AN APPARATUS AND A METHOD FOR CLEANING

Abstract: The disclosure relates to an apparatus for cleaning an opening (1) in the wall (2) of a soda recovery boiler (3), and an outlet spout (4), the apparatus comprising a carrier (5) for a cleaning device (6) and drive means (7). The carrier (5) and the drive means (7) fulfil the function of operating device for the cleaning device (6). The cleaning device (6) is on cleaning movements, movable in and out through the opening (1) and up and down along the outlet spout (4). The operating device realises the cleaning movements and displays a rotary unit (10) for rotation of a tool included in the cleaning device (6) about a longitudinal axis (12) in the carrier (5). The cleaning device (6) is double-sided and eccentric in relation to the longitudinal axis (12). The disclosure further relates to a method of cleaning an opening (1) in the wall of a soda recovery boiler (3) and an outlet spout (4), comprising the steps that an elongate cleaning device (6) is directed in towards the opening (1), that the cleaning device (6) is moved towards and through the opening (1), as well as along the spout (4) and back to a position of rest, that the cleaning device (6) is rotated about a longitudinal axis (12) to the cleaning device (6) and that the cleaning device (6) is moved towards and through the opening (1) as well as along the spout (4) and back to a position of rest. The cleaning is carried out at different radial distances from the longitudinal axis (12) depending upon the rotary position of a cleaning tool (11) disposed on the cleaning device (6).
AN APPARATUS AND A METHOD FOR CLEANING

TECHNICAL FIELD

The present invention relates to an apparatus for cleaning an opening in the wall of a soda recovery boiler, and an outlet spout which extends from the opening, comprising a carrier for a cleaning device which, in its free end, has a cleaning head or tool and, on cleaning movements, is insertable and reciprocal in the opening and movable along the outlet spout, and an operating device for realising the cleaning movements, the operating device having a rotary unit for rotation of the cleaning device about its longitudinal axis.

The present invention also relates to a method of cleaning an opening in the wall of a soda recovery boiler and an outlet spout which extends from the opening, comprising the steps that an elongate cleaning device which, in its free end, has a cleaning head or tool, is held supported by an operating device, that the cleaning device is directed into the opening, that the cleaning device is moved in a cleaning movement towards and through the opening and back to a position of rest, and that the cleaning device is rotated about a longitudinal axis to the cleaning device.

BACKGROUND ART

Soda recovery boilers of the type which are employed in the pulp industry fulfil two functions, namely to produce heat and to recover chemicals. To this end, the soda recovery boiler has a lower combustion furnace where lye is injected and residual products from the timber are combusted, and the cooking chemicals are recovered. When this combustion takes place, a smelt is formed of the recovery chemicals in the lower region of the furnace. The smelt is led via one or more outlet spouts down to a smelt dissolving unit which is placed beside the furnace. The temperature of the smelt lies in the range of between 900 and 1000°C.
When the smelt runs out through an opening in the boiler wall and down along the outlet spout, the smelt often solidifies and adheres in the outlet spout and in the opening of the boiler wall.

Previously, the opening of the boiler wall has been cleaned manually, as well as the outlet spout, from slag and solidifying chemicals with the aid of a handspike or a crowbar. Because of the elevated temperature, this is an extremely hazardous and unpleasant job. If, for example, a plug were to form in the opening of the boiler wall, the level of recovery chemicals in the boiler would rise in order subsequently to pulsate out when the plug has been removed. There is also a risk that there is liquid smelt beneath the hardened smelt in the outlet spout, which can splash up on the operator during cleaning. This entails that the risk of burns is imminent.

On the surface of the solidified smelt, a hard layer is formed which is difficult to breach on cleaning, and in such an event on manual cleaning of the opening of the boiler wall and the smelt spout using a handspike or a crowbar, considerable force is required to remove the hardened smelt. Thus, sufficient force and power for optimum cleaning and for chipping away hardened smelt may be difficult to achieve using muscle power alone.

Machinery that is employed for realising the cleaning operation under consideration here is also previously known in the art, please see e.g. SE 522 148 C2, SE 525 844 C2 and USPS 5,542,650.

