United States Patent [19]

Duval

[11] **3,740,926**

[45] **June 26, 1973**

[54] **PORTABLE ELECTRONIC PRECIPITATOR**

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[73] Assignee: **Texas Electronic Precipitator Co.,** Garland, Tex.

[22] Filed: **Dec. 15, 1970**

[21] Appl. No.: **98,429**

[52] **U.S. Cl.**..... **55/104,** 55/126, 55/129, 55/138, 55/139, 55/143, 55/151, 55/481

[51] **Int. Cl.**..... **B03c 3/66**

[58] **Field of Search**..... 55/104, 105, 106, 55/139, 136, 137, 138, 140, 141, 143, 145, 270, 274, 481

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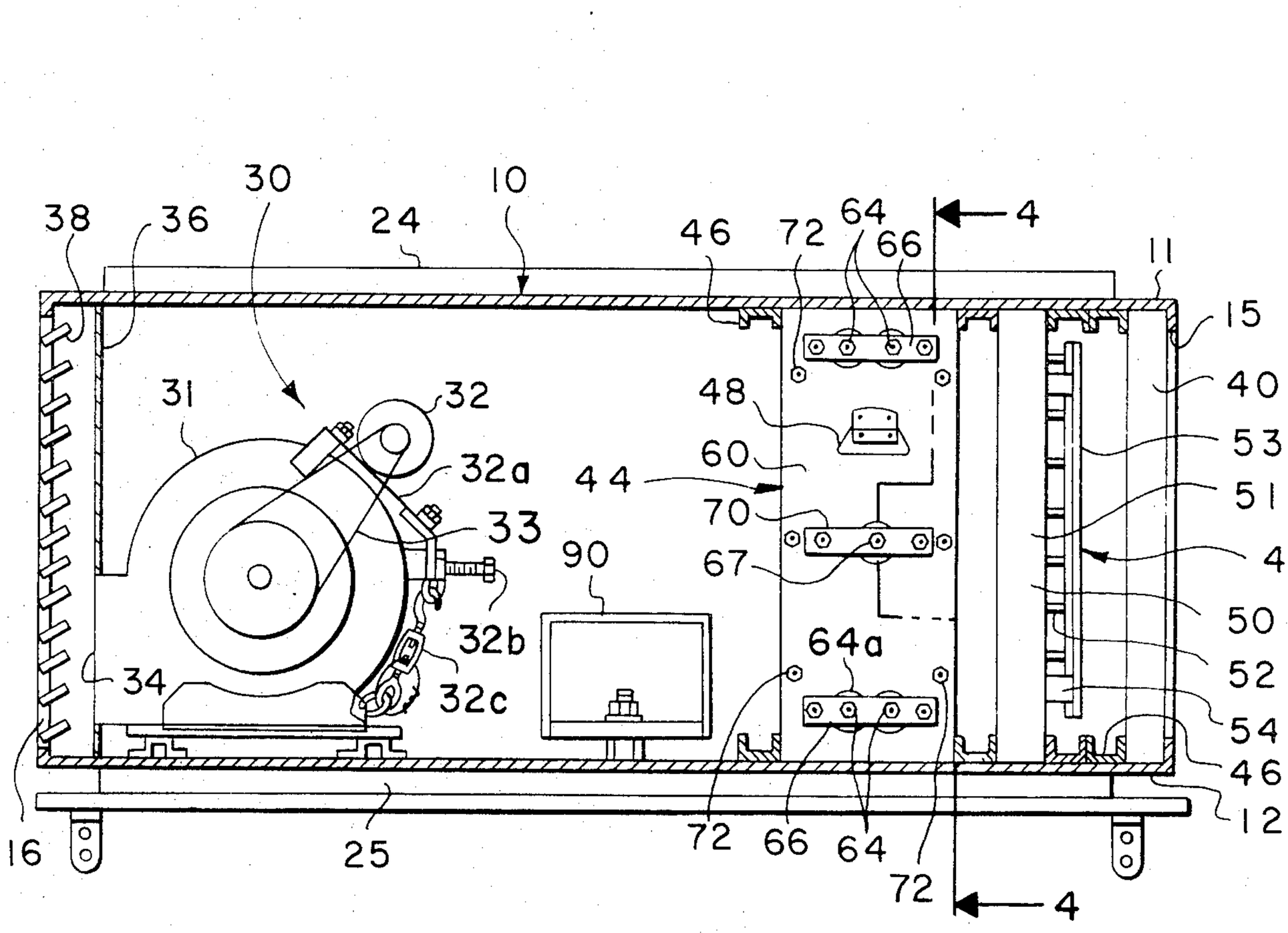
Primary Examiner—Dennis E. Talbert, Jr.
Attorney—Giles C. Clegg, Jr., Jack A. Kanz and Richard E. Bee

[57] **ABSTRACT**

A two-stage type electrostatic precipitator mechanism is carried within a rectangular cabinet having an air intake at one end and an air outlet at the other. A blower mechanism is carried within the cabinet for moving air through the cabinet and past the ionizing wires and collecting plates of the precipitator mechanism. A power supply circuit provides high voltages for the ionizing wires and collecting plates and an indicator lamp is connected in circuit with such power supply circuit for providing an alarm signal when the collecting plates become too dirty. The spacing between the collecting plates and the value of the high voltage supplied thereto are of an unconventional nature and provide improved operating performance. The precipitator unit as a whole is constructed so that it can be operated in either a normal or an upside-down position.

