# United States Patent

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[54] **IONIZATION APPARATUS**
**10 Claims, 5 Drawing Figs.**


[52] **U.S. Cl.** ..... **317/4,** 317/262
[51] **Int. Cl.** ..... **H05b 3/00**
[50] **Field of Search** ..... 317/3, 4, 262; 204/318, 320, 179, 313; 260/694



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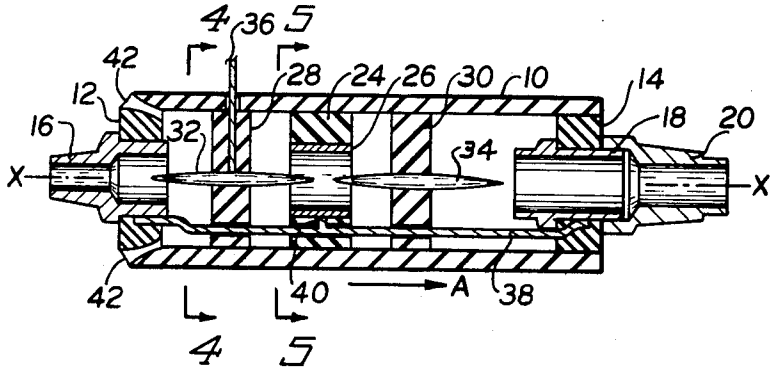
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**ABSTRACT:** An ion-cell having an elongated hollow body having an inlet at one end and an outlet at the other for the passage of a stream of compressed air therethrough, a wall located downstream of the inlet having a central opening therein, a conductive sleeve or lining secured in the central opening, an electrode member supported in the body between the inlet and wall member, and means for inducing an ion field between the electrode and the conductive sleeve to saturate the gas stream.

