

ELECTROSTATIC PRECIPITATOR CLEANING

FIELD OF THE INVENTION

The field of the invention relates to a wet electrostatic precipitator comprising an
5 ancillary component cleaning device and a method of cleaning a wet electrostatic
precipitator.

BACKGROUND

Electrostatic precipitator devices collect dust and particulate contaminants from
10 gas, for example, from air or from exhaust gases formed as part of an industrial
process. Electrostatic precipitator devices collect contaminants by using an
electrostatic force. For example, an electrostatic precipitator device may be
configured to generate electrons by means of corona discharge. The generated
electrons ionise surrounding air or other gas molecules. Ionised gas molecules
15 within the electrostatic precipitator device combine with particulate matter carried
in the air or exhaust gas. As a result, particulates become charged and may be
attracted to appropriately grounded collection electrodes by electrostatic force.

Electrostatic precipitator devices may comprise one or more collection electrodes
20 which are electrically grounded and one or more discharge electrodes, to which a
high voltage is applied. When a high voltage is applied to the discharge
electrodes, a corona discharge forms between the discharge electrodes and the
collection electrodes. Collection and discharge electrodes are both typically
electrically conductive.

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Efficient operation of an electrostatic precipitator device may depend upon the
nature of the corona discharge between the discharge electrode and the
collection electrode. For example, increasing a distance between the discharge
electrode and the collection electrode results in reduced efficiency and requires a
30 larger voltage to be applied to the discharge electrode to enable the appropriate
efficiency to be restored. Similarly, decreasing the distance between the
discharge electrode and the collection electrode improves efficiency, but

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electrical breakdown is more likely at reduced distances which may render the electrostatic precipitator inoperable.

5 Particulate build up within an electrostatic precipitator can have a detrimental impact upon efficient operation of an electrostatic precipitator device. A build-up of particulate matter can cause short circuiting and /or a corona discharge to form in a manner which does not support efficient overall operation of the electrostatic precipitator device. Wet electrostatic precipitator devices use fluid, for example, water, to clean one or more main components of the precipitator device.

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Aspects and embodiments may offer a mechanism to ameliorate particulate build up and improve efficient operation of a wet electrostatic precipitator device.

SUMMARY

15 One aspect provides a wet electrostatic precipitator comprising an ancillary component cleaning device, the cleaning device comprising: a cleaning assembly moveably supportable within the wet electrostatic precipitator; the cleaning assembly comprising a scraper; the scraper being configurable to abut an ancillary component of the wet electrostatic precipitator, such that movement of
20 the cleaning assembly within the wet electrostatic precipitator causes movement of the scraper with respect to the ancillary component and wherein the ancillary component comprises a component of a separation assembly provided in the wet electrostatic precipitator to maintain electrical isolation between the discharge and collection electrodes.

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Accordingly, alongside primary particulate clearing and cleaning mechanisms provided to the main components of a wet electrostatic precipitator, a secondary or supplementary clearing arrangement may be provided to assist in clearing one or more ancillary components of the wet electrostatic precipitator. Accordingly,
30 by clearing components other than the primary electrodes, general particulate or agglomerate build up can be mitigated and efficient operation of the primary components of the electrostatic precipitator may be maintained for a greater

period than may be expected without the ancillary component clearing. In some arrangements, the ancillary component to be cleared by the cleaning device comprises a component located adjacent a primary electrostatic precipitator component. Accordingly, particulate or agglomerate build up on such a
5 component may be such that, if not cleared, contact with the primary component may be made, and operation of the primary component(s) detrimentally impacted. Aspects may be provided as a supplementary clearing device and are not configured to clear the primary electrostatic precipitator components, for example, a precipitator discharge or collection electrode.

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According to some embodiments, the ancillary component may comprise a component of a separation assembly provided in an electrostatic precipitator to maintain electrical isolation between the discharge and collection electrodes. Accordingly, mitigating a build up of particulate or agglomerate on ancillary
15 components provided and located to maintain separation of discharge and collection electrodes may help to prevent undesirable contact occurring between those electrodes.