5 Claims, 7 Drawing Figures



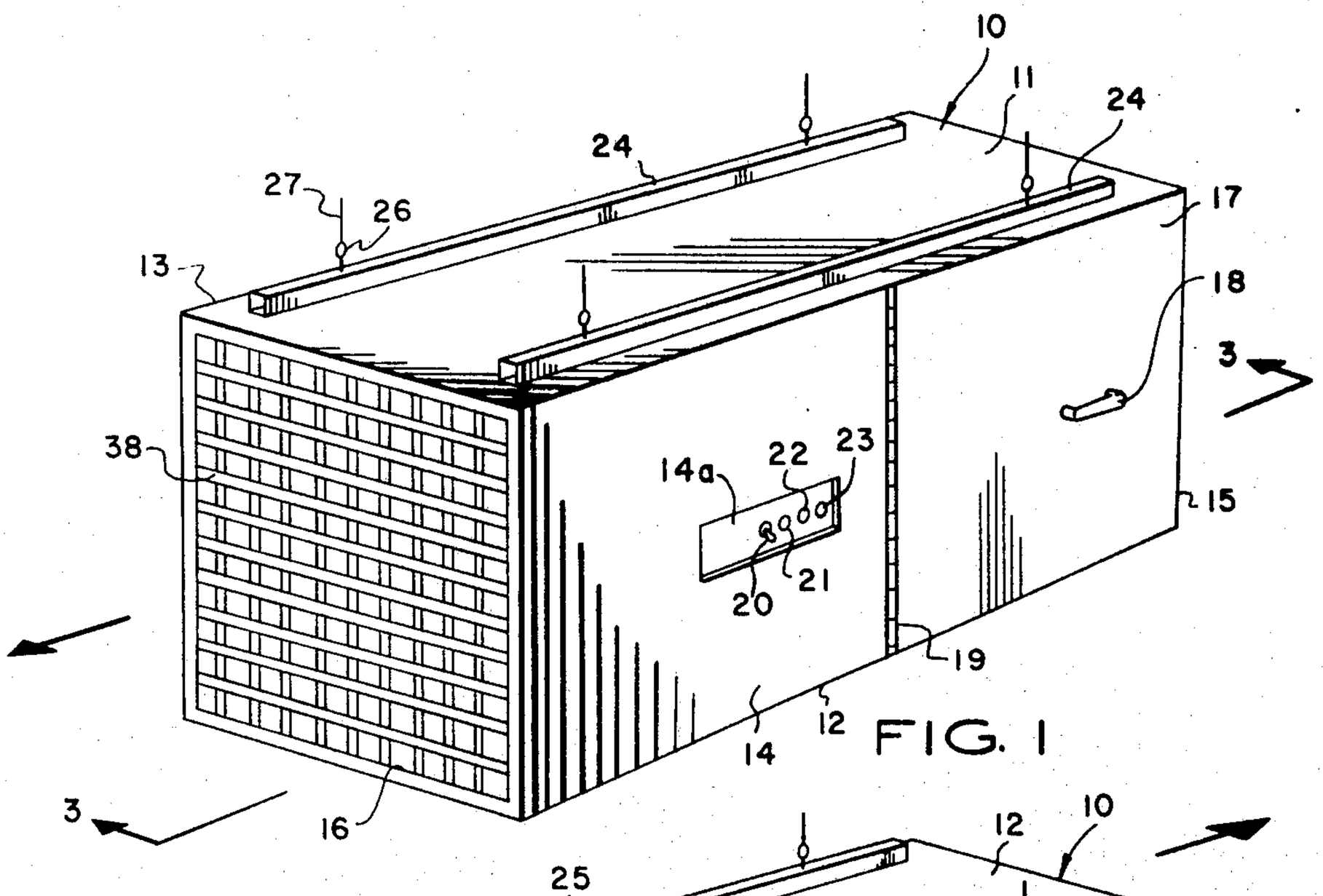


FIG. 1

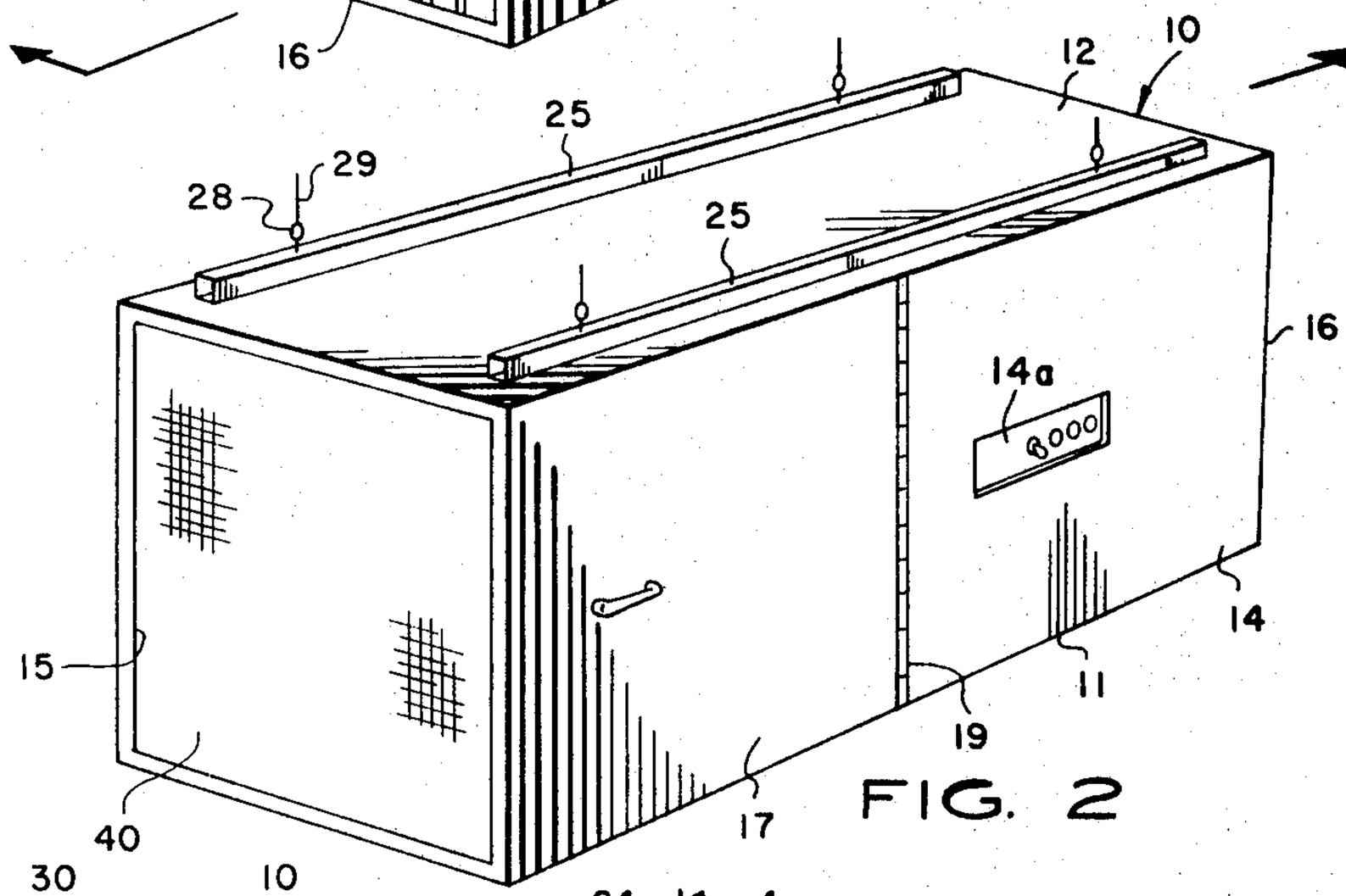


FIG. 2

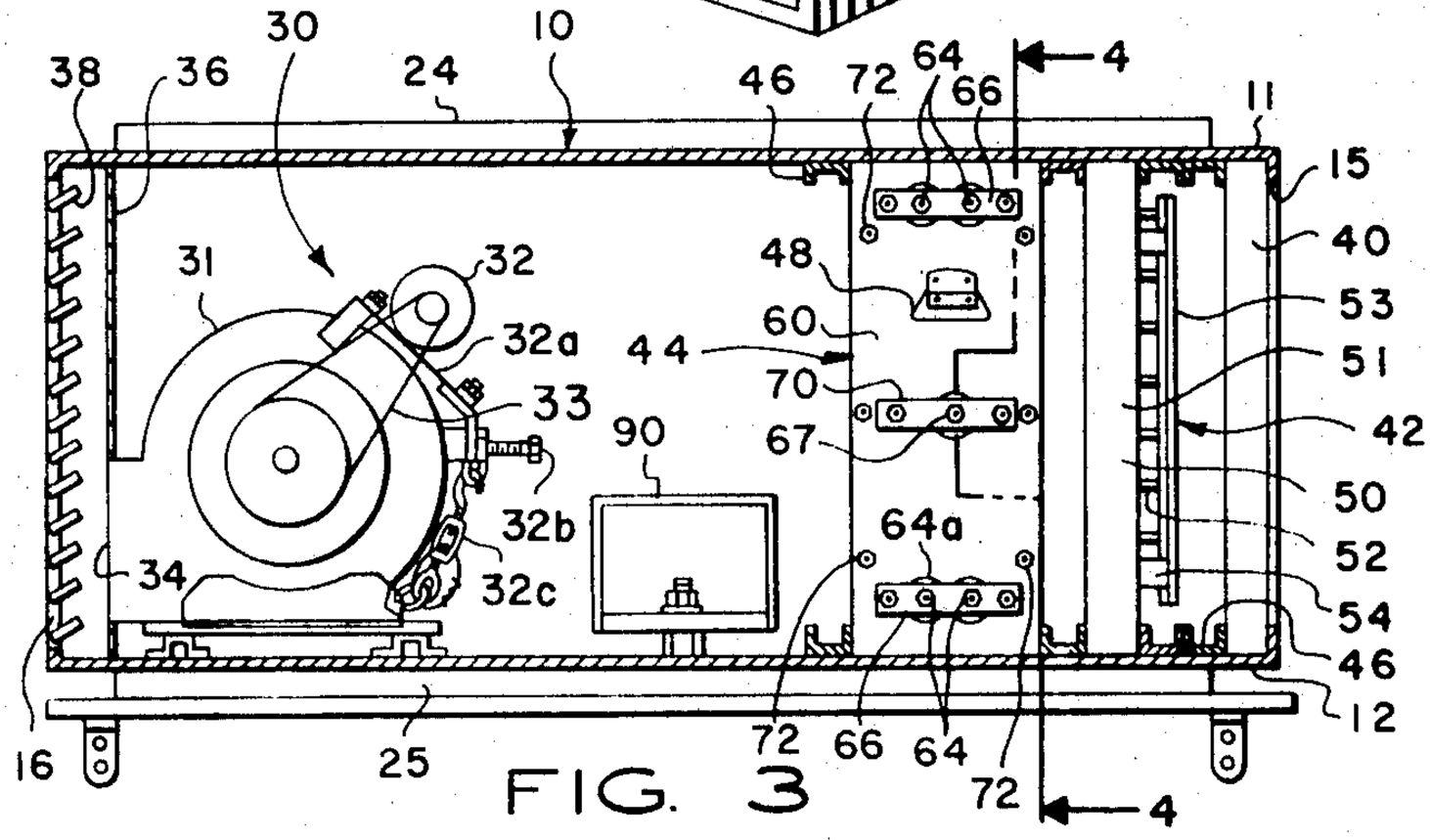