**PROBLEM STRUCTURE**

The present invention accordingly has for its object to design the apparatus intimated by way of introduction so that it obviates the drawbacks inherent in the prior art technology. In particular, the present invention has for its object to design the apparatus such that this simplifies and renders more efficient the cleaning of outlet openings and outlet spouts in a soda recovery boiler, and to design the apparatus so that it does not damage the spout on cleaning. Further, the present invention has for
its object to make for cleaning of large through-flow areas using small cleaning forces.

The present invention also relates to a method whose purpose is to simplify and render more efficient the cleaning of outlet openings and outlet spouts in a soda recovery boiler, fully in analogy with the apparatus according to the present invention.

SOLUTION

The objects forming the basis of the present invention will be attained if the apparatus intimated by way of introduction is characterised in that the tool has a first part and a second part which are located substantially in register with one another, one on either side of the longitudinal axis, the tool being asymmetric about the longitudinal axis in that the first and second tool parts display different cross-sectional configurations in a plane at right angles to the longitudinal axis.

The objects forming the basis of the present invention will also be attained if the method described by way of introduction is characterised in that the cleaning tool, by rotation, is caused to clean areas of different configurations.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

The present invention will now be described in greater detail hereinbelow, with reference to the accompanying Drawings. In the accompanying Drawings:

Fig. 1 is a perspective view of a schematically presented portion of a wall of a soda recovery boiler with an opening and an outlet spout extending therefrom obliquely downwards and outwards;

Fig. 2 is a perspective view of the apparatus according to the present invention; and
Figs. 3 to 6 show an alternative embodiment.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring to the Drawings, Fig. 1 schematically shows an apparatus for cleaning an outlet opening 1 in a wall 2, preferably a wall to a soda recovery boiler 3. From the outlet opening 1, an outlet channel or spout 4 extends outwards and obliquely downwards from the opening 1. While not being apparent from the accompanying Drawings, the lower end of the outlet spout 4 discharges in a smelt dissolving unit for recovery of cooking chemicals.

When the soda recovery boiler 3 is in operation, solidified cooking chemicals are accumulated in the outlet opening 1 and the outlet spout 4, with the result that the outlet opening 1 is fouled and blocked, and hardened smelt accumulates in the outlet spout 4 and blocks it.

For cleaning the outlet opening 1 and the outlet spout 4, the apparatus according to the present invention comprises a cleaning tool 11 (Figs. 2 to 6) which is disposed on an elongate cleaning device 6 in the form of a rod, a tube or the like. The cleaning device is supported and operated by an operating device whose purpose is to set the tool 11 in suitable cleaning movements.

In the embodiment illustrated in Fig. 1, the operating device comprises a carrier 5 in the form of a carriage which is drivable under the action of drive means 7 in the direction of the double-headed arrow 8.

The carriage supports a frame 20 in which the cleaning device 6 is secured. The frame 20 is pivotally connected to the carriage by the intermediary of joints 21 so that the frame may be pivoted in a vertical plane, which entails that the tool 11 may, in the vertical direction, follow the outlet spout 4 when the carriage is moved in accordance with the double-headed arrow 8. The vertical adjustment of the frame may be put into effect under the action of a vertical adjustment device.
The cleaning device 6, which has the tool 11 in its free end, is in the form of a handspike, a crowbar, an elongate profile, solid or tubular. On cleaning movements, the tool 11 is movable along the outlet spout 4 in through the opening 1 to the interior of the boiler 3, out through the opening 1, and back down along the outlet spout 4. The tool 11 may also be held in one or more positions above the outlet spout 4.

The carrier or carriage 5 is connected to the drive means 7 for realising the cleaning movements. The drive means 7 is disposed to drive the cleaning device 6 via the carriage 5 in cleaning movements for cleaning the outlet opening 1, where the cleaning device 6 is moved from the region outside the opening, through the opening 1 and in to the interior of the boiler 3 and out again. The drive means 7 also drives the cleaning device 6 in a movement down along the outlet spout 4. These cleaning movements for the outlet opening 1 and the outlet spout 4 largely correspond to those movements which a manual cleaning of the outlet opening 1 and the outlet spout 4 would involve.

