A method is described for heating lightweight metal ingots (1), with the lightweight metal ingots (1) being heated in a furnace (2) by hot burner exhaust gases. In order to provide advantageous heating conditions it is proposed that the lightweight metal ingots (1), prior to their heating in the furnace (2), are preheated via at least one preheating apparatus (9) which rests in a planar manner thereon and is supplied by a fluid heat carrier which is heated in heat exchange by the hot exhaust gases from the furnace (2) and is guided in a circuit (7).
METHOD FOR HEATING LIGHTWEIGHT METAL INGOTS

FIELD OF THE INVENTION

[0001] The invention relates to a method for heating lightweight metal ingots, with the lightweight metal ingots being heated in a furnace by hot burner exhaust gases.

DESCRIPTION OF THE PRIOR ART

[0002] Lightweight metal ingots are heated in a furnace, usually a pusher-type furnace, for hot rolling lightweight metal ingots. For this purpose it is known to incinerate fluid or gaseous fuels in burners and to subject the lightweight metal ingots to hot exhaust gases from the burners which are circulated by means of a fan. In order to enable the utilization of the tangential exhaust heat from the exhaust gases of the furnace, the combustion air required for the burner is preheated with the hot exhaust gases by means of heat exchange, by means of which it is possible to save fuel. Higher flame temperatures support the formation of nitrogen oxides however which are hazardous to the environment.

[0003] For the heat treatment of sheets it is also known (EP 2 014 777 A1) to arrange the sheet between two heat-transfer plates and to supply thermal energy to said heat-transfer plates, so that the heat is transferred to the sheet by the heat-transfer plates which lie in a planar manner on the sheet. Such devices for the thermal treatment of sheets cannot make any contribution to heating lightweight metal ingots rapidly to the required hot rolling temperature.

SUMMARY OF THE INVENTION

[0004] The invention is thus based on the object of providing a method for heating lightweight metal ingots of the kind mentioned above in such a way that a preheating of the lightweight metal ingots with reduction of the environmental pollution by nitrogen oxides is enabled by utilizing the waste heat of the exhaust gases of the furnace.

[0005] This object is achieved by the invention in such a way that the lightweight metal ingots, prior to their heating in the furnace, are preheated via at least one preheating apparatus which rests in a planar manner thereon and is supplied by a fluid heat carrier which is heated in heat exchange with the hot exhaust gases from the furnace and is guided in a circuit.

[0006] By preheating the lightweight metal ingots with the help of the tangible waste heat of the exhaust gases of the furnace, preheating of the combustion air can be omitted, so that the flame temperature can be lower and the likelihood of forming nitrogen oxides is reduced considerably. Due to the preheating of the lightweight metal ingots, the lower temperature of the exhaust gases of the burner hardly has an influence on the processing time of the lightweight metal ingots in the furnace, so that comparatively short heating times can be ensured. The direct preheating of the lightweight metal ingots with the help of the hot exhaust gases from the furnace would require complex devices which are comparable to a furnace. In order to avoid such complexity, a fluid heat carrier which is circulated is heated by heat exchange with the help of the tangible waste heat of the hot exhaust gases from the furnace, with the help of which the preheating device is supplied, on which the lightweight metal ingots are placed in a planar manner, so that the lightweight metal ingots resting on the preheating device are transferred the heat of the heat carrier supplying the preheating device. As a result of the heat carrier circuit, the preheating device can also be placed remotely from the furnace because the heat carrier can also be pumped over larger distances in insulated pipelines without any special measures. The preheating of the lightweight metal ingots can consequently be inserted at advantageous point in the processing line of the lightweight metal ingots.

[0007] A conventional apparatus can be assumed for the purpose of heating lightweight metal ingots in a furnace heated via a burner, in which a heat exchanger can be provided which is supplied with hot exhaust gases of the furnace. In contrast to conventional apparatuses of this kind, the heat exchanger is arranged together with one of the lightweight metal ingots in a preheating device in a heat carrier circuit which accommodates the ingots in planar contact, so that it is not the combustion air for the furnace burners that is heated via the heat exchangers but a fluid heat carrier which then emits its heat to the preheating device which accommodates the lightweight metal ingots.

