Dec. 25, 1951 I. R. CUMMINGS 2,579,552

ELECTROSTATIC DUST PRECIPITATOR

Filed Jan. 15, 1947 2 SHEETS—SHEET 1

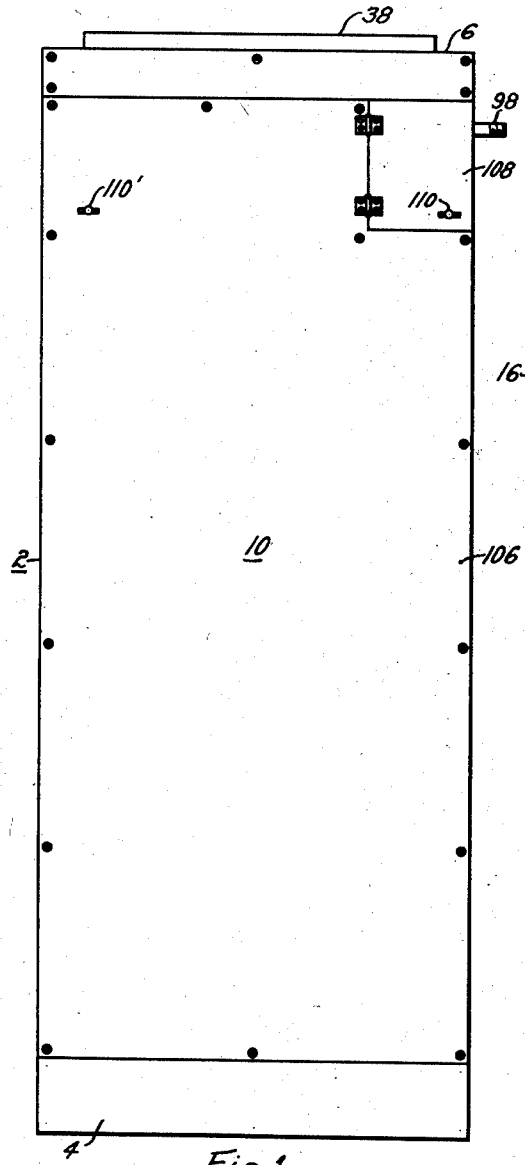


Fig. 1.

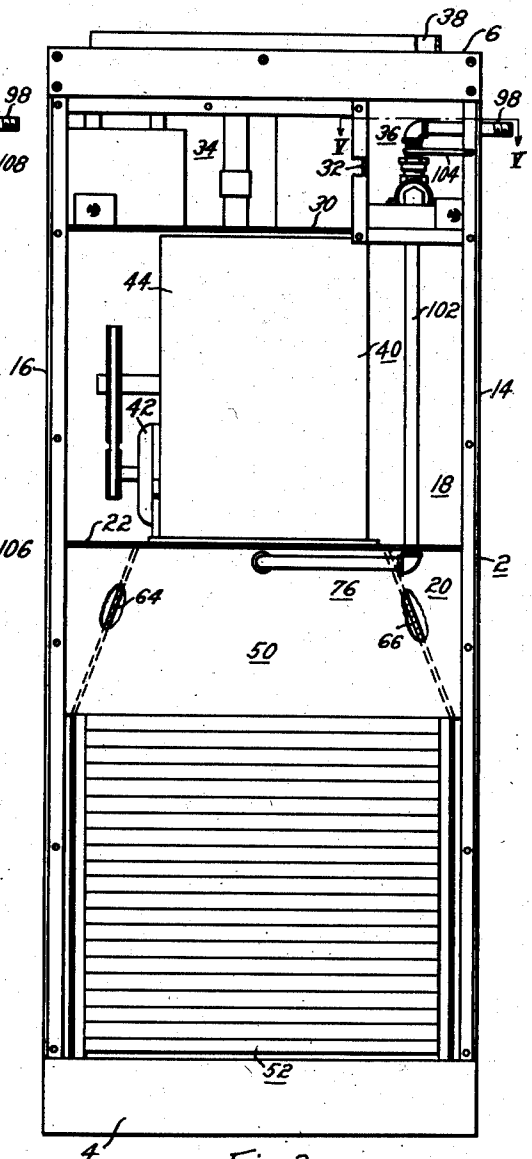
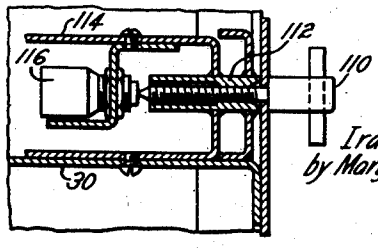


Fig. 2.