FIG. 3

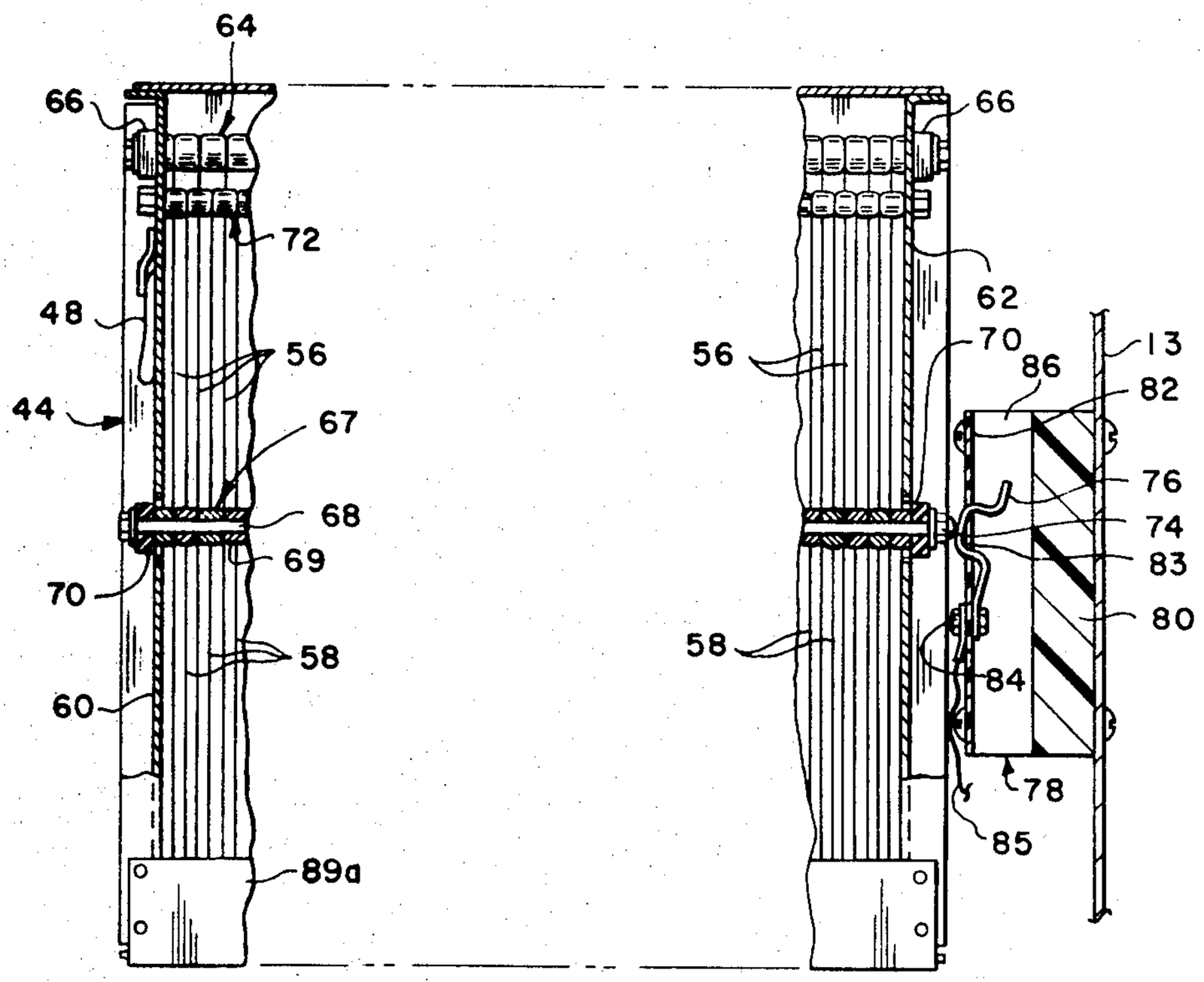

64
66
72
48
56
44
67
68
69
70
58
60
89a
66
62
56
70
86
13
82
76
74
83
80
58
84
78
85