According to some embodiments, movement of the cleaning assembly within the
20 electrostatic precipitator causes movement of the scraper along a surface or edge of the ancillary component. The motion of the scraper along the surface or edge may help to dislodge or clear particulate or agglomerate build up on the edge or surface.

25 According to some embodiments, the scraper comprises a narrow elongate element. Provision of a scraper having a small surface area helps to avoid build-up of particulate or agglomerate on the scraper itself. A scraper having a small contact area with the ancillary component may allow for more effective clearing, by virtue of increased pressure on the edge or contact portion of the scraper with
30 the ancillary component.

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According to some embodiments, the scraper comprises a wire. According to some embodiments, the scraper is electrically earthable. According to some embodiments, contact between the scraper and ancillary component causes electrical earthing of the scraper. Accordingly, the earthing of the scraper may
5 aid prevention of any build up of particulate or agglomerate on the scraper itself.

According to some embodiments, the device is coupleable to a motor configured to move the cleaning assembly relative to the ancillary component. According to some embodiments, the device is arrangeable within the electrostatic precipitator
10 such that the cleaning assembly is carried by a flow of cleaning fluid to move the body relative to the ancillary component. According to some embodiments, the cleaning fluid comprises a flow of water configured to clean at least one collection electrode surface in the electrostatic precipitator device. According to some
15 embodiments, the cleaning fluid comprises a continuous or pulsed flow of gas configured to clean at least one collection electrode surface in the electrostatic precipitator device. Accordingly, relative movement between the scraper of the cleaning device and the ancillary component may be implemented in various active or passive ways. Implementation of a device which utilises a passive drive
20 mechanism may allow for provision of an ancillary component clearing device which can be retrofitted to existing electrostatic precipitators.

According to some embodiments, the electrostatic precipitator comprises a primary component clearing mechanism. The primary component may comprise a discharge or collection electrode. The clearing mechanism may comprise one
25 or more of: a washing mechanism, rapping mechanism or air blasting mechanism.

A further aspect provides a method of cleaning an ancillary component of a wet electrostatic precipitator comprising: providing a cleaning device comprising a
30 cleaning assembly comprising a scraper; arranging the cleaning assembly of the cleaning device to be moveably supported within the wet electrostatic precipitator; configuring the scraper to abut the ancillary component of the wet

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electrostatic precipitator, such that movement of the cleaning assembly within the wet electrostatic precipitator causes movement of the scraper with respect to the ancillary component and wherein the ancillary component comprises a component of a separation assembly provided in the wet electrostatic
5 precipitator to maintain electrical isolation between the discharge and collection electrodes.

Further particular and preferred aspects are set out in the accompanying independent and dependent claims. Features of the dependent claims may be
10 combined with features of the independent claims as appropriate, and in combinations other than those explicitly set out in the claims.

Where an apparatus feature is described as being operable to provide a function, it will be appreciated that this includes an apparatus feature which provides that
15 function or which is adapted or configured to provide that function.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention will now be described further, with reference to the accompanying drawings, in which:

- 20 Figure 1 illustrates an example electrostatic precipitator;
Figure 2 is a magnified view of a portion of the example electrostatic precipitator of Figure 1;
Figure 3 illustrates as a perspective view, a water feed plate 120 such as that shown in the electrostatic precipitator of Figures 1 and 2;
25 Figure 4 is a photograph showing some of the main components of a precipitator such as that shown in Figures 1 and 2;
Figure 5 is a photograph showing some of the main components of a precipitator such as that shown in Figures 1 and 2;
Figure 6 illustrates a clearing device according to one example embodiment
30 suitable for use in an electrostatic precipitator such as that shown in Figure 1 and Figure 2;

Figure 7 illustrates an alternative clearing device according to one example embodiment suitable for use in an electrostatic precipitator such as that shown in Figure 1 and Figure 2; and

Figure 8 is a photograph showing some of the main components of a WESP such as that shown in Figures 1 and 2, in which a device such as that shown in Figure 6 is operational.

DESCRIPTION OF THE EMBODIMENTS

Before discussing the embodiments in any more detail, first an overview will be provided. Embodiments provide an arrangement which operates to support efficient operation of an electrostatic precipitator device. Arrangements seek to provide a mechanism and method to reduce build-up of particulates, thereby supporting reliable generation of a corona discharge within an electrostatic precipitator.

