June 17, 1947. E. H. R. PEGG 2,422,564

ELECTRICAL DUST-PRECIPITATOR

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Fig. 1.

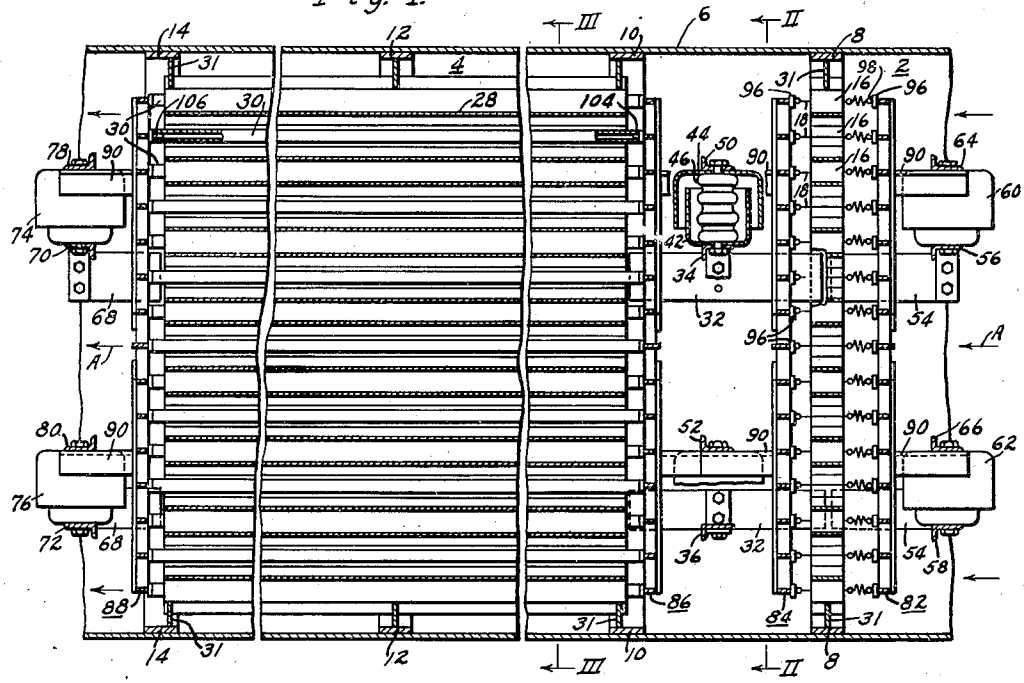


Fig. 4.

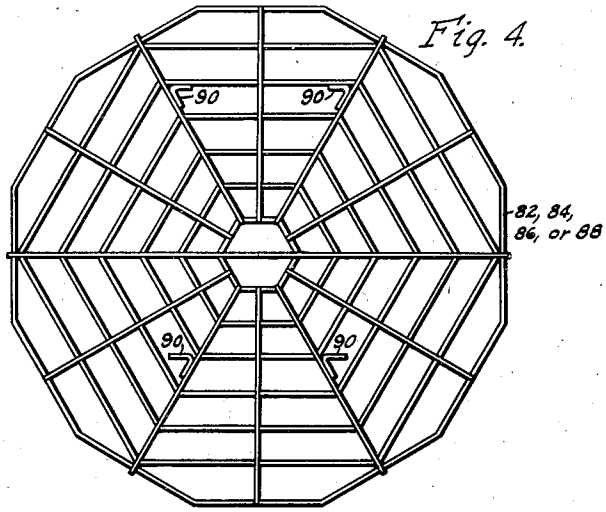


Fig. 5.

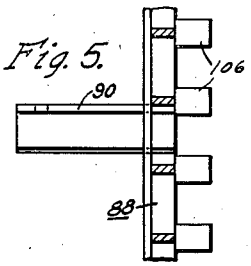


Fig. 6.

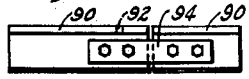


Fig. 8.

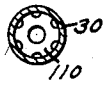
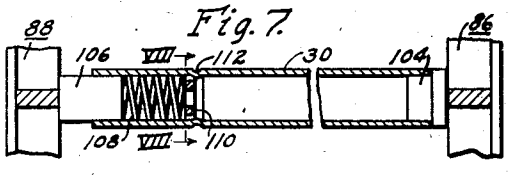


Fig. 7.



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ELECTRICAL DUST-PRECIPITATOR

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Fig. 2.

