

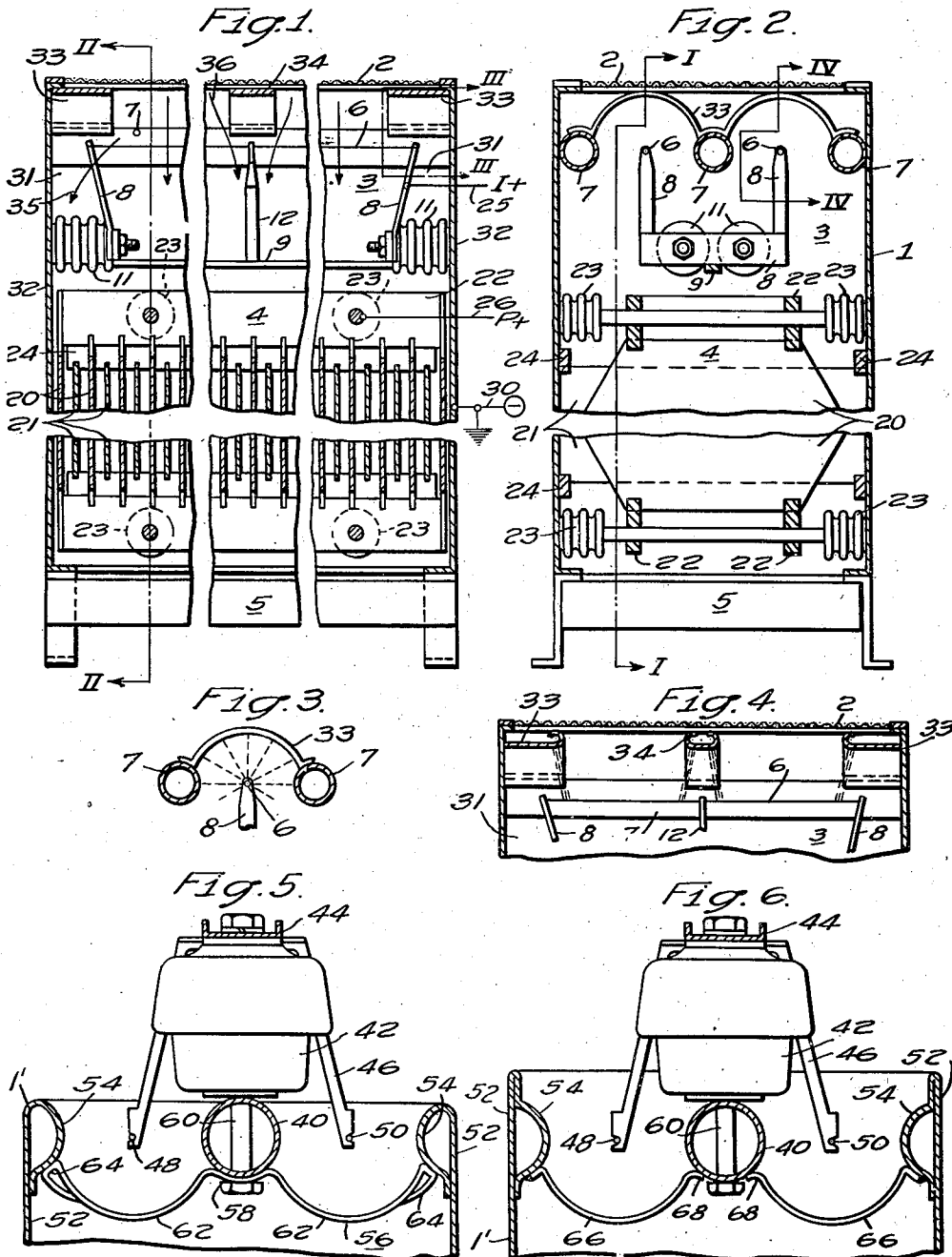
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MEANS OF CHARGING DUST AT WIRE SUPPORTS OF ELECTRICAL PRECIPITATORS

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MEANS OF CHARGING DUST AT WIRE SUPPORTS OF ELECTRICAL PRECIPITATORS

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My invention relates to electrical precipitators employed to electrically precipitate from air, or any other gaseous medium, any contained, or suspended, dust particles, fogs, smokes, or other particulate matter, and which for convenience, is hereinafter embracively termed dust.

The present invention is related somewhat to the gas-purifying electrical precipitator comprising the subject matter of my Patent No. 2,129,783, issued September 13, 1938, and assigned to the Westinghouse Electric & Manufacturing Company. In such a precipitator, the gas is first blown through an ionizing zone or chamber and then through a precipitating zone or chamber, a significant feature of the precipitator being that the ionizing wire or wires are of such small diameter that practically utilizable charging of the suspended particles of dust may be obtained at a wire-charging voltage giving ionizing currents at which negligible ozone generation occurs, and that the power input is low when the precipitator is used for cleaning air.