Fig. 7.



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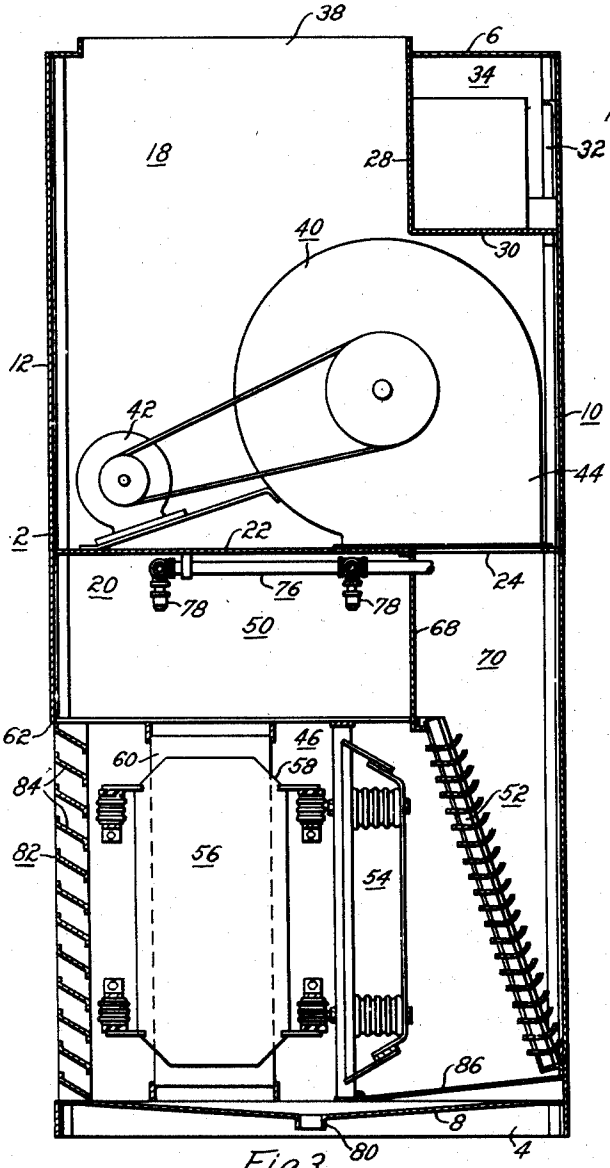

Fig. 3.

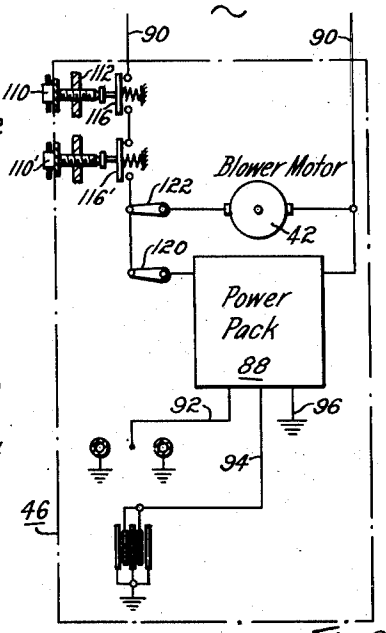

Fig. 6.

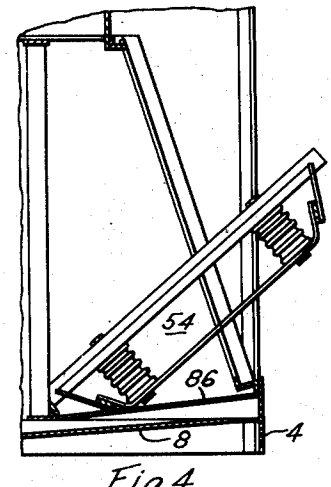

Fig. 4.

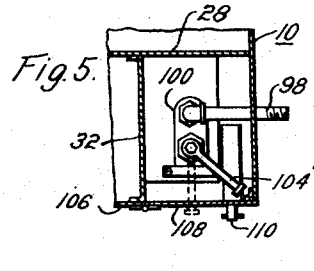

Fig. 5.

