April 1, 1952 L. H. CARLSON 2,591,404

ELECTROSTATIC PRECIPITATOR

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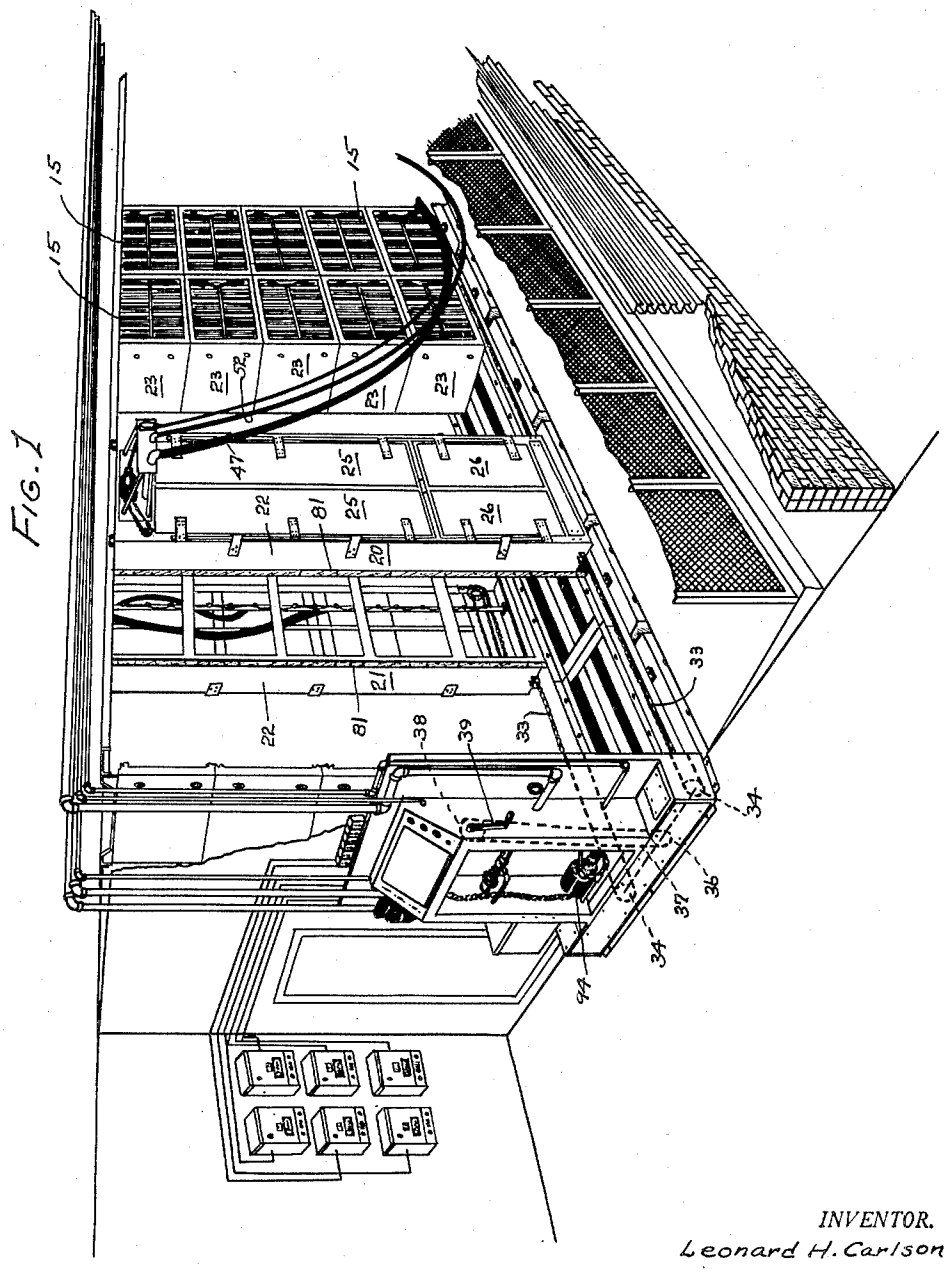
FIG. 1



