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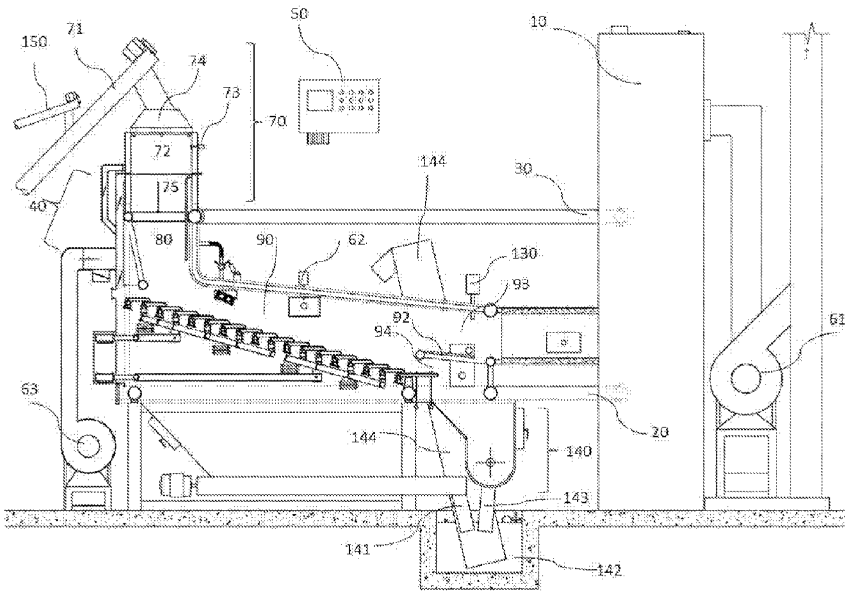

Figure – 1

(57) **Abstract:** Patent subject gasification process smokeless combustion, fully automated capacity and efficiency maximization solid fuel burner system, which allows for solid fueled operation of a boiler (10) through replacement with the liquid fuel or natural gas burners on the front side of existing liquid or gas fueled boilers (10), incorporates the fully automated gasification process that carries out water vapor generation, air-fuel preheating, gasification with air + water vapor and smokeless combustion processes, and a smokeless combustion method, and is a gasifier solid fuel burner system that maximizes combustion capacity and efficiency by minimizing all losses through a functional system, components and elements throughout a continuous process starting with solid fuel feed, gasification and smokeless combustion and completed with the discharge of combustion waste ashes-clinkers.

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GASIFICATION PROCESS SMOKELESS COMBUSTION, FULLY AUTOMATED CAPACITY AND EFFICIENCY MAXIMIZATION SOLID FUEL BURNER SYSTEM

TECHNICAL FIELD

The invention relates to a gasification process smokeless combustion, fully automated capacity and efficiency maximization solid fuel burner system, which, through replacement with the liquid or gas fuel burner on the front side of boilers operating with liquid and gas fuels in the state of the art, enable that the boiler operates with solid fuel.

Due to the fact that the earth has far greater coal reserves than petroleum and natural gas, gas fuels produced through gasification of coals as a fossil fuel seem to replace petroleum and natural gas in the coming years. It is of importance that coal, which is the most common solid fuel and has a wide area of use in heating and industry fields, is burned with high efficiency and without smoke.

"Gasification Process Smokeless Combustion, Fully Automated Capacity and Efficiency Maximization Solid Fuel Burner System", subject to the invention enabling that boilers function with solid fuel through mounting on the front side of existing hot water, steam and hot oil boilers, has been developed after years of research-development (R&D) works, and is a new, technological solid fuel burner that maximizes both the smokeless combustion efficiency and the combustion capacity through gasification process.

As the patent subject solid fuel burner is an invention shaped after developing the no. 2011/08126 patent subject burner, it will be suitable to provide brief information on the existing solid fuel combustion systems and gasification, and make a comparative, detailed explanation of the development on such patent.

SOLID FUEL COMBUSTION SYSTEMS IN THE STATE OF THE ART

In existing boilers in the state of the art, mechanical or automated coal combustion systems can be explained in three groups in terms of fuel feed and combustion method.

1) Overfeed stoker coal combustion systems
2) Underfeed stoker coal combustion systems
3) Pulverized coal burner systems

Overfeed stoker systems can be classified in three groups namely ejection type stokers, propulsion stokers and rotary grate (pallet) stokers.

In ejection type overfeed stokers, combustion is ensured through scattering fresh coal on the flame in the fixed or traveling grate combustion chamber with a mechanical ejection system. Due to the fact that combustible gasses rapidly coming out of the fresh coal scattered on the combustion bed with an automated ejection system cannot be burned, combustion efficiency remains at a very low level.

In advanced type overfeed stoker combustion systems, coal is fed directly over the grate. As generation of smoke as an incomplete combustion product also cannot be avoided in these combustion systems, combustion efficiency also remains at a low level.

In rotary grate (pallet) type overfeed combustion systems, fresh coal directly fed over the pallet rotary grates starts burning, and completes the combustion as ash and clinker from the other end. In this type of overfeed combustion systems, generation of smoke due to incomplete combustion arising from the combustion method cannot be avoided, and combustion efficiency also remains at a low level.

Underfeed stokers are loaded to the combustion system function of a boiler through application on the front side of the boiler as a pre-furnace. Due to the method of coal feed to the combustion chamber, a relatively more efficient combustion is attained in terms of combustibility of flammable gasses compared with the combustion system in overfeed stokers.

Pulverized coal burner systems are combustion systems that have a wide area of use especially in thermal power stations generating electricity. As a significant part of the gasses rapidly coming out from the fresh pulverized coal ejected to the combustion chamber are not burned, generation of smoke cannot be avoided.

The art that can be considered as **the closest prior art (CPA)** to our patent application subject within the scope of the state of the art is the coal burner with patent no. **TR 2011/08126**. As our patent application subject gasification process smokeless combustion solid fuel burner system is an invention created upon developing the subject burner of this patent, developments on such patent as well as comparative, detailed explanations are included in the following chapters.

Gasification:

Gasification is the process of transforming hydrocarbonated fuels such as coal, petroleum, biomass and solid wastes into flammable gasses such as carbon monoxide (CO), Hydrogen (H2) and Methane (CH4) through partial oxidation. Gasification process can be performed through using air, water vapor or their mixtures at various ratios as oxidants; on a pressurized or atmospherically fixed bed, a bubble fluidized bed, circulating fluidized bed, using drift current and plasma gasifiers. The amount of oxygen necessary in gasification processes are generally one-third of or less than the amount needed for theoretical combustion, and such ratio can differ based on the property of the gasified coal.

The purpose of coal gasification is; to obtain gas products through making coal react with water vapor, air, oxygen and hydrogen. Composition and amount of gasses generated through gasification of coals depend on the type and activity of the coal, type of the used gasses and the adopted gasification method. It is of importance that gas fuels obtained especially from gasification of volatile and high-humidity lignite, semi-bituminous and bituminous coals are utilized economically.

DESCRIPTION OF THE INVENTION

The invention is "Gasification process smokeless combustion, fully automated capacity and efficiency maximization solid fuel burner system", and it has been developed after years of research-development (R&D) and optimization studies.

Invention subject solid fuel burner system incorporates a smokeless combustion method through a fully automated, controlled gasification process ensured in the solid fuel gasification duct through the gasification and combustion air inlet and distribution system, gasification and combustion air supply system, solid fuel feed and gasification preparation system. On the other hand, it is a fully automated gasification smokeless combustion new technology solid fuel burner system that, with its smokeless combustion chamber design, adjustable grate system according to the combustion efficiency and combustion efficiency-sensitive automation system, maximizes solid fuel combustion capacity and smokeless combustion efficiency through a news system and elements that minimize capacity and efficiency losses in the control of combustion and disposals of the wastes.

Invention subject gasification process smokeless combustion, fully automated capacity and efficiency maximization new solid fuel burner has been developed to be implemented in the industry through replacement with the liquid/gas fuel burners on the existing domestic and industrial hot water, superheated water, hot oil and steam boilers in the state of the art.

A solid fuel burner mounted on an industrial type large capacity steam boiler is illustrated in Figure 1. and in Figure 2, a detailed view is provided for the gasification and smokeless combustion process used in the system.

Functional section, system and parts of the patent subject gasification process smokeless combustion solid fuel burner are shown in Figure 1 as mounted on an existing boiler.

