Sept. 9, 1941. G. W. PENNEY 2,255,677

ELECTRICAL PRECIPITATOR, ESPECIALLY FOR MINUTE DUST PARTICLES

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Fig. 1.

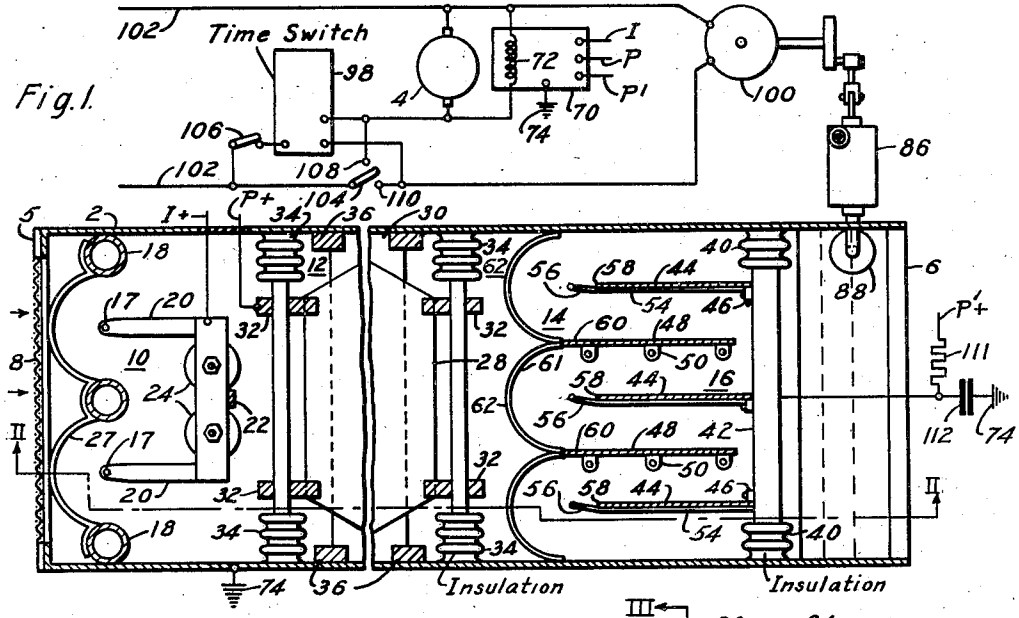


Fig. 2.

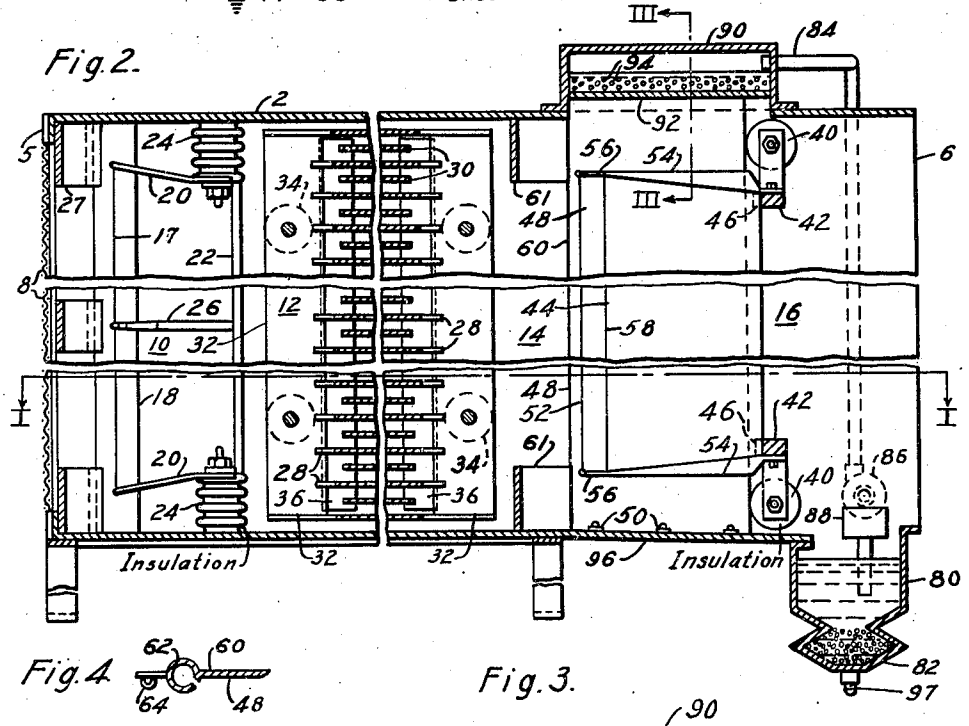
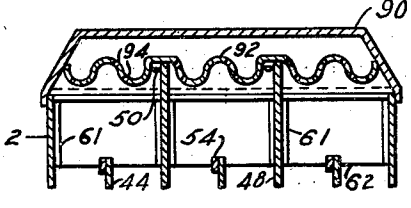


