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(54) **METHOD FOR CONNECTING HEAT EXCHANGING SURFACES TO A MAIN STRUCTURE OF A BOILER, BOILER AND BOILER MODULE**

(57) The method for connecting heat exchanging surfaces to a main structure (2) of a boiler comprises erecting the main structure (2), assembling modules (5) comprising at least outer hanger supports (6) and peripheral heat exchanging surfaces (7), connecting the outer hanger supports (6) to the main structure (2), connecting together the peripheral heat exchanging surfaces (7) of adjacent modules (5).

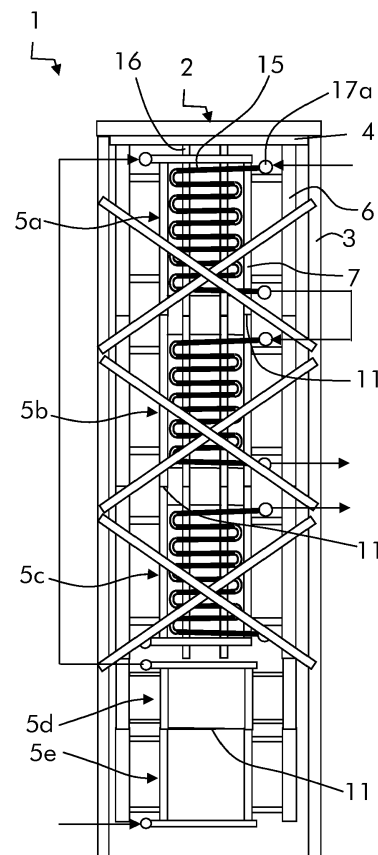


Fig. 4

Description

TECHNICAL FIELD

[0001] The present invention relates to a method for connecting heat exchanging surfaces to a main structure of a boiler, boiler and boiler module.

[0002] Preferably, the boiler is a large boiler of a power plant for electric power generation.

BACKGROUND

[0003] Boilers are known to comprise a main structure (also known as steel structure) that supports heat exchanging surfaces such as (from the top of the boiler downwards) an economizer, a reheater, a superheater, an evaporator.

[0004] Typically, during the erection of the boiler, the main structure is erected first and the heat exchanging surfaces are then element-by-element connected to the main structure, often by handling them with large cranes.

[0005] This erection process is very time consuming, because of the element-by-element connection and, in addition, because the large cranes could hinder each other.

SUMMARY

[0006] An aspect of the invention includes providing a method for connecting heat exchanging surfaces to a main structure of a boiler, a boiler and a boiler module that allow a quick boiler erection. In particular, the heat exchanging surfaces can e.g. be the economizer and/or reheater and/or superheater and/or evaporator.

[0007] These and further aspects are attained by providing a method for connecting heat exchanging surfaces to a main structure of a boiler, a boiler and a boiler module in accordance with the accompanying claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Further characteristics and advantages will be more apparent from the description of a preferred but non-exclusive embodiment of the method, boiler and boiler module, illustrated by way of non-limiting example in the accompanying drawings, in which:

Figures 1 and 2 show steps of the method for connecting heat exchanging surfaces to a main structure of the boiler;

Figures 3 and 4 show different examples of boilers; Figures 5 through 8 show different examples of modules;

Figures 9 and 10 show different examples of reciprocal connection of peripheral heat exchanging surfaces;

Figures 11 and 12 show different examples of reciprocal connection of internal heat exchanging surfaces;

es;

Figures 13 through 18 show the steps of the method for assembling a module.

5 DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0009] In the following the boiler and the modules used to erect the boiler are described first.

10 **[0010]** The boiler 1 (figures 2 and 3) comprises a main structure 2 including a tower 3 and a top grid 4 above the tower 3. The main structure 2 supports heat exchanging surfaces. The boiler can be any type of boiler, such as e.g. a tower boiler or a two pass boiler.

15 **[0011]** The main structure 2 is connected to and supports modules 5 that define heat exchanging surfaces. According to the specific design of the boiler, the modules 5 can be a whole or a section of: an evaporator, a superheater, a reheater, an economizer.

20 **[0012]** Each module 5 comprises (figures 5-8) outer hanger supports 6 and peripheral heat exchanging surfaces 7; preferably each module defines a cross section of the boiler.

25 **[0013]** The outer hanger supports 6 can be connected to and support the peripheral heat exchanging surfaces 7 e.g. via posts (other example are anyhow possible).

[0014] The outer hanger supports 6 can be solid bars or tubular bar, e.g. to allow steam circulation through them, in order to allow a similar thermal expansion for the outer hanger supports 6 as for the peripheral heat exchanging surfaces 7 and counteract differential expansion through the boiler that could cause stress.

30 **[0015]** The peripheral heat exchanging surfaces 7 can be defined by tubed walls, e.g. they can comprise tubes 8 and fins 9 (but the fins 9 are optional).

35 **[0016]** The outer hanger supports 6 are directly (i.e. the supports 6 are connected to the main structure 2) or indirectly (i.e. the supports 6 are connected to another element that is in turn directly or indirectly connected to the main structure 2) connected to the main structure 2. Preferably the outer hanger supports 6 are directly or indirectly connected to the upper part of the main structure 2 and/or top grid 4.

40 **[0017]** The peripheral heat exchanging surfaces 7 of each module 5 are connected to the peripheral heat exchanging surfaces 7 of another module 5.

45 **[0018]** In one example (figure 9), the connection of the peripheral heat exchanging surfaces 7a, 7b of different modules 5 can be done by welding each tube 8a of the peripheral heat exchanging surfaces 7a to another tube 8b of the peripheral heat exchanging surfaces 7b. Reference 11 indicates the welds between the tubes 8a, 8b. Preferably the welds 11 are also provided between the fins 9a, 9b of the peripheral heat exchanging surfaces 7a, 7b.

