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(54) Method of and device for removing scale deposits from a steel slab heat treatment construction

(57) The invention relates to a method of removing scale deposits (50) from a steel slab heat treatment construction (1), in particular the beams (10) of a walking beam furnace. The method comprises at least a quenching step of quenching the scale deposits (50) with a fluid quenching medium (52). The invention also relates to a device (20) for removing scale deposits from a steel slab heat treatment construction (1) comprising at a least a delivery means (30) for delivering a fluid quenching medium (52) to the scale deposits (50).

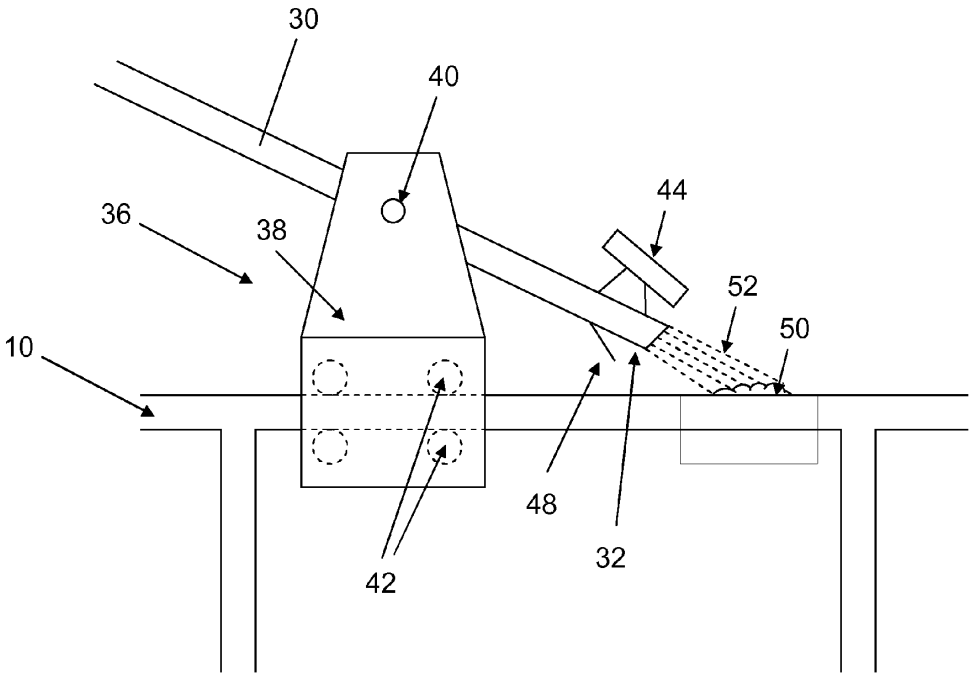

Figure 2

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Description

[0001] The present invention relates to a method of removing scale deposits from a steel slab heat treatment construction, as well as a suitable removal device.

[0002] It is well known that in reheating of steel products such as blooms the surface oxidises and the resulting scale may become detached from the steel surface and be deposited on the furnace hearth or beams in a walking beam furnace. During treatment of subsequent steel blooms layers of scale may be formed on top of each other. These layers can fuse together to form nodules, the size of which increases in time. These nodules are mechanically bonded to the furnace and will cause mechanical damage to the underside of subsequently treated hot blooms. In turn this damage can lead to surface defects in the final product.

[0003] The prior art has provided several ways for removal of these nodules. E.g. JP A 53089813 has disclosed a scraper for removal of scale from the upper surface of the walking beams and from the surface of the stationary hearth. The scraper is operated from outside the furnace. It is also known to employ pneumatic tools to "chip" the scale off, but it is also known that these pneumatic tools have shown only limited success, in particular in walking beam surfaces.

[0004] JP A 62136518, JP A 3079714, JP A 4280913 and JP 5171256 disclose the use of gas as a physical/mechanical means to blow off scale that is present on the beams of a walking furnace.

[0005] Another known method comprises walking back a cold slab through the furnace in order to mechanically break the connections between the scale deposits and beams.

[0006] It is an object of the present invention to provide a method of and device for removal of scale deposits from a steel slab heat treatment construction, which allow for a more efficient removal.

[0007] According to a first aspect of the present invention a method of removing scale deposits from a steel slab heat treatment construction, in particular the beams of a walking beam furnace, comprises at least a quenching step of quenching scale deposits with a fluid quenching medium. In the method according to the invention a fluid quenching medium, such as a gas or liquid, is applied to the scale deposit to be removed. This relatively fast and local cooling generates high thermal stresses due to the temperature differences created, in particular at the interface between deposit and the structure that support the deposit. These thermal stresses generated cause disruption of the mechanical bonding of the deposit to the supporting structure. The deposit thus loosened can be easily removed with minimum force to leave a clean construction. In other words in the method according to the invention heat transfer from the scale deposit to the quenching medium is higher than heat transfer from the hot heat treatment construction to the scale deposit.

