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(54) **SYSTEM AND METHOD FOR OPTIMISING COMBUSTION IN PULVERISED SOLID FUEL BOILERS, AND BOILER INCLUDING SUCH A SYSTEM**

(57) The invention relates to a system which includes a boiler (1), sets of main burners (2F, 2E, 2D, 2C) located at various levels or areas through which pulverised solid fuel is injected into the boiler (1), and main mills (3F, 3E, 3D, 3C) of solid fuel, each one of which is connected to each one of the sets of main burners (2F, 2E, 2D, 2C) to which a flow of solid fuel is directed. Furthermore, the invention includes a replacement mill (3B) intended for operating only on the set of main burners (2F, 2E, 2D, 2C) whose associated main mill (3F, 3E, 3D, 3C) has shut down, as well as a permanently operational backup mill (3A) which directs an additional flow of solid fuel towards the selected set(s) of main burners (2F, 2E, 2D, 2C), complementing the flow of solid fuel provided by the main mills (3F, 3E, 3D, 3C).

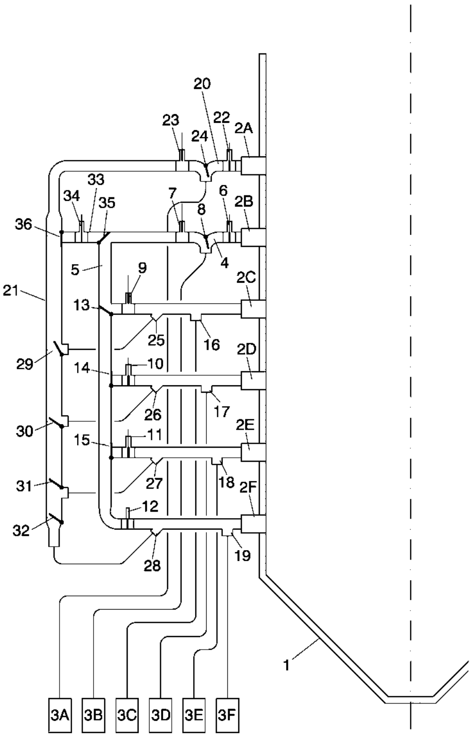

FIG. 1

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Description

OBJECT OF THE INVENTION

[0001] The invention refers, as stated in the title of this descriptive report, to a combustion system using pulverized solid fuel (for example coal or biomass) in a boiler and a method, associated with this system, to optimise the process with a view to reducing contaminating gas emissions, such as nitrogen oxides, as well as optimising the boiler's performance and operation.

FIELD OF APPLICATION

[0002] The field of application for this invention is industrial boilers.

BACKGROUND OF THE INVENTION

[0003] The vast majority of developments over the last few years to optimise industrial boilers (for example in electrical generation units) have focussed on reducing contaminating gas emissions. These gases include nitrogen oxides (NO_x), generated during fossil fuel combustion such as coal, fuel oil or natural gas in industrial boilers. NO_x gases mainly comprise NO and NO_2 and are among the gas pollutants most harmful to our health and the environment.

[0004] Nitrogen oxides are precursors of photochemical smog and acid rain, phenomena with direct effects on the health of animals, vegetation and human beings.

[0005] The technologies applied to reduce NO_x emissions in this type of installation can be mainly classified into two groups: modifications and adjustments to the combustion process or primary measures and post-combustion abatement or secondary measures.

[0006] Within the primary measures group, one of the strategies applied is based on stratification of air and fuel supplies to the boiler. In this respect, the lines of actions in existing units include adjusting the operation parameters of the thermal power unit and implementing modifications in the boilers such as installing low NO_x burners, OFA registers (Over Fire Air), UFA (Under Fire Air), etc.

[0007] Stratification targets combustion in two or more stages, where the first or initial stage is rich in fuel and the second or subsequent stages are low in fuel. This refers to reducing the oxygen available in the areas critical for NO_x formation and reducing the quantity of fuel that is burnt at the maximum flame temperature. Using this procedure it acts on the thermal NO (weakened by rich mixtures) and on the NO in the fuel (turning it into N_2 in the part originating from the combustion of volatiles).

[0008] One method of carrying out the concept of stratified combustion in stages is given in detail in patent US 6,790,031. This patent is to be applied to tangential boilers where the fuel is injected into the boiler through several sets of burners (normally associated with the same mill) arranged at successive heights. Regarding the usual uniform distribution of fuel by level, the aforementioned patent establishes the stratification of the fuel contribution as an invention, so that it is higher at the lower burner level and reduces gradually through the upper levels reaching a minimum at the highest level. Using this configuration produces a reducing zone (with oxygen deficit) in the lower area of the combustion chamber and an oxidising zone in the top area, which translates into a significant reduction of NO_x emissions.

[0009] The field of action for the purpose defined in the aforementioned document is restricted exclusively to the boiler for a thermo-electric power unit. In this way, it does not allude to the physical resources or the method to achieve stratification of fuel that is advocated as key when reducing NO_x emissions.

[0010] Document JP 59145406 defines a pulverized coal boiler with low NO_x generation equipped with a large number of burners grouped together into several levels or stages. The burners are divided into two groups, depending on the air/fuel ratio that they are fed: main burners and denitrification burners. The boiler has several levels of main burners and several levels of denitrification burners, the latter having an air/fuel ratio within the range 0.2-0.8. According to the inventors, the hydrocarbon radicals generated by the substoichiometric conditions in the denitrification burners cause an overall reduction in NO_x emissions.

[0011] The coal pneumatic transport system is designed so as to guarantee supplying those levels of denitrification burners considered as key for the of overall NO_x reduction process, even in the event of a mill stopping.

