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(54) **AN ELECTROSTATIC DUST PRECIPITATOR**

(57) An electrostatic precipitator (1) to remove dust from the gas stream (F), comprising an inlet section (2) with at least one gas distribution device (3) including distribution panels (4) in solid or perforated design, to reduce the concentration of dust particles, to reduce the pressure drops and to control the velocity profile of the gas stream (F), further comprising the main separation chamber (7) with at least one group of electrodes (8), further comprising at least one bottom hopper (9) with at least one baffle (24) and also an outlet section (10), with a horizontal gap (11) being formed between the lower edges (5) of the distribution panels (4) forming the gas distribution device (3) and the lower inclined wall (6) of the inlet section (2), wherein the gas distribution device (3) consists of a system of vertically or obliquely arranged distribution panels (4), between which vertical or oblique slots (12) are created for the passage of the gas stream (F) into the main separation chamber (7).

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## Description

### Field of the Invention

**[0001]** The present invention relates to an electrostatic precipitator, i.e. the environmental field and the field of gas purification in operations producing waste gas stream polluted with solid particles, such as incineration plants, boiler plants, cement plants, etc.

### Background of the Invention

**[0002]** Electrostatic precipitators remove dust particles from flue gas for various process applications. The quality of gas stream distribution inside the electrostatic precipitator is important to maximize the operational efficiency of the precipitator. Whereas the requirements to reduce pollution are becoming more stringent and the operating conditions of operations producing polluted gas change, the need for ever larger electrostatic precipitators increases. Increasing dust-producing operations or production volume results in higher dust load on precipitators and the need for improved efficiency of dust separation. Where there exist space constraints on the extension of the existing electrostatic precipitation system with new or system-extending elements, it is necessary to improve the participation efficiency of the already installed dust collectors.

**[0003]** The standard electrostatic precipitator consists of a main separation chamber with an electrode assembly. In addition, electrodes can be supplemented with gas distribution devices, which consist of distribution panels or separate distribution panels, with the task of acting as a baffle to the gas stream and with the shape forcing the gas to flow around or pass through these distribution panels and thus reduce the velocity of the gas stream when it flows around, and thus release heavier dust particles, which fall out of the flow due to gravity and fall downwards. As standard, the electrostatic precipitator also consists of an inlet, typically rectangular or pyramidal section, expanding towards the main separation chamber and equipped with one or more gas distribution devices. The gas distribution device here also includes perforated or solid distribution panels, which have the same function as in the main separation chamber. The main purpose of the inlet section is to reduce as much as possible the amount of solid dust particles in the gas stream entering between the electrodes in the main separation chamber. A high concentration of dust particles causes more frequent sparks, discharges the electrodes more and reduces their efficiency. Furthermore, the electrostatic precipitator is usually equipped with at least one bottom hopper, usually located under the main separation chamber to collect separated dust also from other parts of the electrostatic precipitator. At the same time, the hopper is equipped with a hole or opening for the discharge of collected dust. Furthermore, the electrostatic precipitator is usually equipped with an outlet section, typically also rectangular or pyramidal in shape, which can also be equipped with gas distribution devices. A horizontal gap is used between the lower edge of the distribution panels and the lower inclined wall of the inlet and outlet sections, so that the distribution panels are not in direct contact with the lower inclined wall.

**[0004]** In the document, the gas stream direction means the direction from the entry to the inlet section of the electrostatic precipitator, through the main separation chamber to the exit from the outlet section of the electrostatic precipitator.

**[0005]** To achieve the required quality of gas distribution in the electrostatic precipitator, various gas distribution devices are used. These are the various internal elements located in the electrostatic precipitator. These elements are designed to create the required velocity profile of the gas stream at the inlet and outlet sections of the precipitator. These elements are, for example, a turning vane, which is a flat or curved thin but long plate, installed to minimize the pressure drop and control the distribution of gas stream velocity and reduce the concentration of dust in the dust in the gas stream. An example of this solution is document WO2020026370. Another element, which is a perforated plate, serves a similar purpose. It is a plate or steel sheet with round or square openings of various diameters located at the inlet or outlet section of the electrostatic precipitator and used for the purpose of distributing the balancing gas stream. An example of this solution is document WO0194023A1. Other elements used are anti-sneakage baffles. These are the internal baffle elements in the precipitator that prevent the gas from flowing around the active zone or field of the electrostatic precipitator. These are usually located along the vertical walls of the case. Typically, the baffle surface is orthogonal to the direction of gas stream. An example of this solution is document US4725289A. Other elements used are hopper baffles. These are the internal baffle elements in the bottom hopper of the precipitator that prevent the separated dust from being swept back into the gas stream. An example is document EP0254832A2.

**[0006]** The gas distribution devices in the precipitator are mostly designed to achieve the required quality of gas distribution and to minimize gas stream resistance. The collection of a certain amount of dust on the gas distribution screens is considered as a side effect that does not directly affect the sizing of the electrostatic precipitator, i.e. the calculation of the required size of the electrostatic precipitator to achieve the required efficiency of dust removal from the gas. In applications of electrostatic precipitators for the separation of dust in a technological process where there is a risk of dust sticking to the separating elements of the electrostatic precipitator, gas distribution systems with a knocking system are used. An example is, for instance, the solution as per document WO2020026370A1. A rapping gas distribution device prevents dust from settling on gas distribution screens by forcing dust out of the flow distribution screen plates so that the distribution devices remain without obstacles unblocked with layers of dust. Pollution or deposits on distribution devices can cause significant distortion of gas stream patterns. The amount of dust collected on the inlet screens of gas distribution with a rapping system also does not directly affect the sizing of the electrostatic precipitator.

**[0007]** The advantage of the typical arrangement of known gas distribution panels at the inlet of the electrostatic precipitator is that a certain amount of dust is collected on the top of inlet distribution gas screens and subsequently, as they slide down or fall from the turning vanes, the dust avalanches are effectively blown out by the gas stream through openings in the lower parts of distribution devices.

**[0008]** In the openings of the perforated panels of the gas distribution screen, the gas stream velocity is higher than the average gas velocity in the cross-sectional area just upstream of the gas distribution screen, and the locally stronger gas streams in these openings disperse the collected, stacked dust.

