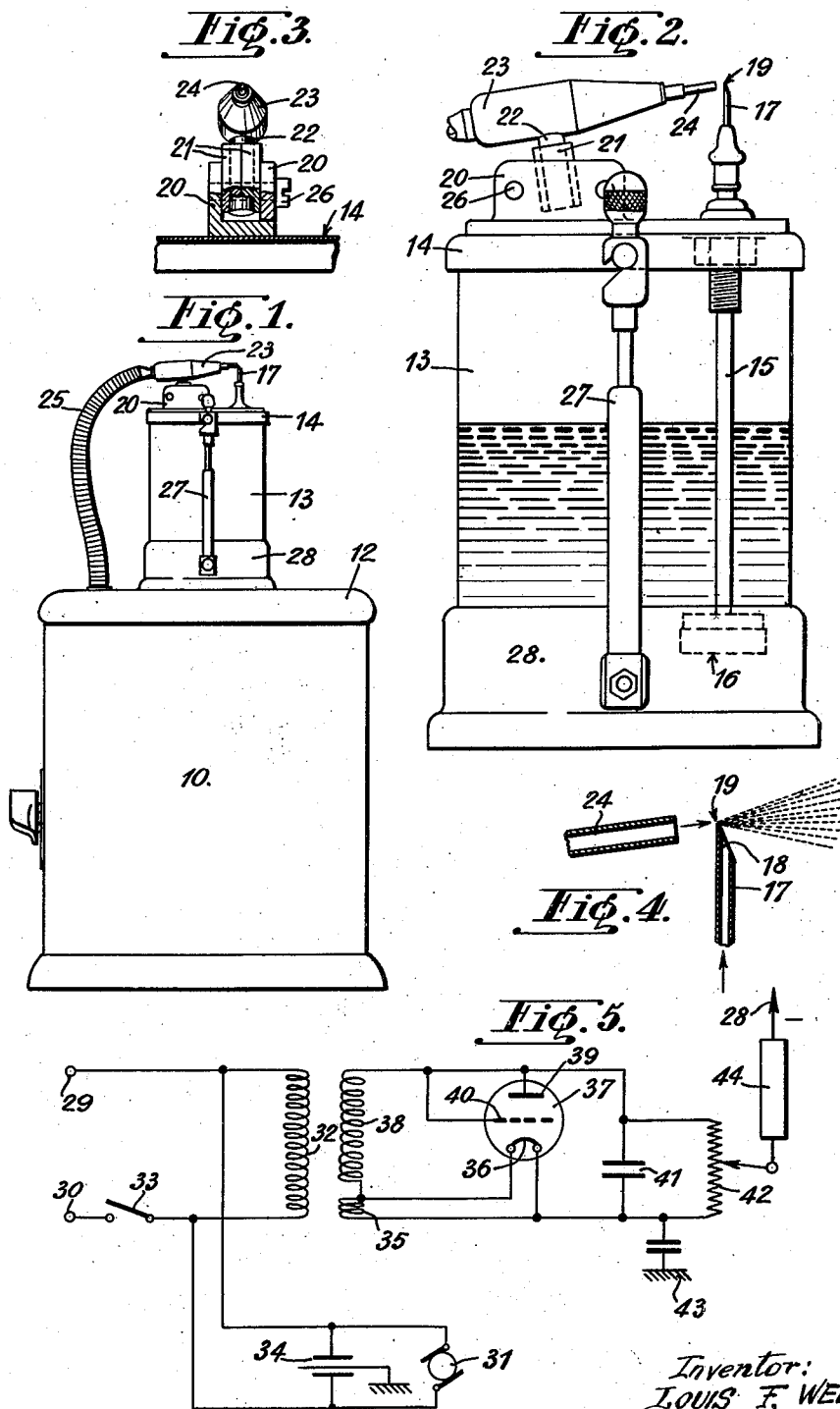


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ARRANGEMENT FOR IMPROVING THE BIOLOGICAL
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ARRANGEMENT FOR IMPROVING THE BIOLOGICAL PROPERTIES OF AIR IN ROOMS

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It is already known that the biological properties of air may be improved through the introduction of water or of liquid particles, especially water particles which are electrically laden (liquid ions). It has also been proposed to allow the direct diffusion of electrically laden liquid particles into the atmosphere surrounding the producing source of said particles.

