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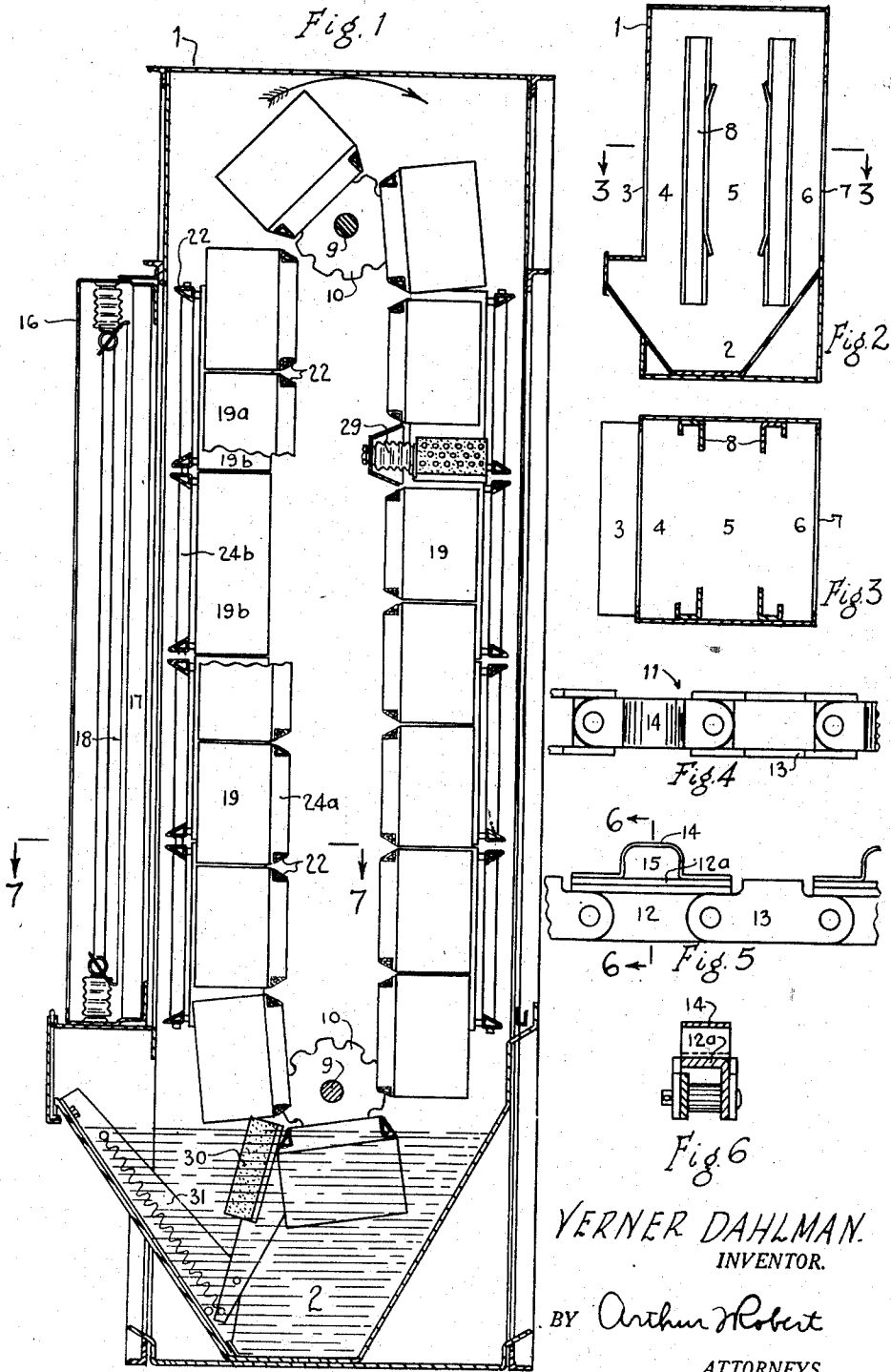
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2,383,111