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ELECTROSTATIC PRECIPITATOR

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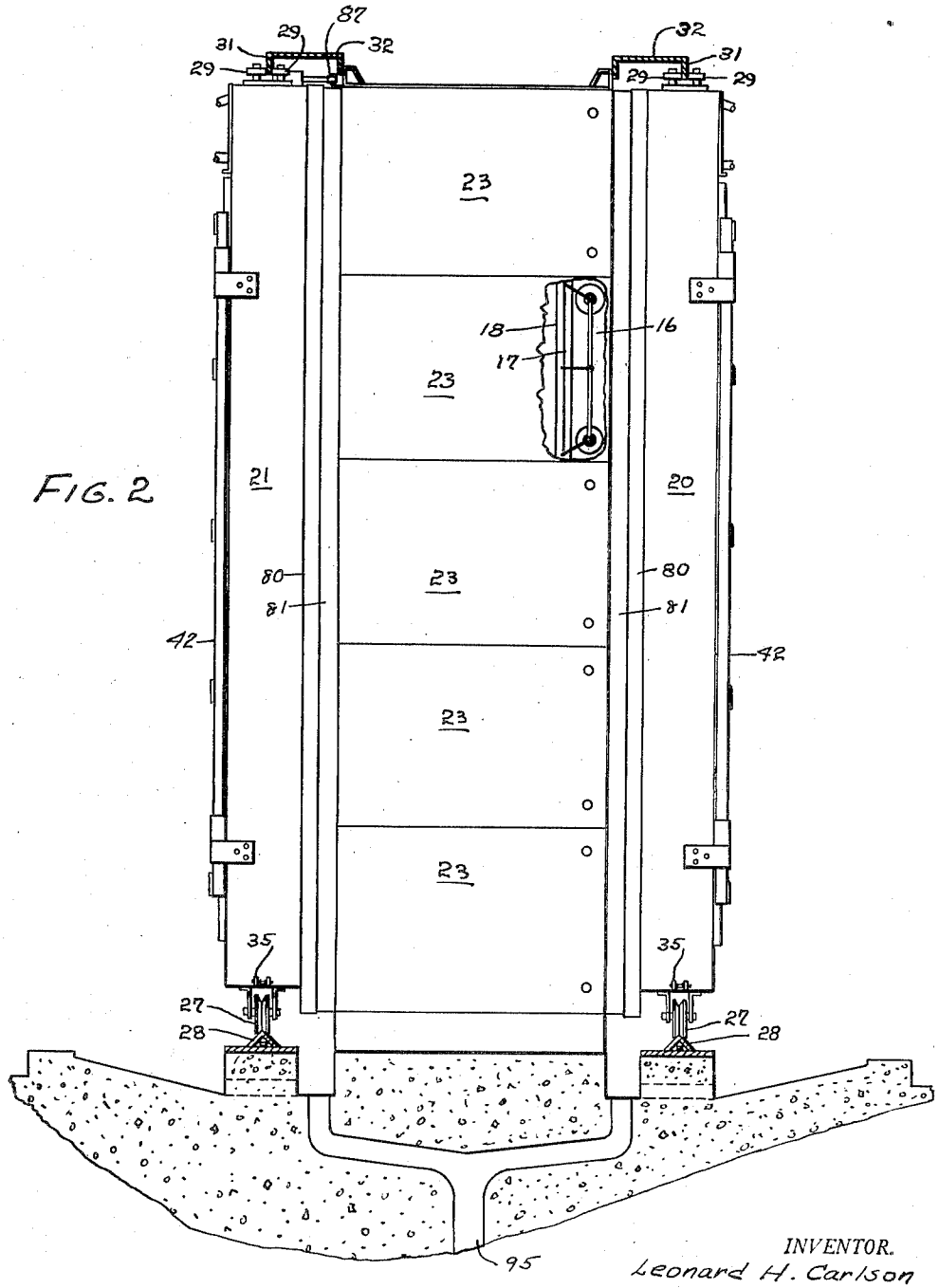
FIG. 2



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ELECTROSTATIC PRECIPITATOR

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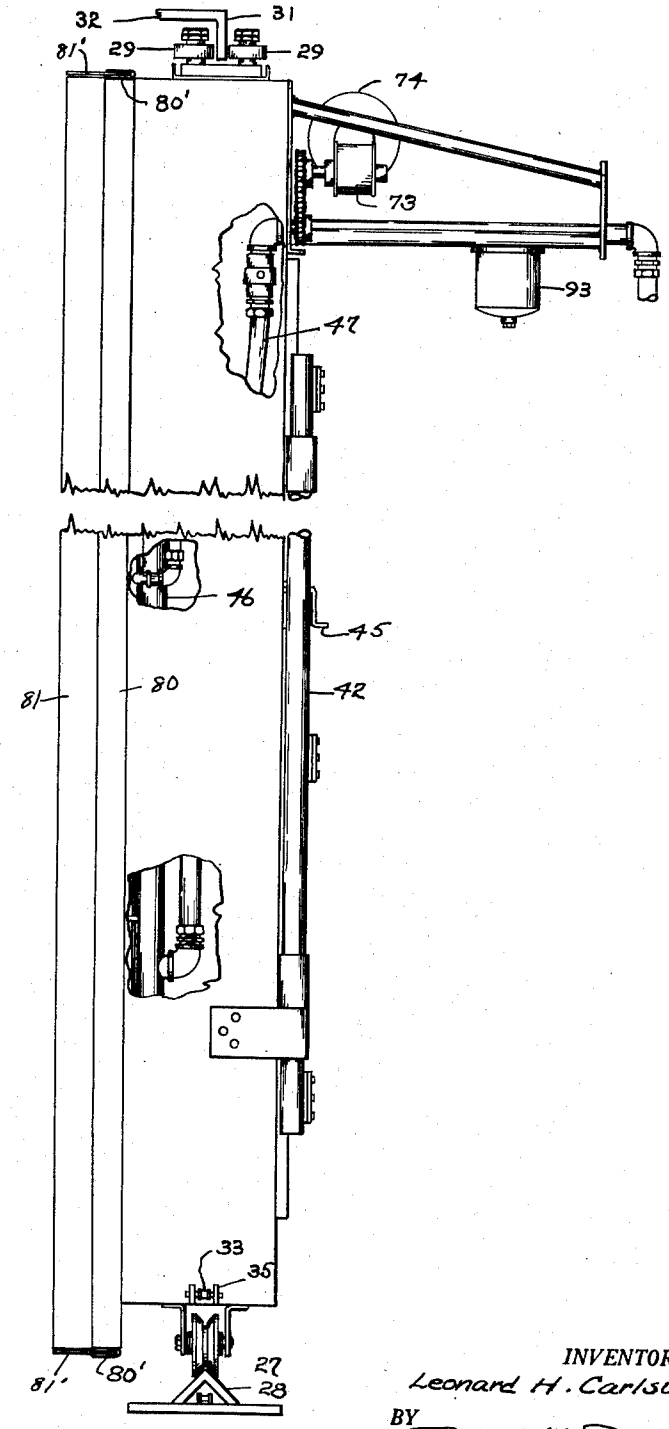

