

Oct. 28, 1952

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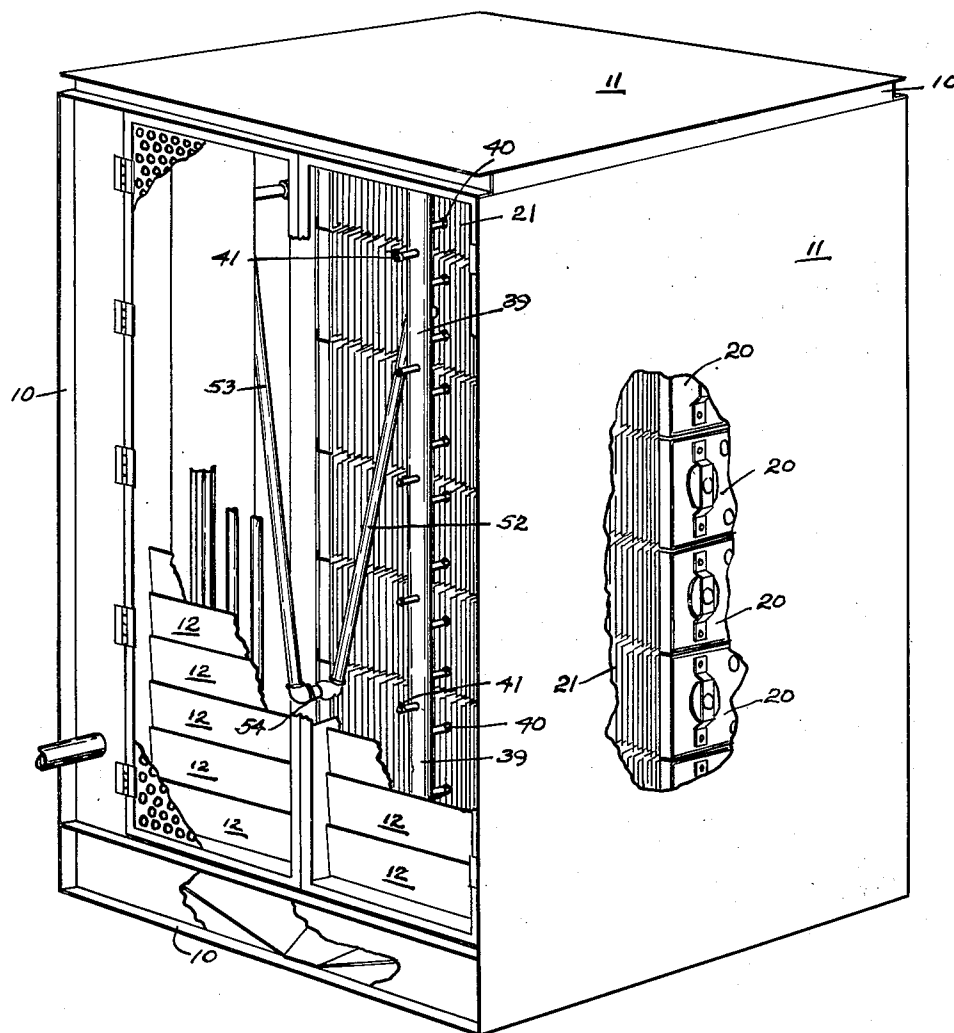
2,615,529