[0012] It is thereby established that these key burners are connected to two different mills, so that if one of these mills fails the burners will be fed by the other mill. This presents limitations regarding the degree of maintenance for the fuel supply patterns established as optimum as, although each burner has a parallel system of fuel ducts associated to two mills, only one of them transports coal when the system is in operation. In fact, providing service to a determined level of denitrification burners occurs at the cost of interrupting or drastically reducing the supply of coal to a level of main burners or another level of denitrification burners not considered as key.

[0013] In some cases the purpose of the technological development is focussed on resolving a problem associated with operating the plant rather than optimising the combustion process itself. Such is the case of the invention appearing in patent GB 582,593. This document looks at a solution to the problem of instability derived from the imbalance caused by lack of availability for a mill and the consequent lack of service for the burners fed by it. The invention focuses on a very specific configuration of the fuel transport system which defines several groups of burners, each of these groups fed by a system of ducts, and a larger number of mills. The connection between the mills and the duct systems is made so that each group of burners can be fed by more than one mill, so that, as long as the number of active mills is equal to the number of duct systems, supply to all burners is assured.

[0014] Selecting the mill to supply each duct system is done via specially designed and protected on/off valves that connect the group of burners involved with one mill or another.

[0015] The invention itself does not advocate any type of adjustment to the fuel supply to each group of burners. In its design, it is established as being merely operative that, independently of the mill that might be out of service, the design conditions are maintained regarding carbon injection.

DESCRIPTION OF THE INVENTION

[0016] This invention refers firstly to an optimised system for the combustion of pulverized solid fuel with a view to reducing contaminating gas emissions, such as nitrogen oxides and/or improving the performance and operation of the industrial boilers, as the existing boilers in electrical generation units.

[0017] This system comprises a boiler equipped with plurality of burners distributed into several groups arranged at different levels or in zones, with each group made up of several burners, a group of solid fuel mills (at least one more than the number of mills required to generate the maximum load of the boiler) and means of transporting the solid fuel that communicate the mills with the burners.

[0018] The main specific feature introduced by the invention consists of being able to establish patterns for differential solid fuel supplies between each group of burners, associated with meeting a determined operating target (reducing NO_x, improving performance, reducing unburnt carbon, etc.) so that these patterns are not modified by unavailability of one of the mills.

[0019] To do this, the equipment conveying the fuel to the boiler is organised to include the following elements:

- Groups of burners called main burners located in different zones or levels, through which the pulverized solid fuel is injected into the boiler preferentially.

- Solid fuel mills, known as the main mills, each connected to the main burners belonging to a group. These mills will operate whenever required by the load demand.

- A solid fuel mill, known as the substitution mill that will only operate if one of the main mills stops. This mill would be connected to the burners for each of the main burner groups and, optionally, to an auxiliary burner group. In this way, each group of main burners would be connected to its corresponding main mill and, in parallel, all of them are connected to the substitution mill. The whole supply for the substitution mill would be diverted, through the connections and the sets of relevant dampers, to the main burner group whose mill had stopped.

- A group of pulverized solid fuel distributors (the same number as burners making up each group). Each distributor connects the substitution mill to a burner in each of the main burner groups to which it diverts the two-phase air-solid fuel current, in the event of a stoppage in its associated main mill.

- A solid fuel mill, known as the support mill, also connected to each of the main burner groups and optionally, to an additional group or level of auxiliary burners. This mill would always be in service, generating a flow of solid fuel which would be added to the main burner groups. Therefore, each main burner group would transport the solid fuel produced by its associated main mill plus a percentage of the distribution from the solid fuel flow produced by the support mill.

- A group of pulverized solid fuel flow splitters (the same number as burners making up each group). Each splitter connects the support mill to a burner from each of the main burner groups and generates adjustable flows of the two-phase air-solid fuel mixture to be added to the streams transported through their connected burners. The streams leaving the splitters are split up by flow deflectors, arranged according to the required distribution.

[0020] As a complementary feature, this considers the possibility of incorporating connections between the input sections of the distributors and the flow splitters. These connections will be enabled when there is a stoppage in the support mill. In this way, the substitution mill will perform the functions of the support mill, should the latter fail.

[0021] The organisation above gives great flexibility to the unit's operation as, in addition to guaranteeing the supply of solid fuel to certain groups of burners in the event of a mill stopping, it also makes it possible to establish extreme strategies to stratify the fuel fed to the boiler, by allowing certain burners to be supplied with solid fuel from two different mills.

[0022] It should be highlighted that the means available to establish fuel stratification strategies in conventional boilers are normally reduced to adjusting mill production. In this respect, their normally narrow operating margins regarding their nominal capacity impose an insurmountable limit on the potential benefits that greater stratification can offer. In addition, and no less important, this way of operating, far from the optimum point of design for the mills, has a negative influence on its operation that can lead to mechanical problems (wear, vibration, rejection of solid fuel, etc.) and worsening the granulometry of the solid fuel produced.

[0023] This invention, therefore, allows to assure and adjust the fuel supply to certain groups of main burners, permitting supply patterns to be established that can lead to great stratification between different groups of burners, without the need to operate the mills outside their normal design point and independently of the mill that might be taken out of service for maintenance or another purpose.

[0024] This invention also focuses on an operation method that, by using the elements described, can stratify the fuel through the following process:

- Selecting a differential injection pattern among the different groups of main burners.
- Selecting the mills that will supply the main burners. Depending on the load requested from the boiler, this selection will be made from among the main mills and the substitution mill if a main mill stops.
- Adjusting the deflectors of the splitters that distribute the production of the support mill between the groups of main burners, to establish differential streams between them.

DESCRIPTION OF THE FIGURES

[0025] To complement the description, and in order to make it easier to understand the characteristics of the invention, a series of diagrams is attached for illustrative purposes whilst not limiting further aspects:

Figure 1 shows a preferential view of the invention applied to a tangential boiler equipped with 24 burners, arranged on 6 levels of 4 burners each located in the corners. It represents the burners and transport ducts associated with one of the corners and the arrangement of the other three is understood to be the same.