FIG. 3

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ELECTROSTATIC PRECIPITATOR

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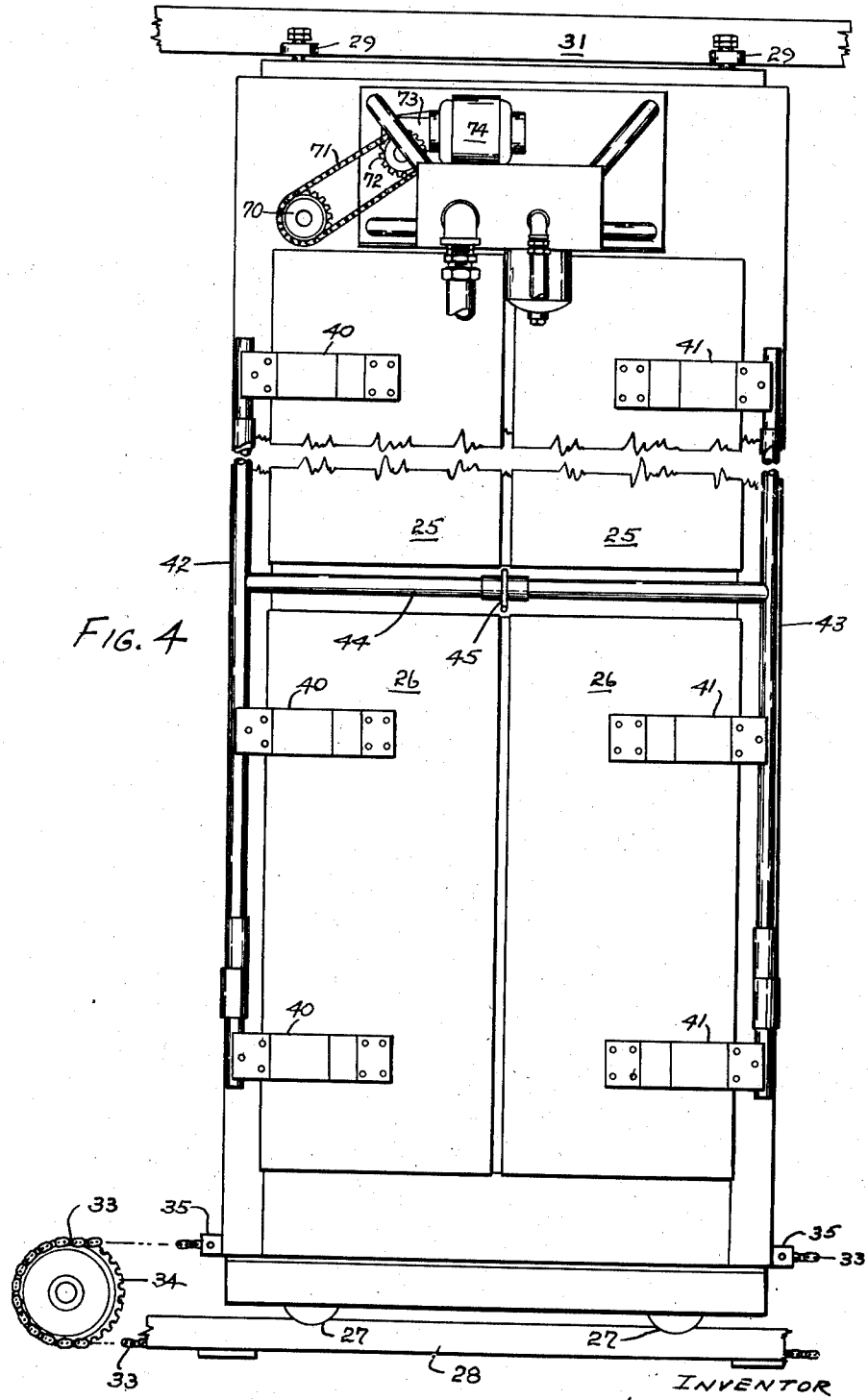