[0008] In a preferred embodiment of the method according to the invention the quenching step comprises jetting the fluid quenching medium to a scale deposit. In this embodiment a focussed jet of quenching medium is forced to the scale deposit while directed contact between the quenching medium and the adjacent steel slab heat treatment construction is limited as far as possible, thereby maintaining the temperature differences and thus thermal stresses between deposit and supporting structure, in particular at the interface. Furthermore the jet force as such, in particular when the jet is pulsed, aids to remove the scale deposit once the mechanical bonding is disrupted. If necessary, simultaneously with the quenching step a mechanical scale treatment step of mechanically treating scale is performed, such as pneumatic chipping.

[0009] Suitable examples of the fluid quenching medium comprise nitrogen, compressed air and argon. Water could also be used since it has increased cooling capacity.

[0010] Advantageously the method also comprises a step of determining the position of the scale deposit. If the position of the deposit is actually known, then the quenching step can be performed more effectively, in particular the quenching medium can be directed to quench only the scale nodule and not the supporting construction.

[0011] In a further preferred embodiment thereof the appearance of a scale deposit is visually observed, and upon the scale deposit becoming dark in appearance, the mechanical scale treatment is started. The dark appearance of the scale deposit contrary to the appearance of the supporting structure is a visually perceivable indication, that the scale deposit has been quenched sufficiently in view of easy removal.

[0012] Advantageously the pressure and/or flow rate of the quenching medium are controlled in order to allow adjustment of the jetted quenching medium to the nodule treated.

[0013] According to a second aspect the invention relates to a device for removing scale deposits from a steel slab heat treatment construction, in particular the beams of a walking beam furnace, comprising at a least a delivery means for delivering a fluid quenching medium to the scale deposits. The device according to the invention offers the same effects and advantages as explained above with respect to the method according to the invention.

[0014] In order to direct the quenching medium to the interface in an embodiment of the device according to the invention the delivery means comprises a lance having a feed end for receiving the fluid quenching medium and a nozzle end for jetting the fluid quenching medium to the interface of a scale deposit and the adjacent steel slab heat treatment construction. Advantageously the lance has a length that is sufficient to reach all affected areas in the high temperature zones of the walking beam surface. E.g. the lance has a length of up to 10 m.

[0015] Typically the deposit size is in the range of 30 mm to 100 mm. Preferably the dimensions of the nozzle at the nozzle end are smaller than this deposit size. More preferably the nozzle end comprises a nozzle having a diameter in the range of 2-15 mm allowing an accurate focussing of the quenching medium at the preferred positions.

[0016] Pressure controllers and/or flow controllers can be incorporated in the device according to the invention offering adjustment of the quenching medium to the scale deposit that is treated.

[0017] In a preferred embodiment the device according to the invention also comprises a vision means for determining the position of a scale deposit in the vicinity of delivery end of the delivery means, such as the nozzle end. Suitable vision means comprises a mini camera, preferably shielded against the heat e.g. a water cooled mini camera, in combination with a image display means outside the heat treatment construction.

[0018] The components of the device according to the invention that are vulnerable to heat are advantageously shielded or otherwise heat protected, depending on the expected residence time in the hot atmosphere. E.g. the lance may be externally cooled, internally cooled such as self cooled by the quenching medium, for example flowing in concentric tubes or shielded by a heat resistant material. The components itself can also be manufactured from heat resistant material.

[0019] As explained above with respect to the method according to the invention advantageously the device also comprises a tool for mechanical treatment of a scale deposit, such as at the nozzle end of the lance.

[0020] In view of the dimensions and weight of the delivery means the device advantageously further comprises a movable support carrying the delivery means. The image display means may be provided on this movable support. Similarly the device advantageously comprises manoeuvring means for guiding and supporting the free end of the delivery means, such as the nozzle end of the lance. In an embodiment the manoeuvring means is designed such that it is able to "sit" on a beam of a walking beam furnace, e.g. rollers or a sliding system shaped around one or more of the beams in a walking beam furnace.

[0021] The invention is further illustrated by the attached drawing, wherein:

Figure 1 is an embodiment of a device according to the invention; and
Figure 2 shows a detail thereof.

