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

(11) Publication number: **0 237 512 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **87850075.0**

(51) Int. Cl.[4]: **B 03 C 3/70**

(22) Date of filing: **10.03.87**

(30) Priority: **11.03.86 SE 8601124**

(43) Date of publication of application:
16.09.87 Bulletin 87/38

(84) Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

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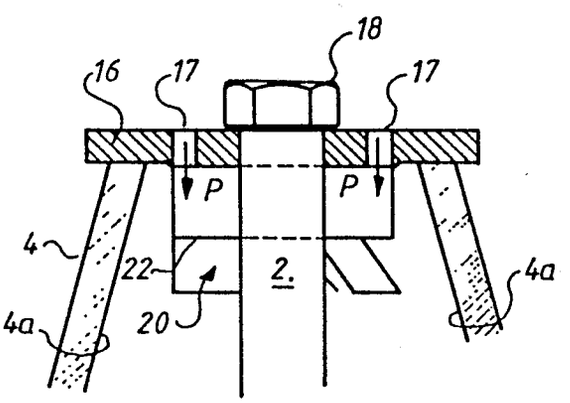
(54) An arrangement in insulators that form part of electrostatic dust separators.

(57) The present invention relates to an arrangement in an insulator (4) which forms part of an electrostatic dust separator and which has an insulator part provided with one or more first holes (17) through which a gas flow can pass for the purpose of reducing or eliminating the collection of dust on the inner wall sections (4a) of the insulator. Located downstream of the first holes (17) as seen in the direction of gas flow, is one or more turbulence generating devices (20). A container (21) is arranged adjacent the aforementioned insulator part and has a configuration such that all of the first holes (17) in the insulator part open into the container. The container surface facing away from the aforementioned insulator part is provided with a plurality of second holes (22) which discharge or open upstream of the turbulence generating device (20).



EP 0 237 512 A1

Description

An arrangement in insulators that form part of electrostatic dust precipitators.

TECHNICAL FIELD

The present invention relates to an arrangement in insulators which form part of electrostatic dust precipitators, and preferably to an arrangement in an insulator which supports a discharge electrode and which has an electrode attachment and supporting upper part.

This insulator part is positioned horizontally and has provided therein one or more first holes through which air can enter the interior of the insulator and pass therealong into the electrostatic precipitator, for the purpose of reducing or eliminating the tendency of dust to collect on the internal wall surfaces of the insulator.

Although the invention can be applied with particular advantage to discharge-electrode insulators, it will be understood that the invention may also be applied with auxiliary operating rods and other devices which may influence the voltage supply, e.g. percussion mechanisms for cleansing electrodes of dust that has collected thereon.

For the sake of simplicity the following description of the invention will be made with reference to its application with discharge-electrode insulators.

BACKGROUND PRIOR ART

The US Patent Specification Serial No. 3 531 918 teaches an insulator for supporting a discharge electrode of an electrostatic dust precipitator and provided with an electrode supporting part to this end. The supporting part of this known insulator has provided therein one or more first holes through which air under pressure can flow into the dust precipitator, for the purpose of reducing or eliminating the collection of dust on the inner wall surfaces of the insulator.

The known insulator comprises a cylindrical body which presents an upper planar, horizontal part for co-action with a discharge electrode holding plate. The plate has extending therethrough a number of holes through which air under pressure can enter and pass through the interior of the insulator and down to the electrostatic dust precipitator.

Located above the holes in the prior art arrangement is a cover member which defines a first chamber having incorporated therein a non-return valve, or check valve, which is intended to ensure that air will pass solely in one direction, namely down towards the dust precipitator. The cover member, or hood, is surrounded by a further cover member, or hood, which forms a second chamber, to which a source of air under pressure is connected through a connecting conduit.

The arrangement taught by US Patent Specification Serial No. 3 033 918 also forms part of the prior art, in which the insulators are heated and thermally insulated from the surroundings, in order to decrease the risk of water or acid condensing on the surfaces of the insulators.

