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ION GENERATOR HAVING A METAL PLATE THAT PRODUCES IONIZING PHOTOELECTRONS UPON EXPOSURE TO ULTRA-VIOLET LIGHT

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2 Sheets-Sheet 1

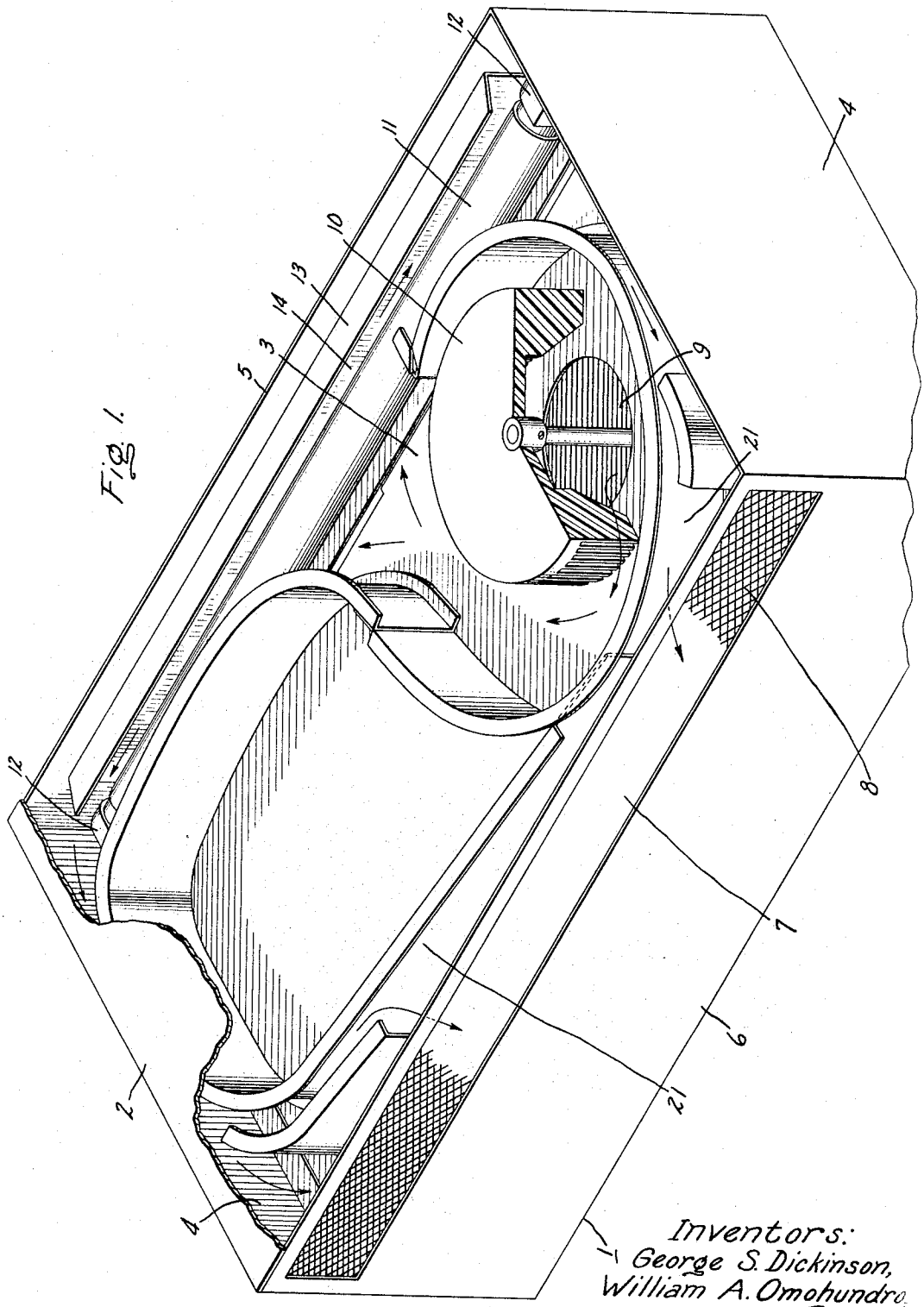

Fig. 1.

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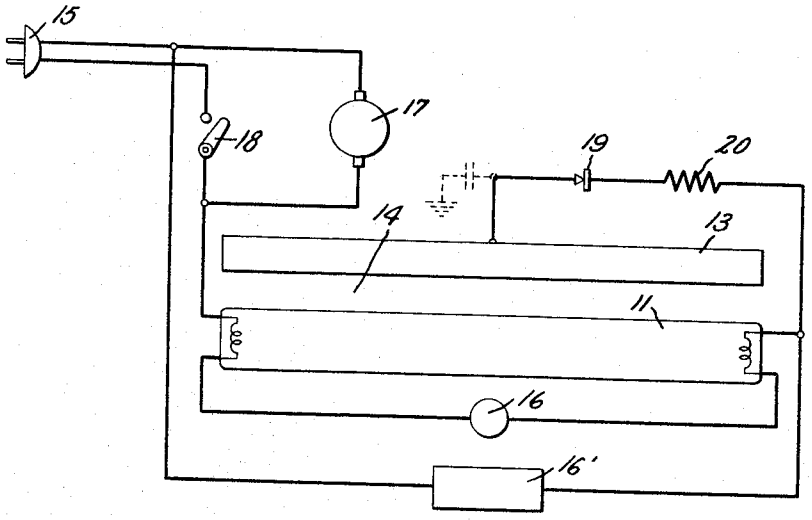
Fig. 2.



