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(71) Applicant: **Kamwest Solutions Oy Ab**
00210 Helsinki (FI)

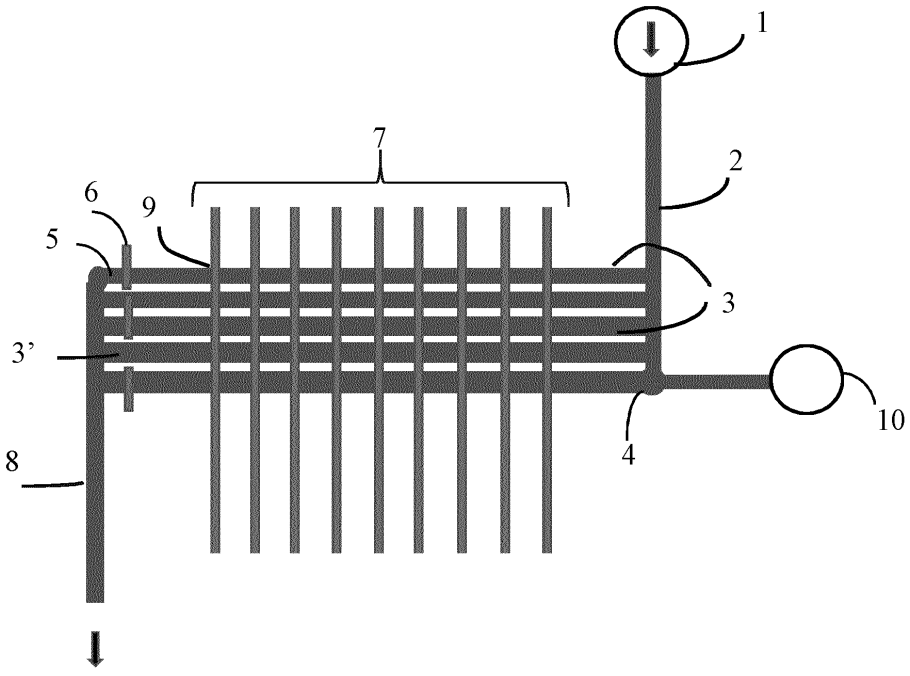
(72) Inventors:
- **WESTERLUND, Kurt**
00210 Helsinki (FI)
- **LINDQVIST, Bengt**
00210 Helsinki (FI)

(74) Representative: **Laine IP Oy**
Porkkalankatu 24
00180 Helsinki (FI)

Remarks:
Claims 16-26 &28-30 are deemed to be abandoned due to non-payment of the claims fees (Rule 45(3) EPC).

(54) SYSTEM FOR CLEANING OF HEAT-TRANSFER SURFACES

(57) System for cleaning a heat-transfer surface from solid depositions, and the use of water hammering for cleaning of heat-transfer surfaces. The system comprises a source of incompressible fluid adapted to provide a flow of the fluid at a pressure; and a flow channel having an inlet and an outlet. The channel comprises a pipe which endures the pressure of the fluid and which is rigidly connected to the heat-transfer surface and mounted for vibrating movement. A valve communicates with the outlet of the flow channel. By closing the valve, the flow of fluid through the channel will be reduced or even prevented thus creating a pressure impulse, also known as water hammering, for vibrating the pipe and for thereby achieving removal of solid depositions from the heat-transfer surfaces which are rigidly connected to the pipes.



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Description

Field of the Invention

[0001] The present invention relates to cleaning of heat-transfer surfaces by removing solid matter deposited thereon. In particular, the present invention relates to a system for cleaning of the surfaces by vibration.

Background

[0002] It is known in the art to shake heat-transfer surfaces, such as heat delivery surface, in boilers using a mechanical impact device. Such a device typically comprises a body, a hammer piece, an anvil unit, and drive means for moving the hammer piece back and forth supported by the body. There can also be a spring for conveying impact energy from the hammer piece to the anvil unit. Efficient cleaning can be achieved the impact devices. Extensive use of mechanical impacts can still give cause to mechanical wear in metal parts.

[0003] There is a need for alternative solutions for vibrating the heat-transfer surfaces.