ELECTROSTATIC PRECIPITATOR

Filed Oct. 1, 1948

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FIG. 1



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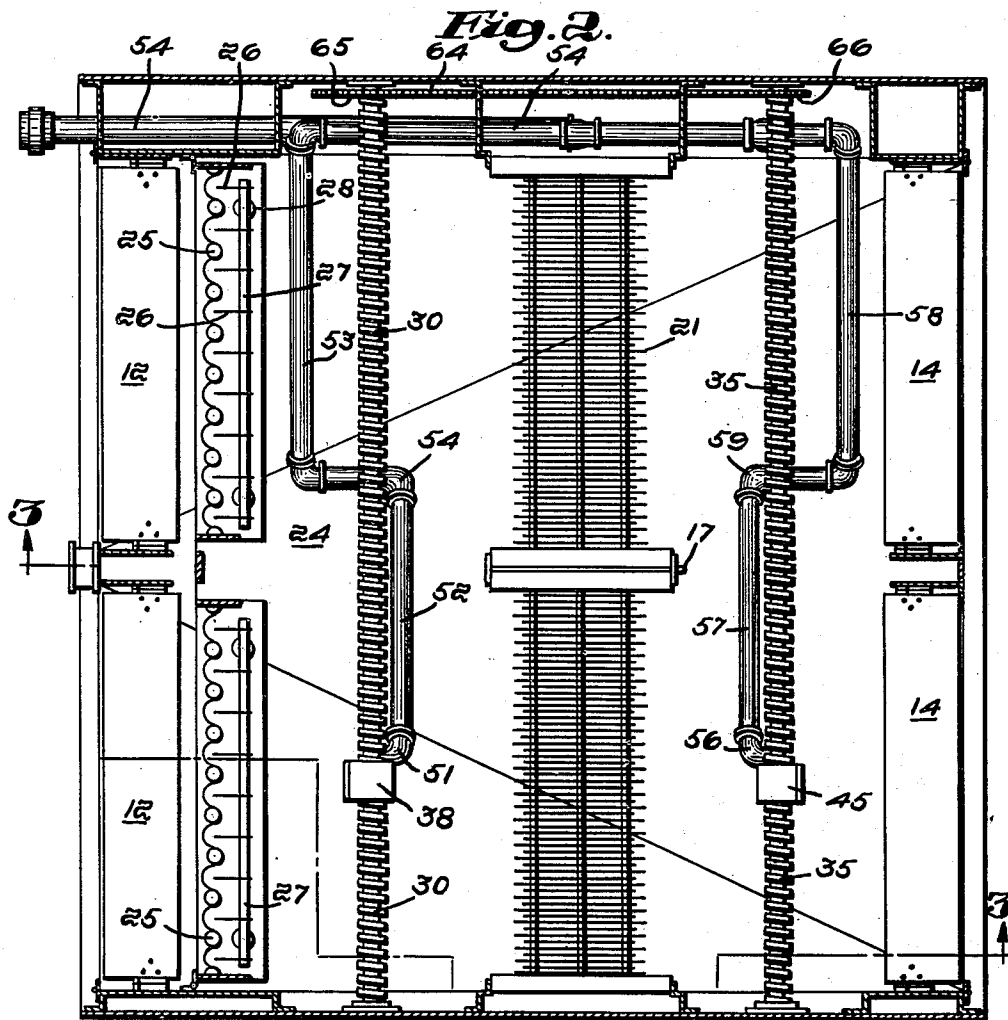
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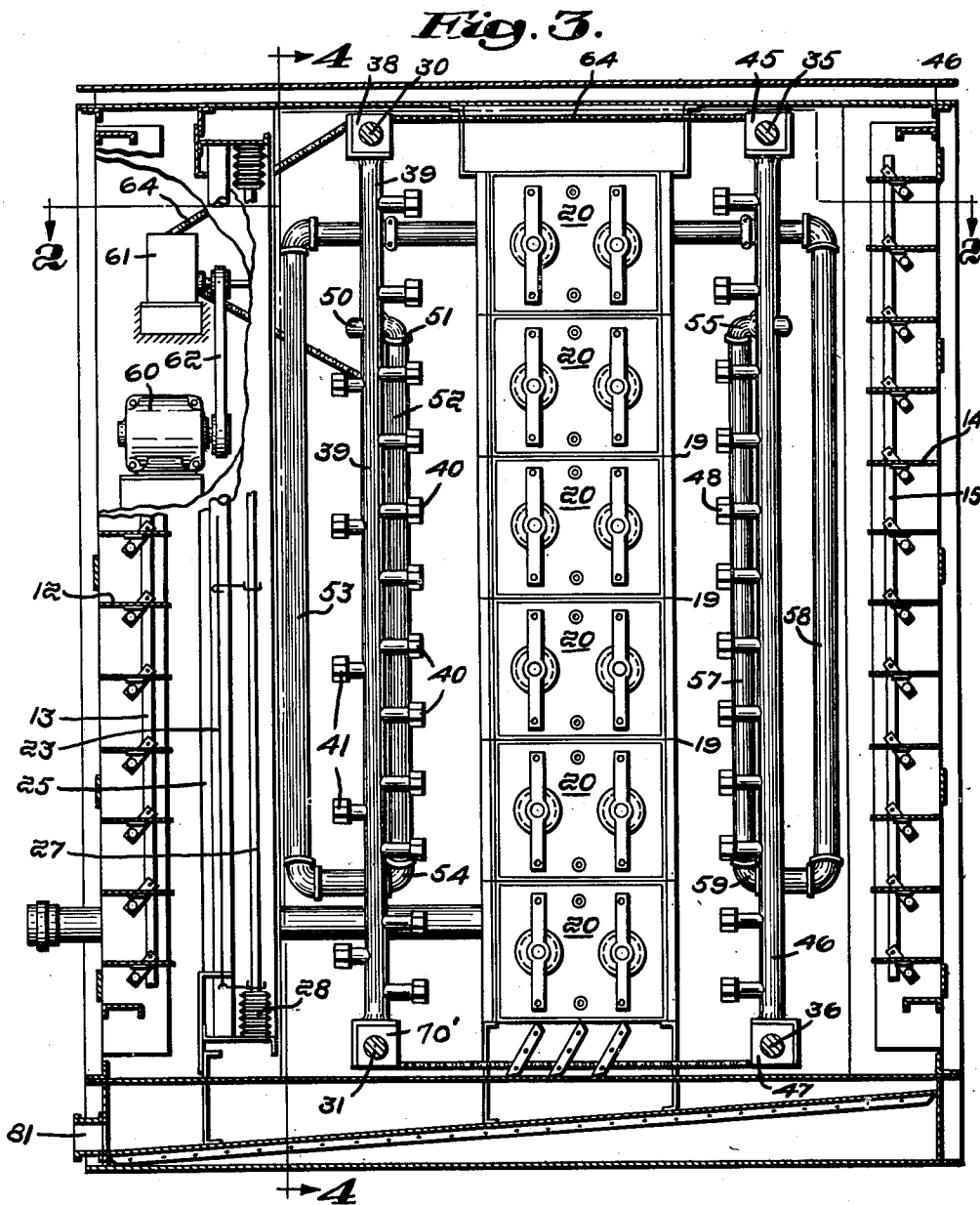
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ELECTROSTATIC PRECIPITATOR