The carriage 5 may have the drive means 7 as an integrated unit. The carriage 5 is designed so as to be movable towards and away from the wall 2, in accordance with the double-headed arrow 8, for example by being fitted with wheels 9.

The operating device, in particular the frame 20, has a rotary unit 10 for rotating the first tool 11 on the free end of the cleaning device 6, about a longitudinal axis 12 to the cleaning device 6. The rotary unit 10 is realised, for example, by means of gear wheels, a rotation cylinder etc.

The tool 11 is designed to be double-sided, for a double action cleaning of the opening 1 and the outlet spout 4. Fig. 2 shows the double-sided tool 11, which has a first and second tool part 14, 15, the first tool part 14 having a smaller cross-sectional dimension than the second tool part 15. The first and second tool parts 14 and 15 are adapted to the dimensions and configuration of the opening 1 and the outlet spout 4. In the example illustrated in Fig. 1, the cross section of the opening 1 and the spout 4
is in the form of a vertically elongate hole, but other configurations are also possible, such as for example V-shaped etc.

In one embodiment (Figs. 3 to 6) the tool 11 is of eccentric design so that the two 5 parts 14 and 15 located in register with one another in relation to the centre line 12 of the cleaning device 6 display different radial projections in relation to the centre line 12. In another embodiment (Fig. 2), both of the tool parts 14 and 15 may display the same radial projection.

The eccentricity of the first 14 and second 15 tool parts of the tool 11 may also be realised in that the longitudinal centre axis of the tool 11 does not coincide with the centre line 12 of the cleaning device 6. Hence, in this embodiment, the tool 11 is eccentrically connected to the cleaning device 6.

Another alternative entails that the cleaning device 6 is slightly curved so that its outer portion cooperating with the tool 11 makes a slight angle with its inner portion facing towards the carriage 5.

The eccentric design entails that a tool 11 with a small frontal surface and consequently requiring a relatively slight cleaning force can clean a considerably larger cross-sectional area in the outlet opening 1 and along the outlet spout 4.

In the embodiment according to Fig. 2, the first tool part 14 is adapted for cleaning those parts of the opening 1 which, in the vertical direction, are disposed lowermost and uppermost and that part of the outlet spout 4 which is located furthest down. The second tool part 15 is adapted for cleaning those parts of the opening 1 and the outlet spout 4 which are disposed on the sides of the opening and the spout.

The first and second tool parts 14 and 15 have through-going apertures 16 and 17 through which smelt may pass during the cleaning movements. The through-going apertures 16 and 17 entail, when cleaning, for example the opening 1 when this is blocked or only partly blocked by solidified smelt, that smelt may pass through the
tool 11 during the cleaning operation and, by such means, smelt is prevented from pulsating in a large quantity out of the opening 1 when the tool 11 is removed after the cleaning operation. Correspondingly, smelt may pass through the tool 11 when it is used for cleaning the spout 4.

In the embodiment according to Fig. 2, the first tool part 14 is a rod or bar profile which may have a circular, tubular or other cross section, and the second tool part 15 is a bar or rod profile with a semicircular or other hollow or unclosed cross section, these tool parts being disposed on the cleaning device 6. The first and second tool parts 14 and 15 are elongate and are buttressed by means of reinforcements 18 and 19, respectively, and the tool parts 14 and 15 extend along the extent of the cleaning device 6. Naturally, the tool parts 14 and 15 may be produced in other configurations which are adapted to suit the configuration of the outlet opening 1 and the outlet spout 4. The tool parts 14 and 15 may also be closed or solid and possess outer cross sectional dimensions which are smaller than the inner cross sectional dimensions of the opening 1 and the outlet spout 4, in which event the smelt has the possibility of running beside the tool 1 during cleaning.

The tool parts 14 and 15 according to Fig. 2 may also be eccentric inasmuch as they possess different radial projections in relation to the longitudinal axis 12.

In that case when the spout 4 is bent to V-shaped cross section, there is a risk of cracking in the spout because of tensions and fractures in the material. In this case, the spout 4 should not be cleaned all the way down into the trough, in which event the tool parts 14 and 15 would ideally display a tubular and crescent-shaped cross section. In this case, the tool parts 14 and 15 display transverse dimensions which are larger than the inner transverse dimension of the spout in the region of its lower, apex formed trough so as to avoid the risk that the tool 11 will clean all the way down into the trough of the spout 4.