AUTOMATIC ELECTRICAL PRECIPITATOR

Filed March 18, 1943

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

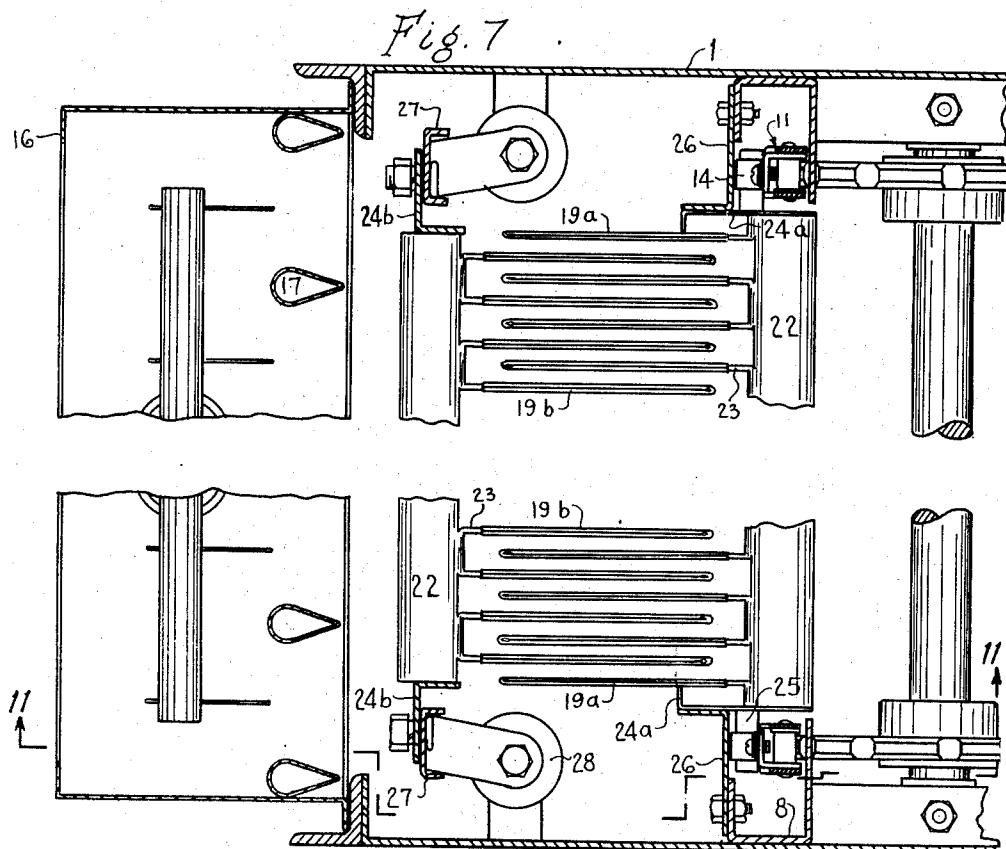
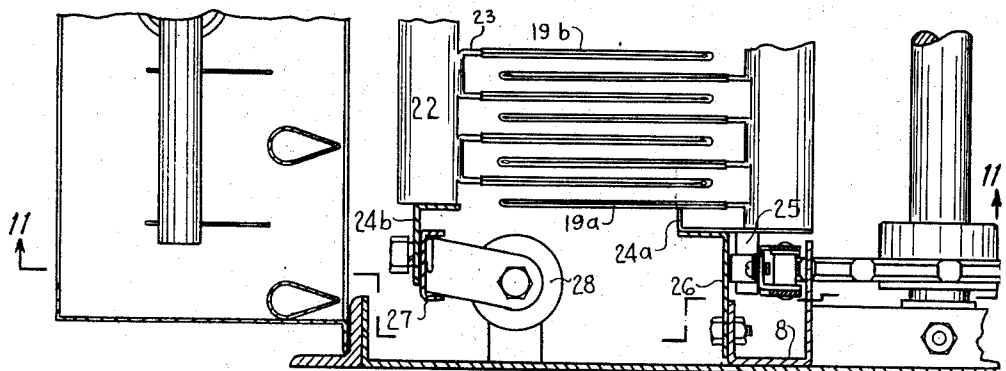
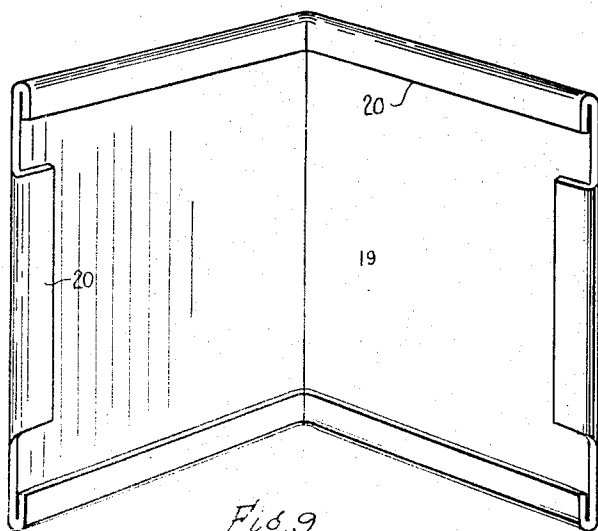
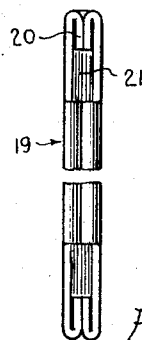