An electrostatic precipitator typically operates to remove particulate matter from a gas by enabling ionisation of the particulate matter and making use of electrostatic forces. A corona discharge is formed in by providing at least one discharge electrode held at a high voltage and at least one collection electrode held electrically at earth. The resulting corona discharge forms ionised particles in a gas between the electrodes.

The collection electrodes or “earth plates” in an electrostatic precipitator (ESP) collect particulates as a result of charged particles being attracted to those plates.

The particulates can then be removed from the collection electrodes and other electrically neutral or earthed regions. A dry electrostatic precipitator device may be such that particulates are removed by rapping (a process of physically vibrating or hitting the electrode plates to dislodge particulate build up) the collection electrodes, or by air blasting the collection electrodes. In a wet electrostatic precipitator (WESP) the collection electrodes are typically washed by a fluid, for example, water, to prevent particulate build up. Arrangements

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recognise that in some applications, particulates can form solid agglomerates on components other than the primary collection electrodes and that typical particulate removal techniques may be ineffective.

5 It will be appreciated that if particulates excessively build up on a collection electrode (or discharge electrode) the build-up can lead to issues including: a decrease in electrode-plate separation distance thus leading to intermittent electrical arcing which may reduce particulate removal performance; a decrease
10 in electrode-plate separation distance may lead to full electrical shortage and subsequently a loss of particulate charging entirely rendering an ESP non-operational; a decrease in electrode-plate separation may lead to intermittent arcing which consequently requires use of higher capacity power supplies; and, the build-up of particulate on the earth surface may lead to back-corona, consequently increasing draw of current from a power supply.

15 Described arrangements recognise that in some electrostatic precipitator devices, there may be ancillary components (ie components other than the discharge and collection electrodes) that are earthed or electrically neutral which cannot be rapped, air blasted or washed due to the close proximity of those earthed
20 components to high voltage components or other essential primary components of the electrostatic precipitator. Rapping or washing in relation to closely spaced components can, for example, lead to an unexpected connection and electrical shorting between those closely spaced components. Furthermore, described arrangements recognise that a particular application chosen for some
25 electrostatic precipitator devices may result in agglomeration of particulate matter which can be problematic to remove via standard rapping, air blasting and/or washing techniques. Arrangements recognise that it may be possible to use mechanical scraping as a mechanism to clean one or more ancillary component surfaces within an ESP. Maintaining cleaner surfaces even in relation to ancillary
30 components of a precipitator, particularly those located in the immediate vicinity of the primary functional components, may make it possible to elongate the time

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an ESP can remain in efficient operation before faults resulting from particulate build-up occur.

Mechanical scraping of ESP components may be achieved in various ways. A
5 scraper may comprise an element having a scraping edge or surface configured to engage with a surface of a component to be cleared. The scraping edge may be moveable across one or more surfaces or edges of a component to be cleared. Motion of the scraper may occur by virtue of selection and application of
10 an appropriate electromechanical configuration, for example, by appropriate coupling of a scraper to a motor. Motion of the scraper may occur as a result of one or more components or fluids associated with standard operation of an ESP or WESP, for example, as a result of a flow of a cleaning fluid already used to wash an earthed collection electrode, or movement effected by an air blast arrangement already in operation within an ESP.

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Electrostatic Precipitator

Figure 1 illustrates an example electrostatic precipitator 10. The electrostatic precipitator 10 comprises a housing 20 having inlets (not shown) which receive an effluent stream and outlets (not shown) which provide a treated effluent
20 stream. In this example electrostatic precipitator, the housing 20 is generally cylindrical in shape. However, it will be appreciated that the housing 20 may be of any suitable shape and that the inlets and the outlets may be located at any suitable position.

25 The electrostatic precipitator 10 shown in Figure 1 comprises a wet electrostatic precipitator (WESP) and comprises a cylindrical inner earthed plate forming a collection electrode 30, a cylindrical outer earthed plate forming a collection electrode 40, and a discharge electrode cage 50. The discharge electrode cage 50 is held at high voltage, for example, 5 – 50kV and, in the example shown, the
30 cylindrical inner collection electrode 30 is washed.