It has been found in the practical execution of such proposed methods that with voltages that are not very considerable and do not reach at least a few thousand volts for the ionization of the liquid particles, either the number of ions obtained (elementary density of discharge) is not sufficient or else the moisture of the air increases in a prohibitive manner;

Such difficulties come more particularly to the fore when the laden particles are to be directly diffused into the atmosphere. In air conditioning arrangements on the contrary it was possible to apply higher voltages without any difficulty and at the same time the possibility arose of reducing the moisture of the air at the start.

Arrangements with a very high ionizing voltage were by reason of their high price, bulk and danger not suitable to be used in those places such as homes, schools, or conference halls and the like where large stationary apparatuses can be arranged only with great difficulty, while a technical looking after of the high voltage system is not possible.

Now it has been found that if the liquid is atomized into sufficiently fine droplets and if an ionizing electrode is used that is in direct contact with the liquid, it is possible to obtain the surprising result that even with ionizing voltages of less than 1500 volts a number of ions is obtained that is above the magnitude of 10^3 per cm^3 of air without any inadmissible increase in the moisture contents of the air.

The invention relates to an arrangement for improving the biological properties of air in rooms through the production and diffusion of electrically laden liquid particles, in particular water particles.

The arrangement according to the invention comprises consequently an ionizing electrode lying in direct contact with the liquid to be atomized, a source of voltage connected electrically with the ionizing electrode for feeding an electric voltage under 1500 volts, and an atomizing device designed in a manner such that it allows an atomization fine enough for the average volume of the atomized liquid particles to be small enough for the total volume of the liquid parti-

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cles required for the production of 10^3 liquid ions (carrying such an elementary load) to reach at a maximum 10^{-5} cub. cm. and preferably no more than 10^{-6} cub. cm.

The required fineness of atomization, that is the admissible average volume of the particles depends on the magnitude of the ionization voltage and also on the arrangement and constitution of the ionizing electrode. Generally speaking, an atomization is sufficient for which the average volume of the particles does not rise beyond 10^{-9} cub. cm. In the case of ionizing voltages under 1,000 volts, for instance of about 300 to 600 volts, which voltages are of particular advantage by reason for instance of their easy insulation and rectification, a still finer atomization is required for which the average volume lies for instance under 10^{-11} cub. cm., that is for which the production of 10^3 ions requires at the most a volume of 10^{-8} cub. cm.

Arrangements for very fine atomization of liquids are already known per se and also in cooperation with the ionization of air. However, it has not been recognized heretofore, at least it has not been mentioned anywhere in technical literature, that the combination of fine atomization with an electrode in direct contact with the liquid provides the possibility of reducing the electric voltage required for the ionization to as considerable an extent as now found.

The reduction of the voltage required for the ionization shows, in particular in cooperation with movable arrangements that are consequently portable or transportable, a series of important advantages for the conditioning of the air of different rooms for instance of living rooms, school rooms and the like; the source of voltage is much cheaper, simpler and smaller in the case of lower voltages. In the case where a unipolar ionization is desired, the rectification of lower voltages is incomparably simpler than in the case of voltages of several thousand volts.

One of the most important advantages resides however in the fact that the danger of puncture is practically removed in the case of lower voltages so that the apparatus may be constituted in a manner such that the touching of any component that may be reached from outside cannot lead to a dangerous permanent current or current impulse. In the case of arrangements incorporated in private residences and the like and where unexperienced persons may touch or tamper with the arrangement, it should be taken into account that in spite of any warning notices

and the like, parts lying under voltage do, in practice, get touched.

For removing the danger of such arrangements, it is therefore essential that the parts that may be touched should either not be submitted to voltage or else be connected in a manner such that the apparition of a dangerous current or current impulse remains impossible in case of any touching thereof.

