(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 515 088 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 158(3) EPC

(43) Date of publication:
16.03.2005 Bulletin 2005/11

(21) Application number: **03730995.2**

(22) Date of filing: **26.05.2003**

(51) Int Cl.[7]: **F23C 11/00**

(86) International application number:
PCT/UA2003/000018

(87) International publication number:
WO 2003/102469 (11.12.2003 Gazette 2003/50)

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR
Designated Extension States:
AL LT LV MK

(30) Priority: **30.05.2002 UA 02054421**

(71) Applicant: **Mal'tsev, Vadim Aleksandrovich**
Donetsk, 83000 (UA)

(72) Inventors:
- **MAL'TSEV, Vadim Aleksandrovich**
Donetsk, 83000 (UA)
- **KUSHNIR, Vyacheslav Michailovich**
Donetsk, 83000 (UA)
- **PEDOS, Valeriy Andreevich**
Donetskaya obl., 85612 (UA)
- **NIKOLAYEV, Nikolay Nikolayevich**
Donetsk, 83054 (UA)

(74) Representative: **Wilson Gunn Skerrett**
Charles House
148/9 Great Charles Street
Birmingham B3 3HT (GB)

(54) METHOD FOR PREPARING OXIDISER FOR FUEL COMBUSTION

(57) The discovery relates to heat-and-power engineering, and can be used for fuel combustion. The objective of the invention is to save energy and protect the environment. The purpose of the invention is to develop such an oxydiser preparation device for fuel combustion, which could intensify the fuel combustion process as much as possible, while reducing the quantity of the air feed and the quantity of waste gases. The problem is solved in that the device comprises a grid electrode, electrically insulated from the walls of the oxydiser pipeline, and in addition the grid electrode is fitted with electric charge exhausters, which are preferably 60-120 mm. long, the blunt ends of which are firmly fastened to the intersection units of the longitudinal and transverse conductors of the grid, while the pointed ends are orientated in the direction of movement of the oxydiser flow.

Such a construction makes it possible to increase the efficiency of the heating units and reduce the air consumption and the amount of harmful substances ejected into the atmosphere. In addition, the nearer the device presented is positioned to the fuel combustion location, the greater the effect of its operation will be. The intensification of the fuel combustion process, due to a more intensive ionisation of the oxydiser resulting from the use of the device presented, makes it possible to reduce the fuel expenditure in the thermal power station boiler installations by a mean value of 0.5-1.5% and in the thermal electric power station boiler installations by 2.5-3%, to increase the efficiency of the thermal power station heating units by 0.5-1.0%, and of the thermal electric power station heating units of industrial installations and industrial boiler units by 2.0-3.0%, and to reduce the gross ejection of harmful substances into the atmosphere by a mean of 8-12%.

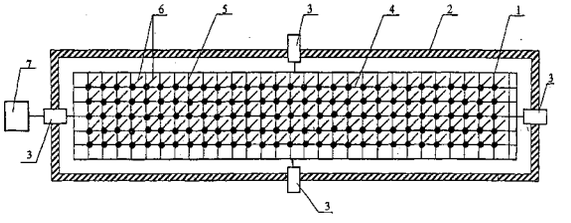

Fig. 1

EP 1 515 088 A1

Description

Area of technology

[0001] The discovery relates to heat-and-power engineering, and can be used in fuel combustion. The objective of the invention is to save energy and to protect the environment.

State of the art

[0002] A device is known which comprises a rod-shaped electrode connected to an alternating current source and a high-voltage pulse tension source [Russian patent no. 2058510, F24F3/16, published 20. 4. '96]. This type of oxydiser preparation makes it possible to increase the electronic emission and to obtain a gas discharge using an electrical tension of a few tens of kilowatts, instead of hundreds or thousands.

[0003] The disadvantage of this design is its complexity and energy consumption.