FIG. 4

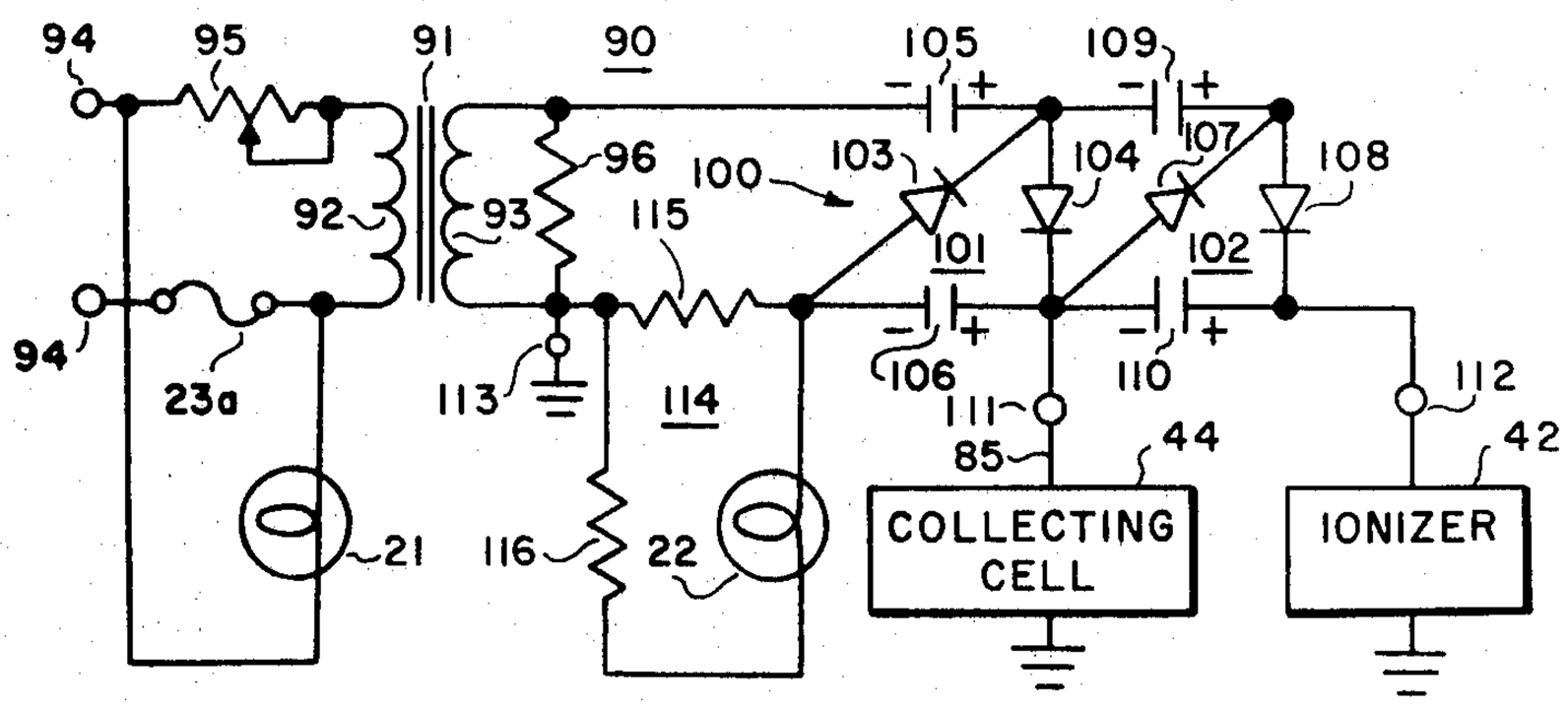

94
95
91
90
105
109
96
100
103
104
107
108
92
93
115
101
102
94
23a
113
114
106
110
111
112
85
44
42
21
116
22
COLLECTING CELL
IONIZER