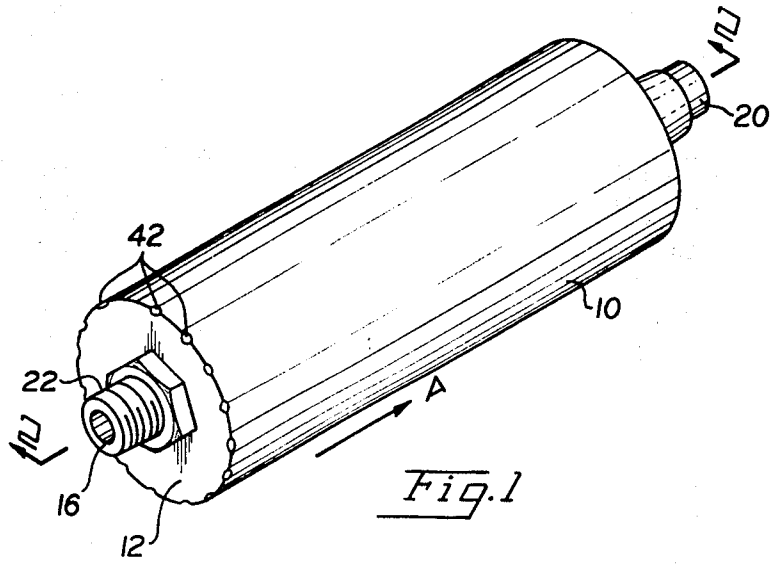



Fig. 1

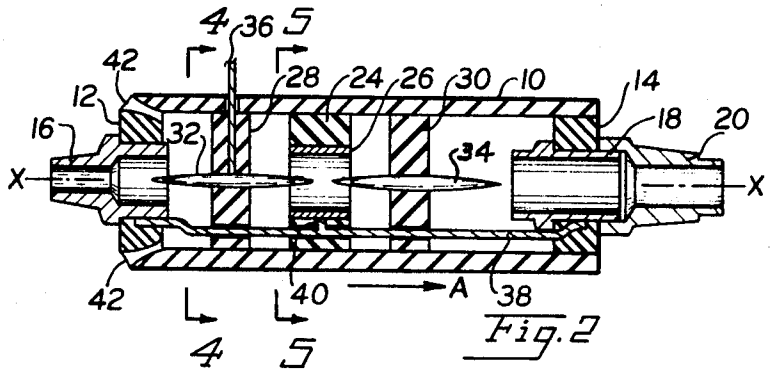



Fig. 2

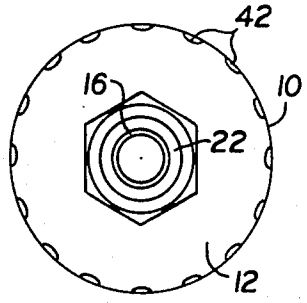



Fig. 3

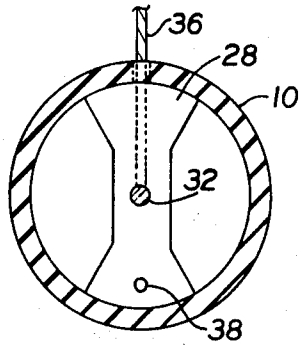



Fig. 4

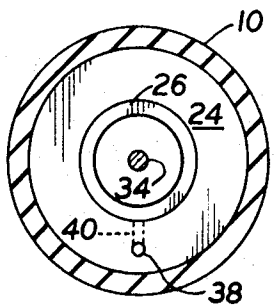



Fig. 5

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# IONIZATION APPARATUS

The present invention relates to apparatus for ionizing a stream of gaseous media and in particular to an ionizing cell for electrically charging a pressured stream of gas.

Compressed air or pressurized streams of special gases are employed in many capacities. For example, streams of air are used to clean small particulate matter from machine parts, or molded pieces preparatory to painting or further treatment; to remove dust or other minute particulate matter from food containers, such as milk bottles, jars etc., before they are filled, and, to electrically neutralize work pieces which for some reason become statically charged with electricity, as for example reams of cut paper being fed to printing presses. These are only three of the many uses to which ionized gas streams can be put, however they are illustrative of the variety, complexity and importance of this technique and the apparatus to accomplish the desired end.

In general the apparatus employed comprises means for passing the compressed gas through an ionized or electrically charged field wherein the stream of gas absorbs or picks up the ion particles which it then carries to the work piece. It is essential that such apparatus be portable, efficient, safe and easily usable since to be otherwise would negate their value.

It is an object of the present invention to provide an ionizing cell wherein a stream of gas may be electrically charged.

It is an object of this invention to provide a portable easily handled ion-cell device. It is a further object to provide an ion-cell which is efficient in operation utilizing to a maximum extent the power impact required for its operation.

It is a further object of the present invention to provide an ion-cell for ionizing a stream of gas consistently and uniformly.

It is a further object of the present invention to provide an ion-cell in which the direction of flow of the air stream is controlled and accurately maintained.

It is further an object of this invention to provide an ion-cell which simultaneous with the ionization of the gas reduces the relative moisture content thereof.

It is still a further and specific object of this invention to provide a simple, economical ion-cell readily usable in present processes without the need for major modification and change in other associated apparatus.

## SUMMARY OF THE PRESENT INVENTION

According to the present invention an ion-cell is provided comprising an elongated hollow body having an inlet at one end and an outlet at the other for the passage of a stream of compressed air therethrough, a wall located downstream of the inlet having a central opening therein, a conductive sleeve or lining secured in the central opening, an electrode member supported in the body between the inlet and wall member, and means for inducing an ion field between the electrode and the conductive sleeve to saturate the gas stream.

In the preferred embodiment a second member similar to the electrode is also provided between the sleeve and the outlet end for transmitting the ion field to that end.

In still another embodiment the body is provided with a plurality of venturi orifices surrounding the inlet, whereby dry air is sucked into the body to reduce the moisture of the gas stream.

The aforementioned objects and others, together with a detailed description of the present invention will be seen from the following description and the attached drawings.

## BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a perspective view of the cell of the present invention,

FIG. 2 is a longitudinal sectional view of the cell taken along the line 2—2 of FIG. 1,

FIG. 3 is an end view of the cell shown in FIG. 1,

FIG. 4 is a transverse sectional view of the cell taken along line 4—4 of FIG. 1, and

FIG. 5 is a sectional view similar to that of FIG. 4 taken along line 5—5 of FIG. 1.



Turning now to the drawings the present device in its preferred form comprises a cylindrical hollow body 10, of insulating nonconductive material through which a gas, such as air, is adapted to flow in the direction of the arrow A. The body which may be rectangular or of other elongated configuration is closed at its upstream and downstream ends by washerlike caps 12 and 14 respectively of similar nonconductive materials. Each cap 12 and 14 is provided with a cylindrical metallic conductive nipple 16 and 18 respectively. The nipples 16 and 18 are coaxially secured along the central axis x—x of the body 10, by conventional removable nut and flange fittings and are provided with threaded exterior ends by which connection may be made to a suitable hose or conduit (not shown). In the embodiment depicted the downstream nipple 18, provided with an outlet nozzle 20, easily functions as the terminus of an ion-gun, while the upstream nipple 16, provided merely with exposed threads 22, functions as an inlet for highly pressurized gas and may be connected to a source thereof (not shown) in conventional manner.

