(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
26 August 2010 (26.08.2010)

PCT

(10) International Publication Number
WO 2010/096026 A2

(51) International Patent Classification: Not classified

(21) International Application Number:
PCT/TR2010/000036

(22) International Filing Date:
22 February 2010 (22.02.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2009/01252 20 February 2009 (20.02.2009) TR

(72) Inventor; and
(71) Applicant : **OZCAN, Ali, Nizami** [TR/TR]; Cigdem Mah., 1550 Cad. No.19/11, Balgat Ankara (TR).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Declarations under Rule 4.17**:

— *of inventorship (Rule 4.17(iv))*

**Published**:

— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

— *with information concerning incorporation by reference of missing parts and/or elements (Rule 20.6)*

WO 2010/096026 A2

(54) **Title**: FULL AUTOMATIC SMOKELESS COAL BURNER ADJUSTABLE FOR COAL TYPE

(57) **Abstract**: Coal burner, which is the subject matter of the patent, is a full-automatic smokeless combustion new technologic coal burner which undertakes the function of burning system of the boiler when applied by being installed in front of existing boilers of hot water, superheated water, superheated oil and evaporation with solid, liquid and gaseous fuel oils and which converts the boiler with liquid or gaseous boiler into boiler with solid waste and which has the full-automation coal feeding and ash-cinder extracting system, full-automation burning air equipage which provides the possibility of being adjusted according to the rate of volatile in the structure of the coal, adjustment system of burning bed which provides the facility to be adjusted according to the grain sizes of the coals and ash — cinder rate in the structure and special grill system with full automation and also full-automation dry desulphurization system which provides the possibility to be adjusted according to the content of the sulphur in the structure of the coal, and by burning the coal in combustor with high burning productivity through full automation feeding, equipage of burning air and special grilling system by being adjusted according to the ash-cinder, volatile and sulphur content in the structure of the coal, it also decreases the sulphur dioxide emissions through full-automation dry desulphurization and produces solution to air pollution without needing filtration system on the chimney exit of the boiler since it prevents the formation of smoke in its source due high productivity of burning.

# DESCRIPTION

## "FULL AUTOMATIC SMOKELESS COAL BURNER ADJUSTABLE FOR COAL TYPE"

This invention is related to a coal burner which undertakes the function of burning system of the boiler when applied by being installed in front of hot water and evaporation boilers with existing solid, liquid and gaseous fuel oil and which converts the boiler with liquid or gaseous boiler into boiler with solid waste and which enables burning with coal without smoke by adjusting according to the type of the coal via full automation.

Liquid and gaseous fuel oils can be generally burnt with high productivity due to their being homogeneous. However, the burning productivity decreases considerably due to formation of smoke during the when fuel oils used for heating and in industry and particularly volatile coals are burn in the existing boiler or burning systems and the loss of energy can reach up to great sizes. Liquid fuel oils and particularly natural gas have been increasingly common in our days and they are naturally used in large area for both heating and in the field of industry in the thermal plants which generate coal and electric energy in the countries which are in rich coal reserves.

Currently, the coal is burnt through special burners in the boilers in thermal plants which generate electric energy after the coal is converted into dust, whereas pieced coal is burnt through mechanic-loaded stokers in the liquid bed systems in the boilers with big capacity used in the industry-type or central heating with relative high burning productivity. However, fly ash retainer multi cyclones and watery filters are absolutely used in such burning systems since the burning is not achieved fully and without smoke in the burning systems of the conventionally upper and lower loaded stokers and in liquid bed systems, and in spite of this, the smoke and polluting emissions which are produced due to deficient burning considerably causes air pollution. On the other hand, the coal is burnt on the grill with a considerable amount of productivity in the existing manually loaded boilers of water and evaporation with small and middle capacity used mostly in heating; the air pollution resulting from the polluting emissions reach up to great sizes since generally no filter is used in this type of boilers.

The invention called 'Full-automatic smokeless coal burner adjustable for coal type' undertakes the function of burning system of the boiler by being installed in front of hot water and evaporation boilers with existing solid, liquid and gaseous fuel oil and converts the boiler with liquid or gaseous boiler into boiler with solid waste. While full-automation non-smoke combustible coal burner burns the coal in combustor with high burning productivity through full automation feeding, equipage of burning air and special grilling system by being adjusted according to the ash-cinder, volatile and sulphur content in the structure of the coal, it also decreases the sulphur dioxide emissions through full-automation dry desulphurization and produces solution to air pollution without needing filtration system on the chimney exit of the boiler since it prevents the formation of smoke in its source due high productivity of burning.

It will be reasonable to examine briefly the concept of burning, properties of full burning and coal burning and the formation of smoke and polluting emissions for explaining the technological differences between the full-automation non-smoke combustible coal burner, which is the subject matter of the patent and burning systems with solid burning systems of the existing burners.

## 1. COMBUSTION, COMBUSTION CHARARCTERISTIC OF THE COAL, FORMATION OF SMOKE AND POLLUTING EMISSIONS:

Combustion is a chemical process which is ended with the production of heat and light energy after fusion of carbon and other combustible materials in the structure of solid, liquid or gaseous fuel oils with the oxygen at the temperature over a certain ignition temperature.

The fuel oil first must be in contact with air so that it can be burnt because the oxygen is supplied from the air in practice. The following three conditions should be satisfied along with the adequate amount of air so that fuel oil can be fully burnt in burning process.

a) Temperature over the ignition temperature (Temperature)
b) Well mixture of the air and the fuel oil (Turbulence)
c) Time required for completion of burning (Time)

These three requirements re known as "The Three T's of Combustion: Temperature, Turbulence and Time" in English literature.

In terms of burning technique, adequate amount of air should be first supplied and the fuel oil should be mixed with the air in turbulent way over certain ignition temperature which may change according to the type of the fuel oil and this situation should be sustained for a certain amount of time so that fuel oil can be fully burnt in a burning system.

Whether it is solid, liquid or gaseous, a burning system which satisfies such conditions during the burning of fuel oil may produce full burning and burning without smoke because the smoke is the product of deficient burning product.

Coal is fossil fuel oil which consists of several flammable materials, humid and non-flammable mineral substances. The flammable materials which consist of fixed carbon and volatile materials during the time when the coal is burnt burn and mineral materials are left over as ash and cinder.

Coals are generally classified by taking carbon, volatile substance, humid and ash rates as the components. According to this basis, it is divided into three main groups, namely, 'anthracite' whose volatile substance rate is very low, 'bituminous coal' or 'stone coal' which consists of volatile at middle level and 'brown coal' which consists of volatile at high level.

When the coal is warmed, the volatile substances in the structure of the coal start to be released as combustible gas (hydrocarbon gases and tar vapor) by being subject to distilling even when they are below the level of ignition temperature. The coal which consists of fixed carbon left over after such volatile substances are fully distilled is called 'coke'. Thus, combustible gases which are released during the time when the coal is burnt and two fuel oil in the form of liquid and gas in a way to include fixed carbon section are possibly to be burnt. Owing to the fact that the combustible gases which are released have higher ignition temperature, the basic problem for burning particularly coals with high volatiles such as brown coal-like materials is to provide required conditions in the combustor so that fuel oil in the form of two different conditions (liquid and gas) with different ignition temperature can burn fully at the same time.

During the time when coals with high volatile such as brown coal-like materials, deficient burning may occur because the technical properties of burning system are not feasible for providing full-burning conditions abovementioned. Two types of smoke are formed depending on the conditions during deficient burning in the burning system.

**a) Brown Smoke (Gray Smoke):**

If the temperature of the combustor is lower than the ignition temperature of the combusting gases released, even if there is adequate amount of air, hydrocarbon gases leave the system before the gases are burnt and released from the chimney in the state of smoke. Because this smoke which consists of non-burnt hydrocarbons and tar vapor has the appearance of brown color (or gray according to type of the coal), this type of smoke is called brown smoke (gray smoke). There is both fuel oil loss due to hydrocarbon gases which are released from the chimney without being burnt – 75% of them is methane gases – and energy loss carried within them due to heating such gases up to heat of chimney gases.