Figure 2 represents a typical pattern for supplying solid fuel (typically coal) in conventional boilers, with a view to stratifying fuel into levels to reduce NO_x emissions.

Figure 3 shows a fuel stratification pattern, quantitatively more emphatic than in the case of figure 2, obtained by applying this invention to get a greater reduction of NO_x.

Figure 4 shows a pattern obtained by applying this invention to reduce the NO_x as a compromise to controlling the level of unburnt carbon in fly ash.

PREFERRED EMBODIMENT OF THE INVENTION

[0026] The description below gives a possible version of the aforementioned invention. Its application is extensive both in the case of producing a new boiler and the case of adapting an existing plant.

[0027] In this case, let's consider the tangential boiler (1) represented in figure 1, equipped with 24 burners grouped into 6 levels or heights in groups of burners (2A, 2B, 2C, 2D, 2E, 2F) each including 4 burners per level located in the corners of the boiler (1), where the groups of burners for the four lower levels comprise the main burner groups (2F, 2E, 2D, 2C) and the groups of burners on the top two levels comprise the auxiliary burner groups (2A, 2B). The solid fuel (typically coal) supplied to the boiler (1) comes from 6 mills (3A, 3B, 3C, 3D, 3E, 3F), from where a two-phase air/solid fuel mixture is distributed to the burners (2A, 2B, 2C, 2D, 2E, 2F) through a network of pneumatic transport ducts. The full boiler load can be obtained with contribution from only 5 of the mills in operation, working at their nominal setting. For simplicity's sake, figure 1 represents the transport ducts to the burners of the groups (2A, 2B, 2C, 2D, 2E, 2F) located in one of the corners of the boiler (1), as the distribution is exactly the same for the other three corners.

[0028] Among the mills (3A, 3B, 3C, 3D, 3E, 3F), we can firstly distinguish main mills (3F, 3E, 3D and 3C), that respectively supply the main burner groups (2F, 2E, 2D, 2C). From each of the main mills (3F, 3E, 3D and 3C) 4 ducts transport fuel to the main burners on their corresponding level.

[0029] From the aforementioned mills we should also distinguish a substitution mill (3B), from which 4 transport ducts also run, one for each corner. These ducts rise to the level of the first group of auxiliary burners (2B) where they split by means of the first three-way connections (4) (one per corner) into 2 groups of alternate lines; some towards the first group of auxiliary burners (2B) and others towards the distributors (5) (there are 4 distributors, one per corner) dropping down with outputs on the 4 lower levels. The first three-way connections (4) have 2 guillotine valves (6, 7) connected to their outputs to guarantee that one of the lines is completely closed when the opposite one is activated. They also have a first deflector (8) to minimise pressure drop caused by the change in direction. The distributors (5) divert the flow of solid fuel from the substitution mill (3B) towards one of the main burner groups (2F, 2E, 2D, 2B, 2C), if their corresponding main mill is out of service. The group of main burners (2F, 2E, 2D, 2B, 2C) supplied by the substitution mill (3B) is selected by means of guillotine valves (9, 10, 11, 12) and flow deflectors (13, 14, 15) associated with each output of the distributors (5).

[0030] On the other hand, the outputs for the distributors (5) join up with the ducts from the main mills (3F, 3E, 3D and 3C) by means of junctions (16, 17, 18, 19) located downstream of the guillotine valves (9, 10, 11, 12).

[0031] This also considers incorporating a support mill (3A), from which 4 transport ducts lead, one for each corner, that rise to the level where there is a second group of auxiliary burners (2A) where they split by means of the second three-way connections (20) (one per corner) into 2 groups of alternate lines; some towards the second group of auxiliary burners (2A) and others towards flow splitters (21) (there are 4 splitters, one per corner) dropping down with output to the 4 lower levels of burners. The second three-way connections (20) have these 2 guillotine valves (22, 23) on their outputs to guarantee that one of the lines is completely closed when the opposite one is activated. They also have a second deflector (24) to minimise pressure drop caused by the change in direction. The splitter (21) for each corner divides the flow of solid fuel from the support mill (3A) into 4 streams of two-phase air/solid fuel mixture sent towards the burners of this corner belonging to the main burner groups (2F, 2E, 2D, 2C). Each of these support streams joins each duct that connects the distributor (5) outputs for this corner with the burners belonging to the main burner groups (2F, 2E, 2D, 2C) through junctions (25, 26, 27, 28) located between the guillotine valves (9, 10, 11, 12) and the junctions (16, 17, 18, 19) with the ducts from the main mills (3F, 3E, 3D, 3C).

[0032] The distribution of the support two-phase mixture between the main burner groups (2F, 2E, 2D, 2C) is regulated by means of flow deflectors (29, 30, 31, 32) equipped with mechanisms for their intermediate positioning depending on the required distribution in terms of flows and granulometry of the solid fuel.

[0033] At each corner, the distributor (5) and the splitter (21) are connected through a joining duct (33) fitted with a guillotine valve (34) and a third set of flow deflectors (35, 36). This connection allows the substitution mill (3B) to take on the support mill work (3A) when this is out of service.

[0034] The configuration described for the system to transport fuel to the boiler (1) allows operation methodologies to be applied that are not feasible or maintainable in conventional combustion units, where each level of burners is supplied exclusively by a single mill.