By reason of the removal of any danger of puncture, it is possible to obtain immediately, starting from the new facts disclosed, the desired safety of the arrangement when touched, this being performed without screening the live components (which alone is not generally sufficient) while the consumption of current at the ionizing electrode is so small even for arrangements designed for the treatment of several hundreds of cubic meters of air, that the value of the resistance of the circuit across the components that may be reached from outside (inner resistance of the apparatus) may be selected so high and the capacity that may be short-circuited from outside may be selected with a value so small that the permanent current or current impulse produced through cross-circuiting does not even rise above the threshold of sensitivity. Thus for instance the inner resistance may be high enough and the capacity adapted to be short-circuited from the outside may be so small that the intensity of the permanent short-circuit current may lie underneath 10 milliamperes and the quantity of electricity in the capacitive current impulse may lie underneath 10 microcoulombs. The arrangements working with high voltages, that is with voltages that do not remove the danger of puncture, cannot provide such a safety or any similar safety.

Among the different types of atomizing devices, those suit more particularly the purpose of the invention that operate with a stream of air. Said stream of air urges further along the liquid ions lying in the vicinity of the ionizing electrode whereby it is possible to obtain a lesser density of ions in the vicinity of the electrodes and thereby a lesser reaction of the spatial load on the ionizing process together with an improvement of the efficiency of the ionization. When using such an atomizing device, the ionizing voltage can be correspondingly reduced. In order to still further improve the efficiency of ionization and allow a further possibility of reducing the ionizing voltage, the ionizing electrode is advantageously provided with a sharp tip. In the atomizing devices mentioned hereinabove and operating with a stream of air it has been found of particular advantage to use an arrangement of a pointed electrode on the side of the liquid nozzle that is the nearest the air nozzle. The pointed ionizing electrode may advantageously be constituted by the conductive liquid nozzle itself, made for instance of metal, said nozzle being cut obliquely in a manner such that its wall shows a sharp tip on the side facing the air nozzle.

It has been found that with such an arrangement of the nozzle or with such an arrangement of the pointed ionization electrode, the major part of the liquid continues advancing along the wall of the nozzle up to its tip and is atomized only at said tip that is at the point of maximum load density.

Accompanying drawings show by way of example a form of execution of the present invention, in which drawings:

Fig. 1 is a side view of the whole arrangement.

Fig. 2 is a similar view of the atomizing device and of the liquid container at a larger scale.

Fig. 3 illustrates the atomizer in front view.

Fig. 4 shows a diagrammatic longitudinal section of the air and liquid nozzles, and finally

Fig. 5 is a wiring diagram of the arrangement.

The arrangement illustrated includes a support 10 on which is located the atomizing device. Inside the support 10 is housed an electric motor 31 driving an air compressor that is not shown. The motor and the air compressor are preferably arranged in a manner known per se and/or are acoustically insulated in a manner such that their noise may lie immediately underneath the noise level inside a closed room in a large city, in order to avoid any disturbance in the work or rest conditions through the humming of the device. The motor 31 is fed by the mains (Fig. 5); the energy feeding mains provide also the current for the ionizing voltage source constituted by the transformer 32—35 and 38 and by the rectifier system 36, 37, 41, 42, that are also carried inside the support 10.

The support 10 is closed at its upper part by a cover 12 of insulating material such as artificial resin, wood, or the like.

On the support is secured a container 13 preferably of glass inside which the liquid to be atomized, for instance sea-water containing some bay salt is contained. The container 13 is closed by a cover 14 held in position by means of two elastic arms 27 pivotally connected with the dished metal part 28.

A vertical tube 15 passes through the cover 14 and carries at its lower end a filter 16 dipping inside the liquid to be found in the container. The tube ends at its upper part with a nozzle 17 that is cut off obliquely at 18 in a manner such that a tip 19 is provided (Fig. 4). The nozzle is preferably made of conductive material and serves as an ionizing electrode. The nozzle 17 assumes the shape of a capillary tube and its inner diameter measures advantageously less than 0.5 mm., say 0.3 mm.