[0022] In Figures 1 and 2 an embodiment of a device according to the invention is diagrammatically shown, wherein reference numeral 1 indicates a steel slab heat treatment construction, in particular a walking beam furnace, including stationary and walking beams 10 (only two shown). These beams are arranged in a furnace housing 12. The device according to the invention is indicated in its entirety by reference numeral 20. It comprises a movable carrier 22 having (driven) wheels 24 and a rotary supporting disc 26, arranged near the exit 14 of the housing 12. The carrier 22 supports the feed end 28 of a delivery means 30, here exemplified by a lance. The opposite nozzle end 32 is vertically movable and is supported by the movable carrier 22, e.g. using piston-cylinder assemblies 34. The nozzle end 32 is guided by a manoeuvring guide 36 sitting on a beam 10. Figure 2 shows an embodiment of a manoeuvring guide 36 comprising a body 38 connected to the lance 30 at pivot 40. The body 38 carries upper and lower rollers 42 sitting on beam 10. The nozzle end 32 is provided with a vision means 44, e.g. a water cooled camera. The display means 46 thereof are arranged at the movable carrier 22. A mechanical tool 48 for assisting removal, such as a chipper, is also provided at the nozzle end 32.

[0023] In operation the nozzle end 32 is manoeuvred into position in the direct vicinity of scale nodule 50 on beam 10 using the vision means 44 and suitable movement of carrier 22 and lance 30. Then quenching medium 52 is jetted to the nodule 50, in particular the interface of nodule 50 and beam 10. If necessary, the pressure and/or flow rate of quenching medium are adjusted to the nodule size. If the nodule 50 becomes dark as can be viewed on the display 46, the nodule 50 will spall off or can be easily chipped off by chipping tool 48.

Claims

1. Method of removing scale deposits from a steel slab heat treatment construction (1), in particular the beams (10) of a walking beam furnace, comprising at least a quenching step of quenching scale deposits (50) with a fluid quenching medium (52).

2. Method according to claim 1, wherein the quenching step comprises jetting the fluid quenching medium (52) to a scale deposit (50).

3. Method according to any one of the preceding claims, further comprising a step of determining the position of the scale deposit (50).

4. Method according to any one of the preceding claims, wherein simultaneously with the quenching step a mechanical scale treatment step of mechanically treating scale is performed.

5. Method according to claim 4, wherein the appearance of a scale deposit is observed, and upon the scale deposit becoming dark in appearance, the mechanical scale treatment is started.

6. Device (20) for removing scale deposits (50) from a steel slab heat treatment construction (1), in particular the beams (10) of a walking beam furnace, com-

prising at a least a delivery means (30) for delivering a fluid quenching medium (52) to the scale deposits (50).

7. Device according to claim 6, wherein the delivery means comprises a lance (30) having a feed end (28) for receiving the fluid quenching medium and a nozzle end (32) for jetting the fluid quenching medium (52) to the interface of a scale deposit (50) and the adjacent steel slab heat treatment construction (1).

8. Device according to claim 7, wherein the nozzle end (32) comprises a nozzle having a diameter in the range of 2-15 mm.

9. Device according to any one of the preceding claims 6-8, further comprising a vision means (44, 46) for determining the position of a scale deposit (50).

10. Device according to any one of the preceding claims 6-9, further comprising at the nozzle end (32) a tool (48) for mechanical treatment of a scale deposit (50).

11. Device according to any one of the preceding claims 6-10, further comprising a movable support (22, 26) carrying the delivery means (30).

12. Device according to any one of the preceding claims 6-11, further comprising a manoeuvring means (36) for guiding and supporting the free end (32) of the delivery means (30).

13. Device according to claim 12, wherein the manoeuvring means (36) is designed such that it is able to sit on a walking beam 910) of a walking beam furnace.

14. Device according to any one of the preceding claims 6-13, wherein the delivery means (30) is provided with a self-cooling system.

15. Device according to any one of the preceding claims 6-14, wherein the delivery means (30) are made from a heat resistant material.