**[0009]** In the lower part of the distribution screens, there is typically a large horizontal gap between the inclined wall of the inlet transition and the lower edges of the distribution panels, which allows dust avalanches to spontaneously fall down into the lower part. In this gap, the velocity of the flowing gas is higher, and as a result, the locally stronger gas stream blows the smaller solid particles out of the dust avalanches. This causes the re-dispersed solid particles once collected to enter in a larger volume into the flowing gas entering the first electric field of the electrostatic precipitator.

**[0010]** Electric energy is consumed to collect airborne dust on the surface of the collection plates in the electric field of the electrostatic precipitator. In the case of low and medium resistance of airborne dust, the higher the energy consumption, the higher the efficiency of dust separation in the electrostatic precipitator. Solid particles of smaller size are more efficiently separated from the gas stream with a stronger electric field in the electrostatic precipitator. The strength of the electric field depends on the voltage reached between the electrodes in the electrostatic precipitator; the higher the voltage, the stronger the electric field. The control system of the excitation system for the field of the electrostatic precipitator tries to maintain as high voltage as possible during operation.

**[0011]** If the concentration of solid particles in the inlet gas stream entering the first electric field of the electrostatic precipitator is high, these dust particles cause frequent electric sparks, i.e. short, sharp discharges of the electric field between the electrodes or electric arcs. The higher the concentration of solid particles, the more frequent sparks are detected by the control system. The intensity of sparks or arcs is the main limiter of the voltage and current values achieved, resulting in reduced input power in the input fields of the electrostatic precipitator, resulting in a lower overall efficiency of dust separation.

**[0012]** In the process of electrostatic precipitation of dust particles, the agglomeration and de-agglomeration effects of these particles also take place. The agglomeration effect of particles helps in the separation of solid particles from the gas stream in the electrostatic precipitator. The de-agglomeration effect of particles reduces the collection efficiency of the electrostatic precipitator. The de-agglomeration effect of particles dominates, when agglomerates of very large solid particles with very small particles hit the electrodes at high speed and the impact energy from the collision is transferred to the small particle and the agglomerates are de-fragmented. The larger particle may remain on the surface of the electrodes, but the small particles electrically recharged jump from the electrode at a relatively high velocity into the gas stream in the space between the electrodes. Therefore, the emission of particles at the outlet of the electrostatic precipitator consists mainly of the smallest solid particles.

**[0013]** Coarse solid particles tend to fall down by gravity and overcome fluid resistance in an extended low-velocity zone. In some industrial plants, mechanical pre-collectors are used upstream of electrostatic precipitators to separate solid particles from the flue gas. For the pre-collector, additional space is required upstream of the electrostatic precipitator and an additional system for separating dust from the pre-collector is needed. The pre-collector significantly increases the overall pressure drop on the gas purification device. The pressure drop of the pre-collector is usually much higher than that of the electrostatic precipitator and affects the total energy consumption of the installation, including the required power for induced draft fan.

**[0014]** The main disadvantage of the currently used electrostatic precipitators is that they cannot respond flexibly to the requirement for possible increased separation of solid dust particles, without installing a larger electrostatic precipitator, multiple precipitators in a row or additional pre-collectors. Increasing the size of the electrostatic precipitator or installing additional pre-collectors or precipitators is also often limited by the space available in structures/buildings. Another disadvantage is the already mentioned large horizontal gap between the inclined wall of the inlet transition and the lower edges of the distribution panels. This causes the particles that have already been separated to fall back, generating electric sparks or electric arcs in the electrostatic field of the electrostatic precipitator and reducing the efficiency of separation of dust particles.

**[0015]** The purpose of the invention is to create such an electrostatic precipitator that will be able to control the velocity distribution to achieve the required gas velocity profile so as to increase the efficiency of dust particle separation without the need to increase the external size of the electrostatic precipitator. First of all, it involves reducing the dynamic pressure on the gas distribution device, but at the same time, the purpose of the invention is also to reduce the risk of already separated dust particles falling back into the purified gas stream.

Summary of the Invention

**[0016]** The shortcomings of the currently known electrostatic dust precipitators are overcome by the described electrostatic precipitator, including an inlet section, a main separation chamber, at least one separated dust container, and an outlet section. The inlet section is equipped with at least one gas distribution device containing distribution panels in solid or perforated design. The gas distribution device reduces the concentration of dust particles, reduces the dynamic pressure, and controls the velocity profile of the gas stream. The separation chamber is equipped with at least one group of electrodes and at least one bottom hopper. The bottom hopper is equipped with at least one baffle. A horizontal gap is created between the lower edges of the distribution panels, which form the gas distribution device, and the lower inclined wall of the inlet section. The gas distribution device consists of a system of vertically or obliquely arranged distribution panels, between which vertical or oblique slots are created for the passage of the gas stream from the inlet section into the main separation chamber.

**[0017]** In a preferred embodiment, the distribution panels have a vertical plate base, which is provided with side edges on the sides. The side edges are installed to protrude against the direction of the gas stream.

**[0018]** In another preferred embodiment, the distribution panels have a U-shaped profile, where the side edge makes a 90° angle with the plate base. In this preferred embodiment, the first channel is formed between the side edge and the plate base to collect dust from the gas stream. The collected dust subsequently falls by gravity into the lower part of the distribution panel and further into the bottom hopper.

**[0019]** In another preferred embodiment, the side edges of just one distribution panel are bent inwards at the ends. Due to this bending, the side edges on the distribution panel also create a pair of opposite first channels and a pair of opposite second channels. The channels collect dust from the gas stream. The collected dust subsequently falls by gravity into the lower part of the distribution panel and further into the bottom hopper.

**[0020]** In another preferred embodiment, at least one distribution panel is provided with a flow baffle at its lower part that is adjacent to the lower inclined wall of the inlet section. The flow baffle thus covers at least the lower part of the distribution panel and the adjacent horizontal gap at least in width of the distribution panel. The flow baffle thus eliminates the possibility of collected dust particles falling into the bottom hopper being swept back by the gas stream flowing around the distribution panel.

