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(54) **THICK-THIN COAL DUST SEPARATION AND ARRANGEMENT STRUCTURE FOR SINGLE-FIREBALL EIGHT-CORNER STRAIGHT-FLOW BURNER**

(57) A dense/dilute pulverized coal separator structure (4) of a single-fireball octagonal direct-flow burner, of which a boiler body (1) is provided with eight burner groups, each water cooled wall (9) is provided with two burner groups respectively, each of the burner groups comprises multiple nozzles toward the same burner (10), and center lines of all nozzles on the eight burner groups form an imaginary tangent circle (11) in a furnace along the same tangential direction. In the dense/dilute pulverized coal separator structure (4), eight burner groups are arranged on four water cooled walls (9) of the boiler (1), thus increasing pulverized coal concentration of a pulverized rich coal area, allowing wall heat load  $q_{Hr}$  of a lower burner area to be higher, allowing burning temperature of the area to meet requirements for anthracite burning stability, shortening distance of jet flow from a nozzle outlet to downstream adjacent air flow, being capable of using lower primary pulverized coal air flow velocity, enhancing heat flow intensity at the nozzle outlet, improving convection and radiation heat transfer capacity, and ensuring timely ignition of pulverized anthracite air flow and stable burning of the boiler at low load without oil.

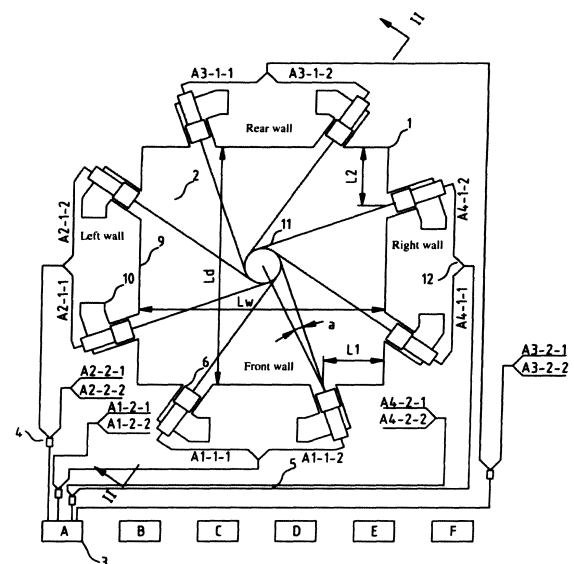


Figure 4

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## Description

### Field of the Invention

[0001] The invention relates to a technology of a pulverized coal burning device, in particular to a dense/dilute pulverized coal separator structure of an anthracite burning single-fireball octagonal direct-flow burner.

### Description of the Related Art

[0002] About 640 billion tons of coal reserves have been proven in China, among which low volatile anthracite accounts for about 14.6% of total coal reserves. Anthracite consumption of domestic thermal power plants accounts for about 3% of total coal consumption for power generation, and the figure is increasing. Anthracite has low volatile content, low hydrogen content, high ignition temperature and slower flame propagation velocity. In case of improper organization of burning, instable burning at low load and easy flameout of boilers at high load in case of poor coal quality easily occur, and burning efficiency is generally lower.

[0003] At present, W flame boilers, quadrangular tangentially fired boilers and front and rear wall swirl opposed firing boilers are used for burning anthracite at home and abroad. The maximum capacity of each W flame boiler is 600MW, the maximum capacity of each quadrangular tangentially fired boiler and front and rear wall swirl opposed firing boiler is 300MW respectively, and design and operation performance of any quadrangular tangentially anthracite firing boiler of 600MW and above are unavailable.

[0004] Domestic power station boiler manufactures have begun to design and manufacture special anthracite firing boilers since the early 1970s. With the development of unit capacity to 600MW - 1300MW, significant changes occur to furnace thermal parameters of boilers compared with 125MW and 300MW anthracite firing boilers, and reduction of furnace volume heat release rate  $q_v$  and extended retention time of pulverized coal in furnaces are favorable for complete burning of anthracite. Meanwhile, furnace wall heat release rate  $q_{Hr}$  of the burner area is reduced, although cross section heat release rate  $q_F$  is increased, total heat absorption of the burner area is increased, resulting in reduction of temperature of the burner area, thus being unfavorable for timely and stable ignition of anthracite. Especially after the capacity is increased to 800MW - 1300MW, the number of corresponding pulverized coal nozzles of a single coal mill has to be increased by 50% - 100% compared with 300MW - 600MW boilers, i.e. from 4 to 6 or 8, due to restriction from thermal power of a single pulverized coal nozzle. A 1000MW ultra supercritical boiler is taken for example, when 6 medium speed coal mills or double inlet and double outlet coal mills are equipped, the number of corresponding pulverized coal nozzles of a single coal mill is 8, and the number of total pulverized coal nozzles reach-

es 48. When quadrangular tangential arrangement of a direct flow burner is employed, the number of primary air pulverized coal nozzles at a single corner is 12, and burners are divided into 2 to 3 groups in the vertical direction, as a result, the distance between two primary air pulverized coal nozzles arranged at the uppermost part and the lowermost part is large, the furnace wall heat release rate  $q_{Hr}$  of the burner area is low, and burning temperature of the area is low, thus being unfavorable for timely and stable ignition of pulverized anthracite air flow and stable burning of the boiler at low load without oil.

[0005] Almost all 50MW, 125MW and 300MW anthracite firing boilers which have been successfully put into operation in China use intermediate storage hot air pulverized coal feed systems, primary air and pulverized coal mixing temperature of the systems can reach 220 - 250°C, with primary air ratio of 14 - 15%, and exhaust air containing moisture can be separated from the primary air and fed into furnaces from upper parts of burners, thus reducing ignition heat of pulverized coal, and the use of the intermediate storage hot air pulverized coal feed systems is the key to successfully burning anthracite in 50 - 300MW boilers. However, with regard to an intermediate storage hot air pulverized coal feed system, as the maximum power output of domestic steel ball mills is about 50t/h, each furnace in units of 600MW and above has to be provided with 6 - 8 mills, the system itself is complex, and the pulverized coal bunker is huge, it is difficult for the design institute to design and arrange the system, and the system covers a larger area. Therefore, after the unit capacity is increased to 600MW, the system is not recommended generally.