REFERENCE NUMBERS

10. Boiler
20. Heating fluid inlet pipe from the boiler to the burner main frame
30. Heating fluid outlet pipe from the burner main frame to the boiler
40. Gasification and combustion air inlet and distribution system
41. Forced blower fan and main air inlet duct
42. Natural draught and aspiration main air inlet duct
43. Gasification air guide duct
44. Gas combustion air guide duct
45. Post-gasification solid combustion air guide duct
50. Combustion efficiency and capacity-sensitive automation system
60. Gasification and combustion air supply system
61. Inverter forced aspiration fan
62. Vacuum gauge
63. Inverter forced blower fan
64. Forced blower fan air inlet valve
65. Natural draught and aspiration air inlet valve
66. Gasification air inlet damper
67. Gas combustion air inlet damper
68. Post-gasification solid combustion air inlet damper
70. Solid fuel feed and gasification preparation system
71. Solid fuel feed spiral conveyor
72. Gasification air circulation double-walled solid fuel feed hopper

72.1. Double-walled solid fuel feed hopper gasification air circulation downwards guide ducts

73. Double-walled solid fuel feed hopper level sensor
74. Solid fuel inflow adapter and connecting flange to the double-walled hopper
75. Gas combustion air circulation double-walled solid fuel preheating tank

75.1. Solid fuel preheating tank gas combustion air circulation and heating ducts

75.2. Gas combustion air guide-circulation plates around the double-walled tank

76. Gas combustion air downward guide pipes

80. Solid fuel gasification duct

81. Front wall of the solid fuel gasification duct

82. Rear wall covering the gas combustion air downward guide ducts

90. Gasification process smokeless combustion chamber

91. Water circulation combustion bed thickness adjustment system of the smokeless combustion chamber

91.1. Finned water pipe combustion bed thickness adjusting plate

91.2. Connection part flexible water circulation connecting pipe

91.3. Manual adjusting plate rod

91.4. Automatic adjusting plate rod

91.5. Automatic adjusting plate level actuator hydraulic piston

92. Refractory coating partition

93. Flame delivery duct from the smokeless combustion chamber

94. Over-grate ash-clinker drag duct

100. Grate openings different travelling-fixed compounded grate system

101. Travelling grate system hydraulic drive actuator unit connected to the automation system

102. Hydraulic piston with separately adjustable speed and stock through the automation system

103. Hydraulic piston connected travelling grate system connection rods mechanism

110. Grate system last fixed compound inlet temperature sensor

120. Grate system last fixed compound outlet temperature sensor

130. Oxygen analyzer controlling the grate movement through the automation system.

140. Solid fuel combustion waste discharge system that prevent capacity and efficiency losses

141. Spiral conveyor and immersed discharge duct for the undergrate ash

142. Float ash-clinker pool providing water supplement at a constant level

143. Spiral conveyor and immersed discharge duct for overgrate ash-clinker

144. Upward sloped waste wet ash-clinker conveying spiral from the ash-clinker pool

150. Inverter lime feed spiral

a: Grate system first part

b: Grate system second part

c: Grate system third part

DETAILED DESCRIPTION OF THE INVENTION

As it is seen in Figure 1, the patent subject solid fuel burner system mounted on the boiler (10) instead of a liquid fuel or natural gas burner; is started through connecting on the lower side to the heater fluid inlet pipe from the boiler to the main frame of the burner (20), and on the upper side to the heating fluid outlet pipe from the burner main frame to the boiler (30).

Patent subject gasification process smokeless combustion, fully automated capacity and efficiency maximization solid fuel burner system is a gasification solid fuel burner with the fully automated gasification process smokeless combustion method that performs water vapor generation, air-fuel pre-heating and gasification with air + water vapor through the gasification and combustion air inlet and distribution system (40), combustion efficiency and capacity-sensitive automation system (50), gasification and combustion air supply system (60), solid fuel feed and gasification preparation system (70), solid fuel gasification duct (80) and the gasification process smokeless combustion chamber (90).

On the other hand, gasification process smokeless combustion, fully automated capacity and efficiency maximization solid fuel burner is; is a fully automated capacity and efficiency maximization solid fuel burner incorporating combustion efficiency and capacity-sensitive automation system (50), travelling-fixed compounded grate system with different grate openings with speed adjustment according to the combustion efficiency (100), grate system last fixed compound inlet temperature system (110) that control the grate movement based on the combustion efficiency and capacity-sensitive automation system (50) through measuring the combustion waste ash-clinker temperature on the last fixed compound in the grate system, and grate system last fixed compound outlet temperature sensor (120), oxygen analyzer (130) that measure the oxygen in the combustion gasses and control the grate movement through the automation system in order to maximize the combustion efficiency and solid fuel combustion wastes discharge system (140) that prevent capacity and efficiency losses.

For the gasification process in the patent subject gasification process smokeless combustion solid fuel burner, gasification air and water vapor supplied through the gasification and combustion air supply system (60) are used within the scope of gasification and combustion air inlet and distribution system (40). However, water vapor is not supplied from an external source, but is the water vapor generated from the construction dampness in the solid fuel fed to gasification air circulation double-walled solid fuel feed hopper (72) with the heat obtained from the solid and gas fuel burned in the gasification process smokeless combustion chamber (90) within the solid fuel feed and gasification preparation system (70), in other words, it is the water in the fed solid fuel.

The new solid fuel burner, vaporizing and using the water especially in lignite and bituminous coals with high humidity and volatile matter contents, in this sense is a gasifier combustion system that is combined with both a highly economic gasifier and a burner that allowing for smokeless and high-efficiency combustion of gases obtained with the gasification process in the gasification process smokeless combustion chamber (90).

In the invention subject smokeless combustion solid fuel burner; the gasification and combustion air inlet and distribution system (40) is mounted on the upper front side of the burner as seen in Figures 1 and 2 and is a system with a removable steel construction design, consists of five functional elements, which are main air inlet duct with forced blower fan (41), natural draught and aspiration main air inlet duct (42), gasification air guide duct (43), gas combustion air guide duct (44) and post-gasification solid combustion air guide duct (45), and performs the air inlet and distribution necessary for smokeless combustion through the gasification system of the combined system.

Gasification and combustion air inlet and distribution system (40) has a gasification air inlet and a combustion air inlet from each of the two alternative rods, which are the main air inlet with forced blower fan (41) and the natural draught and aspiration main inter duct (42). Entering from one of the two alternative ducts, gasification and combustion mutual air is separated in three functional rods, which are upward running gasification air duct (43) and gas combustion air guide duct (44) as well as the downward running post-gasification solid combustion air guide duct (45). Thus, it is both ensured that the gasification process takes place and the gasses generated as a result of the gasification process as well as the coke and semi coke solid part of the coal coming down the grate are burned without any smokes.

Combustion efficiency and capacity-sensitive automation system that controls both the gasification process and the smokeless combustion process (50) in the gasification process smokeless combustion solid fuel burner through all elements constituting the system is not solely a target pressure and temperature-sensitive proportional automation system, but essentially has a different feature that targets combustion efficiency maximization and also maximizes the combustion capacity.

As is known, the two greatest combustion losses in solid fuel combustion systems are losses due to unburned fuel in ashes or clinkers and the loss of access air due to the heat air and oxygen exhausted to the atmosphere.

Combustion efficiency and capacity-sensitive automation system (50) minimizes the losses both due to unburned fuel and excess air through controlling the grate movement by measuring the through the use of grate system (100) last fixed compound inlet temperature sensor (110) and the grate system last fixed compound output temperature sensor (120) on the last fixed compound grate of the travelling-fixed compounded grate system with different grate openings. Likewise, combustion efficiency and capacity-sensitive automation system (50) also minimizes the access air losses through controlling the grate movement and keeping the oxygen ratio at a level to ensure maximum combustion efficiency by measuring the oxygen in combustion gasses through the use of oxygen analyzer (130) that is controlled with the grate movement automation system. Patent subject solid fuel burner minimizes the two most important combustion losses with the combination of grate system last fixed compound inlet temperature sensor (110), grate system last fixed compound outlet temperature sensor (120), and the oxygen analyzer (130), which is controlled with the grate movement automation system, and, thanks to this combustion efficiency and capacity-sensitive automation system (50) with different features contributing to the combustion efficiency maximization, has a distinctive feature in terms of technical benefit.

In the gasification process smokeless combustion new solid fuel burner, the gasification and combustion air entering from three rods are supplied through the gasification and combustion air supply system (60) shown in Figure-3.

The air needed in this gasification and combustion supply system (60) is supplied with the combination of three functional elements, which are the inverter forced aspiration fan (61), which is controlled proportionally through the combustion efficiency and capacity-sensitive automation system (50), the vacuum gauge (62), which controls the inverter forced blower fan (63) through the combustion efficiency and capacity-sensitive automation system (50) by measuring the pressure created by the inverter forced aspiration fan (61) on the gasification process smokeless combustion chamber (90), as well as inverter forced blower fan (63), pressure and flow rate of which are adjusted automatically. Thus, the flow rate and pressure of the gasification and combustion air, which is taken in and distributed according to their functions through the gasification and combustion air inlet and distribution system (40), are optimized. Inverter forced blower fan (63), which creates a pressured airbag under the travelling-fixed compounded grate system (100) with different grate openings as shown in Figure-4 below the gasification process smokeless combustion chamber (90), is controlled by the pressure measuring vacuum gauge (62) in the gasification process smokeless combustion chamber (90) and pumps air at the optimum flow rate and pressure that are selected based on the solid fuel type and ensure maximum combustion efficiency. Thus, maximum combustion capacity on the unit grate surface is achieved and capacity maximization is ensured through overcoming both the grate resistance and the resistance of burning solid fuel as semi coke and coke on the grate. Inverter forced blower fan (63) also maximizes the gasification efficiency and combustion efficiency of gases by performing its functions with the gasification air and gas combustion air at the optimum pressure. On the other hand, the access air that can possibly enter the gasification process smokeless combustion chamber (90) in an uncontrolled way, such possibility is prevented with the inverter forced blower fan (63) and the vacuum gauge (62), which achieve the vacuum value selected through the combustion efficiency and capacity-sensitive automation system (50). It is the system gasification and combustion air supply system (60) that consists of these three elements, which contribute to combustion efficiency maximization also by minimizing access air losses.

When gasification and combustion air supply is necessary, the inverter forced blower fan (63) controlled by the vacuum gauge (62) is stopped, thus a draught solely with the inverter forced aspiration fan (61) or, upon spotting the inverter forced aspiration fan (61) as well, natural draught is ensured.

Gasification and combustion air procured with the inverter forced blower fan (63) enters through the main air inlet duct (41) through the forced blower fan, and is separated to three rods in the gasification and combustion air inlet and distribution system (40), namely two upward rods and one downward rod. The air separated upward is guided separately through gasification air guide duct (43) and gas combustion air guide duct (44), as shown in Figure-2, and the air separated into the downward rod is guided to the post-gasification solid combustion air guide duct (45).