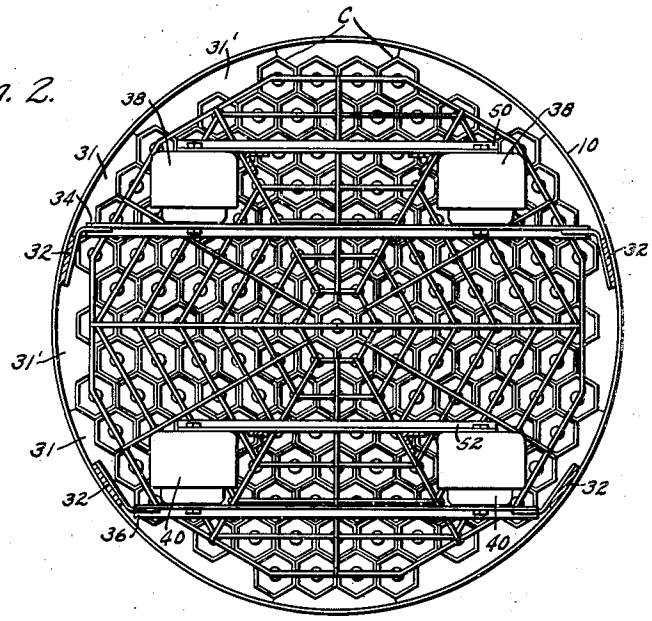
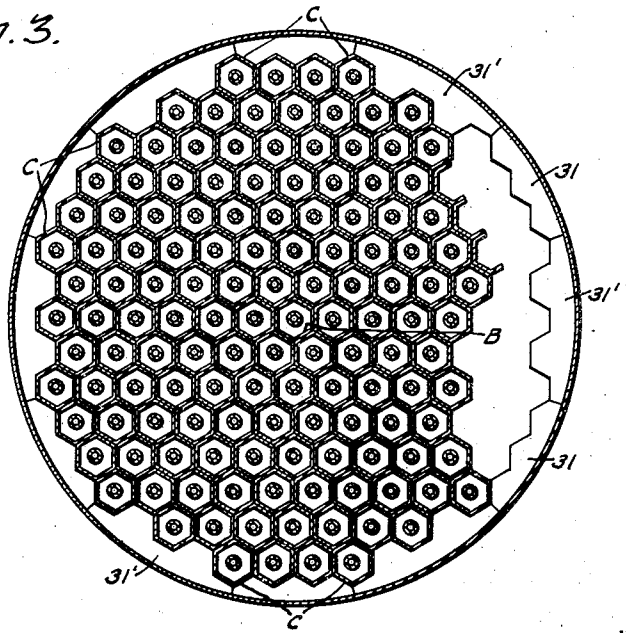


Fig. 3.



WITNESSES:

Leon M. Garman

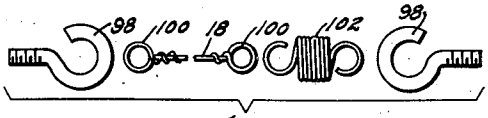


Fig. 9.

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ELECTRICAL DUST-PRECIPITATOR

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4 Claims. (Cl. 183—7)

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My invention is generally directed to improvements in electrical dust-precipitators for cleaning a dust-carrying gas, and is more particularly directed to improvements in that type of electrical dust-precipitators which clean a flowing gas principally by charging gas-borne dust-particles in one region, and subsequently precipitate the charged dust-particles from the gas in another separate region, spaced downstream from the dust-charging region.

It is among the objects of my invention to provide an electrical dust-precipitator of a type described which is simple and sturdy in construction, using many duplicate parts, which is rugged for withstanding shock and vibration, and which will remove extremely fine dust-particles from a gas with a high efficiency in the order of that attained only with electrical precipitators.

A further object of my invention is to provide an electrical dust-precipitator which is sturdily built as a complete structural unit so that it can be bodily inserted into, or removed from, gas conduits of corresponding size.

It is also among the objects of my invention to provide an electrical dust-precipitator of the type described for removing carbonaceous dust-particles from a gas flowing at a high velocity.

Other features and objects of my invention, in addition to the foregoing, will be discernible from the following description of a preferred embodiment, which is to be taken in conjunction with the accompanying drawings on various scales.

In the drawings:

Figure 1 is a vertical central sectional view, with some parts broken away for clarity, of an electrical dust-precipitator in accordance with my invention, the dust-precipitator being shown in a gas-duct;

Fig. 2 is a vertical sectional view, transverse to Fig. 1, substantially on the line II—II thereof, without the gas-duct. Without the sectioned parts, this figure also illustrates end views of the gas-cleaning unit;

Fig. 3 is a vertical sectional view, substantially on the line III—III of Fig. 1, with some parts omitted;

Fig. 4 is an elevational view of a grating used to support the insulated electrodes of the electrical dust-precipitator;

Figs. 5 and 6 are details of 60°-angle members which are secured to gratings such as shown in Fig. 4;

Figs. 7 and 8 are longitudinal and transverse sectional views, respectively, of an insulated non-discharging electrode and its support;

Fig. 9 is an exploded view of an ionizing wire and supporting means therefor.