[0035] As an example of these methodologies, we can highlight the strategy of fuel stratification to reduce NO_x emissions. For a conventional tangential boiler, normally capable of generating the full load with 5 mills in operation, a significant reduction in NO_x has been observed when one of the top 2 levels is stopped and the lower mills are forced to produce a supply pattern distinguished by higher contribution from the lower burner which decreases towards the higher burners, as shown in figure 2. This figure, given as a percentage, represents the quantity of solid fuel provided by each level of burners and how much is produced by each mill, taking nominal production of 100% as a reference for each of them.

[0036] This operating method is limited by the mills' maximum production capacity and, in any case, conditioned by their availability. In this respect, a stoppage in the lower level mill would oblige the top mill to start up to generate the maximum load of the boiler, which would be associated with greater generation of NO_x.

[0037] The system described in this document allows us to establish more emphatic patterns of stratification from the point of view of reducing NO_x, as represented in figure 3. This figure shows the production of each mill as a percentage, the distribution of the support mill production (3A) between each level of main burner groups (2F, 2E, 2D, 2C) and the total flow managed by each level of burner group. It also represents the position of the guillotine valves and deflectors that permit the pattern to work. As we can see, the 4 levels of main burner groups (2F, 2E, 2D, 2C) would be supplied through their respective mills (3F, 3E, 3D, 3C) operating at their nominal load. The substitution mill (3B) would remain stopped whilst the support mill (3A) would be in nominal operation providing its production to the 4 lower levels, divided, based on the position of the deflectors (29, 30, 31, 32), into fractions of 30% for the two lower levels and 20% for the third and fourth.

[0038] Regarding the basic situation above, in the event that one of the main mills stops, for example the main mill (3E) that supplies the second level of groups of burners (2E), the substitution mill (3B) would be put into action, the guillotine valves (11) would be opened for the burners of group (2E) corresponding to the second level and the flow deflectors (15) of the distributors (5) would be activated so that the substitution mill (3B) supply is diverted to this burner group (2E). In parallel, distribution to the other main burner groups would be maintained (including for the second level) concerning the production of the support mill (3A).

[0039] In the same way, regarding the basic situation, in the case of the support mill (3A) stopping, the substitution mill (3B) would be put into action, the guillotine valves (34) would be opened on the joining ducts (33) that communicate the distributors (5) and the splitters (21) and the second deflectors (35, 36) would be activated to divert the streams from the substitution mill (3B) to the splitters (21) as this mill takes on the function of the support mill (3A).

[0040] The previous pattern of providing solid fuel is very practical in cases where co-combustion is considered using coal with another solid fuel (for example, biomass) In this case, the alternative fuel (for example biomass) can be pulverized in the support mill (3A) and from here, by virtue of the system of transport defined, it can be supplied to the main burner groups (2F, 2E, 2D, 2C) along with the respective streams of pulverized coal from the other mills.

[0041] Furthermore, the configuration proposed for the transport system provides great flexibility regarding other possible strategies for fuel distribution by level. One example of this is operating the boiler at full load, with 6 mills in operation, thereby making use of all the milling mass in the unit, with the consequent improvement in the overall granulometry of the pulverized fuel.

[0042] Using the same symbols as figure 3, figure 4 shows the configuration that can establish an operation pattern of the defined strategy. In this case, production from the substitution mill (3B) is diverted to the fifth level in which we find the first group of auxiliary burners (2B) opening the guillotine valves (6), closing the guillotine valves (7) and activating the deflector (8) for the first 3-way connections (4). The only level of burners without a supply would in this case be the level corresponding to the second group of auxiliary burners (2A), whilst the main groups of burners (2F, 2E, 2D, 2C) would be supplied by their corresponding mills, operating slightly under their nominal load, and additionally each one of them using a percentage of the production from the support mill (3A), that would also operate below its nominal load. This injection pattern gives better control of the unburnt carbon in fly ash compromising with a significant reduction in NO_x.

Claims

1. Combustion system in pulverized solid fuel boilers (1) comprising:

    groups of main burners (2F, 2E, 2D, 2C) located on different levels or areas, through which pulverized solid fuel is injected into the boiler (1),
    main mills (3F, 3E, 3D, 3C) for solid fuel, where each of them is connected to each of the main burner groups (2F, 2E, 2D, 2C) to which they send a flow of solid fuel,
    characterized in that it additionally comprises:
    a substitution mill (3B) intended to operate only on the main burner group (2F, 2E, 2D, 2C) whose associated main mill (3F, 3E, 3D, 3C) has stopped,
    a group of distributors (5), whose number of elements coincides with the number of burners in each group, each of which connects the substitution mill (3B) in parallel with a burner from each group of main burners (2F, 2E, 2D, 2C), with flow deflectors (35, 13, 14, 15) and valves (9, 10, 11, 12) in between that, depending on their position, direct the flow from the substitution mill (3B) to the main burners group (2F, 2E, 2D, 2C) whose main mill (3F, 3E, 3D, 3C) has stopped.
    a support mill (3A) that operates constantly and directs an additional flow of solid fuel to the main burner group or groups (2F, 2E, 2D, 2C) selected, supplementing the flow of solid fuel provided by the main mills (3F, 3E, 3D, 3C),
    a group of flow splitters (21), whose number of elements coincides with the number of burners in each group, each of which connects the support mill (3A) in parallel with a burner from each group of main burners (2F, 2E, 2D, 2C), with flow deflectors (36, 29, 30, 31, 32) in between that, depending on their position, direct the flow from the support mill (3A) to the burners they are connected to, depending on the distribution required.

2. Combustion system in pulverized solid fuel boilers of claim 1 **characterized in that** it also includes joining ducts (33) between the distributors (5) and the flow splitters (21) that incorporate a valve (34) that permits communication to be established between the distributors (5) and the flow splitters (21) so that the substitution mill (3B) can carry out the functions of the support mill (3A).

3. Combustion system in pulverized solid fuel boilers of claim 1 **characterized in that** the valves (9, 10, 11, 12, 34) are guillotine type valves.