The specification discloses a conical insulator which has an upper part that co-acts with a plate having provided therein a plurality of holes which are formed on a circular-arcuate line symmetrically in relation to the in sulator.

A first chamber can be pressurized with the aid of a valve, so as to enable a stream of air to pass through the holes. This air stream gives rise to back currents, eddy-currents, or vortices and like turbulence, which contribute in carrying impurities from the dust precipitator into the interior of the insulator, where they collect on from the frusto-conical interior surfaces thereof.

The conical configuration, however, contributes towards forming the enclosure for the narrower end of the first chamber at its upper part, while ensuring a sufficiently wide insulating distance.

SUMMARY OF THE INVENTION

TECHNICAL PROBLEMS

When viewing the prior art disclosed in the aforecited US Patent Specifications, it will be seen that one technical problem in this particular field resides in the provision, with the aid of simple means, of an arrangement which, with a limited gas volume in relation to the volume required by the cited Publications, will effectively cleanse the inner wall surfaces of the insulator from dust collected thereon and effectively decrease the tendency of dust to collect on said surfaces.

The term gas volume shall be understood to include a mixture of gases, such as purely air.

A particular problem encountered in this field is one of ensuring that a small volumetric flow of gas through the narrower end of a frusto-conical insulator will flow in solely one direction through the total extent of the insulator, in the absence of regions of back-flow capable of carrying dust from the interior of the dust precipitator and onto the inner walls of the insulator, such dust particles adhering to said walls in the form of electrically charged deposits.

It will be seen that a technical advantage would be achieved if provisions were made for maintaining the volume of gas used at a low level, since this would save large quantities of thermal energy, owing to the fact that less energy would be required to heat the gas to temperatures above that at which condensation forms on the inner wall surfaces of the insulator.

Another technical problem encountered in this field is one of realizing that in spite of a considerable decrease in the requisite gas flow, e.g. a decrease of about 75%, the gas flow used would be sufficient if said flow, subsequent to having passed through the holes, could be guided in a manner to create a turbulence, e.g. eddy-currents or vortices, and then a rotational helical and spiral turbulence about a centre line of the insulator.

Another technical problem is one of realizing that the aforementioned problems can be solved in existing electrostatic dust precipitators, by installing

therein a pre-fabricated unit which comprises such turbulence generators capable of imparting rotational motion to the gas.

Still a further problem in this regard is one of realizing that when using a pre-fabricated unit and turbulence generating devices in conjunction with first holes in the electrode supporting part of the insulator unit, in the form of a container, shall have provided in the surface thereof remote from said electrode supporting part a plurality of second holes which discharge upstream of the turbulence generators.

In this latter regard a qualified technical problem resides in realizing that, from the aspect of air economy, the second holes in the surfaces of the container remote from the electrode supporting part of the insulator should be present in a greater number and present a smaller cross-sectional area than the first holes located in said supporting insulator part and should be distributed uniformly adjacent respective turbulence generators.

With regard to the construction of a unit which present such turbulence generating means, a further technical problem is one of constructing a container having an external configuration which does not present pronounced surfaces, but which presents certain areas that are prone to disturb field strength concentrations, while still creating conditions for providing eddy-current or vortex or like turbulence generating devices in a simple manner.

Another technical problem is one of creating, with simple means, turbulence generating devices which, with regard to this particular field, will generate an effective and sufficient rotational turbulence about the centre line of the insulator and, primarily with regard to conical insulators, will create conditions for generating a rotational turbulence such as to eliminate thereby the collection of dust on the interior insulator walls which diverge towards the interior of the dust separator.

Finally, it will be seen that a further technical problem resides in creating with the aid of simple means, conditions for heating continuously the air used, or alternatively for utilizing a gas flow which comprises gas that has been cleansed of solids in the electrostatic dust precipitator.

It will also be seen that technical problems reside in the realization that effective turbulence generating devices in this particular context can be given a particularly simple form and may comprise, for example, one or more guide vanes.