The cover 14 carries guiding means 20 inside which may slide a two-part shell 21. The two parts of the shell are hollow and surround the rod 22 the upper end of which carries the head-piece 23 of the air hose 25 with the air-nozzle 24. The guiding means 20 are designed in a manner such that the direction of displacement of the air nozzle 24 may lie in a vertical plane passing through the tip 19 of the liquid nozzle. Screws 26 serve for clamping the shell 21 fast inside the guiding means.

The hose 25 that may be provided in its apparent part with a metal cover is constituted by insulating material whereby the air-feeding head-piece 23 may not be connected electrically with the support 10 and thereby with ground. The tube 15 is also insulated with reference to ground. As already disclosed, the source of voltage for the ionizing device is housed inside the support 10.

The points 29 and 30 of the wiring diagram may be connected with a high voltage alternating current mains or with any other source of alternating current. The switch 33 serves for cutting off the current and thereby stopping the operation of the arrangement. The motor 31 is connected, according to the wiring diagram, directly with the voltage of the mains but it may also receive current through a transformer executed advantageously as an auto-transformer in order to allow the use of the arrangement with different network voltages. This may also be ob-

tained through shunt resistances. In order to shunt off any high frequency currents, there is inserted a condenser 34 in parallel with the motor 31.

The transformer is constituted by a primary winding 32 and two secondary windings 35 and 38 of which the winding 35 serves for heating the cathode 36 of the rectifying tube 37. The drawing illustrates a three-electrode tube as rectifier tube as only very small current intensities are to be considered. The grid 40 and the anode 39 of the tube are connected with one end of the secondary winding and the cathode 36 with the other end of the secondary winding. In parallel with the rectifying gap, there is inserted a condenser 41 and a potentiometer 42. The source of voltage is grounded at 43.

The rectifying gap may be also inserted in series with the potentiometer 42, in case the resistance of the potentiometer is correspondingly smaller than the resistance of the rectifier in the current locking direction.

The rectifying gap may also be constituted by a dry rectifier as the consumption of rectified current as already mentioned is so small as to be practically zero.

In order to avoid any overloading of the rectifier in the case of a rectifying gap inserted in parallel, it is of advantage to provide a sufficiently high resistance under the form of a special resistance or else to constitute the secondary winding 38 in series with the rectifying gap as an element of a considerable ohm value.

The rectified voltage, that is negative in the example illustrated is fed through the high ohmic resistance and the lead 28a to the ionization electrode. The presence of the resistance 44 that may measure a few megohms results in that a permanent short circuit current passing through the ionizing electrode towards ground may be only of a magnitude of 10^{-4} amperes in the case of a rectifying ionizing voltage of 500 volts, so that it is very far underneath the threshold of sensitivity.

The arrangement operates as follows:

After connection of the arrangement with the mains and closing of the switch 33, the motor 31 is started moving and the air compressed by the compressor that is not illustrated passes through the headpiece 23 and out through the nozzle 24. The air thus streaming out sucks liquid through the nozzle 17 and atomizes the latter next to the tip 19. As the liquid particles are atomized in the vicinity of the tip 19 that is at the point where the ionizing capacity of the electrode is a maximum, the latter particles receive, for the major part thereof, an electric charge.

The fine atomization of the liquid obtained according to the invention depends primarily:

1. On the depression in front of the opening of the nozzle;

2. On the throttling action, whether hydrostatic or hydrodynamic, that is exerted on the flow of liquid.

The first-mentioned factor can be adjusted through the relative arrangement and size of the two nozzles and through the pressure of the compressed air.

The second factor depends on the difference in level between the liquid level and the nozzle opening, on the air pressure over the liquid level and on the arrangement and size of the liquid pipes and the nozzles.

The most favourable sizes and values may be adjusted tentatively. Generally speaking, a very fine atomization is obtained when the depres-

sion at the nozzle opening measures at least a few hundred millimeters of water column while the throttling action exerted on the flow of liquid is high enough for the speed of outlet flow through the nozzle opening to measure only a fraction, preferably at the most 30%, of the outlet speed corresponding to depression without any throttling action.