In order to maintain ESP structure and to maintain separation between components of the electrostatic precipitator 10, in the example shown, the discharge electrode cage 50 is mechanically coupled to the inner collection electrode 30. Electrical isolation between the electrode cage 50 and the earthed inner collection electrode is maintained by ensuring the mechanical coupling or connection between the two components includes an electrically insulating element.

It will be appreciated that efficient operation of an electrostatic precipitator device depends upon maintenance of high voltage potential surfaces fully electrically isolated from earthed collection plates. In the example shown, the earthed inner cylindrical collection electrode structure 30 is washed continuously. An additional physical barrier in the form of a separator or guard 66 is provided between a water flow acting to wash the collection electrode 30 and the insulating element forming part of the mechanical coupling. The barrier may itself form part of the mechanical coupling. Without such a barrier or guard, the electrically insulating element forming part of the mechanical coupling between the discharge electrode cage 50 and washed collection electrode 30 could get wet. A wet surface is no longer electrically insulating. The wet surface could provide an electrical leakage path for high voltage and as a result, the ESP device could fail.

Ancillary components such as the mechanical coupling, insulating element and barrier are examples of components within an ESP on which particulate matter may collect and negatively impact upon operation of the ESP, but which may not be cleared as part of standard operation of the ESP.

Described arrangements recognise that despite various existing mechanisms to mitigate the chance of ESP failure, it is possible to further mitigate the chance of ESP failure if mechanisms are provided to reduce build-up of particulate matter on ancillary ESP components where other clearing approaches may be unsuitable. By way of example, it is possible for particulate matter to build up on the mechanical coupling between the discharge electrode and collection

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electrode. Particulate matter may also, for example, build up on the separator or barrier referred to above. The build-up of particulate matter on a component of the mechanical coupling, for example, the separation barrier, can still cause issues with ESP operation. Such ancillary components cannot be easily rapped and cannot be washed with water due to the possibility of affecting the electrical isolation of main operational components of an ESP. The distance between ancillary components of the ESP which cannot be washed or rapped may be increased in some cases to combat the particulate build-up but this is at the expense of an increase in the overall design footprint. Arrangements described in more detail below provide alternative mechanisms for clearing particulate build up from components of an ESP. In particular, arrangements recognise that it is possible to support mechanical cleaning of such components.

Mechanical cleaning may take the form of mechanically loosening, moving or scraping particulate matter from a surface and/or edge of one or more ESP component. The mechanical cleaning may be implemented in various ways. In general, a mechanical cleaning device may be provided which includes at least one component arranged to contact a surface or edge of an ESP component to be cleared of a build-up of particulate matter. The component arranged to contact a surface or edge of the ESP component may comprise a scraper. The scraper may comprise a scraping edge or surface configured to engage with at least a portion of the surface or edge of the component to be cleared. The scraping edge may be moveable across one or more surfaces or edges of a component to be cleared. The scraping edge, for example, may comprise a scraping wire. The scraping edge or element may have a low surface area so that appreciable amounts of particulates or agglomerates cannot adhere to it. The scraping element may itself be held electrically at earth.

The mechanical cleaning device may be actively powered or be a passive device, moved as a result of one or more factor already associated with standard operation of an ESP or WESP, for example, as a result of a flow of cleaning fluid,

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or flow of gas, already required to clean by washing or blowing an earthed collection electrode.

By way of example, operation of a WESP, components of a WESP and a
5 mechanical cleaning device according to one example embodiment are described in detail.