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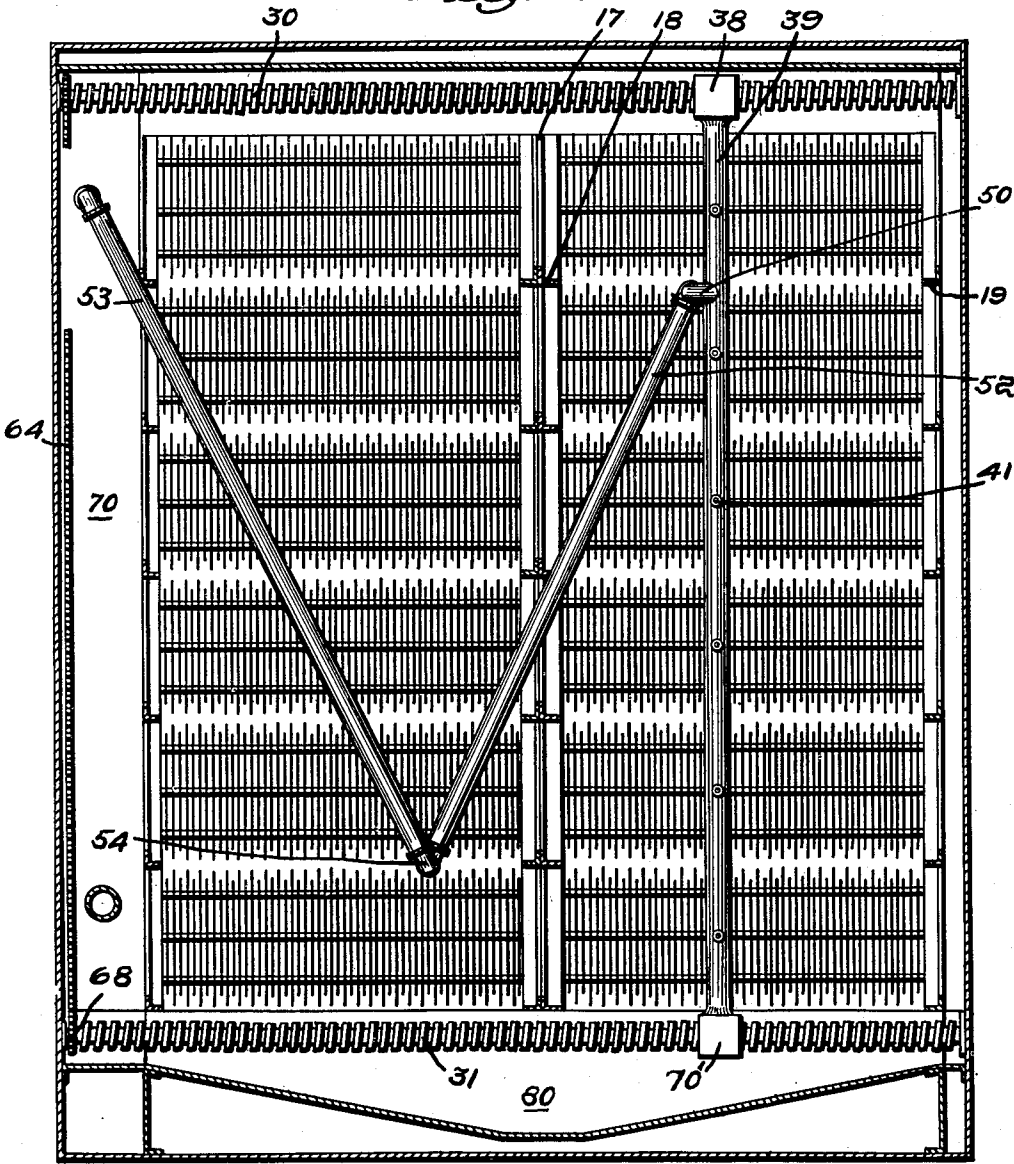
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Fig. 4.