**b) Black Smoke (Particle=soot):**

Although the temperature in the combustor is above the ignition temperature of the combustible gases, if the air is not supplied at adequate amount or the combustible gases are not mixed in turbulence way even if there is adequate amount of air, again deficient burning appears. Although there is severe burning in the zones with a great deal of oxygen, carbon particles are formed as a result of cracking reactions due to high temperature and lave the system in the form of black smoke and soot.
This black smoke which consists of particles cause considerable amount of energy loss due to non-burnt fuel oil with carbon grains and due to energy carried from the burning system by these grains due to being heated.

If there is no homogeneous temperature distribution in the combustor, both gray (brown) and black smoke may be formed simultaneously in the different zones within the combustor.

As seen, the basic reason why smoke is produced during the time when the coal is burning is the failure to burn the combustible gases released fully; in other words, deficient burning. When full burning of the combustible gases is achieved in the combustor, the smoke will be prevented and naturally energy will be saved.

Whether it is in the form of particle or non-burnt hydrocarbons, the formation of the smoke is not only valid for the coal but also for the liquid and gaseous fuel oils. When the burning conditions are not fully provided in the combustor in the burning systems where liquid and gaseous fuel oils are burnt, it is inevitable for this smoke to be formed. However, since it is easier to burn homogeneous liquid and gaseous fuel oils fully and also liquid and gaseous fuel oil boilers have design and automatic control systems to provide burning productivity at high level, burning without smoke may be easily produced in liquid and gaseous burning boilers with appropriately designed combustor in practice.

On the other hand, since carbon monoxide (CO) is formed from the polluting emissions due to lack of oxygen in the combustor, this again appears as the product of deficient burning product.

However, sulphur dioxide ($SO_2$) emission which is formed as a result of the burning of the sulphur in the structure of the burning is not the product of deficient burning; but appears as a product as a result of the burning of the sulphur. Therefore, since it is not possible to eliminated directly the emission of sulphur dioxide due to burning at high level, eliminating the emission of sulphur dioxide may only be achieved through wet desulphurization to be applied on the chimney gases or dry desulphurization method which is provided with the addition of lime and similar kinds of chemical substances to the combustor.

Again, nitrogenous acids (NOx) which are formed in the certain burning conditions of the nitrogen in the structure of the fuel oil or in the air, particularly, as a result of burning of the nitrogen at high temperature are produced as the product of burning. The formation of Nox is dependent on the conditions in the combustor rather than the fuel oil.

As a result, we can express the emissions in two groups as in thee following by dividing them as the emissions due to fuel oil and emissions due to burning system.

| | | |
|---|---|---|
| Sulphur dioxide (SO2) | ——> | fuel oil (90%) |
| Particle (soot, smoke, dust) | ——> | burning system (90%) |
| Hydrocarbons (CmHn) | ——> | burning system (90%) |
| Carbon monoxide (CO) | ——> | burning system (90%) |
| Nitrogen oxides (NOx) | ——> | burning system + fuel oil |

Sulphur dioxide($SO_2$) emissions due to fuel oil may be eliminated by eliminating the content of the sulphur by improving the fuel oil through several physical or chemical processes or through methods known as dry or wet desulphurization rather than the burning system. It is possible to add such kinds of systems operated with such system to the burning system or to design the along with the burning system.

The smoke (particle and non-burnt hydrocarbons), carbon monoxide (CO= and nitrogen oxides (NOx) due to from burning system may be eliminated with the appropriate burning system for the properties of the fuel oil and design of combustor.

## 2. BURNING TECHNOLOGY OF THE EXISTING BOILERS WITH SOLID FUEL OILS:

Existing boilers of hot water, superheated water, superheated oil and vapor used for the purposed of heating and industry in our days may be divided into two groups as welded steel boilers and bulky sliced boilers in terms of the properties of production and construction. These two groups of the boilers may be evaluated as in the following in terms of their capacities to burn solid, liquid and gaseous fuel oils and use of fields.

### A) Welded Steel Boilers

The boilers in this group are the boilers which can be used for home-apartment typed domestic heating and for the industrial purposes. These may be divided into two main groups according to constructive properties.

a) Boilers with Flame-Smoke Hoses
b) Boilers with Water Hoses

The boilers with flame-smoke hoses are the boilers used in the generation of industrial vapor with relatively small and middle capacities as well as central heating facilities with small and middle capacity. Such kinds of boilers may be classified as three different types in terms of constructive properties and design shapes.

1) Half Cylindrical Boilers (DANSK type)
2) Cylindrical Three Shifted Boilers (SKOÇ type)
3) Cylindrical Reverse Pressed (Reverse Flowing) Radiation Boilers

Half cylindrical boilers (DANSK) types are the boilers used commonly in Turkey for heating and designed mainly for the purposes of burning solid fuel oil. Grills are cancelled in such kinds of the boilers and liquid fuel oils may be burnt.

Cylindrical three shifted boilers (SKOÇ) types are the boilers designed mainly for the purposes of liquid and gaseous fuel oil burning. It is not productive to transform them to the boilers with solid fuel oily by mounting grills inside of such kinds of boilers; yet solid fuel oil may be burnt by mounting mechanically loaded coal stokers or front oven instead of boilers.

Cylindrical reverse pressed (reverse flowing) radiation boilers are the boilers with small capacity which are completely designed for the purposes of burning liquid and gaseous fuel oil and mostly used in apartment typed home heating. Since radiation-weighted heat transfer is provided with reverse flowing in small combustor in such kinds of boilers, the possibility to mount grills and burn solid fuel oil is limited.

On the other hand, the boilers with water hoses are the boilers used in the central heating facilities with large capacities of for the industrial purposes. In such kinds of boiler with large capacities, mechanic coal stokers may be mounted in front side instead of boilers of liquid and gaseous fuel oil and solid fuel oil may be burnt. On the other hand, as in the boilers in the thermal plants, there are boilers with water hoses with great capacities designed as the boilers with solid fuel oil.

**B) Bulky Sliced Boilers**

These kinds of boilers are the boilers with small capacities designed for burning liquid and gaseous fuel oil. There are types of boilers which burn solid fuel oil such as coke and bricks. The boilers of gaseous fuel oil are divided into two groups, namely, blast boilers and atmospheric boilers.

**2.1. Burning Technology in the Boilers with Solid Fuel Oil, Burning and Formation of Smoke:**

Boilers with solid fuel oil can be divided into two main groups as manually loaded boilers and mechanically loaded boilers in terms of burning technology.

In the existing manually loaded boilers with hot water and vapor with small and middle capacity used in heating mostly, the coal is burnt with very lower productivity on the grill; since generally no filter is used in these kinds of boilers, air pollution due to polluting emissions reach great sizes.

[11] INCORPORATED BY REFERENCE RULE (20.6) [11]

In the types of the boilers burning solid fuel oils with great capacities used in central heating and industry, the coal is burnt through mechanically loaded stokers or fluidized bed systems; on the other hand, the coal is made to be dust in the special mills for the boilers with larger capacities in the thermal plants for generating electricity and then burnt with special burners of pulverized system.

In the over fed or under fed type-stokers, since the burning is sustained and the stoker factor is made out of order, the coal can be burnt with higher productivity when compared to the manually loaded boilers. In parallel to the sustainability of burning in the fluidized bed burning systems, burning productivity is increased up to higher level since the mixture of air and fuel oil mixture is achieved at optimum level.

However, in both conventional burning systems of over or under fed stokers and fluidized bed systems, since the burning is not achieved fully and without smoke, soot retainer multi cyclones and watery filters are absolutely used in these burning systems; in spite of this, smoke and polluting emissions produced due to deficient burning considerably cause air pollution.

On the other hand, the application possibility of both the mechanically loaded stokers and fluidized bed systems on the boilers with small and middle capacities used in the home-apartment typed domestic heating economically is very limited.

**2.1.1. Burning System in the Boilers with Manually Loaded Fixed Flat Grill and the Burning of Coal**

The burning system consists of manually fixed plat grilled oven, which is out of technology, in the half cylindrical boiler included in te manually loaded boiler group and used commonly in home-apartment type domestic heating.

The fuel oil in this type of boilers with solid fuel oil is laid over the fixed flat grill mounted below half cylindrical furnace. The coal is loaded over the grill with spade by opening the ignition cap in the front side and the ashes fallen in the ash pan under the grill are extracted out by opening the pan of the ash pan and pulling them via rake. The big-pieced cinder left on the grills is extracted out via rake and poker from the door of the ignition. Primary air holes which enable burning by penetrating under the grill are located on the door of ash pan; on the other hand, secondary air holes are located on the ignition cap where the coal is loaded on the upper side. Flame smoke and hot gases released from the oven pass through second and third shift flame smoke hoses and heat the water in the boilers and reach up to the chimney. The flame smoke hoses which are blocked with the flying ashes and soot are cleaned with wire brush by opening the caps of the front smoke case.

