United States Patent [19]

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[54] **IONIZER**

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[52] **U.S. Cl.** **250/324,** 317/4, 250/423

[51] **Int. Cl.** **H05b 3/00**

[58] **Field of Search** 250/324, 325, 326, 423; 317/4

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Assistant Examiner—B. C. Anderson
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[57] **ABSTRACT**

An ionizer is provided with an ion-producing means in the form of a carbon electrode to which a high source of DC potential is applied for generating a substantial amount of ions of the same polarity as that of the applied potential by corona discharge. In an illustrated application, the carbon ion-producing electrode is mounted on a fan of an air ionizer for rotation therewith, for simultaneously generating air ions and rapidly dispensing the ions in the air stream of the fan, which may be directed axially or radially therefrom.

5 Claims, 7 Drawing Figures

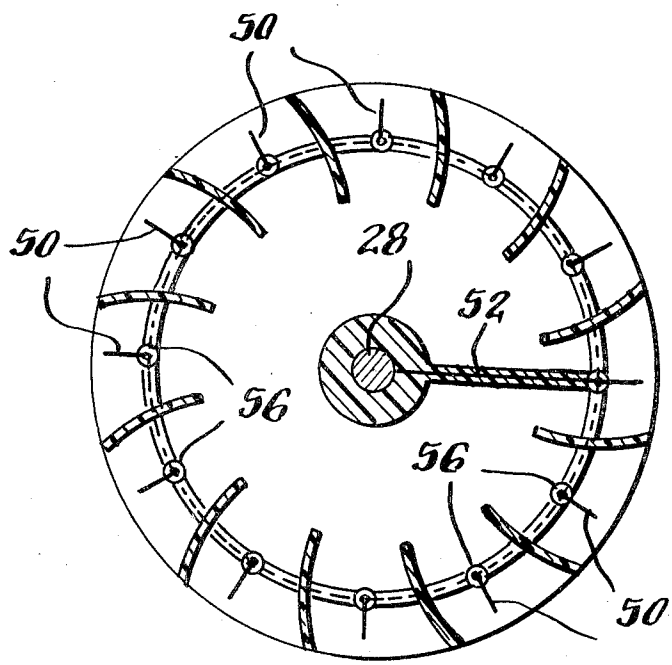


Fig. 1.