[0006] As shown in Figure 1 and Figure 2, a 1000MW ultra supercritical boiler is taken for example to illustrate tangential arrangement of an existing burner. Figure 2 is an II-II sectional view of Figure 1, and Figure 1 is an I-I sectional view of Figure 2. The arrangement comprises a boiler body 1, a furnace 2, coal mills 3, pulverized coal pipes 4, primary air pulverized coal nozzles 5 and secondary air nozzles 6. Each boiler 1 is provided with 6 coal mills 3 with number of A, B, C, D, E and F respectively. The furnace 2 consists of four water cooled walls 7, a burner group 8 is arranged at each corner of the furnace 2, and center lines of nozzles of the quadrangular nozzles 8 form an imaginary tangent circle in the furnace 2. Each burner group 8 is divided into three burner subgroups along the vertical direction at a certain interval; each burner subgroup consists of four primary air pulverized coal nozzles 5 and six secondary air nozzles 6, that is, 12 primary air pulverized coal nozzles 5 and 18 secondary air nozzles 6 are arranged along the vertical direction at an interval, for example, 12 primary air pulverized coal nozzles 5 at No. I corner are numbered with A1-1, A1-2, B1-1, B1-2, C1-1, C1-2, D1-1, D1-2, E1-1, E1-2, F1-1, F1-2, and 12 primary air pulverized coal nozzles 5 at No. 4 corner are numbered with A4-1, A4-2, B4-1, B4-2, C4-1, C4-2, D4-1, D4-2, E4-1, E4-2, F4-1, F4-2. Coal mills 3 are connected with the primary air pulverized coal noz-

zles 5 through the pulverized coal pipes 4, four pulverized coal pipes 4 are arranged at an outlet of each coal mill 3, each pulverized coal pipe 4 is connected with 2 primary air pulverized coal nozzles 5 with similar elevation at the same corner through a pulverized coal distributor 10, for example, coal mill 3 numbered A is connected with eight primary air pulverized coal nozzles 5 numbered A1-1, A1-2, A2-1, A2-2, A3-1, A3-2, A4-1, A4-2. It can be seen that as each burner group 8 is provided with 12 primary air pulverized coal nozzles 5 along the vertical direction at a certain interval, furnace wall heat release rate  $q_{Hr}$  of the burner area is lower in the arrangement, thus being unable to meet the requirements for burning anthracite.

#### Summary of the Invention

**[0007]** The invention provides a dense/dilute pulverized coal separator structure of a single-fireball octagonal direct-flow burner, thus generating higher furnace wall heat release rate  $q_{Hr}$  of the burner area.

**[0008]** In order to realize the purpose, the invention provides a dense/dilute pulverized coal separator structure of a single-fireball octagonal direct-flow burner, comprising:

a boiler body surrounded by four water cooled walls, wherein an inner space formed by the four water cooled walls is a furnace of the boiler body;  
 multiple burners which are arranged on the water cooled walls respectively and communicated with the furnace through the water cooled walls, and on which nozzles, toward inside of the furnace are arranged;  
 pulverized coal pipelines;  
 a dense/dilute pulverized coal separator which is connected with the multiple burners respectively by the pulverized coal pipelines; and  
 multiple coal mills which are connected with the dense/dilute pulverized coal separator by the pulverized coal pipelines;  
 each of the boiler body being provided with at least one of the coal mills;  
 and characterized in that the boiler body is provided with eight burner groups, each of the water cooled walls is provided with two burner groups respectively, each burner group comprises multiple nozzles toward the same burner, and center lines of all nozzles on the eight burner groups form an imaginary tangent circle in the furnace.

**[0009]** The four water cooled walls of the boiler body are respectively arranged as a front wall, a rear wall, a left wall and a right wall of the boiler body, the front wall is arranged opposite to the rear wall, and the left wall is arranged opposite to the right wall; center line of the nozzle of the burner arranged on the front wall or the rear wall intersects with the water cooled wall at which the burner is located at an intersection point, distance be-

tween the intersection point and a joint with the nearest adjacent water cooled wall is  $L1$ ,  $1/10Lw \leq L1 \leq 4/10Lw$ , and  $Lw$  is distance between the front wall and the rear wall of the boiler body.

**[0010]** Center line of the nozzle of the burner arranged on the left wall or the right wall intersects with the water cooled wall at which the burner is located at an intersection point, distance between the intersection point and a joint with the nearest adjacent water cooled wall is  $L2$ ,  $1/10Ld \leq L2 \leq 4/10Ld$ , and  $Ld$  is distance between the left wall and the right wall of the boiler body.

**[0011]** The center line of the nozzle of the burner intersects with the water cooled wall at which the burner is located at an intersection point, the intersection point and center of the imaginary tangent circle form a straight line, and an included angle  $\alpha$  is arranged between the straight line and the center line of the nozzle of the burner,  $0^\circ \leq \alpha \leq 30^\circ$ .

**[0012]** Each of the burner groups is divided into two subgroups along the vertical direction, and the two subgroups are a first burner subgroup arranged at a lower part of the water cooled walls and a second burner subgroup arranged at an upper part of the water cooled walls respectively.

**[0013]** The first burner subgroup comprises a primary air/pulverized rich coal burner on which at least one primary air/pulverized rich coal nozzle and two secondary air nozzles are arranged along the vertical direction, and the primary air/pulverized rich coal nozzle and the secondary air nozzles are arranged at an interval.

**[0014]** The second burner subgroup comprises a primary air/pulverized lean coal burner on which at least one primary air/pulverized lean coal nozzle and two secondary air nozzles are arranged along the vertical direction, and the primary air/pulverized lean coal nozzle and the secondary air nozzles are arranged at an interval.

**[0015]** An outlet of each of the coal mills is connected with multiple pulverized coal pipelines, and each of the pulverized coal pipelines is divided into a pulverized rich coal pipeline and a pulverized lean coal pipeline by the dense/dilute pulverized coal separator.

**[0016]** The pulverized rich coal pipeline is provided with a pulverized coal distributor and divided into multiple thin pulverized rich coal pipelines by the pulverized coal distributor, and the multiple thin pulverized rich coal pipelines are connected with the multiple primary air/pulverized rich coal nozzles respectively.

**[0017]** The pulverized lean coal pipeline is provided with a pulverized coal distributor and divided into multiple thin pulverized lean coal pipelines by the pulverized coal distributor, and the multiple thin pulverized lean coal pipelines are connected with the multiple primary air/pulverized lean coal nozzles respectively.

**[0018]** Distance between the primary air/pulverized lean coal nozzle arranged at the uppermost part and the primary air/pulverized rich coal nozzle arranged at the lowermost part is between 1m and 2m.

**[0019]** Compared with the prior art, the dense/dilute

pulverized coal separator structure of a single-fireball octagonal direct-flow burner of the invention has the following advantages:

1. In the invention, the arrangement of connecting pulverized coal air flow at the outlet of each coal mill with 8 rich primary air/pulverized coal nozzles and 8 lean primary air/pulverized coal nozzles at the same level helps is characterized by increasing pulverized coal concentration of the pulverized rich coal area while meeting thermal power of the whole boiler, allowing furnace wall heat release rate  $q_{Hr}$  of a lower burner area to be higher, allowing burning temperature of the area to meet requirements for anthracite burning stability, and ensuring timely ignition of pulverized anthracite air flow and stable burning of the boiler at low load without oil.
2. Compared with an arrangement of four burner groups at four corners, arrangement of eight burner groups on the four water cooled walls of the boiler is characterized by providing better air supply conditions at both sides of jet flow, being less susceptible to occurrence of wall sticking of primary air pulverized coal, being favorable for preventing slagging and high temperature corrosion of the furnace, and improving adaptability to coal variety.
3. Compared with an arrangement of four burner groups at four corners, arrangement of eight burner groups on the four water cooled walls of the boiler is characterized by shortening distance of jet flow from a nozzle outlet to downstream adjacent air flow, being capable of using lower primary pulverized coal air flow velocity, being favorable for timely ignition of pulverized anthracite air flow and stable burning of the boiler at low load without oil, being capable of reducing secondary air velocity, and being favorable for reducing residual swirl strength of fireball and differential temperature of smoke at the furnace outlet.
4. Compared with an arrangement of four burner groups at four corners, arrangement of eight burner groups on the four water cooled walls of the boiler body is characterized by enhancing heat flow strength at the nozzle outlets, greatly improving convection and radiation heat transfer capacity, and being favorable for timely ignition of pulverized anthracite air flow and stable burning of the boiler at low load without oil.
5. Distance between the primary air/pulverized lean coal nozzle arranged at the uppermost part and the primary air/pulverized rich coal nozzle arranged at the lowermost part is controlled between 1m and 2m, thus reducing total height of the boiler, greatly reducing manufacturing cost of the boiler, and reducing emission of nitrogen oxides from the boiler while meeting distance between the primary air pulverized coal nozzle arranged at the uppermost part and bottom of the furnace outlet and anthracite burning efficiency.