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UNITED STATES PATENT OFFICE

2,579,552

ELECTROSTATIC DUST PRECIPITATOR

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Application January 15, 1947, Serial No. 722,131

7 Claims. (Cl. 183—7)

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Broadly, this invention relates to electrostatic dust-precipitators of a type for removing foreign particulate matter of all sorts from a flowing gas; but, more particularly, this invention is directed to providing a self-contained dust-precipitator of a small size which is suitable for cleaning air to be breathed in places like homes, small offices or stores, and in similar places or locations where the volume-rate of the air to be cleaned by the dust-precipitator is comparatively small and in the order of several hundred cubic feet per minute.

It is an object of this invention to provide a small electrostatic dust-precipitator of a type described which can be easily placed, with its parts readily accessible, in the air-circulating conduit of an air-conditioning system, which has automatic safety and protective features, and which requires little, if any, attention in order to keep it clean and efficient.

In the preferred form of this invention as herein described, electrical air-cleaning elements are utilized which can be operated with limited energy and do not generate objectionable or noxious gases. Preferably, the dust-precipitator is of the two zone or stage type comprising an upstream dust-charging or ionizer element and a downstream dust-precipitating element in which precharged dust is precipitated or collected. A form of such a dust-precipitator is shown in Patent No. 2,129,783, granted September 13, 1938, to G. W. Penney, but other forms are known.

It is among the specific objects of this invention to provide a small-size dust-precipitator unit having built-in washing means for cleaning at least the dust-precipitating element. The washing means can be manually operated, but an interlocking protective arrangement is provided which automatically prevents operation of the washing means while the dust-precipitating element is electrically energized. In a specific arrangement, a valve is so provided inside the casing of the unit that its operating means is interlocked with a part of the unit. This part may be a door or closure which controls the energization of the unit.

It is a more specific object of this invention to provide an electrostatic dust-precipitator unit of a type described which can be used alone or can be installed in an air-conditioning system, such as a hot air heating system. To this end, provision is made in the dust-precipitator unit for optionally including a fan or blower for creating a flow of air through the unit or to aid the air-movement in the air-conditioning system.

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Other objects, features and innovations of this invention will be discernible from the following description of a preferred embodiment to which, however, the invention is not limited. The description is to be taken in conjunction with the accompanying somewhat schematic drawings in which details have been omitted for the sake of simplicity and clarity. In the drawings:

Figure 1 is an elevational view of a dust-precipitator unit embodying my invention;

Fig. 2 is a similar view of the unit but with its front wall removed;

Fig. 3 is a vertical sectional view at right angles to the view of Fig. 2;

Fig. 4 is a partial view of Fig. 3, showing the parts in a position for allowing access to the ionizer element and the dust-precipitating element inside the unit;

Fig. 5 is a horizontal sectional view of a detail, taken on the line V—V of Fig. 2, and illustrating how the washing means is interlocked with a door or closure of the unit;

Fig. 6 is a simplified wiring diagram for the equipment; and

Fig. 7 is a sectional detail view of a time-delay and switch means used for protection purposes.

The particular embodiment of the invention herein described comprises a casing, an air moving means in the form of a blower inside the casing, a dust-precipitation means, a means for removing collected dust or dirt from the dust-precipitation means, and voltage-conversion and energy control means for controllably energizing the dust-precipitation means; the parts being specially arranged in the casing. The casing is indicated in its entirety by the reference numeral 2, and comprises a supporting base-frame 4, a top wall 6, a bottom wall 8, and upright side walls which are identified, for convenience, as a front wall 10, a back wall 12, and opposite lateral side walls 14 and 16. A horizontal partition 22, carried by bars secured to the side walls 14 and 16, divides the inside of the casing into an upper section or portion 18 and a lower section or portion 20. The partition 22 terminates short of the front wall 10 in order to provide an intermediate opening 24 which provides open communication between the upper and lower sections 18 and 20 of the casing.

The upper section 18 contains a voltage conversion and controlling means and also an air-moving means. To this end, small inner dividing walls 28, 30 and 32 are provided which cooperate with outer walls of the casing to form two small adjacent inner compartments 34 and 36 which

are in an upper corner of the casing, and are closed in part by the front wall 10. In this embodiment, the compartment 34 contains parts for the voltage-conversion means and is longer than the compartment 36 which contains a valve for the washing means. The upper section 18 is also provided with an airinlet opening 38 preferably located centrally in the top wall 6 and defined by flanges to which a conduit may be attached, if desired. The inner compartments 34 and 36 are at one side of the inlet opening 38 and offer very little, if any, interference to incoming air flowing to the intake of a centrifugal blower 40. The centrifugal blower 40 is driven, through gearing, by an electric motor 42; and these parts, constituting an air-moving means, are carried on the partition 22. The tangential discharge end 44 of the blower fits the intermediate opening 24 through which the air is forced downwardly into the lower section 20 of the dust-precipitator unit.