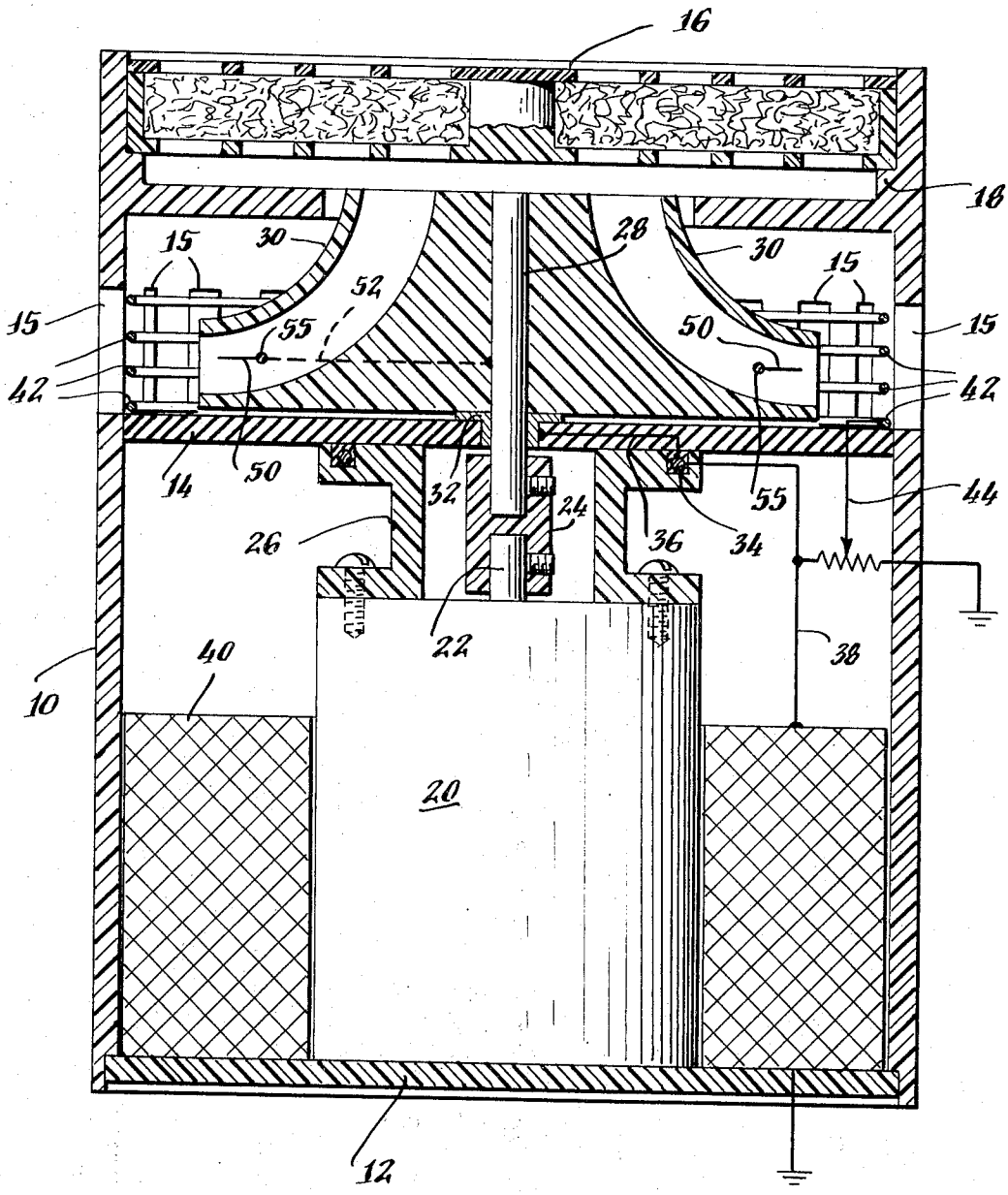

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Fig. 3.

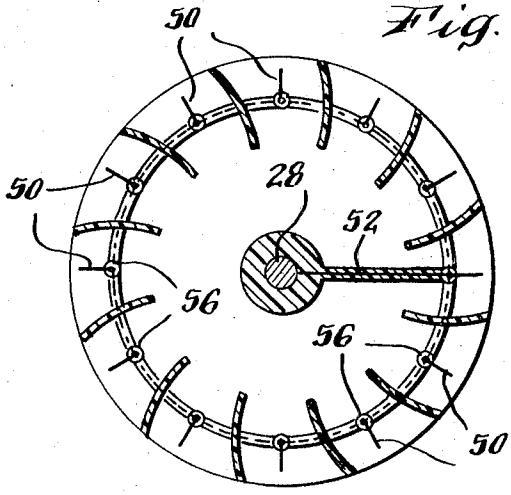


Fig. 7.

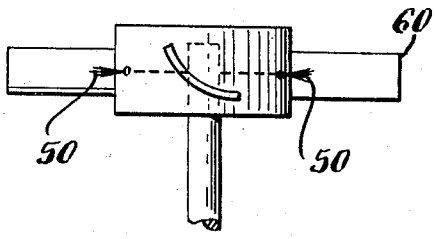


Fig. 6.

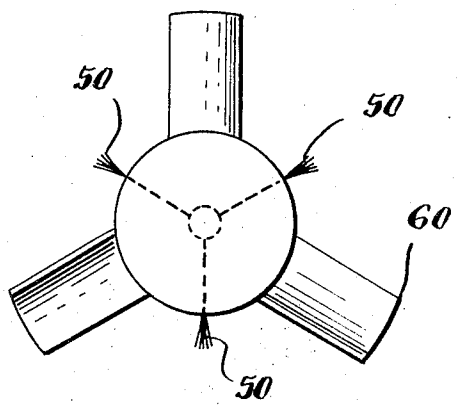


Fig. 2.