Despite the simple form of the turbulence generating means, a further problem nevertheless resides in the provision of means which will ensure that the gas flow will rotate generally uniformly about the symmetry axis of the insulator, despite the fact that the cross-sectional area of the insulator increases in the direction of gas migration towards the interior of the dust precipitator.

SOLUTION

The aforesaid problems are solved in accordance with the present invention by means of an inventive arrangement in preferably an electrode supporting insulator, and then a discharge-electrode supporting insulator which is incorporated in an electrostatic dust precipitator. In this latter application, the insulator has an upper part which supports the electrode and facilitates its attachmental. This electrode supporting and attachment part of the insulator is positioned horizontally and is provided with one or more first holes through which gas can flow into the interior of the insulator and pass therealong and enter the interior of the dust precipitator, therewith to reduce or preferably to eliminate the formation of dust on the inner wall sections of the insulator.

In accordance with the invention there is provided downstream of the first hole or holes, as seen in the direction of gas flow, one or more turbulence generating devices, i.e. devices that will generate rotational turbulence and which direct a rotary air flow along the inner wall section of the insulator.

It is particularly proposed in accordance with the invention that a pre-fabricated unit in the form of a container is arranged adjacent the aforesaid insulator part and is attached to the underneath of the horizontal surface of said part, and has a form such that all of said first, relatively large holes in said part will discharge into the container.

The horizontal surface of the container that faces away from the aforesaid insulator part is also provided with a plurality of second smaller holes, which discharge or open upstream of the turbulence generating devices in the immediate vicinity thereof.

It is also possible within the scope of the present invention for the number of second holes provided in the container surface remote from said insulator part to be much greater than the number of first holes located in said insulator part, and for said second holes to have a smaller cross-sectional size than said first holes, and also to be mutually so dimensioned as to create a given over-pressure in the interior of the container, therewith ensuring a uniform exit velocity of the gas flow from all holes in the container.

In accordance with one particular advantageous embodimental, the turbulence generating devices comprise guide vanes which extend obliquely to the direction in which the gas flow passes through the first holes or the second holes. An advantage is afforded when the guide vanes are planar, or substantially planar, and when the plane of respective guide vanes can be caused to define an angle of from 20 to 70° with the direction of the air flow, preferably an angle of about 45°.

The guide vane may have a particularly simple form, for example a flat rectangular form.

It is proposed in accordance with the invention that the turbulence generating devices are arranged so as to obtain a generally uniform rotation of gas flow around a symmetry axis of the insulator.

In practice an advantage is afforded when the second holes, similarly to the first holes, are of circular cross-section. When the holes are circular it is proposed that the centre distance, or span, between mutually adjacent holes is less than twice the diameter of said holes. The smaller, second holes will be distributed uniformly along the hole of the container surface that faces away from the

aforesaid insulator part.

The turbulence generating devices will suitably be greater than four in number, although preferably less than twelve. It has been found in practice that satisfactory results are obtained with eight such devices.

The separate and pre-fabricated unit in the form of a container shall have a circular cross-sectional shape, and the turbulence generating devices will extend between a discharge-electrode holding device and the container periphery.

Finally, a limited gas flow shall be supplied continu ously to the dust precipitator through said holes and said turbulence generating devices, and the gas flow shall be heated with the aid of heating means herefor, preferably an electrically operated heating device.

It has been found that a particular advantage is afforded when the aforesaid arrangement is incorporated in an insulator intended for supporting a discharge electrode (or a collector electrode when the discharge electrode is earthed) and which has a form such as to diverge in a direction away from the turbulence generating devices.

ADVANTAGES

The advantages primarily associated with an arrangement according to the invention reside in the provision of means with which the tendency of dust to collect on the inner wall surfaces of the insulator can be reduced or eliminated with but a small gas flow.

The primary characteristic features of an arrangement according to the invention are set forth in the characterizing clause of the following Claim 1.