50 **[0019]** In another example (figure 10), the modules 5 can have peripheral heat exchanging surfaces 7a, 7b, having collectors 12a, 12b connected to a headers 13a,

13b. The header 13a of a module can be connected to the header 13b of the other module in order to realize the connection. This connection can for example be made with a pipe 14.

[0020] Naturally the connections by directly welding the tubes 8 (and possibly the fins 9) and by connecting together the headers 13a and 13b can be implemented in the same boiler but at different parts thereof.

[0021] The modules 5 can comprise internal heat exchanging surfaces 15 located within the peripheral heat exchanging surfaces 7 (figures 5-7). The module preferably defines a cross section of the boiler.

[0022] The internal heat exchanging surfaces 15 can for example define a superheater or a reheater or an economizer. In addition, they are preferably defined by coil pipes.

[0023] The modules 5 have inner hanger supports 16 connected to the internal heat exchanging surfaces 15. The inner hanger supports 16 can be defined by solid posts or by tubes, in this last case the hanger supports can be part of a superheater or reheater and are connected to headers.

[0024] The internal heat exchanging surfaces 15 of a module are connected to the internal heat exchanging surfaces 15 of another module.

[0025] Also this connection can be done in different ways.

[0026] In one example (figure 12) the internal heat exchanging surfaces 15a, 15b (i.e. the coil pipes defining them) of different modules 5a, 5b are connected together, e.g. welded. For example an intermediate pipe 16 could be used (but this is not mandatory).

[0027] In another example (figure 11), the internal heat exchanging surfaces 15a, 15b (i.e. the coil pipes defining them) have headers 17a, 17b and the internal heat exchanging surfaces 15a, 15b are connected by connecting the header 17a of an internal heat exchanging surface 15a of a module to the header 17b of the internal heat exchanging surface 15b of the other module. For example an intermediate pipe 16 can be used also in this case.

[0028] Advantageously the inner hanger supports 16, the internal heat exchanging surfaces 15, the outer hanger supports 6 and the peripheral heat exchanging surfaces 7 are connected together.

[0029] In the following specific examples of boilers are described more in detail.

EXAMPLE 1 - figure 3

[0030] Figure 3 shows the main structure 2 with a top grid 4 supporting the modules 5a-5e. The modules 5a-5c have their peripheral heat exchanging surfaces 7 that define sections of the superheater; the module 5c has its inner heat exchanging surfaces 15 that define an additional section of the superheater. The modules 5b and 5a have their inner heat exchanging surfaces 15 that define a reheater. The modules 5d and 5e define an evaporator.

[0031] All modules 5a-5e have outer hanger supports 6 that are connected together; the outer hanger supports 6 of the module 5a are directly connected to the top grid 4 and the outer hanger supports 6 of the other modules are connected to the outer hanger supports 6 of overlaying module.

[0032] In addition, the modules 5a-5c also have the inner hanger supports 16 connected together; the inner hanger supports 16 of the module 5a are connected to the top grid 4 and the inner hanger supports 16 of the other modules 5b, 5c are connected to the inner hanger modules 16 of the overlaying module.

[0033] A first duct 20 connects the headers 13e of the module 5e to a water supply; for example the first duct 20 is connected to a supply pump and a condenser, possibly via a reservoir.

[0034] The module 5e and 5d are connected by welds 11 provided between the tubes (and fins) of their peripheral heat exchanging surfaces 7.

[0035] The heaters 13d are connected to the upper headers 13a, the lower headers 13a are connected to the upper headers 13b; the lower headers 13b are connected to the upper header 13c; the lower headers 13c are connected to the lower header 17c of the inner heat exchanging surface of the module 5c; the upper header 17c is connected to the high pressure turbine.

[0036] The upper headers 17a of the inner heat exchanging surface 15a of the module 5a is connected to the high pressure turbine outlet, the lower headers 17a is connected to the upper headers 17b and the lower headers 17b is connected to the low pressure turbine.

[0037] In this example, the modules 5a-5c have the peripheral heat exchanging surfaces 7 provided with collectors and headers and the inner heat exchanging surfaces 15 provided with headers; the connection can thus take place by connecting the headers. For example this connection can be done by providing pipes between the headers.

[0038] The modules 5d and 5e (defining the evaporator) are reciprocally connected by welding their tubes 8, while the connection with the other modules or water supply occurs via headers 13d, 13e.

EXAMPLE 2 - figure 4

[0039] In this example the boiler has a similar structure as the boiler of figure 3, but the modules are connected in a different way, i.e. some connections that in the example 1 are done by collectors and headers are done in this example by directly welding the tubes 8.

[0040] The modules 5a-5b have their peripheral heat exchanging surfaces 7 whose tubes 8 are directly connected together by welds 11. The inner heat exchanging surfaces are also in this example provided with headers. The modules 5d and 5e are connected as described with reference to the example 1.

FURTHER EXAMPLES

[0041] Naturally even if only two example of boilers have been specifically described, the connections among the modules can be any; e.g.:

the modules 5d and 5e can be connected together by collectors and headers instead of directly welding their pipes;
some of the peripheral heat exchanging surfaces 7 of different adjacent modules 5 can have their tube directly welded together while some others can be connected through collectors and headers;
some of the inner heat exchanging surfaces 15 of different adjacent modules can have their tubes 8 directly welded together while some others can be connected through headers.

[0042] In addition it is clear that the specific described configurations for the boilers are not mandatory and the boiler configuration can be any according to the needs; e.g. the evaporator can be defined by one or more modules, the superheater can be defined by one or more modules and/or by peripheral and/or inner heat exchanging surfaces; the reheater can be defined by one or more modules and/or by peripheral and/or inner heat exchanging surfaces.

[0043] In the following some specific example of module are described in detail.

EXAMPLE 3 - figures 5 and 6

[0044] Figures 5 and 6 show a module without one peripheral heat exchanging surface 7 (for clarity); these figures show a module having the peripheral heat exchanging surfaces 7 that are not provided with any collector or header. This module further has inner heat exchanging surfaces 15 that are provided with headers 17. For example the peripheral heat exchanging surfaces define a superheater or a section of a superheater and the inner heat exchanging surfaces can define a superheater or a section of a superheater or a reheater or a section of a reheater.