Fig. 4

Fig. 3.



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UNITED STATES PATENT OFFICE

2,255,677

ELECTRICAL PRECIPITATOR, ESPECIALLY FOR MINUTE DUST PARTICLES

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7 Claims. (Cl. 183—7)

My invention generally relates to electrical apparatus for the cleaning of particulate matter from gases passing through the apparatus. Such particulate matter may comprise fumes, vapors, pollens, smokes, or any other particles of solid or liquid matter suspended, or contained in the gases, and which are hereinafter frequently denoted, for brevity and convenience, generally, as dust or dust particles.

It is a broad object of my invention to provide an electrical precipitator which is highly efficient for cleaning gases regardless of the size and characteristics of the particulate matter in them.

In the form of an electrical precipitator for cleaning dust out of gases shown in my Patent No. 2,129,783, granted September 13, 1938, and assigned to the Westinghouse Electric & Manufacturing Company, the gas is first drawn or blown through an ionizing zone or chamber, where the dust is first ionized or charged, and then through a precipitating zone or chamber where the charged particles of dust are made to precipitate or collect on a plurality of spaced, parallel, collector plates parallel to the general direction of gas-flow, adjacent ones of which are at different potentials with respect to each other, so that the charged particles will be deflected toward a plate and precipitated thereon.

For efficient and commercially-acceptable operation of this type of precipitator, the ionizing field must be sufficiently intense to ionize or charge substantially all of the particles of dust flowing through it, but the ionizing currents preferably are such that negligible ozone generation occurs. In such a precipitator, the collector plates must be suitably designed with consideration given, among other factors, to the voltage between plates, the spacing between the alternate, insulated and uninsulated plates, the extent of the plates in a direction of gas-flow, and the rate of gas-flow through the precipitator zone. For cleaning gases containing a large fraction of dust particles of extremely minute size, of which the particles comprising tobacco smoke or kerosene lamp black smoke might be deemed illustrative, the customary electrical precipitator will operate at a relatively lower efficiency unless the gas-flow is considerably decreased, or the voltage between plates raised to degrees which detract from the advantages of the electrical precipitator.

It is a more particular object of my invention to provide a precipitator which is especially adapted for, although not limited to, the cleaning of gases containing large amounts of extremely minute particles of dust.

It is a further object of my invention to provide an electrical precipitator for the cleaning from gases of particles of dust which do not continuously adhere to the collecting or precipitating plates or electrodes, or for the collecting of dust which does not readily adhere to the collector or precipitator plates or electrodes after a thin layer of dust has already been deposited on them.

My present invention makes use of the discovery that the ionization of a relatively-large particle contained in a gas-flow does not require so intense an ionized electrostatic field as that required for ionizing relatively-minute particles, since the charge on a particle depends on its exterior surface area. Consequently, my invention consists of equipment which first acts upon particles of dust so that they build up into a lesser number of larger particles, and then precipitates the larger particles electrically.

