against damaging action during passage through the furnace. Since the conveyor belt is not subjected to the same high heat as the work the belt is protected against temperature creep effects which might bind it and oxidation is minimized.

By keeping the casing openings to a minimum, it is possible to maintain lower internal gas pressures within the furnace casing, thereby reducing the danger to operators coming near the furnace and minimizing the chances of oxidation of work due to undesired introduction of ambient air through further or larger openings. This insures that the treated work emerges from the furnace bright and clean, and not oxidized and discolored.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by Letters Patent is:

1. Heat treating apparatus comprising a furnace having a casing provided with inlet and outlet openings at opposite sides of a relatively stationary hearth, work conveyor means having spaced flights passing through said openings, means for transferring work from the conveyor flight at said inlet to the furnace hearth, means for transferring work from the furnace hearth to said conveyor flight at the casing exit, and means within the casing for directing said conveyor means in bypass relation to said hearth between said flights.

2. In the heat treating apparatus defined in claim 1, said conveyor means being an endless conveyor and said casing enclosing means for directing said conveyor initially away from the inlet end of said hearth, through the casing and then back to the exit end of said hearth.

3. Heat treating apparatus comprising a furnace surrounded by a casing having aligned work inlet and exit openings, heating means within said furnace defining a generally horizontal heating zone through the furnace in alignment with said openings and a relatively stationary hearth disposed between said openings, conveyor means guided to enter said inlet opening, bypass said heating zone within the casing and then leave the casing at said exit opening, and detachable work carrying receptacles adapted to be pushed by said conveyor means off said conveyor means onto said hearth adjacent said inlet opening and in tandem through said hearth back onto said conveyor means adjacent said exit opening.

4. The heat treating apparatus defined in claim 3, wherein said conveyor means comprises an endless belt having drive projections disengagingly contacting said receptacles.

5. The heat treating means defined in claim 4, wherein said conveyor means comprises fixed guide means along said belt at said inlet and exit openings.

6. The heat treating apparatus defined in claim 4, wherein said drive projections are lugs on said belt and said receptacles are provided with cooperating spacing abutments enabling said lugs to extend between successive receptacles.

7. Heat treating apparatus comprising a furnace having an enclosing casing provided with aligned work inlet and outlet openings, means defining a heating zone within the casing having a relatively stationary hearth floor extending there through, conveyor means comprising an endless belt having a section entering said inlet opening at the level of said floor, a intermediate section bypassing said heating zone and another section leaving said exit opening at the level of said floor, detachable work carrying receptacles on said conveyor means, and drive lugs on said belt for engaging said receptacles, said lugs pushing said receptacles in succession off said conveyor means to said hearth floor where the receptacles abut in tandem and are pushed through said heating zone onto said conveyor means at said other section at the outlet opening where the receptacles are again drive connected to said lugs.

8. In the heat treating apparatus defined in claim 7, sprockets guiding said intermediate belt section through said casing, one of said sprockets being disposed adjacent one effective end of the hearth floor and another being disposed adjacent the other effective end of the hearth floor.

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