EXAMPLE 4 - figure 7

[0045] This module is similar to the module of the example 3; in particular this module has the peripheral heat exchanging surfaces 7 with collectors 12 and headers 13. The inner heat exchanging surface 15 has headers 17 as well. For example the peripheral heat exchanging surfaces define a superheater or a section of a superheater and the inner heat exchanging surfaces can define a superheater or a section of a superheater or a reheater or a section of a reheater.

EXAMPLE 5 - figure 8

[0046] This module has the peripheral heat exchanging surfaces 7 without collectors or headers. No inner heat exchanging surfaces are provided. For example the peripheral heat exchanging surfaces can define an evaporator or a section of an evaporator (in particular an intermediate section of an evaporator to be connected to other sections of evaporator by welding both ends of the tubes 8 of the peripheral heat exchanging surfaces to the tubes 8 of the peripheral heat exchanging surfaces of other modules).

METHOD

[0047] The present invention also refers to a method for connecting heat exchanging surfaces to the main structure 2 of a boiler.

[0048] The method comprises

erecting the main structure 2 (figure 1); typically the tower 3 is erected first and preferably the top grid 4 is not provided on top of it at this stage;
assembling the modules comprising at least outer hanger supports 6 and peripheral heat exchanging surfaces 7, in addition, preferably the module to be connected to the top of the main structure 2 can be connected to the top grid 4;
connecting the outer hanger supports 6 to the main structure 2; this is advantageously done by lifting the modules 5 as indicated by the arrow F, e.g. with strand jacks 29; the strand jacks 29 can be temporary (i.e. in a removable way, such that after erection they can be removed) connected to the main structure 2 (figure 2), when the top grid 4 is part of a module 5 (the module to be connected to the top of the main structure 2), the top grid 4 is lifted via the strand jacks 29 and is then connected to the main structure 2;
connecting together the peripheral heat exchanging surfaces 7 of adjacent modules 5 (figures 3 or 4).

[0049] Connecting the outer hanger supports 6 to the main structure 2 comprises directly or indirectly connecting the outer hanger supports 6 to the main structure 2. This connection can e.g. be a welded connection.

[0050] Connecting together the peripheral heat exchanging surfaces 7 can be done in different ways.

[0051] In one example connecting together the peripheral heat exchanging surfaces 7 comprises welding each tube 8 of a peripheral heat exchanging surface 7 of a module 5 to a tube 8 of a peripheral heat exchanging surface 7 of another module 5.

[0052] In another example, modules can have peripheral heat exchanging surfaces 7 having a collector 12 connected to headers 13; in this case connecting together the peripheral heat exchanging surfaces 7 comprises connecting the header 13 of a module 5 to the header 13 of another module 5.

[0053] When the modules 5 further have internal heat exchanging surfaces 15 located within the peripheral

heat exchanging surfaces 7 and inner hanger supports 16 connected to the internal heat exchanging surface 15, the method further comprises connecting the internal heat exchanging surface 15 of a module 5 to the internal heat exchanging surface 15 of another module 5.

[0054] Also this connection can be done in different ways.

[0055] In one example, connecting the internal heat exchanging surface 15 of a module 5 to the internal heat exchanging surface 15 of another module 5 is done by directly welding the internal heat exchanging surfaces 15 together or via the intermediate pipe 16.

[0056] In another example, when the modules 5 have internal heat exchanging surfaces 15 having headers 17, connecting the internal heat exchanging surface 15 of a module to the internal heat exchanging surface 15 of another module comprises connecting the headers 17 of the internal heat exchanging surface of the module to the header 17 of the internal heat exchanging surfaces the other module.

[0057] Advantageously, the module 5a connected first to the main structure 2 (this module can comprise the top grid 4, but this is not mandatory) is directly hanged to the main structure 2 (e.g. via the top grid 4 according to the design), and the other modules 5b-5e successively connected to the main structure 2 are indirectly connected to the main structure 2 by connecting them in sequence below the modules already connected to the main structure 2.

[0058] Preferably, during lifting the strand jacks 29 are connected to the outer hanger supports 6 and to the peripheral heat exchanging surfaces 7 and to the internal heat exchanging surfaces 15 (if provided). In case a module (the one to be connected at the top of the main structure 2) is provided with the top grid 4, and (as preferred) the outer hanger supports 6, the peripheral heat exchanging surfaces 7 and the internal heat exchanging surfaces 15 (if provided) are connected to the top grid 4, the strand jacks 29 can be only connected to the top grid 4. The present invention also refers to a method to assemble a module.

[0059] This method comprises (figures 13-20) providing a module assembling table 30 (figure 13), providing peripheral heat exchanging surface assembling tables 31 (figure 13), providing the module assembling table with lifting towers 32 (figure 14), assembling the peripheral heat exchanging surfaces 7 on the peripheral heat exchanging surface assembling tables 31 (figure 15), possibly the peripheral heat exchanging surfaces 7 can also be provided with buckstays 33 (i.e. stiffening elements for the peripheral heat exchanging surfaces 7; figure 16), lifting the peripheral heat exchanging surfaces 7 in vertical position on the module assembling table 30 (figure 17), removing the peripheral heat exchanging surface assembling tables 31 (figure 13),

providing outer hanger supports 6 (figure 18) and, if needed, the collector and headers and protections for the collector and headers.

[0060] In addition, at least an internal heat exchanging surface 15 can be installed at least while providing the outer hanger supports 6.

[0061] Naturally the features described may be independently provided from one another.