The cleaning of the opening 1 in the wall 2 of the soda recovery boiler and the smelt spout 4 comprises the steps that an elongate cleaning device 6 with a cleaning tool 11
in the free end thereof is held supported by an operating device, and that the tool 11 is directed in towards the opening 1. In a cleaning movement, the tool 11 is moved towards and through the opening 1 and back to a position of rest below or a slight distance from the spout 4. hi the position of rest, the cleaning device 6 is rotated about a longitudinal axis 12 to the cleaning device 6. In a cleaning movement, the cleaning device 6 is moved towards and through the opening 1 and back to its position of rest.

According to the present invention, a second position of rest is possible immediately outside the opening 1 and slightly above the spout 4. Rotation of the tool 11 is also possible in this position.

During a cleaning movement, the tool 11 is generally also caused to move down along the spout 4 connecting to the opening 1. The cleaning device 6 may also be rotated in the second position of rest about a longitudinal axis 12 to the cleaning device 6 prior to a cleaning movement down along the spout 4. The cleaning device 6 is rotated substantially through 180°, on shifting between the two cleaning movements when cleaning the outlet opening 1 and the spout 4, respectively. In that case when the first tool part 14 is, prior to rotation, turned to face upwards, the first tool part will, after the rotation, be turned to face downwards, and the same hence also applies to the second tool part 15.

The various configurations and transverse dimensions of the first and second tool parts 14 and 15 realise an efficient cleaning, since the first tool part 14 with the smallest transverse dimension may function as a cutting edge and thus cut through the hard surface layer or crust of the solidified smelt use less of a force than that which would be required for the second tool part 15 with the larger transverse dimension to be able to cut through the same crust or surface layer. The force used on employment of a tool 11 with first and second tool parts is substantially half of that compared with if a tool 11 were to be used which is configured for cleaning the entire opening 1 and the entire spout 4, respectively, in one cleaning movement. According to the present invention, half of the opening can be cleaned on each
cleaning movement. When the tool part 15 is turned to face downwards, the lower
sides of the opening are cleaned, and the tool part 14 only partly cleans the upper
region of the opening. When the tool 11 has been rotated through 180°, with the tool
part 15 facing upwards, this cleans the sides of the upper region of the opening and
the tool part 14 only cleans the lower region of the opening.

In addition, the different transverse dimensions of the first and second tool parts 14
and 15 realise an efficient cleaning in that the first tool part 14 can get at and clean
along the lowermost region of the outlet spout 4, while the second tool part 15, once
the tool has been rotated through 180°, will clean along the side areas of the outlet
spout 4.

Hence, this also applies to the outlet opening 1, but here both the lowermost region
of the opening 1 is cleaned at the same time as the upper side regions of the opening
1 in one cleaning movement, and once the tool has been rotated through 180° in a
pause position, both the uppermost region of the opening 1 is cleaned simultaneously
with the lower side edges of the opening 1. On cleaning of the spout 4, the tool 11 is
preferably at the same speed as the speed of the running smelt, in order not to stop
the smelt on its way.

Figs. 3 to 6 show an alternative embodiment of the cleaning tool. In this
embodiment, the cleaning tool has a shaft 22 which is secured in or constitutes a part
of the outer end portion of the cleaning device 6. In the illustrated embodiment, the
shaft 22 is cylindrical and may be coaxially joined together with the cleaning device
6. It is also possible to realise the above-considered eccentricity by fixing together
the shaft 22 and the cleaning device 6 so that their longitudinal centre axes differ
from one another and will preferably be mutually parallel.

In the embodiment according to Figs. 3 to 6, the tool has an outer, substantially
cylindrical portion 23 which, in a direction in towards the carriage 5, merges into the
shaft 22 via a conical transition portion 24. The forward surface 25 on the tool, i.e.
the surface facing away from the carriage 5, is substantially planar and obliquely
slanted in relation to the longitudinal axis of the shaft so that an acute angle of the order of magnitude of between 30 and 60° is formed therebetween. In the transitional region between the planar forward surface 25 and the cylindrical portion 23, there is a small planar surface 26 whose lower defining edge 27, which connects to the circumferential surface of the cylindrical portion 23, may be considered as a cutting edge, whose purpose is to cut through a partly or wholly solidified surface or crust layer on the smelt.