In the manually loaded half cylindrical boilers, certain amount of wood is burnt on the grill in the initial burning and then the loaded is realized by spraying coals with spade over the flame when ember is achieved.

In the manually loaded half cylindrical fixed flat grilled boilers, the coal is burnt with two different methods, namely, sprayed burning method and bedding burning method.

**a) Sprayed Burning Method:**

In this method, the coal is fed to the blaze on the grills by spraying the coal with a spade from the ignition door of the boiler. When fresh coal is sprayed over the bed of fuel oil which becomes ember on the grill in the fine level, the flammable gases which are released rapidly and uncontrollably due to high temperature cause the formation of soot in the form of black smoke due to cracking reactions when they are not mixed with the adequate amount of air.

When the coal is put on the ember in the form of thick layer, this time, fresh coal cools the burning bed considerably and destructs the burning arrangements and it starts to be heated from the lower layers and to become gas. Flame and hot gases from released from the burning bed in the bottom pass through the coal on the upper layers and heat the coal rapidly and distill it and case volatile gases to be released again without control. These flammable gases released go far from the burning zone in the upward direction; so, even adequate amount of air is penetrated through secondary air hole, these leave the system as non-burnt hydrocarbons in the form of gray (brown) smoke without ignition due to lower temperature. On the lowest layer of the coal in contact to burning zone, in spite of lack of temperature, majority part of the flammable gases released in uncontrolled way transform into black smoke as result of 'cracking' reaction due to lack of primary air penetrated under the grill in limited way to the chimney air. When the coal is heated well on the upper layers and reaches up to ignition temperature, majority of the volatile substances releases as smoke from the chimney:

**b) Bedding Method:**

In this method, fresh coal is not loaded over the entire surface of the grill but by stocking on the right and left sides in turn in the shape of pillow. While coked coal is burnt in one section of the grill, the aim is to burn the gases released due to forced heat when compared to the sprayed burning of the coal on the other section. However, although the gases occur within longer time, majority of the gases leaves the system without ignition in the form of gray smoke because the gases released on one section go towards the backside of the furnace in parallel to hot gases released from the ember and they get into contact with the cold surface on the base of the furnace. Thus, although gray smoke released in this method is less concentrated when compared to the sprayed method, it covers longer time. After the coal on the part loaded in the shape f the pillow is subject to distilling and ignited, this transforms into black smoke in the form of soot as a result of the deficient burning on the upper sides due to the high thickness of burning bed. However, in this method, since the secondary air penetrating from the upper side becomes less functions, the productivity decreases due to great plenty of air.

As seen, in the half cylindrical boilers, even if the coal is burnt on the flat grill with spraying method, or bedding is made, it is not possible to prevent the formation of the brown (gray) or black smoke since full burning conditions are not satisfied. Since the air released from the chimney are the non-burnt hydrocarbons and carbon particles, majority part of the fuel oil is released as loss from the chimney.

The applied radiator stokers do not use these burning methods according to techniques and great deal of coals is filled in the boiler once because of comfort. Thus, fuel oil losses reach to maximum levels due to formation of gray smoke before very thick burning bed and black smoke (soot) and carbon monoxide after this bed.

Because soot and fume produced due to bad and non-productive burning cause the flame smoke hoses to be obstructed in a very short time, this situation requires the hoses to be cleaned very frequently and cause operational difficulties and decreases the heating productivity of the boiler by making the heat transfer difficult due to soot layer on the hose surfaces.

However, in half cylindrical boilers, the ignition cap is opened and the hot cinders are extracted by rake and coal pieces which are not burnt under the grills or out of the grills and the losses of the ashes also increase. While conducting this process, excess air penetrating into boiler decreases the productivity of the boiler and carbon monoxide emission of non-burnt hot cinders which are extracted out may sometimes cause dangerous situations in terms of the health of the stokers.

As seen, in very out-of-date technological product which is still used commonly, manually loaded and conventional flat grilled half cylindrical boilers, the coal is burnt without productivity since full burning conditions are not satisfied in burning system; and the formation of smoke cannot be prevented. Because the loss of chimney and ashes reach up to maximum level, energy loss due to non-burnt fuel oil also increases at the same ratio. In addition, the factor of stoker plays an important role in daily operation and the operational difficulties decrease the productivity.

**2.1.2. Burning Systems in the Mechanically Loaded Boilers and the Burning of the Coal**

Coal burning systems in the boilers with mechanically loaded may be divided into four groups in terms of feeding type and burning principle.

1) Coal burning systems with over fed stokers
2) Coal burning systems with under fed stokers
3) Coal burning systems with fluidized bed
4) Pulverized dust coal burning system

Over fed stokers undertake the burning system function of the burning by being applied as front oven on the front side of the boiler or by being placed in the boilers with water hoses and half cylindrical and cylindrical three shifted boilers. While the burning air is given through forced blast under the grill, fresh coal is feed on the grill through mechanical loading. Coal burning systems of the over-fed stokers may be divided into three groups, namely, flinging type stokers, forward driven stokers and rotating grilled (palletized) stokers.

In the over fed stokers with flinging type, fresh coal is burnt by spraying them on the fire in combustor with fixed or moving stepped grills with mechanic flinging system; the burning principle is the application of sprayed burning method in the manually loaded boiler by feeding automatically. Due to formation of black smoke due to failure to burn the volatile rapidly released from the fresh coal sprayed with the automatic flinging system on the burning bed, it has become compulsory to use particle retainer multi cyclones or watery filters in the exit of the chimney.

In the burning system of forward driven type over fed stoker, burning process similar to burning principle with bedding method in the manually loaded boilers is realized; only operation easiness and possibility to reach up to big capacities occur due to mechanically



11 INCORPORATED BY REFERENCE (RULE 20.6)

loading. Since the formation of gray and black some is not prevented in such burning systems, filtration systems such as multi cyclone or watery filter are required in the exit of the chimney.

In the burning systems fed from the upper side of rotating grills (palletized) types, fresh coal fed from one of the end of the palletized rotating grills starts to be burnt and the burning is completed as ash and cinder on the other end and burning principle consists of burning process similar to mixture of pulverized burning system and bedding system in the manually loaded boilers. Because the palletized rotating grills are extended in the burning systems fed from the upper side and the rotating rate may be increased, large capacities can be reached; however, since formation of smoke cannot be prevented due to deficient burning due to the burning principle, again filtration systems in the exit of the chimney are required.

Stokers (coal stokers) fed from the lower sides undertake the function of burning system of the boilers by putting in the furnace of the half cylindrical and cylindrical three shifted boilers or applying them as front oven in front of the boilers. In the coal burning system with stokers fed from the lower sides, the coal is fed to the fixed grilled combustor from the lower side through a helezon and burning air is given with forced blast fan in parallel to the coal fed from the lower sides. Because the coal is fed to combustor through certain front heating, more productive burning can be achieved in terms of burning the volatile when compared to the burning system in the manually loaded boilers and burning system in the stokers fed from the upper sides. However, during the when the ash and the cinder as the left over from the burning are taken by stokers from the fixed grill manually, both the loss of ashes increase and the formation of smoke cannot be prevented due to destruction of burning arrangement and the decreasing burning productivity. It has become compulsory to use filtration system such as dust retainer multi cyclones and watery filters in the exit of the chimneys of the boilers where burning system with stokers fed from the lower sides are applied.

Coal burning systems with liquid bed are rather appropriate for dusty or fine grained coals and are the burning systems applied in the industrial typed watery hoses with great capacity. Burning systems with liquid beds are based on the principle of burning by making the coals liquid as if burning in the pan along with the sorbent materials in the burning bed and pressured hot air given under the spongy plate resistant to high temperature under the combustor. Coals are automatically fed to helezon conveyor to fluidized fuel bed from the upper side. Since the air is well mixed with the fixed carbon part of the coal in the burning bed (turbulence), fixed carbon part of the coal by achieving well burning is burnt; however, gray smoke and particle (black smoke) formed from non-burnt hydrocarbons in this system due to failure to full-burning of the volatiles in the structure of the fresh coal fed to the combustor. Therefore, it is absolutely necessary to use watery filter and soot retainer multi cyclone in the exit of the chimney.