FIG. 4

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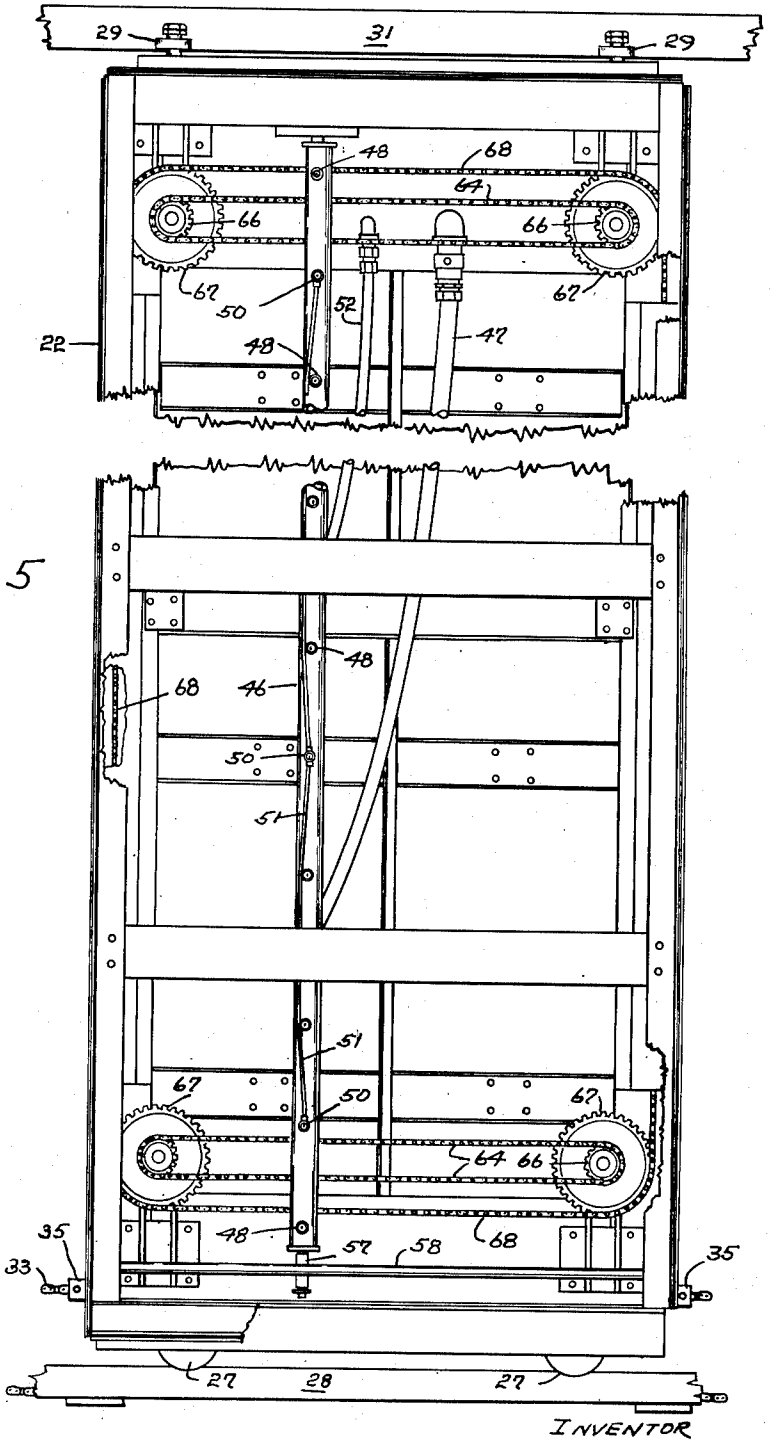