Summary of the Invention

[0004] In one aspect, the present invention relates to a system for cleaning a heat-transfer surface by vibration from solid depositions thereon, which system comprises in particular

- a source of incompressible fluid adapted to provide a flow of said fluid at a predetermined pressure;
- a flow channel for the fluid having an inlet and an outlet, said inlet being connected to the source, and said channel comprising a pipe capable of enduring said predetermined pressure, said pipe being rigidly connected to the heat-transfer surface and mounted for vibrating movement; and
- a valve communicating with the outlet of the flow channel.

[0005] The valve is adapted to at least partially close the flow channel against flow of fluid through said channel so as to achieve a pressure impulse for vibrating the pipe and for thereby achieving removal of solid depositions from the heat-transfer surfaces.

[0006] In another aspect, the present invention relates to the use of water hammering for cleaning of a heat-transfer surface from solid depositions by achieving vibrating movement of the surfaces.

[0007] More specifically, the present invention is characterized by what is stated in the characterizing parts of the independent claims.

[0008] Considerable advantages are obtained by the present invention. The invention provides an efficient way of vibrating the heat-transfer while minimizing any mechanical wear of hot metal materials. The present system contains a minimum of moving mechanical parts. In particular, the closing member, such as disc or ball, of the valve can easily be replaced.

[0009] In some embodiments, the vibrating structure is used for suspending the heat-transfer surfaces which simplifies the construction and enhances vibrational movements of the heat-transfer surfaces.

[0010] The present invention can be used for cleaning of various pieces of equipment which comprise heat-transfer surfaces which gather solid matter depositions during conventional use thereof. Thus, for example, a system as discussed herein is suitable for cleaning heat-transfer surfaces for example, in a power boiler, a recovery boiler, a soda recovery boiler or unit, and in waste heat recovery, waste heat removal boiler, or a gas cooler.

[0011] Further features of the embodiments of the present invention will appear from the following detailed description.

Brief Description of the Drawing

[0012] The attached figure shows in schematical sideview an embodiment of the invention.

Embodiments

[0013] It is noted that, as used herein, the singular forms of "a", "an" and "the" include plural referents unless the context clearly dictates otherwise. It will be further understood that the term "comprises" and/or "comprising", when used in this specification, specify the presence of stated features, steps, operations, elements, and/or components, but do not preclude the addition of one or more other features, steps, operations, elements, components, and/or groups thereof.

[0014] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and the present disclosure, and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0015] In the present context, the term "valve" refers to a mechanical device that is capable of controlling the flow of fluids by opening, closing or partially obstructing (i.e. restricting the free flow of fluid through) a passage. The passage is, herein, also referred to as "flow channel".

[0016] In the present context, the term "heat-transfer surface" is used to designate surfaces, in particular mechanical surfaces which are capable of transferring heat from one side (the warmer side) of the surface to the opposite (the cooler) side. Thus, the term "heat-transfer surface", in the singular, also covers the concept of "heat delivery surface", such as boiler faces and convection packs, as well as heat-transfer structure "bundles" (i.e.

plurality of single heat-transfer plates or tubes).

[0017] The attached drawing shows an embodiment comprising a system for cleaning of heat-transfer surfaces, schematically designated with reference numeral 7. Such surfaces typically comprise metallic surfaces, in particular steel surfaces, with internal heating for heat delivery to the ambient (the surrounding). Other heat-transfer surfaces are metal structures which contain heat-transfer fluid for transferring heat from the ambient surrounding the heat-transfer surfaces.

[0018] Soot, ash, mineral depositions and other dirt (not shown) typically gathers on the heat delivery surfaces during use.

[0019] In the embodiment shown, the system comprises a source 1 of incompressible fluid - also referred to as a "working fluid" - adapted to provide a flow of said fluid at a predetermined pressure. The source can be a pump, for example a separate circulating or booster pump for circulating liquid or a feed water pump, or a boiler drum, adapted to generate a pressure sufficient high to maintain the fluid in liquid state.

[0020] Further, in the figure, a flow channel 3 for the fluid is depicted. The flow channel has an inlet 4 and an outlet 5. The channel comprises a pipe capable of enduring the fluid pressure generated by the source 1 of the fluid.

[0021] The pipe is rigidly connected at point 8 (and at corresponding points at the other surfaces) to the heat-transfer surface 7 to be cleaned and mounted such that vibrating movement of the pipe is possible.