[0008] The relevant aspect for the heat transfer is the flush contact of the ingots on the preheating device over the largest possible area. For this purpose, the preheating device can comprise a frame with a contact surface for the lightweight metal ingots and a heat transfer plate which extends transversally to the contact surface, which forms a contact area for the lightweight metal ingots and through which the heat carrier flows. The heat transfer plate is preferably composed of two layers which form at least one flow conduit for the heat carrier between themselves and of which the layer forming the contact area shall have advantageous properties for heat transfer. The opposite layer shall be arranged in such a way that heat losses are avoided to the highest possible extent, which requires either a layer of a heat-insulating material or a layer provided with heat insulation. In order to ensure the contact of the one layer on the lightweight metal ingots over a large area for the purpose of possible loss-free heat transfer, the layer of the heat transfer plate forming the contact area can be subdivided into fields by grooves resulting in bending points. When the heat carrier is conveyed with sufficient conveying pressure between the two layers in order to supply the layer of the heat transfer plate forming the contact area with a respective hydraulic pressure, it is possible to ensure a flush contact of this layer forming the contact area with lightweight metal ingots in cooperation with the groove-like bending points, even when the lightweight metal ingots show uneven sections. The layer of the heat exchanger plate facing away from the lightweight metal ingots forms an abutment, so that this layer facing away from the lightweight metal ingots must be arranged in a sufficiently rigid manner itself or must be supported accordingly.

[0009] A further measure to support a planar contact of the preheating device on the lightweight metal ingots is to support the heat transfer plate in a resilient manner on the side facing away from the contact area. This resilient support allows automatic compensation when the contact surface does not extend parallel to the contacting surface of the lightweight metal ingots.

[0010] Especially advantageous constructional conditions are obtained when the contact surface of the frame for the lightweight metal ingots slopes towards the contact area of the heat transfer plate. In such an arrangement, the lightweight metal ingot to be heated slides along the contact surface against the contact area in order to lie flush against this contact area. In order to avoid sliding friction, the contact surface can have rollers with axes disposed parallel to the
contact surface and to the contact area of the heat transfer plate, so that a lightweight metal ingot which is placed on the rollers of the contact surface with the help of a hoist for example is moved via the rollers against the contact area of the heat transfer plate and is pressed against this contact area with the help of a weight-induced force component.

**BRIEF DESCRIPTION OF THE DRAWINGS**

[0011] The method for heating lightweight metal ingots in accordance with the invention will be explained below in closer detail, wherein:

[0012] FIG. 1 shows an apparatus in accordance with the invention for the heating of lightweight metal ingots in a schematic ingot diagram;

[0013] FIG. 2 shows a preheating device for the lightweight metal ingots in a vertical cross-sectional view, and

[0014] FIG. 3 shows a sectional view along line III-III of FIG. 2 on a smaller scale.

**DESCRIPTION OF THE PREFERRED EMBODIMENT**

[0015] In accordance with FIG. 1, a furnace 2, which is usually a pusher-type furnace, is provided for heating the lightweight metal ingots 1, which furnace is heated with the help of burners 3. At least one fan 4 is provided for distributing the hot burner gases in the furnace 2. The hot exhaust gases from the furnace 2 are removed via an exhaust gas line 5 and supplied to a heat exchanger 6 which is part of a heat carrier circuit 7. Said heat carrier circuit comprises a circulation pump 8 and a preheating device 9 in addition to the heat exchanger 6 for heating the fluid heat carrier, which preheating device comprises a heat exchanger in the form of a heat transfer plate 10, through the fluid heat carrier flows. The lightweight metal ingots 1 accommodated by the preheating device 9 in a planar manner are thus preheated via the closely sitting heat exchanger plate 10 with the help of the heat carrier pumped in the circuit in order to be heated to the required hot rolling temperature after their preheating in the furnace 2, which occurs with the help of the hot exhaust gases of the burner, the tangible waste heat of which is used for heating the fluid heat carrier in the heat exchanger 6 after the heating of the lightweight metal ingots 1. The utilization of the tangible waste heat of the exhaust gases from the furnace 2 not only improves the energy balance, but also allows operating the furnace 2 with a lower flame temperature of burners 3, so that the likelihood of the increased formation of nitrogen oxides can be prevented to a substantial extent.