And the gasification and combustion air procured only with the forced aspiration or natural draught enters the system through the natural draught and aspiration main air inlet duct (42) of the gasification and combustion air inlet and distribution system (40). Air entering through here is also separated into three rods through the gasification air guide duct (43), gas combustion air guide duct (44) and post-gasification solid combustion air guide duct (45), and perform their functions.

Flow rate controls of the air taken into the gasification and combustion inlet and distribution system (40) and distributed as described above, are carried out through the on-off or proportional-gradual operation gasification air inlet damper (66), gas combustion air inlet damper (67) and post-gasification solid combustion air inlet damper (68).

Forced blower fan air inlet valve (64) is connected to the combustion efficiency and capacity-sensitive automation system (50) on the forced blower fan air inlet duct (41), and natural draught and aspiration air inlet valve (65) connected to the combustion efficiency and capacity-sensitive automation system (50) is located on the natural draught and aspiration main air inlet duct (42). These two alternative forced blower fan air inlet valve (64) and natural draught and aspiration air inlet valve (65) operate in connection to the combustion efficiency and capacity-sensitive automation system (50), and when either one is enabled, the other one is automatically disabled. However, when the system is completely shut down or in standby mode, both are disabled.

When the system is operation, the gasification and combustion air in the gasification and combustion air supply system (60), obtained through either a combination of the inverter forced blower fan (61), the vacuum gauge (62) and the inverter aspiration fan (63) or solely aspiration or natural draught, are separated into three rods according to their functions. Air flows separated to these three function rods can be proportionally-gradually adjusted through the gasification air inlet damper (66), gas combustion air inlet damper (67) and post-gasification solid combustion air inlet damper (68), which are connected to the combustion efficiency and capacity-sensitive automation system (50).

Gasification air inlet damper (66), gas combustion air inlet damper (67) and post-gasification solid combustion air inlet damper (68) located on the gasification air guide duct (43), gas combustion air guide duct (44) and post-gasification solid combustion air guide duct (45) in the gasification and combustion air inlet and distribution system (40) can also be manually enabled and disabled, when obligatory or necessary, through a screwed manual adjustment mechanism.

After the gasification and combustion air procured either through the combination of inverter forced blower fan (61), vacuum gauge (62) and inverter aspiration fan (63) or solely through aspiration or natural draught is separated into three functional rods, air flow rates can be controlled with the gasification air inlet damper (66), gas combustion air inlet damper (67) and post-gasification solid combustion air inlet damper (68) on such rods. Especially the post-gasification solid combustion air inlet damper (68) is adjusted so that undergrate access air losses are minimized, and the gasification air and gas combustion air are adjusted according to the properties of the solid fuel. Thus, flow rates of gasification air, gas combustion air and post-gasification solid combustion air coming from three separate rods are optimized according to the used solid fuel and a contribution is made to the maximization of combustion capacity and burning efficiency.

Gasification process smokeless combustion solid fuel burner is kept in standby mode at very low capacities, and the post-gasification solid combustion air inlet damper (68) is disabled, thus completely preventing the access air coming under the grate. Access air losses coming under the grate during long standby periods are minimized through combustion of gasification air and gas combustion air guided solely upward through two rods as well as the low flow rate gases generated after gasification.

Solid fuel feed and gasification preparation system (70) in the patent subject gasification process smokeless combustion new solid fuel burner consists of three subsystems, first of which automatically feeds the needed solid fuel, second one generates the water vapor necessary for heated gasification of the fed solid fuel, and the third one performs the necessary preheating before the gasification process.

Solid fuel feed spiral conveyor (71) of the first subsystem feeds the solid fuel taken from the solid fuel main hopper or the pool to the gasification air circulation double-walled solid fuel feed hopper (72), upon command from the double-walled solid fuel feed hopper level sensor (73), and from the fuel feed spiral conveyor (71) to the double-walled hopper through the solid fuel flow adapter and the connecting flange (74) so that solid fuel is supplied as the solid fuel level decreases. Thus, as the system operates, solid fuel level in the gasification air circulation double-walled solid fuel feed hopper (72) remains constant, which ensures that a stable solid fuel level is maintained during the following gasification and smokeless combustion process.

During the solid fuel feed to the double-walled hopper through the solid fuel flow adapter and the connecting flange (74), it prevents uncontrolled air inlet by achieving a seal. Capacity fluctuation is avoided and efficiency is increased through achieving such seal.

Gasification air circulation double-wall solid fuel feed hopper (72) of the second subsystem has the double-wall feature, which is absent in the previous technique, and it ensures that the gasification air is heated through gasification air circulation between the walls. Moreover, double-wall solid fuel feed hopper guides the gasification air to the solid fuel within the hopper through gasification circulation air downward guide ducts (72.1) and generates the water vapor necessary for gasification by heating the solid fuel. Double-wall and gasification air circulation features of the gasification air circulation double-wall solid fuel feed hopper (72) are the elements that increase the efficiency in terms of both solving the outer surface heat loss problems of the hopper and preparing heated air passing through the walls for the gasification process through heating the solid fuel within the hopper along with the generated water vapor.

Gas combustion air circulation double-walled solid fuel pre-heating tank (75), which is the third subsystem of the solid fuel feed and gasification preparation system (70), has the double-wall feature, which is absent in the previous technique. Gas combustion air circulation double-walled solid fuel preheating tank (75); eliminates the heat losses in the single-wall outer surfaces of the tanks in the previous technique while preheating the gas combustion air through the solid fuel preheating tank gas combustion air circulation and heating ducts (75.1) within the walls, gas combustion air guide-circulation plates (75.2) around the double-wall tank, and gas combustion air downward guide pipes (76) on the inner surface, rear upper part of the double-wall tank. It allows for heating the solid fuel flowing downward within the gas combustion air circulation double-walled solid fuel preheating tank (75) up to the temperature necessary for starting the gasification process.

Gas combustion air, which is guided upward through the gas combustion air guide duct (44), and flow rate of which is adjusted according to the ratios flammable gases in the solid fuel through the gas combustion air inlet damper (67) connected to the combustion efficiency and capacity-sensitive automation system (50), passes through the upper front side of double walls forming the solid fuel preheating tank gas combustion air circulation and heating ducts (75.1), and is initially guided downward. After the gas combustion air changes its direction and is heated around the double-wall tank of the side and rear part of the double-walled solid fuel preheating tank (75) through the gas combustion air guide-circulation plates (75.2), it is directed upward and guided to upper part of the gasification process smokeless combustion chamber (90) again over the rear wall (82) of the downward gasification duct, which also covers the gas combustion air downward guide pipes, through the gas combustion air downward guide pipes (76). Thus, both the heat losses are prevented on the external surfaces of the gas combustion circulation double-walled solid fuel preheating tank (75) and it is ensured that the gas combustion air is highly heated and the flammable gasses within the solid fuel come out in the solid fuel gasification duct (80) in a controlled way and are completely burned in the gasification process smokeless combustion chamber (90), thus contributing to the combustion efficiency maximization.

Solid fuel gasification duct (80) is the part where the gasification process takes place before the solid fuel, prepared through the gasification and combustion air inlet and distribution system (40) and solid fuel feed and gasification preparation system (70) in the paten subject new solid fuel burner, starts burning with the solid and gas parts.

The solid fuel gasification duct (80), which is located between the gas combustion air circulation double-walled solid fuel preheating tank (75) and the gasification process smokeless combustion chamber (90), is surrounded with the front wall of the solid fuel gasification duct (81), which is used to ensure solid fuel flow on to the grate, and the rear wall that also covers gas combustion air downward guide pipes (82), which is used to guide gasification product gases to the upper part of the gasification process smokeless combustion chamber (90).

The solid fuel, after being preheated with air and water vapor, and prepared for gasification, enters the downward flow solid fuel gasification duct (80), and an accelerated gasification process starts as it heated to high temperatures in the gasification process smokeless combustion chamber (90). Coal, which is a solid fuel, reacts with the oxygen within the high temperature water vapor and hot air and transits to the gas production phase, and the created flammable gasses such as CO, H2 and CH4 flow to the upper part of the gasification process smokeless combustion chamber (90). Gravity descending to the starting part of the gasification process smokeless combustion chamber (90) from the end of the downward flow solid fuel gasification duct (80), post-gasification solid fuel coal parts towards the end of the gasification process start to burn as semi coke, and the parts completing the gasification process start to burn as coke.

The gasification process smokeless combustion chamber (90) is the part designed so that both the post-gasification solid part on the grates and the flammable gases created with the gasification process of solid fuel, which goes through the gasification process in the downward flow solid fuel gasification duct (80) and descends, complete the smokeless combustion process under complete combustion circumstances, and two fuels in solid and gas forms can be burned simultaneously.

Solid fuel gasification duct (80), which performs the gasification process, and the gasification process smokeless combustion chamber (90), which burn the gasification product solid and gas parts, are the two main parts which perform both the gasifier and burner functions in the patent subject new solid fuel burner, and thus, complete the gasification + combustion process within the framework of the "gasification process smokeless combustion method".

Gasification process smokeless combustion chamber (90) has a design which ensures that the flammable gases produced in the upper part through the gasification process are heated up to high temperatures with the gas combustion air, and that the complete and smokeless combustion conditions are provided. There is the water circulation combustion bed thickness adjustment system (91) placed on the gasification process smokeless combustion chamber (90), which is opened to the side walls at the upper part of the starting section, and ensures that the necessary combustion bed thickness is adjusted according to the particle sizes of the solid fuel. Water circulation combustion bed thickness adjustment system (91) of the smokeless combustion chamber consists of five elements, which are refractory sheathed finned water piped combustion bed adjustment plate (91.1water circulation connecting pipe (91.2), connecting part of which is flexible, and manual adjustment plate rod (91.3), automated adjustment plate rod (91.4), which is actuated by the combustion efficiency and capacity-sensitive automation system (50), as well as the hydraulic piston (91.5) that actuates the automated adjustment plate rod.