[0022] The inlet 4 of the pipe is connected to the source of fluid, whereas at the outlet 5 there is a valve 8 which communicates with the outlet of the flow channel.

[0023] The valve is adapted, at a preselected point of time - and for a preselected length of time - to restrict or effectively prevent free flow of the fluid through the flow channel 3 so as to achieve a pressure impulse for vibrating the pipe. The vibration of the pipe will propagate to the rigidly connected heat-transfer surface 7. Thereby, removal of solid depositions is made possible by vibration or shaking of the heat-transfer surfaces 7. The fluid is withdrawn from the system through pipe 9 and can be recycled to the pressure source 1 or used for some other purpose.

[0024] In one embodiment, the present invention is used in connection with a boiler. Typically, such a boiler is provided with a main steam/condensate cycle comprising a combination of a condenser and pump or pumps for conducting fluid to feed water tank and from the feed water tank either directly to the boiler drum or via an economizer to the boiler drum.

[0025] In one embodiment, the fluid utilized, as described herein, is either circulated back to the main steam/condensate cycle or vented or discharged after circulation.

[0026] In one embodiment, also applicable to a boiler, water from the bottom of the boiler drum is conducted to the inlet of the fluid flow channel(s) optionally using forced circulation pumping, e.g. with a booster pump. In such an embodiment, the mixture of steam and water flowing back to the boiler drum is, in the drum, subjected to separation of water from steam. Water is then used for achieving the water hammering effect, as discussed, whereas the steam can be overheated before further use.

[0027] In one embodiment, the working incompressible fluid is bled off the main steam/condensate cycle for recycling in the pipe cleaning system at high pressure, thereby rendering a separate circulating or booster pump unnecessary.

[0028] In one embodiment, the present cleaning operation is carried out in combination with parallel use of steam in a boiler. In such an embodiment, steam bled off at the turbine at a pressure of about 4 to 12 bar is used for heating of water, e.g. for use in district heating with the aid of a heat-exchanger.

[0029] In one preferred embodiment, the heat-transfer surface 7 is mounted to allow for vibration.

[0030] Conventionally, the mounting of the surfaces will already allow for some vibrational movement of the heat-transfer surfaces. In one embodiment, the heat-transfer surface 7 is, however, supported and optionally suspended by the flow channel 3 or part(s) thereof.

[0031] Thus, in one embodiment, the heat-transfer surface(s) 7 is/are part of heat-transfer equipment mounted for vibrating movement by suspension in a horizontally arranged flow channel comprising one pipe or several parallel pipes 3.

[0032] In preferred embodiments, the flow channel 3 comprises one metal pipe or preferably a plurality of said metal pipes. In particular, the metal pipes are of stainless steel.

[0033] There can any number of flow channels, in particular horizontal flow channels, but typically there are 2 to 25, for example 4 to 12. At least one, preferably all of the pipes is/are welded to a metal heat-transfer surface 7 to be cleaned. The flow channel pipes can also be welded to constructions encompassing the heat-transfer surfaces in particular if those constructions are mechanically rigidly connected to the heat-transfer surfaces such that any vibration caused in the flow channels will propagate to the heat-transfer surfaces.

[0034] In one embodiment, each metal pipe, or a plurality or all of the pipes, is/are provided with a valve 6 which is adapted to at least partially close the flow channel against the flow of fluid through said channel and so as to achieve a pressure impulse for vibrating the pipe and for achieving removal of solid depositions from the heat-transfer surfaces.

[0035] In one embodiment, the pipes have an outer diameter of 38 to 80 mm. Typically the pipes are thick-walled (i.e. they have a pipe diameter to wall thickness of less than 20). It has been found that such pipes are advantageous in view of the high pressure caused by the pressure impulse.

[0036] In one embodiment, the flow channel can be closed by the valve(s) 6 against 10 to 100 %, in particular

20 to 100 %, preferably 50 to 100 %, for example 60 to 95 % of the fluid of the flow channel, said percentage being calculated from the volume of the flowing fluid.

[0037] In one embodiment, the flow channel comprises a plurality of pipes, and each pipe is connected to a common outlet which is provided with a valve which is adapted to at least partially close the flow channel against the flow of fluid through said channel so as to achieve a pressure impulse for vibrating the pipe and for achieving removal of solid depositions from the heat-transfer surfaces.