The lower section 20 contains a dust-precipitation means 46 which is carried slightly above the bottom wall 8. It also contains a washing means 50 above the dust-precipitation means, and a slanted air-turning vane-structure 52 in front of the dust-precipitation means 46 and under the intermediate opening 24.

The dust-precipitation means 46 can be any suitable structure such as, for example, that shown in Pegg Patent No. 2,380,992, dated August 7, 1945. Preferably, however, the dust-precipitating means 46 consists of an assembly comprising a dust-charging or ionizer element or means 54, such as more particularly herein described and claimed in the copending application Serial No. 722,133, filed concurrently herewith, which is now Patent No. 2,447,933, dated August 24, 1948, and a dust-precipitating cell or means 56, such as more particularly herein described and claimed in the abandoned application Serial No. 722,132, filed concurrently herewith. The precipitating cell 56 comprises an outer framework having continuous rigid parallel opposite end plates between which a plurality of alternately relatively insulated and uninsulated plate-electrodes 58 and 60 are parallely disposed. The framework has wide-open top and bottom sides, an open entrance end toward the vane-structure 52, and an open exit end close to an air-outlet opening 62 in the lower portion of the back wall 12 of the casing. Preferably the end plates are very close to the side walls 14 and 16 of the casing; and calking or baffles or some other means is used to bar air-flow between the end plates and the casing side walls. The structure and arrangement is such that the dust-precipitation means 46 extends across the side-to-side width of the casing but is not the full front-to-back depth of the casing. The height of the dust-precipitation means 46 is less than that of the lower section 20 so that the washing means 50 can be disposed above it and below the partition 22.

The washing means 50 comprises an open-bottom box-like structure formed in part by portions of the back wall 12 and the partition 22. It also includes a pair of opposite walls 64 and 66 which slope toward the end plates of the dust-precipitating cell or element 56, and an inner wall 68. The inner wall 68 extends straight downwardly from the back end of the intermediate opening 24 and completely across the casing so as to form, with the front wall 10, a downwardly extending gas-passage 70 for guiding air from the blower 40. The washing means 50 also comprises a network of piping 76, arranged at the top of the box-like structure. The network includes a plurality of nozzles 78 located at different points distributed over the dust-precipitation means 46 and adapted to throw out sprays of water for washing dirt out of the dust-precipitation means. The spent water containing the dirt flows to the bottom wall 8 which slopes to a drain 80. Spray water is prevented from splashing out of the casing, through the outlet opening 62, by a water deflecting means 82 comprising a plurality of suitably shaped and placed louvers 84 which have portions sloping downwardly toward the front of the casing. Preferably the outlet opening 62 is about the same size as the exit end of the dust-precipitation means 46.

The dust-precipitator is arranged so that it will clean the air while the air is flowing horizontally, although the air flows vertically into it. The air flowing downwardly at the end of the vertically extending gas-passage 70 is turned by the vane-structure 52 horizontally into the entrance end of the dust-precipitation means 46, more specifically, into the dust charging element 54. Consequently, the vane-structure 52 can be considered as being at the intersection of the vertical lines of air flow through gas-flow passage 70 and the horizontal air-flow lines through the dust-precipitation means 46. It is also desirable to cause all of the air flowing through the unit, and especially the air which has passed through the dust-charging element 54, to pass through the dust-precipitating element 56. Accordingly, the inner wall 68 meets the vane-structure 52 below the top of the dust-precipitation means 46; and the vane-structure has its lower edge above the bottom of the dust-precipitation means 46; a slightly sloped baffle 86 being provided at the bottom of the vane-structure for preventing air from flowing below the dust charging element 54.

The dust-precipitation means 46 may be electrically energized by a voltage-conversion means such as that described in the aforesaid Penney patent. Referring to Fig. 2 and to Fig. 6 where the dust-precipitator unit is symbolically represented by the dot-dash rectangle, such voltage-conversion means is mounted in the compartment 34 and comprises various parts including capacitors, resistors, a transformer means and rectifiers properly connected to constitute a power pack 88 for converting a commercial A. C. supply available at a cord or conductors 90 extending into the casing, to the required high voltage D. C. supplied to insulated conductors 92 and 94 and a ground connection 96. The insulated conductors 92 and 94 are suitably secured inside the casing and extend to the respective insulated electrode groups of the dust-precipitation means 46.