Mounted within the body 10 near its longitudinal center thereof but offset toward the upstream end 16, is a circular wall 24 (FIG. 5) which has a central opening in which is secured a ringlike sleeve 26 of metallic conductive material. Located longitudinally to either side of the concentric wall 24 and sleeve 26 and the upstream and downstream ends are nonconductive spacers 28 and 30 respectively. The spacers 28 and 30, as seen in FIG. 4, have an X-like outer configuration and are situated so as to be located in a common plane normal to the longitudinal axis x—x. Secured within the center of the upstream spacers 28 along the axis x—x of the body 10 is a highly conductive elongated electrode member 32, of generally circular needlelike configuration which is provided with a sharply pointed taper at each end. The conductive electrode 32 is of substantial length, the rearmost end extending at least in part within the area of the interior of the upstream nipple 16 and within the area of the interior of the conductive sleeve 26. A similar member 34 to the electrode 32 is supported on the upstream side of the wall 24 between it and the outlet end extending from within the area of the conductive sleeve 26 to a point just short of the area of the downstream nipple 18.

Extending radially within the body 10, though the upstream spacer 28 and into contact with the electrode 32 is a conductive lead 36. The lead 36 is adapted to be connected to one terminal of a source of high-voltage current (not shown). Extending longitudinally from the upstream nipple 16, to which it is electrically connected, through the spacers 28 and 30 and the wall 24 into contact with the downstream nipple 18 is a second conductive lead 38. The lead 38 is provided with a branch 40 which connects it to the metallic sleeve 26 so that this sleeve 26 becomes grounded to both the forward and rear nipples 16 and 18. The nipples 16 and 18 are themselves individually or jointly connected to the second terminal (not shown) of source of voltage, although it is preferable that they merely be grounded in conventional and well-known manner.

Finally the present device is provided with a plurality of spaced tapered holes 42 extending inwardly of the body 10 at about a 45° angle along the circumferential edge of the rear cap 12. Each of the holes 42 are wider at the outside of the body 10 than they are at the inside, thus providing a series of radial venturi orifices adjacent the upstream or inlet end of the device. For convenience of illustration, the orifices 42 have been shown located on the corner of the body 10. In practice, it has been that they could also be on inlet nipple 16 which forms a part of the body structure.

In practice, it is preferable that the nonconductive members such as the body 10, the caps 12 and 14 and the spacers 28 and 30 be made of plastic material such as polyvinylchloride. Similar material affording the ability to unitarily construct the cell may be used. The conductive metallic nipples 16 and 18 fittings and sleeve 26 are preferably formed of brass or other cuprous material. The electrode needle 32 and its companion transmitting needle 34 are best made of stainless steel, both for conductivity and durability. The leads 36 and 38 may be

copper wire of high-voltage capacity. The relative dimensions of the various parts are preferable, as indicated, but all are not critical and some may be modified as required by the application proposed.

Operatively, from a pneumatic standpoint, gas is introduced into the inlet at a pressure anywhere upwards to 200 p.s.i. The gas flows about the first spacer **28**, through the sleeve **26**, about the second spacer **30** and out the forward nozzle **20** into and onto the workpiece to be cleaned, ionized or otherwise treated. Because of the cylindrical form of the body **10**, the alignment of the spacers **28** and **30** and the coaxially alignment of the nipples **16** and **18**, and the concentric rings **24** and **26** little if any turbulence occurs to impede or divert the flow of gas.

Electrically, on application of a current of high-voltage intensity (for example at 15,000 v.) to the electrode pin **32**, arcing is induced between its edges and the internal surfaces of the inlet nipple **16** and of the brass sleeve **26**. Due to the taper of the electrode pin **32** and the sleeve like configuration of the nipple **16** and the sleeve **26**, the arcing produces a corona field of 360° substantially saturating their interiors with an extremely high amount of ion particles. The amount of saturation within the nipple **16** is relatively small compared with that induced within the ring **26** because of the forward movement of the gas stream and because the outlet nipple and secondary or transmitting needle **34**, etc., are located forwardly thereof.

The ion particles are generally converged and directed on to the secondary needle **34**. Because of the taper and configuration of the needle **34**, it acts in much the same manner as a radio antenna and transmits the ion field downstream toward the outlet. The velocity of air forced through the cell body **10** also forces the ion field to move in this direction.