In accordance with the instant invention, the cleaning of the gases is accomplished in two stages, the first being a particle-enlarging, or dust-agglomerating, or dust-clustering stage, and the second being a dust-precipitating or dust-collecting stage. In the first stage the smaller particles are electrically caused to combine into larger particles, and in the second stage the larger particles are ionized and electrically precipitated or collected.

In the specific embodiment of my invention which is disclosed in this application, the equipment for the first stage comprises an ionizing zone consisting of ionizing wires between grounded electrodes, and a particle-enlarging zone consisting of a plurality of spaced plates, adjacent ones of which are at a difference of potential. This apparatus is somewhat similar to the ionizing zone and precipitating zone of the apparatus described in my aforesaid patent. However, since the first stage of the new apparatus is employed for agglomerating or clustering the smaller particles into larger-sized particles, and not for depositing or precipitating the particles on the collector plates to any appreciable degree, the component parts of this stage may be modified in some respects as compared to that of the aforesaid patent. For example, the plates may be spaced either farther apart or even closer if the gas velocity is considerably increased, or the plates may be of a smaller extent in the gas-flow direction, or the velocity of gas-flow through the spaced plates may be increased. In fact, the customary design may be employed, and what is

known as "blow-off" relied upon as a source of particle-clusters, "blow-off" being the dislodging, or deflecting-back, into the gas-stream, of dust clusters or agglomerates from the plates to which or on which particles of dust had already been deflected or deposited.

The equipment for the second stage also comprises an ionizing zone consisting of ionizing wires between grounded electrodes, and a precipitating or collecting zone consisting of grounded plates spaced between high-potential plates. But this equipment, while similar in its general aspects to that of the first stage, is distinctly different in the specific structure and relationship of the parts. In the equipment for this precipitating zone, the collector plates are relatively-widely spaced. Additionally, in my specific embodiment, I utilize the grounded plates in the dual capacity of grounded plates for the precipitating zone and ground electrodes for the ionizing zone. Similarly, I utilize the high-potential plates in a dual capacity, in the first of which it performs its normal function in the precipitating zone, and in the second of which it acts as a support for the ionizing wires of the ionizing zone. Consequently, a simple but rugged structure is achieved which can be economically manufactured and which, for that matter, can be employed per se for the electrical precipitation of relatively larger-size particles, or even smaller-size particles if suitable adjustments of voltages and gas-flow velocity are made, or the size of the plates increased.

A further feature of my invention lies in the utilization of a liquid for washing the electrical parts of the second stage equipment for the purpose of washing any precipitated and accumulated dirt or grime from the plates of this stage, and coating the plates for increased efficiency in collecting deposited particles.

In accordance with this feature, I provide an oil-circulating system which can be either intermittently or continuously operated for discharging oil upon the second stage equipment to wash it and coat it with a layer of oil. In order to prevent the oil from streaking, that is, flowing in fixed established paths, I prefer to use a reciprocating pump in the oil-circulating system so that the variable pressure of the oil as it discharges from the nozzle onto the precipitating equipment will cause it to sweep the plates fairly completely.

Many other novel features, elements, and advantages of my invention will be apparent from or uncovered in the following description of one preferred embodiment thereof, which is to be taken in conjunction with the following somewhat-schematic drawing, in which:

Figure 1 represents a horizontal, sectional view, substantially on the line I—I of Fig. 2, of a complete equipment in accordance with my invention. This figure also schematically shows the electrical apparatus and connections which I may employ;

Fig. 2 is a vertical, sectional view, substantially on the line II—II of Fig. 1, of the equipment;

Fig. 3 is a fragmentary, vertical, sectional view on the line III—III of Fig. 2; and

Fig. 4 is a fragmentary, sectional view showing a modified form of the forward edge of a grounded plate of the precipitating plates for the second stage equipment.