Pulverize dusty coal burning systems are the burning systems are particularly used commonly in the boilers with water hoses having very big capacities in the thermal plants which generate electric energy. After the coal is made into dust in special grounding mills for such kinds of burning systems, the fuel oil is burnt in pulverized way by pulverizing air-fuel oil mixture appropriate for the lower temperature value of the fuel oil from several points into combustor in a way to form turbulence. Highly productive burning is achieved due to appropriate air – fuel oil rate and turbulence mixture in the combustor. However, since the volatile in the structure of fresh dusty coal pulverized into combustor is rapidly released, some parts of these volatile substances are not burnt and transformed into particle due to cracking reactions. For

this reason, desulphurization systems with big capacities are used in order to eliminate sulphur dioxide emissions due to coal with high sulphure and watery filters in the exit of the chimney.

## 3. "FULL AUTOMATIC SMOKELESS COAL BURNER ADJUSTABLE FOR COAL TYPE"

The subject matter of my patent called 'Full-Automation non-Smoke Combustible Coal Burner Adjustable According to Type of Coal' numbered TR 1995 00911 B, which is designed upon long-years research – development and optimization works is a full-automation non-smoke combustible new technologic coal burner which has the full-automation coal feeding and ash-cinder extracting system, full-automation burning air equipage which provides the possibility of being adjusted according to the rate of volatile in the structure of the coal, adjustment system of burning bed which provides the facility to be adjusted according to the grain sizes of the coals and ash – cinder rate in the structure and special grill system with full automation and also full-automation dry desulphurization system which provides the possibility to be adjusted according to the content of the sulphur in the structure of the coal, and by burning the coal in combustor with high burning productivity through full automation feeding, equipage of burning air and special grilling system by being adjusted according to the ash-cinder, volatile and sulphur content in the structure of the coal, it also decreases the sulphur dioxide emissions through full-automation dry desulphurization and produces solution to air pollution without needing filtration system such as soot retainer multi cyclones, watery filters and wet desulphurization on the chimney exit of the boiler since it prevents the formation of smoke in its source due high productivity of burning.

New coal burner with full automation, which is the subject matter of the invention, is developed to be applied on the boilers of hot water, superheated water, superheated oil and evaporation for rather heating with middle and big capacity and / or for the purposes of industry and it is designed in the shape of double walled or with water hose joined to the plant chimney of the boiled on which it is applied. Double-walled designed coal burner is indicated in Figure 1 and coal burner designed with water hose is shown in Figure 2.

The functional system, parts and sections in the figures are numbered and their corresponding meanings are indicated as the following.

1. Automation and security system with PLC control sensitive to heat or pressure
2. Main air entrance clap which is commanded from automation panel
3. Inverted forced aspiration fan which is commanded from automation panel
4. Chimney by-pass damper
5. Coal-type volatile adjustment clap
6. Banded or helezon conveyor enabling automatic coal feeding
7. Coal feeding silo
8. Lime feeding helezon feeding lime to dry desulphurization system
9. Lime feeding silo
10. Coal pre-heating bunker
11. Coal distilling chamber
12. Combustor
13. Inverted grill movement reducer
14. Stepped moving – fixed special grill system
15. Ash pan
16. Ash pan – cinder pan partition

[11] INCORPORATED BY REFERENCE (RULE 20.6)

17. Cinder pan
18. Fire exit conduit
19. Ash carriage helezon conveyor
20. Cinder carriage helezon conveyor
21. Heater fluid entrance hose
22. Entrance flange
23. Exit flange
24. Exit hose
25. By-pass servomotor commanded from automation panel
26. Front mountable front panel
27. Primary air channel
28. Secondary air channel
29. Secondary air heating channels
30. Main air clamp servomotor commanded from automation panel
31. Main air clamp screwed adjustment mechanism
32. Coal-type volatile adjustment clamp servomotor commanded from automation panel
33. Coal-type volatile adjustment clamp screwed adjustment mechanism
34. Level preceptor sensor
35. Eccentric pivot with adjustable stroke
36. Piston rods
37. Moving grill chassis
38. Moving grill carriage pivots
39. Moving grills
40. Fixed grill chassis
41. Fixed grill pivots
42. Fixed grills
43. Carriage
44. Balls
45. Fixed cinder cooling grills
46. Combusting bed adjustment hose / combusting bed adjustment plate
47. Cinder unloading servomotor
48. Ash unloading cap
49. Cinder unloading servomotor
50. Cinder unloading cap
51. Lime feeding clap
52. Servomotor opening and closing lime feeding clap
53. Vibrator enabling lime flow
54. A series of special hose enabling duet lime to flow in uniform way
55. Lime feeding silo level perception sensor
56. Sight glass
57. Combusting – sight cap
58. Door for cinder with sight glass
59. Door for cinder
60. Pivot care panel
61. Lubrication caps
62. Furnace of existing boiler
63. Fire box
64. Flame – smoke hoses
65. Boiler chimney
66. Caps of front smoke case

[11] INCORPORATED BY REFERENCE (RULE 20.6)

67. Rear smoke case
68. Rear cap of the boiler

As seen in Figures 1 and 2, main body consists of twenty main components, namely, automation and security system with PLC control sensitive to heat or pressure which is designed to have two walls or water hoses (1), main air entrance clap which is commanded from automation panel (2), inverted forced aspiration fan which is again commanded from automation panel (3) chimney by-pass damper (4), coal-type volatile adjustment clap (5), banded or helezon conveyor enabling automatic coal feeding (6), coal feeding silo commanding the conveyor with the level sensor on it (7), lime feeding helezon feeding lime to dry desulphurization system in parallel to coal feeding (8), lime feeding silo (9), coal pre-heating bunker (10), coal distilling chamber (11), combustor (12), inverted grill movement reducer commanded from automation panel by being adjusted according to the type of the coal (13), stepped moving – fixed special grill system (14), ash pan (15), ash pan – cinder pan partition (16), cinder pan (17), fire exit conduit (18), ash carriage helezon conveyor (19) and cinder carriage helezon conveyor (20),

The main body of the coal burner which constitutes distilling chamber, combustor and flame exit conduit has been designed with two walls or water hoses depending on the operation conditions and flow of the heater on which the boiler operates jointly; circulation of the heater flow in the main body of the burner is achieved by joining heater fluid entrance hose (21) and entrance flange (22) to the boiler in front of which it is installed from the lower section through joining the exit flange (23) with the exit hose (24) on the upper side.

In the new coal burner, which is the subject matter of the patent, there is PLC controlled automation and security system sensitive to temperature or pressure (1); and within the programs and adjustments made from the panel of this system according to the needs of the operator, coal feeding, controlling the burning rate with the burning air rate and grill movement, operating dry desulphurization system and extracting the ash-cinder are executed fully automatically.

Burning air is supplied for the coal burner which is the subject matter of the invention from inverted forced aspiration fan (3) commanded from the automation panel and aspiration fan which operated in the gradual rotations with the inverter provides possibility for air rate appropriate for the desired capacity. By-pass damper (4) which is closed and opened via by-pass servomotor (25) commanded from the automation panel is automatically opened as soon as aspiration fan is out of order and supplies burning air at the lowest capacity with the natural force of the chimney.

New coal burner has common main air entrance clamp (2) on front mountable front panel on the burner (26) and primary air channel through which the primary air is subject to pre-heating (27) under the main air entrance clamps and secondary air channel (28) on the upper side where secondary air is subject to pre-heating. After the secondary air channel passes through the upper side of the coal pre-heating bunker, it tends downward and extends to the secondary air heating channels (29) on the rear wall of the distilling chamber as indicated in the figure.

Burning air supplied from the forced aspiration fan or natural chimney force enters jointly from the single main air entrance (2) clamp in front side as secondary and primary air as indicated in the figure; the primary air entered through the lower section of the clamp direct downward and passes through the primary main channel (27) and reaches to the combustor

[11] INCORPORATED BY REFERENCE (RULE 20.6)[11]

under the grill. On the other hand, the secondary air enters from the upper section of main air clamp and directs upward and passes the coal-type adjustment clamp (5) on the secondary air channel (28) and then circulates around the upper side of the coal pre-heating bunker and becomes subject to certain pre-heating in the secondary air channel extending to the upper section of the distilling chamber and reaches to the upper side of the combustors as being well heated while passing through secondary heating channels (29) on the rear section of the distilling room (11).