[0004] Another device is known which comprises rod-shaped electrodes connected to an electrical current source and positioned in the walls of an initial burner nozzle [USSR patent application no. 1048245, F23D13/44, published 15. 10. '83].

[0005] However, it should be pointed out that with a design of this nature ionisation of the oxydiser takes place in the gas discharge, which requires a higher voltage, and moreover in the conditions of a dusty ambience the gas discharge is unstable, and this can lead to complications during operation.

Description of invention

[0006] Essentially, the nearest technical equivalent to the invention in question is a device which comprises a grid-shaped electrode, which is positioned in the oxydiser piping, and electrically insulated from the oxydiser piping walls [Ukraine patent no. 24193 A, F23C 11/00, published 7. 7. '98].

[0007] However, the use of this device does not allow the desired depth of ionisation of the air (the oxydiser) and the desired uniform distribution of ionised particles across the oxydiser flow section to be obtained, or even the desired maximum intensification of fuel combustion.

[0008] The objective of the invention is to create an oxydiser preparation device for fuel combustion which could intensify the fuel combustion process as much as possible, and reduce the air feed level and the quantity of waste gases through the positioning of electric charge exhausters on the electrode grid, the pointed ends of which are orientated in the direction of movement of the oxydiser flow, which makes it possible to reduce the quantity of harmful substances ejected into the environment and to increase the efficiency of heating units.

[0009] The problem posed is solved in that the following improvements are provided for in a device for oxydiser preparation which comprises a rod-shaped electrode, positioned in the oxydiser piping and electrically insulated from the walls of the oxydiser piping.

[0010] The electrode grid is equipped with electric charge exhausters positioned at right angles to the grid floor;

[0011] The electric charge exhausters are preferably 60-120 mm. long;

[0012] The electric charge exhausters are tightly fastened by the blunt ends to the intersection units of the longitudinal and transverse conductors of the grid;

[0013] The pointed ends of the electric charge exhausters are orientated in the direction of the air flow movement.

[0014] An electric current of 20-25 kilowatts DC is applied to the grid-shaped electrode with the electric charge exhausters. The charged grid creates a non-uniform electrical field in the airline, through which air is fed from the pressurised blower fan to the fuel burners of the heating unit.

[0015] As a result of the passage of the air through the electrical field, it is ionised. In addition, the oxygen contained in the air, and used as an oxydiser during combustion is activated. The activated charged particles of oxygen flow from the tips of the electric charge exhausters, and are uniformly distributed over the entire section of the oxydiser's mobile flow, are captured by them and taken away to the fuel device.

[0016] The degree of ionisation of the oxydiser is specified by the current leak level (cll), and depends on the height of the electric charge exhausters.

h = 40 mm.	cll = 1.8 ma
h = 50 mm.	cll = 1.8 ma
h = 60 mm.	cll = 2.0 ma
h = 80 mm.	cll = 2.5 ma
h = 120 mm.	cll = 3.5 ma

(continued)

h - 130 mm. h = 140 mm.	cll = 3.5 ma cll = 3.4 ma

[0017] These measurements show that a more efficient ionisation process takes place if the length of the electric charge exhausters is 60-120 mm.. If the length of the electric charge exhausters is less than 60 mm., the current leak level is reduced, and the degree of ionisation of the oxydiser is not great enough to intensify the fuel oxidation process.

[0018] If the electric charge exhausters are made longer than 120 mm., this is not expedient since, if all parameters for carrying out the fuel combustion process are constant, and with attention being paid to the life of the charged particles, the current leak level remains approximately constant.

[0019] The activated oxygen present in the air, and used as an oxydiser during combustion, intensifies the combustion reaction, assists in a fuller burning of the combustion constituents of the fuel, reduces the volume of oxydiser (air) which is essential for the combustion of a specific quantity of fuel, by comparison with normal conditions, increases the combustion temperature and reduces the torch length, which leads to the intensification of radiant heat emission. This has a positive effect on increasing the efficiency of heating units. The actual reduction of the volume of oxydiser (air) leads to a reduction in heat losses through waste gases. And as a result of the fact that the amount of air fed into the combustion is reduced, there is a corresponding decrease in the quantity of smoke gases being led off into the atmosphere and as a result the heat loss is curtailed. Consequently, under unchanged conditions (from a percentage point of view), as regards the waste gases of harmful substances, their gross ejection into the atmosphere is reduced.