In the illustrated embodiment of my invention, which is only one of the forms which the invention can take, air to be cleaned or treated is drawn or blown through an open end of an open-ended casing **2** which is preferably rectangular in cross section. A velocity head may be applied to the air by means of a blower of any suitable type driven by a motor **4** which may be placed in a conduit connected to the entrance or forward end **5** or to the exit, or back end **6** of the casing **2**. In passing through the casing **2**, the air or gas first passes through a protective screening **8** and then through the first stage of the equipment which comprises an ionizing zone **10** and a zone **12** designated, for convenience, as an agglomerating zone. In this first stage the particles in the gas are agglomerated, and then pass along with the gas to the second stage of my equipment which comprises an ionizing zone **14** and a precipitating zone **16** where the dust is cleaned from the air. After this treatment, the air continues out through the exit **6** either for further treatment, if desired, or it may be discharged into the premises, or the equivalent, to be supplied with cleaned air.

The ionizing zone **10** comprises a plurality of ionizing means disposed transversely with respect to the direction of gas-flow which is shown by the arrows in Fig. 1. Each ionizing means comprises a plurality of relatively-fine wires **17**, each of which is disposed in centrally-spaced relation between relatively-large grounded electrodes **18** which are preferably tubular or curved in section so that they present curved surfaces to the ionizing wires. The tubular electrodes **18** are, in this embodiment, directly secured to, and, therefore, grounded on, the casing **2** which is made of metal. The ionizing wires **17** may be suspended between rigid, armed, metal end-supports **20** carried by a metal skeleton-framework **22** which is supported inside the casing on insulators **24**. For longer wires, metal intermediate-supports **26** may be employed which are also carried on the insulated framework **22**.

In accordance with the teachings of my patent application, Serial No. 300,392, filed October 20, 1939, I add curved baffle means **27** to the ionizing zone in such manner that they obstruct the direct gas-flow to the end spaces between the ionizing wires and supports **20** on the one hand, and the adjacent sides of the casing **2** on the other, and also obstruct the gas-flow adjacent the intermediate-support **26**. These baffles cooperate with the ionizing wires **17** to create a substantially vertically-directed ionized electrostatic field so that any gas-flow through the aforesaid end spaces or in proximity to the wire supports must pass through an ionized field, and, consequently, substantially all the dust carried in the gas-flow will be adequately charged.

The precipitating chamber **12** may consist of a large number of insulated, spaced plates **28** and grounded plates **30** alternating with each other and spaced fairly closely together parallel to the direction of gas-flow. The plates are preferably of metal, and the insulated plates **28** are supported and maintained spaced by notched, metallic, supporting bars **32** carried by insulating means including insulators **34** so that these plates and bars are completely insulated electrically from the grounded plates **30** and the casing **2**. The non-insulated, grounded, precipitator plates **30** are supported and spaced by means of metallic, notched bars **36** carried by the casing **2**.

The second stage of my equipment includes a plurality of insulators **40** which support metallic bars **42** to which are secured the insulated plates

44 by means of ears 46 which may be stamped or otherwise formed integrally with the plates 44 and then turned over, and any suitable securing means may be employed for fastening each end of the plates 44 to two cross bars 42. Intermediate of the spaced plates 44 are grounded plates 48 having ears 50 by means of which they are secured to the sides of the casing 2. A considerably lesser number of plate-electrodes 44 and 48 are employed in the second stage of my equipment than in the first stage, and I have found that with a gas-flow velocity in the neighborhood of 300 to 400 feet per minute, a spacing of approximately 1½ to 2 inches between plates is adequate for ionizing and precipitating agglomerated particles, with insulated plate dimensions of approximately 10 x 33 inches, the shorter dimension being in the direction of gas-flow. With such relationships, and potential between plates of approximately 12,000 volts direct current, agglomerated particles of tobacco smoke or kerosene lamp black smoke will be substantially completely cleaned out of the gas-flow. In other words, these values for the collecting stage will adequately precipitate and collect even the most minute particles of dust as long as they have been previously either agglomerated, or gathered into clusters which "blow-off" from plates of a prior passage through an electrical precipitator, in effect. For commercially-practical embodiments a potential gradient of 4000 to 10,000 volts per inch of spacing between plates will precipitate the agglomerated particles with acceptable standards of cleaning efficiency.