In the refractory sheathed finned water piped combustion bed thickness adjustment plate (91.1), which can be adjusted so that is can be demounted from the cap that opens to side walls of the gasification process smokeless combustion chamber (90), the part at the middle of the gasification process smokeless combustion chamber (90) consists of two or three pipes depending on the capacity, and the part at the side walls consists of the uppermost pipe. With this design, it has been ensured that bed thickness at the middle part of the gasification process smokeless combustion chamber (90) is smaller, and the bed thickness by the side walls is greater. Thus, flow rate imbalance at the middle and side parts of the gasification process smokeless combustion chamber (90) has been eliminated through adapting the decreasing flow rate of the coal due to the friction on the side walls to the higher coal flow rate at the middle part. Water circulation is ensured through the water circulation connecting pipe (91.2) with flexible connecting part, which led from the lower connector on the one side wall of the gasification process smokeless combustion chamber (90), through the pipes in the finned water piped combustion bed thickness adjustment plate (91.1), and connected to the upper part of the wall on the other side. Finned water piped combustion bed thickness adjustment plate (91.1) can adjust the thickness of the combustion bed with a circular movement within an angle range of approximately 15 to 75 through the external manual adjustment plate rod (91.3) around the axis of the uppermost pipe, or the automated adjustment plate rod (91.4) and the hydraulic piston (91.5), which actuates the automated adjustment plate rod. Thus, the fact that thickness of the combustion bed can be adjusted instantly even during the operation of the system delivers a solution of the combustion efficiency decrease upon disruption of the solid combustion air/gas combustion air balance after gasification due to the resistance of the solid fuel on the combustion bed as a result of the particle size or clinkering-caking property of the solid fuel. And this feature contributes to combustion efficiency maximization by minimizing the losses due to large coal particles or low clinker melting temperatures.

In the patent subject solid fuel burner, the travelling-fixed compounded grate system with different grate openings (100) minimize ash losses in the solid part after the gasification of the solid fuel with adjusted bed thickness and ensure combustion through the circulation combustion bed thickness adjustment system (91) of the smokeless combustion chamber. This travelling-fixed compounded grate system with different grate openings (100) also has the features that can adjust the speed and waiting time of the travelling grates with the combustion efficiency and capacity-sensitive automation system (50) so that complete and smokeless combustion efficiency of the solid fuel with the post-gasification solid and gas parts in the gasification process smokeless combustion chamber (90) is maximized through prevention of access air losses.

As shown in Figure 4, back and forth movement of travelling grades of this travelling-fixed compounded grate system with different grate openings (100) is actuated through the grate system hydraulic drive unit (101) connected to the combustion efficiency and capacity-sensitive automation system (50) as well as the hydraulic piston (102) with adjustable speed and stroke setting and the travelling grate system connecting rods mechanism (103) connected to hydraulic pistons. Pneumatic systems can also be preferred instead of hydraulics. The travelling-fixed compounded grate system with different grate openings (100), designed in three parts, consists of different grate segments and moves at separately adjusted speeds and strokes due to the post-gasification solid part combustion process in the is gasification process smokeless combustion chamber (90) and different properties of the phases during the process. In the first part (a) of the grate system in the starting part of the gasification process smokeless combustion chamber (90), openings between grate segments have been selected so that coal dust cannot fall from such openings in order to prevent small coal particles coming down from the solid fuel gasification duct (80) do not fall under the grate without combustion (for example, to prevent coal dusts in 0.5 - 10 mm particles from falling). In the second part (b) of the grate system in the middle part gasification process smokeless combustion chamber (90), as more oxygen is needed due to stronger combustion, grate openings have been designed to be wider, and in the third part (c) of the grate system at the end of the gasification process smokeless combustion chamber (90), grate openings have been designed to be relatively narrower in order to prevent unnecessary access air passage between the combustion ashes and clinkers. Speed and stroke of the travelling-fixed compounded grate system with different grate openings (100) can be adjusted separately through the panel of the combustion efficiency and capacity-sensitive automation system (50) also based on the combustion properties of the used solid fuel. Thus, both undergrate ash losses and overgrate access air losses through ashes-clinkers are minimized, and combustion efficiency of the used solid fuel, based on its type, is maximized.

In the gasification process smokeless combustion new solid fuel burner, there are grate system last fixed compound inlet temperature sensor (110) and grate system last fixed compound outlet temperature sensor (120) which measure the overgrate ash-clinker temperature and control the grate movement through the combustion efficiency and capacity-sensitive automation system (50).

Last fixed grate segment of the travelling-fixed compounded grate system with different grate openings (100) has been designed to be longer than and different from the segments in other compounds. It has been ensured that two demountable grate system last fixed compound inlet temperature sensor (110) and grate system last fixed compound outlet temperature sensor (120) are placed on special housings on the lower side of the last fixed grate segment. Temperature of the overgrate ash-clinker left from the gasification process smokeless combustion chamber (90) is measured through these two grate system last fixed compound inlet temperature system (110) and grate system last fixed compound outlet temperature system (120) placed on the starting and ending points of the last compound fixed grate with a long design, and it is ensured that the travelling grate receives command from the combustion efficiency and capacity-sensitive automation system (50) and wait at the high ash-clinker temperature at the ending point of the last compound fixed grate, and start operating again at the low ash-clinker temperature at the starting point of the grate. Thus, as entrance and exit temperatures on the last compound fixed grate are stabilized between the values selected based on the type of the fuel, both the unburned overgrate ash-clinker is prevented from falling down, and the entry of access air outside the combustion is avoided through preventing the ashes-clinker from cooling down on the previous compounds. By means of these elements, which are absent in the previous art, not only losses due to unburned fuel under the overgrate ashes-clinkers are prevented, but also access air losses are minimized.

In the event that overgrate ash-clinker cools down before the last compound due to long waiting periods of the travelling grates, if the unnecessary air passage through the ashes-clinkers is present, access air loss can amount to significant levels. With the purpose of completely eliminating these losses through control, the oxygen analyzer (130) in the patent subject gasification process smokeless combustion new solid fuel burner, which measure the oxygen in the combustion gases and control the grate movement with the automation system, is also included as a functional system that maximizes the combustion efficiency.

Oxygen ratio in combustion gases, which is an indicator of access air coefficient (ƛ) during combustion, is considered to be optimal 6% for coal in solid fuel combustion systems. However, as the oxygen ratio decreases from 6% to 5%, although maximum combustion efficiency is achieved, especially at values below 5%, access air coefficient decreases, and consequently, the combustion efficiency decreases due to incomplete combustion product carbon monoxide and particle (soot) emission as a result of inadequate oxygen. And when the oxygen ratio increases above 6%, air losses gradually increase.

Oxygen analyzer (130), which measures the oxygen content of gases and control the grate movement with the automation system after being mounted on the end part of the gasification process smokeless combustion chamber (90) or on the combustion product outlet point, ensures that travelling grates wait or operate depending on the lower and upper limits (for example, lower limit 5% - upper limit 6%) selected through the combustion efficiency and capacity-sensitive automation system (50) panel according to the fuel type in order to achieve maximum combustion efficiency. When the oxygen content of combustion gases reaches the selected upper limit (for instance, 6%), grates of the travelling-fixed compounded grate system with different grate openings (100) are actuated, and upon such actuation, when the decreasing oxygen ratio is at the selected lower limit (for instance, 5%), grates are put into standby mode through the combustion efficiency and capacity-sensitive automation system (50). When the oxygen ratio reaches back to the upper limit (for instance, 6%) due to access air in last compounds of the grate system as the solid part of the fuel on grates that has been stopped for a certain amount of time burns, grates are actuated and oxygen ratio is decreased.

Thus, the oxygen analyzer (130) controlled through the grate movement automation system, which is absent in the previous art, stabilizes the combustion efficiency by achieving the highest position between the lower and upper oxygen ratio value, and the most important aspect in this sense, regardless of the functioning capacity of the solid fuel burner, is minimizing access air losses.

Oxygen analyzer (130) controlling the grate movement through the automation system, can also be mounted on the combustion gases outlet of the boiler (10) it is mounted on with the purpose of measuring the oxygen content in the combustion product gases in the patent subject gasification process smokeless combustion new solid fuel burner.

There is a refractory sheathed partition (92) in the travelling-fixed compounded grate system with different grate openings (100) under the gasification process smokeless combustion chamber (90), which starts over the combustion ash-clinker forward guide last compound fixed grate and separates combustion product ash-clinker and gases. There is the flame flow duct (93) from the smokeless combustion chamber, in which combustion product hot gases and flames flow forward, above this refractory sheathed partition (92), and below is the overgrate ash-clinker draught duct (94). Refractory sheathed partition (92) decreases heat losses through preventing cooling clinkers from being reheated while stabilizes the temperature in the ending part of the gasification process smokeless combustion chamber (90). Refractory sheath around this refractory sheathed partition (92) is also a heat preserving element that is necessary of achieving a complete combustion of the gasification product flammable gases with high ignition temperatures. This refractory sheathed partition (92) minimizes heat losses, ensures that flammable gases with high ignition temperatures are completely burned, and contributes to maximization of combustion efficiency.

Patent subject gasification process smokeless combustion solid fuel burner incorporates water jacketed or water piped and refractory sheathed two-part flame outlet duct, which ensure the passage of combustion product heated gases and flame through establishing a sealed connection of the gasification process smokeless combustion chamber (90) to the burner connection inlet of the water piped or double-wall boiler within the scope of the state of the art.

Patent subject new solid fuel burner, which performs smokeless combustion with high efficiency through the gasification process, also incorporates a system that prevents capacity and efficiency losses arising during the discharge of solid fuel combustion residual ashes and clinkers.