Main air entrance clamp (2) may be automatically opened and closed fully gradually according to desired temperature or pressure level by depending on the servomotor (30) commanded from the panel of PLC controlled automation system. Main air clamp can be adjusted and fixed manually through screwed adjustment mechanism (31) when required or in cases where the automation system becomes out of order.

Coal-type adjustment clamp (5) can be adjusted gradually according to coal type depending on the servomotor (32) commanded from the panel of PLC controlled automation system according to type of the coal used; furthermore, it can be also manually adjusted and fixed according to the rate of the volatile in the structure of the coal used with the screwed adjustment mechanism with butterfly cap (33) when required.

Coal-type volatile adjustment clamp (5) may be adjusted in five ways according to type of the coal to be used, for example, as full open for brown coal with high volatile; as three quarters open for the coals with middle volatile (75%); as half open for the coals with relatively lower volatile (50%); as one quarter open for the coals with lower volatiles (25%) and as close for the coals such as coke with no volatile. It is enough to adjust this clamp manually from the panel of PLC controlled automation panel according to type of coal in daily operation.

Adjusting the primary and secondary air amount having different functions during burning is achieved through the single circular movement of the main clamp gradually and it is allowed for the primary and secondary air rate to be controlled from the panel of PLC controlled automation panel automatically and for the channels to enable the primary and secondary air to function well through distribution arrangement for the full burning.

The full-automation new coal burner, which is the subject matter of the invention, has coal feeding band or helezon conveyor (6) which enables the coals to be fed from the coal main silo or pool and coal feeding silo (7) and it can be taken in and out of order as the level of coal in the coal feeding silo decreases depending on the PLC controlled automation system by being commanded from the level preceptor sensor (34) on the coal feeding silo of the conveyor

The full-automation new coal burner, which is the subject matter of the invention, has stepped moving-fixed special grill system (14) which can be adjusted with command from the automation panel according to the type of the coal under the combustor (12). This inverted grill movement reducer (13) which gives forward and backward movement to moving-fixed grills of this special grill system (14) through eccentric pivot (35) and piston rods (36) whose strokes can be adjusted and whose movement rate and rime can be adjusted from PLC controlled automation panel according to ash-cinder rate and lower temperature value of the coal in the structure of the coal. Stepped special grill system consists of fixed grills resistant to high heat (42) put on the fixed grill pivots (41) mountable on fixed grill chassis (40) and moving grills resistant to high heat (39) mountable on the carriage pivots of moving grill

mounted (38) on moving grill chassis (37) and it moves on the balls (44) mounted on the ball beds of epical carriage (43) installed on the side walls of the burner and under the grill chassis (37) of the moving grills. There are fixed cinder cooling grills (45) which enable the hot cinder to cool by keeping them waiting before they gall in cinder helezon in cinder pan on the upper side of cinder pan (17) after the last step of the fixed grills mounted on the ash pan – cinder pan partition (16).

The full-automation new coal burner, which is the subject matter of the invention, has, in the initial section of combustor (12), adjustment system of burning bed thickness for two choices consisting of connection flanges and burning bed adjustment plate (46) which is with secondary air cooling give downward and upward movement and adjustment hose of burning bed (46) at different diameters mountable from the outer side in the burner with two walls as indicated in Figure 1 and which enable the thickness of the burning bed on the grills to be adjusted according to grain size of the coal to be burnt on the upper side of the beginning part as indicated in Figure 2. Water circulation is achieved by joining the burning bed to the side walls of the burning chamber through entrance and exit flanges per and hoses with small or big diameters are used according to the grain size of the coal to be used and thus bed height of the coal flowing over the grills can b adjusted. Adjustment plate of burning bed can be mountable from the outer side and the height of burning bed is allowed to be adjusted by giving downward – upward movement. Thus, while small grained coals are burnt, the resistance of the burning bed to primary air penetrating under the grills is decreased with lower thickness of burning bed and the air-fuel ail mixture is achieved up to the upper layers of the burning bed and even small grained coals are enabled to be burnt with high productivity.

The grill system under the combustor may be adjusted through inverted grill reducer provided that the rate and the movement time of the downward-backward moving grills are adjusted from the automation panel according to coal type used and grain size; thus, all the coal types with high cinder rate from the lower to high calories can be burnt in productive way. Inverted aspiration fan adjusted from the automation panel according to the pressure or temperature desired in the operation supplies burning air with the chimney force needed in parallel to adjusted grill movement according to type of the coal and grain size of the coals. When the pressure or temperature level reach up to the desired levels, the rotation of the aspiration fan will be decreased according to the program on the automation panel and main air entrance clamp gradually closes and movement rate of the grills and operation time will decrease and the burning capacity decreases; when the pressure or temperatures decreases down to certain value, the rate of chimney aspiration fan will increase again automatically and main air entrance clamp will open and grill rate and operation time increase in parallel to them. Thus, the system is enabled to operate with full automation according to the program on the PLC controlled automation panel within the range of desired pressure or temperature in operation.

Fine ashes fallen under the grills and cinders fallen in cinder pan by sliding over the cinder cooling grills through ash carriage helezon conveyor (19) in lower section of the ash pan are fully extracted out as in the coal feeding through the command taken from the panel of PLC controlled automation system through cinder carriage helezon conveyor (20) in the lower section of the cinder pan.

On the exit of ash carrying helezon conveyor (19) is ash unloading cap (50) which is automatically closed and opened fully depending on the cinder unloading servomotor (49) commanded from the automation panel in the exit of cinder carriage helezon conveyor (20)

and ash unloading cap which is automatically closed and opened depending on the ash unloading servomotor (47) commanded from the PLC controlled automation panel.

The full-automation new coal burner, which is the subject matter of the invention, deigned with two walls or water hoses, has two full-automation dry desulphurization system which can be adjusted according to the sulphur content of the coal to feed the lime from the upper side of the initial section of the ceiling of the combustor for the second one (12) and from the upper side of coal pre-heating bunker (10) for the first one. By feeding the lime from two different functional points, the powdered lime is allowed to be in contact with the coals and gases during and before burning, the productivity of desulphurization process is increased; thus, the aim is to eliminate the sulphur dioxide emission.

This dry desulphurization system consists of series of private hoses (54) which enable the dust and lime to flow in uniform way and vibrator (53) which enables the lime to flow by giving vibrations to lime feeding clamp, and servomotor opening and closing lime feeding clamp (52), special lime feeding clamp which adjusts the dust lime in the dust feeding silo to flow in rate appropriately for the sulphure rate in the structure of the coal (51), lime feeding silo (9), lime feeding helezon (8) and that lime feeding helezon (8) feeds by being in and out of the order automatically as the lime level decreases in the silo in parallel to feeding the dust lime to coal taken from the pool or main silo of dust lime commanded from PLC controlled automation panel (1) and level perception censor (55) on the lime feeding silo (9).

Special lime feeding clamp (51) which adjusts the flow rate of the lime according to the rate of sulphur in the structure of the coal can be automatically adjusted with a servomotor (52) commanded from panel (1) of the PLC controlled automation system and also can be adjusted manually according to type of the coal used manually when necessary or by keeping automation system out of order.

Dry desulphurization system which is adjusted according to sulphur rate in the coal used enable the powdered lime fed to get into chemical reaction with the sulphur dioxide at the most appropriate point of the combustor by getting in and out of the order in full automation way in parallel to coal amount fed automatically and grill movement and transforms sulphur dioxide to calcium sulphur. Thus, this new coal burner eliminates the emission of carbon dioxide due to coal with high level of sulphur thanks to dry desulphurization system with full automation in parallel to smoke and carbon monoxide emissions through full-automation non-smoke burning.

The new coal burner, which is the subject matter of the patent, as seen in the picture, has two ignition-sight caps (57) with sight glass (56) resistant to high temperature on it and used for initial ignition and which is opened to combustor from the side sections and there are two cinder ash doors (58) with sight windows having sight glass resistant to high temperature on it which provides possibility for maintenance and repair in the burner when necessary and which enables us to see the cinders and cinder helezon on the last step of the grills in the upper size o the cinder ash. In addition, there is door of ash-pan (59) opened to ash pan to make intervention and maintenance and repairing possible on the grill system from the lower sections. There is pivot care panel (60) which can be mountable on the burner from the front side and which protects the eccentric pivots and beds which give movement to the grills under the front side of the burner; and there are lubrication caps (61) which enable the eccentric pivots and piston rods to be lubricated on the panel.