To provide the ionizing zone of the second stage of my equipment, each of the insulated plates 44 serves as a supporting means for an ionizing wire 52. In order to suport these wires from the plates, metallic supporting rods 54 are secured at each side edge of the plates and have narrow projecting members or portions 56. The wires 52 are strung between the extremities of two members 56 on each of the plates 54. Preferably, the member portions 56 are sufficiently long so that the wires 52 can be supported a sufficient distance from the edges 58 to be out of the shielding influence of the insulated plates, this shielding influence being the tendency of a relatively massive support near the ionizing wires to create dark regions or regions of inadequate ionization at the wires.

The grounded plates 48 are deliberately made of a greater length than the insulated plates 44 so that they have projecting portions 60 which pass beyond the edges 58 of the insulated plates. The projecting portions 60 extend somewhat beyond the wires 52 in a direction counter to that of the gas-flow. Consequently, an ionized electrostatic field can be created between the ionizing wires 52 and the projecting portions 60 of the grounded plates, including the corresponding portions of the casing 2. Suitable grounded baffles 61 may be provided for the second stage equipment, these baffles being similar in purpose and design to the baffles 27 of the first stage equipment.

The protruding projections 60 of the grounded plates 48 may be modified to provide curved portions 62, such as shown in Fig. 4, opposite the ionizing wires 52. In this modification, it is preferred that each portion 62 extend only substantially the length of the wires 52, the remaining projecting portions of a grounded plate at each side of the portion 62 being flat and provided with an ear 64 for securing the grounded plate to the casing.

In the operation of the device thus far described any dust passing through the ionizing zone 10 is electrically charged in this zone, and then agglomerated or clustered in the zone 12 in the event that this zone acts as an agglomerating zone. If the zone 12 is a precipitating zone, the dust may collect temporarily on the plates 28 and 30, and build-up into clusters or agglomerates which are ultimately blown off the plates by the gas-flow.

Regardless of how the enlarged particles are formed in the zone 12, they are subsequently re-ionized or re-charged in the zone 14 in the second stage of the equipment and then collected or precipitated onto the precipitating plates 44 and 48 of the precipitating zone 16.

I prefer to treat the particles of dust in the first stage of my apparatus by means of unidirectional electrostatic fields, for I have found that the use of a unidirectional field enables me to employ a relatively-low voltage gradient and one which yields negligible ozone generation. Consequently, I provide the separate ionizing zone 10 and the separate dust-agglomerating zone 12. Both zones 10 and 12 may be built in accordance with the general teachings of my aforesaid patent with the plates 28 and 30 spaced about $\frac{1}{16}$ of an inch apart. Any suitable current-conducting means may be provided for energizing or charging the ionizing wires and the relatively insulated plates and I have indicated the positive unidirectional voltages applied to the ionizing wires 17 and to the insulated plates 28 by conductors I+ and P+, respectively. In accordance with the teachings of my aforesaid patent, a voltage of 14,000 volts or thereabouts may be applied between the ionizing wires 17 and the ground electrodes 18, yielding an average voltage-gradient of about 9300 volts per inch; while the voltage-gradient between the plates 28 and 30 may be considerably higher than this average-gradient. However, as hereinbefore mentioned, by increasing the gas flow or shortening the length of the plates, or by some other expedient having the purpose of discouraging the sticking of the dust onto the plates 28 and 30, the zone may be made to act as a dust agglomerating means, or the equivalent.

Voltages may be derived from any suitable sources, such as, for example, the rectifying and voltage doubling circuits shown in my aforesaid patent and schematically indicated at 70 in Fig. 1, in which the primary of the step-up transformer is indicated at 72, and the positive terminals to be connected to the different parts of the equipment schematically indicated by I, P, and P'. The negative terminal of the different voltage means is represented schematically as grounded on the casing 2, as indicated at 74.

The potential supplied to the second stage equipment is also unidirectional, and the positive terminal P' is connected to a bar 42 by means of a conductor indicated at P'+.