Solid fuel combustion residual ashes and clinkers discharge system (140), which prevents capacity and efficiency losses, consist of; spiral conveyor and immersed discharge duct (141) that discharge the ashes falling under the grate after the combustion as well as the ashes-clinkers dragged at the last compound of the travelling-fixed compounded grate system with different grate openings (100) through establishing air tightness, float ash-clinker pool (142) that provides water at a constant level, spiral conveyor and immersed discharge duct (143) for overgrate ashes-clinkers, and the waste wet ash-clinker conveyance spiral (144) sloped upward from the ash-clinker pool.

In the patent subject solid fuel burner, fine ashes falling between the grates under the gasification process smokeless combustion chamber (90) are discharged to the float ash-clinker pool (142) below the clinker pit, which provides water a constant level, through the spiral conveyor for ashes and immersed ash discharge duct (141) under the ash pit. And the ashes-clinkers that are dragged over the last compound fixed grate and fall down slide through the refractory sheathed downward sloped plate below, and discharged to the float ash-clinker pool (142), which provides water at a constant level, through the spiral conveyor and immersed discharged duct (143) for the overgrate ashes-clinkers. Soaked ashes and clinkers are discharged by conveying through the upward sloped waste wet ash-clinker conveyance spiral (144) placed under the ash-clinker pool to the waste ash-clinker truck or hopper.

In the solid fuel combustion wastes discharge system preventing capacity and efficiency losses (140); the spiral conveyor and immersed discharge duct (141) for undergrate ashes, the spiral conveyor and immersed discharge duct (143) and the upward sloped waste wet ash-clinker conveyance spiral (144) from the ash-clinker pool for overgrate ashes operate fully automatically with the command received from the combustion efficiency and capacity-sensitive automation system (50).

In the patent subject solid fuel burner, while ashes-clinkers are discharged through spiral conveyors, which is controlled by the combustion efficiency and capacity-sensitive automation system (50) and are enabled or disabled fully automatically within certain periods and intervals adjusted according to the fuel type, inlet of the cool air bypassing the spirals into the gasification process smokeless combustion chamber (90), flame outlet duct and the boiler (10) is prevented. Thus, both access air losses outside the combustion are minimized, and decrease of combustion capacity is prevented through blocking the needed gasification and combustion air of the bypassing air. This system, which also eliminates atmosphere pollution problem due to wet ash and clinker, and is absent in the previous art, contributes to combustion efficiency maximization by removing capacity fluctuations through preventing the access air inlet outside the combustion from spiral conveyors.

In the patent subject gasification process smokeless combustion solid fuel burner, a more economical and efficient dry desulphurization system than the previous one is incorporated, which incorporates different features than the previous art and consists of a solid fuel feed spiral conveyor (71) and inverter lime feed spiral (150) from the lime hopper aimed for high-sulphur coals. A transfer is ensured from the lime main hopper and pool of the dry desulphurization system to the solid fuel feed spiral conveyor (71) through the inverter lime feed spiral (150), speed of which can be adjusted from the combustion efficiency and capacity-sensitive automation system (50). With the lime transferred to the solid fuel feed spiral (71), an efficient lime-coal blend is achieved, and the gasification air is entered to the gasification air circulation double-wall solid fuel feed hopper (72). Solid fuel feed spiral conveyor (71) and inverter lime feed spiral (150) operate simultaneously, and when the solid fuel feed spiral conveyor (71) stops, lime feed spiral (150) also stops. When coals with low sulphur content are used, inverter lime feed spiral (150) of the dry desulphurization system is disabled, and only the solid fuel feed spiral conveyor (71) is operated.

Optimum amount of lime necessary for the coal is fed to through selecting the speed of the inverter lime feed spiral (150) according to the sulphur content of combustion gases through the panel of the combustion efficiency and capacity-sensitive automation system (50) or screen of the connected computer. Thus, both combustion losses due to unnecessary access lime is prevented, and sulphur dioxide emission is reduced to the minimum level through achieving the most effective position in the dry desulphurization.

Optimum amount of lime feed from the lime hopper to the solid fuel feed spiral (71) through the inverter lime feed spiral (150) for high-sulphur coals, which is absent in the previous art, not only contributes to combustion efficiency maximization, but also minimizes sulphur dioxide emission through achieving maximum efficiency level in the dry desulphurization system with an effective lime-coal blend.

In conclusion, the mode of operation in the patent subject gasification process smokeless combustion, fully automated capacity and efficiency maximization solid fuel burner system can be explained, in brief, with the following operation steps.

airtight solid fuel feed to the gasification air circulation double-wall fuel feed hopper (72), passage of the air coming into the system with the inverter forced blower fan (63) through the forced blower fan main air inlet duct (41) downward to the post-gasification solid combustion air guide duct (45) and upward post-gasification air guide duct (43) and gas combustion air guide duct (44), heating the air passing through the gasification air guide duct (43) by circling it around the double wall of the gasification air circulation double-wall solid fuel feed hopper (72) and blowing the double-wall solid fuel feed hopper gasification circulation air to the solid fuel through the downward guide ducts (72.1), converting the moisture content of the solid fuel heated in the gasification air circulation double-wall solid fuel feed hopper (72) to water vapor, intake of the air coming from the gas combustion air guide duct (44) to solid fuel preheating tank gas combustion air circulation and heating ducts (75.1) within the walls of the gas combustion air circulation double-walled solid fuel preheating tank (75) and circling the gas combustion air around the double walls of the gas combustion air circulation double-walled coal preheating tank (75) through guide-circulation plates (75.2) and arrival of the gas combustion air running through the inner surface upper part of the double-wall tank and the ending part of the solid fuel gasification duct (80) to the downward guide pipes (76), direction of the gas combustion air coming from downward guide pipes (76) to the upper part of the gasification process smokeless combustion chamber (90) to burn the gases generated within the solid fuel gasification duct (80), entry of the solid fuel, having been preheated along with air and water vapor and prepared to gasification, to downward flow solid fuel gasification duct (80) and initiation of a slow, accelerated gasification process as it gets closer to high temperatures in the gasification process smokeless combustion chamber (90), transition of the solid fuel (coal) to the gas generation phase through reacting with the oxygen in water vapor and hot air, flow of the generated flammable gases towards the upper part of the gasification process smokeless combustion chamber (90), participation of flammable gases, generated with the gasification process within the downward flow solid fuel gasification duct (80) at the upper part of the gasification process smokeless combustion chamber (90), to smokeless combustion process under complete combustion circumstances through mixing them with the gas combustion air coming through gas combustion air downward guide ducts (76), descend of the solid fuel coming down after a gasification process within the downward flow solid fuel gasification duct (80), having been separated from its gas, to the starting point of the travelling-fixed compounded grate system with different grate openings (100), solid fuel with separated gases starting the burn, burning in the travelling-fixed compounded grate system with different grate openings (100), and proceeding until the last compound, measuring the temperature of the solid fuel combustion waste at the last compound with the grate system last fixed compound outlet temperature sensor (120), and comparison of such temperature with the value entered from the combustion efficiency and capacity sensitive automation system (50), and if the temperature is higher, stopping the travelling grates of the travelling-fixed compounded grate system (100) in order to prevent solid waste losses, measuring the inlet temperature at the last compound of the travelling-fixed compounded grate system with different grate openings (100) through the grate system last fixed compound inlet temperature sensor (110), and if it is lower than the temperature entered from the combustion efficiency and capacity-sensitive automation system (50), actuating the travelling-fixed compounded grate system with different grate openings (100), oxygen analyzer (130), which measures the oxygen ratio in combustion product gases and controls the grate movement with the automation system in order to maximize the combustion efficiency in the system, ensuring that travelling grates are enabled or disabled depending on the lower and upper limits selected on the panel of the combustion efficiency and capacity-sensitive automation system (50) based on the fuel type to achieve maximum combustion efficiency, proceeding the solid fuel combustion waste through the last compound and dropping it to spiral conveyor and immersed discharged duct (143) for overgrate ashes-clinkers, evacuation of the combustion wastes falling to the spiral conveyor and immersed discharge duct (143) upon establishing air tightness in the gasification process smokeless combustion chamber (90).

As it can be seen, patent subject gasification process smokeless combustion, fully automated capacity and efficiency maximization solid fuel burner system is a gasifier solid fuel burner that minimizes all losses through a functional system, components and elements, which are, as described in detail above, a continuous process consisting of the smokeless combustion method that performs water vapor generation, air-fuel preheating, gasification with air + water vapor and smokeless combustion processes, and it performs the gasification, smokeless combustion and combustion waste ash-clinker discharge .

Patent subject fully automated new solid fuel burner system, which, upon replacement with the liquid fuel or natural gas burners on the front side of existing liquid or gas fueled boilers (10), allows for solid fuel operation of the boiler (10), makes a breakthrough in this field by achieving the maximum possible efficiency and capacity in a solid fuel combustion system and preventing air and environmental pollution.