## Brief Description of the Drawing

### [0020]

Figure 1 is a schematic diagram of burner arrangement of the prior art, and an I-I sectional view of Figure 2;

Figure 2 is a schematic diagram of burner arrangement of the prior art, and an II-II sectional view of Figure 1;

Figure 3 is a structural diagram of a medium speed coal mill or double inlet and double outlet direct-fired pulverizing system with a dense/dilute pulverized coal separator of the dense/dilute pulverized coal separator structure of a single-fireball octagonal direct-flow burner of the invention;

Figure 4 is a schematic diagram of the dense/dilute pulverized coal separator structure of a single-fireball octagonal direct-flow burner of the invention, and an I-I sectional view of Figure 5; and

Figure 5 is a schematic diagram of the dense/dilute pulverized coal separator structure of a single-fireball octagonal direct-flow burner of the invention, and an II-II sectional view of Figure 4.

## Description of the Preferred Embodiment

[0021] The preferred embodiments of the invention will be described in combination with accompanying drawings.

[0022] As shown in Figure 4, in an embodiment of the disclosed dense/dilute pulverized coal separator structure of an anthracite burning single-fireball octagonal direct-flow burner, each boiler comprises a boiler body 1 which comprises four water cooled walls 9, and the four water cooled walls 9 surround and form the boiler body 1, and an inner space formed by the four water cooled walls is a furnace 2 of the boiler body 1. The furnace 2 is  $L_d$  in depth and  $L_w$  in width. Each boiler body 1 is provided with eight burner groups which are arranged on four water cooled walls 9 of the boiler body 1 respectively, each water cooled wall is provided with two burner groups, and each burner group comprises multiple vertically arranged burners 10. The eight burner groups are arranged circularly by centering on center of the furnace 2, and angle spacing between two burner groups is the same. Each burner 10 is provided with nozzles, in the same burner group, the direction of nozzles of the burner 10 is the same, nozzles of burners 10 in the eight burner groups are arranged toward inside of the furnace 2, center lines of all nozzles in the eight burner groups (i.e., jet directions of all nozzles in the eight burner groups) form an imaginary tangent circle 11 in a counterclockwise direction in the furnace 2 (in counterclockwise direction in overlook), and the center of the imaginary tangent circle 11 coincides with the center of the furnace 2.

[0023] Center line of the nozzle of each burner 10 intersects with a corresponding water cooled wall 9 of the

burner 10 at an intersection point, the intersection point and the center of the imaginary tangent circle 11 form a straight line, and an included angle  $\alpha$  is formed between the straight line and the center line of the nozzle of the burner 10, with value range of  $0^\circ \leq \alpha \leq 30^\circ$ . In the embodiment, the included angle  $\alpha$  is  $4^\circ$ , i.e.  $\alpha = 4^\circ$ .

**[0024]** Among four water cooled walls 9 of the boiler body 1, two opposite water cooled walls 9 are a front wall and a rear wall of the boiler body 1, and the other two wall cooled walls 9 are a left wall and a right of the boiler body 1, distance between the front wall and the rear wall of the boiler body 1 is depth  $L_d$  of the furnace 2, and distance between the left wall and the right wall of the boiler body 1 is width  $L_w$  of the furnace 2.

**[0025]** Center line of the nozzle of the burner 10 arranged on the front wall or the rear wall of the boiler body 1 intersects with the water cooled wall 9 at which the burner 10 is located at an intersection point, and distance between the intersection point and an edge (joint between two adjacent water cooled walls 9 is at the edge) of the nearest furnace 2 is  $L_1$ , with value range of  $1/10L_w \leq L_1 \leq 4/10L_w$ . In the embodiment,  $L_1$  is a quarter of the width  $L_w$  of the furnace 2, i.e.,  $L_1 = 1/4L_w$ .

**[0026]** Similarly, center line of the nozzle of the burner 10 respectively arranged on the left wall and the right wall of the boiler body 1 intersects with the water cooled wall 9 at which the burner 10 is located at an intersection point, and distance between the intersection point and an edge (joint between two adjacent water cooled walls 9 is at the edge) of the nearest furnace 2 is  $L_2$ , with value range of  $1/10L_d \leq L_2 \leq 4/10L_d$ . In the embodiment,  $L_2$  is a quarter of the depth  $L_d$  of the furnace 2, i.e.,  $L_2 = 1/4L_d$ .

**[0027]** As shown in Figure 5 in combination with Figure 4, each burner group is divided into two subgroups along the vertical direction, and the two subgroups are a first burner subgroup arranged at a lower side wall of the boiler body I and a second burner subgroup arranged at an upper side wall of the boiler body 1.

**[0028]** Burners 10 in the first burner subgroup are primary air/pulverized rich coal burners which are provided with nozzles, the nozzles are arranged toward inside of the furnace according to the structure, and communicated with inside of the furnace. The nozzles arranged on the primary air/pulverized rich coal burners comprises six primary air/pulverized rich coal nozzles 6 and seven secondary air nozzles 8, the primary air/pulverized rich coal nozzles 6 are arranged between two adjacent secondary air nozzles 8 at an interval.

**[0029]** All secondary air nozzles 8 are connected with a large secondary air bellow through pipelines, and the large secondary air bellow is connected with an external secondary air pipeline. In order to ensure safe burning, secondary air is fed into the boiler through the secondary air nozzles 8.

**[0030]** The twelve primary air/pulverized rich coal nozzles 6 on the primary air/pulverized rich coal burners of the two burner groups arranged on the front wall are numbered with A1-1-1, A1-1-2, B1-1-1, B1-1-2, C1-1-1,

C1-1-2, D1-1-1, D1-1-2, E1-1-1, E1-1-2, F1-1-1, F1-1-2 respectively. The twelve primary air/pulverized rich coal nozzles 6 on the primary air/pulverized rich coal burners of the two burner groups arranged on the rear wall are numbered with A3-1-1, A3-1-2, B3-1-1, B3-1-2, C3-1-1, C3-1-2, D3-1-1, D3-1-2, E3-1-1, E3-1-2, F3-1-1, F3-1-2 respectively. The twelve primary air/pulverized rich coal nozzles 6 on the primary air/pulverized rich coal burners of the two burner groups arranged on the left wall are numbered with A2-1-1, A2-1-2, B2-1-1, B2-1-2, C2-1-1, C2-1-2, D2-1-1, D2-1-2, E2-1-1, E2-1-2, F2-1-1, F2-1-2 respectively. The twelve primary air/pulverized rich coal nozzles 6 on the primary air/pulverized rich coal burners of the two burner groups arranged on the right wall are numbered with A4-1-1, A4-1-2, B4-1-1, B4-1-2, C4-1-1, C4-1-2, D4-1-1, D4-1-2, E4-1-1, E4-1-2, F4-1-1, F4-1-2 respectively.