BRIEF DESCRIPTION OF THE DRAWING

An exemplifying embodiment at present preferred and exhibiting characteristics significant of the present invention will now be described in more detail with reference to the accompanying drawing, in which

Figure 1 illustrates a prior art arrangement in side view;

Figure 2 is a sectional side view of an inventive arrangement in an electrode supporting insulator which presents a plurality of turbulence generating devices and which is incorporated in an electrostatic dusk precipitator;

Figure 3 is a side view of a pre-fabricated container which incorporates said turbulence generating devices;

Figure 4 is a horizontal projection of the container illustrated in Figure 3; and

Figure 5 illustrates an air stream heating device.

DESCRIPTION OF AN EMBODIMENT AT PRESENT PREFERRED

Figure 1 illustrates in side view the known arrangement in discharge-electrode supporting insulators forming part of electrostatic precipitators described and illustrated in the US Patent Specification 3 531 918.

In the arrangement illustrated in Figure 1 a discharge electrode 1 is attached to an electrode-support device 2 which extends through a sleeve 3 and an insulator 4. The insulator 4 is located above a cover plate 5, which covers the electrostatic precipitator.

The insulator 4 has an upper, horizontally extending plate 6 having provided therein a number of large holes 7. In the illustrated embodiment four such holes are provided. The plate 6 is intended to support and to retain the support device 2, and a further plate 8 is provided for improving the air distribution. This further plate 8 is provided with a number of smaller holes 9, which are located in the vicinity of the holes 7, such that air will pass in essentially laminar flow through the holes 9 and 7, through the insulator 4, and the sleeve 3, and into the electrostatic dust precipitator.

A first hood or cover member 10 is placed above the plate 8 and is attached to the horizontal insulator plate 6 so as to define a chamber 11, which is placed under pressure. A non-return valve 12 is provided for causing air in a further chamber 13, defined by a further hood or cover member 14, to enter the first chamber 11. The air is obtained from a source of pressurized air (not shown) connected to the second chamber 13 via a connection 15.

The arrangement according to the present invention is illustrated in Figure 2, from which it will be seen that the insulator 4 has arranged on the upper part thereof a horizontally positioned plate 16 which is provided with a number of holes 17, the diameter of which is from 10mm to 15mm. The plate 16 also secures the discharge-electrode support device 2, with the aid of a nut 18.

For the purpose of reducing the air flow that is permitted to pass through the holes 9 and 7 of the Figure 1 embodiment and, in spite of a reduction in air flow of 50-70%, still eliminate the collection of dust on the inner wall surfaces 4a of the insulator 4, the inventive arrangement incorporates one or more devices 20 for generating rotational turbulence, e.g. a vortex-like turbulence, at a location downstream of the first holes 17, when seen in the flow direction "P" of the air flow. In the illustrated embodiment eight such turbulence generating devices are positioned symmetrically around the electrode supporting device 2.

The present invention particularly proposes the use of a pre-fabricated container 21 which is attached at one end 21a thereof to the undersurface of the horizontal plate 16, or arranged in the vicinity of said undersurface. The container has a cylindrical shape and is arranged such that all of the aforesaid first holes 17 in the electrode supporting part 2 open into the container. The planar surface 21b of the insulator part 16 facing away from the container has provided therein a larger number of second holes 22, which open immediately upstream of the turbulence generating device or devices 20.

The second holes 22 provided in the surface of the container 21 facing away from the insulator part 16 are greater in number than the first holes provided in said part and have a smaller cross-sectional area than said first holes. The first holes are preferably

circular and arranged concentrically in relation to the electrode supporting device 2, in one single row, while the second holes 22 are distributed uniformly over the lower surface 21b of the conductor 21. In accordance with the invention, the second holes are circular and so positioned that the centre distance between mutually adjacent holes is less than twice the diameter thereof, as will best be seen from Figure 4. In practice, the second holes should not have a diameter greater than 10mmoles, and preferably have a diameter between 2 and 6mm.

The turbulence generating device or devices 20 comprises, or comprise, a plate or plates 23 positioned obliquely to the direction of the air flow through the first holes 17 or the second holes 22.

Although the illustrated plates have an elongated rectangular configuration, it will be understood that the plates may alternatively have a square shape.