10 REFERENCE NUMBERS

[0062]

1	boiler
2	main structure
3	tower
4	top grid
5, 5a-5e	module
6	outer hanger support
7, 7a, 7b	periferal heat exchanging surface
8, 8a, 8b	tubes
9, 9a, 9b	fins
11	weld
12, 12a, 12b	collector
13, 13a-13e	header
14	pipe
15, 15a, 15b	internal heat exchanging surface
16	inner hanger support
17, 17a, 17b	header
20	first duct
29	strand jack
F	lifting

35 Claims

1. A method for connecting heat exchanging surfaces to a main structure (2) of a boiler, the method comprising erecting the main structure (2), **characterized by** assembling modules (5) comprising at least outer hanger supports (6) and peripheral heat exchanging surfaces (7), connecting the outer hanger supports (6) to the main structure (2), connecting together the peripheral heat exchanging surfaces (7) of adjacent modules (5).
2. The method of claim 1, **characterized in that** assembling modules (5) further comprising providing a top grid (4) connected to at least at least outer hanger supports (6) and peripheral heat exchanging surfaces (7), and connecting the outer hanger supports (6) to the main structure (2) comprises connecting the top grid (4) to the top of the main structure (2).
3. The method of claim 1, **characterized in that** con-

- necting the outer hanger supports (6) to the main structure (2) comprises directly or indirectly connecting the outer hanger supports (6) to an upper part of the main structure (2).
4. The method of claim 1, **characterized in that** connecting together the peripheral heat exchanging surfaces (7) comprises welding each tube (8) of a peripheral heat exchanging surface (7) of a module (5) to a tube (8) of a peripheral heat exchanging surface (7) of another module (5). 5 10
 5. The method of claim 1, **characterized in that** at least two modules (5) have at least a peripheral heat exchanging surface (7) having a collector (12) connected to a header (13), wherein connecting together the peripheral heat exchanging surfaces (7) comprises connecting the header (13) of a module (5) to the header (13) of another module (5). 15 20
 6. The method of claim 1, **characterized in that** at least two modules (5) further comprise an internal heat exchanging surface (15) located within the peripheral heat exchanging surfaces (7), inner hanger supports (16) connected to the internal heat exchanging surface (15), the method further comprising connecting the internal heat exchanging surface (15) of a module (5) to the internal heat exchanging surface (15) of another module (5). 25 30
 7. The method of claim 6, **characterized in that** the module (5) has an internal heat exchanging surface (15) having a header (17), and the other module (5) has an internal heat exchanging surface (15) having at least a header (17), wherein connecting the internal heat exchanging surfaces (15) of a module (5) to the internal heat exchanging surfaces (15) of another module (5) comprises connecting the header (17) of the internal heat exchanging surface (15) of the module (5) to the header (17) of the internal heat exchanging surfaces (15) the other module (5). 35 40
 8. The method of claim 1, **characterized in that** a module (5) connected first to the main structure (2) is directly hanged to the main structure (2), and at least a module (5) successively connected to the main structure (2) is indirectly connected to the main structure (2) by connecting it below the module (5) already connected to the main structure (2). 45 50
 9. A method to assemble a module (5), **characterized by** comprising providing a module assembling table (30), providing peripheral heat exchanging surface assembling tables (31), 55
 - providing the module assembling table (30) with lifting towers (32), assembling the peripheral heat exchanging surfaces (7) on the peripheral heat exchanging surface assembling tables (31), lifting the peripheral heat exchanging surfaces (7) in vertical position on the module assembling table (30), removing the peripheral heat exchanging surface assembling tables (31), providing outer hanger supports (6).
 10. The method of claim 9, **characterized by** installing at least an internal heat exchanging surface (15) at least while providing the outer hanger supports (6).
 11. A boiler comprising a main structure (2) and modules connected to the main structure, wherein each module (5) comprises at least outer hanger supports (6) and peripheral heat exchanging surfaces (7), the outer hanger supports (6) are connected to the main structure (2), the peripheral heat exchanging surfaces (7) of each module (5) are connected to the peripheral heat exchanging surfaces (7) of another module (5).
 12. The boiler of claim 11, **characterized in that** each tube (8) of the peripheral heat exchanging surfaces (7) of a module (5) is welded to another tube (8) of the peripheral heat exchanging surfaces (7) of another module (5).
 13. The boiler of claim 11, **characterized in that** at least two modules (5) have peripheral heat exchanging surfaces (7) having a collector (12) connected to a header (13), wherein a header (13) of a module (5) is connected to the header (13) of the other module (5).
 14. The boiler of claim 11, **characterized in that** at least two modules (5) comprise internal heat exchanging surfaces (15) located within the peripheral heat exchanging surfaces (7), inner hanger supports (16) connected to the internal heat exchanging surfaces (15), wherein the internal heat exchanging surfaces (15) of a module (5) are connected to the internal heat exchanging surfaces (15) of the other module (5).
 15. The boiler of claim 14, **characterized in that** at least two internal heat exchanging surfaces (15) have headers (17), and the at least two internal heat exchanging surfaces (15) are connected by connecting the header (17) of an internal heat exchanging surface (15) of a module (5) to the header (17) of the internal heat exchanging surface (15) of the other module (5).

16. The boiler of claim 15, **characterized by** comprising internal heat exchanging surfaces (15) located within the peripheral heat exchanging surfaces (7), inner hanger supports (16) connected to the internal heat exchanging surfaces (15). 5
17. A boiler module comprising at least outer hanger supports (6) and peripheral heat exchanging surfaces (7). 10
18. The boiler module of claim 17, **characterized by** further comprising internal heat exchanging surfaces (15) located within the peripheral heat exchanging surfaces (7), inner hanger supports (16) connected to the internal heat exchanging surfaces (15). 15