The ionizing wire of such a precipitator is preferably less than 32 mils in diameter. In the usual construction of a precipitator built in accordance with the teachings and principles contained in the aforesaid Penney patent, the wire is much finer than this upper limit and is frequently as little as 5 mils in diameter or even less, the actual diameter being kept as small as possible, consistent with sufficient strength to withstand rough usage in the actual commercial embodiments of the apparatus. In general, the ionizing wire of such a precipitator is usually maintained taut, or in some degree of tension.

The ionizing wire itself is part of an ionizing means which usually comprises one or more such ionizing wires alternating with curved electrodes, generally grounded, and designated as ground electrodes, at a suitable potential with respect to the wires for creating an ionized electrostatic field extending in the regions between the wires and ground electrodes and of low power consumption and negligible generation of ozone or oxides of nitrogen.

Since the ionizing wires are at a high potential relative to the ground electrodes, the wires must necessarily be insulated from the electrodes; and, moreover, since a supporting structure must be provided for the ionizing means, the ground electrodes are generally part of, or electrically-connected to, the supporting structure which may be in the form of a metal casing. This means that the ionizing wires must also be electrically insulated from this casing, and for this

purpose, the parts of the wire in proximity to the casing sides are secured between end supports spaced and insulated from the proximate sides of the casing, or box, or whatever form the supporting means may take or be called.

This space between the wire end supports, or the end of a wire, and the casing sides is a region in which, in prior structures, the ionizing current is inadequate, that is, the dust carried by the air or gas passing through the region is not sufficiently electrically-charged for efficient precipitation of the dust subsequently in the precipitating chamber. This region of inadequate ionization is enlarged right at the end supports for the wires which introduce dark or shielded spots, extending about $\frac{1}{2}$ " or so from the support, of little or inadequate ionization. Dark spots are also present to some extent at any intermediate supports for the ionizing wires, which are generally employed in the longer ionizing units.

In large precipitating apparatus having long ionizing wires, transverse to the gas flow, the total regions of inadequate, or less-than sufficient, ionization is small compared to the total regions of adequate, or sufficient, ionization to charge the dust particles for precipitation, and the total overall cleaning efficiency of the apparatus is little affected by the dark regions. But as the length of the wires goes down, the proportion of the former regions to the latter increases with a manifest adverse affect on efficiency. Thus, for example, in an apparatus in which nine-tenths of the air is sufficiently well ionized to yield a cleaning efficiency of 95%, and the remaining one-tenth is inadequately ionized so that its cleaning efficiency is, only, say 50%, then the total efficiency would be only 90.5%. When even 90.5% efficiency represents a high degree of air cleaning possible only with electrical precipitators of the type described and ample for practically all cleaning purposes, nevertheless, it is an object of this invention to devise a means to further increase the efficiency of precipitating apparatus by increasing the ionization in the regions previously inadequately ionized.

It is an object of my invention, therefore, to provide a means for assuring adequate ionization of all the air or gas passing through an electrical precipitator of the type described, and more particularly to assure ionization of the gas passing through the end spaces previously mentioned and the shielded spots around the ionizing-wire supports.

It is a purpose of my invention to provide suitable means, to act as part of the ground electrodes, so arranged that adequately ionized fields are created in the path of the air flowing to the aforesaid end spaces or dark spots, the means also acting as baffles or air-guides preventing the air from flowing into these end spaces or dark spots without first passing through the adequately ionized fields thus created.

With the foregoing and other objects in view, my invention consists of the features, elements, combination and apparatus hereinafter described and claimed, and illustrated in the accompanying drawing, in which:

Figure 1 is a longitudinal, vertical, sectional view of an exemplary form of embodiment of my invention, the section plane being indicated in I—I of Fig. 2;

Fig. 2 is a vertical, sectional view at right angles to the view of Fig. 1 on a plane indicated by the line II—II of Fig. 1 and with parts broken away or omitted for purposes of clarity of illustration;

Figs. 3 and 4 are fragmentary sectional views of details and taken on the lines III—III of Fig. 1 and IV—IV of Fig. 2, respectively, Fig. 4 showing a slight modification;

Fig. 5 is a cross-sectional view through another embodiment of a precipitator ionizing unit such as described and claimed in the application of Edward H. R. Pegg, Serial No. 286,577, filed July 26, 1939, and assigned to the Westinghouse Electric & Manufacturing Company; and

Fig. 6 is a cross-sectional view of a detail showing baffle means connected to a cell side rather than to the central ground electrode of Fig. 5.

