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THE DEVELOPMENT AND APPLICATION OF MECHANICAL AND ELECTRONIC MULTIPLEX DOUBLE FIELDS ESP

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ABSTRACT
This paper demonstrates the technical and structure characteristics of the new type Multiplex Double Fields ESP of our company. This ESP not only separates the charging and dust collecting completely, but also optimizes the electric operation of each section and make the best of the Double Fields advantage so that it can enhance the collecting of the high resistance and low resistance dust, which improves the dust cleaning efficiency. LongKing has gained national patent on this technique.

PREFACE

ESP can treat large volume of gas with little resistance and high efficiency, which makes it the best equipment for atmosphere pollution abatement. But traditional ESP is sensitive to dust resistance, for those whose ?<10^4O.cm(for example the fly ash combustibles(Cfh)>12%) or?>10^{11}O.cm (such as low sulfur, low Na, low gas water content, high silicon aluminium dust), all can sharply decrease the dust cleaning efficiency. To keep high efficiency, the number of fields should be increased or gas velocity of fields should be decreased, which will sharply increase ESP size and make high investment. Thus ESP manufacturers from inland and abroad are developing new technology and ESP with smaller size and low steel consumption and high efficiency and adaptable for wide variety of gases.

For normal single field ESP, the charging and dust collecting happen in the same section, which makes it difficult for optimizing both of them.

For high resistance dust, since the charge of dust on collecting plate is hard to be released, high voltage drop is formed on the dust layers which accumulating to a certain thickness, which causes gas gap breakdown between layers that makes back corona and decrease dust cleaning efficiency.

For low resistance dust, when arriving collecting plate, it not only releases charge but also gets positive charge the same as the collecting electrode because of electrostatic induction. If the force formed by positive charge is big enough to overcome the adhesion force of dust, then the dust accumulated on collecting electrode will go back to gas flow and may be brought away, which lowers efficiency.

Double fields ESP separates charging from dust collecting to avoid mutual affection.
As to the structure of the new type double fields ESP of our company, it not only separates charging from dust collecting, but also uses continuous multiplex small double fields with respective power supplies for charging and dust collecting, which optimizes the electric operation of each section to adapt the collecting of high and low resistance dust and prevent the back corona of high resistance dust from happening and the rebound of low resistance particle and then, improves the dust cleaning efficiency.

This technology gained national patent in April , 2005.