Figure 2 is a magnified view of a portion of the wet electrostatic precipitator of Figure 1. Figure 2 shows a mechanical coupling 60 between discharge electrode
10 cage 50 and inner wet collection electrode 30. The mechanical coupling 60 is received within the housing 20. In this embodiment, the mechanical coupling 60 is coaxially located within the housing 20. The mechanical coupling 60 is dimensioned to be spaced away from surfaces of the hollow housing 20 and extends along an elongate axis of the housing 20. An electrical coupling (not
15 shown) couples to the discharge electrode cage 50. The mechanical coupling 60 is electrically isolated from the housing 20. The discharge electrode cage 50 comprises a number of shafts 70. In this example, the shafts 70 are elongate plates extending along the elongate axis of the housing 20 from an annular
20 support 80. The shafts 70 are positioned circumferentially around the annular support 80. A number of axially spaced teeth 90 extend radially from each of the shafts 70. In the example shown, the teeth 90 are integrally formed with the shafts 70. In particular, the shaft 70 and the teeth 90 are formed from a metal plate which is stamped or cut to form the comb structure. Conveniently, the shafts 70 may be bent or folded to provide a surface for fixing to the annular
25 support 80.

The discharge electrode cage 50 and inner collection electrode 30 are connected by the mechanical coupling 60. The mechanical coupling 60 comprises an elongate shaft 62 and an insulating element 64. The insulating element ensures
30 that whilst discharge electrode cage 50 and inner collection electrode 30 are mechanically connected they are not electrically connected. In the example shown, the insulator comprises a series of axially spaced annular plate-like

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elements 65 which serve as an electrical insulator and electrical guard in the region of the ends of the substantially cylindrical concentrically arranged inner wet collection electrode 30 and discharge electrode cage 50. The plate-like elements 65 also form a physical barrier between those ESP components. The mechanical coupling 60 includes a barrier or guard 66 in the form of an open-ended cylinder arranged between wet the inner collection electrode 30 and the insulating element 64. The guard 66 acts as a barrier between fluid used to wash the wet collection electrode 30 and the insulating element 64. In the arrangement of Figure 2, the guard 66 extends axially beyond the end of collection electrode 30 to protect insulating element 64 from splashes of liquid used to clean the collection electrode 30.

In the arrangement of Figure 2, wet cleaning of electrode 30 is implemented. An internal water reservoir (not shown in Figure 2) collects in a cavity 100 formed between an inner surface 32 of the hollow cylindrical collection electrode 30 and an outer surface 67 of the barrier 66. A water feed 110 provides a supply of water to the cavity 100 via a feed plate 120, shown in more detail in a later figure. Water from the feed 110 fills the cavity 100 until water level in the cavity reaches a top lip 34, in the form of a water-weir lip, of the inner collection electrode 30. Water pours over the water-weir lip 34 and onto an outer surface 36 of the collection electrode 30.

In operation, as described previously, the discharge electrode cage 50 is held at a high potential to cause a corona discharge. The corona discharge causes ionisation of particulate matter within an ESP, which is then attracted to an outer surface of the earthed collection electrodes 30, 40 in the ESP. In the example shown in Figure 2, the outer surface 36 of the inner electrode is washed with water to clear that particulate collection. Substantially continuous clearing of the outer surface 36 can be achieved by allowing water within cavity 100 to pass over the weir lip 34 and to then pass along the outer surface 36, washing away collected particulate matter. The presence of water on outer surface 36 does not

impact the potential difference between the discharge electrode cage 50 and the collection electrode 30.

Figure 3 illustrates as a perspective view, a water feed plate 120 such as that
5 shown in the electrostatic precipitator of Figures 1 and 2. Water feed plate 120
takes the form of a substantially annular plate and, as shown in Figure 2, can be
located immediately beneath barrier 66 of the mechanical coupling 60. The feed
plate 120 includes an opening 122 to allow ingress of water from water feed 110.
Baffles 124 formed on the plate 120 together form one or more channels 126
10 through which the ingress of water from the water feed is forced. Water entering
the plate 120 from the water feed exits the plate tangentially via outlets 128 into
cavity 100. The water in cavity 100 has a "whirlpool" circulatory motion as a
result of the tangential release of feed water from the outlets 128 of the feed
plate.

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Figures 4 and 5 are photographs showing some of the main components of a
WESP such as that shown in Figures 1 and 2, in which particulate build-up can
be seen. In particular, Figure 4 is a photograph along the axis of the ESP from
electrode cage 50 annular support 80. The shafts 70 of the electrode cage 50
20 can be seen extending away from the camera. The cavity 100 which, in use,
receives a water reservoir can be seen, formed between the collection electrode
30 and the barrier 66. Despite being generally clean, the photographed WESP
components include a region A of particulate build up on the upper edge of
barrier 66. As explained earlier, the barrier 66 is not washed, nor can it be air
25 blasted or rapped to remove particulate matter. The build-up of particulate matter
in region A can impact negatively upon overall ESP operation.