What I claim is:

1. An air conditioning apparatus, substantially comprising, in combination, an electrically substantially conductive spray nozzle, a constricted duct for connecting said nozzle with a supply of liquid, a source of an electric potential between about 300 and about 1500 volts, means connecting one pole of said source to said spray nozzle for electrically charging a liquid passing therethrough, and an air nozzle having an outlet for releasing air under pressure, said air nozzle being electrically insulated from said spray nozzle and said outlet being arranged close to that of said spray nozzle whereby air being released from said air nozzle can cause the release by suction from said spray nozzle of charged liquid and its atomization.

2. An air conditioning apparatus substantially comprising, in combination, a pointed hollow electrode, a capillary duct for connecting the interior of said electrode with a supply of an aqueous liquid, a source of electric potential between about 300 and about 1500 volts, means for connecting the negative pole of that source with said electrode for electrically charging a liquid passing therethrough, and a nozzle having an outlet for releasing air under pressure, said nozzle being arranged close to but insulatingly spaced from said electrode whereby air being released from said nozzle can cause the release by suction from said electrode of charged liquid and its atomization.

3. An air conditioning apparatus as set forth in claim 2, in which said electrode forms the end of said capillary duct and is cut obliquely to form a sharp tip on the side facing said nozzle.

4. An air conditioning apparatus as set forth in claim 2, in which said nozzle is adjustably arranged relative to said electrode.

5. An air conditioning apparatus as set forth in claim 2, in which means are associated with said source for adjusting the value of said negative potential.

6. An air conditioning apparatus as set forth in claim 2, in which said source is connected with said electrode through a high electric resistance having a minimum value of about 5 megohms.

7. An air conditioning apparatus substantially consisting, in combination, of an electrically insulated container for an electrically conductive liquid, a metallic spray nozzle mounted on said container, a duct connecting the interior of said container to said spray nozzle, an air nozzle for releasing air under pressure arranged in spaced, suction producing relation to said spray nozzle, a source of direct current of a voltage below about 1500 volts, means for grounding the positive pole of said source, and a high electric resistance connecting said spray nozzle and the negative pole of said source.

8. An air conditioning apparatus, substantially consisting, in combination, of a container for an electrically conductive liquid, a metallic spray nozzle insulatingly mounted on said container above the highest level of a liquid therein, a duct connecting the interior of said container to said spray nozzle, throttling means in said duct, an

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air nozzle for releasing air under pressure arranged in spaced, suction producing relation to said spray nozzle, a source of direct current of a voltage below about 1500 volts, means for grounding the positive pole of said source, and a high electric resistance connecting said spray nozzle and the negative pole of said source.

9. In an air conditioning apparatus as set forth in claim 8, said throttling means including a capillary tube having an inner diameter of less than 0.5 millimeter.

10. In an air conditioning apparatus as set forth in claim 8, filter means arranged at the inlet of said duct.

11. An air conditioning unit substantially consisting, in combination, of a casing, an air compressor and a source of direct current having a voltage between about 300 and about 1500 volts in said casing, a container for a liquid associated electrically insulatingly with said casing, an electrically substantially conductive spray nozzle mounted on top of said container, a constricted duct connecting the interior of said container with said spray nozzle, an air nozzle adjustably and insulatingly arranged on top of said container in a suction producing relation to said spray nozzle, flexible means for connecting said air nozzle with said compressor, means for connecting the negative pole of said source of current with said spray nozzle, and means for con-

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necting the positive pole of said source with said casing.

12. A method for air conditioning, comprising the steps of supplying a column of aqueous liquid having an average diameter of less than 0.5 millimeter to an aperture in an electrode, passing an air stream close to said aperture to produce a suction and atomizing effect upon said liquid therein and to remove therefrom liquid particles having a volume below about 10^{-8} cc., and supplying negative electricity of a voltage between about 300 and about 1500 volts to a sharply curved surface close to said aperture for charging therewith the liquid passing said aperture.

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