Fig. 10

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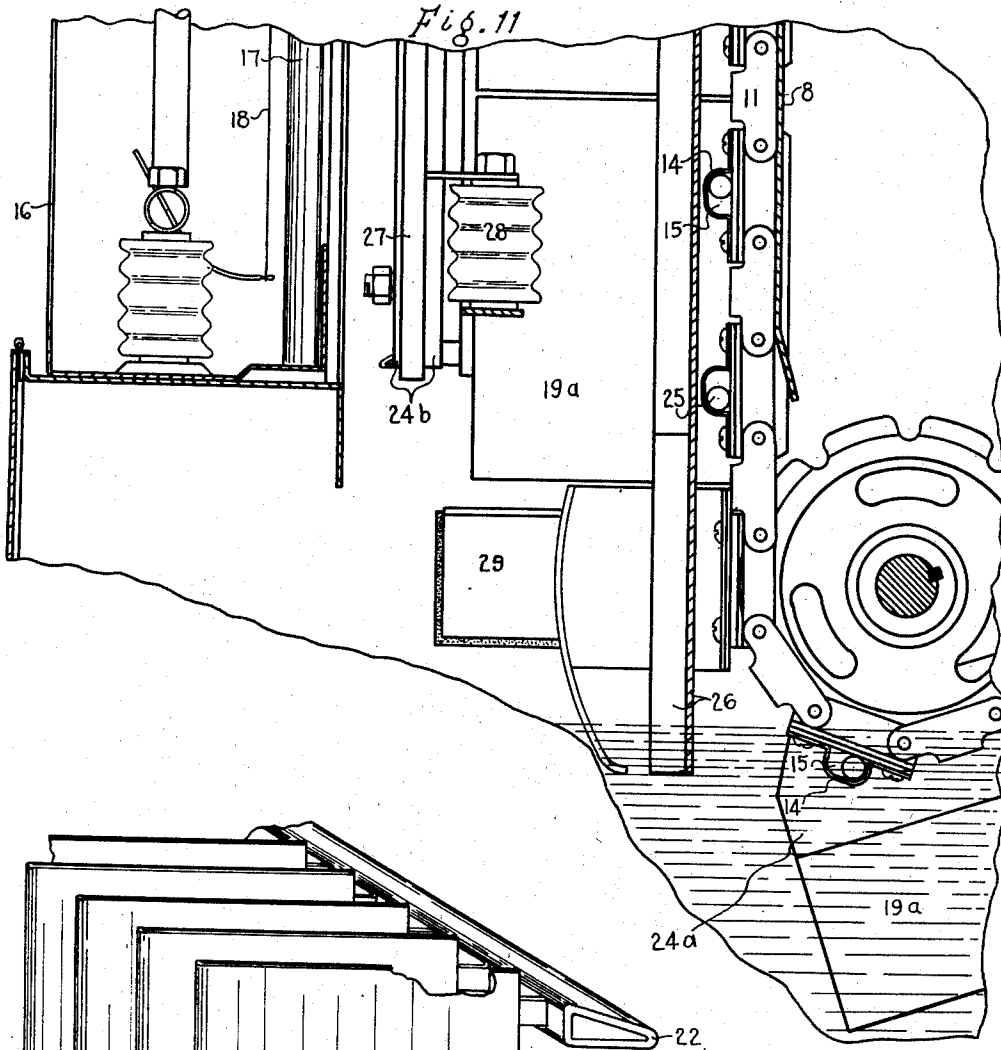
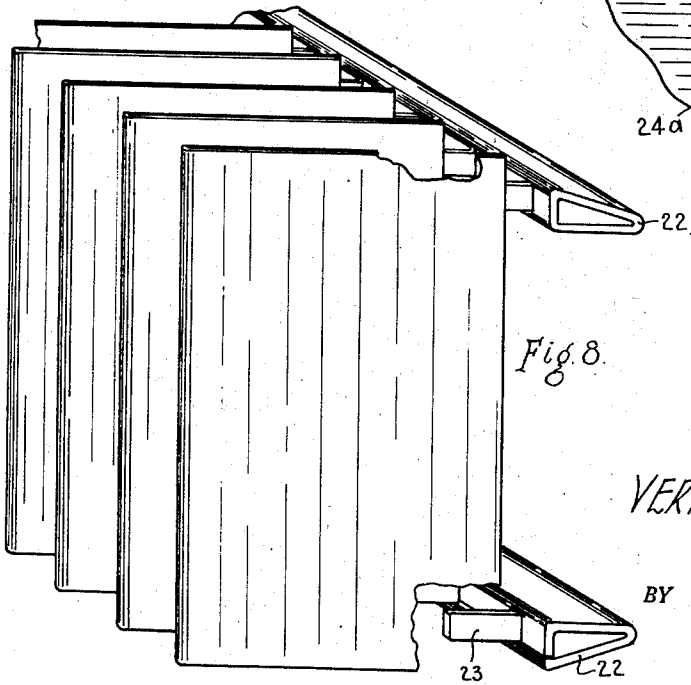
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AUTOMATIC ELECTRICAL PRECIPITATOR