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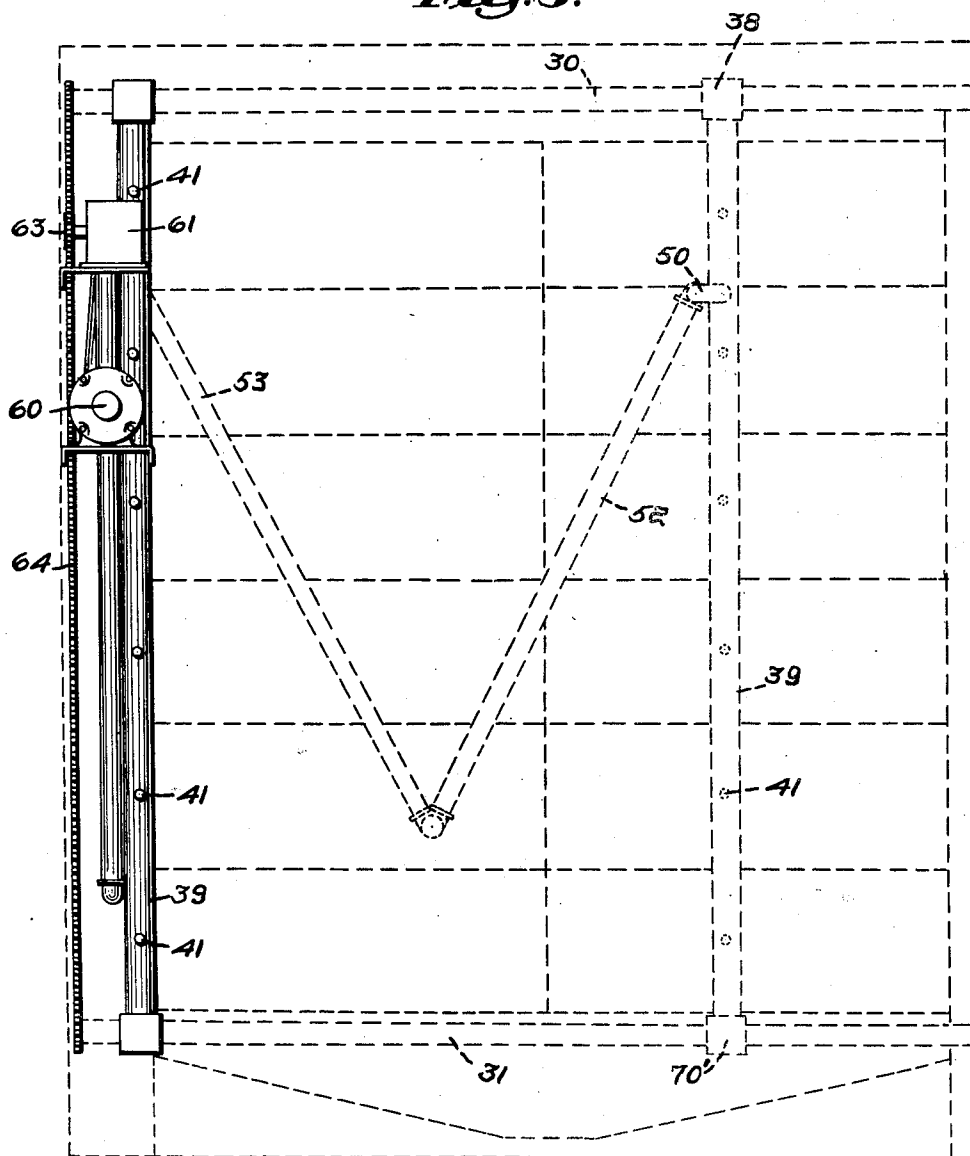
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Fig. 5.