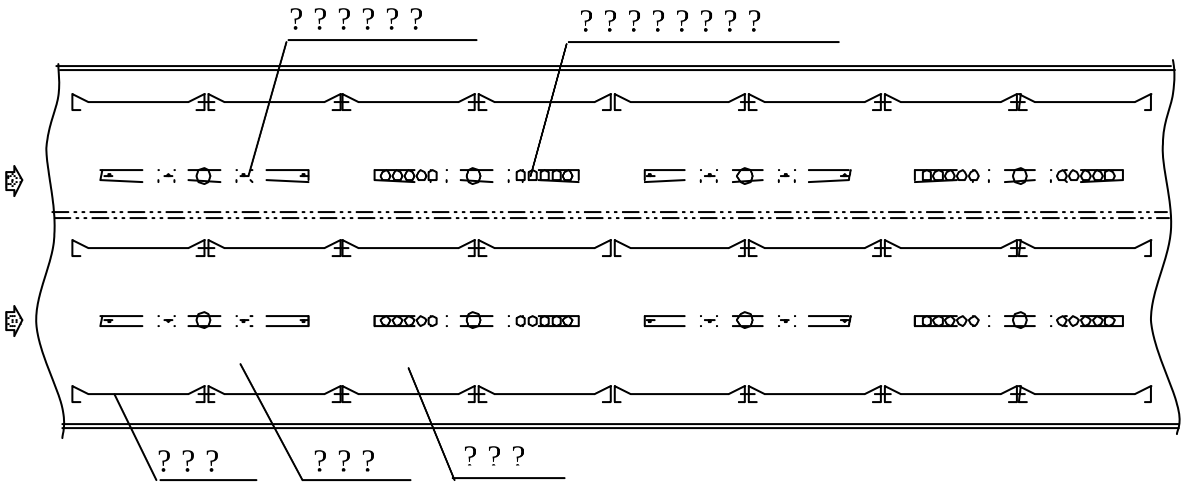
1 CHARACTERISTICS OF MECHANICAL AND ELECTRONIC MULTIPLEX DOUBLE FIELDS ESP

By using "mechanical and electronic multiplex double fields structure"technique, we can not only separate the charging area from collecting area totally but also make continuous multiplex configuration; meanwhile make respective multiplex configuration for power supply as to charging area and collecting area, which forms "mechanical and electronic multiplex double fields"Check coal and collecting field.(as to figure 1).

Since charging area and collecting area takes their own power supplies respectively and power supply for collecting area is 80kV, which optimizing the electric operation conditions of each section and enhance the charging and dust collecting, it can adapt a wider scope of work conditions and prevent back corona well.

As to dust collection,there is full charging for the first half field and the dust of negative charge is collected on the collecting plate.

Discharge electrode **Discharge auxiliary collecting electrode**



Collecting electrode Discharge area Collecting area

? 1: “? ? ? ? ? ? ? ”? ? ? ? ? ? ? ? ?

Figure 1:“Mechanical and electronic multiplex double fields” collecting field

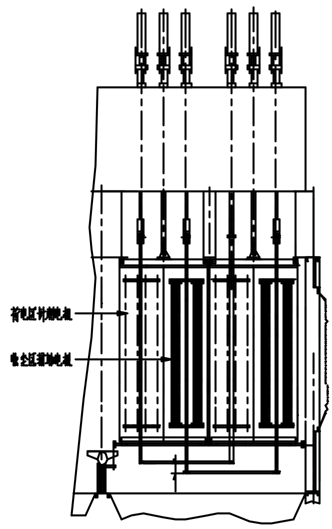
Auxiliary electrode and collecting plate of second half area form a uniform field ,which can enhance field strength and breakdown voltage. This area makes no corona, so no back corona there. Since there is no enough design for collecting positive ions in the normal ESP, the auxiliary electrode is designed to collect positive ions dust, which improves dust collecting efficiency and ,through different kinds of power supplies, we can adjust the rapping period and electric parameter to optimize the opertion(prevent or delay the back corona)and improve the efficiency.

With the increacing requirement of environment pretection, using the double fields ESP in second half field to collect fine high-resistance dust and high Cfh dust is good to ensure the oulet emission to be lower than 50mg/Nm^3, which improves the efficiency.

2 WIRE-PLATE OF MECHANICAL AND ELECTRONIC MULTIPLEX DOUBLE FIELDS

2.1 Wire-plate

As to the structure of BE ESP, there is normal BE wire-plate for dust charging in front field and for collecting charged dust on collecting plate.



As an important field, the last field separate the double-mast Emitting frame of a standard section of BE ESP into two single-mast emitting frames, each single-mast emitting frame for two collecting plates, as to the flow direction two adjacent single-mast emitting frames respectively acts as discharging electrode and auxiliary electrode staggered arranged, i.e.: discharging electrodes for the front field and auxiliary electrode for dust collecting for the at backstage field, see figure 2.

-------Spike electrode of charging area
-------Auxiliary electrode of collecting area
Figure 2

Auxiliary electrode
Take the circular pipes as electrodes that opposite to the BE collecting plate, which form a uniform field as to figure 3. The pipes has big surface area, which makes big collecting area for collecting positive-ion dust.