FIG. 5

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ELECTROSTATIC PRECIPITATOR

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FIG. 6

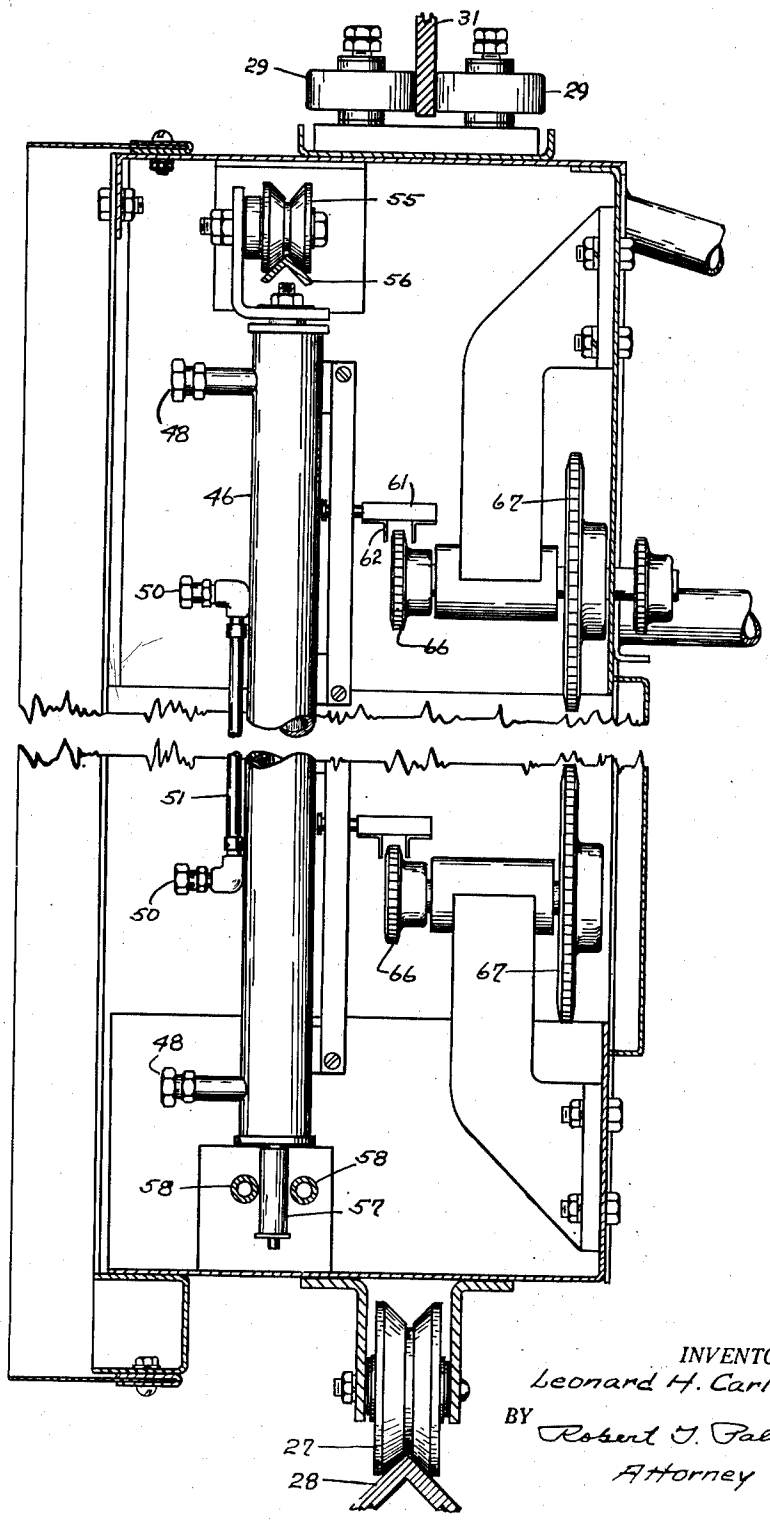

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FIG. 8

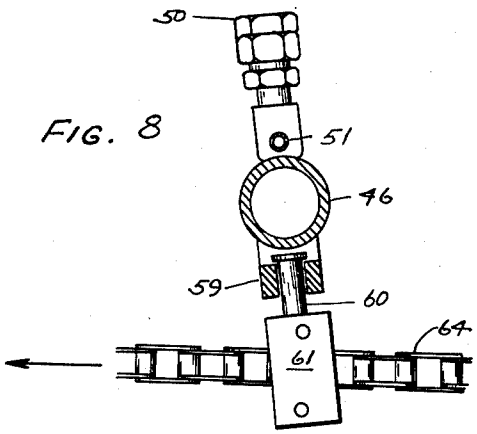

FIG. 9

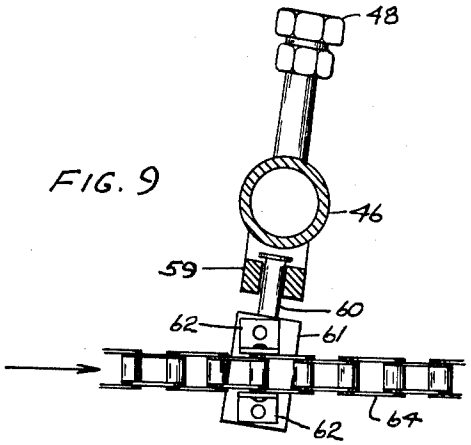

FIG. 7

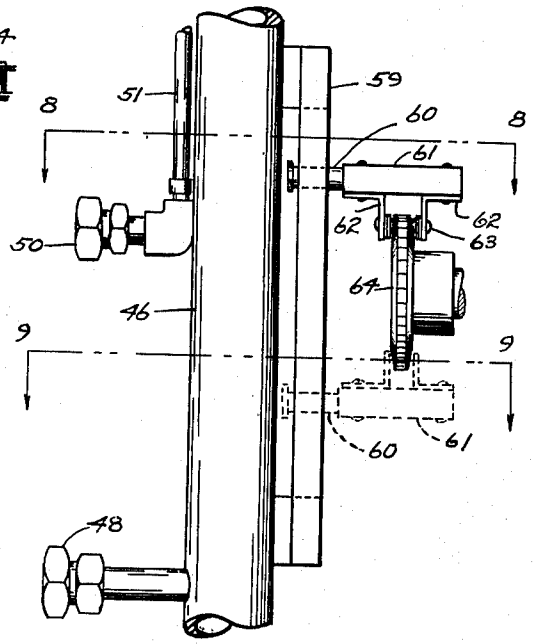

FIG. 10

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FIG. 11

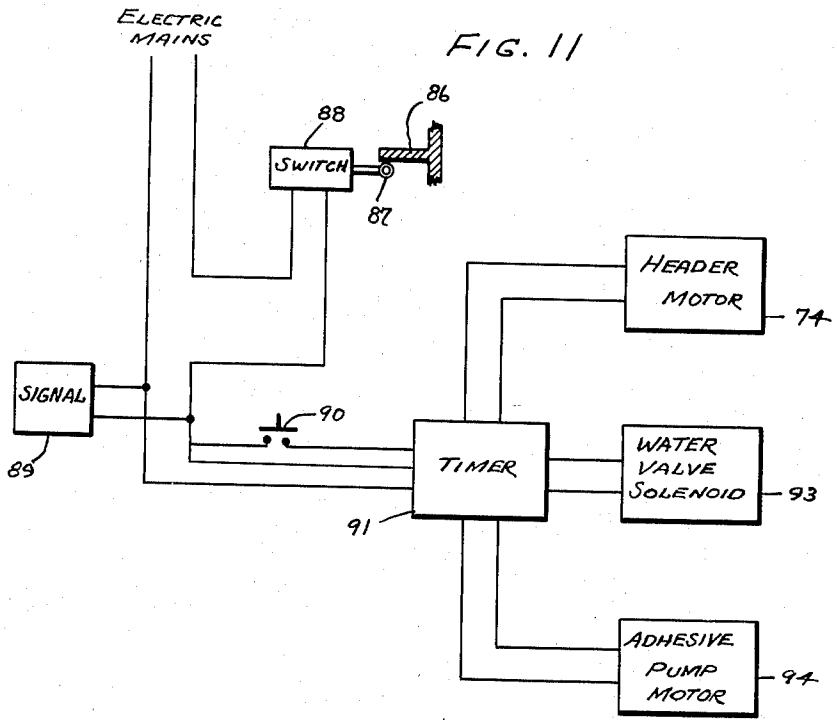
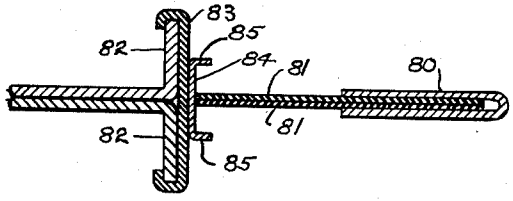


FIG. 12



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Patented Apr. 1, 1952

2,591,404

UNITED STATES PATENT OFFICE

2,591,404

ELECTROSTATIC PRECIPITATOR

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Application November 22, 1950, Serial No. 197,066

11 Claims. (Cl. 183—7)

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This invention relates to electrostatic precipitators for the removal of small foreign particles such as dust, from gases such as air, and relates more particularly to apparatus for cleaning the electrodes of such precipitators.