Figure 5 is a similar photographic view of the internal components of a WESP
such as that shown in Figures 1 to 3. In this instance, all components are
30 exhibiting particulate build up, including significant particulate build up in region
A, at the edge of barrier 66 (also known as the insulator surround).

It has been found that the build up of particulate matter in regions such as region A shown in Figures 4 and 5, can result in an ESP displaying back-corona glow whilst in operation. Back-corona glow resulting from particulate build up significantly increases ESP power draw from a power supply. For best overall
5 ESP performance electrode current is matched to a power supply. If additional current flows due to the formation of a back corona glow, the ESP system ends up drawing more power than is strictly required to only remove particulate matter in a processed fluid.

10 Arrangements recognise that it is possible to provide a device which can support clearing of particulate matter from one or more earthed or neutral component within a electrostatic precipitator.

Figure 6 illustrates a clearing device 200 in accordance with one example
15 embodiment suitable for use in an electrostatic precipitator such as that shown in Figure 1 and Figure 2. The device 200 comprises a cleaning assembly including a body 210 which supports a scraper 220. In the example shown, the device is dimensioned to be locatable within the cavity 100 formed between the inner collection electrode 30 and the barrier 66. In particular, the body is dimensioned
20 such that it can be adjacent to, but spaced apart from, the inner surface 32 of the collection electrode 30 and the outer surface 67 of the barrier 66. The device body 210 has a curvature selected such that it conforms to the space between the inner collection electrode 30 and the barrier 66. Such a selection of dimensioning and shaping allows the device 200 to freely circulate in cavity and
25 allows the body to carry the scraper 220 on a path which circumnavigates the barrier 66. The body 210 of the device extends down into the cavity 100 and is at least partially submerged within the reservoir of cleaning fluid within the cavity 100. The body 210 of the device may be formed from a material which prevents the device 200 floating in the water, or other cleaning fluid, supplied to cavity 100.
30 The material selected for the body of the device is also not so dense or the device so heavy to prevent movement of fluid within the reservoir acting to carry the device 200 along.

The material and weight of the device is carefully selected such that the device 200 does not simply float at the surface of the reservoir, and is prevented from sinking into cavity 100 by scraper 210 resting on an upper edge of the barrier 66.

5 The body of the device is kept upright by provision of a support 230 which is arranged on the body such that, in use, it rests upon the water weir lip 34 of the inner collection electrode 30. In other words, the body of the device is suspended from the scraper 220 and support 230, such that it is located within the cavity, touching neither the inner surface 32 of the collection electrode 30 nor
10 the outer surface 67 of the barrier 66. Because the axial length of the barrier is such that it extends axially beyond the length of the collection electrode, the scraper 220 is held in a slot provided in a scraper support 225 which projects from an upper surface of the device body 210, whilst the stabilising support 230 is held in position within a slot which extends down into the device body itself.

15 In use, circumferential movement of cleaning fluid within the cavity 100 induced by the plate described in relation to Figure 3 acts to carry the device 200 around in a substantially circular path. The circumferential movement of the cleaning fluid is induced by provision of the water feed plate ensures that the cleaning fluid
20 flows uniformly over the water weir lip 34 to clean all portions of the inner collection electrode. It is this existing circumferential movement of the cleaning fluid which is utilised in the illustrated embodiment to induce movement of the cleaning assembly relative to other components of the ESP. The body 210 includes a shaped nose region 215, to reduce frictional fluid resistance to
25 movement of the device within the reservoir. The scraper 220 rests upon the edge of the barrier and acts to dislodge any particulate matter which has accumulated and adhered to the top edge of the barrier 66. Any dislodged particulate matter may fall towards the insulating element 64 and therefore be less likely to impact upon operation of the discharge and collection electrodes or
30 may fall into the cleaning fluid and then pass over the water weir lip 34. The improved clearing of the barrier can help increase the maintenance interval of an electrostatic precipitator.