Non-smoke combustible coal burner is put in front of the existing coilers of hot water or vapor and undertakes the burning system of the boiler by being mounted on the ignition door of the boiler through connection flange of the flame exit conduit and the flames and hot gases released from the flame exit conduit of the burner gets out of the chimney (65) after circulating through the flame-smoke hoses (64) after passing the furnace (62) and fire box (63). Flame-smoke hoses of the boilers are cleaned by opening the front smoke case caps (66) and ashes and soot accumulated in the back side are taken by opening the cleaning cap or bars on the rear smoke case (67). The flying aches which are accumulated in the furnace of the burner by extracting along the flame exit conduit with the flames may be taken out through cinder helezon after pulling them to cinder pan with a long rake by opening the rear cap (68) of the boiler or if there is no rear cap of the boiler by entering into cider-pan of the boiler.

Coal feeding, cinder extracting and grill movement system may be preferred manually since it may be considered that automatic coal feeding with helezon and cinder extracting in the non-smoke coal burners applied on the boilers with small capacity cause extra cost. Such kinds of burners with small capacity are desired according to the basis that they are filled two times, namely once in the morning and once in the evening under normal operation conditions; so the burning continues with very lower burning rate at nights by tuning down the air clamp or adjusting the chained thermostat commanded to air clamp at lower temperature. Bu tuning up the air clamp in the morning or adjusting at the desired temperature at mechanic thermostat, ashes and cinders are made to fall and accelerated by giving movement to grills with the grill movement reducers; new coals are filled in the bunker which is empties. The ashes in the ash pan are extracted by opening the door of the ash pan, whereas the cinder in the cinder pan is extracted by opening the rear door of the cinder pan. Main air entrance clamp joining to the mechanic thermostat adjusted according to external air temperature is automatically closed and opened and both comfort and economy are achieved through one operation at desired temperature.

**3.1. Burning of the Coal in Full-Automatic Smokeless Coal Burner, Prevention of the Smoke and Polluting Emissions:**

In the new coal burner with full automation, fresh coals fed to the coal feeding silo automatically through coal feeding helezone commanded from the panel of PLC controlled automation and security system go towards the combustor on the grills from the coal distilling chamber fully automatically with the movement given automatically by the inverted grill movement reducer to moving grills of stepped moving – fixed grill system according to type f the coal and also with its own weight after being subject to certain pre-heating in preheating bunker. The coal subject to distilling with the forced pre-heating can be burnt with the fixed carbon part of coked coal and flammable gases released without smoke under the full burning conditions in the combustor. The ashes which are the left-over of the burning fall in the ash-pan under the grills, whereas the cinder left on the grills fall in cinder pan after sliding through fixed cinder cooling grills after the last step of the fixed grill due to the movement of the moving grill with steps moving in backward and forward way automatically. The fine ashes accumulated in the ash pan are extracted out automatically through ashes carriage helezon conveyor commanded from the automation panel, and the ashes and the cinder in the cinder pan are extracted out automatically through cinder carriage helezon conveyor commanded from the automation panel.

[11] INCORPORATED BY REFERENCE RULE (20.6)

While the coals are fed with full-automation mechanism which provides decisive flow to burning chamber, ashes and cinders as the left-over of the burning leave burning cells automatically thanks to this mechanism and fixed and continuous burning is achieved.

Dry desulphurization system with full automation eliminates the sulphur dioxide emission through the desulphurization of the sulphure in the content of the coal thanks to powdered lime rate which can be adjusted by depending on the sulphur amount in the content of the coal according to coal type in parallel to this automatic and non-continuous burning process.

As indicated in Figures 1 and 2, in new coal burner, which is the subject matter of the invention, burning the coal continuously with full automation mechanism and prevention of smoke and sulphur dioxide is achieved through these phases.

Fresh coal which is fed to coal feeding silo through coal feeding helezon commanded from the panel of PLC controlled automation system first undergoes a certain pre-heating in the coal pre-heating bunker of the burner and then gets into contact with the hot coal in the entrance of the distilling chamber and starts to be heated slowly. The coal in the distilling chamber is heated by taking come certain amount of the heat released in the combustor through radiation and conduction. As the coal is burnt in the combustor, while the coal in the distilling channel moves towards the combustor, the coal in the pre-heating bunker enters into distilling chamber while sliding slowly downward with its own weight. Powdered lime is automatically fed to the lime feeding silo through lime feeding helezon belonging to special desulphurization system in parallel to coal feeding helezon. In parallel to downward flow of the coal, powdered lime flows into the initial section of the combustor by being adjusted according to the suphur rate in the content of the coal.

As the coal in the distilling chamber approaches towards the burning chamber in the downward direction, it becomes subject to forced distilling and the volatile substances in the structure of the coal are released as gas in decisive way. The flammable gases which are released in controllable way and have higher ignition temperature than the normal ignition temperature of the coal (600-700 °C) is entered into the hottest part (850 °C on average) of the system on the burning bed in the burning chamber with chimney force provided with the inverted forced aspiration fan and during this time, it is mixed with the secondary air at the adequate amount which comes after being heated well due to high temperature in turbulence way and burnt. Thanks to the special design of combustor, this temperature required for full burning is kept for some time; so all of the gases are burnt under the full burning conditions in the combustor and the formation of smoke in the form of gray and black is prevented in its source. Since the coal in the distilling chamber releases most of the volatile substances in its content as the flammable gases at the end of the distilling process, this coal enters as semi-coke or fully coke while descending into combustor.

While the fixed carbon part of the coal entering in to combustor of the coal burner with full automation after releasing majority part or all of the flammable gases is burnt with the primary air entering along the moving-fixed grills with special steps, carbon monoxide which is produces due to deficient burning in the parts on the upper sides of the burning bed when the air is not fully dominated is ignited at high temperature with the flammable gases of the coal with the help of the secondary air which is well heated on the upper side and in distilling chamber and burnt under full burning conditions. Thus, the coke part which consists of fixed carbon of the coal filled in advance and gas part of the coal which is filled later and still in the distilling chamber are burn simultaneously under full burning conditions formed in the

combustor over the grills and smoke and carbon monoxide formation is prevented once the solid and gas parts of the coal are burnt fully.

Sulphur dioxide which is produced as a result of the burning of the sulphure in the structure of the coal engages with chemical reaction with powdered lime (calcium hydroxide) reached to the combustor through special dry desulphurization and is turned into calcium sulphure (plaster) and the formation of sulphur dioxide is prevented in the combustor.

While the part of ashes and cinder as the left-over of the burning which can fall thrugh the gaps of the grills are accumulated in the ash pan in the combustor of the burner, the parts left on the grills slide towards fixed cinder cooling grills on the rear of the combustor. These ashes and cinders which are fully burn at the end of the combustor are eliminated as movement reducer of inverted grills gives forward-backward movement to the special stepped moving grills automatically and the cinders left on the grills are driven to the fixed cinder cooling grills after the last step of the fixed grills. The cinders which are fully cool on the fixed cinder cooling grills fall to cinder carriage helezon conveyor in the cinder ash after sliding with the following grill movement. Thus, while burning left-over leave the ash and cinder combustor thanks to full-automation mechanism with the help of its own weight and movements of the grills the coal which becomes coke in the form of ember moves forward to the end of the coal burning chamber. While the coal which is subject to forced distilling in the distilling chamber enters into combustor, the coal in the pre-heating bunker flows down to the distilling room with full-automation mechanism. At the end of this process, fresh coal is fed automatically to coal feeding silo whose level of coal decreases through coal feeding helezon commanded from the panel of PLC controlled automation and the newly fed coals become subject to the same process. Thus, full and non-smoke burning process is repeated periodically without interruption while feeding the coals, falling the ashes and cinders or extracting them our.