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UNITED STATES PATENT OFFICE

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ELECTROSTATIC PRECIPITATOR

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Application October 1, 1948, Serial No. 52,329

12 Claims. (Cl. 183—7)

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This invention relates to electrostatic precipitators for the removal of foreign particles from gases, such as air.

In the most successful form of electrostatic precipitators for removing small foreign particles, hereinafter referred to as dust, from gases, the gases are moved first through an upstream, ionizing zone or chamber, and then through a downstream, dust collecting zone or chamber. In the ionizing chamber, the dust particles entrained in a gas to be cleaned are given electrostatic charges and in the collector chamber, the charged dust particles are caused to be attracted to, and to precipitate upon, dust collecting electrodes.

The dust collecting electrodes usually are closely spaced plates, alternate of which are grounded and the others of which are insulated from the grounded ones. A difference of potential is established between the grounded and the insulated plates for establishing an electric field therebetween. Usually the dust particles are given positive electrostatic charges in the ionizing chamber, and the insulated collector plates are positively charged so that the charged dust particles are attracted to the grounded plates. Experience has shown, however, that although most of the dust is attracted to the grounded plates, some is attracted to and adheres to the insulated plates. Some dust also precipitates upon the ionizer electrodes. The dust precipitated on the electrodes adheres thereto and for efficiency in operation has to be removed at intervals.

The most widely used method of cleaning the ionizer and collector electrodes is by washing them with a liquid such as water or a light oil sprayed through nozzles upon the electrodes. The collector plates have substantial areas and extend substantial distance in the direction of gas flow and, due to this and to their close spacing, it is difficult to project cleaning fluid with sufficient force upon all of their surfaces for providing adequate cleaning. For adequate cleaning, the liquid should exert a scouring or wiping effect upon all surfaces of the collector plates.

The conventional washing systems have liquid spray nozzles which in some cases, are fixed and in some cases are movable, but in either case are so arranged that most of the liquid which is sprayed strikes the plate surfaces at angles so that its force is dissipated through impact. Fur-

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thermore, the washing action is not sufficiently effective over those surfaces of the plates which are furthest removed from the spray nozzles.

Another disadvantage of the conventional washing system is that the spray headers and the piping and other components connected thereto, are in the gas stream when not in use, and interfere with the gas flow and, as a result, with the collection efficiency.

This invention overcomes the described disadvantages of the prior electrostatic precipitators, and has other advantages, which will be described, over the prior precipitators.

A feature of this invention is that the spray nozzles are arranged to be moved horizontally along the collector plates so that each nozzle sprays liquid between adjacent plates and parallel to their surfaces thereby effectively scraping the deposited dust therefrom.