The ionizer and collector electrodes of an electrostatic precipitator become loaded with collected particles after a period of operation, and it is necessary to clean them, usually by washing them with water. The large precipitators used in industrial installations, usually consist of many vertical and horizontal rows of precipitator units connected in a common casing. In order to avoid taking such a precipitator out of service for periodic cleaning, it is proposed that only one vertical row at a time of precipitator units in such a precipitator, be taken out of service and its electrodes cleaned, while the remainder of the precipitator units remain in service.

In one embodiment of this invention, an electrostatic precipitator has a number of similar precipitator units stacked in vertical and horizontal rows, with electrode cleaning means comprising an upstream box extending vertically from the top to the bottom of the precipitator, and having a width equal to that of a precipitator unit, and a similar downstream box aligned with the upstream box. Each box contains a vertically extending spray header having spaced water and adhesive spray nozzles, the headers being movable horizontally within the boxes by chain and sprocket mechanisms.

Since in order to conserve space, the boxes will be aligned with one vertical row of units, where no cleaning is going on, they are equipped with doors which when open, permit air to flow through the boxes.

The upstream box acts as a damper closing the inlets of the vertical row of units with which it is aligned when its doors are closed, and its spray nozzles are directed to spray liquid downstream onto the upstream sides of the ionizer and collector electrodes.

The downstream box acts as a damper closing the outlets of the vertical row of units with which it is aligned when its doors are closed, and its spray nozzles are directed to spray liquid upstream between the collector plates at the downstream sides thereof.

The two boxes are movable with their doors closed, horizontally as a unit by chains driven by a crank rotated by an operator. An indicator pointer will show the approximate location of the boxes and when they are in alignment with

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a vertical row of precipitator units to be cleaned, a light flashes. The operator will then open a switch connecting the power supply to the row of units to be cleaned, and will then press a button which starts a timer setting up an automatic sequence of operations including in order: the start of the header moving motor, the opening of the water supply valve, the closing, after about five minutes, of the water supply valve, the provision of a drain period of about twenty minutes, the opening of the adhesive supply valve, the spraying of the adhesive for about thirty seconds completing the wash cycle. The timer will then be in its original position and automatically stops timing. The next row of cells may then be washed in a similar manner.

A feature of this invention is that the spray header is moved from a starting point across the width of a precipitator unit and then back again several times during each spray period, and is rotated about its axis in an arc of a circle in one direction at the start of its movement across the width of a precipitator unit, and is rotated about its axis in an arc of a circle in the opposite direction at the start of its movement back to its starting point, these rotations of the header causing its spray nozzles to spray liquid at an angle to the planes of the collector plates so as to spray liquid angularly against one side of each plate in the horizontal travel of the header in one direction, and causing its spray nozzles to spray liquid at an opposite angle to the planes of the plates so as to spray liquid angularly against the other side of each plate in its horizontal travel in the opposite direction. This results not only in more effective spraying of liquid upon the plate surfaces than in the prior spraying arrangements in which the nozzles were fixed and directed to spray into the centers of the spaces between adjacent plates, but results also in the spraying of liquid upon the downstream sides of the tubular ionizer electrodes which previously has not been accomplished.

An object of this invention is to provide improved apparatus for cleaning electrodes of electrostatic precipitators.

Another object of this invention is to provide improved apparatus for washing of the electrodes of electrostatic precipitators.

Another object of this invention is to provide improved apparatus for the spraying of adhesive upon the collector electrodes of electrostatic precipitators.

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

Fig. 1 is a perspective view of a portion of an electrostatic precipitator embodying this invention;

Fig. 2 is an end elevation showing a vertically extending row of precipitator units, and the upstream and downstream washer boxes aligned with the units for washing same, a portion of a side of one of the units being removed for illustrating the ionizer electrodes.

Fig. 3 is an end elevation with portions removed, of one of the washer boxes of the precipitator;

Fig. 4 is a side elevation looking at the door containing side of the box of Fig. 3;

Fig. 5 is a side elevation looking at the open side of the box of Fig. 3, the side opposite that shown by Fig. 4;

Fig. 6 is an enlarged, end elevation of the box with one of its end walls removed for illustrating the components within the box;

Fig. 7 is an enlarged partial end of the header within the box, and of the mechanism for rotating the header;

Fig. 8 is a sectional view along the lines 8—8 of Fig. 7;

Fig. 9 is a sectional view along the lines 9—9 of Fig. 7;

Fig. 10 is a partial sectional view showing the seal at the inner edges of the doors of the box when the doors are closed;

Fig. 11 is a circuit schematic of the control system used, and

Fig. 12 is an enlarged view, in section, illustrating a gas seal between a box and a precipitator unit with which it is aligned.

The electrostatic precipitator consists of a plurality of collecter cells **15** of the type illustrated in detail in the Earl L. Richardson application, Serial No. 757,785, filed June 28, 1947 (now Patent 2,535,696, dated December 26, 1950), arranged in vertical and horizontal rows. An ionizer assembly consisting of the frame **16** containing the insulatedly supported ionizer wires **17** and the grounded, tubular electrodes **18** is supported at the upstream side of each cell. For the purpose of description, a collector cell and its associated ionizer assembly is referred to as a precipitator unit.

As is known, it is the practice to spray the collector plates of such cells with an adhesive for aiding the plates to retain the dust electrostatically deposited thereon, the plates being periodically washed with water for removing the deposited matter and then resprayed with adhesive.