[0020] In addition to this, in industrial furnaces, requiring an orientated heat exchange from the torch to the heat absorption surface, in the event that an electrical field is laid down the torch will "adhere more densely" to the heating surface. The electrified fuel particles will approach the earthed heating surface and will create a high-temperature area near it, which provides a certain increase in the kinetic energy of the torch.

[0021] As a result, the fuel does not need to be heated up as much as would be necessary in normal circumstances to generate a unit of heat. All of this leads to an increase in the efficiency of heating units and, in sum, to a saving of fuel. The effect will be greater if the grid electrode is positioned directly in front of the fuel ignitor.

[0022] Thus an analysis of the essential characteristic features displayed by the device presented has shown that such features, or the similar features which are developed within the set of characteristics, are not present in the known technical solutions, which means a conclusion can be drawn that the set of features of the device presented fulfils the criterion for "presence of difference", and to an extent sufficient for the achievement of the technical result obtained by the invention.

Short description of drawings

[0023] The core of the invention is clarified by a detailed description of a specific embodiment, with references to the appended drawing, where the proposed device is presented schematically.

Best variant specific embodiment

[0024] The drawing shows the device presented, set up in an airline. The oxydiser preparation device for fuel combustion comprises a metallic electrode grid 1, set up inside an airline 2, separated from the walls of the airline 2 by continuous ceramic insulators 3. At the intersection points of the longitudinal 4 and transverse 5 electric charge conductors, electric charge exhausters 6 have been set up. The electrical voltage on the electrode 1 is supplied by a power source 7 through the continuous ceramic insulator 3.

[0025] The proposed device works in the following manner.

[0026] Air containing an oxydiser is fed along the airline 2 into the fuel ignitor (not shown on drawing). In the airline 2, the oxydiser travels through an electrode which takes the form of a metallic grid 1, made up of longitudinal 4 and transverse 5 electric charge conductors, firmly fastened at the intersection points of the electric charge exhauster conductors 6. An electric current of 20-25 Ka is fed onto the electrode 1 through a continuous ceramic insulator 3. The grid becomes charged, and creates a non-uniform electrical field in the airline, under the influence of which the oxydiser travelling through the electrode is activated to generate atomic oxygen, and becomes a more powerful oxydiser than molecular oxygen. In addition, the power of the rectifier used to obtain the essential current does not exceed 20 Watts.

[0027] The operation of the oxydiser preparation device for fuel combustion has been tested on the boiler installations of various companies in the Ukraine: "Cherkass Instrument Making Plant", "Donyetsk Metallurgical Plant" VAT et al..

[0028] Table 1 lists the comparative data which support the effectiveness of the electro-physical influence of the device presented and the prototype for fuel combustion.

Table 1

Item no.	Indicators	Cherkass Instrument Making Plant (water heating boiler KV-GM-30)	"Donyetsk Mettalurgical Plant" VAT (boiler BKZ-75-39-F5)
1	Operation of boiler with prototype ionisation device switched on:		
	Efficiency of boiler, %	92.63	85.87
	Specific natural gas expenditure, $m.^3$/Gcal.	136.72	166.36 (kg. u. t./Gcal)
	Specific electrical energy expenditure on draught and blast, kilowatt hours/Gcal.		13.12
2	Operation of boiler with ionisation device according to invention switched on		
	Efficiency, %	93.78	88.58
	Specific natural gas expenditure, $m.^3$/Gcal.	132.80	161.28 kg.u.t./Gcal.
	Specific electrical energy expenditure on draught and blast, kilowatt.hour/Gcal.		11.95
	Natural gas saving for production of 1 Gcal. of heat, $m.^3$/Gcal.	3.92	5.08
	Electro-energy saving per 1 Gcal. of heat		1.17 kilowatt.hour/Gcal.
3	Annual natural gas saving, $m.^3$/ year	174885 x 3.92 = 724741 $m.^3$/ year	-
4	Annual comparison fuel saving, kg. u. t./year Re-calculated in natural gas terms, $m.^3$/year	-	708097 x 5.08 = 3597133 3597133 x (7000:8000) = 3147491
5	Annual electro-energy saving, kilowatt.hour/year		708097 x 1.17 = 828474