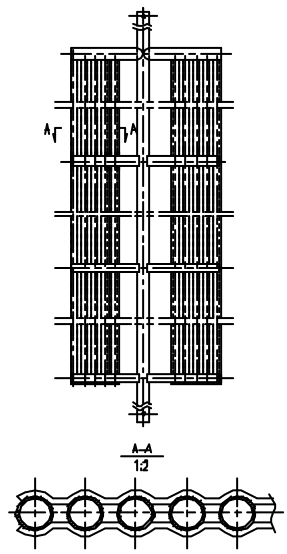


Figure 3

3 HV POWER SUPPLY OF MECHANICAL AND ELECTRONIC MULTIPLEX DOUBLE FIELDS ESP

The collecting area of double fields ESP is tested to have high operating voltage and no corona current through current density test. So it takes the discharge zone according to normal plate current density and voltage. In collecting area, considering the charged dust entering the first field, the output voltage of the HV Transformer Rectifier Equipment is taken as 80 kV.

4 APPLICATION EXAMPLE

In one power plant inland, a 2X130t/h boiler Membrane electrostatic precipitator is retrofitted into BES102-4 mechanical and electronic multiplex double fields ESP, see figure4

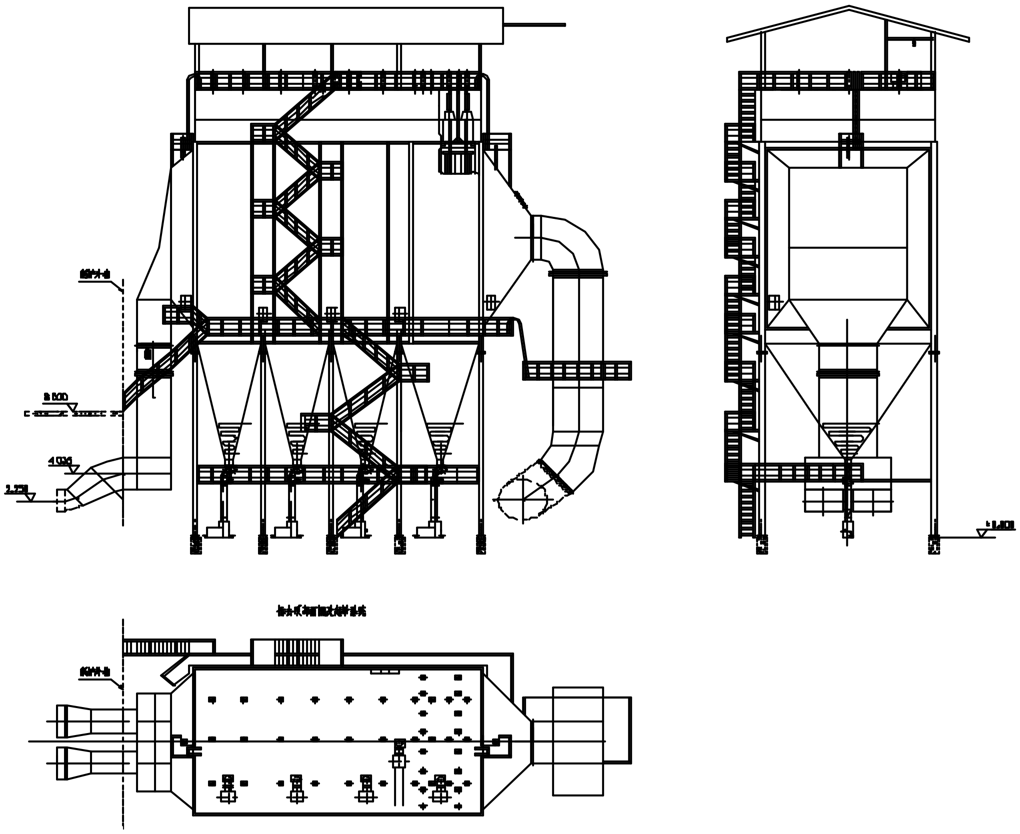


Figure 4

4.1 Boiler technological parameter

4.1.1 Boiler type: Mid-temperature and mid-pressure gas shielded boiler

4.1.2 Maximum continuous evaporation rate130t/h

4.1.3 Air pre-heater type: Tubular air pre-heater

4.1.4 Ash removing way: ash pumping

4.2 Original design parameter

4.2.1 ESP number for each boiler: one

4.2.2 Fields number : 4

4.2.3 Inlet gas volume of ESP: 230000m^3/h

4.2.4 Inlet gas temperature of ESP: 145^{o}C

4.2.5 Inlet dust volume of ESP: 44.4g/Nm^3

4.2.6 Outle emission concentration: <150mg/Nm^3

4.2.7 Mechanical resistance: =245Pa

4.2.8 Mechanical air leakage: =2.5%

4.2.9 Dust cleaning efficiency: =99.66%

4.3 Coals

4.3.1 Coal type

The coals designed in this project is local bituminous coal and anthracitic coal of proportion 1/1, check coal is anthracitic coal.

Coal analysis Item	Signal	Unit	Coals designed	Check coal
Carbon as received Basis	Car	%	55.87	48.00
Hydrogen as received Basis	Har	%	1.59	1.41
Oxygen as received Basis	Oar	%	2.55	2.54
Nitrogen as received Basis	Nar	%	0.73	0.90
Sulphur as received Basis	Sar	%	0.62	1.00
Dry ash-free basis volatile component	Vdaf	%	10.46	8.99
Ash content	Aar	%	31.04	37.55
Total moisture	Mt.ar	%	7.60	8.60
Basis received low heat value	Qnet.ar	MJ/kg	20.08	15.95

4.3.2 Ash content analysis

Item	Signal	Unit	Coals designed	Check coal
SiO_2	SiO_2	%	52.96	60.56
Al_2O_3	Al_2O_3	%	26.49	22.28