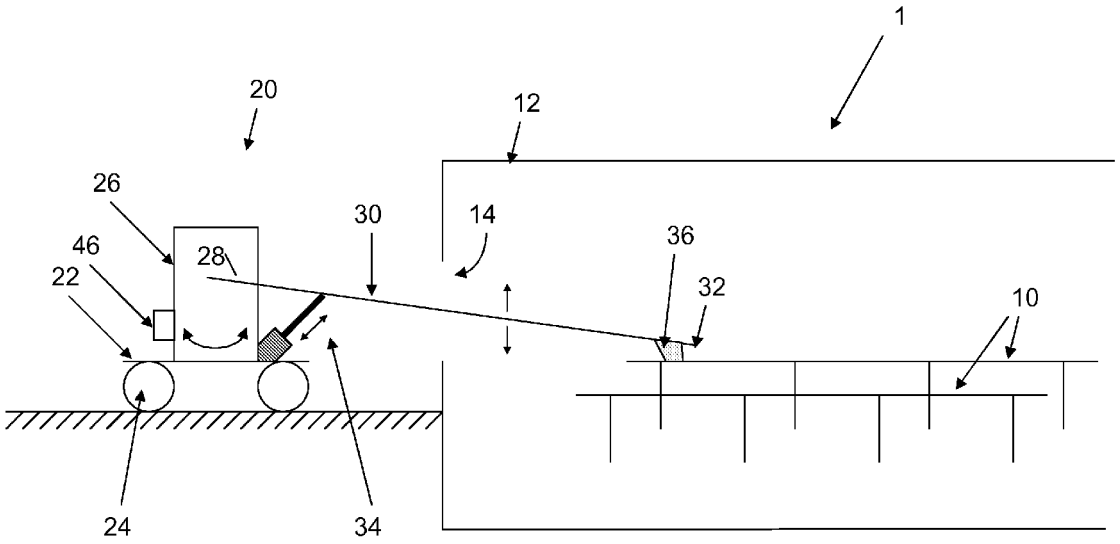

Figure 1

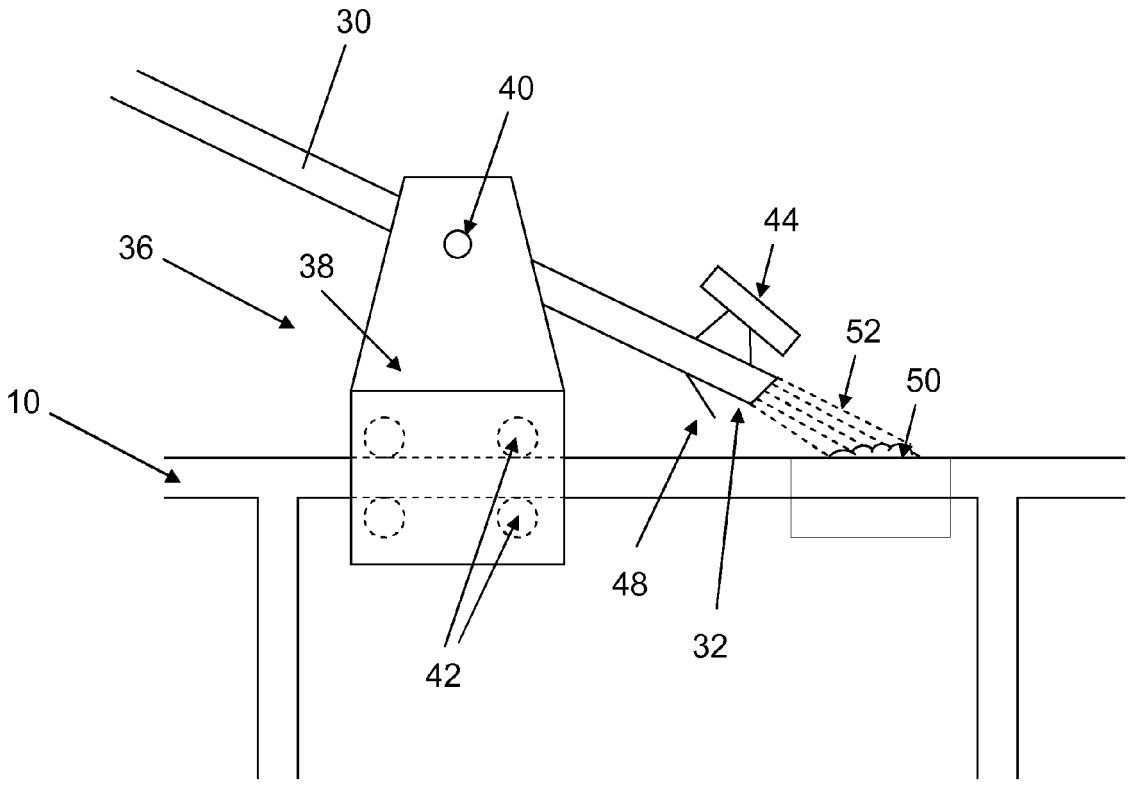

Figure 2

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EUROPEAN SEARCH REPORT

Application Number
EP 11 17 0934

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	1 December 2011	Lilimpakis, Emmanuel

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X : particularly relevant if taken alone
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