The scraper 220 in the example shown takes the form of a metal rod or wire, as does stabilising support 230. The wire scraper has a low surface area so that appreciable amounts of particulates or agglomerates cannot adhere to it as it
5 scrapes the edge of the barrier 66. The scraper wire 220 is also held electrically at earth, at least by virtue of direct contact with barrier 66.

Figure 7 illustrates an alternative clearing device according to one example embodiment suitable for use in an electrostatic precipitator such as that shown in
10 Figure 1 and Figure 2. In this alternative embodiment, the device 300 comprises a body 310 which supports a scraper 320. In the example shown, the device is located inside the barrier 66, between an inner surface of the barrier and the insulating element 64. The body 310 takes the form of an elongate portion connectable at one end to the scraper 320 and at the other to a cog 330. The
15 cog 330 is substantially annular and has a toothed inner ring surface 334 and a smooth outer ring 336 surface. The toothed inner ring surface 334 is configured to engage with cooperating teeth of a drive cog 340, connectable to a rotating drive shaft 350 which extends through the water feed plate 120 along the axis of the precipitator. Rotation of the drive cog 340 causes the device 300 to move
20 around the circumference of the barrier 66. The scraper 320 supported by device body 310 takes the form of a wire which extends over, and engages with, the upper edge of barrier 66, thereby effecting the same scraping and clearing of agglomerates or particulate matter which may have accumulated on the upper edge of the barrier during use of the electrostatic precipitator as described in
25 relation to the example embodiment shown in Figure 6.

Figure 8 is a photograph showing some of the main components of a WESP such as that shown in Figures 1 and 2, in which a device such as that shown in Figure 6 is operational. Clearing device 200 can be seen located in the cavity 100
30 between the inner collection electrode 30 and the barrier 66. Although particulate build up can be seen on, for example, the discharge electrode shafts 70, the annular support 80 and the insulating element plates 65, there is no significant

build up at the barrier 66, of the kind which could cause failure or inefficient operation of the electrostatic precipitator.

It will be appreciated that described arrangements are such that an ESP is provided in the form of a WESP. Use of a WESP supports a short-electrode spacing, because water or other fluid can be used to clear at least one primary operational component of the WESP. The normal operating corona current of a WESP is low. It is set at a level which is sufficient to provide the field which causes particles to travel in addition to providing the charging mechanism for these particles.

Aspects recognise that provision of a cleaning device, for example, in the form of a scraper, facilitates clearing of particulate matter which might otherwise build up on a section of the WESP between a water washed weir and an insulator surface. It has been observed that if such particulate build up is not cleared, back-corona or arcing may occur at the operating voltage of the WESP. Aspects recognise that some components, including ancillary components of a WESP, cannot be rapped to dislodge or remove a build up of particulate matter. This can be particularly true in a WESP since particulates may be wet and so cannot be easily dislodged or removed in this manner. Provision of a moving cleaning part, which can be continuously or periodically moving within the WESP can help to avoid particulate build up. Whilst it may intuitively be thought that provision of an additional device or component within the operational zone of a WESP might cause additional debris build up, it has been found that by providing a thin, wire-like mechanical scraper on a moving body, the scraper can clear any particulate build up yet prevent build-up of particulate material on itself or the scraped ancillary component. In other words, the cleaning device described may help mitigate build up occurring to a degree that could result in undesirable electrical pathways within the WESP.

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According to described arrangements, an interface between an insulator and a water washed section of the WESP is cleared. In other words, the ancillary

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component to be cleared may comprise a component which is not itself an insulator, and may be earthed but unwashed. Aspects provide a mechanism to clear build up which may occur on an ancillary part of a WESP which cannot be washed or rapped.

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It will be appreciated that in some described implementations, the cleaning device is powered by tangential water flow already forming part of WESP primary operation and that any debris removed by the cleaning device can be washed away by the tangential water flow already forming part of WESP primary
10 operation. Accordingly, no additional collection hopper for dislodged or cleaned particulate matter is required. Furthermore, provision of appropriate component(s) on the cleaning device may assist water wicking over a weir of the WESP. In the arrangements illustrated, the stabilising support 230 operates to level the cleaning device, thereby reducing resistance to movement of the
15 cleaning device and helping the device slide around the circumference of the WESP, but also acts to provide a path to help water wick evenly over the weir.