Another feature of this invention is that the spray nozzles are arranged to be moved horizontally across the gas entering and the gas leaving ends of the collector plates, the nozzles at the upstream ends of the plates spraying liquid towards the downstream ends thereof, and the nozzles at the downstream ends of the plates spraying liquid towards the upstream ends thereof, the two sets of nozzles effectively washing and cleaning all of the plate surfaces.

Another feature of the invention is that the spray header carrying the nozzles at the upstream ends of the collector plates also has nozzles which spray cleaning liquid upon the ionizer electrodes.

Another feature of this invention is that during the periods the precipitator is cleaning gas, the spray headers and their pipes and other components are completely removed from the gas stream.

Another feature of this invention is that an efficient compact electrostatic precipitator is provided which is self-contained in that it encloses its own separate ionizing, collection, and washing apparatus, with louvers in its upstream and downstream ends which are closed when the electrodes are washed, and which is adapted to be operated in series with other similar precipitators so that one at a time can be removed from service for cleaning while the others remain in service.

Another feature of the invention is that the collector chamber comprises a plurality of similar, compact collector cells which are easily removed and installed, and which can readily be stacked one above the other and/or one alongside the other for providing any desired size of collector chamber.

An object of the invention is to provide a compact, self-contained electrostatic precipitator having its individual ionizing electrodes, collector electrodes, and electrode washing mechanism whereby it can be combined with other similar precipitators for providing a dust collection system of any desired size.

Another object of the invention is to provide an improved electrode washing system for the electrodes of an electrostatic precipitator.

Another object of the invention is to provide electrode washing components for an electrostatic precipitator which are isolated from the gas stream when the precipitator is operated to clean a gas.

The invention will now be described with reference to the drawing of which:

Fig. 1 is a perspective view of an electrostatic precipitator embodying this invention, with a portion at the front and one side removed for illustrating the arrangement of the inner components;

Fig. 2 is a plan view, in section, of the precipitator, the section being taken along the lines 2—2 of Fig. 3;

Fig. 3 is a side elevation, in section, of the precipitator, the section being taken along the lines 3—3 of Fig. 2;

Fig. 4 is a section, of the precipitator, the section being taken along the lines 4—4 of Fig. 3, and

Fig. 5 is a front elevation corresponding to Fig. 4 but illustrates the position of the electrode washing equipment removed from the gas stream when not in use.

The precipitator as illustrated has a cubical shape with a structural steel frame 10 and sheet metal sides 11, two sides being open for the entry and exit of gas. The gas entering end of the precipitator has the plurality of spaced, inlet louvers 12 therein which are interconnected by the linkage 15 so that they can be simultaneously adjusted to open or closed positions.

The structural steel frame 17 extends vertically at the longitudinal and transverse center of the precipitator and has the spaced outwardly extending shelves 18 thereon. The opposite sides of the frame-work of the precipitator have the shelves 19 thereon which are aligned with corresponding shelves 18. The collector cells 20 are placed on the shelves 18 and 19. In the embodiment illustrated, the collector chamber contains twelve cells arranged in two vertical rows with six cells in each row stacked one above the other. The collector cells are similar and are of the type disclosed in the E. L. Richardson Patent No. 2,535,696. The cells are self-contained, are compact and light in weight, and can easily be removed from, and installed in, the collector chamber, as for servicing or replacement. As illustrated most clearly by Figs. 1, 2, and 4, the collector plates 21 of the cells 20 are arranged vertically, the plates of each underlying cell being in vertical alignment with the corresponding plates of the similar cell located above it.

Located downstream of the inlet louvers 12 is the ionizing chamber 24 which contains the plurality of vertically extending, relatively large,

tubular ionizer electrodes 25 between which are suspended the ionizer wires 23 carried on the ends of the supports 26, the supports 26 being attached to the bars 27, which in turn are supported by the insulators 28. This ionizer electrode arrangement is conventional.

The equipment for washing the ionizer electrodes and the collector plates will now be described. Located between the ionizer electrodes and the collector cells are the upper and lower, threaded rods 30 and 31 respectively. These rods are located above and below respectively, the collector chamber, and are completely out of the gas stream passing between the ionizer and collector chambers.

The upper and lower threaded rods 35 and 36 are arranged between the collector cells 20 and the outlet louvers 14, these rods also being out of the gas stream, the upper rod 35 being in horizontal alignment with the upper rod 30, and the lower rod 36 being in horizontal alignment with the lower rod 31.