CLAIMS

1. The invention is a gasification process smokeless combustion, fully automated capacity and efficiency maximization solid fuel burner system ensuring that, when replaced with the liquid or gas fuel burner, liquid and gas fueled boilers (10) operate with solid fuel, **and it incorporates;**

- **gasification and combustion air inlet and distribution system (40)** in order to achieve gasification and complete combustion in the system by separating the gasification air and gas combustion air in the system,
- **combustion efficiency and capacity-sensitive automation system (50),** in which preferred data in the system are entered and which keeps combustion efficiency and combustion capacity under control based on such data and targets maximization of combustion efficiency,
- **gasification and combustion air supply system (60),** which is used at the system inlet and outlet for gasification and gas combustion air supply, operating in connection to the mentioned combustion efficiency and capacity-sensitive automation system (50),
- **solid fuel feed and gasification preparation system (70),** which is used for controlled solid fuel feed and which generates the water vapor necessary for gasification through heating the solid fuel with its double-wall structure, and performs the necessary preheating before the gasification process,
- **solid fuel gasification duct (80),** in which the pre-combustion gasification process of the coal, which is prepared through the gasification and combustion air inlet and distribution system (40) mentioned in the solid fuel burner and the mentioned solid fuel feed and gasification preparation system (70), takes place, and the coal is separated as solid and gas,
- **gasification process smokeless combustion chamber (90**), where smokeless combustion processes of both the solid part, forming on the grates, and the flammable gas part, generated with the gasification process, of the solid fuel descending after the gasification process in the downward flow solid fuel gasification duct (80) are completed under complete combustion circumstances,

- **travelling-fixed compounded grate system with different grate openings (100),** which can adjust the speed and standby periods of travelling grates through the mentioned combustion efficiency and capacity-sensitive automation system (50) so that the total combustion efficiency of solid and gas parts of the solid fuel in the mentioned gasification process smokeless combustion chamber (90) is maximized through preventing access air losses,
- **solid fuel combustion wastes discharge system (140)** , which is used to discharge the ashes falling down the grate and ashes-clinkers dragged over the last compound of the mentioned travelling-fixed compounded grate system with different grate openings (100), and **prevents capacity and efficiency losses**

features.

2. It is the gasification process smokeless combustion, fully automated capacity and efficiency maximization solid fuel burner system, and **is characterized with;**

- sealed solid fuel feed to the gasification air circulation double-wall solid fuel feed hopper (72),
- guiding the air entering the system with the inverter forced blower fan (63) through the forced blower main air inlet duct (41) to the downward post-gasification combustion air guide duct (45) and upward, to gasification air guide duct (43) and gas combustion air guide duct (44),
- heating the air passing through the gasification air guide duct (43) through circulation around the walls of the gasification air circulation double-wall solid fuel feed hopper (72), and blowing the double wall solid fuel feed hopper gasification circulation air onto the solid fuel through downward guide ducts (72.1),
- converting the moisture content in the solid fuel heated within the gasification air circulation double-wall solid fuel feed hopper (72) into water vapor,
- entrance of the air coming from the gas combustion air guide duct (44) to the solid fuel preheating tank gas combustion air circulation and heating ducts (75.1) within the gas combustion air circulation double-walled solid fuel preheating tank (75), passing through to the gas combustion air guide-circulation plates (75.2) around the walls in the gas combustion air circulation double-walled coal preheating tank (75) and arrival of the gas combustion air running from the rear upper part of the double-

wall tank until the last part of the solid fuel gasification duct (80) to the downward guide pipes (76),

- guiding the gas combustion air to the upper part of the gasification process smokeless combustion chamber (90) in order to burn the gases generated through combustion of the gas combustion air in the solid fuel gasification duct (80) coming from the gas combustion air downward guide ducts (76),
- the solid fuel prepared for gasification after a preheating process along with air and water vapor entering an accelerated gasification process as it approaches to the high temperatures in the gasification process smokeless combustion chamber (90) upon entering the downward flow solid fuel gasification duct (80),
- transition of the solid fuel (coal) to the gas generation phase upon reacting with the oxygen in water vapor and hot air, flow of the generated flammable gases towards the upper part of the gasification process smokeless combustion chamber (90),
- participation of flammable gases, generated in the downward flow solid fuel gasification duct (80) at the upper part of the gasification process smokeless combustion chamber (90) through the gasification process, to the smokeless combustion process under complete combustion circumstances upon mixing with the gas combustion air coming from the gas combustion air downward guide ducts (76),
- descend of the solid fuel, gas in which is separated after the gasification process in the downward flow solid fuel gasification duct (80) to the starting point of the travelling-fixed compounded grate system with different grate openings (100),
- solid fuel with separated gas starting to burn and proceed until the last compound of the travelling-fixed compounded grate system with different grate openings (100),
- measuring the temperature of the solid fuel combustion waste at the last compound with the grate system last compound outlet temperature sensor (120), comparing it with the value entered through the combustion efficiency and capacity-sensitive automation system (50) , and if it is higher, deactivating the travelling grates of the travelling-fixed compounded grate system with different grate openings (100) in order to prevent unburned solid fuel losses,
- measuring the inlet temperature at the last compound in the travelling-fixed compounded grate system with different grate openings (100) with the grate system last compound inlet temperature sensor (110), and if it is lower than the temperature

value entered through the combustion efficiency and capacity-sensitive automation system (50), actuating the travelling-fixed grate system with different grate openings (100),

- oxygen analyzer (130), which measures the oxygen content of combustion product gases and controls grate movements through the automation system in order to maximize the combustion efficiency in the system, ensuring that travelling grates are activated or deactivated according to the lower and upper limits selected through the panel of the combustion efficiency and capacity-sensitive automation system (50) based on the fuel type in order to achieve maximum combustion efficiency,
- proceeding the solid fuel combustion waste through the last compound, and descending to the spiral conveyor and immersion discharge duct (143) for overgrate ashes-clinkers,
- discharge of combustion wastes descending on the spiral conveyor and immersed discharge duct (143) upon ensuring air tightness in the gasification process smokeless combustion chamber (90),

operation steps.

3. It is the travelling-fixed compounded grate system with different grate openings (100) suitable for Claim-1, **and is characterized with incorporating;**

- **grate system last fixed compound inlet temperature sensor (110),** which is located on the last compound inlet part of the travelling-fixed compounded grate system with different grate openings (100), operates in connection with the combustion efficiency and capacity-sensitive automation system (50), measures the temperature of the solid fuel combustion waste at the last compound, and is used in reactivation of travelling grates of the travelling-fixed compounded grate system with different grate openings (100) depending on the comparison of the measured temperature with the initially determined value,
- **grate system last fixed compound outlet temperature sensor (120),** which is located on the last compound outlet part of the travelling-fixed compounded grate system with different grate openings (100), and is used for measuring the temperature of the solid fuel combustion waste at the last compound, reporting to the combustion efficiency and capacity-sensitive automation system (50), and deactivating the

travelling grates of the travelling-fixed compounded grate system with different grate openings (100) depending on the comparison with the initially determined value,

features.

4. It is the gasification process smokeless combustion chamber (90) suitable for Claim -1, **and is characterized with incorporating;** the **oxygen analyzer (130),** which is used at the combustion product gases outlet point, **controls grate movements through measuring the oxygen content** in combustion gases in order to maximize the combustion efficiency in the gasification process smokeless combustion chamber (90), is used for minimizing losses due to access air by maintaining an oxygen ratio that will ensure maximum combustion efficiency, operating in connection to the combustion efficiency and capacity-sensitive automation system (50), sending data in order to deactivate grates based on the decreasing oxygen ratio and to reactivate the grates when the oxygen ratio increases due to access air at last compounds of the grate system as the solid part of the fuel on the deactivated grates burn, and maximizes combustion efficiency by keeping oxygen ratio under control.

5. It is the gasification and combustion air inlet and distribution system (40) suitable for Claim -1, **and is characterized with incorporating;**

- **forced blower fan main air inlet duct (41),** through which the air coming from the inverter forced blower fan (63) is taken in,
- **natural draught and aspiration main air inlet duct (42),** through which the air coming from the inverter forced aspiration fan (61) or with natural draught is taken in,
- **gasification air guide duct (43),** which passes the air guided for gasification process to the walls of the gasification air circulation double-wall solid fuel feed hopper (72), and transmits the gasification air to the solid fuel,
- **gas combustion air guide duct (44),** which passes the air guided to achieve complete combustion of post-gasification gases to the walls of the gas combustion air circulation double-wall coal preheating tank (75),

- **post-gasification solid fuel combustion air guide duct (45),** which is used to achieve complete combustion of post-gasification solid fuels in the gasification process smokeless combustion chamber (90)

  features.

6. It is the gasification and combustion air supply system (60) suitable for Claim -1, **and is characterized with incorporating;**

- **inverter forced aspiration fan (61),** which is proportionately controlled by the combustion efficiency and capacity-sensitive automation system (50),
- **inverter forced blower fan (63),** pressure and flow rate of which are automatically adjusted, and which is used to provide automatic air inlet to the system,
- **vacuum gauge (62),** which measures the vacuum of the inverter forced aspiration fan (61) of the gasification process smokeless combustion chamber (90) and controls the inverter forced blower fan (63) through the combustion efficiency and capacity-sensitive automation system (50),

  features.

7. It is the solid fuel feed and gasification preparation system (70) suitable for Claim -1, **and is characterized with incorporating;**

- **solid fuel feed spiral conveyor (71),** which is used in solid fuel feed to the solid fuel burner,
- **gasification air circulation double-wall solid fuel feed hopper (72),** which is produced with double walls, and in which the moisture in the solid fuel fed to the system is converted to vapor,
- **solid fuel flow adapter and connecting flange to the double-wall hopper (74)**, which is used to establish air tightness while feeding solid fuel to the system and to prevent uncontrolled air intake to the system,
- **has combustion air circulation double-walled solid fuel preheating tank (75),** which is produced with double walls in order to eliminate heat losses, and is used for heating the downward flowing solid fuel up to the temperature necessary for initiation of the gasification, and to preheat the gas combustion air,

features.

8. It is the gas combustion air circulation double-walled coal preheating tank (75) suitable for Claim -1 or Claim -7, **and is characterized with incorporating;**

- **coal preheating tank gas combustion air circulation and heating ducts (75.1),** in which the air within the double wall is used in the preheating process of the solid fuel,
- **gas combustion air guide-circulation plates around the double-wall tank (75.2),** which are used to ensure the air is guided and circulated within the gas combustion air circulation double-walled solid fuel preheating tank (75),
- **gas combustion air downward guide ducts (76)**, which starts from the inner surface, rear upper part of the gas combustion air circulation double-walled coal preheating tank (75) and conveys the air necessary for gas combustion to the solid fuel gasification duct (80),

features.