[0029] Where

708097 is the heat production from the BK3 boilers (Gcal./year)
7000 is the calorie content of the comparison fuel, Kcal./kg.
8000 is the calorie content of natural gas, kcal/$m.^3$

[0030] The experimental data displayed clearly demonstrate the advantage of the invention by comparison with the prototype: the efficiency of the heating unit is increased; there is a saving in natural gas and in electrical energy.

[0031] Table 2 lists experimental and calculated data if the temperature of the waste gases is reduced and the excess air ratio for the boiler if the prototype air ionisation device and the air ionisation device according to invention are switched on.

Table 2

Item no.	Name of indicators	Values measured	for
		Ionisation device switched on (prototype)	Ionisation device switched on (according to invention)
1	Steam production, tonnes/hour	43.0	43.8
2	Heated steam pressure, ° C.	36.0	36.0
3	Superheated steam temperature, ° C.	440	435
4	Feed water temperature, ° C.	107	107
5	Natural gas expenditure, $m.^3$/ hour	4020	4020
6	Air pressure after blower, kgs./ $m.^2$	140	80
7	Pressure gradient on air heater, kgs./$m.^2$	25	15
8	Composition of combustion products for air heater, %		
	RO_2	5.1	5.9
	O_2	13.7	11.9
	CO	0.003	0.0003
	NO_x	40	37
0	Smoke extraction load, A	35	32
10	Blower fan load, A	145	135

[0032] The results of the experimental investigations (Table 2) also indicate the advantage of the device presented: the load on the smoke extraction and the blower fan is reduced, the amounts of harmful substances ejected into the atmosphere are reduced, and the generation of steam et al. is increased.

Industrial applicability

[0033] Thus, in accordance with the data from Tables 1 and 2, we can draw the conclusion that the set of characteristic features of the device presented is fully capable of solving the problem presented, and in addition that the device presented appears simple to manufacture and is distinguished by its stability and operational reliability.

[0034] The device presented is capable of carrying out the fuel combustion process more intensely, due to a more intensive ionisation of the oxydiser, which makes it possible to reduce the expenditure of fuel in thermal power station boiler installations by a mean level of 0.5-1.5%, and in the boiler installations of thermal electric power stations for industrial plants by 2.5-3%; to increase the efficiency of thermal power station heating units by 0.5-1.0%, and of the heating units of thermal electric power stations for industrial plants by 2.0-3.0%, and to reduce the gross ejection of harmful substances into the atmosphere by a mean level of 8-12%.

[0035] These data indicate that the set of characteristic features presented makes it possible to obtain a new and more positive effect.

[0036] The device presented is technically easy to manufacture, with the aid of known equipment, and using known technologies and accessible materials.

Claims

1. An oxydiser preparation device for fuel combustion, comprising a grid electrode, electrically insulated from the walls of the oxydiser pipeline, is distinguished by the fact that the grid electrode is fitted with electric charge exhausters, which are preferably 60-120 mm. long, the blunt end of which is firmly fastened in the intersection units of the longitudinal and transverse conductors of the grid, while the pointed ends are orientated in the direction of

movement of the oxydiser flow.

2. Device as paragraph 1, distinguished by the fact that each electric charge exhauster is installed at right angles to the grid floor.