**[0021]** In the following preferred embodiment, the distribution panel is made of metal or plastic profiles.

**[0022]** In another preferred embodiment, the electrostatic precipitator is equipped with a rapping system for removing sticky dust particles from the distribution panels with the gas distribution device, separate rapping system for removing sticky dust particles from the groups of electrodes and another rapping system for removing sticky dust particles from the walls of the inlet section.

**[0023]** In another preferred embodiment, the rapping system consists of a device from the group of devices: sound horn, electromagnetic hammer, pneumatic hammer, electromagnetic vibrator, hammer with a shock bar.

**[0024]** In the following preferred embodiment, the distribution panels are suspended on a chain link at their upper edge and mounted on a guide at their lower part. This type of mounting of the distribution panel is used for laterally limited movable mounting of the distribution panels and for creating free oscillations caused by the flow of gas around and through these distribution panels. This results in the automatic removing of collected dust layers from these distribution panels.

**[0025]** In another preferred embodiment, each distribution panel is equipped with a gas baffle. In this preferred embodiment, the flow baffles are streamlined shape arranged in such a way that the spacing between the lower parts of two adjacent flow baffles increases in the direction of the gas stream.

**[0026]** In another preferred embodiment, the lower part of the distribution panel is movable and is fixed to the upper part of the distribution panel by means of a hinge or a chain link.

**[0027]** In another preferred embodiment, the distribution panels are perforated and are provided with openings arranged in at least one vertical row below each other.

**[0028]** This invention relates to an electrostatic precipitator for purifying gases from the gas stream with a relatively high dust load. Examples of operations with a high dust load are operations for fossil fuel combustion in energy boilers, pulp and paper production plants, or operations of lime and cement plants. This invention is primarily intended for work under relatively high dust load conditions with limited space requirements and higher requirements for efficiency of dust separation.

**[0029]** The main advantage of this electrostatic precipitator is that it is able to significantly increase the amount of dust separated from the gas stream without the need to increase the size of the electrostatic precipitator for this increase in efficiency. Therefore, the electrostatic precipitator can achieve a higher efficiency of dust separation, with lower total energy consumption for electrostatic precipitation, and thus reduction in the necessary operating costs. With this improvement of parameters, the ability to efficiently control the gas velocity distribution to achieve the required gas velocity profile has not changed. In this invention, on the contrary, the pressure drops on the gas distribution device are maintained low and the risk of already separated dust particles being swept back into the purified gas stream is reduced.

Explanation of drawings

**[0030]** The invention will be explained in detail by drawings which illustrate:

Fig. 1 side section of an electrostatic precipitator with inlet section, main separation chamber, outlet section and two bottom hoppers. The inlet section is a system of three gas distribution devices consisting of an assembly of vertically placed distribution panels with openings located in one vertical row, where the lower edge of each distribution panel is covered by a flow baffle. The main separation chamber is equipped with a pair of electrode assemblies and, in the lower part, two bottom hoppers each with a pair of baffles. The outlet section is equipped with one gas distribution device with the similar design as those in the inlet section. Assemblies in the inlet section and in the main separation chamber are equipped with a rapping mechanism in the form of a hammer and a shock bar.

Fig. 2 3D detailed view of a gas distribution device consisting of an assembly of four vertically stacked "C" shaped distribution panels, each with one vertical row of round openings. The distribution panels are suspended from above on chain links, and their lower part is covered with flow baffles and mounted on a guide. The figure depicts the direction of the gas stream and at the same time the adjacency of the flow baffles to the lower inclined wall of the inlet section.

Fig. 3 3D detailed view of the assembly shown in Fig. 2 with a better representation of the increasing spacing between the flow baffles in the direction of the gas stream.

Fig. 4 3D detailed view of four different designs of distribution panels according to the size of the plate base and the shape and size of the side edges and the shape, number and location of the openings. The design of the flow baffles is also different.

Fig. 5 3D detailed view of a pair of distribution panels with their movable lower part.

Examples of the invention embodiments

**[0031]** The described invention improves the current state of the art in such a way that, for the electrostatic precipitator 1 developed according to the background of the invention, with the same size of the electrostatic precipitator 1, it significantly increases its efficiency, reduces the energy performance, and also improves the parameters of the gas stream F pattern when it flows through the electrostatic precipitator 1.

**[0032]** According to the illustration of the invention shown in Fig. 1, at first glance, the presented electrostatic precipitator 1 does not differ much from the background of the invention. It also consists of an inlet section 2 of a pyramid shape, a main separation chamber 7, of a rectangular shape, at least one bottom hopper 9, and an outlet section 10 of a pyramid shape. It does not differ in that the inlet section 2 is equipped with at least one gas distribution device 3 containing distribution panels 4 in solid or perforated design, or in the purpose of this gas distribution device 3. Also here the gas distribution device 3 reduces the concentration of dust particles, reduces the dynamic pressure and controls the velocity profile of the gas stream F. Even the main separation chamber 7 does not differ much from the background of the invention, where it is equipped with at least one group of electrodes 8 and the bottom hopper 9 is equipped with at least one baffle 24 as standard. The difference is also not that a horizontal gap 11 is created between the lower edges 5 of the distribution panels 4, which form the gas distribution device 3, and the lower inclined wall 6 of the inlet section 2; see Fig. 1, 3 and 5. The significant and main difference is that the gas distribution device 3 consists of a system of vertically or obliquely arranged distribution panels 4, between which vertical or oblique slots 12 are created for the passage of the gas stream F from the inlet section 2 into the main separation chamber 7.

**[0033]** According to a specific embodiment of the invention shown in Fig. 2 to 5, the distribution panels 4 have a vertical plate base 13, which is provided with side edges 14 on the sides. The side edges 14 are installed to protrude against the direction of the gas stream F.

**[0034]** According to a non-illustrated embodiment of the invention, the distribution panels 4 have a U-shaped profile, and thus the side edge 14 makes a 90° angle with the plate base 13. In this embodiment of the invention, the first channel 17 is formed between the side edge 14 and the plate base 13 to collect dust particles from the gas stream F. The collected dust layer subsequently falls by gravity into the lower part 15 of the distribution panel 4 and further into the bottom hopper 9.