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ION GENERATOR HAVING A METAL PLATE THAT PRODUCES IONIZING PHOTOELECTRONS UPON EXPOSURE TO ULTRA-VIOLET LIGHT

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The present invention relates to an ion generator, and more particularly to a device for generating only negative ions and for discharging these ions into atmospheric air within an enclosed area such as a room.

Various devices have been used or proposed for discharging negative ions into a room. Some of these devices produce both negative and positive ions by thermionic emission, radioactivity and by the action of electric fields. With these systems both positive and negative ions are generated and some means is usually provided for neutralizing the positive ions so that only the negative ions are discharged into the room. It is also known that negative ions may be generated by photo emission. In the operation of such a system a body is bombarded with photons which are irradiated from a suitable source, such as ultra-violet light, to cause negative electricity or electrons to leave the body and follow electrostatic lines of force. The electrons emitted from the body attach themselves to molecules which are present in the air and the molecules having picked up a free electron become negative ions. This invention is concerned with such a photo emissive type negative ion generator.

It is a primary object of this invention to provide an improved photo emissive type ion generator having a high electron emission and ion generation rate.

Another object of the invention is to provide an improved ion generator for discharging the negative ions before they become neutralized within the ion generator by coming into contact with neutral or positively charged bodies within the ion generator.

It is a further object of this invention to provide an improved ion generating device having an electron emitting plate which will continue to effectively emit electrons although grease may be adsorbed by the emitting plate.

Briefly stated, in accordance with one aspect of the invention, an object is arranged for bombardment by a source of irradiation for emitting electrons to form ions, and the electron emitting plate is impressed with a negative voltage to repell the negative charges which are formed within the ion generator. The voltage is so selected that the ions will travel very slowly from the object to the source of irradiation along the electrostatic lines of force between the electron emitting object and the source of irradiation. While the negative ions are slowly being repelled from the object toward the source, they are also being acted upon by an air stream of predetermined velocity which carries the generated ions through the air gap between the electron emitting object and the source and discharges them from the ion generator before they become neutralized. By this arrangement a relatively great number of negative ions may be generated and swept into a room before the ions or the electrons emitted from the plate fall back to the electron emitting object, reach the source of irradition, or become neutralized or adsorbed in some other manner. In addition, with such an arrangement, continued operation of the ion generator does not result in an appreciable decrease in the number of electrons emitted from the object or in the number of ions generated although grease may be adsorbed on the emitting object.

Further objects and advantages of the invention as well as other modifications thereof will become apparent as the description proceeds. This invention will be better understood by reference to the accompanying drawings in which:

FIG. 1 is a perspective view of an ion generating unit embodying the invention; and

FIG. 2 is a circuit diagram for the device illustrated in FIG. 1.

Referring now to FIG. 1 of the drawings, there is illustrated an ion generator comprising a housing or casing **1** which suitably encloses the operative parts of the ion generator. The casing **1** preferably is made of sheet metal and includes a top wall **2**, shown broken away for purposes of illustration, a bottom wall **3**, side walls **4**, rear wall **5** and front wall **6**. The front wall **6** is formed with an ionized air discharge opening **7** which may be provided with a grille **8**. A suitable air inlet opening **9** is provided in the bottom wall **3** of the ion generator, and a fan **10** is arranged for forcing air through the ion generator in a manner to be more particularly described hereinafter.

In the embodiment illustrated, a tubular ultra-violet ray lamp **11** is provided as the source of irradiation and the lamp is suitably mounted at the rear of the casing between vertically disposed electrode supporting brackets **12**. An elongated metal plate **13** is provided for emitting electrons when it is bombarded by photons from the source of irradiation **11**. The plate **13** is preferably formed of tin or other suitable metal which will emit electrons. As shown, the plate partially surrounds the source of irradiation **11** to provide an air gap **14** between the plate and the ultra-violet lamp.

Referring now to the circuit diagram of FIG. 2, it is evident that the ultra-violet lamp **11** may be suitably connected to a standard 120 volt 60 cycle alternating current source by a conventional plug connector **15**. A starter **16** and a ballast **16'** are also connected in the circuit in a conventional manner for properly energizing the ultra-violet lamp **11**. As shown, a fan motor **17** is connected in parallel with the ultra-violet lamp and a switch **18** is provided for simultaneously energizing the fan motor **17** and the ultra-violet lamp **11**.

With this arrangement photons from lamp **11** may bombard plate **13** to cause electrons to leave the plate and follow electrostatic lines of force in the air gap **14** between the plate **13** and the lamp **11**. It is believed that these electrons attach themselves to gas molecules which are present in the air gap **14** to form ions. These ions attract water molecules and it appears that approximately ten molecules of water may be united with one of these ions to form an airborne ionized particle.