[0038] In one embodiment, the flow channel is provided with a by-pass conduit. For example, such a by-pass conduit is adapted to conduct at least a portion of the fluid fed to the flow channel past the valve when the flow channel is closed by the valve.

[0039] In one embodiment, as shown in the drawing, the flow channel comprises a plurality of pipes 3, and wherein at least one of the pipes 3' is adapted to allow for free flow of the fluid through the pipe to form a by-pass conduit, while at least one of the pipes 3 is adapted simultaneously to close 6 its channel to achieve a pressure impulse for vibrating the pipe and for thereby achieving removal of solid depositions from the heat-transfer surfaces.

[0040] In one preferred embodiment, the source of incompressible fluid is capable of generating a linear flow of fluid of up to 50 m/s, in particular up to 25 m/s, preferably of 1 to 10 m/s through a single flow channel or through each flow channel.

[0041] In one embodiment, at least one, preferably each valve has a closing time for the fluid of less than 100 ms, preferably less than 20 ms, for example 0.5 to 10 ms, in particular about 0.5 to 7.5 ms or 0.5 to 2ms.

[0042] In one embodiment, the valves are adapted to closing 95 to 99.5 % of the cross-section of the flow channel available for the fluid flow.

[0043] In one embodiment, the valve used is a disc valve. The disc valve has, in some embodiments, an aperture extending through the disc to allow for some bleeding of the valve to achieve the predetermined closing time of valve or retardation of the fluid flow.

[0044] In one embodiment, the valve or valves is/are capable of achieving a retardation (negative) acceleration of the fluid flow of 200 to 1600 m/s^2, in particular about 600 to 1000 m/s^2.

[0045] By the afore-described arrangement, water hammering will be generated in the fluid flow channels 3. Therefore, the embodiment(s) discussed herein will allow for the use of water hammering for cleaning of a heat-transfer surface from solid depositions by vibrating movement of the surfaces. In particular, water hammering is achieved in a zone of horizontal flow through a conduit rigidly connected to the heat-transfer surface. This is the case with the embodiment shown in the drawing.

[0046] As a result of the pressure impulse generated, the pressure of the fluid will increase upstream from the valve. To dampen the effect of such a reverse (negative) pressure impulse on the piping upstream of the valve, there is, in one embodiment, arranged in the fluid flow channel a pressure dampening means, for example pulsation damper, e.g. expansion bellow.

[0047] For illustrative purposes, the position of one such dampening means is indicated in the drawing and marked with reference numeral 10. In one embodiment, each of the fluid flow channels having valves is provided with such a dampening means.

[0048] The dampening means, such as a pulsation damper, e.g. expansion bellow, may comprise a flexible or preferably rigid walled container typically containing both a liquid phase and a gas phase. The reverse pressure pulse emanating from the generation of the water hammering is taken up by the liquid and gas phases.

[0049] Similarly, (non-shown) pressure dampening means can be arranged down-stream of the valves to mitigate the risk of cavitation.

[0050] After a pressure impulse has been generated as explained above, the valve will be opened again to allow for acceleration of the fluid flow. There can be a cascade of closing phases with intervening opening phases. In one embodiment, such a cycle will comprise 2 to 100 pressure impulses with intervening acceleration phases. The acceleration phases can have a duration of up to 60 s, in particular up to 30 s, for example 1 to 20 s.

[0051] In one embodiment, the valve will be opened after 0.1 to 10 s, for example 0.5 to 5 s, after the generation of the pressure impulse.

[0052] In one embodiment, the incompressible fluid consists of water, although other fluids, such as various heat-transfer oils or even mercury, can be used as well. Typically, in embodiments, the water will be heated when contacted with the heat-transfer surfaces. In one embodiment, the water-gas surface has a temperature of above the dewpoint of corrosive gas components and below a point of hot corrosion of metal, such as 10 to 300 °C, for example 95 to 225 °C.

[0053] In one embodiment, the water is preferably free from oxygen and calcium impurities.

[0054] In one embodiment, the flow channel 3 has a zone of essentially horizontal flow of the fluid before, preferably immediately before, valve 6 and the outlet 5 of the flow channel. As a result, the pressure impulse for vibrating the pipe is generated in the horizontal zone. Typically, the flow channel is connected to or comprises a zone of essentially vertical flow of the fluid before the zone of essentially horizonal flow of the fluid. Further, the flow channel is connected to or comprises a zone of essentially vertical flow of the fluid after the zone of horizonal flow of the fluid.