4. Combustion system in pulverized solid fuel boilers of claim 1 **characterized in that** it additionally includes a first group of auxiliary burners (2B), located a level above the main burner groups (2F, 2E, 2D, 2E), that are connected to the substitution mill (3B) and the distributors (5).

5. Combustion system in pulverized solid fuel boilers of claim 4 **characterized in that** it includes a first group of 3-way connections (4), whose number of elements coincides with the number of burners making up each group, that establish the connection between the first group of auxiliary burners (2B), the substitution mill (3B) and the distributors (5).

6. Combustion system in pulverized solid fuel boilers of claim 5 **characterized in that** the first group of 3-way connections (4) incorporates a first two-position deflector (8) that minimises pressure drop due to the direction change.

7. Combustion system in pulverized solid fuel boilers of claims 1 or 4 **characterized in that** it additionally includes a second group of auxiliary burners (2A), located a level above the main burner groups (2F, 2E, 2D, 2E), that are connected to the support mill (3A) and the flow splitters (21).

8. Combustion system in pulverized solid fuel boilers of claim 7, **characterized in that** it includes a second group of 3-way connections (20), whose number of elements coincides with the number of burners in each group, that establish the connection between the second group of auxiliary burners (2A), the support mill (3A) and the flow splitters (21).

9. Combustion system in pulverized solid fuel boilers of claim 8, **characterized in that** the second group of 3-way connections (20) incorporates a second two-position deflector (24) that minimises pressure drop due the direction change.

10. Pulverized solid fuel boiler that incorporates the system described in any of claims 1 to 9.

11. Procedure to optimise combustion in pulverized solid fuel boilers that uses the system described in any of claims 1 to 9, **characterized in that** it includes the

stages of:

selecting a differential injection pattern among the different groups of main burners (2F, 2E, 2D, 2E),
selecting the main mills (3F, 3E, 3D, 3C) that will supply the main burner groups (2F, 2E, 2D, 2E) depending on the load requested from the boiler (1),
adjusting the flow deflectors (26, 29, 30, 31, 32) of the flow splitters (21) that distribute the flow from the support mill (3A) among the main burner groups (2F, 2E, 2D, 2E) located at different levels, to establish differential provisions between different levels.

12. Procedure for optimising combustion in pulverized solid fuel boilers of claim 11, **characterized in that** it includes the stage of activating the substitution mill (3B) if a main mill stops (3F, 3E, 3D, 3C, 3B) and adjusting the deflectors (35, 13, 14, 15) to direct the flow towards the specific group among the main burner groups (2F, 2E, 2D, 2E) whose main corresponding mill (3F, 3E, 3D, 3C) has stopped.

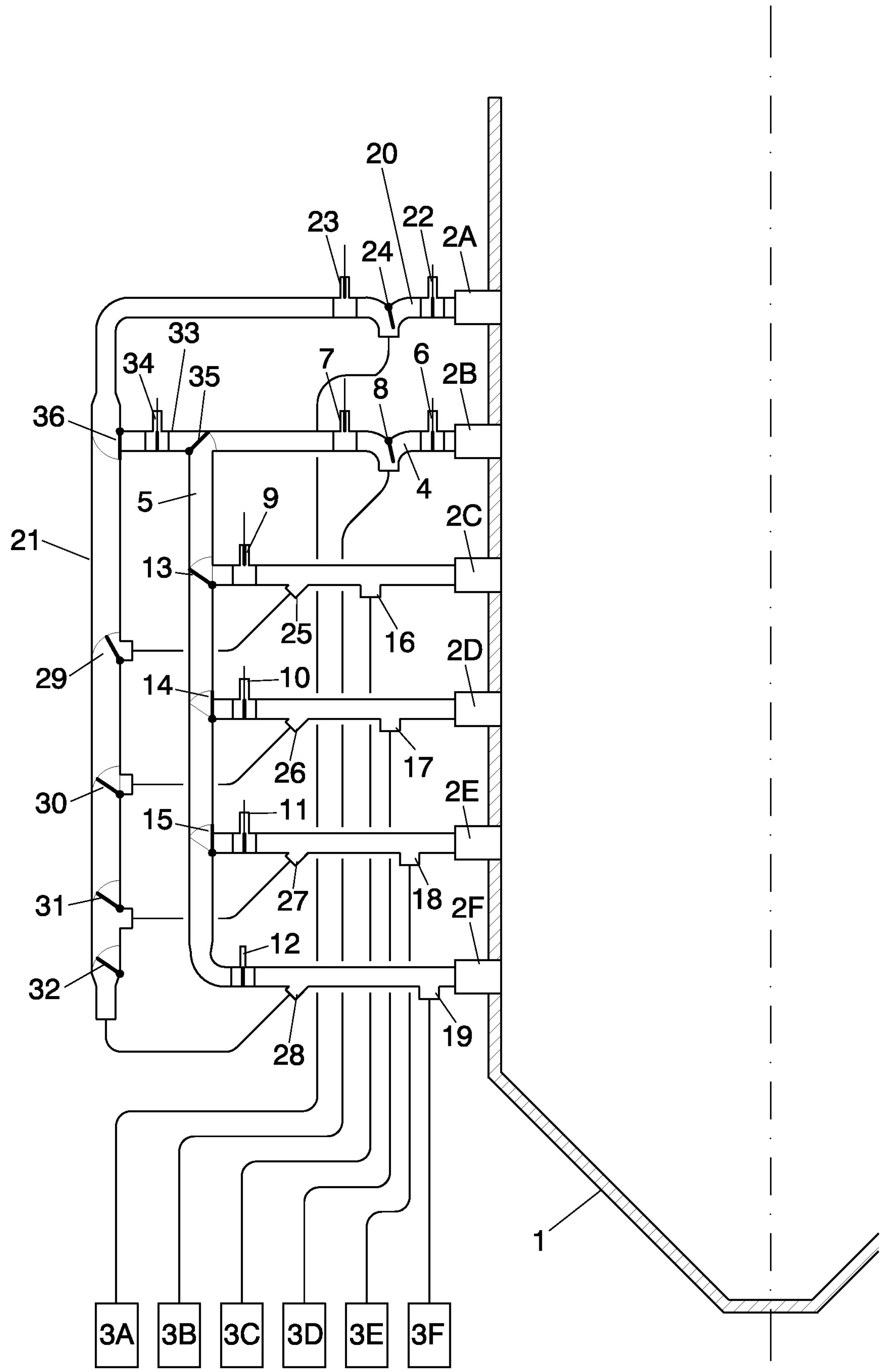
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FIG. 1