It is apparent that in the second stage equipment the voltage between the ionizing elements of the ionizing zone and the voltage between the precipitating elements of the precipitating zone are the same since the ionizing wires are directly supported in conductive relation to the insulated plates 44, and the grounded plates 48 have portions 60 forming part of the ionizing means. However, since this second stage equipment deals

only with larger-size particles, the ionizing field need not be so intense as that required for an ionizing field which must adequately charge dust particles of all sizes. Furthermore, in spite of the wider spacing employed, the collector plates will attract these larger size particles to them even with a relatively-less intense ionizing field, because the larger particles can accumulate a larger charge, and while particles passing in proximity to the ionizing wires **52** will, however, be charged more intensely than those passing in proximity to the grounded portion **58**, because of the respective arrangement of the plates and ionizing wires these particles have to travel a greater distance to reach the oppositely-charged collector plates upon which the dust deposits.

I prefer to add an oil-washing expedient to the second stage equipment of my invention, and to this end I provide a circulating system which includes an elongated reservoir **80** having a dust-settling chamber **82** formed by inwardly bending the sides of the reservoir **80**, somewhat above the bottom of the reservoir **80**. This reservoir **80** is adapted to contain oil which may be pumped by means of a conduit system **84** including a reciprocating pump **86** and an oil filter **88**. The conduit system **84** has the pump inlet disposed below the minimum oil level in the reservoir **80**, and has an outlet discharging into a chamber **90**, forming part of the casing **2** and disposed above the second stage equipment comprising the ionizing zone **14** and precipitating zone **16**. This chamber **90** has a corrugated bottom **92** which is perforated with a plurality of holes **94** preferably directed in all directions so that oil will squirt from them onto the collecting plates **44** and **48**, and the ionizing wires **52**.

When the pump **86** is operating the variable pressure of the oil in the chamber **90** causes the oil flowing through the apertures **94** to squirt in changing directions, so that, in effect, a thorough washing of the parts is obtained without streaking, to the end that the apparatus will be effectively cleaned. The plates of the second stage equipment are vertically disposed, and the bottom part **96** of the casing below them may be tilted downwardly toward the reservoir **80** so that this circulating oil will flow into the reservoir carrying with it the dirt which had been deposited on the equipment.

The oil-circulating system may be operated either continuously, in which case a large volume of oil should be used with a large reservoir so that the washed-down dirt can settle into the settling chamber **82**, or it may be operated intermittently, in which case a lesser volume of oil may be employed with the dirt settling during quiescent periods. A drain **97** may be employed to remove any sediment accumulating in the chamber **82**.

I prefer to operate the washing system intermittently, and to this end, I apply a time switch **98** in the circuit to a motor **100**, which drives the oil-circulating pump **86**. This time switch can be adjusted to close the circuit to the motor from the supply conductors **102** for one or more short intervals during the day, or for one or more short intervals during greater periods of time. In actual practice, I prefer to disconnect the electrical power-precipitating elements, and stop the gas-flow during the interval in which the equipment is being washed. Consequently, the time switch also controls the circuit to the motor **4** which drives the blower which forces the air through the casing **2**, and the electrical system **70**. The time switch is such that when the circuit of the motor **100** is energized, the circuit to the motor **4** and electrical system **70** is opened, and vice versa.

If it be desired to manipulate the apparatus manually, a hand switch **104** is provided in parallel with the time switch which can be normally disposed in an intermediate non-circuit-closing position while the time switch is in operation. The manually-operable means can be made effective by opening a switch **106**, thereby disconnecting the time switch and closing the switch **104** upon its contact **108**, whereupon the apparatus will operate for cleaning the gas, or upon its contact **110**, whereupon the apparatus will operate to wash the second stage equipment in the manner aforesaid.

It will be thus observed that I have provided a device which can be used to effectively remove all sizes and kinds of dirt from a gas-flow. I make this statement with the full knowledge of the fact that 75% or more of agglomerated kerosene lamp black smoke particles, ranging in size to as little as 10 microns, and, perhaps slightly less, will pass through the ordinary mechanical filter.