FIG. 6

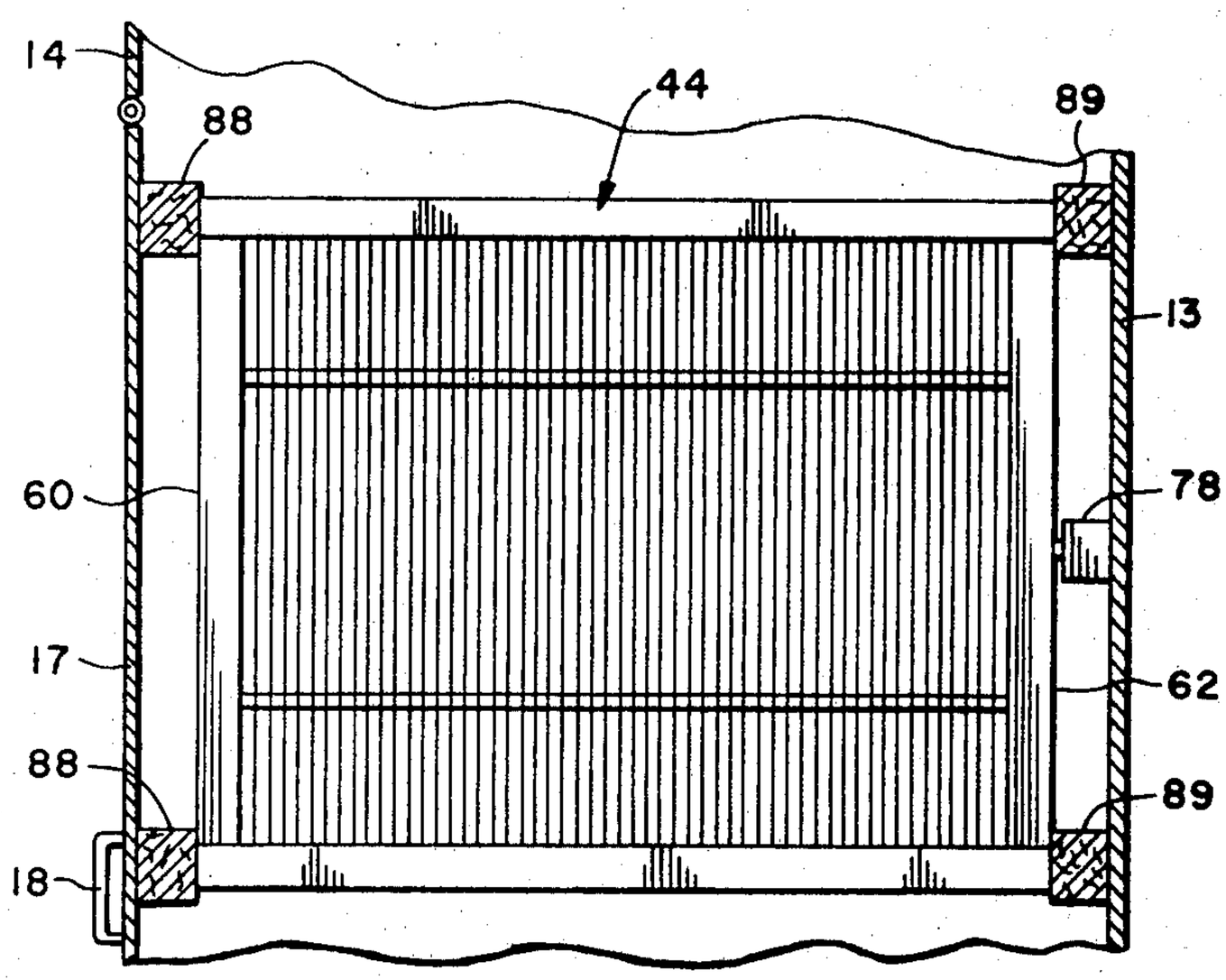
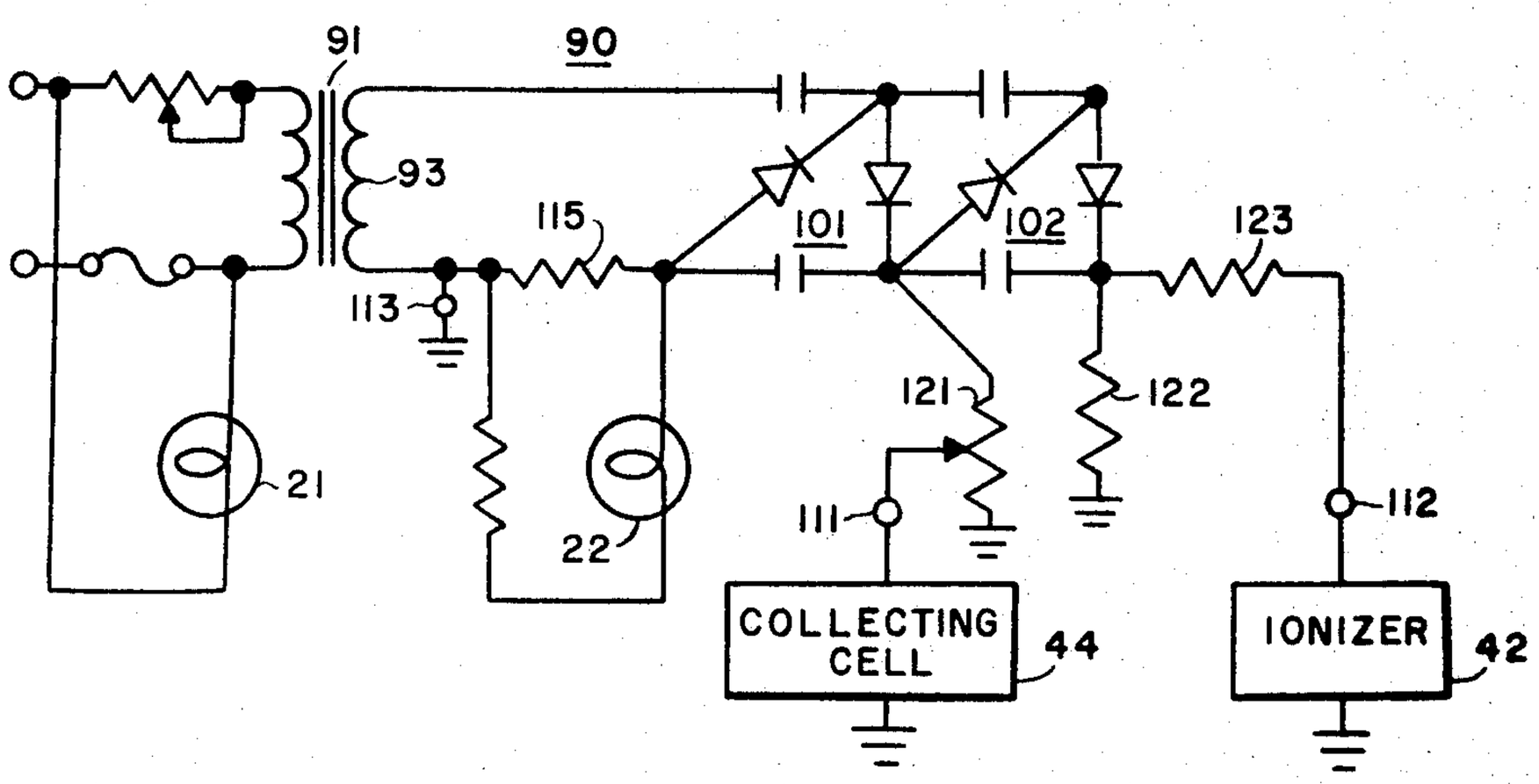

14
88
44
89
13
60
78
17
62
88
89
18

FIG. 5


91
90
93
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101
102
123
113
121
122
21
22
111
112
COLLECTING CELL
44
IONIZER
42

FIG. 7

PORTABLE ELECTRONIC PRECIPITATOR

BACKGROUND OF THE INVENTION

This invention relates to electronic precipitators and, particularly, to portable electronic precipitators for cleaning the air in an interior space frequented by human beings.

It has been heretofore proposed to use a compact portable electronic precipitation in a people-inhabited room or interior space for purposes of cleaning the air in the room. Such a precipitator is particularly useful for removing solids and liquid such as smoke, oil mist and the like from the air. The previously proposed precipitators, however, suffer from various limitations and disadvantages. For one thing, the operation of the precipitator causes the air-borne particles to be deposited on and adhere to the surfaces of the collecting plates therein. As the use continues, the particle layer or film become thicker and thicker, thus reducing the air space between the collecting plates. Eventually, the air gap between collecting plates becomes sufficiently small such that electrical arcing occurs between plates. Arcing reduces the voltage across the plate, substantially reducing the efficiency of the unit and increasing the amount of ozone produced. This can, of course, be prevented by periodic cleaning of the collecting plates. Unfortunately, however, there are many variables which enter into determining the length of time required for the particle deposit to build up to a dangerous thickness. Thus, it is difficult to know how often the collecting plates should be cleaned in order to maintain efficient operation.

Another problem with previously proposed portable type precipitators is that they tend to produce more ozone than is desired. If such ozone concentration should become very significant, it could have a toxic effect on the human inhabitants in the room. Also, the smell of such ozone may be disagreeable to some of the inhabitants.

A further problem with some previously proposed portable type precipitators is that their construction allows some of the room air to pass through the precipitator without passing between the collecting plates. This undesired blow-by reduces the overall efficiency of the precipitator.

It is an object of the invention, therefore, to provide a new and improved portable electronic precipitator which substantially overcomes one or more of the limitations of the portable precipitators heretofore proposed.

It is another object of the invention to provide a new and improved portable electronic precipitator which substantially avoids excessive ozone production and the like and in which an indication is provided if the collecting plates become excessively dirty.