[0055] In one embodiment, the pressure source, such as pump or boiler drum, is adapted to generate a pressure sufficient high to maintain the fluid in liquid state.

[0056] In one embodiment, the valve 6 is adapted to at least partially close the flow channel against flow of water through said channel so as to achieve water ham-

mering for vibrating the pipe and the heat-transfer surface connected thereto.

[0057] In one embodiment, the system comprises a plurality of horizontally mounted pipes forming a flow channel having an inlet, which is connected to a source of pressurized fluid, and an outlet, said pipes being provided with valves communicating with and preferably connected to the outlet for restricting or preventing the flow of pressurized fluid, at least one of the pipes being adapted to allow for essentially free flow of the fluid.

List of Reference Numerals

[0058]

1. Pressure source
2. Conduit
3. Flow channels (with valves)
3'. Flow channel (without a valve)
4. Inlet of flow channel
5. Outlet of flow channel
6. Valve
7. Heat-transfer surfaces
8. Outlet pipe
9. Suspension point of heat-transfer surface on flow channel
10. Pulsation damper

Industrial Applicability

[0059] The system as disclosed above can be used for various purposes. In particular it can be used for cleaning heat-transfer surfaces that are part of heat-transfer equipment, such as of

- a power boiler, such as a heat boiler;
- a recovery boiler, such as a kiln for reburning lime sludge;
- a soda recovery boiler or unit;
- a waste heat recovery;
- waste heat removal boiler; or
- gas cooler.

[0060] In one embodiment, the hear-transfer surface comprises an energizer.

Claims

1. System for cleaning a heat-transfer surface by vibration from solid depositions thereon, said system comprising

   - a source of incompressible fluid adapted to provide a flow of said fluid at a pressure;
   - a flow channel for the fluid having an inlet and an outlet, said inlet being connected to the source, and said channel comprising a pipe capable of enduring the pressure of the fluid, said pipe being rigidly connected to the heat-transfer surface and mounted for vibrating movement; and
   - a valve communicating with the outlet of the flow channel;

   said valve being adapted to at least partially close the flow channel against flow of fluid through said channel so as to achieve a pressure impulse for vibrating the pipe and for thereby achieving removal of solid depositions from the heat-transfer surfaces.

2. The system according to claim 1, wherein the heat-transfer surface is mounted to allow for vibration thereof, and wherein the heat-transfer surface is preferably supported and optionally suspended by the flow channel or part thereof.

3. The system according to claim 1 or 2, wherein the flow channel comprises one metal pipe or preferably a plurality of said metal pipes, and at least one, preferably all of said pipes is or are, respectively, welded to a metal heat-transfer surface to be cleaned or to a part thereof.

4. The system according to any of the preceding claims, wherein each metal pipe, or a plurality or all of the pipes, is or are, respectively, provided with a valve which is adapted to at least partially close the flow channel against the flow of fluid through said channel so as to achieve a pressure impulse for vibrating the pipe and for achieving removal of solid depositions from the heat-transfer surfaces.

5. The system according to any of the preceding claims, wherein the flow channel is closed against 10 to 100 %, in particular 20 to 100 %, preferably 50 to 100 %, for example 60 to 95 % of the fluid of the flow channel, said percentage being calculated from the volume of the flowing fluid.

6. The system according to any of the preceding claims, wherein the flow channel comprises a plurality of pipes, and wherein each pipe is connected to a common outlet which is provided with a valve which is adapted to at least partially close the flow channel

against the flow of fluid through said channel so as to achieve a pressure impulse for vibrating the pipe and for achieving removal of solid depositions from the heat-transfer surfaces.

7. The system according to any of the preceding claims, wherein the flow channel is provided with a by-pass conduit.

8. The system according to claim 7, wherein the by-pass conduit is adapted to conduct at least a portion of the fluid fed to the flow channel past the valve when the flow channel is closed by the valve.

9. The system according to claim 7 or 8, wherein the flow channel comprises a plurality of pipes, and wherein at least one of the pipes is adapted to allow for free flow of the fluid through said pipe to form a by-pass conduit, while at least one of the pipes is adapted simultaneously to close its channel to achieve a pressure impulse for vibrating the pipe and for thereby achieving removal of solid depositions from the heat-transfer surfaces.