A gas-cleaning means in accordance with my invention comprises an upstream dust-charging

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means, indicated in its entirety by the reference numeral 2, and a downstream dust-precipitating means, indicated in its entirety by the reference numeral 4. Such a gas-cleaning means is built as a rigid unit for installation into a suitable gas-duct such as the gas-duct 6 which, in this case, is round. Structurally, the gas-cleaning unit comprises a plurality of coaxial rings or hoops 8, 10, 12 and 14 which are alike. These rings are short hollow cylinders and are spaced longitudinally in the direction of gas-flow which is indicated by the arrows A. The ring 8 is a part of the dust-charging means 2, and is the farthest upstream ring. The rings 10, 12 and 14 are part of the dust-precipitating means 4, and are successively further downstream than the ring 8. These rings carry the structural parts of the gas-cleaning means, the intermediate ring 12 being a reenforcing ring of which as many can be provided as the desired strength, length, and rigidity of the gas-cleaning unit demands.

The dust-charging means also comprises a plurality of low potential or uninsulated electrodes in the form of tubes 16, and a plurality of insulated ionizing wires 18; an ionizing wire 18 extending coaxially through each tube 16. The tube-electrodes 16 have their axes extending longitudinally, following the direction of gas-flow. They have a regular hexagon contour in cross-section and are assembled so as to provide a tube assembly which lies within the ring 8.

The dust-precipitating means 4 also includes a plurality of low potential or uninsulated electrodes in the form of tubes 28, and a plurality of insulated non-discharging electrodes 30 in the form of hollow rods; a rod 30 extending coaxially through each tube. The tubes 28 are assembled to provide a tube-assembly which lies within the rings 10, 12 and 14.

In this particular embodiment, the tubes 16 of the dust-charging means and the tubes 28 of the dust-precipitating means are of the same construction, except with respect to length; the tubes 16 being relatively much shorter than the tubes 28, or conversely, the tubes 28 being comparatively relatively long.

The tube-assemblies of the dust-charging means 2 and of the dust-precipitating means 4 are similarly constructed. The tubes of each tube-assembly are coextensive and are welded together in juxtaposed position with sides fitting after the fashion indicated in Figs. 2 and 3. For convenience and economy in manufacturing, each tube has a lengthwise or longitudinal slit in one of its sides, this side being placed against a solid side of the abutting tube. Each tube-assembly has a series of nested or concentric hexagon layers about a center tube B, except for the outermost groups of tubes C, as indicated in Figs. 2 and 3. In order to get as many hexag-

onal tubes as possible within the circular periphery of the rings, corner tubes of the outermost layer which comprises groups C, are omitted.

Sealing means are used for barring gas-flow between the inside of a ring and the outside of the associated tube-assembly, the sealing means comprising a plurality of separate segments 31 and 31', of two forms only, which are alternately arranged around the inside of each ring, as shown in Figs. 2 and 3. The segment 31 has a serrated edge embracing side of single corners of hexagons; while the segment 31' has a serrated edge embracing three sides of hexagons. In Fig. 3, tubes have been omitted to show the segments more clearly.

The ring 8, the tube-assembly of the tubes 16, and the associated sealing segments 31 and 31' are welded, or otherwise secured, into a first unit-part; and the rings 10, 12 and 14, the associated segments 31 and 31', and the tube-assembly of the tubes 28 are similarly secured into a second unit-part. The unit-parts are rigidly secured together into a more comprehensive unit by means of a plurality of strong intermediate plates 32 extending between and secured to the insides of the rings 8 and 10. In the embodiment shown, four plates 32 have been provided, each being in vertical and horizontal alignment with another, as is apparent from Fig. 2, but additional plates may be provided if desired.

The four plates specifically mentioned also support insulating means for the insulated electrodes of the dust-charging means and the dust-precipitating means. A feature of the construction shown resides in the use of common insulators for supporting the facing ends of the electrodes of both the dust-charging means and the dust-precipitating means. To this end, an upper angle bar 34 is rigidly secured to the upper plates 32 and a lower angle bar 36 is rigidly secured to the lower plates 32. The angle bars 34 and 36 are parallel, and are disposed so as to securely receive spaced upper and lower insulating assemblies 38 and 40, respectively.

