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(54) ELECTROSTATIC PRECIPITATOR WITH TWO TRANSFORMERS PER FIELD, FOR INDEPENDENTLY ENERGISING ONE GROUP OF ELECTRODES AT THE START AND ANOTHER GROUP OF ELECTRODES AT THE END OF THE SAME CORRIDOR

(57) The invention defines a new model of Electrostatic Precipitator (ESP) provided with a new control variable, obtained by adding a second HV transformer to each ESP Field. One HV transformer will have the task to control the voltage applied to relayed and locally isolated emitting electrodes, while the other HV transformer controls the voltage applied to the remaining non-relayed and non-isolated emitting electrodes of the corridors of the field. This dual independent control capability results in a large increase in collection efficiency.

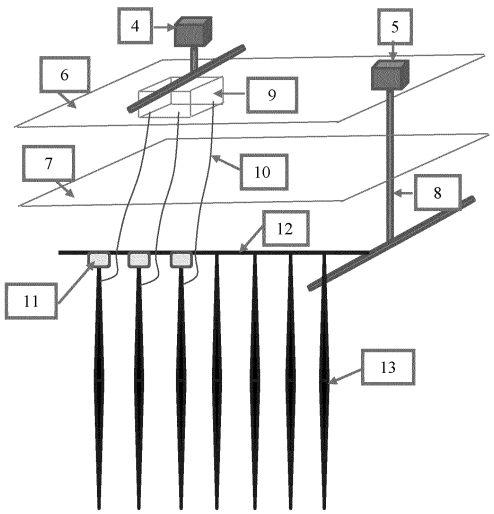

FIGURE 2

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Description

FIELD OF THE INVENTION

[0001] Electrostatic Precipitators (ESPs) are industrial pollution particulate and/or gaseous emission control equipment.

BACKGROUND OF THE INVENTION

[0002] All modern ESPs have the same basic operating principle: High Voltage is applied to a series of consecutive emitting electrodes, positioned in the center lines of a set of identical parallel corridors. These elements, associated with a **single** High Voltage Transformer form a set called Field. On each of the emitting electrodes an ionization effect is produced by the HV. The ionized zone around each emitting electrode is known as Corona.

[0003] The ions generated in the Corona migrate towards the grounded plates, known as collector plates, which form the walls of each corridor in the field. As the ions travels transversally to the direction of the particles that travel dragged by the flow of the effluent to be cleansed, the ions lend electrostatic charges to the particles.

[0004] Under the action of the Electric Field originated at the emitting electrodes, the now charged particles are pushed towards the collector plates, where they are deposited in form of layers which are subsequently removed by mechanical beating actions.

[0005] The main limitations of efficiency of conventional modern ESPs in this process of collecting particles are called Sparking and Back Corona.

[0006] These two effects are directly proportional to the High Voltage applied. If the particles being collected have low resistivity the layer formed is conductive, what brings the ground near to the emitting electrode, favoring the dielectric rupture in the form of a spark. If the particles being collected have high resistivity the layer formed is resistive, what impedes the flow of charges to the ground, resulting in another adverse effect known as back corona.

[0007] The only way to cope with these restrictive phenomena is to lower the applied HV, what causes loss of efficiency, mainly in the capture of submicron particles, which tends to penetrate all along the entire length of de ESP. The present invention attacks these limitations and at the same time allows the ESP to operate at a higher voltage level, creating the ability to capture superfine particles. As simultaneously the coarser particles are also collected, the layer formed presents an important characteristic, of mixed composition in an effect of a sponge. In the deposited layers the coarser particles retain in their midst the fines ones. This is the utmost better place for the super fines particles to be captured, avoiding re entrainment and giving a much higher efficiency to the ESP. The present invention uses HV relays in a few emitting electrodes together with local insulators, what enables the local control of sparking and/or back corona, without the necessity of lowering the HV. The presence of the second HV in each Field, to feed the remaining non relayed emitting electrodes, creates a new control variable, not existent in any modern ESP, which results in an even greater increase in collection efficiency.