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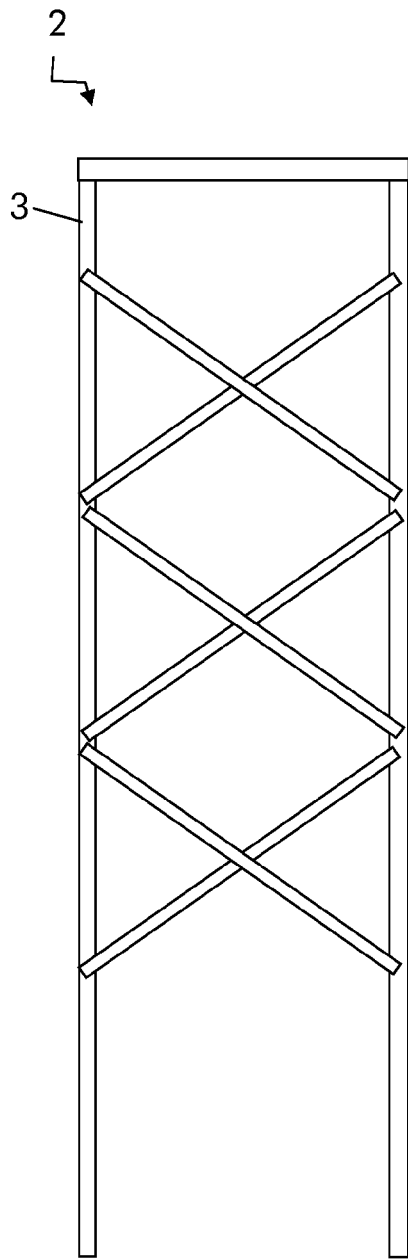