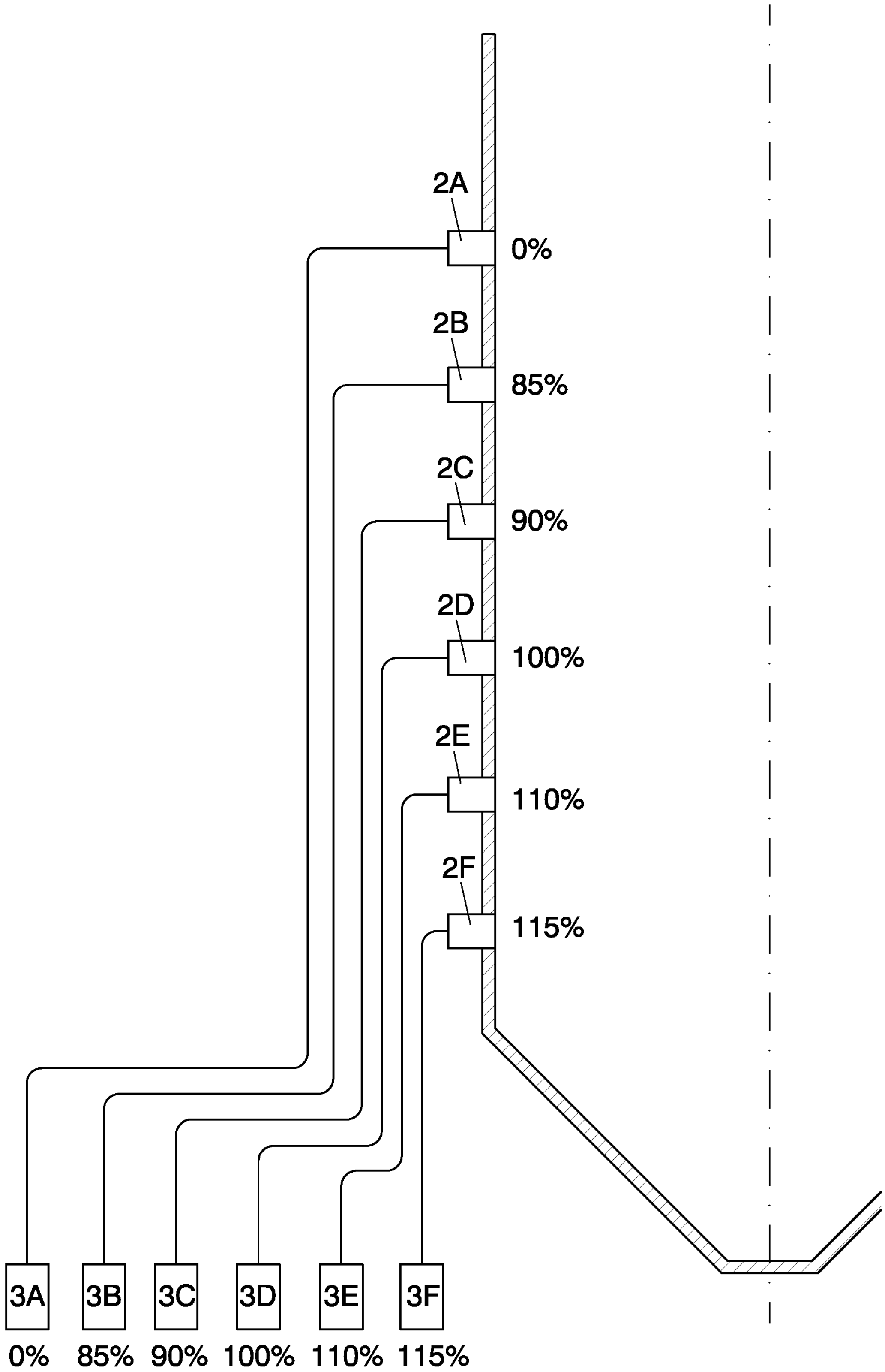
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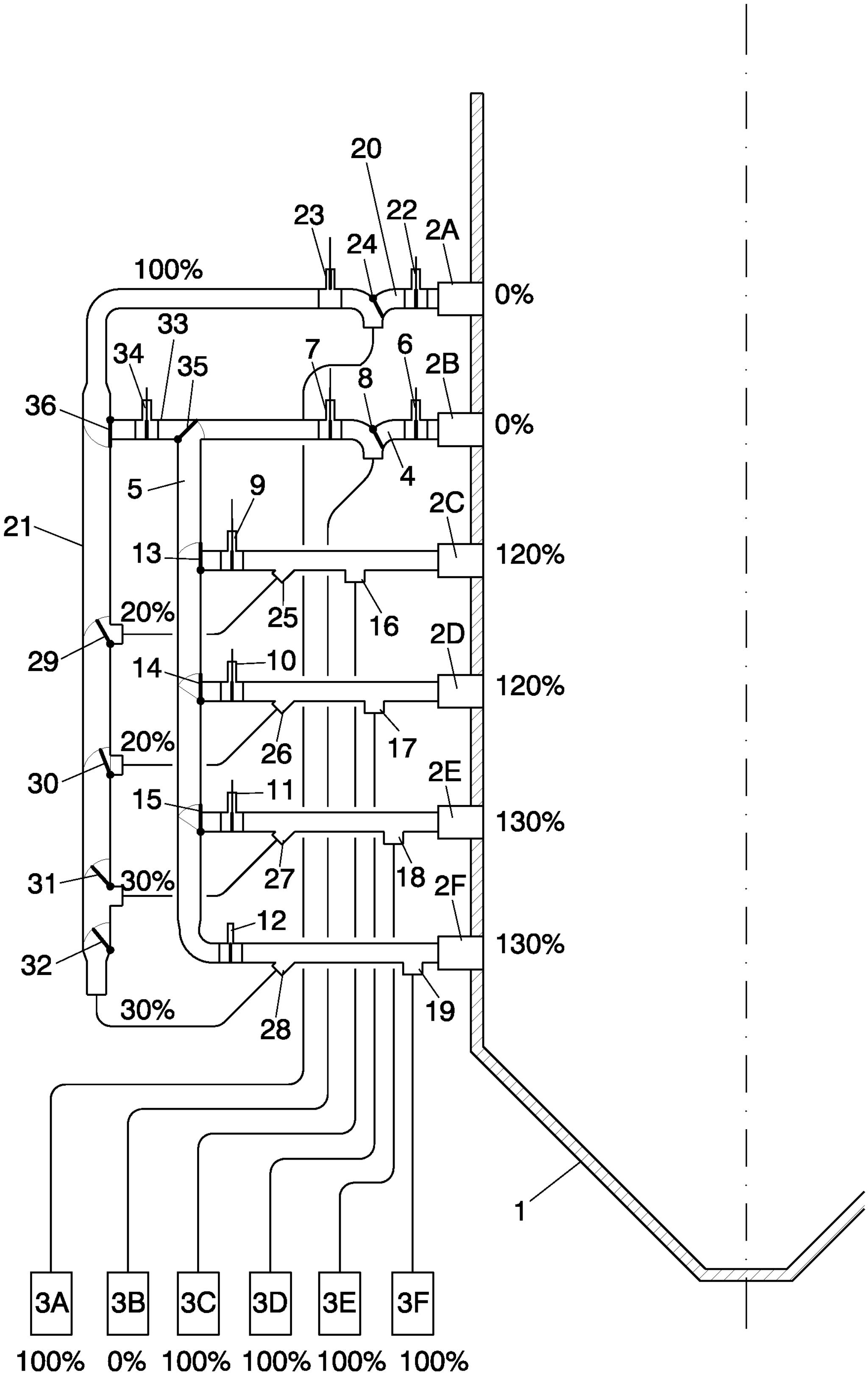
FIG. 2