Filed March 18, 1943

3 Sheets-Sheet 3



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2,383,111

AUTOMATIC ELECTRICAL PRECIPITATOR

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Application March 18, 1943, Serial No. 479,665

13 Claims. (Cl. 183—7)

This invention relates to automatic electrostatic precipitators, i. e., electrical precipitators of the automatic or self-cleaning type disclosed in the Pound-Rush U. S. Patent #2,212,885, granted August 27, 1940. Although cleaners of this type could be designed for the heavy duty uses of dust arrestors or collectors which handle large volumes of air containing process dust, i. e., heavy or dense dust concentrations, for all practical purposes, their design is limited to the light duty uses of ventilating air cleaners which handle large volumes of air containing atmospheric dust, i. e., light dust concentrations. Both process and atmospheric dust particles range from extremely small microscopic sizes upwardly but the average size of the process dust particle is, as a rule, much larger than that of the atmospheric dust particle.

The principal object of this invention is to improve automatic electrical precipitators to the end of rendering them easier to construct and less liable to electrical insulation failures.

Another object is to eliminate the necessity of insulating individual precipitating plates with a consequent simplification of the cleaner as a whole and a lessening of the chances of insulation failure.

A further object is to provide a novel cell assembly of the plate type.

The invention mainly resides in the feature of mounting all of the alternate precipitating plates, i. e., all plates of one electrical sign, for movement along a path having gas-cleaning and filter-cleaning areas and all of the intermediate precipitating plates, i. e., all plates of the opposite electrical sign, in the gas cleaning area to interleave the alternate plates as they pass through that area. With this arrangement one set of plates may be insulated as a whole from the opposite set of plates, thus eliminating the necessity of insulating individual plates. Furthermore, since it is easier electrically to insulate stationary parts than it is to insulate moving parts, all of the moving plates may be electrically grounded through the conveyor, thus eliminating any necessity for insulating moving plates and requiring only the insulation of the stationary plates as a whole.

In electrical air cleaners of the pre-ionizing type wherein an ionizer is placed in advance of the precipitating plate-type electrodes, it is customary to employ positive ionization so that the bulk, of the charged particles, is deposited on the negative or grounded plates which are called the "cold" plates as distinguished from the positively charged "hot" plates. Normally the plates

are charged with an operating voltage below the "pin point threshold" voltage of the negative plates; that is to say the voltage at which, as the operating voltage is gradually raised, pale corona discharges first appear in the dark as pin points or light scattered over the negative plates, but particularly along the marginal edges. These pin point corona discharges produce ionization which is herein termed "pin point ionization." On the negatively charged cold plates, pin point ionization has the disadvantage of imparting negative charges to adjacent dust particles which are either deposited on the hot plates where they are not wanted, or discharged with the clean air creating a very undesirable space charge. As the marginal edges of the plates are made progressively thinner and sharper, the pin point threshold voltage is progressively lowered; hence, the operating voltage must be lowered even more if pin point ionization is to be avoided.

A still further object is to provide a novel form of precipitating plate which not only facilitates the assembly of the plates into cells, but also substantially decreases the tendency of pin point ionization to occur along their marginal edges and correspondingly increases their pin point threshold voltage which necessarily permits the use of substantially higher operating voltages than would be permissible otherwise.