10. The system according to any of the preceding claims, wherein the source of incompressible fluid, capable of generating a linear flow of fluid of 1 to 10 m/s through the or through each flow channel.

11. The system according to any of the preceding claims, wherein the flow channel is placed in communication with a pump, such as a circulating or booster pump for circulating liquid, or water feed pump, or a boiler drum.

12. The system according to any of the preceding claims, wherein at least one, preferably each valve has a closing time of less than 100 ms, preferably less than 20 ms, for example 0.5 to 10 ms, in particular about 0.5 to 7.5 ms, such as 0.5 to 2 ms.

13. The system according to any of the preceding claims, wherein at least one or each valve is adapted to closing 95 to 99.5 % of the cross-section of the flow channel available for the fluid flow.

14. The system according to any of the preceding claims, wherein at least one or each valve is capable of achieving a retardation (negative acceleration) of the fluid flow of 200 to 1600 m/s^2, in particular about 600 to 100 m/s^2.

15. The system according to any of the preceding claims, wherein the heat-transfer surface to be cleaned is a part of heat-transfer equipment, such as

- a power boiler, such as a heat boiler;
- a recovery boiler, such as a kiln for reburning lime sludge;
- a soda recovery boiler or unit;
- a waste heat recovery;
- waste heat removal boiler; or
- gas cooler.

16. The system according to any of the preceding claims, wherein the hear-transfer surface comprises an energizer.

17. The system according to any of the preceding claims, wherein the incompressible fluid consists of water, and the water-gas surface having a temperature of above the dewpoint of corrosive gas components and below a point of hot corrosion of metal, such as 10 to 300 °C, for example 95 to 225 °C.

18. The system according to any of the preceding claims, wherein the flow channel is adapted to allow for a zone of essentially horizontal flow of the fluid before, preferably immediately before, said valve, in particular to achieve said pressure impulse for vibrating the pipe in the horizontal zone.

19. The system according to any of the preceding claims, wherein the flow channel is adapted to allow for a zone of essentially vertical flow of the fluid before a zone of essentially horizonal flow of the fluid.

20. The system according to any of the preceding claims, wherein the flow channel is adapted to allow for a zone of essentially vertical flow of the fluid after the zone of essentially horizonal flow of the fluid.

21. The system according to any of the preceding claims, wherein the pressure source, such as pump, optionally a separate circulating or booster pump for circulating liquid or a feed water pump, or a boiler drum, is adapted to generate a pressure sufficient high to maintain the fluid in liquid state.

22. The system according to any of the preceding claims, wherein at least one or each valve is adapted to at least partially close the flow channel against flow of water through said channel so as to achieve water hammering for vibrating the pipe and the heat-transfer surface connected thereto.

23. The system according to any of the preceding claims, comprising a plurality of horizontally mounted pipes forming a flow channel having an inlet, which is connected to a source of pressurized fluid, and an outlet, said pipes being provided with valves communicating with and preferably connected to the outlet for restricting or preventing the flow of pressurized fluid, at least one of the pipes being adapted to allow for essentially free flow of the fluid.

24. The system according to any of the preceding claims, wherein the source of incompressible fluid comprises fluid is bled off a main steam/condensate cycle for circulation in the pipes at high pressure.

25. The system according to claim 24 wherein the fluid utilized is either circulated back to a main steam/condensate cycle or vented or discharged after circulation.

26. The system according to any of the preceding claims, comprising a pulsation damper, e.g. expansion bellow for reducing the pressure of negative (reversed) pressure impulses generated during the closing of the fluid flow channel.