[0016] The preheating device 9 per se is shown in closer detail in FIGS. 2 and 3. In accordance with the illustrated embodiment, the preheating device 9 comprises a frame 11 which determines a contact surface 13 which is defined by rollers 12. The heat transfer plate 10 through which the heat carrier flows extends transversally to said contact surface 13, preferably perpendicularly thereto, with the heat transfer plate resting on the support legs 14 of the frame, as shown in FIG. 2. Since the frame 11 is arranged in such a way that the contact surface 13 slopes towards the heat transfer plate 10 and axes of the rollers 12 of the contact area 13 extend parallel to the contact area 13 and parallel to the heat exchanger plate 10, the lightweight metal ingots 1 which are placed on the rollers 12 are rolled towards the heat exchanger plate 10 as a result of their weight, which forms a contact area 15 for the lightweight metal ingots 1. The heat exchanger plate 10 which sits close via the contact area 15 to the respective lightweight metal ingot 1 thus transfers the heat of the heat carrier flowing through the heat exchanger plate 10 onto the respective lightweight metal ingot 1 as a result of the given temperature differences.

[0017] In order to provide simple constructive conditions, the heat exchanger plate 10 comprises two layers 16 and 17 between which at least one flow conduit 18 is obtained for the fluid heat carrier which is connected to a flow line 19 and a return line 20 of the heat carrier circuit 7. The flow conduit 18 which extends in a meandering manner in the embodiment according to FIG. 3 is formed by milled portions in one of the two layers 16 and 17, preferably in the layer 17 facing away from the contact area 15. Since a mutual sealed delimitation of the individual sections of the flow conduit 18 is irrelevant, it is sufficient to seal the two layers 16 and 17 against one another by a seal 21 provided circumferentially around the edge.

[0018] In order to support the planar contact of the contact area 15 formed by the layer 16 on the respective lightweight metal ingot 1, this layer 16 can be subdivided by grooves 22 in mutually delimited fields, with the grooves forming bending points which allow an adjustment of the contact area 15 to the opposite area of the respective lightweight metal ingot 1 by respective deformation of the layer 16 when the layer 16 is subjected to the fluid heat carrier. The opposite layer 17 must represent a respective abutment and must either have a sufficient rigidity against bending or must be supported in a rigid manner against bending. In order to prevent heat losses, the layer 17 of the heat exchanger plate 10 which faces away from the lightweight metal ingot 1 is provided with a thermal insulation. Layer 17 could also be produced itself from a thermally insulation material.

[0019] A further possibility to support the flush contact of the lightweight metal ingot 1 on the contact area 15 of the heat exchanger plate 10 is to support the heat exchanger plate 10 via spring elements 24 in relation to the support legs 14 of the frame 11, thus enabling an automatic overall alignment of the heat exchanger plate 10 in relation to the stop area of the respective lightweight metal ingot 1. The embodiment shows spring elements 24 in the form of coil springs, which is not mandatory however.

1. A method for heating lightweight metal ingots, with the lightweight metal ingots being heated in a furnace by hot burner exhaust gases, wherein the lightweight metal ingots (1), prior to their heating in the furnace (2), are preheated via at least one preheating apparatus (9) which rests in a planar manner thereon and is supplied by a fluid heat carrier which is heated in heat exchange by the hot exhaust gases from the furnace (2) and is guided in a circuit (7).

2. An apparatus for heating lightweight metal ingots, comprising a furnace heated via burners and a heat exchanger which is supplied with the hot exhaust gases of the furnace, wherein the heat exchanger (6) and a preheating device (9) which accommodates the lightweight metal ingots (1) in planar contact are disposed in a heat carrier circuit (7) for a fluid heat carrier.

3. An apparatus according to claim 2, wherein the preheating device (9) comprises a frame (11) with a contact surface (13) for the lightweight metal ingots (1) and a heat transfer plate (10) which extends transversely to the contact surface
(13), which forms a contact area (15) for the lightweight metal ingots (1) and through which the heat carrier flows.

4. An apparatus according to claim 3, wherein the heat transfer plate (10) is composed of two layers (16, 17) which form at least one flow conduit (18) for the heat carrier between themselves.

5. An apparatus according to claim 4, wherein the layer (16) of the heat transfer plate (10) forming the contact area (15) is subdivided into individual fields by grooves (22) forming bending points.

6. An apparatus according to claim 3, wherein the heat transfer plate (10) is resiliently supported on the side facing away from the contact area (15).

7. An apparatus according to claim 3, wherein the contact surface (13) of the frame (11) for the lightweight metal ingots (1) slopes towards the contact area (15).

8. An apparatus according to claim 7, wherein the contact surface (13) comprises rollers (12) with axes which are parallel to the contact surface (13) and the contact area (15).

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