Fig. 1

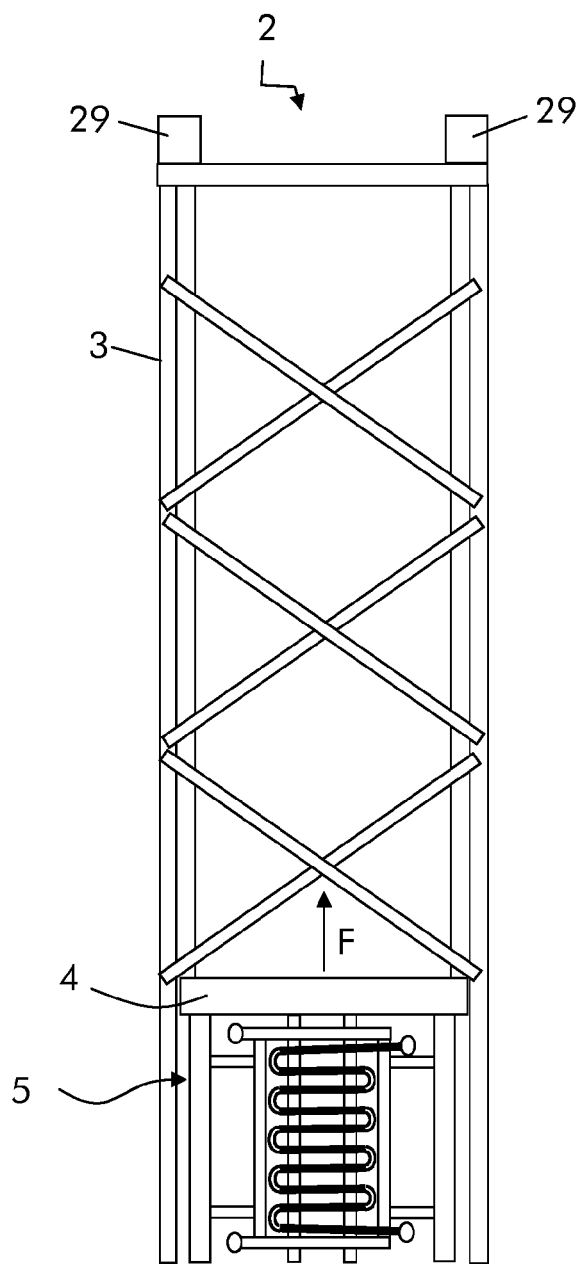


Fig. 2

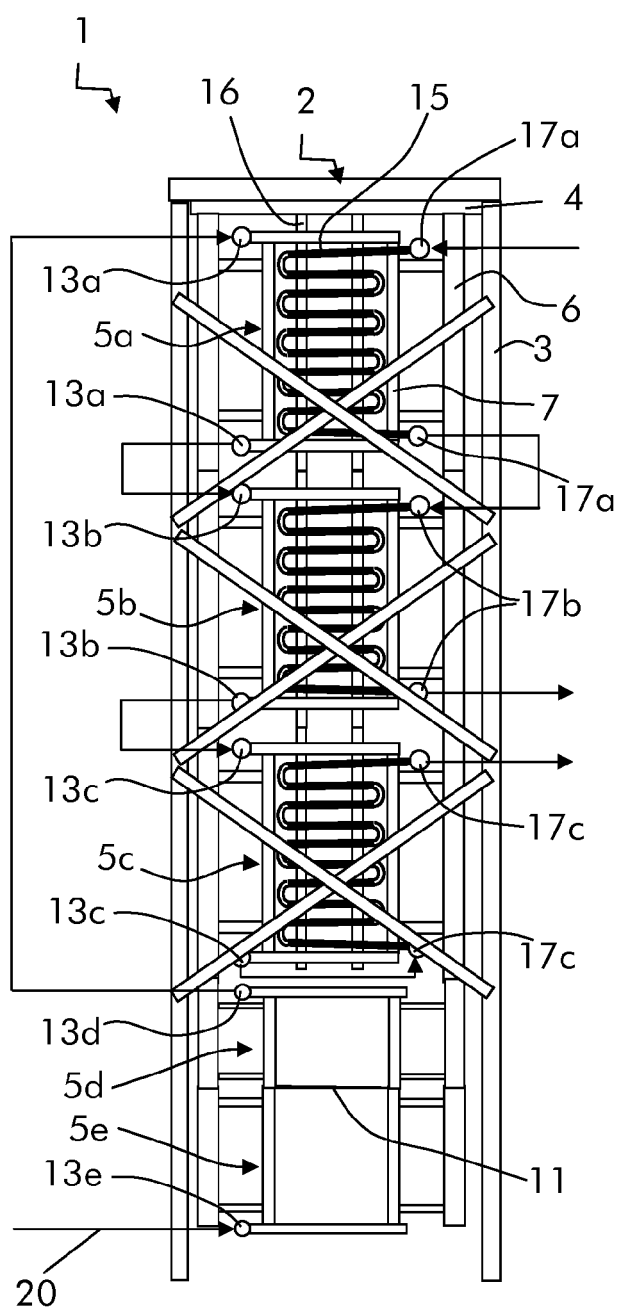


Fig. 3

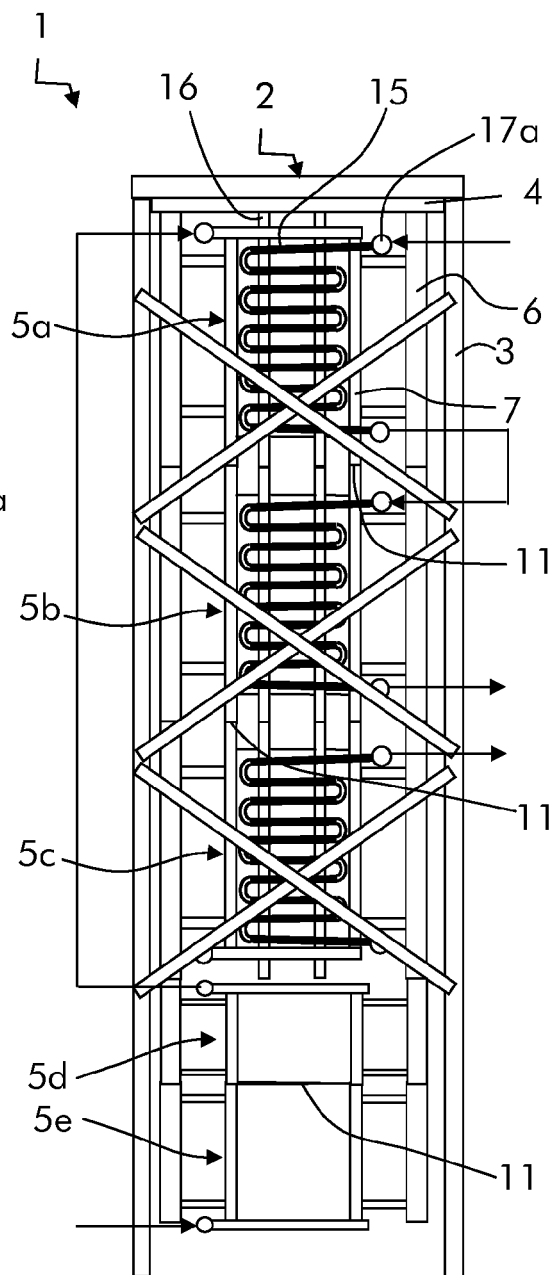


Fig. 4

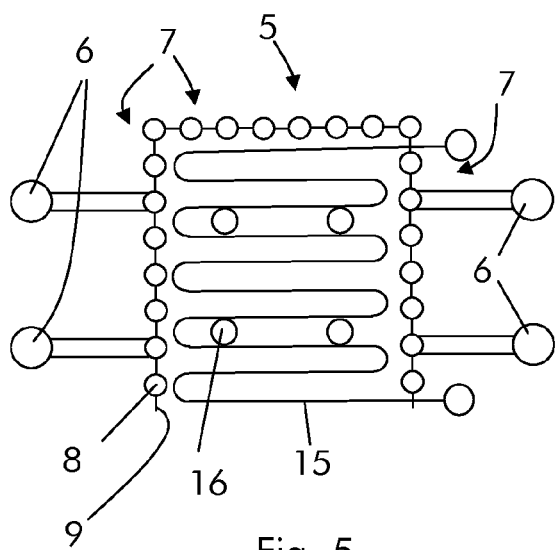


Fig. 5

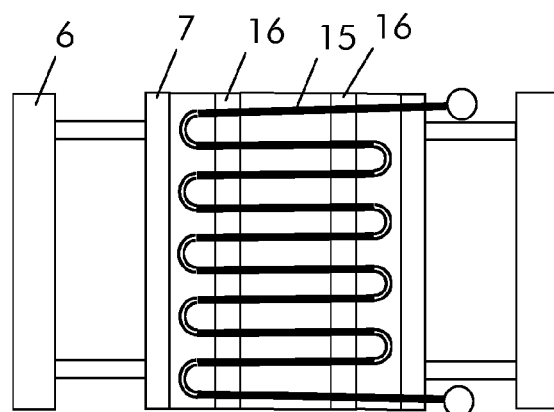


Fig. 6

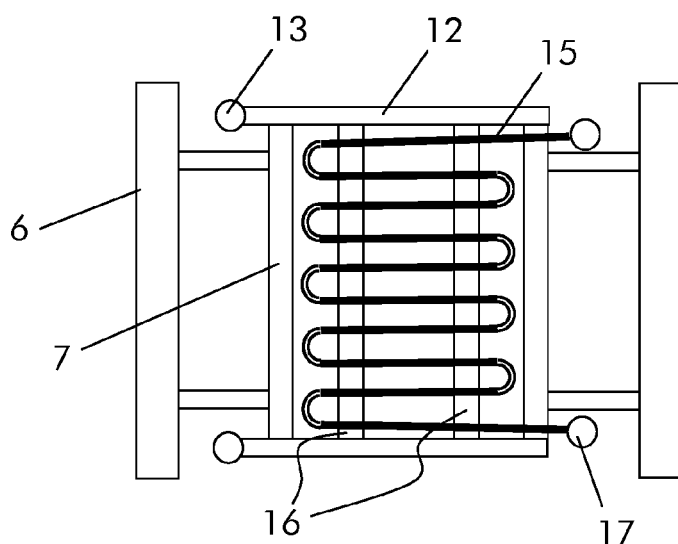


Fig. 7

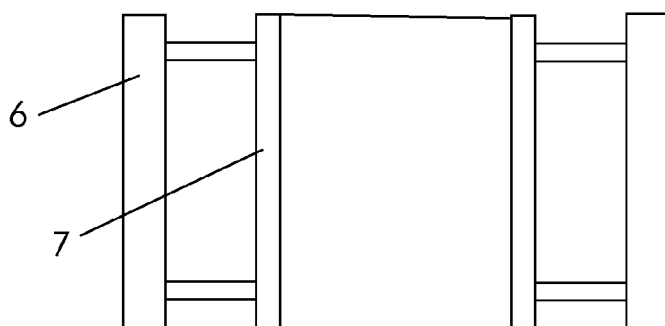


Fig. 8

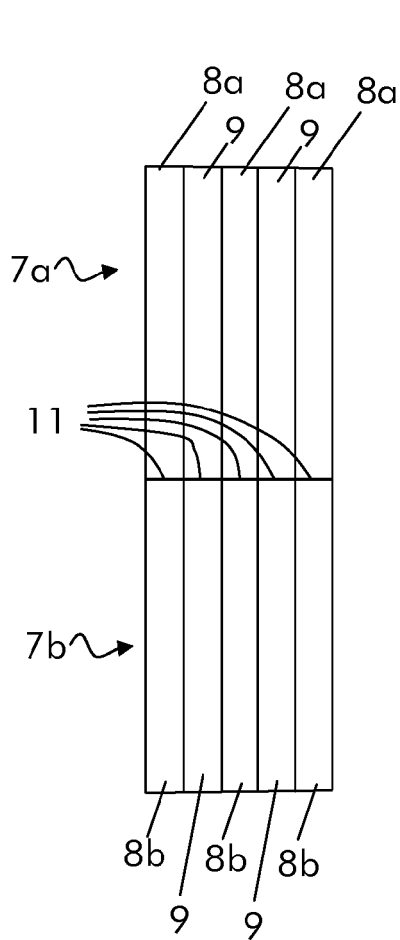


Fig. 9

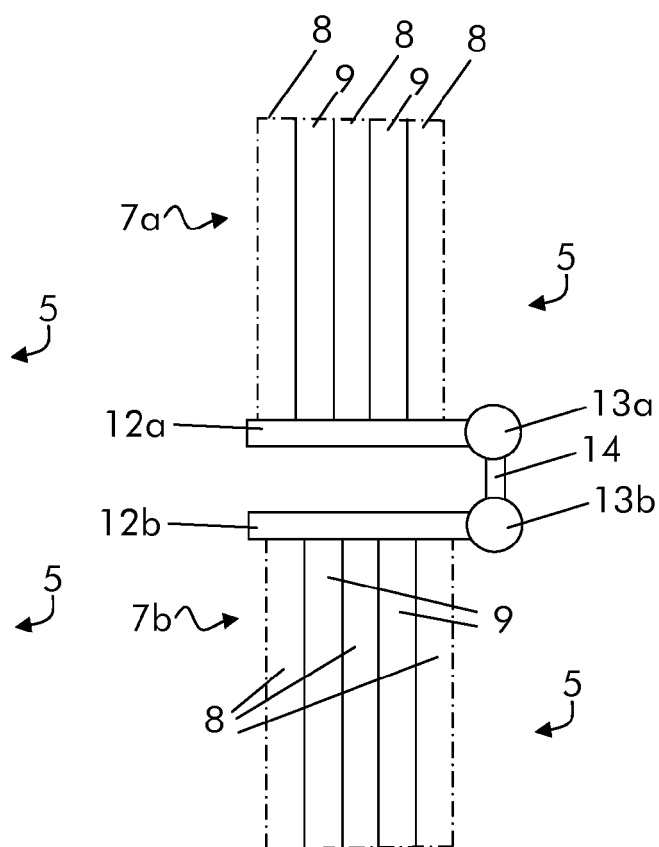


Fig. 10

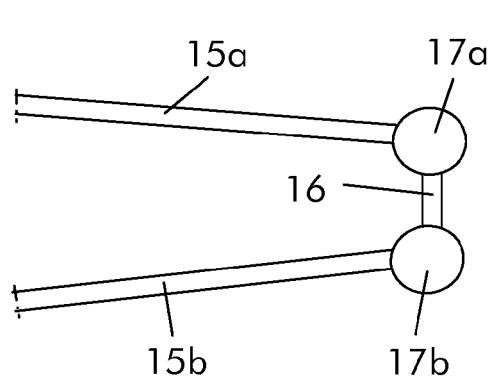


Fig. 11

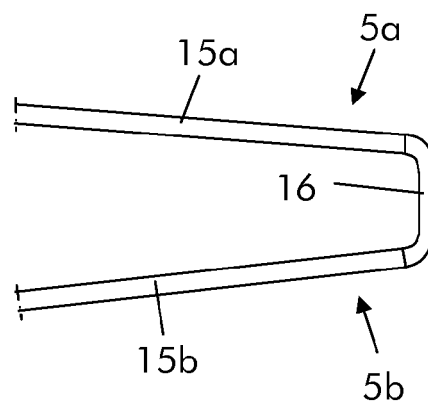


Fig. 12

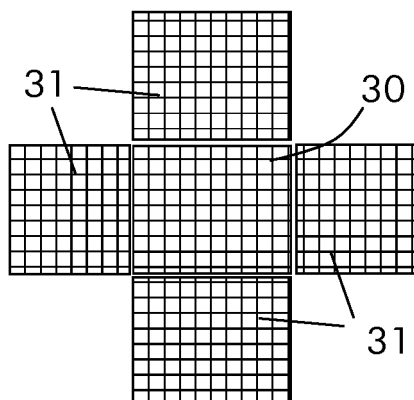


Fig. 13

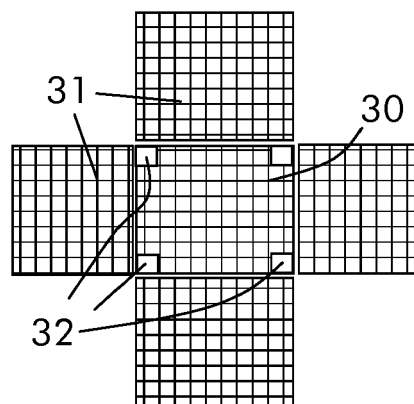


Fig. 14

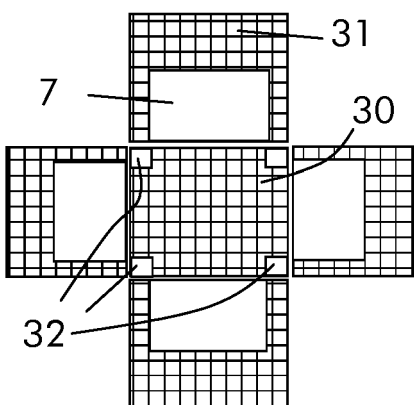


Fig. 15

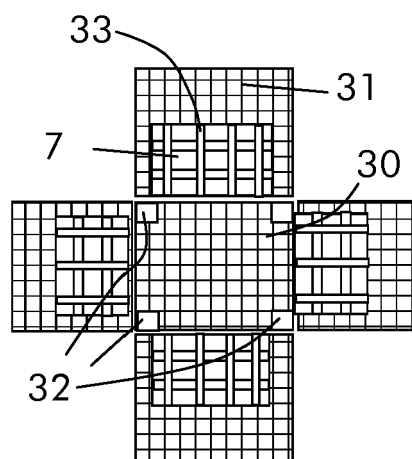


Fig. 16

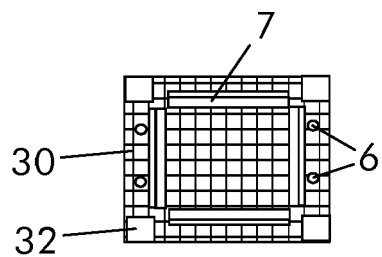


Fig. 17

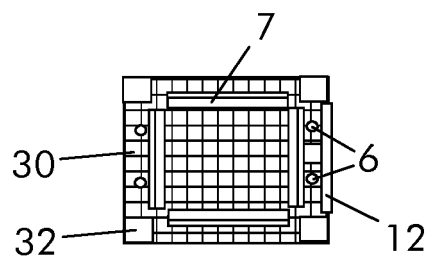


Fig. 18



EUROPEAN SEARCH REPORT

Application Number
EP 15 16 4252

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 2007/272172 A1 (KAWAGUCHI SHIGEYOSHI [JP] ET AL) 29 November 2007 (2007-11-29)	1-4,8,11,12,17,18	INV. F22B37/24 F22B37/10 F22B37/22
A	* paragraphs [0038] - [0052]; figures 1-14 *	9	