For a better understanding of the present invention, together with other and further objects and features thereof, reference is had to the following description taken in connection with the accompanying drawings, the scope of the invention being pointed out in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring to the drawings:

FIG. **1** is a perspective view of a portable electronic precipitator constructed in accordance with the present invention;

FIG. **2** is a perspective view similar to FIG. **1** except that the precipitator unit is turned upside-down so that the direction of air flow is reversed;

FIG. **3** is an elevational view taken along section line **3—3** of FIG. **1** and showing the precipitator with the front panel removed;

FIG. **4** is a cross-sectional view taken along section line **4—4** of FIG. **3** and showing further details of the collecting cell;

FIG. **5** is a top view of the collecting cell used in the FIG. **1** precipitator unit;

FIG. **6** is an electrical circuit diagram for a first embodiment of a power supply unit carried within the FIG. **1** precipitator; and

FIG. **7** is a circuit diagram for a second embodiment of a power supply unit.

DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

Referring to FIG. **1**, there is shown a portable electronic precipitator for cleaning the air in a room or other interior environment frequented by human beings. The precipitator includes a rectangular metal cabinet **10** having a top panel **11**, a bottom panel **12**, a back panel **13** and a front panel **14**. The cabinet **10** also includes an air intake **15** located at the right hand end in FIG. **1** and an air outltet **16** located at the left hand end in FIG. **1**. The front panel **14** includes a hinged door **17** having a handle **18**, the door hinge being indicated at **19**. The remainder of the front panel **14** is permanently secured to the top and bottom panels **11** and **12**. An on-off switch **20**, a pair of indicator lamps **21** and **22** and a fuse holder **23** are mounted on a panel plate **14a** releasably secured to the non-door portion of the front panel **14**.

FIG. **2** shows the precipitator cabinet **10** of FIG. **1** turned upside-down so that the top panel **11** is on the bottom and the bottom panel **12** is on the top. This reverses the direction of air flow, the air moving from left to right in FIG. **2**. At the same time, the front panel **14** is still facing in the forwardly direction. During installation, the panel plate **14a** is unfastened, rotated 180° and then refastened. This keeps the printed legends on plate **14a** in a non-inverted condition for easier reading of same.

As indicated in FIG. **1**, a first set of mounting members **24** is secured to the top panel **11**, while, as indicated in FIG. **2**, a second set of mounting members **25** is secured to the bottom panel **12**. These mounting members **24** and **25** are in the form of hollow square-shaped metal channel members welded or bolted to the top and bottom panels **11** and **12**. Various metal eyelets **26** may be screwed into the mounting members **24** for purposes of suspending the cabinet **10** from the ceiling of a room by way of wires **27**. Similarly, when the upside-down position of FIG. **2** is desired, various eyelets **28** may be screwed into the bottom panel mounting members **25** for suspending the cabinet **10** by means of wires **29**. Alternatively, the cabinet **10** may be set on top of a shelf (shown in FIG. **3**) or some form of horizontally extending support brackets which extend outward from a wall of the room.

As will be seen, the various units, components and mechanisms located within the cabinet **10** are constructed so that the precipitator operates perfectly satisfactorily either with the top panel **11** on top and the bottom panel **12** on bottom or vice-versa. This upside-

down feature gives the user a greater degree of freedom in the manner of placement of the cabinet **10** in the room. In particular, the cabinet **10** can be mounted so that the air flow is from right to left or vice-versa, as desired, and yet the front panel **14** will still face in the same direction for purposes of allowing access to the service door **17** for enabling periodic replacement of the precipitator mechanism within the cabinet **10** by clean mechanisms. This is particularly important where it is desired to have the back panel **13** located against or near a wall of the room. In other words, the cabinet **10** can be mounted against a wall of the room and the user will still have a choice as to the direction of air flow.

Referring now to FIG. **3**, there is shown a front elevational view of the precipitator unit of FIG. **1** with the front panel **14** (including door **17**) removed. As seen in FIG. **3**, there is carried within the cabinet **10** a blower unit **30** for moving air through the cabinet **10** from the intake **15** to the outlet **16.** Blower unit **30** includes a squirrel cage type fan blade mechanism **31** and an electric motor **32** mounted thereon and coupled to the squirrel cage rotor by way of pulley belt **33.** Motor **32** is mounted on a plate **32***a*, one end of which is pivotally pinned to the housing of fan **31** and the other end of which is supported by a tension adjustment screw **32***b* for adjusting the tension of pulley belt **33.** An adjustable linkage **32***c* running to the base plate for the fan housing maintains the proper belt tension when the unit is operated in the inverted position of FIG. **2.** The outlet opening **34** of the fan blade mechanism **31** is mounted in an exhaust port formed in an otherwise solid partition **36** which extends completely across the left-hand end of the cabinet **10** a short distance inside the cabinet outlet **16.** A louver structure **38** is mounted in the air outlet **16** for covering the opening at the left-hand end of the precipitator and, at the same time, allowing the discharge of the cleaned air back into the room.

A mechanical air filter **40** is removably mounted immediately inside the cabinet intake opening **15.** Filter **40** may be of either the glass wool or metal excelsior type and serves to prevent larger size solid particles or materials from entering the interior of the cabinet **10.** Filter **40** also serves to impart a pressure drop across the inlet so that a more uniform velocity distribution is achieved.

Also carried within the cabinet **10** is a precipitator mechanism located in the air flow path for removing the smaller airborne particles (tobacco smoke, oil mist, etc.) from the air as it passes through the cabinet **10.** In the present embodiment, the precipitator mechanism is a two stage type of electrostatic precipitator and, as such, includes an ionizer unit **42** and a collecting cell unit **44** located downstream of the ionizer unit **42.** Each of units **42** and **44** extends across the width and height of the interior of the cabinet **10** and each is removably mounted within the cabinet **10** by means of slideways formed by channels **46** which are secured to the top and bottom panels **11** and **12** and which run horizontally from the front to the back of the cabinet **10.** Thus, the ionizer and collecting cell units **42** and **44** (as well as the filter **40**) can be removed from the cabinet **10** by opening the service door **17** and pulling them in the forwardly direction. Collecting cell unit **44** is provided with a handle **48** for facilitating its removal.