[0008] The technical problem that has not been solved by the state of the art of all conventional ESPs is the fact that all electrodes in each field receive the same voltage although is a known fact that the surroundings of consecutive emitting electrodes are different in term of particles concentrations. The introduction of local emitting electrode alumina insulators together with dedicated relays enables **local control** over sparking and back corona. The non-relayed electrodes, at the end of each corridor, can and will receive a higher voltage, since in this region, after partial collection already occurred in the switched electrodes, there is always a lower concentration of suspended particulates. This fact allows the use of a higher voltage in this region, and consequently greater collection efficiency. Modern ESPs have one transformer per field and can only apply the same voltage to all electrodes in the corridor. The present solution was to develop the invention of ESPs with 2 Transformers per field, one dedicated to selective switching and another for conventional action. As the voltages in each transformer can be applied at different values, the **new control variable** referred was created.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

Figure 1 shows one photo of the interior of an industrial ESP where the first test of the use of alumina local isolators was made. To perform the test the local isolators were "jumped", by means of tiny stripes of metal fixed by bolts at their surfaces. The real isolators won't be jumped and will have the format needed in each of the different types of ESPs 'designs. The alumina isolators proved to be reliable in further tests.

Local insulator made of Alumina (1)

Emitting electrode (2)

Collector plate (3)

Figure 2 shows the scheme for independent energizing two groups of emitting electrodes of the same corridor. With the effluent flow direction from left to wright in Figure 2, the electrodes at the entrance of the corridor (all of these electrodes have alumina local insulators at both points of fixation, although the scheme in Figure 2 and the photo in Figure 1 show just one extremity of each electrode) are powered by

High Voltage Transformer number 4 while the electrodes at the end of the corridor are powered independently by the High Voltage Transformer number 5.

Transformer dedicated to the group of isolated emitting electrodes (4)

Transformer dedicated to the group of non-isolated emitting electrodes (5)

Cold ceiling (6)

Hot ceiling (7)

HV conductor and distribution bars (8)

Relay Box (9)

High insulation flexible cables (10)

Local alumina electrode insulators (11)

Internal HV bus (12)

Emitting Electrodes (13)

DETAILED DESCRIPTION OF THE INVENTION

[0010] The configuration with 2 HV Transformers per field also eliminates the need to "shunt" the high voltage from the internal bus to the relay box and return to the electrodes, which eliminates the main spurious ionization points on the internal bus and reduces drilling in ceilings, with the elimination of many potential voltage leakage points. This solution has a high value from the point of view of the practical feasibility of building the technology. The HV relays, commercially available, were also tested in the proceedings related to Figure 1 and shown high reliability. Any potential fabricator will then have all the new components tested as viable,

[0011] The use of two different voltage levels along the same corridor have not been tested yet, since the procedures related to Figure 1 was an experiment of upgrading a conventional ESP, with just one HV Transformer per field but is theoretically sound in terms of expected efficiency increase and with no practical impediment to be constructed.

[0012] Industrial Electrostatic Precipitators have maintained the construction concept practically unchanged since the beginning, this concept being the use of Fields, each field controlled by its own Transformer.

[0013] The technical improvements that have been made over the years are many and varied, from electrode formats to post-beat energization recovery techniques to the beat shapes themselves. None of them, however, even came close to the concept presented here of operating the same line of electrodes in each corridor differently in its in and out sections.

[0014] So, the invention defines a **New Model of Electrostatic Precipitator (ESP)** and/or a new way of updating ESPs already in operation.

EXAMPLES OF EMBODIMENTS OF THE INVENTION

[0015] The technology was tested in two laboratorial experiments, one of them on a full scale, as related to Figure 1 and presented total viability, although when attempting to implement it in an industrial environment a series of insulation problems and spurious ionizations were encountered and demanded further work, which led to the present invention.

Claims

1. ndustrial Electrostatic Precipitator with two HV transformers (4) and (5) per field. One HV transformer (4) feeds a group of locally isolated (11) emitting electrodes while the second HV transformer (5) feeds the remaining non-isolated (13) emitting electrodes of the same corridor. Each HV transformer has its own independent control system, both acting in synchrony by means of as special parameterization set. That allows the simultaneous application of two independent voltage levels to both groups of emitting electrodes of the same corridor. The configuration enables that the group of relayed and isolated emitting electrodes can be individually controlled to avoid sparking and/or back corona while the group of non-relayed and non-isolated emitting electrodes can be independently parameterized in a more favorable condition.