A	----- WO 2012/173092 A1 (HITACHI PLANT TECHNOLOGIES LTD [JP]; BABCOCK HITACHI KK [JP]; NAKAMITS) 20 December 2012 (2012-12-20) * figures 1-3 *	1,11,17	
A	----- EP 0 777 080 A1 (GEC ALSTHOM STEIN IND [FR]) 4 June 1997 (1997-06-04) * abstract; figures 1--6 *	1,9,11,17	
Y	JP 2002 213707 A (MITSUBISHI HEAVY IND LTD) 31 July 2002 (2002-07-31) * figures 1,2,4-6 *	1-4,8,11,12,17,18	TECHNICAL FIELDS SEARCHED (IPC)
A	----- JP H06 313501 A (HITACHI PLANT ENG & CONSTR CO) 8 November 1994 (1994-11-08) * figures 1,4,5 *	1,9,11,17	F22B
A	----- JP H11 100902 A (HITACHI PLANT ENG & CONSTR CO) 13 April 1999 (1999-04-13) * abstract; figure 1 *	1,11,17	
A	----- JP H06 323503 A (HITACHI PLANT ENG & CONSTR CO) 25 November 1994 (1994-11-25) * figures 1-5 *	1,11,17	
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 22 February 2016	Examiner Coquau, Stéphane
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 03.02 (P04C01)



Application Number

EP 15 16 4252

CLAIMS INCURRING FEES

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

☐ 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):

☐ 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:

see sheet B

☒ 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).