Although illustrative embodiments of the invention have been disclosed in detail
20 herein, with reference to the accompanying drawings, it is understood that the invention is not limited to the precise embodiment and that various changes and modifications can be effected therein by one skilled in the art without departing from the scope of the invention as defined by the appended claims and their equivalents.

25

REFERENCE SIGNS

	10	electrostatic precipitator
	20	housing
	30	inner collection electrode
5	32	inner surface of inner collection electrode
	34	water weir lip
	36	outer surface of inner collection electrode
	40	outer collection electrode
	50	discharge electrode cage
10	60	mechanical coupling
	62	coupling shaft
	64	insulating element
	65	annular plates of insulating element
	66	guard or barrier
15	67	outer surface of guard or barrier
	70	discharge electrode shafts
	80	annular shaft support
	90	shaft teeth
	100	cavity
20	110	water feed
	120	water feed plate
	124	water feed plate baffles
	126	water plate channel
	128	water plate outlets
25	200	clearing device
	210	clearing device body
	215	shaped nose
	220	scraper
	225	scraper support
30	230	stabilising support
	300	clearing device
	310	body of clearing device

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- 320 scraper
- 330 cog
- 334 toothed inner ring of cog
- 336 smooth outer ring of cog
- 5 340 drive cog
- 350 drive shaft

CLAIMS

1. A wet electrostatic precipitator comprising an ancillary component cleaning device, the cleaning device comprising:
 - 5 a cleaning assembly moveably supportable within the wet electrostatic precipitator; the assembly comprising a scraper;
the scraper being configurable to abut an ancillary component of the wet electrostatic precipitator, such that movement of the cleaning assembly within the wet electrostatic precipitator causes movement of the scraper with respect to the ancillary component and wherein the ancillary component comprises a
10 component of a separation assembly provided in the wet electrostatic precipitator to maintain electrical isolation between the discharge and collection electrodes.
- 15 2. A wet electrostatic precipitator according to claim 1, wherein movement of the cleaning assembly within the electrostatic precipitator causes movement of the scraper along a surface or edge of the ancillary component.
3. A wet electrostatic precipitator according to any preceding claim, wherein
20 the scraper comprises a narrow elongate element.
4. A wet electrostatic precipitator according to any preceding claim, wherein the scraper comprises a wire.
- 25 5. A wet electrostatic precipitator according to any preceding claim, wherein the scraper is electrically earthable.
6. A wet electrostatic precipitator according to claim 5, wherein contact
between the scraper and ancillary component causes electrical earthing of the
30 scraper.

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7. A wet electrostatic precipitator according to any preceding claim, wherein the cleaning device is couple to a motor configured to move the cleaning assembly relative to the ancillary component.
- 5 8. A wet electrostatic precipitator according to any one of claims 1 to 6, wherein the cleaning device is arranged within the electrostatic precipitator such that the cleaning assembly is carried by a flow of cleaning fluid to move the cleaning assembly relative to the ancillary component.
- 10 9. A wet electrostatic precipitator according to claim 8, wherein the cleaning fluid comprises a flow of water configured to clean at least one collection electrode surface of the electrostatic precipitator device.
- 15 10. A wet electrostatic precipitator according to claim 8, wherein the cleaning fluid comprises a continuous or pulsed flow of gas configured to clean at least one collection electrode surface in the electrostatic precipitator device.
11. A method of cleaning an ancillary component of a wet electrostatic precipitator comprising:
- 20 providing a cleaning device comprising a cleaning assembly comprising a scraper;
- arranging the cleaning assembly of the cleaning device to be moveably supported within the wet electrostatic precipitator;
- 25 configuring the scraper to abut the ancillary component of the wet electrostatic precipitator, such that movement of the cleaning assembly within the wet electrostatic precipitator causes movement of the scraper with respect to the ancillary component and wherein the ancillary component comprises a component of a separation assembly provided in the wet electrostatic precipitator to maintain electrical isolation between
- 30 the discharge and collection electrodes.