The ionizer unit **40** includes a four-sided frame-like metal chassis **50** having a vertically spaced series of horizontal metal plates or fins (not shown) which extend from the front panel end **51** to the rear panel end (not visible) of the chassis **50.** Located intermediate these horizontal fins are horizontally-extending ionizer wires (not visible) which are strung between the ends of inwardly extending metal fingers **52** which form parts of and extend toward the left from a pair of side-located vertically running channel members **53** (the rearward one of which is hidden by the forward one). The channel members **53** are spaced from the chassis **50** by means of electrical insulators **54.** The application of a relatively high positive voltage to the ionizer wires causes a corona discharge between such wires and the grounded fins, the latter being grounded by way of the ionizer chassis **50** and the cabinet **10.** The gaseous ionization thus produced by such corona discharge serves to charge the suspended airborne particles as they move through the ionizer unit **40.**

FIG. **4** is a cross-sectional view taken along line **4**—**4** of FIG. **3** and shows in greater detail the construction of the collecting cell unit **44.** Such collecting cell unit **44** includes a group of spaced electrically conductive elements located in the air flow path for removing from the air the airborne particles charged by the ionizer unit **40.** As seen in FIG. **4**, these electrically conductive elements comprise two interleaved sets of spaced parallel plates, the plates in the first set being designated by reference numeral **56** and the plates in the second set being designated by reference numeral **58.** Plates **56** will be referred to as the positive plates, while plates **58** will be referred to as the negative plates. When in place in cabinet **10**, the positive plates **56** are connected to a source of high positive voltage, while the negative plates **58** are grounded to the cabinet. In FIG. **4**, the plates **56** and **58** are being viewed in an edgewise manner, such plates being supported between and extending parallel to a pair of end plates **60** and **62**, the former of which is seen in elevation in FIG. **3.** Thus, the collecting cell plates **56** and **58** have their larger surfaces disposed in line with the direction of air flow.

The positive plates **56** are supported near their four corners by four spacer assemblies **64** which pass through end plate holes **64***a* (FIG. **3**) and are bolted to insulator blocks **66** which are, in turn, bolted to the end plates **60** and **62.** A further positive plate spacer assembly **67** extends through the middle of the collecting cell plates. As seen in FIG. **4**, such center spacer assembly **67** comprises an elongated metal bolt or shaft **68** having a series of metal spacer rings **69** mounted thereon. Shaft **68** passes through small, tight-fitting holes in the positive plates **56.** Spacer rings **69** clamp the plates **56** in position and maintain the desired spacing therebetween. Such rings **69** pass through holes in the negative plates **58** and end plates **60** and **62** of larger diameter than the rings **69** such that there is no electrical contact therebetween. The ends of spacer shaft **68** are bolted to insulator blocks **70** which are, in turn, bolted to the end plates **60** and **62.** The construction is such that all of the positive plates **56** are in electrical contact with the center shaft **68** and the plates **56** and shaft **68** are electrically insulated from both the negative plates **58** and the end plates **60** and **62.**

Negative plates **58** are supported in a somewhat similar manner by means of spacer assemblies **72** located near the four corners thereof. The metal center shafts

of these spacer assemblies **72** are bolted directly to the end plates **60** and **62** for purposes of grounding the negative plates **58** to the cabinet **10.** The negative plates **58** are somewhat longer in the direction of air flow than positive plates **56** so that spacer assemblies **72** may be located clear of the positive plates **56.**

Electrical contact is made with the positive plates **56** by means of a nut **74** on the rearward end of the center spacer shaft **68.** When the collecting cell unit **44** is in place in the cabinet **10,** this nut **74** engages a contact spring **76** in a contact assembly **78** mounted on the inner wall of the back panel **13** of the cabinet **10.** Contact assembly **78** includes an insulator block **80** which is bolted to the back panel **13** and a support plate **82** which is bolted to the front side of the insulator block **80.** Contact spring **76** is a strip of resilient metal material bent to provide a forwardly extending hump portion which extends through an opening **83** in the support plate **82.** The lower end of contact spring **76** is secured to the plate **82** by screws **84.** The lugged end of an insulated conductor wire **85** is looped over and makes contact with one of the screws **84.** Conductor wire **85** runs to an electrical power supply unit to be considered hereinafter. A vertical slot or channel **86** is cut into the insulator block **80** for accommodating the contact spring **76.**

FIG. **5** shows a top view of the collecting cell unit **44.** A pair of vertically-extending resillient sealing strips **88** are secured to the inside of door **17** for engaging end plate **60** of collecting cell unit **44,** while a second pair of vertically-extending resillient sealing strips **89** are secured to the inside of back panel **13** for engaging the other end plate **62** of unit **44.** These strips **88** and **89** may be made of felt or other suitable material and serve to prevent air flow on the exterior sides of the end plates **60** and **62.** Upper and lower baffle plates **89***a* (only the lower of which is visible in FIG. **4**) prevent air flow past the collecting cell unit **44** in regions above and below the effective areas of collecting plates **56** and **58.** Thus, undesired blow-by is prevented and the efficiency of the precipitator unit is increased.

Referring to FIG. **6** there is shown the circuit diagram for a power supply unit **90** carried within the cabinet **10** for producing the desired electrical potential differences between the conductive elements in the ionizer unit **42** and the collecting cell unit **44.** Physically, the power supply unit **90** is secured to the bottom panel **12** at the location indicated in FIG. **3.** As seen in FIG. **6,** the power supply unit **90** includes a volgage step-up transformer **91** having a primary winding **92** and a secondary winding **93.** Primary winding **92** is coupled to a pair of terminals **94** which are adapted to be connected to a source of alternating-current power such as, for example, an alternating-current power line. A rheostat **95** is connected between one of the terminals **94** and one end of the primary winding **92.** A fuse **23***a* (located in fuse holder **23**) is connected between the other terminal **94** and one end of the primary winding **92.** A red-colored indicator lamp **21** is connected in parallel with the rheostat **95** and a secondary winding **92** for indicating that the high-voltage power supply unit **90** is being energized.

Connected to the secondary winding **93** of the step-up transformer **91** is a rectifier circuit **100** of the voltage quadrupler type. A bleeder resistor **96** is also connected across secondary winding **93** to stabilize the loading on transformer **91** and thus the voltage across secondary **93.** Quadrupler circuit **100** includes a first voltage doubler **101** connected in cascade with a second voltage doubler **102.** Voltage doubler **101** includes a pair of semiconductor diodes **103** and **104** and a pair of capacitors **105** and **106.** The second voltage doubler **102** includes a pair of semiconductor diodes **107** and **108** and a pair of capacitors **109** and **110.** High-voltage output terminals for the quadrupler circuit **100** are indicated at **111** and **112.** A common ground return terminal is indicated at **113,** such terminal **113** being grounded to the cabinet **10.**

The operation of the quadrupler circuit **100,** which is well known in the electrical arts, is such that there is produced between the first high-voltage output terminal **111** and the ground terminal **113** a direct-current voltage difference of approximately (slightly less than) twice the peak value of one-half cycle of the alternating-current voltage appearing across the secondary winding **93** of the step-up transformer **91.** There is produced between the second high-voltage output terminal **112** and the ground terminal **113** a direct-current voltage difference equal to (slightly less than) twice the voltage difference between the first high-voltage terminal **111** and the ground terminal **113.** The voltages at terminals **111** and **112** are of positive polarity. In the present embodiment, the turns ratio of the step-up transformer **91** is constructed so that, with an input voltage of 90 volts at terminals **94,** the magnitude of the positive direct-current voltage appearing at the first high-voltage terminal is approximately 4.4 kilovolts, while the magnitude of the positive direct-current voltage appearing at the second high-voltage terminal **112** is approximately **8.4** kilovolts, both being measured with respect to the ground terminal **113.**

As indicated in FIG. **6,** the first or lower-value high-voltage terminal **111** is connected to the positive plates **56** in the collecting cell **44** by way of the conductor wire **85** and the contact assembly **78** previously considered. The second or higher-value high-voltage output terminal **112,** on the other hand, is connected to the ionizing wires in the ionizer unit **42.** An important feature of this FIG. **6** power supply embodiment is that the circuit is constructed so that the ionizer **42** cannot operate unless the collecting cell unit **44** is also operating. This results from the fact that units **42** and **44** are connected directly to the voltage doublers **101** and **102** and from the further fact that the second doubler **102** cannot function unless the first doubler **101** is operating. This interlock feature prevents the undesired escape of ionized particles into the room in the event the collecting cell unit **44** should become inoperative.