Assuming that each of respective plates is, or are, allotted a plane "A", Figure 3, this plane shall be caused to define with said direction of air flow an angle between 20 and 70°, this angle being referenced "a" in Figure 3. In the illustrated preferred embodimental of the plane "A" forms an angle of 45° with the direction of air flow.

As illustrated in Figure 4, the container 21 has a circular cross-sectional shape, and an edge part 23a of respective turbulence generating devices extends radially between a discharge-electrode holding device 2 and the periphery 21c of the container, with the upper surface or edge orientated in the radius of the container.

Finally, it is proposed in accordance with the invention that means are provided which will enable the air flow through the connection 15 illustrated in Figure 1 to be modified, since in accordance with the present invention the air flow is much smaller than that required with the prior art apparatus, and consequently the air flow can be supplied continuously via an air-flow heating device 25, comprising a tube which protectively encloses an electronically heated coil 26, around which air is caused to flow, via the connection 15′, prior to entering the chamber 13. The reference 27 illustrates a connecting plug for electrical supply voltage.

The turbulence generating devices shall be constructed so that when a plurality of air jets (passing through holes 22) strike against the plate 23, the jets are deflected and "roll" along the wall section 4c of the insulator, thereby imparting to the whole of the air mass in the interior of the insulator a clockwise spiralling motion, therewith to cleanse the insulator wall 4a.

The air flow to be heated may comprise a previously heated gas flow cleansed in the dust precipitator, thereby reducing to a low level the additional thermal energy which need be supplied through the heating device 27.

It will be understood that the invention is not restricted to the aforedescribed exemplifying embodiment, and that modifications can be made within the concept of the invention illustrated in the following claims.

Claims

1. An arrangement in an insulator which forms part of an electrostatic dust precipitator (4) and which has an upper insulator part (16) in which there is provided one or more first holes (17) through which gas can flow for the purpose of reducing or eliminating the collection of dust on the inner wall sections of the insulator, characterized in that located downstream of the first holes (17) in the upper insulator part (16), as seen in the direction of gas flow is one or more turbulence generating devices (20), for example in the form of a guide vane or vanes (23) positioned obliquely in relation to the direction of the gas flow (P) through the first holes (17) and which vane or vanes is, or are, intended to impart to the gas flow or air flow a rotational spiral movement for the purpose of cleansing the insulator wall (4a).

2. An arrangement according to Claim 1, characterized in that a container (21) is arranged adjacent the insulator part (16) and has a form such that all of the first holes (17) provided in the insulator part discharge into the container; and in that the container surface (21b) facing away from said part is provided with a plurality of second holes (22) which discharge upstream of said turbulence generating devices (20).

3. An arrangement according to Claim 2, characterised in that the second holes (22) provided in the container surface facing away from said insulator part are greater in number than the first holes (17) in said part and have a smaller cross-sectional area.

4. An arrangement according to Claim 1, characterized in that respective guide vanes comprise a planar or substantially planar plate.

5. An arrangement according to Claim 1 or 4, characterized in that respective guide vanes are located in a plane (A) which is orientated so as to form an angle of between 20 and 70° to the direction of gas flow, preferably an angle of about 45°.

6. An arrangement according to Claim 1, characterized in that the turbulence generating devices (20) are constructed to cause the gas flow to rotate substantially uniformly around a symmetry axis of the insulator.

7. An arrangement according to Claim 2, characterized in that the second holes (22) are circular and are so located that the centre distance between mutually adjacent holes is less than twice the diameter thereof.

8. An arrangement according to Claim 2, characterized in that the second holes (22) are uniformly distributed along the container surface facing away from said insular part.

9. An arrangement according to Claim 1, characterized in that the turbulence generating devices (20) are greater than four in number but

less than twelve.

10. An arrangement according to Claim 2, characterized in that the container (21) has a circular cross-sectional shape; and in that the turbulence generating devices (20) extend between a discharge-electrode holding device (2) and the container periphery (21c).

11. An arrangement according to any of the preceding Claims, characterized in that a gas flow can be supplied continuously via a gas-flow heating device (25).