FIGURE 1

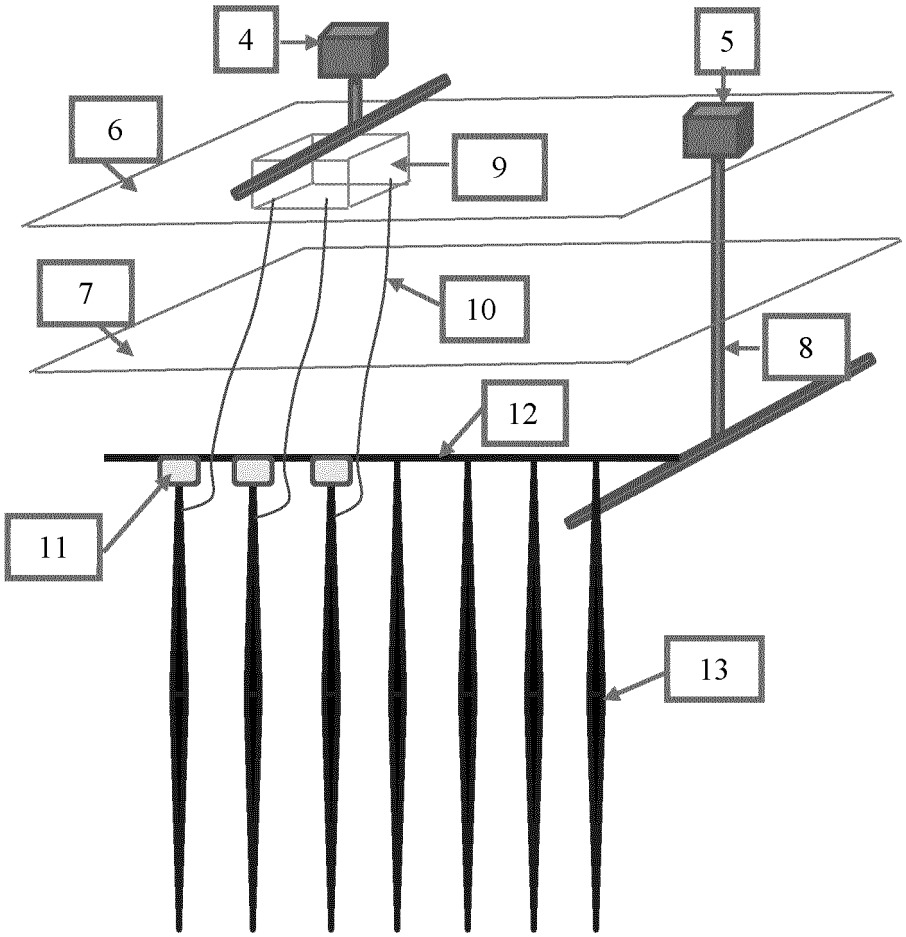

FIGURE 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/BR2023/050105

A. CLASSIFICATION OF SUBJECT MATTER

B03C 3/66 (2006.01)i; B03C 3/68 (2006.01)i; B03C 3/02 (2006.01)i
CPC: B03C3/66, B03C3/68, B03C3/02

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)

B03C

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

Base de Patentes INPI-BR

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

ESPACENET, DERWENT INNOVATIONS INDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	BR MU8403336 U (BERTHOUD JOSE SIMOES [BR]) 21 March 2006 (2006-03-21) (The whole document.)	1
A	BR 102013031946 A2 (BERTHOUD JOSE SIMOES [BR]) 17 November 2015 (2015-11-17) (The whole document.)	1
A	BR PI0503469 A (BERTHOUD JOSE SIMOES [BR]) 23 January 2007 (2007-01-23) (The whole document.)	1

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

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"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
24 May 2023	**26 May 2023**
Name and mailing address of the ISA/BR **National Institute of Industrial Property (Brazil)** **Rua Mayrink Veiga, 9, 6º andar, CEP 20.090-910 Rio de Janeiro – RJ** **Brazil** Telephone No. **(55 21) 3037-3742, 3037-3984**	Authorized officer **Rafael D'AGOSTINI** Telephone No. **+55 21 3037 4528 - 3037 3319**

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/BR2023/050105

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2011116174 A1 (RAY ISAAC [US]) 22 September 2011 (2011-09-22) (The whole document.)	1

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/BR2023/050105

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