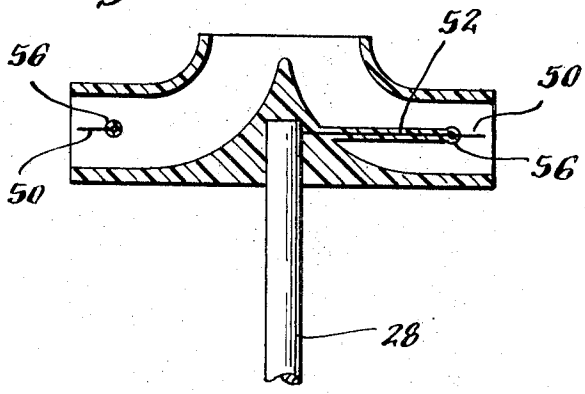


Fig. 4.

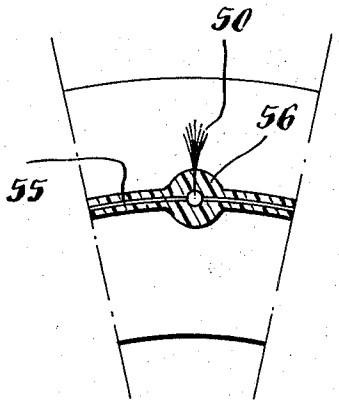
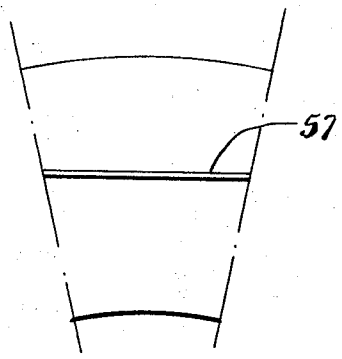


Fig. 5.



IONIZER

BACKGROUND OF THE INVENTION

This invention relates to an ionizer for generating ions by corona discharge, and more particularly in one form thereof to an air ionizer for generating and dispensing ionized air.

Ion generation is becoming increasingly important for a number of applications. Some industries are plagued by static charge that attracts dust and dirt and causes self-attraction of charged particles, making it difficult to operate certain types of equipment, for example, that which is utilized to stack plastic bags, handle webs of plastic or paper, and other material-handling functions. Many electrical apparatus, including computers, can be affected by electrostatic charge on the surface of the wiring or on isolated chassis parts. If the static charge build-up is large enough to produce a spark, the result could be as little as an annoying personal shock, or as serious as an explosion. In another application, ions are generated to place a charge on photo-sensitive paper or other such materials in the document-reproduction field. Another important area which is under investigation is the effect of air ions on plants and living organisms, including their effect on humans. The results of such investigations tend to show that a preponderance of positive air ions in the air has a detrimental effect on most humans, causing headaches, nervousness, and a generally reduced capability of the thinking processes to function normally. On the other hand, an excess of negative air ions appears to favorably influence the central nervous system, lower blood pressure, reduce the tendency to fatigue, increase the capacity to concentrate, and produce an over-all calming effect of wellbeing.

A number of approaches have been taken for generating ions which operate on the corona discharge principle, utilizing metallic needles or wire of very small diameter. Among the problems which exist with known systems is the lack of adequate generation of ions in a small space, as well as their speed of removal. Since the air ions have a relatively short life, from milliseconds to 30 seconds, they must be generated in adequate quantity and dispensed promptly in order to derive any benefit therefrom. In corona discharge systems ion density is also a function of the speed of removal from the electrode. Another problem encountered in corona discharge devices is the generation of toxic ozone and nitrous oxides, which are not only undesirable, but which cannot be tolerated in large quantities.

Accordingly, it is an object of this invention to provide an ionizer for generating ions in substantial quantities in a small space wile avoiding substantial production of ozone and other toxic gases.

A further object of this invention is to provide a new and novel ion-producing means which is incorporated with an ion-dispensing means for simultaneously generating and dispensing ions to the surrounding area.