The apparatus of my invention may be employed either with the first stage acting to agglomerate dust, or the first stage acting to agglomerate and precipitate dust on its plates from where the enlarged dust particles may "blow-off" into the second stage, although, in the preferred form, this stage is designed primarily for agglomerating. It should be noted, however, that the second ionizing zone is necessary because the dust particles ionized in the ionizing zone **10** substantially lose their charge in passing through the zone **12**.

When a single circuit is employed for the various high potentials required, it is preferable to insert a resistor **111** in the conductor P'+, and to add a fairly large capacitor **112** between the lead P'+ supplying positive unidirectional potential to the plates **44** and ground. Such a circuit maintains the voltage on the plates **44** and ionizing wires **52** in the event the closely-spaced plates **28** and **30** may be temporarily shorted or spark-over, as might happen when an extra large dust cluster is caught between them. In the event of such a short, the potential supplied by the system **70** momentarily will drop considerably, but because of the capacitor **112**, the potential on the insulated parts of the second stage will be maintained temporarily so that the dust will nevertheless be precipitated while the short, such as previously described, clears.

With the oiling system of my invention, the plates and ionizing wires can be thoroughly washed at regular intervals, or as often as is necessary. Moreover, when the oil washing is completed, the excess oil on the parts will drain, but a coating or film of oil will necessarily remain on the plates, this coating increasing the efficiency of the plates for holding the dust particles by adhesion. Any oil that may coat on the ionizing wires is quickly dispelled because of the ionized field. The first stage equipment is preferably maintained dry during operation and free from oily coatings so that it acts to enlarge or cluster the particles, rather than collect them on its plates.

While, I have shown my invention in the embodiment which I believe now to be the best

mode of application thereof, it is obvious that many modifications and adjustments may be made therein. Thus, for example, the second stage equipment of my invention particularly cooperates with the apparatus of the first stage in the preferred embodiment. However, it is obvious that this second stage equipment can be employed per se for dust cleaning by suitable adjustment of voltage, or gas-flow, or even particle size.

I claim as my invention:

1. A device of the class described for removing dust including finely-divided dust particles from a gas-flow which comprises, successively in the direction of the gas-flow: ionizing means for the dust particles, comprising insulated ionizing wires and ground electrodes spaced therefrom; agglomerating means for the dust particles comprising a plurality of relatively closely spaced eletcrodes, adjacent ones of which are relatively insulated from each other; a second ionizing means; and a precipitating means comprising a plurality of plates substantially parallel to the gas-flow, the last said plates being relatively widely spaced with adjacent ones relatively insulated from each other; limited-energy means to apply a potential gradient between the adjacent electrodes of said spaced electrodes, and between the plates of the last said plurality of plates, said means including a device for maintaining the gradient between the plates of the last said plurality of plates in the event of a temporary short between electrodes of the first said plurality of spaced electrodes.

2. An electrical precipitator for the cleaning of dust from gases comprising, a casing having openings for the intake of gases to be cleaned and discharge of cleaned gases, a plurality of spaced plates between said intake and discharge openings, and parallel to the direction of gas-flow, said plates being arranged in two series, with the plates of one series alternating with, and being relatively insulated from, the plates of the second series, said plates being vertically disposed; ionizing means disposed before said plates in the direction of gas-flow; liquid discharge means for discharging liquid on said plates for washing collected dust from said plates said liquid discharge means including a pulsating device for variably spreading discharging liquid over said plates by varying the pressure on the liquid during discharge.