The washing means 50 must be connected to a supply of washing fluid. The usual tap water supply system is recommended for general purposes. The network piping 76 of the washing means includes a connection 98 at an outer wall of the casing to which a water supply pipe can be connected. The piping also includes a control valve 100 in the compartment 36 and a feed pipe 102 disposed inside the casing, which extends from the valve 100 to the network 76 which includes the nozzles 78. A throttle valve may be provided in this feed pipe or in the supply pipe outside the casing. The control valve 100 is preferably of the on-off type and has a manually

operable member in the form of a handle 104 for turning the water on and off.

The dust-precipitator unit can function for electrically cleaning air only while the water flow is cut off. To this end, the front wall 10 of the casing 2 comprises a plurality of interlocked movable members which serve as doors or closures for the casing. In this particular embodiment, the front wall 10 comprises a large removable closure member 106 that water-tightly covers almost the entire front side of the casing except for the compartment 36. The last is covered by a separate small door 108 hinged to the closure member 106 and separately fastenable to the casing.

In order to open or close the door 108, it is necessary to manually turn a screw 110 which passes through a hole in the door, and fits a nut 112, or the equivalent, fixed to a bracket structure 114 secured inside the casing, preferably to the dividing walls forming the compartment 36. The nut is near the front opening which is closed by the door 108; and the distance between it and the door in closed position, is considerably less than the length of the screw 110 so that several turns are required to fully thread the screw through the nut. At the end of its movement, the screw engages and closes a switch 116 which may be of the conventional push button type. The switch is in the low voltage supply of the voltage-conversion means, as for example, in series in the circuit of the conductors 90. When it is desired to open the door 108, it is necessary to thread the screw 110 out of the nut 112. The first movement of the screw opens the switch 116, thereby deenergizing the power pack 88 and removing high voltage from the dust-precipitation means 46. However, before the door can be opened, several moments are consumed for fully removing the screw from the nut after the switch 116 has been opened. During this time any charge on the capacitors of the power pack will dissipate. A similar protective time-delay switch mechanism comprising a screw 110' and a switch 116' is provided for the closure member 106.

As shown in Fig. 6, the energizing conductors 90 feed the power pack 88 and the blower motor 42 in parallel. The supply of power is controlled by switch 116 and 116' both of which must be closed in order to make operating power available in the dust-precipitator unit. Additional manually operable switches 120 and 122 are separately provided for independently controlling the power pack and blower, respectively. If it is desired to operate the blower without operating the power pack, the switch 120 can be placed in open position. If the dust-precipitator unit is utilized in systems having their own draft-inducing means, the blower 40 and its motor 42 can be entirely omitted from the unit.

For washing the dust-precipitation means, only the door 108 need be opened for access to the compartment 36 where the handle 104 of the control valve 100 is located. However, the valve and handle are so disposed that the handle lies within the compartment only when the valve is closed. The handle can be turned to open the valve only when the door 108 is opened, because in valve-opening position the handle projects outward through the opening normally closed by the door. Consequently, the door can be closed only when the water supply is shut off, and the washing means 50 is operable only while the door is open. Since opening of the door 108 also opens the switch 116, it is evident that the washing means is operable only while the high voltage parts of the dust-precipitator unit are deenergized.

It is also desirable to provide access to the interior of the dust-precipitator unit, especially the dust-precipitation means 46. To this end, the vane-structure 52 is removably fastened in the casing and can be removed through the front wall opening which is exposed when the closure member 106 is opened. The water-deflecting means 82 may also be removably secured to the casing. In order to provide ready access to the dust-charging means 54 without disturbing the dust-precipitating means 56, the high voltage parts of the former are built as a hinged unit which can be moved forwardly so as to protrude out of the front opening of the casing as indicated in Fig. 4. The baffle 86 acts as a stop for holding the dust-charging means in tilted position. In such position it is easy to repair or replace an ionizing wire or to reach inside the dust-precipitating means 56 for any purpose.

While the invention has been described in a preferred form, it is obvious that other forms and embodiments can be built embodying the teachings of this invention; and as time goes on it may be expected that many changes will be made in the embodiment herein described so that forms of my invention may eventually be radically different from that herein described but nevertheless incorporate the teachings and principles thereof.