**[0035]** According to a specific embodiment of the invention, shown in Fig. 2 to 5, the side edges 14 of the distribution panel 4 are in the shape of the letter "L" and are also arranged to protrude against the gas stream F. This arrangement of the distribution panel 4 thus creates the shape of the letter "C" in cross-section. Since the side edges 14 of the distribution panel 4 are bent inwards at the ends, they also create a pair of opposite first channels 17 and a pair of opposite second channels 17'. The channels 17, 17' collect dust particles from the gas stream F. The dust layer subsequently falls by gravity into the lower part of the distribution panel 4 and further into the bottom hopper 9.

**[0036]** According to the embodiment of the invention, shown in Fig. 1 to 5, at least one distribution panel 4 is provided with a flow baffle 16 at its lower part that is adjacent to the lower inclined wall 6 of the inlet section 2. Due to its shape and location, the flow baffle 16 thus covers at least the lower part 15 of the distribution panel 4 and the adjacent horizontal gap 11 at least in width of the distribution panel 4. The flow baffle 16 thus eliminates the possibility of dust particles falling into the bottom hopper 9 being swept back by the gas stream F flowing around the distribution panel 4.

**[0037]** In another specific embodiment of the invention, the electrostatic precipitator 1 is equipped with a rapping system for removing sticky dust layers from the distribution panels 4 with the gas distribution device 3, rapping system for removing sticky dust layers from the groups of electrodes 8 and rapping system for removing sticky dust layers from the walls of the inlet section 2. The rapping system can have different designs. According to a non-illustrated embodiments of the invention, the rapping system consists of a device from the group of devices: sound horn, electromagnetic hammer, pneumatic hammer, electromagnetic vibrator. According to the embodiment of the invention, shown in Fig. 1, the knocking system consists of a hammer 21 with a shock rod 20.

**[0038]** The rapping system can be replaced or supplemented by fixing the distribution panels 4 so that the gas stream F flowing around these distribution panels 4 causes their vibrations, which would cause the knocking of settled dust. Such an embodiment is the embodiment of the invention as shown in Fig. 2 and 3. These illustrations depict the embodiment where the distribution panels 4 are suspended on a chain link 22 at their upper edge 25 and mounted on a guide 18 at their lower part 15. This type of mounting of the distribution panel 4 allows limited movement of the mounting of the distribution panels 4. Thanks to the created vibrations, heavier dust layers are automatically removed from these distribution panels 4.

**[0039]** Fig. 3 and 5 show a specific spatial arrangement of the flow baffles 16, highlighting their arrangement in such a way that the spacing 23 of the lower parts of two adjacent flow baffles 16 increases in the direction of the gas stream F. This arrangement prevents the blocking of falling dust particles and clusters of these particles adhered to the distribution panels 4 and the creation of places in the gas stream F that promote the formation of dust clusters. For the same reason, the flow baffle 16 is preferably formed as a streamlined shape with inclined surfaces that do not support dust deposits, see Fig. 2 and 3, with the open side adjacent to the lower inclined wall 6 of the inlet section 2. An expert can easily provide many other possible shape and material designs of the flow baffles 16, which will meet the main condition of their use, i.e. preventing the passage of the gas stream F to the dust particles collected by the distribution panels 4 and falling into bottom hopper 9.

**[0040]** To support the function of better dust collection, according to a specific embodiment of the invention, shown specifically in Fig. 5, it is possible to create the distribution panels 4 in such a way that their lower part 15 is movable and is fixed to the upper part 26 of the distribution panel 4 by means of a hinge or a chain link 22.

**[0041]** The distribution panels 4 are preferably made in such a way that they are perforated, while the openings 19 formed in them facilitate the gas stream F, so that the gas stream F not only flows around but also passes through the distribution panels 4. As shown in Fig. 4, the openings 19 in the distribution panel 4 are arranged in at least one vertical row below each other, but also in two, and according to non-illustrated embodiments of the invention, there may be more of these rows, while the diameter of the opening 19 is chosen mainly in relation to the optimized velocity of the gas stream F at which the gas stream F is to pass through the electrostatic precipitator 1.

**[0042]** The distribution panel is usually made of metal or plastic profiles, but an expert can also provide other profile shapes of the distribution panels 4, the material of the distribution panels 4, the size and number of openings 19 in the distribution panels 4.

**[0043]** This invention relates to the electrostatic precipitator 1 for purifying gases from the gas stream with a relatively high dust load. Examples of operations with a high dust load are operations for fossil fuel combustion in energy boilers, pulp and paper production plants, or operations of lime and cement plants. This invention is primarily intended for work under relatively high dust load conditions with limited space requirements and higher requirements for efficiency of dust separation.

**[0044]** Comparison of the specific improvement and the change of the achieved parameters compared to the background for the electrostatic precipitator 1 in the lignite-fired installation, i.e. in the boiler with an output of 800 MW.

Table 1 Operational requirements for electrostatic precipitator 1

| Required parameter | Parameter value old | Parameter value new |
|---|---|---|
| Dust concentration at the entry of the inlet section | max. 28 $g/Nm^3$ (wet gas) | max. 42 $g/Nm^3$ (wet gas) |
| Guarantee on outlet dust emissions | <50 $mg/Nm^3$ dry gas @ 6% $O_2$ | <25 $mg/Nm^3$ dry gas @ 6% O2 |
| Required guarantee on collection efficiency | 99.821% | 99.940% |

Table 2 Design parameters while maintaining the built-up size of the electrostatic precipitator 1

| Parameter | Value before | Possible modification | Modification according to the invention |
|---|---|---|---|
| Weight of all gas distribution devices | 42,148 kg | --- | 52,500 kg |
| Weight of one group of electrodes | Length of the assembly: 3.2 m Weight: 469,660 kg | + another assembly with a length of 4 m | Length of the assembly: 2.4 m Weight: 352,245 kg |
| Electrostatic precipitator (SCA) with electrode spacing | 400 mm, 44.70 m2/(m3/s) | 400 mm, 64 m2/(m3/s) | --- |
| Total consumption of the electrostatic precipitator at full boiler load | 2,972 kW | 4,418 kW | 4,089 kW |
| Type of improvement | | Extension to include additional groups of electrodes with a length of = 4.0 m and exchange of existing high-voltage electrodes for high-frequency power electrodes | Modifications of the gas distribution device in the inlet section according to the invention |
| Total weight of new elements | | 540,109 kg | 404,775 kg |

**[0045]** Total savings compared with improvement of the electrostatic precipitator according to the background of the invention and according to the invention are that according to the invention, the same space is required for the electrostatic precipitator 1 to achieve the new operational parameters, but the electric energy consumption is 328 kW lower and the weight of the electrostatic precipitator 1 will be 135,334 kg less.