In the illustrated embodiments of my invention, which are only a few of the many forms which the invention can take, air to be treated or cleaned is drawn through the top of a precipitator cabinet or casing 1 through a protective screening 2 and passes downwardly to an ionizing unit or chamber 3 in the top of the casing, where the air and particulate matter it contains are ionized or charged, after which the air continues downwardly and passes into a precipitating chamber 4 where the dust may be precipitated or agglomerated, after which the air may continue for further treatment, if desired or may be discharged into the premises, a blower 5 being illustrative as means for drawing or forcing the air through the apparatus.

The ionizing chamber or zone 3 usually comprises a plurality of ionizing means disposed transversely with respect to the direction of air-flow, each ionizing means comprising a fine wire 6 which is disposed in centrally-spaced relation between two relatively large electrodes 7 which are preferably tubular or curved in section so that they present curved surfaces toward the ionizing wire. The tubular electrodes 7 are, in this embodiment, directly secured to, and, therefore, grounded on the precipitator casing 1, and the ionizing wires 6 are suspended between rigid metal end supports 8 carried by a skeleton framework 9 which is supported inside the casing by insulators 11. For the longer wires, it is usually necessary to support each wire at one or more intermediate points, as by means of rigid metal intermediate supports 12 which are also carried on the insulated skeleton framework 9.

In the particular embodiment shown in Figs. 1 and 2 the precipitating chamber 4 consists of a large number of spaced insulated plates 20 and grounded plates 21 alternating with each other

and spaced closely together parallel to the direction of air flow. The insulated precipitating plates 20 are supported and spaced by notched metallic supporting bars 22 carried by insulating means including the insulators 23 so that the precipitating plates and the metallic supporting bars are completely insulated from the grounded plates and precipitator casing. The non-insulated grounded precipitating plates 21 are supported and spaced by means of notched bars 24 carried by the casing 1.

As explained in my aforesaid patent the ionizing wires 6 and the insulated precipitator plates 20 are, preferably, unidirectionally charged with respect to the uninsulated or grounded parts 15 which comprise the ground electrodes 7 and the grounded plates 21. Because of the greater spacing between each wire 6 and its associated tubular electrodes 7 as compared with the spacing between the alternate plates 20 and 21 of the precipitating chamber, the ionizing voltage, that is, the voltage between an ionizing wire and ground electrode 7, is frequently higher than the precipitating voltage, that is, the voltage between the plates 20 and 21. I have indicated that unidirectional voltages are applied to the ionizing wire 6 and the precipitating plates 20 by schematically showing, as indicated by the reference numerals 25 and 26, respectively, the positive terminal of the unidirectional ionizing source of voltage I+ and the positive terminal of the unidirectional precipitating source of voltage P+. The negative terminal or terminals (—) of the voltage means is represented schematically as grounded on the frame of the casing 1, as indicated at 30, it being understood that because the metal bars 24 are secured to the casing, the grounded plates 21 are therefore also conductively connected to the negative terminals, as are the ground electrodes 7.

The structure thus described has been found satisfactory in use, but nevertheless, its efficiency can be impaired by dark regions of inadequate ionization for it may be observed that, if no other means were supplied, air could flow in the end spaces 31 between the end supports 8 and opposed sides 32 of the casing. No ionizing wire is present in this space, and, therefore, any air that might be permitted to come into the casing along the sides 32 would pass directly into the spaces 31 and from there into the precipitating chamber. However, since this air would not pass through an adequately ionized region, the dust in it would not be properly charged, and this portion of the air-flow would, therefore, not be so efficiently cleaned.

Another source of inadequately ionized regions exists adjacent the end supports 8 and the intermediate supports 12 in the vicinity of the ionizing wires and may extend approximately $\frac{1}{2}$ " or so from the actual point of contact between the wires and the supports. These dark spots or shielded regions which have been found to exist are more particularly pointed out in the application of Russell A. Nielsen, Serial No. 286,589, filed July 26, 1939, and assigned to the Westinghouse Electric & Manufacturing Company.

In order to completely accomplish the purpose of my invention, I provide end baffles and electrode means 33 for directing the air that might otherwise flow along the inside of the casing sides 32, in a direction which will make it pass through an adequately ionized region, and for the same purpose, I also provide intermediate air baffle and electrode means 34 to force the air

flowing through the dark spots adjacent the intermediate supports 12 through an adequately-ionized field.