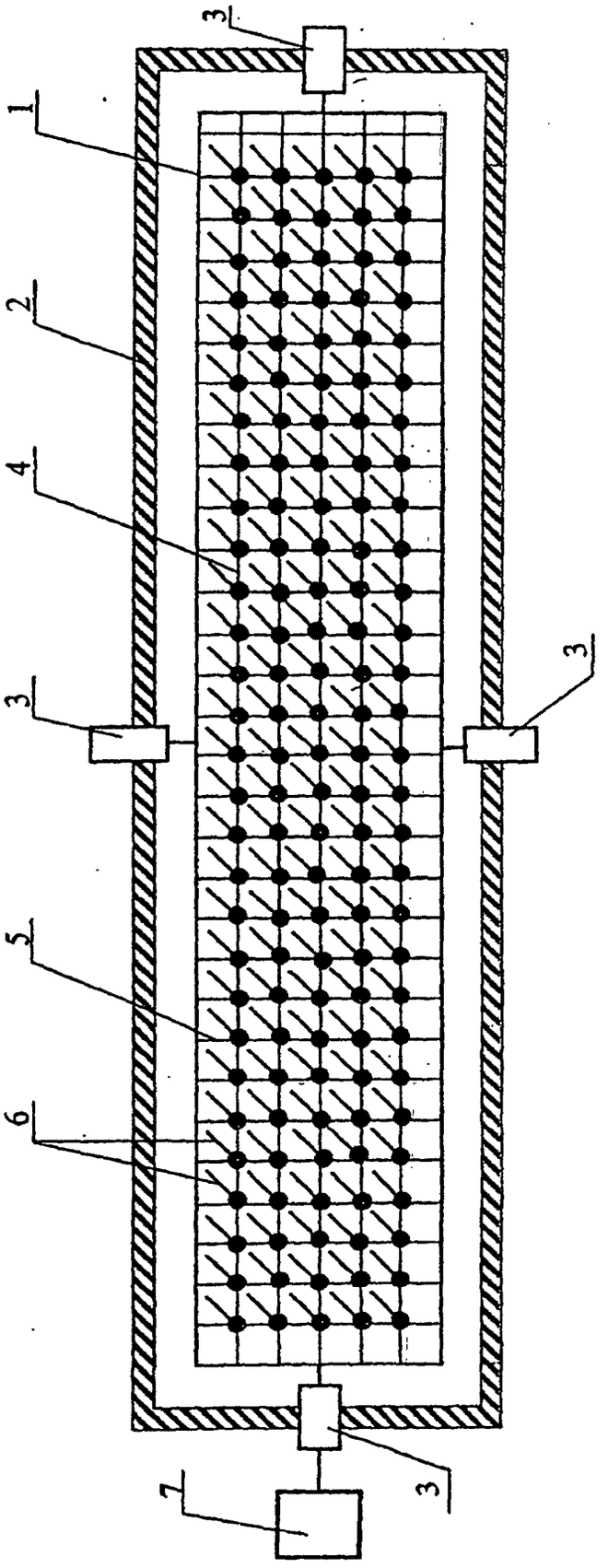

Fig. 1

PCT/UA 03/00018

A. CLASSIFICATION OF SUBJECT MATTER

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	UA 24193 A (SCHKLYAR VIKTOR SOLOMONOVICH et al) 30.10.1998	1, 2
A	SU 1198324 A (M. YA. PURMAL) 15.12.1985	1, 2
A	RU 2008501 C1 (POPOV VALERY ANDREEVICH) 28.02.1994	1, 2
A	SU 1288448 A2 (M. YA. PURMAL) 07.02.1987	1, 2
A	US 5085040 A (THE SECRETARY OF STATE FOR DEFENCE IN HER BRITANNIC MAJESTY'S GOVERNMENT OF THE UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND) Feb. 4, 1992	1, 2
A		1, 2

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
(08.09.2003)	(18.09.2003)
Name and mailing address of the ISA/ RU	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)