As indicated in Fig. 1, each insulating assembly comprises relatively insulated nested oppositely-directed metal cans or cups 42 and 44, the cup 42 being secured to the uninsulated end of an inner insulator 46 and the cup 44 being secured to the insulated end of the insulator. When the cups are oppositely charged, an electrostatic field is provided between them for precipitating any dust tending to flow toward the insulator 46. The cups may be provided with one or more drainage holes. An upper angular cross-bar 50 is secured across the upper insulating assemblies 38 and a similar lower bar 52 across the insulated ends of the lower insulating assemblies 40.

Generally similar insulating structures are provided at the upstream and downstream ends of the gas-cleaning unit. At the upstream end, plates 54 are secured to the ring 8, with portions protruding upstream. An upper angle bar 56 and a lower bar 58, carried by the plates 54, support spaced upper and lower insulating assemblies 60 and 62, respectively. An upper insulated angular cross-bar 64 extends between the insulated ends of the upper insulating assemblies 60 and a lower insulated cross-bar 66 extends between the insulated ends of the lower insulating assemblies 62. At the downstream end of the unit, plates 68 support upper and lower angle bars 70 and 72 which carry upper and lower insulating assemblies 74 and 76, respectively, insulatedly carrying upper and lower angular cross-bars 78 and 80, respectively.

For supporting the ends of the insulated electrodes of the dust-charging means and the dust-precipitating means, gratings 82 and 84 are provided at the respective ends of the tube-electrodes 16 and gratings 86 and 88 are provided at the respective ends of the tube-electrodes 28. Each grating is in the form of a spider-web and of a size to lie within the supporting structure with adequate air insulation. Secured to each grating is a plurality of 60°-angle bars 90 which extend away from the electrodes supported by the associated grating and are secured to the upper and lower insulated cross-bars 50 and 52, or 64 and 66, or 78 and 80, as the case may be.

Fig. 5 shows a 60°-angle bar for use with the extreme upstream and downstream gratings 82 and 88.

Fig. 6 shows two such angle bars extending toward each other from the gratings 84 and 86, one of the bars being provided with a hole 92 for bolting to an insulated cross-bar 50 or 52. A plate 94 is fastened to both legs of the bars so that these bars 90 are unitary and carry the gratings to which they are secured and associated parts. Accordingly, each grating is securely carried by an insulating assembly.

The gratings 82, 84 at each end of the dust-charging means 2 are provided with a plurality of blocks 96 aligned with the axes of the tube-electrodes 16. Each pair of directly facing blocks 96 carries means for resiliently removably carrying an ionizing wire 18 in tension. As shown in Fig. 9, each ionizing wire is preformed with end loops 100, one of which fits a hook 98 and the other of which fits an end of a spring 102 whose other end fits the other hook 98. The hooks 98 are fastened to the blocks 96.

The gratings 86, 88 at each end of the dust-precipitating means 4 are provided with co-operating stub-shafts 104 and 106 aligned with the axes of the tube-electrodes 28, each such pair of directly facing stub-shafts removably holding a hollow non-discharging rod-electrode 30.

As shown in Figs. 7 and 8, the stub-shaft 104 on the grating 86 is shorter than the stub-shaft 106 on the grating 88. Both fit into the rod-electrode 30 with enough end clearance to permit the rod-electrode to be pushed against a compression spring 108 so that the end of the rod-electrode at the stub-shaft 104 can be slipped by it. The spring 108 is braced against a perforated disc 110 bearing on an inside bulge 112 in the rod-electrode 30.

With the structure described, a single high-potential conductor, connected to any of the insulated crossbars, will energize or charge the insulated ionizing wires 18 and the insulating non-discharging rod-electrodes 30. The ionizing wires discharge to the tube-electrodes 16, thereby providing a shallow ionized electrostatic field within each tube through which the gas passes so that the gas-borne dust-particles are electrically charged. The charged dust-particles are carried into the dust-precipitating means where they are precipitated to the tube-electrodes 28 by the substantially non-ionized electrostatic field between each non-discharging electrode 30 and its associated tube-electrode 28.

When arranged longitudinally as shown, the ionizing wires can be comparatively short to minimize vibration and breakage. Except for the insulators, all of the tubes, plates, angle bars, cross bars, and other parts of the gas-cleaning unit can

be made of stainless steel, copper alloys, or other materials resistant to corrosion by salt-water and sea-air. The arrangement of hexagonal tubes provides a honeycomb structure of great strength with a maximum number of tubes for a circular gas-duct. The insulated electrodes are supported by a simple rigid structure lying within the confines of the rings 8, 10, 12, and 14 about which the unit is built.