Fe_2O_3	Fe_2O_3	%	11.24	8.28
CaO	CaO	%	1.06	0.88
MgO	MgO	%	0.98	0.20
K_2O	K_2O	%	3.36	2.89
Na_2O	Na_2O	%	1.93	0.64
TiO_2	TiO_2	%	0.66	1.03
SO_3	SO_3	%	0.55	4.90
Cfh	Cfh	%	32.51	

4.3.3 Ash resistance

Parameter	test voltage(V)				
	10	100	250	500	1000
Gas temperature(?)	150				
Electrode factor K1	13.6				
O measuring range K2	10^3	10^2	10^2	10^2	10^2

Voltage factorK3		10	25	50	100
Resistance value R MO		15	14	2.4	3.5
Specific resistance? O.cm		$2.04X10^{11}$	$4.76X10^{11}$	$1.63X10^{11}$	$4.76X10^{11}$

4.4 ESP parameter
4.4.1 Type BES102-4
4.4.2 Cross section $102m^2$
4.4.3 Effective height of plate 12m
4.4.4 Passage number 21
4.4.5 Effective length of field 12.272m
4.4.6 Collect plate type ZT24+BE
4.4.7 Emission electrode type V15 line + auxiliary electrode
4.5 ESP electric operation parameter

Field		U1 V	I1 A	U2 KV	I2 mA	Sparking rate %
1 Field		282	83	52	298	12
2 Field		345	103	57	400	5
3 Field		315	115	50	450	0
4 Field(double fields)	Charge field	364	93	60	360	0
	Collecting field	359	13	79	36	0

4.6 Result of ESP test
These two boiler was retrofitted respectively in April and June, 2004. After ESP operating for 3000 hours, the efficiency test was done on the ESP with full-load operation, using designed coals . The efficiency is 99.93% with outlet emission 27.4mg/ Nm^3, which met and exceed the requirement that designed.

5 CONCLUSION
With the rapid development of the power industry? building material? metallurgies? chemical industries and so on, there will be an great increase in gas emission treatment.ESP dust-collecting is currently a main method for dust handling in our country.

Because of the industrialization and urbanization, we will face big challenge of various environment problems.

To improve people's quality of life, the authority raises the requirement of environmental protection and makes strict dust emission standard, thus the efficiency and reliability of ESP should be improved. To develop a new type ESP with high cost performance is very important for developing our environmental protection industry and ESP technology and , it has a large potential market.