A unique arrangement is provided for substantially increasing the number of electrons emitted from plate **13** while the plate is being bombarded by photons from the ultra-violet lamp. Thus, with an increase in the number of free electrons there is a corresponding increase in the number of ions which may be formed in the air gap **14**. These improved results are achieved by connecting the plate **13** to the line side of the ultra-violet lamp through a diode **19** oriented with its cathode connected to the line and its anode to the plate **13**. With this construction, stray capacitance exists between the plate **13** and its surroundings as illustrated by the dotted line phantom circuit shown in FIG. 2. In the embodiment illustrated, this stray capacitance amounts to approximately .002 microfarad and causes an alternating current voltage to be induced on the plate. This alternating current voltage is rectified by the diode **19**. By this arrangement, the negative polarization of the plate dispels an electron space charge at the plate to thereby greatly

increase the number of ions generated by insuring that the electrons emitted and the ions formed do not fall to the plate and return the electron to the plate. In addition, with such an arrangement it has been found that adsorption of grease in a monomolecular layer on the emitting plate does not cause a substantial decrease in the number of electrons emitted from the plate. Apparently, the repulsion by the negative charge gives the electron enough energy to pass through the layer of contaminant.

While it is preferable to employ silicone diodes for effectively polarizing the plate **13**, transistors used as diodes have also been found to be suitable. With the use of a PNP transistor, the N lead woud be connected to the line, while one of the P leads would be connected to the emitting plate. It will also be understood that the plate may be effectively polarized with a battery applied voltage, or the plate may be connected to ground through a suitable transistor or diode.

A line current limiting resistor **20** may be located in series with the diode between the diode and the line to eliminate shock hazard, and in the embodiment illustrated the value of the resistor and the diode and the other parameters of this circuit are so selected so that the plate is made negative by approximately 40 volts with respect to the lamp **11**.

It is desired to provide a definite relationship between the plate voltage, the distance from the ultra-violet lamp to the plate, the air velocity through the air gap, and the length of the air gap from the point at which air enters the space between the lamp and the plate to the point at which the air is discharged from the air gap. In the embodiment shown in FIG. 1, two different air streams are caused to flow through two air gaps in which ions may be formed. Air is drawn in through opening **9** by fan **10** and is directed by the baffle walls **21** to the central portion of the ultra-violet lamp **11**. As it reaches the lamp, the air is split into two streams. One stream flows to the left through a left ion air gap between the plate **13** and the ultra-violet tube **11**, it is discharged from the air gap, flows along the left side wall **4**, and is directed by the baffle walls **21** out of the casing through opening **8**. The second air stream flows to the right through a right air gap between the ultra-violet lamp **11** and the plate **13**, it is discharged from this air gap and flows along the right wall of the casing and out through opening **8**. The velocity of the air through the air gap between the plate and the ultra-violet lamp is selected so that an ion which is formed at the central portion of the plate **13** at the air intake portion of either one of the air gaps will be carried through one of the air gaps before it can be repelled to the lamp by the voltage applied to plate **13**. In this manner, the ionized molecule remains an ion and does not become neutralized, or adsorbed. For example, in the embodiment illustrated, the average distance from the target to the lamp is approximately .375", the length of the left air gap is 10", while the length of the right air gap is 7", and the plate **13** is made negative by approximately 40 volts with respect to the lamp. With reference to the air gaps, the air velocity through the gaps is more than 500 feet-per-minute.

While there has been shown and described a specific embodiment of the invention, it is not desired that the invention be limited to the particular form shown and described, and it is intended by the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention. For example, the emitting plate may be formed as a cylinder which surrounds the ultra-violet lamp, and air may be forced in one end of the annular gap between the plate and the tube and out through the other end of the air gap without departing from the spirit of the invention.

What we claim is:

1. An ion generator comprising: a source of alternating electric current, an ultra-violet lamp for irradiating photons connected to said source of alternating electric current, a plate located adjacent to said ultra-violet lamp whereby the photons irradiated from said lamp may cause electrons to be emitted from said plate, said lamp and said plate being arranged to form an air gap separating the plate from the lamp, means for introducing molecules which are capable of being ionized into said air gap so that the molecules may pick up the electrons emitted by said plate and form negative ions, a diode connected to said plate and to said alternating electric current source for impressing a negative voltage on said plate to dispel electron space charge and to repell the negative ions from said plate.

2. An ion generator comprising: a source of irradiation for irradiating photons, a plate formed of tin located adjacent to said source of irradiation whereby the photons irradiated from said source may cause electrons to be emitted from said tin plate, said source of irradiation and said plate being arranged to form an air gap separating the plate from said source, means for introducing molecules which are capable of being ionized into said air gap so that the molecules may pick up the electrons emitted by said tin plate and form negative ions, silicone diode means for impressing a negative voltage on said plate to dispel electron space charge and to repell said negative ions from said plate, and means for causing an air stream to flow in said air gap for discharging said ions from said air gap before they become neutralized.

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