The rod 30 has threaded thereon the fitting 38 which is attached to the upper, closed end of the liquid header 39. The closed, lower end of the header 39 has attached thereto the fitting 70' which is threaded on the lower rod 31.

The header 39 has the spaced downstream spray nozzles 40, two of which face the upstream ends of the plates of each collector cell 20. The header 39 also has the spaced, vertically aligned, upstream, spray nozzles 41, each of which are arranged to wash the entire surfaces of the ionizer electrodes.

The fitting 45 is threaded onto the downstream, upper, threaded rod 35 and is attached to the upper, closed end of the liquid header 46. The fitting 47 is attached to the lower, closed end of the header 46, and is threaded onto the lower, downstream, threaded rod 36. The header 46 has the spaced, vertically aligned, nozzles 48 extending upstream therefrom, two of these nozzles being in alignment with the downstream ends of the collector plates of each collector cell 20.

The upstream header 39 has the pipe fitting 50 extending therefrom, and which is threaded into the swivel pipe connection 51 which, in turn, is threaded on the upper end of the pipe 52. The lower end of the pipe 52 and the lower end of the pipe 53 are connected together through a swivel pipe fitting 54. The upper end of the pipe 53 is connected to the liquid supply pipe 54.

The downstream header 46 has the pipe fitting 55 extending therefrom, and which is threaded into the swivel pipe connection 56, which, in turn, is threaded on the upper end of the pipe 57. The lower end of the pipe 57, and the lower end of the pipe 58 are connected together through a swivel pipe connection 59. The upper end of the pipe 58 is connected to the supply pipe 54.

Arranged at one side of the gas passage through the precipitator, the left-hand side facing Figs. 1, 3, and 5 of the drawing, is the electric motor 60 which is connected to the speed reducing gear mechanism 61 by the belt 62. The mechanism 61 has a sprocket 63 with which the chain 64 meshes. The chain 64 extends around and meshes with the sprocket 65 on one end of the upper threaded rod 30, extends around and meshes with the sprocket 66 on the corresponding end of the upper, downstream, threaded rod 35, then meshes with a similar sprocket on the corresponding end of the downstream, threaded rod 36, and then meshes with the sprocket 68 on the corresponding end of the upstream, lower, threaded rod 31.

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The chain 64 is an endless chain, and as it is rotated through the gear reducing mechanism 61 by the motor 60, it rotates simultaneously the threaded rods 30, 31, 35, and 36. This rotation of the threaded rods causes horizontal movement of the fittings 38 and 40 attached to the upstream header 39, and the downstream fittings 45 and 47 attached to the downstream header 46, causing corresponding horizontal movement of the two headers.

Normally, when the electrostatic precipitator is operating to clean gas, the inlet louvres 12 and the outlet louvres 14 will be open in the positions illustrated most clearly by Fig. 3. At this time, the headers will be in the passage 70 (Fig. 4), which is at the left hand side of the gas passage through the precipitator, in the position illustrated by the full lines of Fig. 5. The dashed lines illustrating the upstream header and the piping of Fig. 5, show another position of the header when it is being used to spray cleaning liquid between the collector plates and on the ionizer electrodes.

Figs. 1, 2, and 4 illustrate one position of the upstream and downstream headers when they are being used to clean the electrodes.

The sump 80 is provided in the lower portion of the precipitator and is adapted to be drained through the drain connection 81.

After a period of operation, long enough to have caused enough sufficient dust to have been collected that cleaning is required, then the high voltage current applied to the ionizer and collector electrodes is removed, and the inlet louvres 12 and the outlet louvres 14 are closed. This can be done manually or by suitable automatic controls. The cleaning liquid which may be a light oil as is commonly used for cleaning the electrodes of electrostatic precipitators is supplied into the pipe 54. The energizing circuit of the motor 60 is then closed, causing it to rotate. This causes the chain 64 to revolve, and causes the headers 39 and 46 to move from the position, shown by the full lines of Fig. 5, horizontally towards the right hand side of the precipitator. This causes the upstream nozzles 41 of the header 39 to wash the dust adhering to the ionizing electrodes therefrom. The downstream nozzles 40 of the upstream header 39 move slowly across the upstream ends of the collector plates 21 of the collector cells 20, and spray the cleaning liquid in between the plates parallel to their surfaces, so that the energy of the spray is expended in scouring or wiping the plate surfaces. Since the spray from the downstream nozzles 40 of the upstream header 39 may not be effective to completely clean the downstream portions of the collector plates, the upstream nozzles 48 of the downstream header 46 spray liquid into the spaces between the downstream ends of adjacent collector plates, and parallel to the plate surfaces as in the case of the nozzles 40, thus scouring or wiping the downstream portions of the plates.