An indication of the size of an apparatus embodying my invention, to which I am by no means limited, may be obtained from the following dimensions of a specific construction for cleaning gases flowing at about 1000 feet per minute. The unit had an overall length of 77½ inches and a diameter of close to 36 inches. The tube-electrodes for the dust-charging means were 2½ inches long and the tube-electrodes for the dust-precipitating means 47 inches long, all tubes being 2½ inches between parallel opposite sides. The ionizing wires had a length of about 3¾ inches between centers of their end loops and a .015 inch diameter. The nondischarging rod-electrodes had an overall length of 48¼ inches and an outside diameter of ⅞ inch.

While I have described my invention in a preferred form, it is obvious that features of it are subject to modification. For example, instead of hexagonal tubes, round tubes might be used for the uninsulated electrodes; nor need the tubes of the dust-charging means be of the same cross-sectional area as those of the dust-precipitating means.

I claim as my invention:

1. Electrostatic equipment of a type described adapted to treat a gas flowing longitudinally, comprising a hollow cylindrical gas-duct, electrode-means comprising a first group and a second group of substantially coextensive juxtaposed hexagonal tubes, the tubes of each group being secured together inside said cylindrical gas-duct, sealing means for closing the space between each of said groups of tubes and said cylindrical gas-duct, said sealing means being secured to each of said groups of tubes and to said cylindrical gas-duct, a plurality of bar members carried by said cylindrical gas-duct, and extending transversely across it at the ends of said tubes, a plurality of insulators carried by said bar members, the insulators between said groups of tubes having longitudinal bars secured thereto, transverse grating means carried by the insulators at the far ends of said tubes, transverse grating means carried at each end of said longitudinal bars, and electrodes carried by said grating means axially passing through said tubes, in insulated spaced relation thereto.

2. Electrostatic equipment of a type described for treating a gas flowing longitudinally, comprising a plurality of ring members spaced longitudinally, a first group of substantially coextensive juxtaposed relatively short hexagonal tubes secured together, said group being secured to and inside of an upstream one of said ring members, a second group of substantially coextensive juxtaposed relatively long hexagonal tubes secured together, said second group being secured to and inside of a plurality of spaced downstream ring members, longitudinal bar members rigidly connecting said upstream ring member and the downstream ring member next adjacent to it, in

a manner to provide a space between said groups of tubes, additional bar members secured to certain of said ring members so as to extend beyond the upstream end of the said first group of tubes and the downstream end of said second group of tubes, insulator means carried by said bar members, a transverse grating member carried by said insulator means near each end of each said group of tubes, ionizing wires carried by the grating members at opposite ends of said first group of tubes, said ionizing wires passing centrally through the tubes of said first group, and non-discharging electrodes carried by the grating members at opposite ends of said second group of tubes, said electrodes passing centrally through the tubes of said second group.

3. Gas cleaning means for a gas flowing longitudinally, comprising a downstream dust-charging means and an upstream dust-precipitating means; said dust-charging means comprising a plurality of substantially coextensive longitudinal relatively short hexagonal tube-electrodes, an ionizing wire insulatedly extending through each of said tube-electrodes, and a transverse insulated grating at each end of said dust-charging means, having means for anchoring each end of said ionizing wires; said dust-precipitating means comprising a plurality of substantially coextensive longitudinal relatively long hexagonal-tube precipitating-electrodes, a non-discharging electrode insulatedly extending through each of said precipitating-electrodes, and a transverse insulated grating at each end of said dust-precipitating means, having means for anchoring each end of said precipitating-electrodes; said gas-cleaning means comprising insulators at each of its ends for carrying the gratings thereat, and a plurality of common insulators for carrying the gratings which are disposed between said tube-electrodes and said precipitating-electrodes.

4. Dust-precipitating means comprising a tubular outer electrode, a non-discharging hollow rod-electrode inside said outer electrode, and means for replaceably supporting said rod-electrode, comprising a stub-rod fitting one end of said rod-electrode, another relatively longer stub-rod fitting the other end of said rod-electrode, said rod-electrode having a bulge spaced from said longer stub-rod, a perforated disc bearing on said bulge, and a compression spring bearing on said disc and said longer stub-rod.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,221,601	Nielsen	Nov. 12, 1940
1,634,372	Lewers	July 5, 1927
2,024,226	Irwin et al.	Dec. 17, 1935
1,357,466	Moller	Nov. 2, 1920
1,478,798	Schmidt	Dec. 25, 1923
1,982,470	Franks	Nov. 27, 1934
2,008,246	Deutsch	July 16, 1935

FOREIGN PATENTS

Number	Country	Date
553,753	Great Britain	June 3, 1943