An air cleaner embodying the invention is illustrated in the accompanying drawings:

Figure 1 is a vertical central section through the cleaner, the sprocket chains being omitted together with some of the movable plate cells for the sake of clearness;

Figure 2 is a schematic view of the casing as it appears in Figure 1;

Figure 3 is a section along 3—3 of Figure 2;

Figures 4 and 5 are top plan and side elevational views of corresponding link portions of the conveyor chain;

Figure 6 is a section along 6—6 of Figure 5;

Figure 7 is a horizontal sectional view corresponding to one taken along line 7—7 of Figure 1 but showing the movable plates in elevation instead of section for the sake of clearness;

Figure 8 is a broken perspective view of a movable plate cell;

Figure 9 is a perspective view of a single precipitating plate shown during one stage of its manufacture;

Figure 10 is an elevational view of the securing edge of a single precipitating plate; and

Figure 11 is a section corresponding to one

taken along line 11-11 of Figure 7 with the bottom portion of the cleaner broken off.

The cleaner illustrated comprises: a housing preferably composed of sheet metal; an upright conveyor within the housing; an ionizer; and an electrical filter medium or precipitator of the plate type.

The housing or casing 1 conventionally includes: a bottom filter-cleaning area in the form of an oil bath 2; and an air or gas passageway extending horizontally through the casing above the bath from an upstream or front gas inlet 3 to a downstream or rear gas outlet 7. Between the front inlet 3 and rear outlet 7, the gas successively passes through the following areas: a front gas-cleaning area 4, a central conveyor area 5; and a rear gas-cleaning area 6. The front and rear limits of the central conveyor area 5 are defined by a pair of vertically-arranged front and rear conveyor guides, in the form of channel irons 8, mounted on each vertical side wall of the casing 1.

The upright conveyor, which occupies the central conveyor area 5 comprises: an upper and a lower shaft 9, rotatably mounted on suitable bearings (not shown) which are rigidly secured to opposite side walls of the housing 1; a pair of laterally-spaced suitably-notched sprockets 10 on each shaft 9; and a pair of vertically-arranged laterally-spaced sprocket chains 11, one on the upper and lower sprockets adjacent each side of the housing. The upstream and downstream, or front and rear, flights of each chain 11 respectively lie within the channels of the adjacent front and rear conveyor guides 8.

Each conveyor chain 11, as indicated in Figures 4-6, is composed of an endless series of alternate links and a similar series of intermediate links. Each alternate link includes a pair of laterally spaced straps 12, one of which is extended or flanged upwardly and then bent over the link to form a lug 12a. Each intermediate link similarly includes a pair of straps 13, but is made wider than the alternate link so that it can be telescopically fitted over and pivotally secured thereto. Each lug 12a of the alternate links carries a bent rigid handle-like strap 14 which cooperates with the lug to form a fixed eye 15.

The ionizer 16 may be of any suitable form. Since the ionizer illustrated is of the type described and illustrated in the Pound-Rush U. S. Patent #2,212,885, granted August 27, 1940, to which reference may be had for details of its structure and operation, it should suffice to say that it includes a grounded assembly of large electrodes 17 and an insulated assembly of fine wire electrodes 18. The ionizer 16 may be mounted in the central or conveyor area 5, but is preferably mounted on the outside of the housing 1 over the gas inlet opening 3.

The electrical filter medium or precipitator conventionally includes a plurality of vertically-arranged plates 19 (i. e., alternate plates 19a and intermediate plates 19b), which, in the gas cleaning area assume the interleaved spaced-plate relationship of an electrical air condenser and thereby form, along and across the medium, a plurality of narrow gas passages extending through the medium (see Figure 7). In accordance with the main feature of my invention, the alternate plates 19a are mounted on the conveyor for movement along fixed paths extending through the gas-cleaning and filter-cleaning areas while the intermediate plates 19b are

mounted on the housing to extend in a fixed position in each gas-cleaning area where they interleave the fixed paths of the alternate plates and thus interleave the alternate plates themselves as they pass through the the gas-cleaning areas.

In other words, all electrically positive plates are mounted as one assembly and all electrically negative plates as an independent assembly. This is advantageous since it enables all positive plates to be insulated from all negative plates simply by insulating one assembly as a unit from the other assembly and thereby not only avoids the multiplicity of insulating parts normally required to insulate the positive plates individually from the negative plates, but also correspondingly reduces the labor involved in manufacture and substantially minimizes the possibility of electrical break-downs resulting from insulation failures. Furthermore, since the insulation may be, and preferably is, applied to the stationary assembly, the difficulties attending the insulation of a movable assembly, are avoided.