The corona created by the arcing contains a balance of both positive and negative ions which, when the gas is simultaneously supplied, imparts to the gas a balanced electrical composition. The charged gas is directed outwardly of the nozzle **20**. The grounding of the outlet nozzle insures directional control to the flow of ionized gas since, a partial electric driving force is maintained, acting like a magnet to draw the charged gas and by preventing the absorption of the ions by the conductive nipple and nozzle. Because of the two 360° coronas created within the ring **26** and the nipple **18**, the gas is itself uniformly saturated with ions. There are no blank spaces or un-ionized gas pockets. As a result the effluent gas is uniformly and consistently ionized.

The flow of gas, under pressure through the body **10** creates a partial vacuum adjacent the rear end and about the inner ends of the orifices **42** which consequently causes the sucking of ambient air through the orifices **42** into the body. Because of the taper of the orifices **42** which create a venturi effect, the inrushing air is stripped of its moisture which collects on the lip or outer edge of the orifices. As a result the incoming atmospheric air is substantially dry and when it mixes with the gas reduces by a considerable extent the relative moisture content thereof. It is well known that gases under high pressure contain minute droplets of water or free moisture, which are released on the expansion of the gas into the atmosphere, as would occur in the operation of this or similar devices. However, because of the provision of the radial venturi orifices the present device drastically reduces the moisture content of the gas and overcomes this problem.

It will be apparent to those skilled in this art that the foregoing description of the preferred embodiment of the present invention illustrates an improved ionized gas producing device capable of producing large quantities of uniformly charged gases in a consistent inexpensive and simple manner. The device may be used to treat air or special gases for particular use and is limited only in application by the volume of gas and the rate at which it is passed relative to the current and voltage impressed.

Since a number of modifications and changes have been alluded to herein it is to be understood that the preferred embodiment is shown by way of illustration only and that scope of the present invention is to be limited only by the claims appended hereto.

What is claimed:

1. Apparatus for the ionization of a gas stream comprising an elongated hollow body having a conductive inlet part at one end and an outlet part at the other end along a common longitudinal axis, a wall in said body located downstream of said inlet part and upstream of said outlet, said wall having a conductive sleeve defining a central opening therein, a first elongated electrode member supported along the common longitudinal axis and spaced between said inlet part and said wall sleeve, means for connecting said electrode and the sleeve to a source of voltage to thereby induce electrical 360° arcing between said electrode and inlet part and said electrode and said sleeve to produce corona fields of ion particles therebetween, and said inlet being adapted for connection to a source of gas under pressure whereby said gas may be caused to flow from said inlet to said outlet through said fields of ion particles becoming charged thereby with a balanced composition of positive and negative ions.

2. The apparatus according to claim **1** wherein said body is cylindrical and said parts, wall and electrode are coaxially located therein.

3. The apparatus according to claim **2** wherein said electrode extends within the interior of said inlet and said conductive sleeve.

4. The apparatus according to claim **2** wherein the wall opening is of substantially smaller diameter than the diameter of the body to thereby constrict the passage therethrough.

5. The apparatus according to claim **4** including a second electrode member located downstream between said sleeve and the outlet part, the outlet part being conductive, the second electrode being located along the axis of said body and being insulated therefrom thereby to freely transmit ion-emission to said outlet by an induced 360° arcing between said sleeve and second electrode and said second electrode and said outlet part.

6. The apparatus according to claim **1**, and at least a constricted orifice adjacent said inlet for the entry of ambient gas into said body in response to the movement of gas from said inlet to said outlet.

7. The apparatus according to claim **5** wherein said electrodes are needle like members, symmetrically formed with a taper at each end and a generally circular cross section.

8. The apparatus according to claim **7** wherein the ends of the electrode members are flattened into a plane substantially transverse to their longitudinal axis.

9. Apparatus for ionizing a gas stream comprising a body for passing a gas in an axial direction from an inlet having a conductive part to an outlet, means having a conductive element for constricting the passage of the gas along said axis within said body, electrode means between said inlet part and said conductive element for creating 360° ion corona fields therebetween and substantially within the area of constriction, said corona field between said electrode and part and element substantially saturating said area and charging a gas passing from said inlet to said outlet with a composition of positive and negative ions.

10. The apparatus according to claim **9** wherein said electrode is a needle like member, symmetrically formed to a dimension at its opposite ends narrower than at its center, and said ends each extends into overlying relation with said conductive part and element respectively.