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7
6
34
35
8
2B
36
0%
4
5
9
2C
21
13
120%
20%
25
16
2D
29
14
10
120%
20%
26
17
30
2E
15
11
130%
31
30%
27
18
2F
12
32
130%
30%
28
19
1
3A
3B
3C
3D
3E
3F
100%
0%
100%
100%
100%
100%

FIG. 3

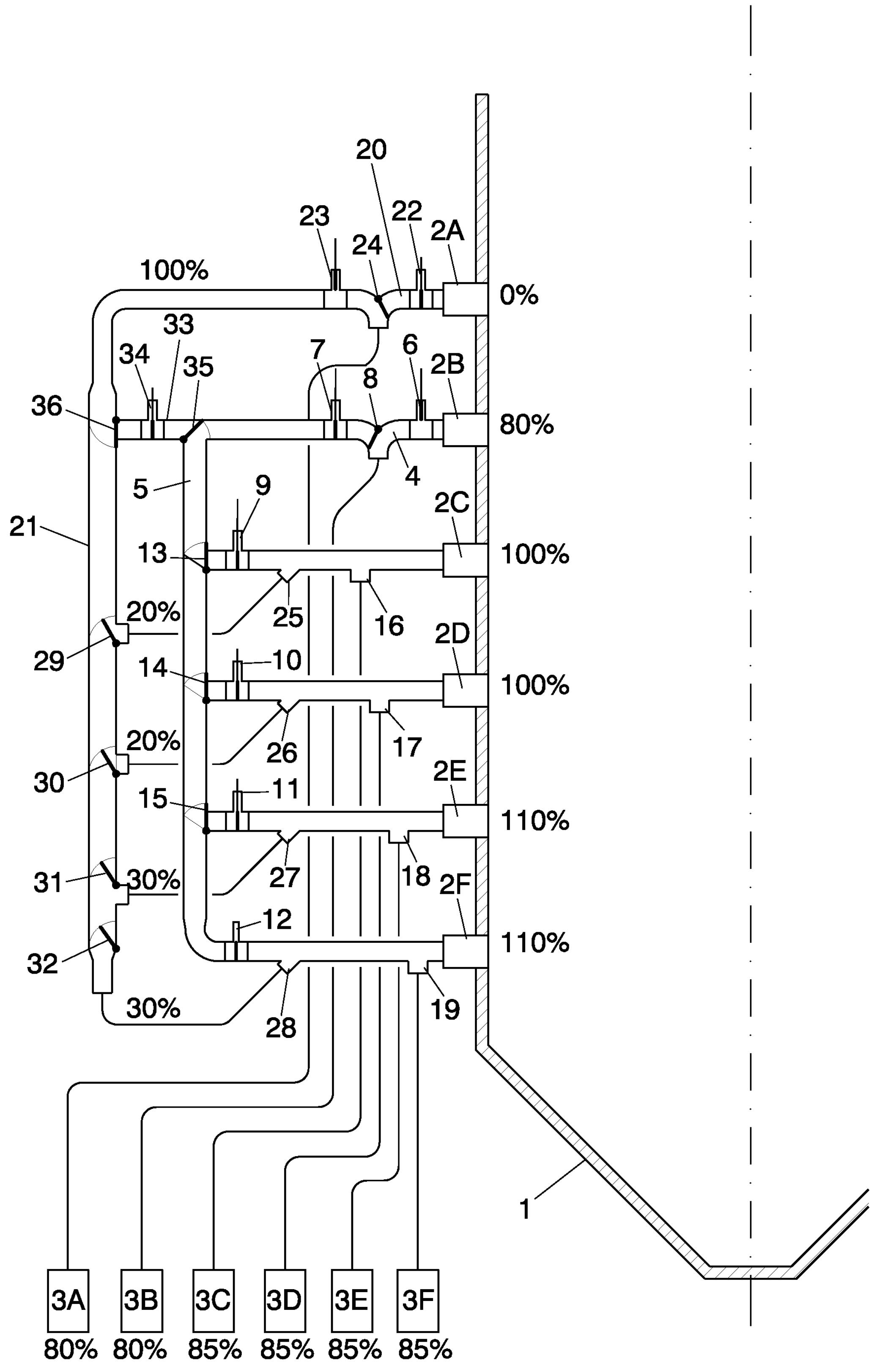
20
23
22
24
2A
100%
0%
33
34
35
7
6
8
2B
36
80%
5
4
9
2C
21
13
100%
20%
25
16
29
14
10
2D
100%
20%
26
17
30
15
11
2E
110%
31
30%
27
18
2F
12
110%
32
30%
28
19
1
3A
3B
3C
3D
3E
3F
80%
80%
85%
85%
85%
85%