**LACK OF UNITY OF INVENTION
SHEET B**

Application Number

EP 15 16 4252

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:

1. claims: 1-8, 11-18

Method for connecting heat exchanging surfaces to a boiler main structure, and boiler comprising particular means for connecting heat exchange surfaces to the boiler main structure.

2. claims: 9, 10

Method to assemble a module comprising heat exchange surfaces.

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 15 16 4252

5

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007272172 A1	29-11-2007	CA 2585323 A1	29-11-2007
		JP 4800843 B2	26-10-2011
		JP 2007315732 A	06-12-2007
		US 2007272172 A1	29-11-2007
WO 2012173092 A1	20-12-2012	JP 5743205 B2	01-07-2015
		JP 2013002739 A	07-01-2013
		WO 2012173092 A1	20-12-2012
EP 0777080 A1	04-06-1997	CN 1159538 A	17-09-1997
		EP 0777080 A1	04-06-1997
		ES 2144220 T3	01-06-2000
		FR 2741701 A1	30-05-1997
		GR 3033106 T3	31-08-2000
		PT 777080 E	30-06-2000
		RU 2156918 C2	27-09-2000
		ZA 9609914 A	18-06-1997
JP 2002213707 A	31-07-2002	NONE	
JP H06313501 A	08-11-1994	NONE	
JP H11100902 A	13-04-1999	NONE	
JP H06323503 A	25-11-1994	JP 2927320 B2	28-07-1999
		JP H06323503 A	25-11-1994