Connected in circuit with the power supply means represented by step-up transformer **91** and rectifier circuit **100** is indicator means **114** for providing an alarm signal when the electrically conductive plates **56** and **58** in the collecting cell unit **44** become too dirty. This indicator means includes a current-sensing element represented by a current-sensing resistor **115** connected in series with the transformer secondary winding **93** and the rectifier circuit **100** for sensing the leakage current passing between the collecting cell plates **56** and **58.** The indicator means further includes an amber-colored indicator lamp **22** and a current-limiting resistor **116** connected in series across the current-sensing resistor **115.** When the leakage current flowing between the positive and negative collecting plates **56** and **58** indicates that the build up of the particle film

on such plates has reached the critical level, the voltage drop across the current-sensing resistor **115** reaches a value sufficient to cause a lighting of the indicator lamp **22.** This provides a visual alarm signal which indicates that the collecting cell plates **56** and **58** have become too dirty.

The collecting cell unit **44** is constructed so that the spacing between neighboring ones of the positive and negative collecting cell plates **56** and **58** is not more than 0.205 inches. The high-voltage power supply unit **90** is constructed so that the voltage difference or potential difference between negative and positive plates **56** and **58** is less than 5,000 volts. This collecting cell spacing and collecting cell potential difference are significantly less than those used in conventional precipitator apparatus. It has been found, however, that such reduced spacing and voltage parameters provide an improved air cleaning action while, at the same time, decreasing the amount of ozone produced. The desired spacing factor between neighboring collector cell plates is obtained by the proper choice of lateral dimensions for the various spacer rings used on the spacer assemblies **64, 67** and **72.** The desired potential difference value is obtained primarily by proper proportioning of the turn ratio in the step-up transformer **91.** Rheostat **95** enables some adjustment of the high-voltage output values but is included primarily for purposes of compensating for differences in alternating-current power line voltages at different places of use.

FIG. **7** shows a modified form of construction for the power supply unit **90.** In FIG. **7,** the bleeder resistor **96** of FIG. **6** is omitted. In place thereof, bleeder resistors **121** and **122** are connected between the output terminals of voltage doublers **101** and **102,** respectively, and chassis ground. Resistor **121** is of the potentiometer type and collecting cell **44** is connected to the sliding tap thereof. Ionizer unit **42** is connected to the output terminal of the second doubler **102** by way of a current limiting resistor **123.** The sliding tap on resistor **121** enables proper adjustment of the collecting cell voltage relative to the ionizer voltage. The FIG. **7** circuit has the advantage that less heat is generated by the bleeder resistors but suffers from the disadvantage that the interlock feature of the FIG. **6** circuit is not as complete.

Cabinet **10** and service door **17** are constructed in an air-tight manner such that when the door **17** is closed, air can enter or leave the cabinet **10** only by way of intake **15** and outlet **16.** The latching mechanism associated with door handle **18** is provided with a safety interlock mechanism (not shown) such that the high-voltage power supply **90** is automatically turned off whenever the service door **17** is open. Also, the power cord and plug used for connecting the unit to the power line is of the three-wire and three-prong type with one wire and prong being used to ground the cabinet **10.**

In use, the blower unit **30** serves to cause air in the room to be drawn into the intake **15,** to pass through the cabinet **10** and to be discharged from the outlet **16.** As the particle-laden air passes through the corona discharge produced by the ionizer unit **42,** the airborne particles acquire an electrical charge. Thereafter, as such charged particles move through the collecting cell unit **44,** they are electrically attracted to the plates **56** and **58** and deposit themselves thereon. As this deposit or film on the collecting plates **56** and **58** builds up, the leakage current between plates **56** and **58** increases. When the magnitude of such leakage current reaches the dangerous level such that arcing may begin to occur, the voltage drop across the current-sensing resistor **115** becomes sufficient to light the amber-colored indicator lamp **22.** This visual indication warns the user that the collecting plates **56** and **58** have become too dirty and need cleaning.

While there has been described what is at present considered to be a preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is, therefore, intended to cover all such changes and modifications as fall within the true spirit and scope of the invention.

I claim

1. A portable electronic precipitator for cleaning the air in a room or other relatively enclosed environment frequented by human beings comprising:

a rectangular cabinet having top, bottom, front and back panels and an air intake at one end and an air outlet at the opposite end;

blower means carried within the cabinet for moving air from the intake to the outlet;

precipitator means carried within the cabinet and including a group of spaced electrically conductive elements located in the air flow path for removing airborne particles from the air; and,

power supply means carried within the cabinet for producing a substantial electrical potential difference between different ones of the conductive elements;

the blower means, precipitator means and power supply means being mounted within the cabinet so that the precipitator can be operated either with the top panel on top and the bottom panel on bottom or vice versa;

first mounting means secured to the top panel and second mounting means secured to the bottom panel of the cabinet so that the cabinet may be mounted either with the top panel up and the bottom panel down or vice versa;

indicator means connected in the circuit with the power supply means for providing an alarm signal when the conductive elements become too dirty for desired operational efficiency;

said front panel including a hinged door for providing access to the interior of the unit, the direction in which said front panel faces being capable of being made constant as the direction of air flow is reversed by reversing the one said mounting means used for mounting said precipitator; and

a panel plate mounting the controls for said precipitator and releasably secured to a fixed portion of said front panel whereby as the mounting is changed from one of said mounting means to the other, the panel plate means can be rotated **180°** to maintain the printed legends on the plate in a non inverted condition.

2. A portable electronic percipitator in accordance with claim **1** wherein the indicator means is constructed and connected to sense the leakage current passing between the electrically conductive elements.

3. A portable electronic precipitator in accordance with claim **1** wherein the power supply means includes a step-up transformer and rectifier circuit means coupled to the secondary thereof for supplying a relatively large unidirectional voltage to some of the electrically

conductive elements and wherein the indicator means includes a current sensing means connected in series with the transformer secondary winding and the rectifier circuit means.

4. A portable electronic precipitator in accordance with claim **3** wherein the current sensing means includes an indicator lamp for providing a visual alarm signal when the electrically conductive elements become too dirty.

5. A portable electronic precipitator in accordance with claim **3** wherein the current sensing means includes a current sensing resistor connected in series with the transformer secondary winding and the rectifier circuit means and further includes an indicator lamp and current limiting resistor connected in series across the current sensing resistor.

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