9. It is the gasification air circulation double-wall coal feed hopper (72) suitable for Claim -1 or Claim -7, **and is characterized with incorporating**; **double-wall coal feed hopper gasification circulation air downward guide ducts (72.1),** which is used to ensure that the gasification air coming through the walls of the gasification air circulation double-wall coal feed hopper (72) is heated and guided to the coal in the hopper, and to generate the water vapor necessary for gasification through heating the solid fuel, feature.

10. It is the solid fuel gasification duct (80) suitable for Claim -1, **and is characterized with;**

- **front wall of the solid fuel gasification duct (81),** which is located between the has combustion air circulation double-walled coal preheating tank (75) and the gasification process smokeless combustion chamber (90), and is used to ensure that the post-gasification solid fuel in the downward flow solid fuel gasification chamber (80), which ensures that the solid fuel goes into an accelerated gasification process as it gets closer to high temperatures in the solid fuel gasification process smokeless combustion chamber (90) and passes to the gas generation phase upon reacting with the oxygen within water vapor and hot air, flows to the grate starting point,

- **rear wall that also covers the gas combustion air downward guide pipes (82),** which is used guide gasification product gases to the upper part of the gasification process smokeless combustion chamber (90)

features.

11. It is the gasification process smokeless combustion chamber (90) suitable for Claim -1, **and is characterized with incorporating;**

- **water circulation combustion bed thickness adjustment system of the smokeless combustion chamber (91),** which opens to the side walls on the upper part of the starting point, and is used for adjusting the combustion bed thickness deemed necessary based on the particle sizes of the solid fuel,
- **refractory sheathed partition (92),** which separates the combustion waste ashes-clinkers and combustion product hot gases and flames in the gasification process smokeless combustion chamber (90), reduces heat losses by preventing the cooling ashes-clinkers from being reheated, and is used for stabilizing the temperature at the ending part of the gasification process smokeless combustion chamber (90),
- **flame flow duct from smokeless combustion chamber (93)**, in which combustion product hot gases and flames rapidly flow forward through the upper part of the refractory sheathed partition (92),
- **overgrate ash-clinker draught duct (94),** in which ashes-clinkers are dragged through the lower part of the refractory sheathed partition (92),

features.

12. It is the travelling-fixed compounded grate system with different grate openings (100) suitable for Claim -1 **and is characterized with incorporating;**

- **grate system first part (a),** which is created to prevent small unburned coal particles at the starting point of the gasification process smokeless combustion chamber (90) from dropping, and grate openings of which are selected to be narrow,

- **grate system second part (b),** which is located in the middle of the gasification process smokeless combustion chamber (90), and grate openings of which are selected to be wide due to more oxygen demand due to stronger combustion,
- **grate system third part (c),** which is located at the end of the gasification process smokeless combustion chamber (90), and grate openings of which are selected to be narrow in order to prevent unnecessary access air passage through combustion product ashes and clinkers,

features.

13. It is the solid fuel combustion wastes discharge system (140) suitable for Claim -1, **and is characterized with incorporating;**

- **spiral conveyor and immersed ash discharge duct (141) for undergrate ashes**, which is used for conveying fine ashes falling through grate openings under the gasification process smokeless combustion chamber (90),
- **float ash-clinker pool providing constant water supply (142),** to which the ashes-clinkers under the clinker pit are discharged,
- **spiral conveyor and immersed discharge duct for overgrate ashes-clinkers (143**), which has been created to ensure that the ashes-clinkers falling down over the last compound fixed grate are discharged through the refractory sheathed downward sloped plate under the clinker pit,
- **waste wet ash-clinker conveyance spiral with up sloped from the ash-clinker pool (144)**, which is used for discharge of wet ashes and clinkers,

features.

14. It is the water circulation combustion bed thickness adjustment system (91) of the smokeless combustion chamber suitable for Claim -1 or Claim -11, **and is characterized with incorporating;**

- **finned water piped combustion bed thickness adjustment plate (91.1),** which is used for adjusting the thickness of the combustion bed,
- **water circulation connecting pipe with flexible connection part (91.2),** in which water intake to the water circulation combustion bed thickness adjustment system (91) of the smokeless combustion chamber is ensured for cooling,

- **manual adjustment plate rod (91.3)**, which is used to ensure external, manual adjustment of the finned water piped combustion bed thickness adjustment plate (91.1),
- **automated adjustment plate rod (91.4),** which is commanded by the combustion efficiency and capacity-sensitive automation system (50) used for adjusting the finned water piped combustion bed thickness adjustment plate (91.1),

features.

15. It is the solid fuel feed spiral conveyor (71) suitable for Claim -1 or Claim -7, **and is characterized with incorporating**; **inverter lime feed spiral (150**), which is, in cases that the fuel fed in the system is high-sulphur coal, used to reduce sulphur dioxide emission to the minimum level, and which feeds lime to the solid fuel feed spiral conveyor (71) based on the sulphur content of the coal in order to provide an effective lime-coal blend through receiving command from the combustion efficiency and capacity-sensitive automation system (50), feature.

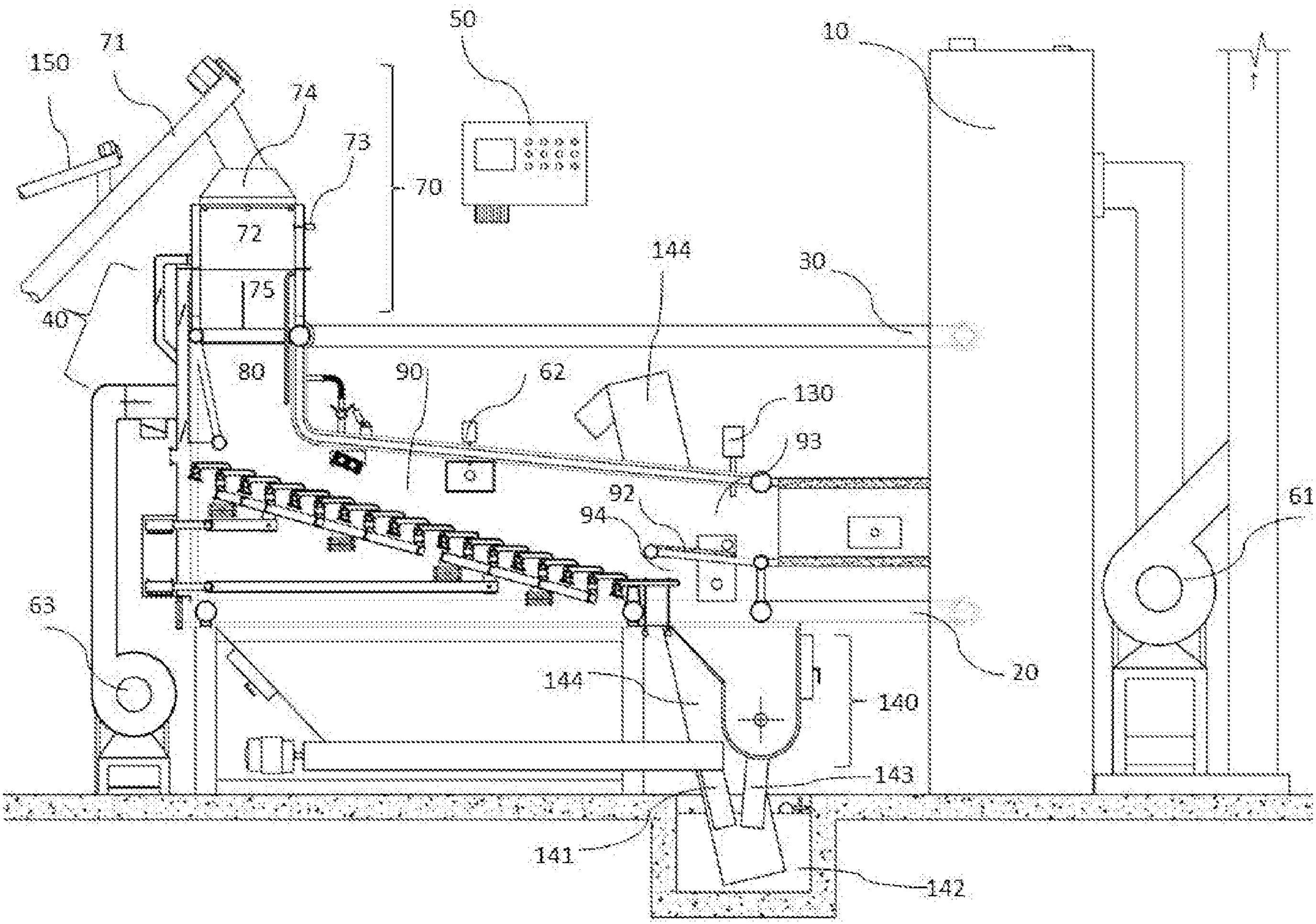
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Figure – 1