12. An arrangement according to any of the preceding Claims, characterized in that the interior surface of the insulator has a form which diverges away from the turbulence generating devices.

13. An arrangement according to any of the preceding Claims, characterized in that the insulator is constructed to form an electrode support device, preferably a discharge-electrode support device.

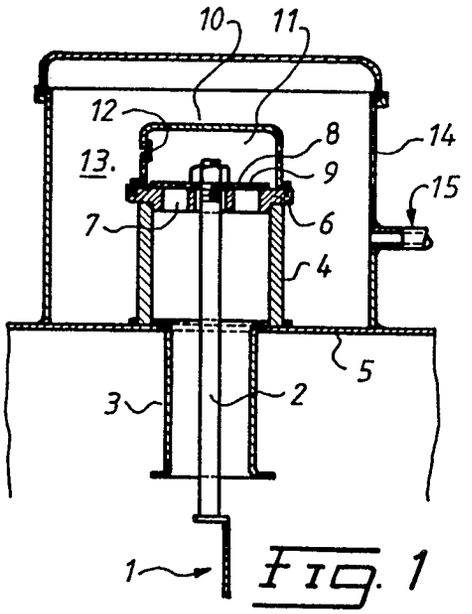


Fig. 1

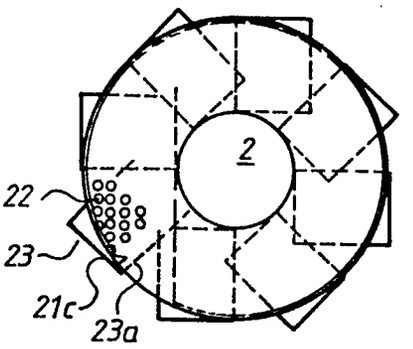


Fig. 4

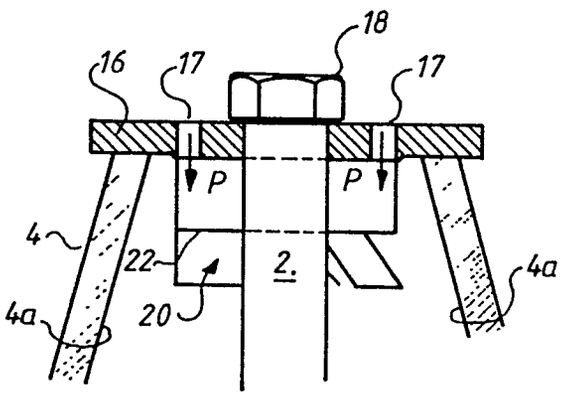


Fig. 2

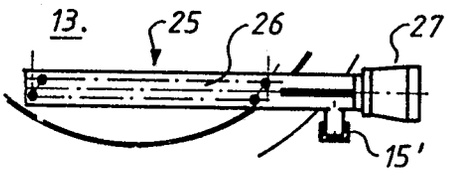


Fig. 5

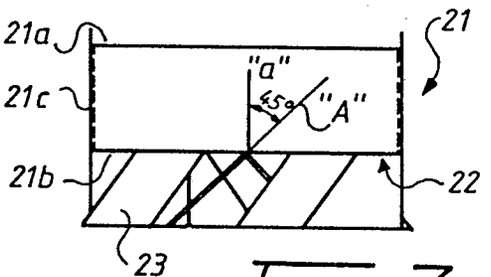


Fig. 3

European Patent Office

EUROPEAN SEARCH REPORT

Application number
EP 87 85 0075.0

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	US-A-3 531 918 (VEGEBY) & SE-B-329 596	1-3, 7 8, 13	B 03 C 3/70
A	DE-C-328 828 (KIRCHHOFF)	1	
Y	CH-A-443 227 (SVENSKA CARBON BLACK AB) * Esp. column 3, line 65- column 4, line 5*	1, 6	
A	US-A-3 033 918 (WIEMER) & DE-B-1 213 215	11, 12	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

B 03 C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
STOCKHOLM	11-05-1987	AUBY J.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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