As seen, in the full-automation new coal burner, the subject matter of the invention, which can be adjusted according to type of the coal, the coal which is automatically fed with the coal feeding helezon is burnt with the solid and gaseous parts at high productivity in the combustor under full burning conditions by being subject to pre-heating and forced and controlled distilling, as a result of which, formation of smoke and emission of carbon monoxide is prevented; furthermore, in parallel to the flow of coal to the combustor, sulphur dioxide emission is prevented through full-automation special dry desulphurization system which can be adjusted according to sulphur which is the content of the coal.

Consequently, 'Full Automatic Smokeless Coal Burner Adjustable for Coal Type' which is the subject matter of the invention undertakes the function of burning system of the boiler when applied by being installed in front of existing boilers of hot water, superheated water, superheated oil and evaporation with solid, liquid and gaseous fuel oils by being adjusted according to the rate of volatile in the structure of the coal, grain sizes of the coals and ash – cinder rate in the structure and by burning the coal in combustor with high burning productivity through special grill system and it also prevents sulphur dioxide emission due to its dry desulphurization method. Full automatic smokeless coal burner provides solution to air pollution without needing filtration system on the chimney exit of the boiler since it prevents the formation of smoke and carbon monoxide in its source due high productivity of burning.

11

11 INCORPORATED BY REFERENCE (RULE 20.6)

## CLAIMS

1. The subject matter of the invention is the stoker; depending on the operation chimney of the boilers of hot water, superheated water, superheated oil or vapor where applied, it is a non-smoke combustible coal burner adjustable according to type of the coal whose main body consists of twenty main components, namely, automation and security system with PLC control sensitive to heat or pressure which is designed to have two walls or water hoses (1), main air entrance clap which is commanded from automation panel (2), inverted forced aspiration fan which is again commanded from automation panel (3) chimney by-pass damper (4), coal-type volatile adjustment clap (5), banded or helezon conveyor enabling automatic coal feeding (6), coal feeding silo commanding the conveyor with the level sensor on it (7), lime feeding helezon feeding lime to dry desulphurization system in parallel to coal feeding (8), lime feeding silo (9), coal pre-heating bunker (10), coal distilling chamber (11), combustor (12), inverted grill movement reducer commanded from automation panel by being adjusted according to the type of the coal (13), stepped moving – fixed special grill system (14), ash pan (15), ash pan – cinder pan partition (16), cinder pan (17), fire exit conduit (18), ash carriage helezon conveyor (19) and cinder carriage helezon conveyor (20), and which has the full-automation coal feeding and ash-cinder extracting system, full-automation burning air equipage which provides the possibility of being adjusted according to the rate of volatile in the structure of the coal, adjustment system of burning bed which provides the facility to be adjusted according to the grain sizes of the coals and ash – cinder rate in the structure and special grill system with full automation and also full-automation dry desulphurization system which provides the possibility to be adjusted according to the content of the sulphur in the structure of the coal.

2. This is the coal burner in Claim 1 and its property is that it has automation and security system with PLC control (1) and the burning air is supplied through inverted forced aspiration fan which is commanded from this system (3) and chimney by-pass damper (4) which is closed and opened with a by-pass servomotor (25).

3. This is the coal burner in Claims 1 and 2 and its property is that it has front mountable front panel on the burner (26) and there is coal-type volatile adjustment clap (5) which provides the facility to be adjusted according to the volatile rate in the structure of the coal used, common main air entrance clamp (2) on this front panel, primary air channel (27) under the main air entrance clamps and secondary air channel on the upper side (28).

4. This is coal burner in Claims 1, 2 and 3; and its property is that main air entrance clamp (2) can be opened and closed fully automatically in gradual way according to pressure level and temperature desired in the operation joining to the a servomotor (30) commanded from the PLC controlled utomation panel; in addition, it can be manually adjusted with a screwed adjustment mechanism (31) in cases where the automation system is out of order or when required.

5. This is coal burner in Claims 1, 2 and 3; and its property is that coal-type volatile adjustment clamp (5) can be adjusted in gradual way according to coal type used dependently on the servomotor (32) commanded from PLC controlled automation panel and also manually adjusted and fixed according to the rate of the volatile in the structure of the coal used with the screwed adjustment mechanism with butterfly cap (33) when required.

11 INCORPORATED BY REFERENCE RULE (20.6) 11

6. This is the coal burner in Claims 1 and 2; and its property is that there is coal feeding band or helezon conveyor (6) which enables the coals to be fed from the coal main silo or pool and coal feeding silo (7) and it can be taken in and out of order as the level of coal in the coal feeding silo decreases depending on the PLC controlled automation system by being commanded from the level preceptor sensor (34) on the coal feeding silo of the conveyor.

7. This is the coal burner in Claims 1 and 2; and its property is that there is stepped moving-fixed special grill system (14) which can be adjusted with command from the automation panel according to the type of the coal under the combustor (12) and this special grill system has inverted grill movement reducer (13) which gives forward and backward movement to moving grills of this special grill system through eccentric pivot (35) and piston rods (36) whose strokes can be adjusted and whose movement rate and rime can be adjusted from PLC controlled automation panel according to ash-cinder rate and lower temperature value of the coal in the structure of the coal.

8. This is coal burner in Claims 1, 2 and 7; its main property is that stepped special grill system consists of fixed grills resistant to high heat (42) put on the fixed grill pivots (41) mountable on fixed grill chassis (40) and moving grills resistant to high heat (39) mountable on the carriage pivots of moving grill mounted (38) on moving grill chassis (37) and it moves on the balls (44) mounted on the ball beds of epical carriage (43) installed on the side walls of the burner and under the grill chassis (37) of the moving grills.

9. This is coal burner in Claims 1, 2 and 8; its property is that there are fixed cinder cooling grills (45) which enable the hot cinder to cool by keeping them waiting before they gall in cinder helezon in cinder pan on the upper side of cinder pan (17) after the last step of the fixed grills mounted on the ash pan – cinder pan partition (16).

10. This is coal burner in Claims 1, 2 and 9; its property is that combustor (12) has adjustment system of burning bed thickness for two choices consisting of connection flanges and burning bed adjustment plate (46) which is with secondary air cooling to give mo downward and upward movement and adjustment hose of burning bed (46) at different diameters mountable from the outer side in the burner with two walls and which enable the thickness of the burning bed on the grills to be adjusted according to grain size of the coal to be burnt on the upper side of the beginning part.

11. This is coal burner in Claims 1, 2 and 10; and its property is that on the exit of ash carrying helezon conveyor (19) is ash unloading cap (50) which is automatically closed and opened fully depending on the cinder unloading servomotor (49) commanded from the automation panel in the exit of cinder carriage helezon conveyor (20) and ash unloading cap which is automatically closed and opened depending on the ash unloading servomotor (47) commanded from the PLC controlled automation panel.

12. This is coal burner in Claims 1, 2 and 7; and its property is that there is two full-automation dry desulphurization system consisting of a series of private hoses (54) which enable the dust and lime to flow in uniform way and vibrator (53) which enables the lime to flow by giving vibrations to lime feeding clamp, and servomotor opening and closing lime feeding clamp (52), special lime feeding clamp which adjusts the dust lime in the dust feeding silo to flow in rate appropriately for the sulphure rate in the structure of the coal (51), lime feeding silo (9), lime feeding helezon (8) to feed the lime from the upper side of the initial section of the ceiling of the combustor for the second one (12) and from the upper side of coal pre-heating bunker (10) for the first one.

11 INCORPORATED BY REFERENCE (RULE 20.6) 11

13. This is coal burner in Claims 1, 2 and 12; and its property is that lime feeding helezon (8) feeds by being in and out of the order automatically as the lime level decreases in the silo in parallel to feeding the dust lime to coal taken from the pool or main silo of dust lime commanded from PLC controlled automation panel (1) and level perception censor (55) on the lime feeding silo (9).