Referring more particularly to Fig. 3 which might be deemed to indicate a cross-sectional view of either of the baffles 33 or 34, it may be observed that the baffle is substantially semi-cylindrical and extends between two of the adjacent ground electrodes 7 contacting them so that it is in electrically conductive relation thereto. The curvature of these baffles is such that the radius is approximately the same as the distance from a wire to either of the ground electrodes 7. In actual practice I prefer to make the baffles or shield as far or slightly further from the ionizing wire as are the ground electrodes 7.

In extent, the end baffle 33 covers the end space 31 and protrudes slightly inward of the end support 8 for a distance sufficient to create, in conjunction with the ionizing wire, a substantially vertical ionized field. The intermediate baffles 34 are similarly disposed with parts protruding parallel to the ionizing wire and for extents a little beyond the intermediate supports. If desired, the free edges of the baffles may be curled, as shown in Fig. 4, to decrease air resistance and prevent corona formation from sharp edges.

Referring back to Fig. 3, it may be observed that since the baffles are at ground potential, an electrostatic field will be created between the baffles and the ionizing wire, as shown more or less symbolically by the somewhat radial lines extending from the wire 6 in Fig. 3, and the dotted lines to the baffles from the wire in Fig. 4. This ionizing field has approximately the same gradient as a field directed to the ground electrodes since the metallic baffles 33 and 34 are disposed approximately as far from the ionizing wire as the ground electrodes. I prefer to avoid a shorter spacing between the shields and the ionizing wires because of the possibility that the increased field gradient might yield increased ozone generation or, if short enough, might possibly break down the air space completely at times. I prefer to avoid too great a spacing between the points of the shields and the wire for the reason that the field might become too weak for an adequate ionizing current so that the air-borne dust will not be adequately charged.

It is always desirable to make the baffles as narrow as possible in order to reduce the resistance to air flow. Since the field from the ionizing wire to the baffles can be angular with respect to a vertical plane, the baffles need not necessarily extend beyond the dark spots on the wire, and may, in fact, be of less length. For example, I have found that an intermediate baffle of $\frac{3}{8}$ " width created a field of adequate ionization.

In operation, the air-flow entering the top of the casing, which is shown by the arrows, may be deemed to be divided into distinct portions: that part, which flows straight through, and that part which flows down around the baffles or shields 33 and 34 and into the space 31 at the sides of the casing or into the dark regions near the intermediate supports 12. The first portion will, of course, be adequately ionized by virtue of its passing directly between a freely-suspended part of the wire 6 and a part of the grounded electrode 7, while the second portion will be ionized now by the field existing between the wire 6 and the baffles 33 and 34, the air, neces-

sarily being compelled to pass through this field, as shown by the arrows 35 and 36, these arrows being representative of the gas flowing in the end spaces 31 and the dark spots about the supports.

By virtue of my invention, it will be at once perceived that the efficiency of precipitation is increased by the measures which I have taken to compel the gas to flow through adequately ionized regions in its entirety. There are no dark spots or end spaces through which the air may flow without being ionized, and I have thus improved an electrical precipitator of the type described to that extent.

In Fig. 5 I show the application of my invention to a more modern type of ionizing unit, as more particularly described in the aforesaid Pegg application Serial No. 286,572. Such a unit generally comprises a central electrode 40 upon which is secured an end of each of a plurality of spaced insulators 42, across the other ends of which extends a bar 44 to which the end supports 46 for ionizing wires 48 and 50 may be secured. The casing 1 in this embodiment takes the form of a rectangular cell having sides 52 parallel to the ionizing wires, and provided with turned-over and rounded edges to provide ground electrodes 54 cooperating with the other ground electrode 40.

The ground electrode 40, the insulator 42, the bar 44, the end supports 46, and the wires 48 and 50 are assembled as a unit in themselves and can be secured to the casing, as more particularly described in the mentioned Pegg application. To add a baffle structure to this unit, a suitably curved shield 56 is provided having a central portion 58 fitting the lower part of the tubular electrode 40 and an aperture through which the bolt 60 passes which secures an insulator 42 to the electrode 40. Curved shield and electrode portions 62 extend from both sides of the central portion 58, each terminating in curved end portions 64 fitting the contour of the ground electrodes 54, the curved portions 62 of shields 56 having just enough spring in them so as to press against these electrodes.

In the event it is desired to secure the shields to the casing ground electrodes rather than to the removable ionizing unit, it is possible to secure, as by welding, a side of a shield 66 to the electrodes 54, the other side being provided with a down-turned edge 68 to make a contact with the tubular electrode 40 when the ionizing unit, as a whole, is inserted in its place in the cell 1.