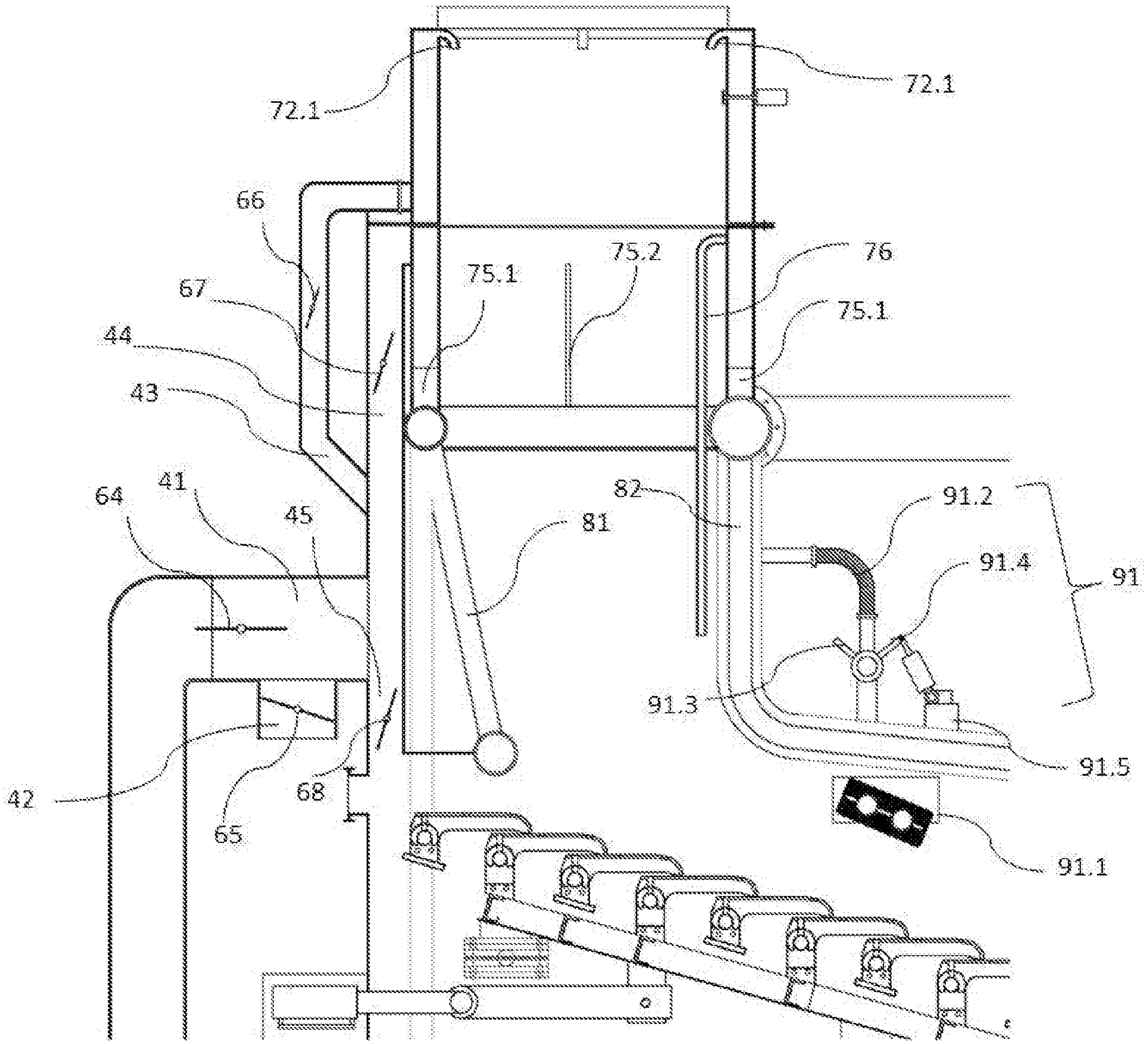
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Figure – 2

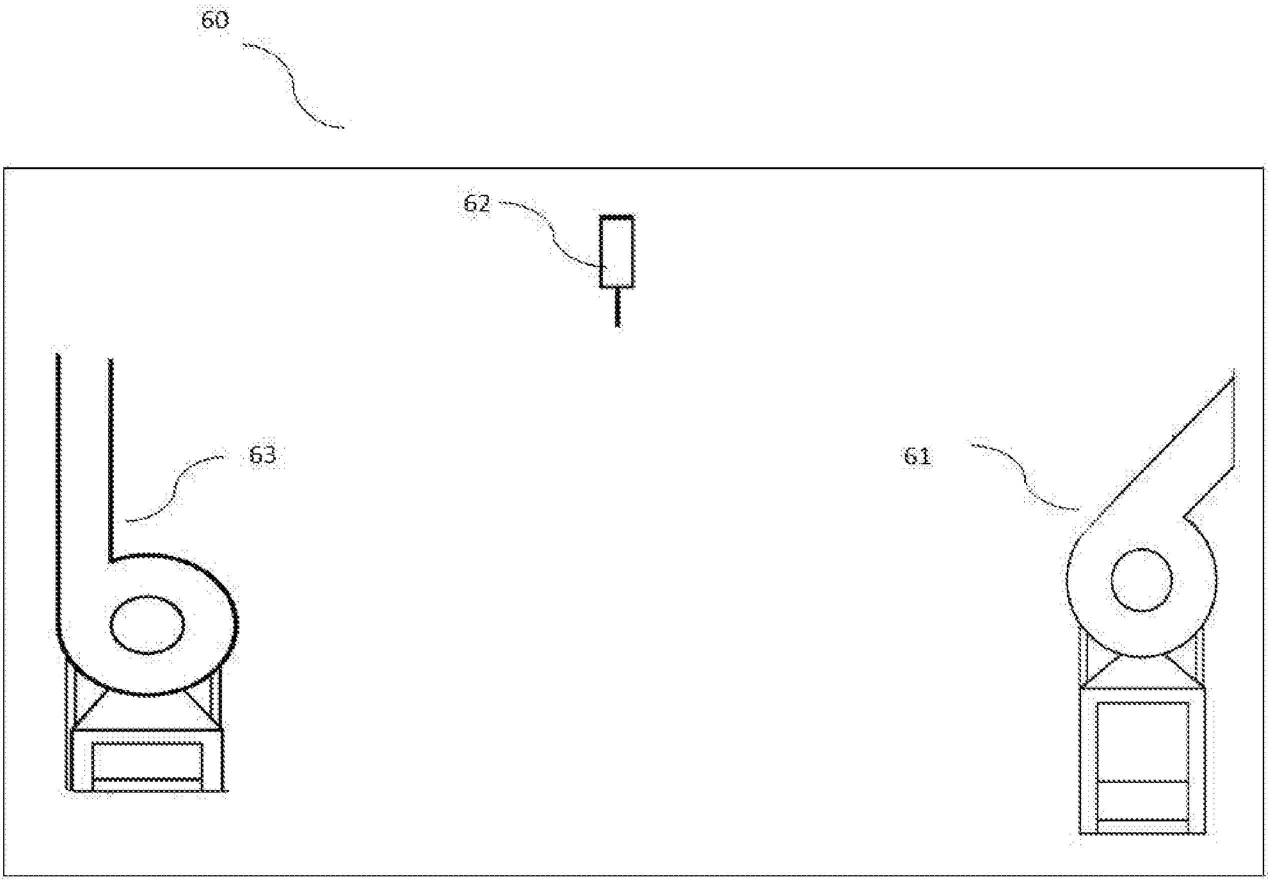

Figure – 3

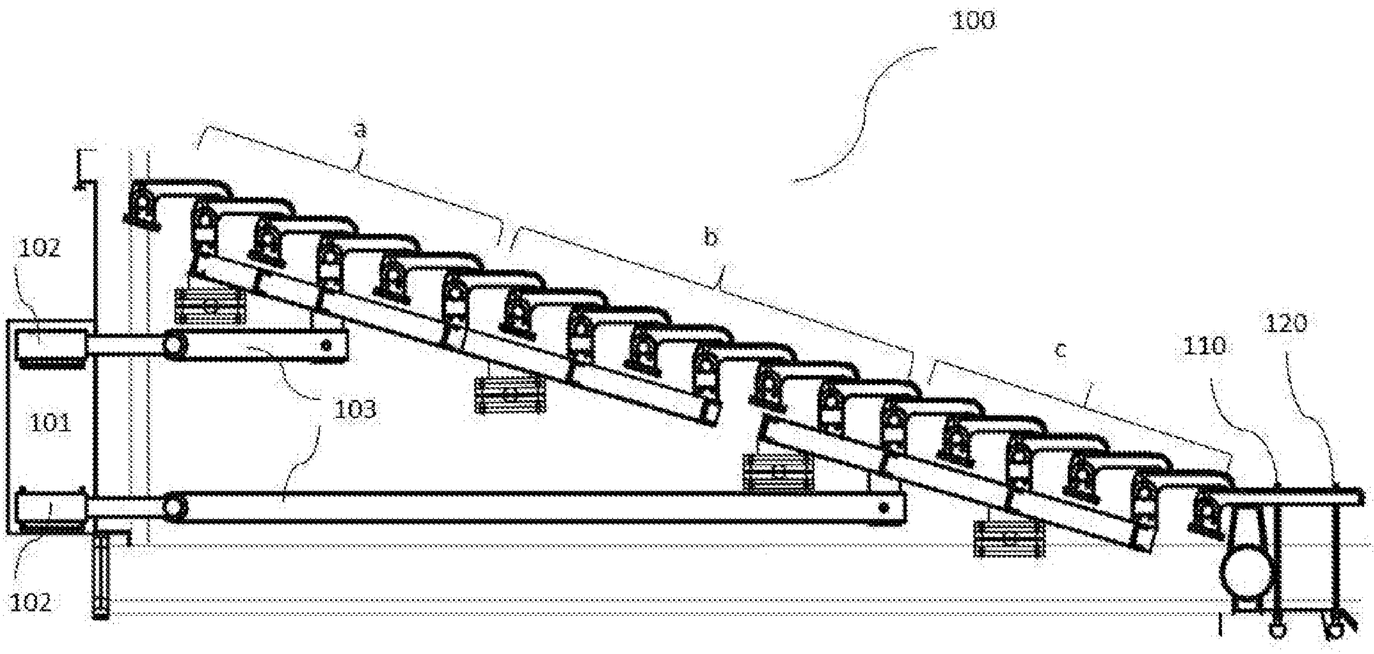

Figure – 4