The invention provides that each vertical row of units be separated from an adjacent vertical row by casing walls so that the vertical rows can be washed in succession by an upstream washer box **20** and a similar downstream washer box **21**. The boxes are movable simultaneously so as to line-up with the upstream and downstream sides of a vertical row of cells, at which time their vertical end walls **22** have the vertical resilient seals **81** thereon which contact the vertical end walls **23** at the ends of each row of units, and have the horizontal resilient seals **81'** at the ends of the seals **81**, forming therewith air seals around the air inlets and outlets of a vertical row of units. The boxes have doors **25** and **26** which when closed, seal the upstream and downstream sides of the vertical row of units with which they are aligned, for preventing the passage of air therethrough, and the escape of spray droplets

therefrom, and when opened, permit free passage of air through the units with which they are aligned.

The end walls **23** of the units contact and together form vertical casing walls at the opposite sides of each vertical row of units. The tops and bottoms of the units are open for the drainage of liquid, and their fronts and backs are open and are inlets and outlets respectively, for the passage of the air being cleaned.

The boxes **20** and **21** are supported at their lower ends by the V-grooved rollers **27** on the inverted angles **28** acting as rails at the base of the precipitator. They have the rollers **29** on their upper ends which contact the opposite sides of the vertical guide rail **31** which is one wall of the channel **32**.

The chains **33** on the sprockets **34** at one end of the precipitator, and on similar sprockets which are not illustrated, at the other end of the precipitator, are connected at **35** to the boxes, and through the sprockets **36** and **37** and the chain **38** to the crankarm **39** so that when the latter is rotated by an operator, the boxes are movable horizontally on the rollers **27** so as to be positioned in alignment with any of the vertical rows of units.

The doors **25** and **26** are on the upstream side of the upstream box **20**, and on the downstream side of the downstream box **21**. Two pairs of doors are provided on each box because due to the extreme height thereof, one set of sheet metal doors would be difficult to maintain in alignment. The doors are connected to the leaf springs **40** and **41** which are attached to the vertically extending rods **42** and **43** respectively, which are interconnected by the horizontally extending rods **44** when the doors are closed. The catch **45** at the inner ends of the rods **44** secures them together when the doors are closed.

Each box contains a spray header **46** which is connected through the hose **47** and piping connections **48** to a solenoid operated valve in a water supply pipe. The header has the spaced water spray nozzles **49** thereon connecting with the interior thereof, and has thereon the spaced adhesive spray nozzles **50** which are connected by the tubing **51** and the hose **52** to an adhesive pump.

The upper end of the header is attached by the angle **54** to the V-grooved roller **55** which rides on the horizontally extending rail **56**. The lower end of the header has the vertically extending roller **57** thereon which is between and contacts the two horizontal guide rails **58**.

Each header has attached thereto adjacent its upper and lower ends, the spaced bars **59** in which are keyed the pins **60**. Each pin **60** is attached to the block **61** which in turn, is attached by the angles **62** and the pin **63** to the chain **64**. The axis of the pin extends horizontally and is coincident with the longitudinal axis of the block **61**. The angles **62** however, are so arranged that while their common axis is perpendicular to the chain, it is at an angle of about 10° to the longitudinal axis of the block **61** and the axis of the pin **60**.

Each chain **64** extends over the small sprockets **66** which are mounted on the shafts of the large sprockets **67**. The single chain **68** is meshed with all of the sprockets **67** for simultaneous rotation thereof. The shaft of one of the sprockets **67** has a sprocket **70** attached thereto, external the box and which is meshed with the chain **71** which in turn, is meshed with the

sprocket 72 connected by the gear box 73 to the electric motor 74.

Rotation of the sprocket 72 by the motor 74 causes the chain 71 to rotate the sprocket 70, and through the sprockets 67 and the chain 68, the sprockets 66 to be rotated. The rotation of the latter sprockets causes rotation of the chain 64, the upper horizontal passes and the lower horizontal passes of which move in opposite direction.

The blocks 61 which are attached to the chains 64 ride around the end sprockets 66. Due to the angular positions of the pins 60, the headers 46 are rotated 10° to one side of a plane parallel the planes of the collector plates of the units 15, on the upper passes of the chains as illustrated by Fig. 8 of the drawing, and are rotated 10° to the other side of such a plane on the lower passes of the chain, as illustrated by Fig. 9 of the drawing. This causes liquid to be sprayed from the nozzles on the headers angularly first against the collector plates on one side thereof, and then angularly against the plates on the other side thereof, ensuring more effective washing than when the centers of the sprays are directed midway between the plates by fixed spray nozzles as has been the practice in the past. The sprays from the upstream spray nozzles also strike the entire downstream surface of each ionizer tube. This has not been accomplished in prior washers.

As illustrated by Fig. 12, the downstream ends of the vertical walls 22 of the upstream box, and the upstream ends of the vertical walls 22 of the downstream box, have attached thereto the metal clips 80 in which are clamped the seals 81 of resilient material such as rubber. The upstream and downstream ends of the vertical walls 23 of the precipitator units have the outwardly turned portions 82 which are held in the channel clamp 83. The clamp 83 has the channel 84 attached thereto and which has the vertical sides 85. When the boxes are in alignment with a vertical row of precipitator units, the seals 81 on the opposite sides of the boxes contact the channels 84 between their sides 85. When moving from alignment with one vertical row of units into alignment with another row, the seals 81 slip over the sides 85 of the channels 84. Similar seals 81′ in the clips 80′ extend horizontally from the boxes at the upper and lower ends of the seals 80.

Fig. 2 illustrates the drain passages 95 for the water draining from the precipitator units, the water draining to a sewer since there is no recirculation.