**[0031]** The primary air/pulverized rich coal nozzles 6 numbered A1-1-1, A1-1-2, A3-1-1, A3-1-2, A2-1-1, A2-1-2, A4-1-1, A4-1-2 are correspondingly arranged on the same level as nozzles of the same level. The primary air/pulverized rich coal nozzles 6 numbered B1-1-1, B1-1-2, B3-1-1, B3-1-2, B2-1-1, B2-1-2, B4-1-1, B4-1-2 are correspondingly arranged on the same level as nozzles of the same level. The primary air/pulverized rich coal nozzles 6 numbered C1-1-1, C1-1-2, C3-1-1, C3-1-2, C2-1-1, C2-1-2, C4-1-1, C4-1-2 are correspondingly arranged on the same level as nozzles of the same level. The primary air/pulverized rich coal nozzles 6 numbered D1-1-1, D1-1-2, D3-1-1, D3-1-2, D2-1-1, D2-1-2, D4-1-1, D4-1-2 are correspondingly arranged on the same level as nozzles of the same level. The primary air/pulverized rich coal nozzles 6 numbered E1-1-1, E1-1-2, E3-1-1, E3-1-2, E2-1-1, E2-1-2, E4-1-1, E4-1-2 are correspondingly arranged on the same level as nozzles of the same level. The primary air/pulverized rich coal nozzles 6 numbered F1-1-1, F1-1-2, F3-1-1, F3-1-2, F2-1-1, F2-1-2, F4-1-1, F4-1-2 are correspondingly arranged on the same level as nozzles of the same level.

**[0032]** Burners 10 in the second burner subgroup are primary air/pulverized lean coal burners which are provided with nozzles, the nozzles are arranged toward inside of the furnace according to the structure, and communicated with inside of the furnace. The nozzles arranged on the primary air/pulverized lean coal burners comprises six primary air/pulverized lean coal nozzles 7 and seven secondary air nozzles 8, the primary air/pulverized lean coal nozzles 7 are arranged between two adjacent secondary air nozzles 8 at an interval.

**[0033]** All secondary air nozzles 8 are connected with a large secondary air bellow through pipelines, and the large secondary air bellow is connected with an external secondary air pipeline. In order to ensure safe burning, secondary air is fed into the boiler through the secondary air nozzles 8.

**[0034]** The twelve primary air/pulverized lean coal nozzles 7 on the primary air/pulverized lean coal burners of the two burner groups arranged on the front wall are num-

bered with A1-2-1, A1-2-2, B1-2-1, B1-2-2, C1-2-1, C1-2-2, D1-2-1, D1-2-2, E1-2-1, E1-2-2, F1-2-1, F1-2-2 respectively. The twelve primary air/pulverized lean coal nozzles 7 on the primary air/pulverized lean coal burners of the two burner groups arranged on the rear wall are numbered with A3-2-1, A3-2-2, B3-2-1, B3-2-2, C3-2-1, C3-2-2, D3-2-1, D3-2-2, E3-2-1, E3-2-2, F3-2-1, F3-2-2 respectively. The twelve primary air/pulverized lean coal nozzles 7 on the primary air/pulverized lean coal burners of the two burner groups arranged on the left wall are numbered with A2-2-1, A2-2-2, B2-2-1, B2-2-2, C2-2-1, C2-2-2, D2-2-1, D2-2-2, E2-2-1, E2-2-2, F2-2-1, F2-2-2 respectively. The twelve primary air/pulverized lean coal nozzles 7 on the primary air/pulverized lean coal burners of the two burner groups arranged on the right wall are numbered with A4-2-1, A4-2-2, B4-2-1, B4-2-2, C4-2-1, C4-2-2, D4-2-1, D4-2-2, E4-2-1, E4-2-2, F4-2-1, F4-2-2 respectively.

**[0035]** The primary air/pulverized lean coal nozzles 7 numbered A1-2-1, A1-2-2, A3-2-1, A3-2-2, A2-2-1, A2-2-2, A4-2-1, A4-2-2 are correspondingly arranged on the same level as nozzles of the same level. The primary air/pulverized lean coal nozzles 7 numbered B1-1-1, B1-1-2, B3-1-1, B3-1-2, B2-1-1, B2-1-2, B4-1-1, B4-1-2 are correspondingly arranged on the same level as nozzles of the same level. The primary air/pulverized lean coal nozzles 7 numbered C1-1-1, C1-1-2, C3-1-1, C3-1-2, C2-1-1, C2-1-2, C4-1-1, C4-1-2 are correspondingly arranged on the same level as nozzles of the same level. The primary air/pulverized lean coal nozzles 7 numbered D1-1-1, D1-1-2, D3-1-1, D3-1-2, D2-1-1, D2-1-2, D4-1-1, D4-1-2 are correspondingly arranged on the same level as nozzles of the same level. The primary air/pulverized lean coal nozzles 7 numbered E-1-1, E1-1-2, E3-1-1, E3-1-2, E2-1-1, E2-1-2, E4-1-1, E4-1-2 are correspondingly arranged on the same level as nozzles of the same level. The primary air/pulverized lean coal nozzles 7 numbered F1-1-1, F1-1-2, F3-1-1, F3-1-2, F2-1-1, F2-1-2, F4-1-1, F4-1-2 are correspondingly arranged on the same level as nozzles of the same level.

**[0036]** In each burner group, the distance between the primary air/pulverized lean coal nozzle 7 arranged at the uppermost part and the primary air/pulverized rich coal nozzle 6 arranged at the lowermost part is between 1m and 2m, thus reducing total height of the boiler, greatly reducing manufacturing cost of the boiler, and reducing emission of nitrogen oxides from the boiler while meeting distance between the primary air pulverized coal nozzle arranged at the uppermost part and bottom of the furnace outlet and anthracite burning efficiency.

**[0037]** Each boiler is provided with six coal mills 3, i.e. a first coal mill A, a second coal mill B, a third coal mill C, a fourth coal mill D, a fifth coal mill E and a sixth coal mill F.

**[0038]** An outlet of each coal mill 3 is connected with four pulverized coal pipelines 5, each pulverized coal pipeline 5 is provided with a dense/dilute pulverized coal separator 4, and the dense/dilute pulverized coal separator

4 divides each pulverized coal pipeline 5 into a pulverized rich coal pipeline and a pulverized lean coal pipeline.

**[0039]** Each pulverized rich coal pipeline is also provided with a pulverized coal distributor 12 which divides the pulverized rich coal pipeline into two thin pulverized rich coal pipelines which are respectively connected with the primary air/pulverized rich coal nozzles 6 of respective primary air/pulverized rich coal burners in the two burner groups arranged on the same water cooled wall 9.