While all precipitating plates 19 may be of any suitable form, straight flat-surfaced plates composed of sheet metal are shown and preferred. These plates should be made as thin as is possible consistent with the required mechanical strength but, with the thinner plates, there is a greater tendency for undesirable pin point ionization to occur between the adjacent edges of oppositely charged plates. This tendency may be reduced by providing the plates with rounded blunt edges but, with progressively thinner plates, this desideratum becomes progressively more difficult to achieve. In accordance with another feature of my invention the alternate and intermediate plates are each formed by folding a thin sheet of metal horizontally over itself along a vertical fold line to provide a two layer plate and by folding the marginal edges 20 of each layer inwardly between layers (see Fig. 9). This type of plate is mechanically strong when made of extremely thin sheet metal. In addition, its marginal edges are rounded or blunted sufficiently to reduce pin point ionization to insignificant proportions. Before passing, it may be noted that marginal sections of each plate adjacent opposite corners of its vertical (securing) edge, are cut off to provide securing recesses 21.

The alternate plates 19a may be mounted on the conveyor, and intermediate plates 19b on the housing, in any suitable manner. Preferably, the alternate and intermediate plates are assembled in groups to form alternate plate and intermediate plate cells respectively. Accordingly, each group of plates 19, either alternate or intermediate, are assembled in vertically-arranged, horizontally-spaced relation so that their opposite vertical edges form opposite vertical gas flow faces and their opposite (top and bottom) horizontal edges form opposite horizontal side faces. The term "cell assembly" thus designates an assembly of parallel plates of one electrical sign or the other. With this assembly, the plates define gas passages extending, in width, from one horizontal side face to the other, and, in length, from one vertical gas-flow face to the other. The plate assembly of each cell is rigidly secured, along one gas flow face only, to the cell framework, the assembly being open along its other gas flow face and along both of its side faces sufficiently to permit its being interleaved with and moved side-

wise relatively to an opposed plate assembly of opposite electrical sign.

The cell framework includes an upper and a lower cross bar 22, each of which is folded to the cross sectional outline of a right angle triangle, from the vertical base of which is struck a horizontal securing lip 23 for each plate. The corresponding lips 23 of the upper and lower cross bars 22 are dimensioned to fit into corresponding upper and lower securing recesses 21 of the corresponding plate. In constructing the cell, the plates are loosely assembled on the lips 23 of the cross bars 22 and then placed in a jig which rigidly holds them in the proper spaced relationship while they are spot welded to the lips.

It will be noted that the upper and lower cross bars on the alternate plate cells are arranged with their inclined sides facing outwardly away from each other as indicated in Figures 1 and 8. On the intermediate plate cells these cross bars are reversed so that their inclined sides face inwardly toward each other as indicated on Figure 1. This is done to facilitate the movement of the alternate plate cells around the sprockets.

Each alternate-plate cell structure, which is of one electrical sign, is completed by welding, or otherwise rigidly securing, to the upper and lower cross bars, at each end of the cell, a vertical end plate 24a. Each vertical end plate 24a carries a pair of upper and lower pins 25 which are placed in the fixed eyes 15 of the conveyor chains 11 to mount the cells upon the chains.

The pitch of the pins 25 is slightly greater than the pitch of adjacent eyes 15 on the vertical flights of the chains 11, so that the pins will press outwardly against the straps 14 forming the eyes. At the turns of the chain the eyes 15 move angularly about the sprockets along a path of greater radius than the radius of the pitch line of the chain. As a result, the pitch of the eyes 15 is increased relatively to the pitch of the pins causing the eyes to move outwardly relatively to the pins.

The space between each end of the alternate plate cells and the adjacent conveyor guide 8 is sealed by an angle iron 26 adjustably secured to the conveyor guide 7. This angle iron seal 26 is adjustably mounted, for movement toward and away from the cells, so that when the cells are properly positioned, the seal may be moved to and fixed in a position where it rubs against the end plates 24a. In this way the seals 26 also cooperate to guide and maintain the cells in proper position during their travel through the gas cleaning areas.

The intermediate-plate cell structure which is of the opposite electrical sign, is completed by welding, or otherwise rigidly securing, to the upper and lower cross bars at each end of the cell, a vertical end plate 24b. These cells are mounted on, but insulated from, the housing by bolting the end plates 24b to vertical bars 27, the upper and lower ends of which are secured to insulators 28 which are rigidly mounted on the housing. The bolting connection between the end plates 24b and the upright bars 27 is horizontally adjustable to a slight degree to permit horizontal adjustment in the position of the intermediate cells. It will be understood, of course, that one group of intermediate-plate cells is thus mounted in the upstream pass or front gas-cleaning area 4 while another set of such cells is similarly mounted in the downstream pass or rear gas-cleaning area 6. Natur-

ally, if the ionizer 16 were placed in the central area 5, the front intermediate-plate cells should be omitted but the arrangement illustrated is much to be preferred.