Industrial applicability

**[0046]** The invention finds its application mainly in the modernization of existing operations with electrostatic precipitators, where it is impossible to increase their parameters by installing larger and more efficient precipitators, because there is no room for them in the construction of the plant. These are mainly operations that produce large amount of dust particles, such as incineration plants, lignite-fired power stations, lime plants, cement plants, etc.

List of reference numerals used in the drawings

**[0047]**

1 electrostatic precipitator
2 inlet section
3 gas distribution device
4 distribution panel
5 lower edge of the distribution panel
6 lower inclined wall of the inlet section
7 main separation chamber
8 group of electrodes
9 Bottom hopper
10 outlet section
11 horizontal gap
12 oblique slot
13 plate base

14 side edge
15 lower part of the distribution panel
16 gas baffle
17 first channel
17’ second channel
18 guide
19 opening
20 shock bar
21 hammer
22 chain link
23 spacing
24 Bottom hopper baffle
25 upper edge of the distribution panel
26 upper part of the distribution panel
F gas stream

## Claims

1. An electrostatic precipitator (1) to remove dust from the gas stream (F), comprising an inlet section (2) with at least one gas distribution device (3) including distribution panels (4) in solid or perforated design, to reduce the concentration of dust particles, to reduce the pressure drops and to control the velocity profile of the gas stream (F), further comprising the main separation chamber (7) with at least one group of electrodes (8), further comprising at least one bottom hopper (9) with at least one baffle (24) and also an outlet section (10), with a horizontal gap (11) being formed between the lower edges (5) of the distribution panels (4) forming the gas distribution device (3) and the lower inclined wall (6) of the inlet section (2), **characterized in that,** the gas distribution device (3) consists of a system of vertically or obliquely arranged distribution panels (4), between which vertical or oblique slots (12) are created for the passage of the gas stream (F) into the main separation chamber (7).

2. The electrostatic precipitator (1) according to claim 1, **characterized in that,** the distribution panels (4) have a vertical plate base (13) provided with side edges (14) on the sides protruding against the direction of the gas stream (F).

3. The electrostatic precipitator (1) according to claim 2, **characterized in that,** the distribution panels (4) have a U-shaped profile, with the side edge (14) making a 90° angle with the plate base (13) and with the first channel (17) being created between the side edge (14) and the plate base (13) to collect dust from the gas stream (F) and to fall by gravity into the lower part of the distribution panel (4) and further into the bottom hopper (9).

4. The electrostatic precipitator (1) according to claims 1 and 2, **characterized in that,** the side edges (14) of just one distribution panel (4) are bent inwards at the ends and thus create a pair of opposite first channels (17) and also a pair of opposite second channels (17’), to collect dust from the gas stream (F) and to fall by gravity into the lower part of the distribution panel (4) and then into the bottom hopper (9).

5. The electrostatic precipitator (1) according to claims 1 to 4, **characterized in that,** at least one distribution panel (4) is provided with the flow baffle (16) at its lower part (15) that is adjacent to the lower inclined wall (6) of the inlet section (2) and covering at least the lower part (15) of the distribution panel (4) and the adjacent horizontal gap (11) at least in width of the distribution panel (4) to eliminate the possibility of dust particles falling into the bottom hopper (9) being swept back.

6. The electrostatic precipitator (1) according to any of claims 1 to 5, **characterized in that,** the distribution panel (4) is made of metal or plastic profiles.

7. The electrostatic precipitator (1) according to any of claims 1 to 6, **characterized in that,** it is equipped with a rapping system for removing sticky dust layers from the distribution panels (4) with the gas distribution device (3), a rapping system for removing sticky dust layers from the groups of electrodes (8) and a rapping system for removing sticky dust layers from the walls of the inlet section (2).

8. The electrostatic precipitator (1) according to claim 7, **characterized in that,** the rapping system consists of a device from the group of devices: sound horn, electromagnetic hammer, pneumatic hammer, electromagnetic vibrator, hammer (21) with a shock rod (20).

**9.** The electrostatic precipitator (1) according to any of claims 1 to 8, **characterized in that,** the distribution panels (4) are suspended on a chain link (22) at their upper edge (25) and are mounted on a guide (18) in their lower part, for laterally limited movable mounting of the distribution panels (4) to create free oscillations caused by the gas stream and automatic removing of dust layers from these distribution panels (4).

**10.** The electrostatic precipitator (1) according to any of claims 5 to 9, **characterized in that,** each distribution panel (4) is provided with a streamlined shape gas baffle (16) and the gas baffles (16) are arranged in such a way that it's inclined surfaces do not support dust deposits and the spacing (23) of the lower parts of two adjacent gas baffles (16) in the direction of the gas stream (F) increases.

**11.** The electrostatic precipitator (1) according to any of claims 1 to 10, **characterized in that,** the lower part (15) of the distribution panel (4) is movable and is fixed to the upper part (26) of the distribution panel (4) by means of a hinge or a chain link (22).

**12.** The electrostatic precipitator (1) according to any of claims 1 to 11, **characterized in that,** the inlet distribution panels (4) are perforated, provided with openings (19) arranged in at least one vertical row below each other.