**[0040]** Each coal mill 3 is connected with the primary air/pulverized rich coal nozzles 6 as follows:

The first coal mill A is respectively connected with the primary air/pulverized rich coal nozzles 6 numbered A1-1-1, A1-1-2, A2-1-1, A2-1-2, A3-1-1, A3-1-2, A4-1-1, A4-1-2.

The second coal mill B is respectively connected with the primary air/pulverized rich coal nozzles 6 numbered B1-1-1, B1-1-2, B2-1-1, B2-1-2, B3-1-1, B3-1-2, B4-1-1, B4-1-2.

The third coal mill C is respectively connected with the primary air/pulverized rich coal nozzles 6 numbered C1-1-1, C1-1-2, C2-1-1, C2-1-2, C3-1-1, C3-1-2, C4-1-1, C4-1-2.

The fourth coal mill D is respectively connected with the primary air/pulverized rich coal nozzles 6 numbered D1-1-1, D1-1-2, D2-1-1, D2-1-2, D3-1-1, D3-1-2, D4-1-1, D4-1-2.

The fifth coal mill E is respectively connected with the primary air/pulverized rich coal nozzles 6 numbered E1-1-1, E1-1-2, E2-1-1, E2-1-2, E3-1-1, E3-1-2, E4-1-1, E4-1-2.

The sixth coal mill F is respectively connected with the primary air/pulverized rich coal nozzles 6 numbered F1-1-1, F1-1-2, F2-1-1, F2-1-2, F3-1-1, F3-1-2, F4-1-1, F4-1-2.

**[0041]** Each pulverized lean coal pipeline is provided with a pulverized coal distributor 12 which divides the pulverized lean coal pipeline into two thin pulverized lean coal pipelines which are respectively connected with the primary air/pulverized lean coal nozzles 7 of respective primary air/pulverized lean coal burners in the two burner groups arranged on the same water cooled wall 9.

**[0042]** Each coal mill 3 is connected with the primary air/pulverized lean coal nozzles 7 as follows:

The first coal mill A is respectively connected with the primary air/pulverized lean coal nozzles 7 numbered A1-2-1, A1-2-2, A2-2-1, A2-2-2, A3-2-1, A3-2-2, A4-2-1, A4-2-2.

The second coal mill B is respectively connected with the primary air/pulverized lean coal nozzles 7 numbered B1-2-1, B1-2-2, B2-2-1, B2-2-2, B3-2-1, B3-2-2, B4-2-1, B4-2-2.

The third coal mill C is respectively connected with the primary air/pulverized lean coal nozzles 7 num-

bered C1-2-1, C1-2-2, C2-2-1, C2-2-2, C3-2-1, C3-2-2, C4-2-1, C4-2-2.

The fourth coal mill D is respectively connected with the primary air/pulverized lean coal nozzles 7 numbered D1-2-1, D1-2-2, D2-2-1, D2-2-2, D3-2-1, D3-2-2, D4-2-1, D4-2-2.

The fifth coal mill E is respectively connected with the primary air/pulverized lean coal nozzles 7 numbered E-2-1, E1-2-2, E2-2-1, E2-2-2, E3-2-1, E3-2-2, E4-2-1, E4-2-2.

The sixth coal mill F is respectively connected with the primary air/pulverized lean coal nozzles 7 numbered F-2-1, F1-2-2, F2-2-1, F2-2-2, F3-2-1, F3-2-2, F4-2-1, F4-2-2.

**[0043]** As shown in Figure 3 in combination with Figure 5, the dense/dilute pulverized coal separator structure of an anthracite burning single-fireball octagonal direct-flow burner of the invention uses a "medium speed coal mill or double inlet and double outlet direct-fired pulverizing system with a dense/dilute pulverized coal separator", the main principle of the structure is to add a dense/dilute pulverized coal separator 4 on each pulverized coal pipeline 5 connected to an outlet of each coal mill 3 so as to separate and divide rich/lean primary air/pulverized coal into an air flow containing 80% pulverized coal and 50% primary air/pulverized rich coal, and an air flow containing remaining 20% pulverized coal and 50% primary air/pulverized lean coal, and the two air flows are fed into the furnace 2 for burning respectively through primary air/pulverized rich coal nozzles 6 and primary air/pulverized lean coal nozzles 7 in the burner groups. The area in the corresponding furnace 2 of the primary air/pulverized rich coal nozzles 6 is a pulverized rich coal burning area, the area in the corresponding furnace 2 of the primary air/pulverized lean coal nozzles 7 is a pulverized lean coal burning area, and the pulverized lean coal burning area is located above the pulverized rich coal burning area.

**[0044]** The use of the "medium speed coal mill or double inlet and double outlet direct-fired pulverizing system with a dense/dilute pulverized coal separator" enables air-pulverized coal ratio and primary air ratio of rich primary air/pulverized coal to be superior to corresponding parameters of intermediate storage hot air pulverized coal feed systems, meanwhile, 50% primary air containing 50% moisture is separated and fed into the furnace 2 from the primary air/pulverized lean coal nozzles 7 located at the upper parts in the burner groups. Although the primary air and pulverized coal mixing temperature is lower than that of boilers using intermediate storage hot air pulverized coal feed systems, in such design, it can be seen from theoretical calculation that ignition heat of pulverized rich coal air flow is basically the same as that of boilers using intermediate storage hot air pulverized coal feed systems, thus ensuring stable ignition of pulverized rich coal air flow.

**[0045]** While the invention has been described in detail and with reference to the preferred embodiment, it is to

be understood that the invention is not restricted thereto. It is apparent to those skilled in the art that various changes and modifications can be made therein in accordance with the disclosure. Therefore, scope of the invention is to be restricted only by the appended claims.

## Claims

1. A dense/dilute pulverized coal separator structure of a single-fireball octagonal direct-flow burner, comprising:

a boiler body (1) surrounded by four water cooled walls (9), wherein an inner space formed by the four water cooled walls (9) is a furnace (2) of the boiler body (1);

multiple burners (10) which are arranged on the water cooled walls (9) respectively and communicated with the furnace (2) through the water cooled walls (9), and on which nozzles toward an inside of the furnace (2) are arranged; pulverized coal pipelines (5);

a dense/dilute pulverized coal separator (4) which are connected with the multiple burners (10) respectively by the pulverized coal pipelines (5); and

multiple coal mills (3) which are connected with the dense/dilute pulverized coal separator (4) by the pulverized coal pipelines (5);

each of the boiler body (1) being associated with at least one of the coal mills (3);

and **characterized in that** the boiler body (1) is provided with eight burner groups, each of the water cooled walls (9) is provided with two burner groups respectively, each burner group comprises multiple nozzles from the same burner (10), and center lines of all nozzles on the eight burner groups form an imaginary tangent circle (11) in the furnace (2).

2. The dense/dilute pulverized coal separator structure of a single-fireball octagonal direct-flow burner according to claim 1, **characterized in that** the four water cooled walls (9) of the boiler body (1) are respectively arranged as a front wall, a rear wall, a left wall and a right wall of the boiler body (1), the front wall is arranged opposite to the rear wall, and the left wall is arranged opposite to the right wall; center line of the nozzle of the burner (10) arranged on the front wall or the rear wall intersects with the water cooled wall (9) at which the nozzle is located at an intersection point, distance between the intersection point and a joint with the nearest adjacent water cooled wall (9) is  $L1$ , where  $1/10Lw \leq L1 \leq 4/10Lw$ , and  $Lw$  is distance between the front wall and the rear wall of the boiler body (1).