In operation an ionizing voltage, of say between 11,000 and 13,000 volts, may be applied between the large and small electrodes while a precipitating voltage, of say between 5,000 and 7,000 volts, may be applied between the positively charged intermediate plates 19b and the negatively charged or grounded alternate plates 19a. The air or gas is drawn or forced through the housing by a suitable blower (not shown) while the conveyor is moved in the direction indicated, by a suitably controlled drive mechanism (not shown), in accordance with usual practice of about $\frac{3}{4}$ " every twelve minutes. As the alternate plates pass upwardly from the oil bath, they interleave the stationary intermediate plates in one gas-cleaning area and remain interleaved until they pass upwardly out of that area. After they cross over the top of the housing, they move downwardly through the other gas-cleaning area in which the interleaving action is repeated until they clear this area and reenter the oil bath.

The ionizer 16 electrically charges the dust, smoke, fume and other air-borne particles passing through it while the electrostatic field set up between the interleaved precipitator plates in both gas-cleaning areas tends to effect the precipitation of the bulk of such particles on the plates in the front area and of the remaining particles on the plates in the rear area. As a result, the removal of the particles from the air stream is efficiently accomplished. When the plates pass through the oil bath in the plate-cleaning area, the precipitated particles are subjected to the washing action of the oil which is fairly effective in removing them from the plates.

The reference numeral 29 and the reference numerals 30 and 31 respectively denote mechanism for cleaning the stationary and movable plate assemblies, the details of which are fully disclosed in my co-pending application Serial Number 489,849.

Having described my invention, I claim:

1. In an electrical gas cleaner: a series of spaced alternate precipitating plates of one electrical sign; means for moving the plates bodily along a path having gas-cleaning and filter-cleaning areas; a series of spaced intermediate precipitating plates of opposite electrical sign mounted in the gas-cleaning area to interleave the alternate plates as they pass bodily through said area, said interleaved plates cooperating to form gas passages therebetween; and means for establishing an electrostatic precipitating field in the gas passages between plates in the gas-cleaning area.

2. In an electrical gas cleaner: a movable assembly of spaced alternate precipitating plates of one electrical sign arranged to travel bodily along a path having gas-cleaning and filter-cleaning areas; a stationary assembly of spaced intermediate precipitating plates of opposite electrical sign mounted in the gas-cleaning area to interleave the alternate plates as they pass bodily through said area, the interleaved alternate and intermediate plates cooperating in the gas-cleaning area to form gas passages therebetween; and means for establishing an electrical precipitating field in the gas passages be-

tween the interleaved plates in the gas-cleaning area.

3. The arrangement of claim 2 wherein: the movable and stationary assemblies are electrically connected-to-ground and insulated-from-ground respectively.

4. The arrangement of claim 2 wherein each assembly is composed of one or more cells, each cell including: a framework; a plate assembly, composed of a number of spaced plates presenting opposite side edges and opposite gas flow edges respectively the opposite side edges forming opposite side faces and the opposite gas-flow edges forming opposite gas flow faces; and means rigidly securing the plate assembly, along one of its gas flow faces only, to the framework, the plate assembly as a whole projecting from the framework and being open along its other gas flow face and its side faces sufficiently to permit its being interleaved with, and moved sidewise relatively to, an opposed plate assembly of opposite electrical sign.

5. In an electrical gas cleaner: a series of alternate and of intermediate precipitating plate cells, each cell being composed of a framework and an assembly of spaced precipitating plates rigidly secured to the framework and projecting outwardly therefrom; means for moving a succession of the alternate cells, which are of one electrical sign, along a path having gas-cleaning and filter-cleaning areas, the cell framework moving along one side of the gas-cleaning area with the alternate plates moving edgewise through said area; and means stationarily mounting the framework of the intermediate cells, which are of the opposite electrical sign, along the other side of the gas-cleaning area with the intermediate plates projecting into said area in position to interleave the alternate plates as they pass through said area.

6. An electrical gas-cleaning precipitating-plate cell of one electrical sign comprising: a framework; a plate assembly, composed of a number of spaced plates presenting opposite side edges and opposite gas-flow edges respectively, the opposite side edges forming opposite side faces and the opposite gas-flow edges forming opposite gas-flow faces; and means rigidly securing the plate assembly, along one of its gas-flow faces only, to the framework, the assembly being open along its other gas-flow face and its side faces sufficiently to permit its being interleaved with, and moved sidewise relatively to, the plate assembly of an opposed cell of opposite electrical sign.