3. An electrical precipitator for cleaning dust from gases comprising; a casing having openings for the intake of gases to be cleaned and the discharge of cleaned gases; a plurality of spaced plates between said intake and discharge openings, said spaced plates being parallel to the direction of gas-flow and arranged in two series, with the plates of one series alternating with, and relatively insulated from, the plates of the other series, the plates of one series being of greater extent in the direction toward said intake opening than the plates of the second series to thereby provide protruding electrodes; ionizing wires between said protruding electrodes transverse to said direction of gas-flow, and spaced electricity conducting means secured to plates of the said second series for supporting said wires substantially parallel to the edges of the last said plates but spaced therefrom out of the shielding influence of the last said plate, the last said means supporting each of said wires at its ends, said wires and said protruding electrodes providing an ionizing zone, portions of the plates of said one series cooperating with substantially transversely aligned portions of the plates of the other series to provide a precipitating zone for collecting dust charged in said ionizing zone.

4. An electrode means for an electrical precipitator having separate ionizing and precipitating zones, comprising a plate electrode having an edge, an ionizing wire, and a plurality of relatively small supporting bars, including an electricity-conducting bar or bars, secured to and extending from said plate electrode to provide exposed ends spaced from the said edge of said plate electrode for supporting said wire at a plurality of spaced points, said wire being supported by said bars near said ends substantially parallel to, and spaced from, the said edge and substantially out of the shielding influence of the said plate electrode.

5. An apparatus of the class described for removing finely-divided dust particles from flowing air which comprises, a conduit of generally rectangular cross-section, and disposed in said conduit successively in the direction of air-flow: insulated ionizing wires and ground electrodes spaced therefrom, both being transverse to the said direction, for charging dust-particles in the air-flow; electric agglomerating means for agglomerating the charged dust particles comprising a plurality of relatively closely spaced plates substantially parallel to the air-flow with adjacent ones of said plates being relatively insulated from each other; and ionizing and precipitating means comprising a plurality of substantially vertical, oppositely-charged relatively widely-spaced plates parallel to the said direction, with adjacent ones of the last said plates being relatively insulated from each other, some of the last said plates having protruding portions beyond some of the other of the last said plates in a direction counter to the air-flow, the number of the last said plurality of plates being considerably less than the number of the first said plurality of plates, said ionizing and precipitating means further comprising ionizing wires, and a plurality of electricity-conducting bars secured to certain of said other of the last said plates for supporting therefrom the last said ionizing wires at a plurality of spaced points, substantially out of the shielding influence of the last said plates to which said bars are secured, said wires being supported transverse to said air-flow but substantially parallel to and between the said protruding portions of said plates and cooperating therewith to provide an ionized field for charging agglomerated particles before they pass between oppositely-charged plates of the last said plurality of widely-spaced plates.

6. An electrical gas-purifying precipitator for removing dust particles from a flowing dust-laden gas, comprising an ionizing zone and a precipitating zone disposed successively in the direction of gas-flow; said ionizing zone comprising a plurality of spaced curved ground electrodes and ionizing means cooperating with said ground electrodes for establishing an ionized electrostatic field for charging the dust particles in the gas-flow, said ionizing means comprising an ionizing-wire; said precipitating zone comprising a plurality of series of plates of some extent in the direction of gas-flow, and paralleling the gas-flow, a first supporting means for alternate ones of said plates, and a second supporting means for the other of said plates, said second supporting means being insulated from said first supporting means and said ground electrodes;

and wire-supporting means for supporting said ionizing-wire directly from one plate of said other of said plates, said wire-supporting means comprising a plurality of small bars secured to said one plate and having ends projecting beyond an edge of said one plate between a pair of said spaced ground electrodes, said ionizing-wire being supported by said bars near said ends, substantially parallel to, and spaced from, the said edge of said one plate and substantially out of the shielding influence of the said one plate.

7. An electrical precipitator for cleaning dust particles from gases comprising means for charging and electrically precipitating the particles, said means comprising a plurality of spaced plates parallel to the direction of gas-flow, said plates being arranged in two series with the plates of one series generally alternating with, and being relatively insulated from, the plates of the second series, said plates being generally vertically disposed, and liquid discharge means for discharging liquid upon said plates for flushing collected dust therefrom, said liquid discharge means comprising a liquid distributing receptacle having a perforated corrugated bottom above said plates including perforations directed toward said plates.

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