3. The dense/dilute pulverized coal separator structure of a single-fireball octagonal direct-flow burner according to claim 2, **characterized in that** the center line of the nozzle of the burner (10) arranged on the left wall or the right wall intersects with the water cooled wall (9) at which the nozzle is located at an intersection point, distance between the intersection point and a joint with the nearest adjacent water cooled wall (9) is  $L_2$ , where  $1/10L_d \leq L_2 \leq 4/10L_d$ , and  $L_d$  is distance between the left wall and the right wall of the boiler body (1).
4. The dense/dilute pulverized coal separator structure of a single-fireball octagonal direct-flow burner according to claim 1, **characterized in that** the center line of the nozzle of the burner (10) intersects with the water cooled wall (9) at which the nozzle is located at an intersection point, the intersection point and center of the imaginary tangent circle (11) form a straight line, and an included angle  $\alpha$  is arranged between the straight line and the center line of the nozzle of the burner (10), where  $0^\circ \leq \alpha \leq 30^\circ$ .
5. The dense/dilute pulverized coal separator structure of a single-fireball octagonal direct-flow burner according to claim 1, **characterized in that** each of the burner groups is divided into two subgroups along the vertical direction, and the two subgroups are a first burner subgroup arranged at a lower part of the water cooled walls (9) and a second burner subgroup arranged at an upper part of the water cooled walls (9) respectively.
6. The dense/dilute pulverized coal separator structure of a single-fireball octagonal direct-flow burner according to claim 5, **characterized in that** the first burner subgroup comprises a primary air/pulverized rich coal burner on which at least one primary air/pulverized rich coal nozzle (6) and two secondary air nozzles (8) are arranged along the vertical direction, and the primary air/pulverized rich coal nozzle (6) and the secondary air nozzles (8) are arranged at an interval.
7. The dense/dilute pulverized coal separator structure of a single-fireball octagonal direct-flow burner according to claim 6, **characterized in that** the second burner subgroup comprises a primary air/pulverized lean coal burner on which at least one primary air/pulverized lean coal nozzle (7) and two secondary air nozzles (8) are arranged along the vertical direction, and the primary air/pulverized lean coal nozzle (7) and the secondary air nozzles (8) are arranged at an interval.
8. The dense/dilute pulverized coal separator structure of a single-fireball octagonal direct-flow burner according to claim 7, **characterized in that** an outlet of each of the coal mills (3) is connected with multiple pulverized coal pipelines (5), and each of the pulverized coal pipeline (5) is divided into a pulverized rich coal pipeline and a pulverized lean coal pipeline by the dense/dilute pulverized coal separator (4).
9. The dense/dilute pulverized coal separator structure of a single-fireball octagonal direct-flow burner according to claim 8, **characterized in that** the pulverized rich coal pipeline is provided with a pulverized coal distributor (12) and divided into multiple thin pulverized rich coal pipelines by the pulverized coal distributor (12), and the multiple thin pulverized rich coal pipelines are connected with the multiple primary air/pulverized rich coal nozzles (6) respectively; the pulverized lean coal pipeline is provided with a pulverized coal distributor (12) and divided into multiple thin pulverized lean coal pipelines by the pulverized coal distributor (12), and the multiple thin pulverized lean coal pipelines are connected with the multiple primary air/pulverized lean coal nozzles (7) respectively.
10. The dense/dilute pulverized coal separator structure of a single-fireball octagonal direct-flow burner according to claim 7, **characterized in that** distance between the primary air/pulverized lean coal nozzle (7) arranged at the uppermost part and the primary air/pulverized rich coal nozzle (6) arranged at the lowermost part is between 1m and 2m.