7. The cell of claim 6 wherein the framework includes: a cross bar extending crosswise relatively to the plate edges of the adjacent gas-flow face; and a series of rigid securing lips, one for each plate, extending from the bar to the plates and rigidly connected to both.

8. An electrical gas-cleaning precipitating-plate cell of one electrical sign comprising: a pair of horizontally-arranged vertically-spaced cross bars; a number of vertically-arranged horizontally-spaced plates presenting horizontal side edges and vertical gas-flow edges respectively, the opposite side edges forming opposite horizontal side faces and the opposite gas-flow edges forming opposite vertical gas-flow faces, the vertical edge of each plate, along one gas-flow face, being formed with an upper and a lower securing recess; a series of lips, one extending from within each upper and each lower securing recess respectively to each upper and each lower

cross bar; and means rigidly securing each lip to each plate and bar.

9. In an electrical gas cleaner; an upright endless conveyor having straight vertical sections and curved end sections; a laterally-spaced pair of upper and of lower straps secured to the conveyor, each strap forming a fixed elongated eye along the outer face of the conveyor, the center-to-center pitch between adjacent upper and lower eyes being greater at the curved sections of the conveyor than it is as the straight sections thereof; an electrical gas-cleaning precipitating-plate cell having a vertical end plate at each of its opposite ends; and a pair of upper and lower pins secured to each end plate in position to extend into corresponding upper and lower eyes of the conveyor to mount the cell on the conveyor, the pitch of the eyes being not larger along the straight sections of the conveyor, but larger along the curved sections thereof, than the pitch of the pins.

10. In an electrical gas cleaner: an upright housing having a horizontal gas passage extending from a gas inlet successively through an upstream gas-cleaning area, a central conveyor area and a downstream gas-cleaning area to a gas outlet; a pair of vertically-arranged conveyor guides mounted on each side of the housing respectively adjacent the upstream and downstream limits of the conveyor area; an endless upright conveyor, having straight-vertical and curved-end sections, mounted in the conveyor area with its straight-vertical sections extending into said conveyor guides; a succession of precipitating cells, each cell having a vertical end plate at each end, mounted on the conveyor; a plate vertically-arranged between each conveyor guide and the space occupied by the adjacent precipitating cells; and means adjustably securing each plate, along one vertical margin, to the adjacent guide for horizontal adjustment toward and from said cell space, the other vertical margin of each plate frictionally engaging the end plates of the adjacent cells.

11. In an electrical gas cleaner having a frame and means on the frame prescribing a path of movement extending through a gas cleaning area: a movable plate assembly composed of a series of spaced parallel plates mounted upon the frame for movement along said path with its plates extending into said path; a relatively stationary plate assembly composed of a similar series of spaced parallel plates mounted on the frame with its plates extending into said path at the gas cleaning area; the plates of one assembly being insulated from the other and of both assemblies being so arranged in said path that they interleave each other and form gas passages therebetween during movement of the movable assembly through the gas cleaning area; means for so moving the movable assembly; and means for establishing an electrostatic precipitating field in the gas passages between plates in the gas cleaning area.

12. A cell-like assembly of precipitating plates for electrical gas cleaners comprising: a framework; and an assembly of plate elements of one electrical sign secured to said framework and projecting outwardly therefrom in spaced parallel relationship, the spaces formed by the projecting portions of the plate elements being open and unobstructed internally between the plates and peripherally along the edges of the plates sufficiently to permit a similar assembly of parallel elements to be unitarily moved into

and removed from interleaving relationship in which successive elements of each assembly extend into successive spaces between elements of the other assembly.

13. A cell-like assembly of precipitating plates for electrical gas cleaners comprising: a framework; and an assembly of precipitating plates of one electrical sign secured to said framework and projecting outwardly therefrom in spaced parallel relationship; the spaces formed by the projecting portions of the plate elements being open and unobstructed internally between plates

5 and peripherally along the edges of the plates sufficiently to enable a similar assembly of spaced parallel precipitating plates of opposite electrical sign to be unitarily moved into and removed from interleaving relationship in which successive plates of each assembly extend into successive spaces between plates of the other assembly, the plates of one assembly cooperating with the plates of the opposite assembly in interleaving
10 relationship to form gas passages therebetween.

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