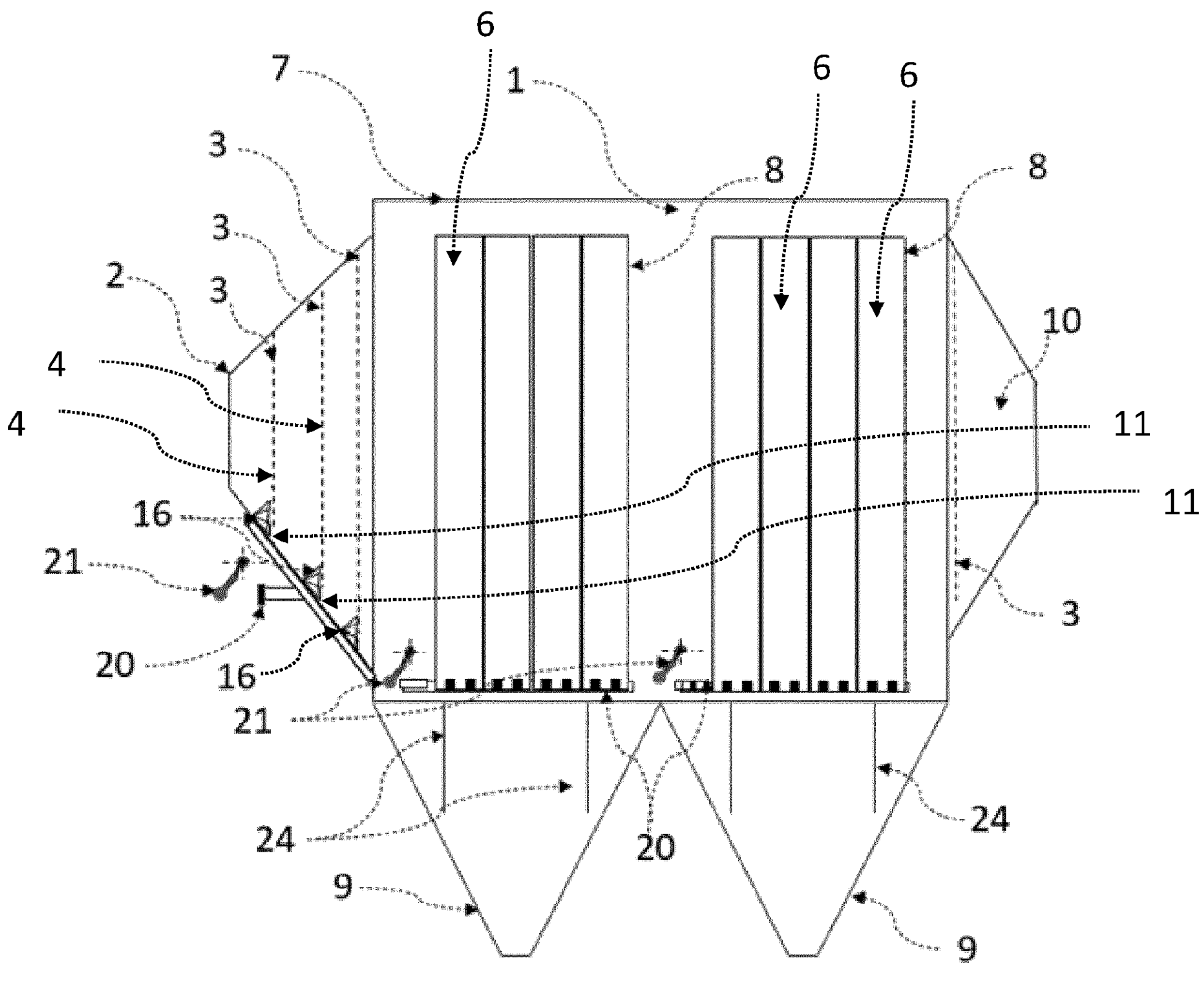


**Fig. 1**

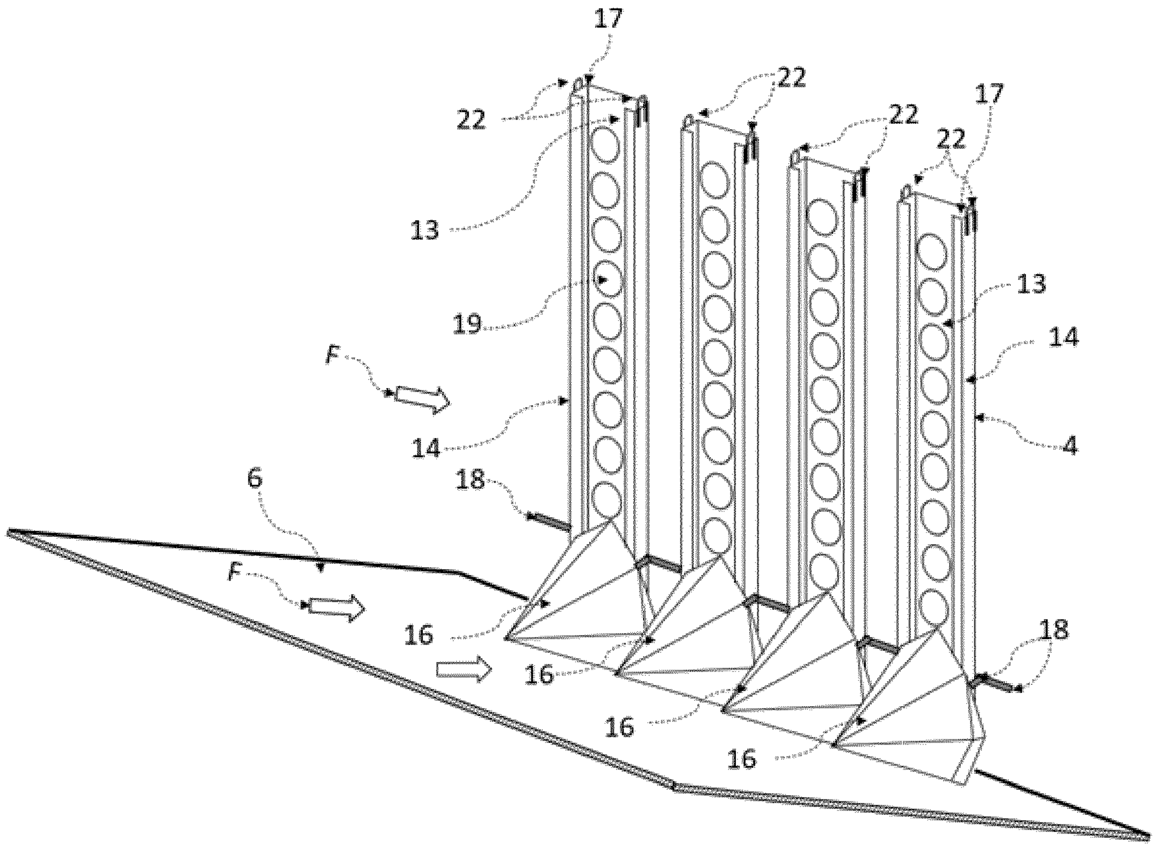


Fig. 2

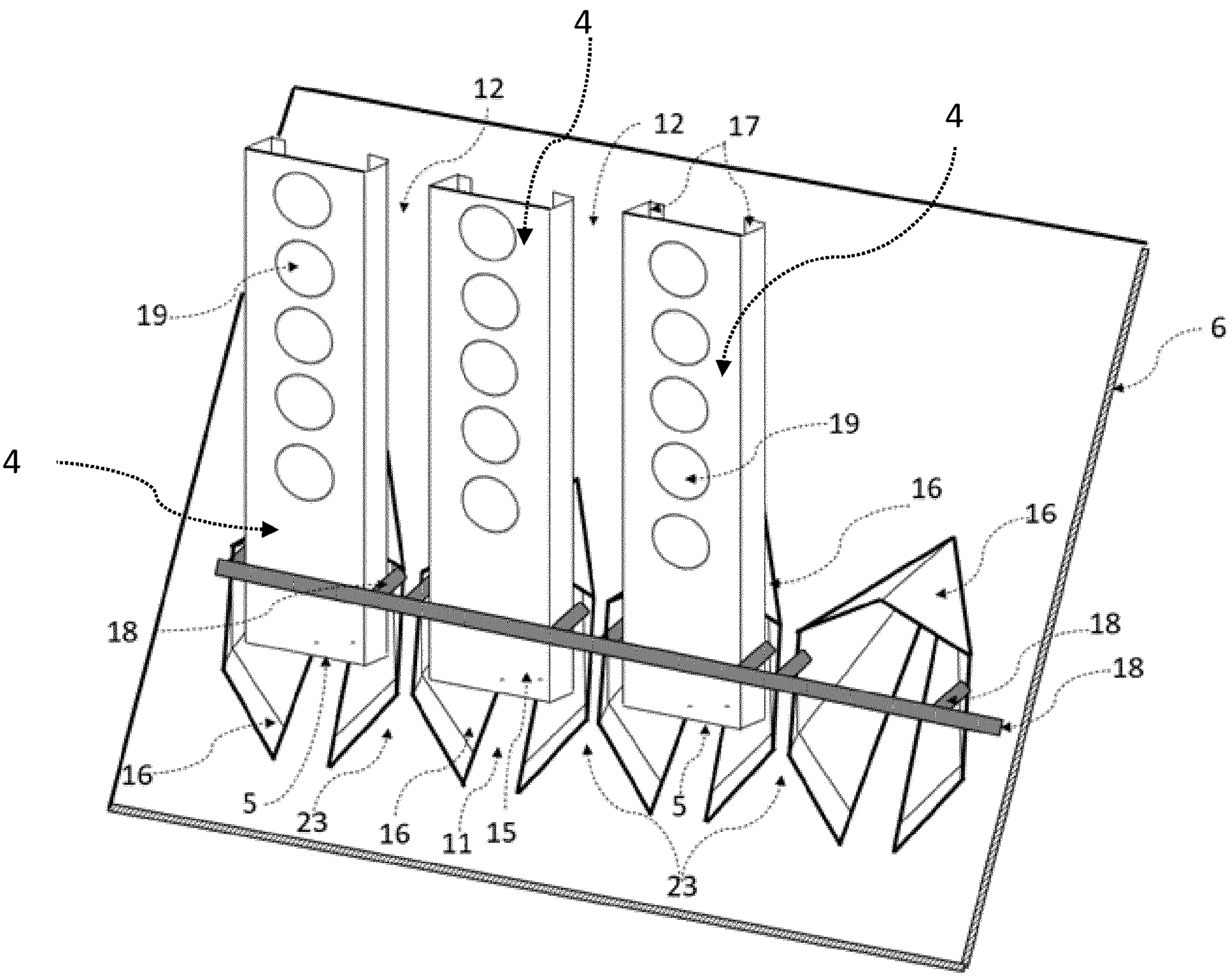


Fig. 3

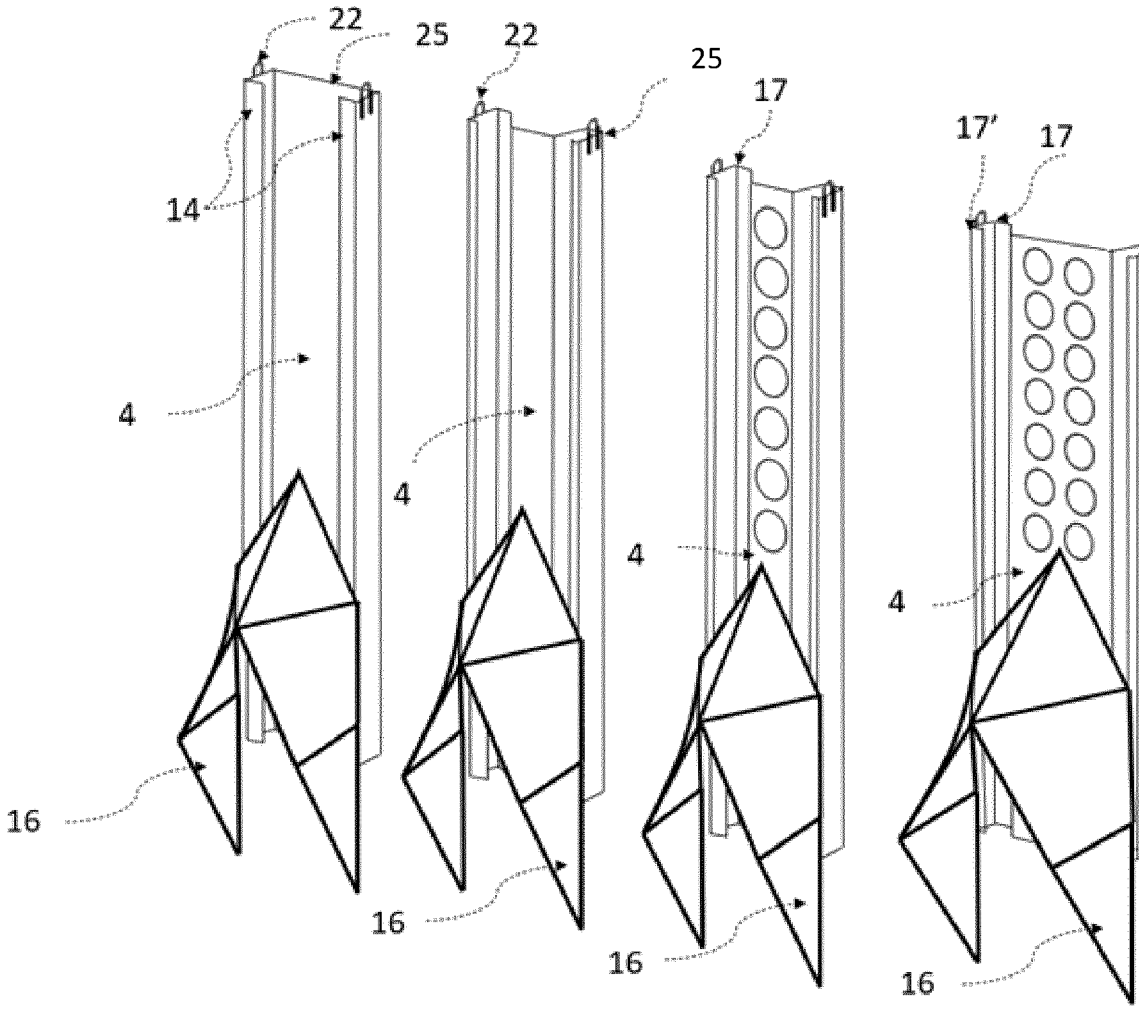