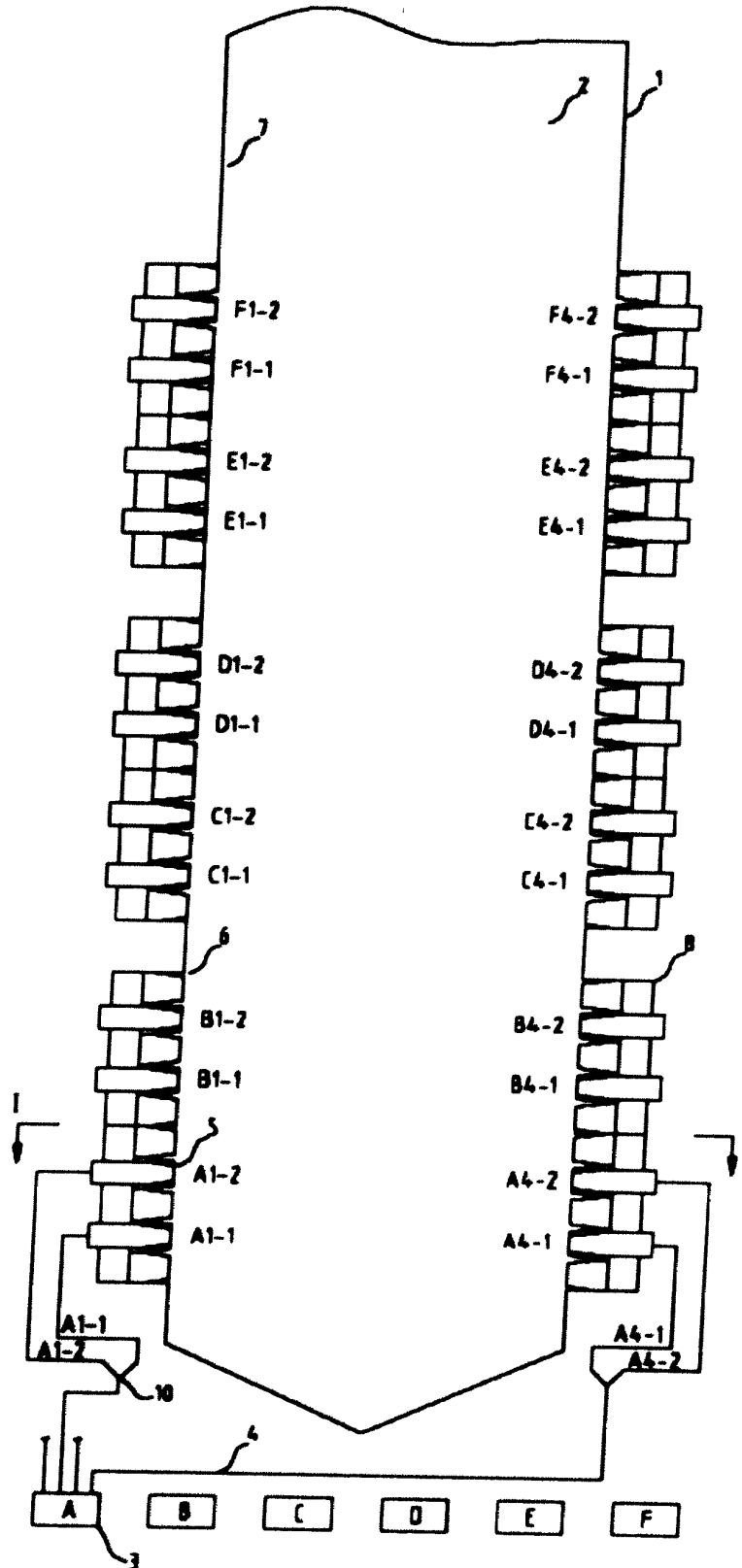


Figure 2

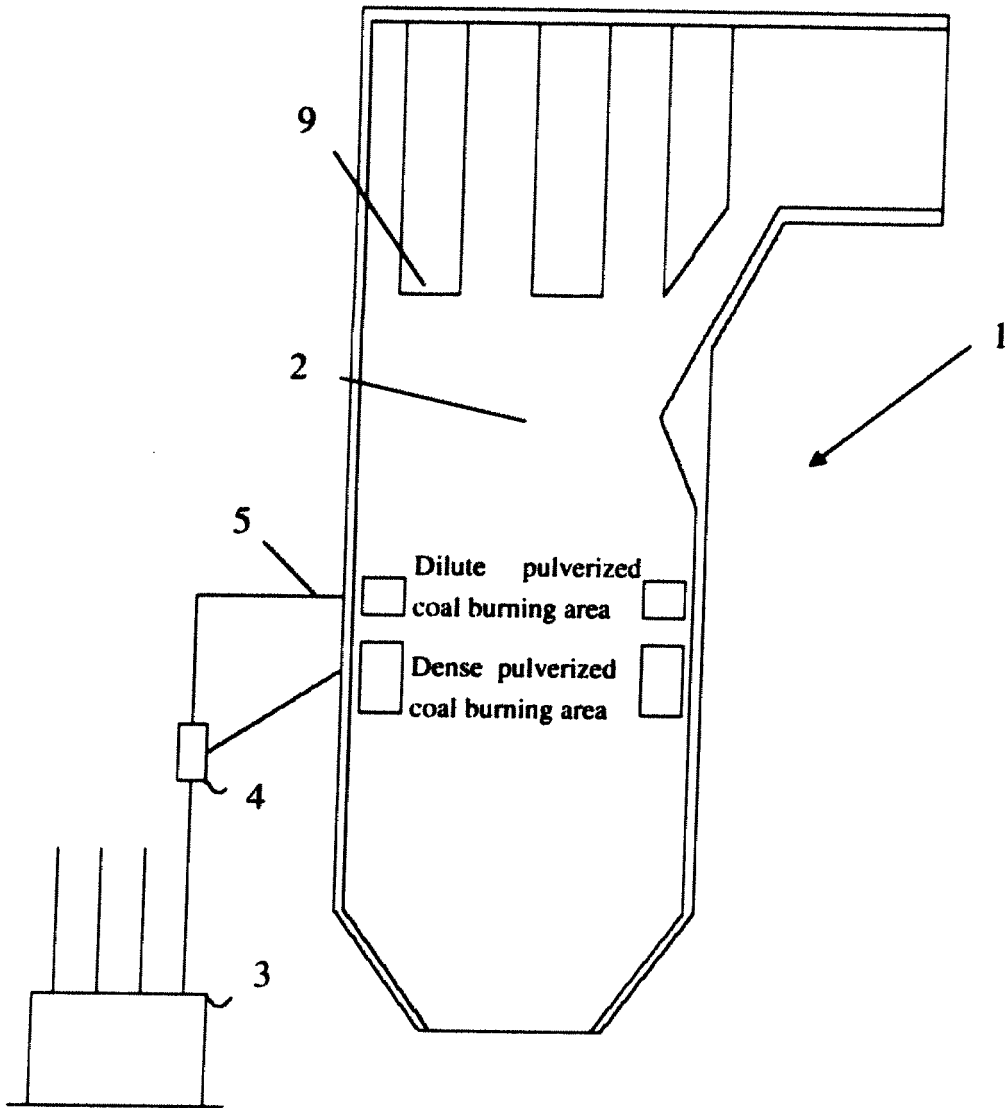


Figure 3

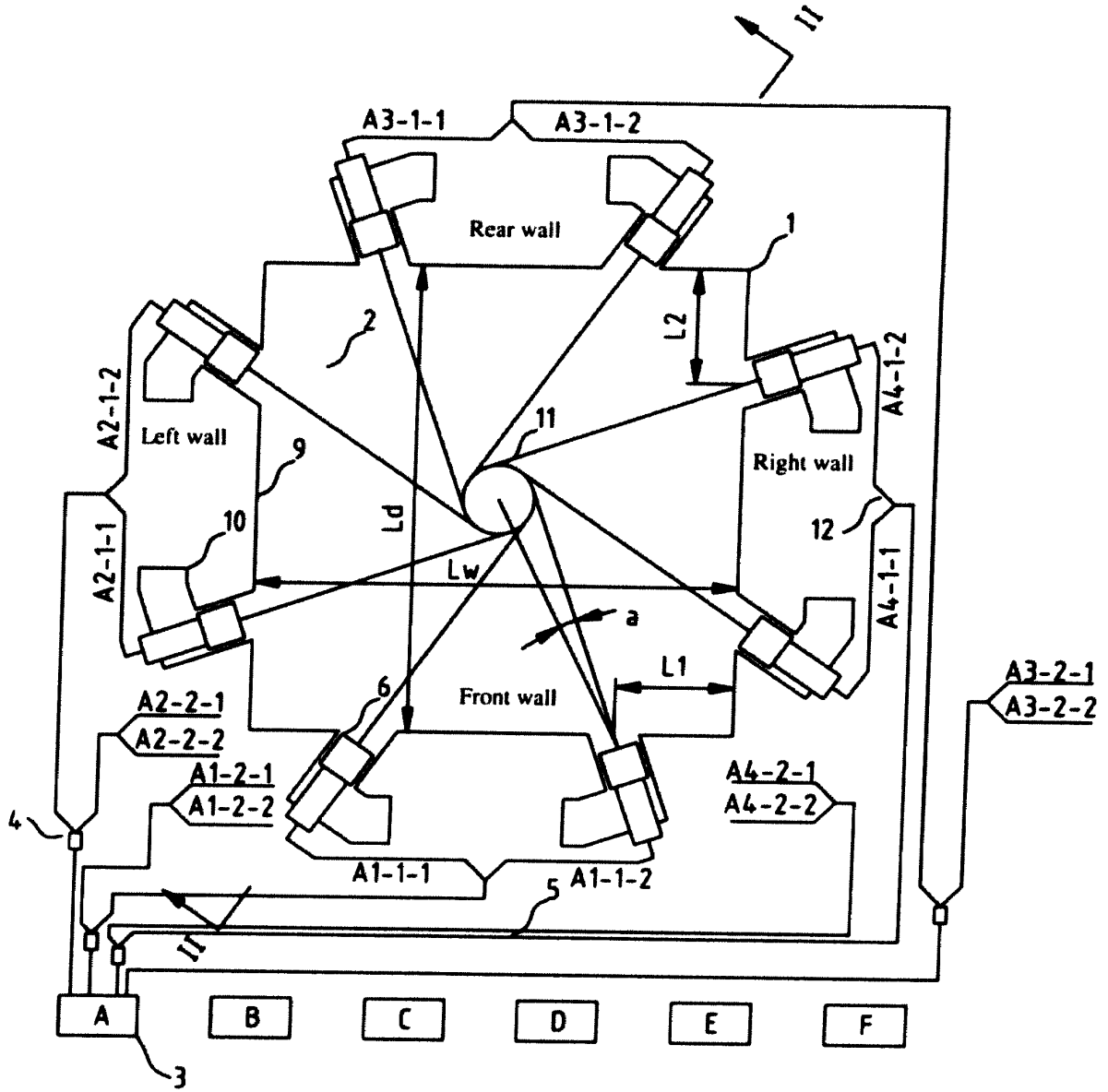


Figure 4

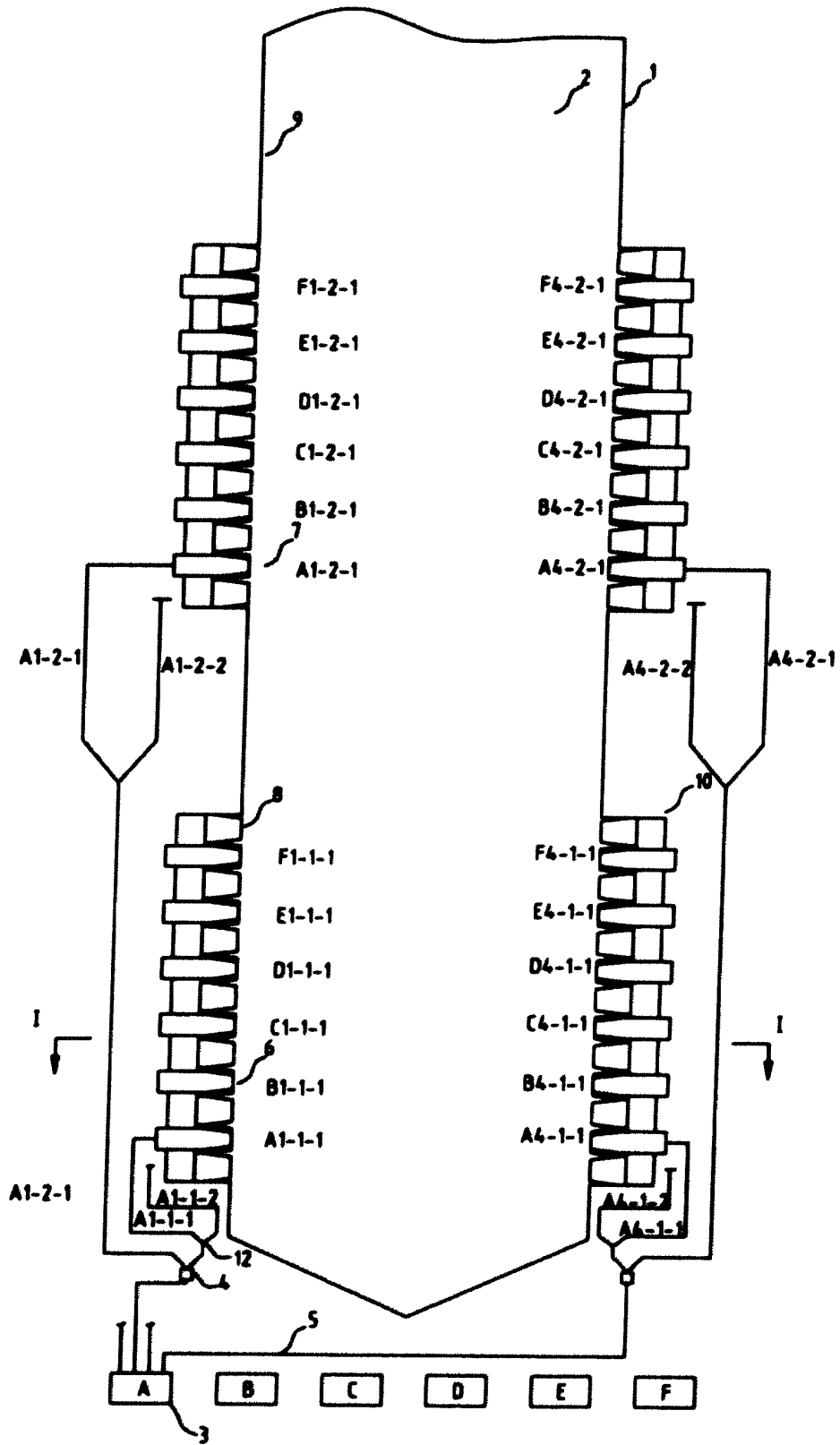


Figure 5

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/CN2012/071222

<b>A. CLASSIFICATION OF SUBJECT MATTER</b>		
See the extra sheet According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b>		
Minimum documentation searched (classification system followed by classification symbols) IPC: F23 C5/-; F23 D1/-; F23 L9/-; F23 C1/-; F23 Q7/-; F23 C7/-		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) CNPAT, CNKI, EPODOC, WPI, boiler?, burner?, nozzle?, eight, tangential w circle, anthracite, single, fireball, shade w powdered, coal, burner		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 101709871 A (SHANGHAI BOILER FACTORY CO., LTD.) 19 May 2010 (19.05.2010) claims 1-3, embodiment 2 and fig. 5	1-10
Y	CN 201582812 U (QINGHUA UNIVERSITY) 15 September 2010 (15.09.2010) claim 1 and fig. 1	1-10
A	CN 101737771 A (SHANGHAI BOILER FACTORY CO., LTD.) 16 June 2010 (16.06.2010) claim 14 and figures 17-19	1-10
A	JP 10-19205 A (MITSUBISHI JUKOGYO KK) 23 January 1998 (23.01.1998) figures 1-6	1-10
A	JP 2001-227702 A (MITSUBISHI JUKOGYO KK) 24 August 2001 (24.08.2001) claims 1-7 and figures 1-5	1-10
A	CN 2646584 Y (HOU, Guilin) 06 October 2004 (06.10.2004) claims 1-3	1-10
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
<p>* Special categories of cited documents:</p> <p>“A” document defining the general state of the art which is not considered to be of particular relevance</p> <p>“E” earlier application or patent but published on or after the international filing date</p> <p>“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>“O” document referring to an oral disclosure, use, exhibition or other means</p> <p>“P” document published prior to the international filing date but later than the priority date claimed</p>		<p>“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>“&amp;” document member of the same patent family</p>
Date of the actual completion of the international search 02 August 2012 (02.08.2012)		Date of mailing of the international search report <b>23 August 2012 (23.08.2012)</b>
Name and mailing address of the ISA State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No. (86-10) 62019451		Authorized officer  WANG, Junfeng  Telephone No. (86-10) <b>82245518</b>

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**INTERNATIONAL SEARCH REPORT**  
**Information on patent family members**

International application No.  
**PCT/CN2012/071222**

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CN 2646584 Y	06.10.2004	None	

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**INTERNATIONAL SEARCH REPORT**

International application No.

**PCT/CN2012/071222**

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

F23 D1/00 (2006.01) i

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F23 C5/32 (2006.01) i

F23 C7/06 (2006.01) i

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F23 L9/02 (2006.01) i

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