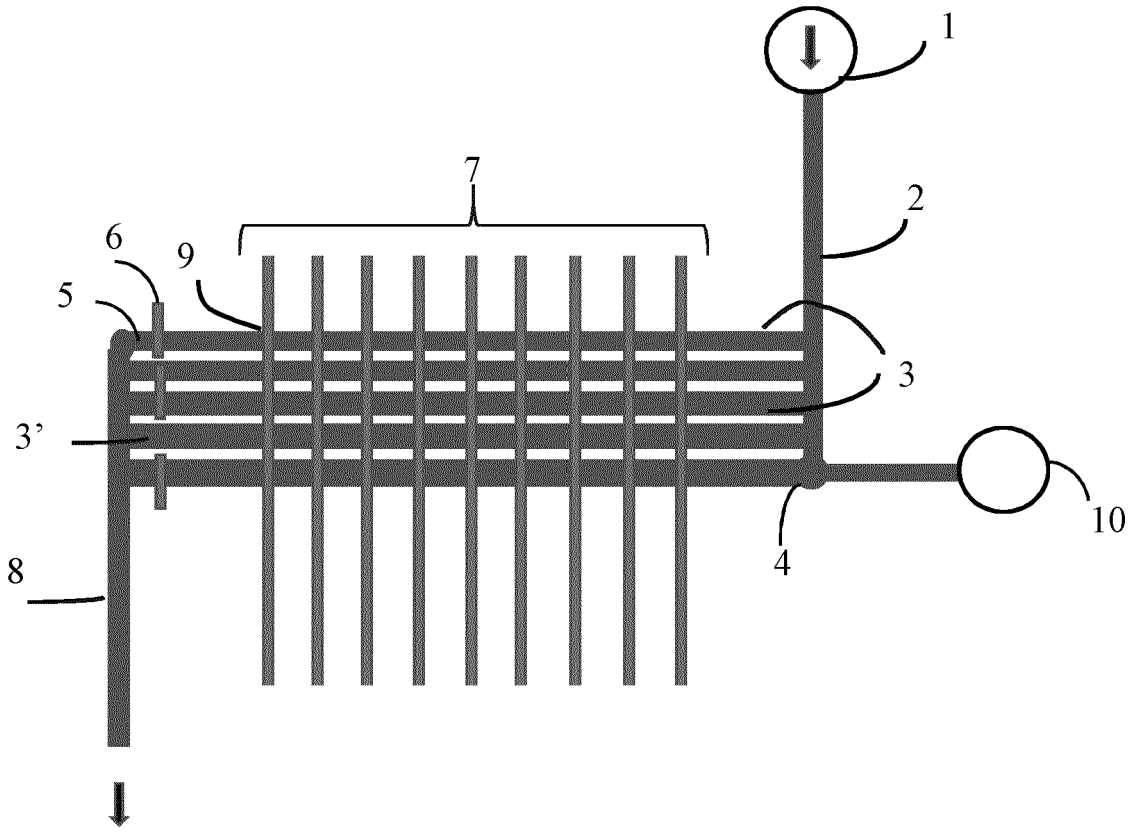
27. Use of water hammering for cleaning of a heat-transfer surface from solid depositions by vibrating movement of said heat-transfer surface.

28. The use according to claim 27, wherein the water hammering is achieved in a zone of horizontal flow through a conduit rigidly connected to said heat-transfer surface.

29. The use according to any of claims 27 or 28, wherein the heat-transfer surface is part of heat-transfer equipment mounted for vibrating movement by suspension in a horizontally arranged flow channel comprising one pipe or several parallel pipes.

30. The use according to any of claims 27 to 29, comprising cleaning a heat-transfer surface that is a part of

- a power boiler, such as a heat boiler;
- a recovery boiler, such as a kiln for reburning lime sludge;
- a soda recovery boiler or unit;
- a waste heat recovery;
- waste heat removal boiler; or
- gas cooler.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EUROPEAN SEARCH REPORT

Application Number
EP 22 39 7506

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	* the whole document *	1-15	B08B9/023
X	DE 197 02 202 A1 (EBARA GERMANY GMBH [DE]) 13 August 1998 (1998-08-13)	27	ADD. F28F13/10
A	* column 2, line 35 - column 4, line 43 * * column 7, lines 21-51; figure 2 *	1-15	
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A	* abstract; figure 1 *	1-15	
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A	* abstract; figures 1-3 * * column 3, lines 13-62 *	1-15	
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A	DE 837 244 C (MASCHF AUGSBURG NUERNBERG AG) 21 April 1952 (1952-04-21) * the whole document *	1	F28F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	11 August 2023	Leclaire, Thomas

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

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Application Number
EP 22 39 7506

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

[X] Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

1-15, 27

[ ] No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

[ ] All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

[ ] As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

[ ] Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

[ ] None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

[ ] The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 22 39 7506

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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11-08-2023

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82