SUMMARY OF THE INVENTION

In carrying out this invention in one illustrative embodiment thereof, an ion-producing means in the form of a carbon electrode is provided, having a high source of DC potential applied thereto for generating a substantial amount of ions of the same polarity as that of the applied potential by corona discharge. The ion-producing means may be mounted on a fan of an air-

ionizer for rotation therewith for simultaneously generating and rapidly dispensing the ions generated thereby in the air stream of the fan, which may be directed axially or radially therefrom.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front elevation, partly in section, of one form of air ionizer embodied in the present invention.

FIG. **2** is a cross-sectional view of the fan shown in FIG. **1.**

FIG. **3** is a top sectional view of the fan shown in FIG. **2.**

FIG. **4** is an enlarged portion of one type of electrode which may be employed in the present invention.

FIG. **5** is an enlarged view of another type of electrode which may be employed in the present invention.

FIG. **6** is a front view of another type of fan which may be employed in the present invention.

FIG. **7** is a top view of FIG. **6.**

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Ions are classified according to size as small, medium or large, and have a lifetime of milliseconds to thirty seconds, depending on their size and polarity. Positive ions are used for charge reversal in copying processes, and are considered favorable for plant life. Negative ions are used for charging zinc oxide paper in copying processes, and are considered favorable for animals, and humans. The generation of positive ions by corona discharge is primarily a gas-phase phenomenon, and is not highly sensitive to the material used for the electrode generating the ions or the surface condition of the electrode. However, the generation of negative ions by corona discharge involves both the gas-phase phenomenon and the electron emission properties of the electrode material utilized and its surface condition. Extensive tests have shown that the dominant ions in air at atmospheric pressure for negative corona are CO_3— ions. The present invention in its broadest scope utilizes this fact by employing a conductive carbon electrode which, as used herein, would include within its scope conductive graphite. The carbon material utilized as a corona discharge electrode has two functions. The first is to supply carbon for the production of CO_3— ions, and second to act as a reducing agent for O_3— and NO— ions. An example of one of the reactions is as follows:

$$O_3- + CO_2 \qquad CO_3- + O_2$$

One preferred form of carbon electrode is shown in FIG. **4,** and identified with the reference numeral **50.** The carbon electrode **50** is in the form of a stranded filament which is cut to the length of ¼ to 1 inch which, when under great magnification, resembles at one end thereof the appearance of a brush. A high source of DC potential, on the order of 10,000 to 30,000 volts, is applied to the electrode **50** to produce a corona discharge along the surface and at the ends of the stranded filament **50.** The polarity of the ions generated is the same as the polarity of the DC potential applied thereto. With the configuration of the carbon electrode **50** as shown in FIG. **4,** hundreds of corona discharges occur on the ends of the filament to produce or generate ions. Since the charge of the ions so generated has the same polarity as the filament ends, the ions so generated are repelled, dispensing them into the outer atmosphere

surrounding the electrode **50.** The generation of the many corona-producing points of the electrode **50** propels the ions rapidly outward. The carbon electrode may also be in the form of a stranded filament **57,** as shown in FIG. **5.** In this case the many strands of the filament **57** generate ions along the surface thereof, of the same polarity as that of the high potential applied thereto. Although the invention is not considered limited to a specific type of carbon electrode, one type which has been found suitable for the present application is produced by Union Carbide Corporation having a diameter of 0.04 in. consisting of five plies with 480 filaments per ply. Although the aforesaid carbon electrode may be used for generating ions for many applications, it is further described herein with reference to an air ionizer utilizing a rotating fan for dispensing the ions. It should be appreciated, however, that in the application described, other types of electrodes, for example metallic electrodes, may also be utilized in that application, and the type of electrode used will depend on the particular requirements of any specific application requiring the generation of ions.