FIG. 4

INFORME DE BÚSQUEDA INTERNACIONAL

Solicitud internacional Nº
PCT/ES2010/070039

A. CLASIFICACIÓN DEL OBJETO DE LA SOLICITUD
INV. F23C6/04 F23K3/00 F23N5/24

De acuerdo con la Clasificación Internacional de Patentes (CIP) o según la clasificación nacional y CIP.

B. SECTORES COMPRENDIDOS POR LA BÚSQUEDA

Documentación mínima buscada (sistema de clasificación seguido de los símbolos de clasificación)
F23C F23K F23N

Otra documentación consultada, además de la documentación mínima, en la medida en que tales documentos formen parte de los sectores comprendidos por la búsqueda

Bases de datos electrónicas consultadas durante la búsqueda internacional (nombre de la base de datos y, si es posible, términos de búsqueda utilizados) EPO-Internal

C. DOCUMENTOS CONSIDERADOS RELEVANTES

Categoría*	Documentos citados, con indicación, si procede, de las partes relevantes	Relevante para las reivindicaciones Nº
X	DE 833 099 C (BABCOCK & WILCOX DAMPFKESSEL) 3 de marzo de 1952 (1952-03-03)	1-3,10
Y	todo el documento	11,12
Y	DE 197 06 988 A1 (LAZISKA ELEKTROWNIA [PL] ELEKTROWNIA IAZISKA S A [PL]) 6 de noviembre de 1997 (1997-11-06)	11,12
A	columna 3, línea 8 - línea 21 figuras 1-3	1,10
A	DE 498 887 C (BABCOCK & WILCOX DAMPFKESSEL) 28 de mayo de 1930 (1930-05-28) todo el documento	1,10-12
	-/--	

[X] En la continuación del Recuadro C se relacionan otros documentos

[X] Los documentos de familias de patentes se indican en el Anexo

* Categorías especiales de documentos citados:

- "A" documento que define el estado general de la técnica no considerado como particularmente relevante.
- "E" solicitud de patente o patente anterior pero publicada en la fecha de presentación internacional o en fecha posterior.
- "L" documento que puede plantear dudas sobre una reivindicación de prioridad o que se cita para determinar la fecha de publicación de otra cita o por una razón especial (como la indicada).
- "O" documento que se refiere a una divulgación oral, a una utilización, a una exposición o a cualquier otro medio.
- "P" documento publicado antes de la fecha de presentación internacional pero con posterioridad a la fecha de prioridad reivindicada.
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- "&" documento que forma parte de la misma familia de patentes.

Fecha en que se ha concluido efectivamente la búsqueda internacional	Fecha de expedición del informe de búsqueda internacional
29 de noviembre de 2010 (29.11.10)	03/12/2010
Nombre y dirección postal de la Administración encargada de la búsqueda internacional S.P.T.O. Nº de fax	Funcionario autorizado Nº de teléfono

Formulario PCT/ISA/210 (segunda hoja) (Julio 2008)

INFORME DE BÚSQUEDA INTERNACIONAL

Solicitud internacional Nº
PCT/ES2010/070039

C (continuación). DOCUMENTOS CONSIDERADOS RELEVANTES

Categoría*	Documentos citados, con indicación, si procede, de las partes relevantes	Relevante para las reivindicaciones Nº
A	EP 0 672 863 A2 (HITACHI LTD [JP]; BABCOCK HITACHI KK [JP]) 20 de septiembre de 1995 (1995-09-20) columna 15, línea 49 - columna 16, línea 45 figuras 20, 21 -----	1,10
A	US 2002/066395 A1 (YAMAMOTO KENJI [JP] ET AL) 6 de junio de 2002 (2002-06-06) párrafo [0076]; figura 15 -----	1,10

Formulario PCT/ISA/210 (continuación de la segunda hoja) (Julio 2008)

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Información relativa a miembros de familias de patentes

Solicitud internacional Nº
PCT/ES2010/070039

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