Seen in the longitudinal direction, the tool has, approximately in register with the conical portion 24, a portion which is partly defined by a cylinder whose longitudinal axis is located a distance from the centre axis of the shaft 22 and which is at right angles thereto. This partly cylindrical portion carries reference numeral 28 in the Drawings and is terminated in a direction towards the shaft 22 by a slanting surface portion 29.

If the same terminology is introduced as that applied in connection with Fig. 2, namely that the smaller tool part is entitled the first tool part 14, this would imply that the cylindrical portion 23 would constitute the first tool part 14 while the partly cylindrical portion 28 would constitute the second tool part 15.

In this analogy, the second tool part 15 has a considerably greater cross-sectional area than the first tool part. Similarly, the radial distance between the top of the second tool part 15 and the centre line of the shaft 22 is considerably larger than the corresponding distance for the first tool part.
WHAT IS CLAIMED IS:

1. An apparatus for cleaning an opening (1) in the wall of a soda recovery boiler, and an outlet spout (4) which extends from the opening, comprising a carrier (5) for a cleaning device (6) which, in its free end, has a cleaning head or tool (11) and, on cleaning movements, is insertable and reciprocal in the opening (1) and movable along the outlet spout (4), and an operating device for realising the cleaning movements, the operating device having a rotary unit (10) for rotation of the cleaning device (6) about its longitudinal axis (12), characterised in that the tool (11) has a first part (14) and a second part (15) which are located substantially in register with one another, one on either side of the longitudinal axis (12), the tool being asymmetric about the longitudinal axis (12) in that the first (14) and second (15) tool parts display different cross-sectional configurations in a plane at right angles to the longitudinal axis.

2. The apparatus as claimed in Claim 1, characterised in that the first and second tool parts (14 and 15, respectively) are eccentric in the sense that their portions located most distally from the longitudinal axis (12) are at different radial distances thereto.

3. The apparatus as claimed in Claim 1 or 2, characterised in that the first tool part (14) displays a smaller cross-sectional dimension than the second tool part (15).

4. The apparatus as claimed in Claim 3, characterised in that the cross-sectional dimensions of the first and second tool parts (14, 15) are adapted to the dimensions of the opening (1) and the outlet spout (4).

5. The apparatus as claimed in Claim 3 or 4, characterised in that the first and second tool parts (14, 15) have through-going apertures (16, 17), through which smelt may pass during the cleaning cycle.
6. The apparatus as claimed in Claim 3 or 4, characterised in that the first and second tool parts (14, 15) are closed and have outer transverse dimensions that are smaller than the inner transverse dimensions of the opening (1) and the spout (4).

7. The apparatus as claimed in any of Claims 1 to 6, characterised in that the tool (11) has, at its end facing away from the cleaning device (6), a cutting edge (27).

8. A method of cleaning an opening (1) in the wall of a soda recovery boiler, and an outlet spout (4) extending from the opening, comprising the steps that an elongate cleaning device (6) which, in its free end, has a cleaning tool (11), is held supported by an operating device, that the cleaning device (6) is directed in towards the opening (1), that the cleaning device (6) is, in a cleaning movement, moved towards and through the opening (1) and back to a position of rest, and that the cleaning device (6) is rotated about a longitudinal axis (12) to the cleaning device (6), characterised in that the cleaning tool (1) is, by the rotation, caused to clean differently configured cleaning regions.

9. The method as claimed in Claim 8, characterised in that the tool (11) is caused to clean at different radial distances from the longitudinal axis (12) of the cleaning device (6).
**INTERNATIONAL SEARCH REPORT**

International application No. PCT/SE2007/000896

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC: F27D, D21C, F22B, B08B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**EPO-INTERNAL, WPI DATA, PAJ**

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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**Date of the actual completion of the international search**

14 January 2008

**Date of mailing of the international search report**

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International patent classification (IPC)

F27D 23/02 (2006.01)
D21C 11/12 (2006.01)
F27D 3/15 (2006.01)

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