Referring now to FIG. **1,** one form of air ionizer is shown, having an enclosure **10,** a bottom panel **12,** a divider **14,** side openings **15,** and a closure **16** in the form of a filter which rests on a ledge **18** in the enclosure **10.** A motor **20,** mounted on the bottom panel **12,** has a rotating motor shaft **22** which drives a fan shaft **28** via a cylindrical coupler **24** having an H-shaped cross-section. A cage-type fan **30** is mounted for rotation on the fan shaft **28** by the motor **20.** The motor **20** is spaced from the divider **14** by a flanged spacer **26.** A doughnut-shaped power supply **40** which supplies a high DC potential, on the order of 10,000 to 30,000 volts, is grounded on one terminal thereof, and the other terminal is connected via conductor **38** to a reflector electrode **34** mounted in the upper flange of the flanged spacer **26.** This electrode is coupled via conductor **36** to metal bearings **32** which apply the source of potential **40** to the fan shaft **28.** It will be understood that other forms of means for applying the potential to the shaft **28** may be utilized; for example, a brush and slip-ring arrangement could be used.

The stationary grid **42** is provided in front of the openings **15** in the enclosure **10,** which is coupled to the source of potential **40** through a potentiometer **44** for controlling the potential on the grid. The grid **42** can be utilized to control or regulate the flow of ions from the ionizer.

As will best be seen in FIGS. **2, 3** and **4,** corona discharge electrodes **50** are mounted on an insulated wire **55,** which is mounted on the fan blades of the fan **30.** The conductor **55** is conductively coupled to the fan shaft **28** by insulated conductor **52.** As will be seen in FIG. **4,** the electrode **50** is mounted to the insulated conductor **55** in an area which may be surrounded by a sphere of insulated material **56** to create turbulence of the air to help move the ions away from the electrode **50** as they are generated. As is illustrated in FIG. **3,** a plurality of electrodes **50** may be spaced within the cage-type fan.

In the preferred form, the electrode **50** would be made of a conductive carbon as described above, which provides hundreds of ion-producing points. However, it will be apparent to those skilled in the art that metallic electrodes in the form of needles may be utilized if desired.

In operation, and assuming that it is desired to generate negative ions, the ion-producing electrodes **50** are coupled to the fan shaft **28** by insulating conductors **52.** The fan shaft **28,** which is rotated by the motor **20** via the motor shaft **22** and the coupler **24,** has a source of high negative potential applied therethrough through the bearings **32** which are coupled via line **36** to reflector electrode **34** and to the negative terminal of the power supply **40** by conductor **38.** The high negative voltage which is transmitted to the electrodes **50** produces a large supply of negative ions. The movement of the fan, along with the plurality of electrodes spaced within the fan blades, moves a stream of air, carrying the ions in a radial direction out through the openings **15** in the enclosure **10,** dispersing them to the areas desired. The construction illustrated provides several important features. With the exception of the conductors and metal shaft, all other portions of the system are made of insulating material, which isolates the grounded motor and power supply from the fan. Since the fan shaft **28** supplies the source of potential to the electrodes **50** and the ions generated are the same polarity as the potential applied to the electrodes, the shaft itself acts as a reflector, sending the ions away from the shaft. A reflector electrode **34** is also provided between the grounded motor and power supply, and electrodes **50,** which reflects the ions and prevents them from being deflected toward the grounded motor and power supply. A large amount of ions are generated because each channel of the radial fan can carry an ion-producing electrode. As was stated previously, the amount of the ions produced is limited by the speed of the ion removal from the ion-producing electrodes **50.** By combining the electrodes with the fan, rapid removal is achieved, since the ions generated are dispensed simultaneously by the movement of electrodes with the fan. The sphere **56** partially surrounding the electrodes **50** also creates turbulence, moving the ions away from the electrodes. The system is also made compact by the combination of the ion production and their removal means into a single integral unit. It will also be noted that, unlike many other systems, a grounded electrode in close proximity to the ion-producing electrode is eliminated in the present system. The present system avoids this by using a high voltage with one terminal to the power supply grounded, and the exposed area of the charge-carrying parts is kept to a minimum. The maintaining of the high voltage-carrying surface at a minimum reduces the production of ozone and other toxic gases. Also, in using a carbon electrode, which is the preferred form, the carbon combines with the oxygen to produce CO_3 —, and prevents the formation of ozone. As was pointed out earlier, the system does not require an opposite field electrode, which also holds down gas production. Then, too, the high voltage-carrying surfaces are maintained at a minimum.