It is, of course, to be understood that the different baffles 33 and 34, 56 and 66, suitably contact the ground electrodes, and are suitably secured, as by soldering or welding or some other means, to one or more of them to maintain them in place. It is important, however, to note that the end baffles preferably divert the air flow so that none of it can pass directly along the sides of the casing or cell, but must pass through the ionized field between the end baffle and that part about the ionizing wire 6 beyond the dark spot at its support, and, in the same way, the intermediate baffles deflect the air flow so that movement of the air through the dark spots thereat is preceded by flow through the adequately ionized field between the end portions of the shield and the wire 6.

While I have shown and described my invention in accordance in the preferred forms of em-

bodiments, and have suggested certain operations and conditions in accordance with my best understanding of the same at the present time, I desire it to be distinctly understood that I am not altogether limited to these understandings or conditions or to the particular forms shown in the drawing.

I claim as my invention:

1. A device of the class described comprising a gas-cleaning precipitator having an ionizing chamber and a separate precipitating chamber successively in the path of a gas-flow for the cleaning of particulate matter from the gas, said ionizing chamber being provided with one or more ionizing units, each unit being disposed transverse to the gas-flow and comprising an insulated supported ionizing wire spaced between substantially uninsulated relatively large ground electrodes, a plurality of relatively rigid supporting means including wire supporting members for insulated supporting said wire, and additional limited-extent ground electrode means substantially spanning said large electrodes for serving as an adjunct to said relatively large electrodes and cooperating with said wire for creating an ionized field through which the portion of said gas-flow in the vicinity of said members must pass.

2. The structure of claim 1 characterized by the last said means comprising curved metallic sheets contacting said ground electrodes and spaced on the side of said wire or wires opposite the said members.

3. The structure of claim 1 characterized by the last said means comprising curved metallic sheets contacting said ground electrodes and spaced on the side of said wire opposite said members, and of an extent slightly beyond said members in the direction of the wire, the curvature of said sheets being such that the inner surfaces are substantially the same distance, or a slightly greater distance, away from the said ionizing wire as are the said large ground electrodes.

4. An electrical precipitator cell having as a part thereof: a metallic casing having sides; and as an additional part a substantially straight tubular electrode, a plurality of insulators, means for supporting an end of each of said insulators on said electrode intermediate the ends thereof, a plurality of armed brackets, means for securing said brackets to the other ends of said insulators with their arms in spaced relation to said electrode, ionizer means including an ionizing wire secured to certain of said arms in spaced relation to said electrode, and paralleling said electrode; and a parti-cylindrical curved metallic sheet contacting said electrode, disposed on the side opposite said brackets and baffling the spaces between the casing sides of said wire and

said brackets and extending slightly inward beyond the nearest end of said ionizing wire.

5. A device of the class described having an ionizing zone and a precipitating zone successively in the path of a gas-flow for the cleaning of particulate matter from the gas, said precipitating zone defining the path of the gas-flow thereat, an open metallic casing having opposed sides between which the gas flows, an ionizing wire inside said casing transverse to the gas-flow, means on one side of said wire for supporting said wire in insulated relation to said casing so that it extends almost to said sides but leaves spaces therewith through which gas might flow, without being adequately ionized, and curved grounded electrode means spaced from said wire on the side of said wire away from said supporting means, cooperating with said ionizing wire for creating an adequately ionized field in the path of the portion of gases flowing through said spaces.

6. In a device of the class described having an ionizing zone and a precipitating zone successively in the path of a gas-flow for the cleaning of particulate matter from the gas, ionizing means comprising an ionizing wire and a parallel ground electrode, means disposed on one side of said wire for supporting said wire in insulated spaced relation to said electrode, and means disposed on the other side of said wire for creating an adequately ionized field with the parts of the wire in proximity to said supporting means, and to guide the portion of said gas flow about said supporting means through said field.

7. A device of the class described generally having an ionizing zone and a precipitating zone successively in the path of a gas-flow, for cleaning particulate matter from the gas, said precipitating zone defining the path of the gas-flow thereat; an outer generally rectangular metallic casing having pairs of opposed sides; said ionizing zone including ionizing means comprising an ionizing wire spaced from one pair of said opposed sides, spaced ground electrodes paralleling said wire to provide an ionizing field with said wire and means including arms for insulated supporting said wire between said ground electrodes, said wire being of less than 32 mils in diameter and being of such fineness that adequate charging of suspended particles in the gas is obtained at a wire-charging voltage below the critical corona voltages, and yielding ionizing currents of negligible zone generation; and additional ground electrode means spaced from said wire for providing, with said wire, an ionizing field in the path of the gas-flow at said arms, the last said field merging into the first said field.

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