In operation, when it is decided that a vertical row of units should be cleaned, an operator rotates the crank 39 to align the boxes 20 and 21 with the selected row, at which time the cam 86 on one of the channels 32 (Figs. 2 and 11) strikes the switch arm 87 and closes the switch 88 causing the signal 89 which may be a light, to be energized, indicating exact alignment has been accomplished.

The operator then closes the doors of the boxes and deenergizes the high voltage supply to the precipitator electrodes of the row of units to be washed. He then presses the control button 90 (Fig. 11) which energizes the timer 91 which after about thirty seconds starts timing and first energizes the header moving motor 74. The solenoid 93 which opens the water supply valve is then energized and holds the valve open for about five minutes. During this five minute period, the motor 74 moves the header back and forth so that water is sprayed from the water

nozzles 48 upon the precipitator electrodes. At the end of the five minute period, the timer closes the valve. After a two minute draining period, the timer starts the adhesive pump motor which runs for thirty seconds and then is stopped by the timer. The timer is then in its original position and stops timing, stopping the header motor 74 at this time.

The operator then re-applies high voltage to the electrodes of the row of precipitator units, and if no more units are to be cleaned, opens the doors of the boxes. If an additional row of units is to be cleaned, the doors of the boxes are not opened and the boxes are moved in alignment with the next row of units to be cleaned. The high voltage supply to the electrodes is disconnected and the button 90 is again depressed, repeating the sequence of operations controlled by the timer described in the foregoing.

Each vertical row of units can be said to have a separate casing comprising the end walls 23, the top of the common casing for all of the units, and the concrete foundation shown by Fig. 2, forming a common base for all of the units. Thus each vertical row can be cleaned without affecting the operation of the other rows.

While one embodiment of the invention has been described for the purpose of illustration, it should be understood that the invention is not limited to the exact apparatus and arrangement of apparatus illustrated, since modifications thereof may be suggested by those skilled in the art without departure from the essence of the invention.

What I claim as my invention, is:

1. An electrostatic precipitator comprising a first casing having a gas inlet and a gas outlet, a precipitator unit in said casing, a washer box aligned with said casing at said inlet and having gas sealing means contacting said casing around said inlet, a vertically extending liquid header in said box, spray nozzles on said header directed to spray liquid downstream with respect to gas flow on said unit, means for moving said header horizontally across said inlet, a second casing having a gas inlet and a gas outlet, in horizontal alignment with said first casing, a precipitator unit in said second casing, and means for moving said box from alignment with said first casing into alignment with said second casing.

2. An electrostatic precipitator as claimed in claim 1 in which the box has a gas inlet and a gas outlet, and has doors for opening and closing said last mentioned inlet.

3. An electrostatic precipitator comprising a first casing having a gas inlet and a gas outlet, a precipitator unit in said casing, a washer box aligned with said casing at said outlet, and having sealing means contacting said casing around said outlet, a vertically extending liquid header in said box, spray nozzles on said header directed to spray liquid upstream with respect to gas flow on said unit, means for moving said header horizontally across said outlet, a second casing having a gas inlet and a gas outlet, in horizontal alignment with said first casing, a precipitator unit in said second casing, and means for moving said box from alignment with said first casing into alignment with said second casing.

4. An electrostatic precipitator as claimed in claim 3 in which the box has a gas inlet and a gas outlet, and has doors for opening and closing said last mentioned outlet.

5. An electrostatic precipitator comprising a first casing having a gas inlet and a gas outlet,

a precipitator unit in said casing, a first washer box aligned with said casing at said inlet and having gas sealing means contacting said casing around said inlet, a liquid header in said box, spray nozzles on said header for spraying liquid downstream with respect to gas flow on said unit, means for moving said header across said inlet, a second washer box aligned with said casing at said outlet and having sealing means contacting said casing around said outlet, a second liquid header in said second box, spray nozzles on said second header for spraying liquid upstream on said unit, means for moving said second header across said outlet, a second casing having a gas inlet and outlet, a precipitator unit in said second casing, and means for simultaneously moving said boxes from alignment with said first casing into alignment with said second casing.

6. An electrostatic precipitator as claimed in claim 5 in which the first box has a gas inlet and outlet with doors for opening and closing its gas inlet, and the second box has a gas inlet and outlet with doors for opening and closing its gas outlet.

7. An electrostatic precipitator as claimed in claim 1 in which the means for moving the header, moves it in a first pass from a starting point across the inlet, and in a second pass back to the starting point, and means is provided for rotating the header about its axis in an arc of a circle to one side of a mid-position on the start of its first pass, and for rotating the header about its axis in an arc of a circle to the other side of the mid-position on the start of the second pass.

8. An electrostatic precipitator as claimed in claim 7 in which the box has a gas inlet and a gas outlet, and has doors for opening and closing said last mentioned inlet.

9. An electrostatic precipitator as claimed in claim 3 in which the means for moving the header, moves it in a first pass from a starting point across the outlet, and in a second pass back to the starting point, and means is provided for rotating the header about its axis in an arc of a circle to one side of a mid-position on the start of the first pass, and for rotating the header about its axis in an arc of a circle to the other side of the mid-position on the start of the second pass.

10. An electrostatic precipitator as claimed in claim 9 in which the box has a gas inlet and a gas outlet, and has doors for opening and closing said last mentioned outlet.

11. An electrostatic precipitator as claimed in claim 5 in which the means for moving each header moves it in a first pass from a starting point at one side of the box in which it is arranged, across the box in which it is arranged, to the other side thereof, and in a second pass back to the starting point, and means is provided for rotating each header about its axis in an arc of a circle to one side of a mid-position on the start of its first pass, and in an arc of a circle to the other side of its mid-position on the start of its second pass.

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