FIG. **5** shows another type of corona discharge electrode **57,** which may be utilized in the form of a metal wire, or preferably conductive carbon in stranded filament form. The electrode **57** is mounted on the fan blade, similarly to the wire **55** in FIG. **4,** but with the surface being exposed and the high voltage applied thereto for creating corona discharge. The electrode will be on the order of 0.002 to 0.004 in. for metal and 0.04 in. for the carbon type. The conductive carbon stranded electrode is preferred since its surface consists

of hundreds of tiny filaments which generate more ions than the similar wire filament. Then, too, because of the larger surface area and with the high negative potential on the stranded electrode, in the case of negative ion generation, the ions are strongly repelled from the surface of electrode **57.**

FIGS. **6** and **7** illustrate the combined ion-producing electrodes and fan in the form in which the air stream is propelled axially instead of radially, as illustrated in FIG. **1.** The fan **60** has a plurality of electrodes **50,** for example like those shown in FIG. **4,** positioned between each of the blades are shown, any suitable plurality may be provided with the electrodes positioned therebetween, and the shape may take many forms. The high voltage may be coupled to the electrodes, utilizing a power supply and the means shown in FIG. **1.** Corona discharge electrodes such as shown in FIG. **5** may also be utilized in place of the electrodes shown by mounting them on the blades to extend between the blades and rotate therewith. The operation of the fans of FIG. **1** and FIG. **7** is the same, except that in the case of FIG. **1** the stream of air with the ions therein is generated radially, whereas the stream of air with ions is generated axially by the fan of FIG. **6.** The same objectives are achieved by the two types of fan generating the air stream, which is to generate a large amount of ions in a small space, with the negligible production of toxic gases, and deliver the ions quickly to the desired area. With respect to the embodiment of FIG. **6,** the compactness is achieved in the same manner as shown in FIG. **1** by a combination of ion production and the air-moving means into an integral ion-generating fan.

Since other modifications and changes, varied to fit particular operating requirements and environments, will be apparent to those skilled in the art, the invention is not considered limited to the examples chosen for purposes of disclosure, and covers all changes and modifications which do not constitute departures from the true spirit and scope of this invention.

I claim:

1. An air ionizer for generating and dispersing ionized air, comprising, in combination,

a. a radial fan having a fan shaft,

b. a rotating cage-type fan blade means mounted on said fan shaft for rapidly moving a stream of air in a radial direction therefrom on the rotation of said fan,

c. ion-producing electrode means mounted on and positioned within said cage type fan blade means in conductive contact with said fan shaft for simultaneously generating air ions and rapidly dispersing said ions by said stream of air into the radial space surrounding said fan,

d. a source of high D.C. potential, and

e. means for conductively coupling said source of high D.C. potential to said fan shaft thereby applying said source of high D.C. potential to said ion-producing electrode means whereby air ions are generated by said ion-producing electrode means by corona discharge.

2. The air ionizer set forth in claim **1** wherein said ion producing electrode means is comprised of conductive carbon electrodes.

3. The air ionizer set forth in claim **2** wherein said conductive carbon electrodes are in the form of stranded filaments of conductive carbon.

4. The air ionizer set forth in claim **1** having

a. a motor and a motor shaft driven thereby,

b. insulated coupling means for coupling said motor shaft to said fan shaft whereby said motor drives said fan shaft, and

c. a reflector electrode mounted between said motor and said ion-producing electrode means and coupled to said source of high D.C. potential of the same polarity applied to said ion-producing electrode means, whereby said reflector electrode repels air ions generated by said ion-producing electrode means.

5. An ionizer for generating ions by corona discharge comprising

a. an ion-producing electrode means comprising conductive carbon in the form of a plurality of stranded filaments, each filament having an extremely small diameter in the micron range,

b. a source of high voltage,

c. means for applying said source of high voltage to said ion-producing electrode means for generating a substantial amount of ions by corona discharge, and

d. fan means for moving a stream of air over said ion producing electrode means, thereby rapidly dispensing the ions generated by said ion producing electrode means.

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