The swivel connections 51, 54, 56, and 59 permit liquid to be supplied to the headers through their supply piping, as they are moved back and forth during the washing operation.

In one actual installation embodying this invention, it was found that the plates could be adequately cleaned by moving the spray headers from their starting position outside the gas stream, past the surfaces of the plates, and back again to their starting position.

While one embodiment of the invention has been described for the purpose of illustration, it

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should be understood that the invention is not limited to the exact apparatus and arrangement of apparatus illustrated, as modifications therefrom may be suggested by those skilled in the art without departure from the essence of the invention.

What is claimed is:

1. An electrostatic precipitator comprising a casing having a gas inlet and a gas outlet and a pair of vertical sides, a plurality of substantially vertically extending, spaced apart collector plates supported in said casing between said inlet and outlet and parallel said sides, said casing having an open space between one of said vertical sides and the outermost of said plates at one side of said plates which is out of alignment with said inlet and plates, a substantially vertically extending liquid header having a plurality of spray nozzles for spraying liquid in between adjacent of said plates, and means for moving said header substantially horizontally back and forth along said plates for washing same, and for moving said header into said space following the washing of said plates, said header when in said space being out of the gas stream flowing from said inlet between said plates.

2. An electrostatic precipitator having a casing having a gas inlet and a gas outlet and a pair of vertical sides, a plurality of substantially vertically extending, spaced apart collector plates supported in said casing between said inlet and outlet and parallel said sides, said casing having an open space between one of said vertical sides and the outermost of said plates at one side of said plates which is out of alignment with said inlet and plates, a substantially vertically extending liquid header having a plurality of spray nozzles for spraying liquid in between adjacent of said plates, said header having ends extending above and below said plates, and means at said ends of said header for moving same substantially horizontally back and forth along said plates for washing same, and for moving said header into said open space when the washing is completed, said header when in said space being out of the gas stream flowing from said inlet between said plates.

3. An electrostatic precipitator comprising a casing having open ends, one forming a gas inlet and the other forming a gas outlet, ionizer electrodes in said casing adjacent said inlet, a plurality of substantially vertically extending collector plates in said casing between said electrodes and said outlet, a substantially vertically extending liquid header movable between said electrodes and said plates, said header having a plurality of downstream nozzles arranged to spray liquid between said collector plates, and having a plurality of upstream spray nozzles arranged to spray liquid upon said electrodes, and means for moving said header substantially horizontally between said electrodes and said plates.

4. An electrostatic precipitator comprising a casing having open ends, one forming a gas inlet and the other forming a gas outlet, ionizer electrodes in said casing adjacent said inlet, a plurality of substantially vertically extending collector plates in said casing between said electrodes and said outlet, a substantially vertically extending liquid header movable between said electrodes and said plates, said header having a plurality of downstream nozzles arranged to spray liquid between said collector plates, and having a plurality of upstream spray nozzles arranged to spray liquid upon said electrodes, said header

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12. An electrostatic precipitator comprising a casing having open ends, one forming a gas inlet and the other forming a gas outlet, said casing having an open space therein at one side thereof, ionizer electrodes in said casing adjacent said inlet, a plurality of substantially vertically extending collector plates in said casing between said electrodes and said outlet, a substantially vertically extending liquid header movable between said electrodes and said plates, said header

having a plurality of downstream nozzles arranged to spray liquid between said collector plates, and having a plurality of upstream spray nozzles arranged to spray liquid upon said electrodes, a second substantially vertically extending header movable between said plates and said outlet and having a plurality of upstream spray nozzles arranged to spray liquid between said plates, and means for moving said headers substantially horizontally along said plates, for washing said plates, and for moving said headers into said space when the washing is completed.

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