The following is claimed as the invention hereof:

1. A self-contained electrostatic dust-precipitator unit comprising an enclosing casing having an outer top wall, and two pairs of outer opposed upstanding side walls, said casing having an inlet opening in the top wall and an outlet opening in the bottom part of one of said side walls, an electrostatic dust-precipitation means comprising an upstream dust-charging means and a downstream dust-precipitating means, the last comprising a plurality of upstanding spaced precipitating-electrodes providing a plurality of gas-passages therebetween from which gas flows toward said outlet opening, said dust-charging means and said dust-precipitating means being generally horizontally displaced, an inner wall inside the casing spaced from the other of said side walls for providing a downwardly directed gas-passage thereat for receiving gas from said inlet opening, and an air-deflecting vane-structure at the bottom of said gas-passage for turning gas from said gas-passage horizontally towards said dust-charging means.

2. A self-contained electrostatic dust-precipitator unit comprising a casing including upstanding side walls, said casing having an inlet opening in the top thereof and an outlet opening, an electrostatic dust-precipitation means inside the casing and comprising an upstream dust-charging means and a downstream dust-precipitating means, the last comprising a plurality of upstanding spaced precipitating-electrodes providing a plurality of gas-passages therebetween, said dust-charging means and said dust-precipitating means being generally horizontally displaced, said casing including an inner wall spaced from said casing side walls and providing a side of a downwardly directed gas-passage inside the casing, means for horizontally turning gas from said gas-passage for flow through said dust-charging means and said plurality of gas-passages, and liquid discharging

means on a level with said inner wall for washing said precipitating-electrodes.

3. A self-contained electrostatic dust-precipitator unit comprising a casing having a top wall with an opening therein, partition means in said casing providing an upper portion and a lower portion therein, said partition means providing an inner opening between said upper and lower portions, an electrical dust-precipitation means under said partition means, said electrical dust-precipitation means having horizontally displaced gas-entrance and gas-exit ends, washing means under said partition means and above said dust-precipitation means for washing the last, said washing means comprising wall-means for diverting gas flow therefrom and directing gas from said inner opening to said gas-entrance end of the dust-precipitation means.

4. A self-contained electrostatic dust-precipitator unit comprising a casing having a bottom wall sloped to a drain, partition means in said casing providing an upper portion and a lower portion therein, said casing having an inlet opening at said upper portion and an outlet opening at said lower portion, said partition means providing an inner opening between said upper and lower portions, an electrical dust-precipitation means under said partition means and above said bottom wall, said electrical dust-precipitation means having open top and bottom sides and horizontally displaced gas-entrance and gas-exit ends, means providing a gas-passage for directing the gas passing through said inner opening to the gas-entrance end of the dust-precipitation means, washing means under said partition means and above said dust-precipitation means for washing the last, said washing means being on a level with a part of said gas-passage.

5. A self-contained electrostatic dust-precipitator comprising a casing having a front wall, a bottom wall and opposed side walls, partition means in said casing providing an upper portion and a lower portion therein, said casing having an inlet opening at said upper portion and an outlet opening at said lower portion, said partition means providing an inner opening between said upper and lower portions, an electrical dust-precipitation means under said partition means, said electrical dust-precipitation means having horizontally displaced gas-entrance and gas-exit ends, said gas-exit end being at said outlet opening, means providing a gas-passage for directing gas from said upper portion of said casing

to the gas-entrance end of the dust-precipitation means, a centrifugal blower in said upper portion of said casing, said blower having a tangential discharge discharging directly into said gas-passage means, and washing means under said partition means and above said dust-precipitation means for washing the last, said washing means being on a level with a part of said gas-passage, said washing means comprising wall-means for diverting gas flow therefrom.

6. A self-contained electrostatic dust-precipitator unit comprising an enclosing casing having an outer top wall, an outer bottom wall, an outer front wall, an outer back wall and outer side walls, said front, back and side walls being upright, said casing having an air-entrance opening and an air-exit opening in the bottom part of one of said upright walls, an electrical dust-precipitation means inside said casing having a pair of open upright sides for horizontally flowing air to enter and leave, said dust-precipitation means having top and bottom open sides, means providing a gas-passage in said casing between said air-entrance opening and one of said pair of open sides, the other of said pair of open sides being substantially at said air-exit opening, said gas-passage providing means comprising an inner wall having a lower edge defining a part of the upper boundary of said gas-passage, washing means comprising a plurality of nozzles above and distributed over said top open side of said dust-precipitating means, said nozzles being higher than said lower edge.

7. A self-contained electrostatic unit as defined in claim 6 but further characterized by said bottom wall being sloped to a drain and by a liquid-diverting means comprising a plurality of louvers in said air-exit opening.

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