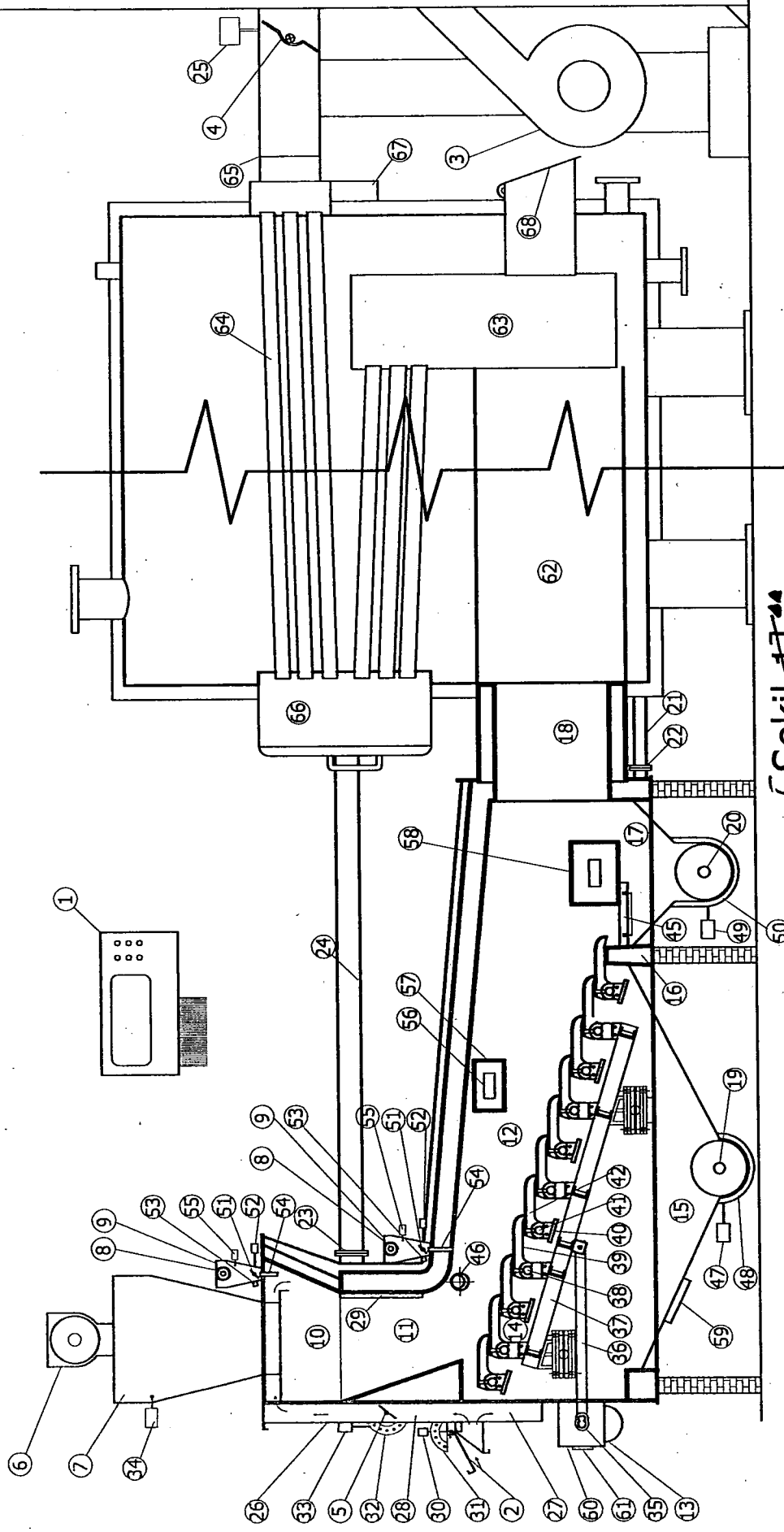
14. This is the coal burner in Claims 1, 2 and 12; and its property is that special lime feeding clamp (51) which adjusts the flow rate of the lime according to the rate of sulphur in the structure of the coal can be automatically adjusted with a servomotor (52) commanded from panel (1) of the PLC controlled automation system and also can be adjusted manually according to type of the coal used manually when necessary or by keeping automation system out of order.

15. This is coal burner in Claims 1, 7 and 9; its property is that there is two ignition-sight cap (57) with sight glass (56) resistant to high temperature on it and used for initial ignition and which is opened to combustor from the side sections and there are two cinder ash doors (58) with sight windows having sight glass resistant to high temperature on it which provides possibility for maintenance and repair in the burner when necessary and which enables us to see the cinders and cinder helezon on the last step of the grills in the upper size o the cinder ash.

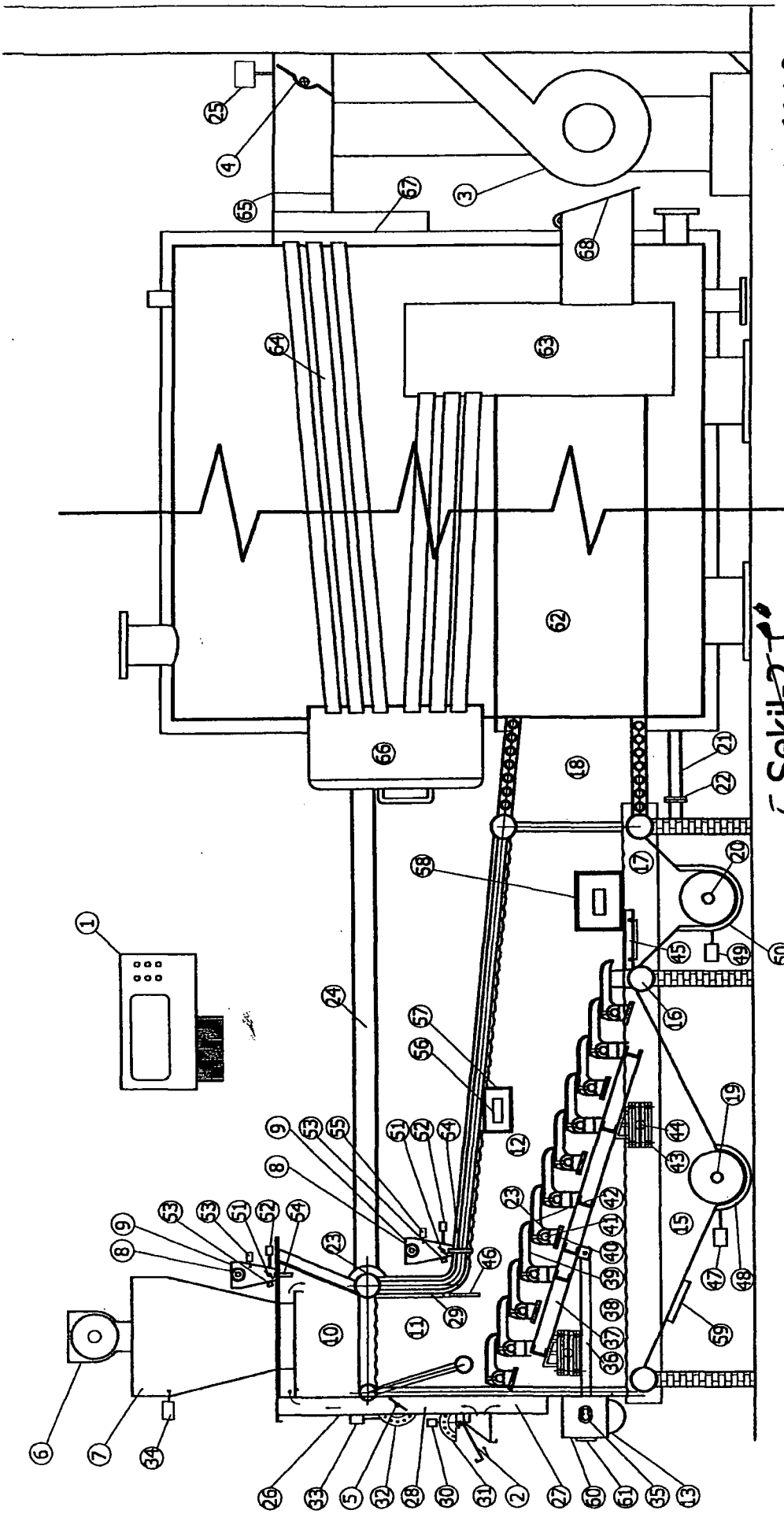
16.This is coal burner in Claims 1 , 7 and 9; and its property is there are pivot care panel (60) mountable on the burner from the front size and which keeps the eccentric pivots and beds and which gives movement to grills in the front lower part and there are lubrication caps (61) which enable the beds of the piston rods on the panel.

11

11 INCORPORATED BY REFERENCE (RULE 20.6)



[Şekil-1]
[F16-1]



20.02.2009

[Şekil-2]
[FIG-2]

" INCORPORATED BY REFERENCE (RULE 20.6) "