Fig. 4

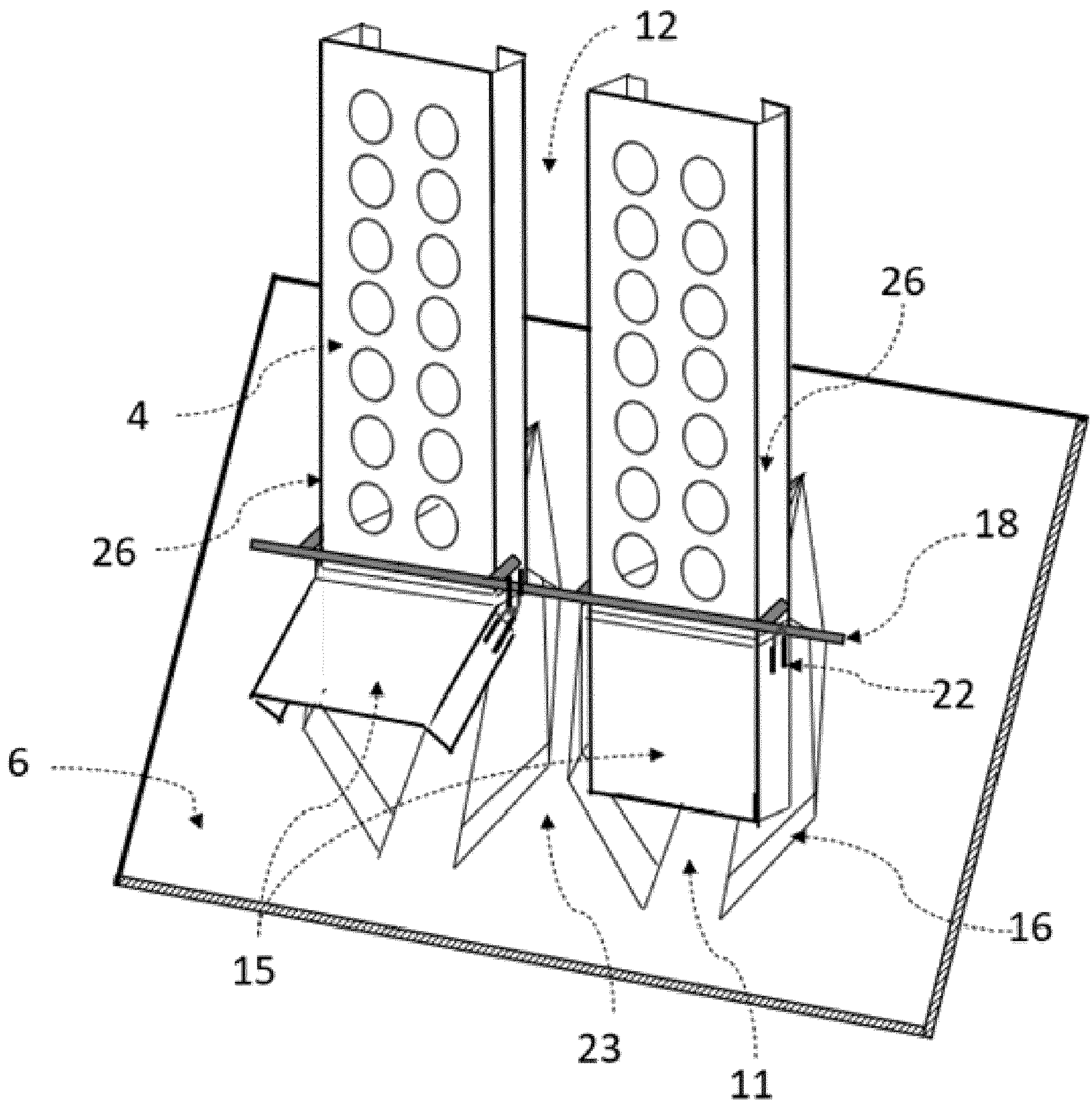


Fig. 5

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Application Number
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The present search report has been drawn up for all claims

1

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| The Hague | 27 June 2024 | Jorna, Pieter |

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