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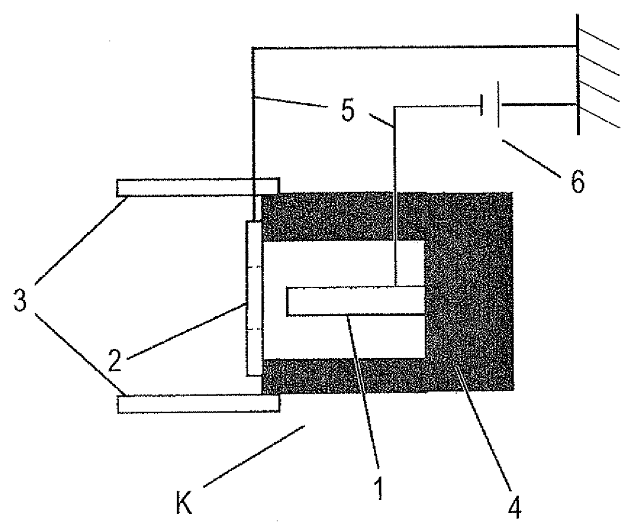
(54) METAL MICROPARTICLE GENERATION DEVICE AND HAIR CARE DEVICE PROVIDED THEREWITH

(57) A metal microparticle generator (K) includes: a first electrode portion (1) to which a voltage is applied; a second electrode portion (2) that is connected to a ground, makes a pair with the first electrode portion (1), generates a discharge with the first electrode portion (1), and thereby serves for emitting metal from the first electrode portion (1), the metal being converted into microparticles; and an ion adsorption portion (3) for capturing a part of ions generated in a vicinity of the first electrode portion (1) by applying the voltage to the first electrode portion (1).

FIG. 1



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Description

TECHNICAL FIELD

[0001] The present invention relates to a metal microparticle generator that adheres metal microparticles onto hair, and to a hair care device including the same.

BACKGROUND ART

[0002] A hair dryer, which is as described in Patent Literature 1 and emits microparticles of transition metal, has been known heretofore. The hair dryer in Patent Literature 1 includes: a discharge unit that applies a voltage to a pair of electrodes containing the transition metal, thereby generates a discharge between the electrodes, and converts the transition metal into microparticles; a microparticle flow passage that builds the discharge unit therein and flows therethrough the microparticles of the transition metal, the microparticles being generated in the discharge unit; and a microparticle outlet that emits the microparticles.

[0003] In the hair dryer in Patent Literature 1, the microparticles of the transition metal, which are generated in the discharge unit, are emitted from the microparticle outlet, and are supplied to hair. It is defined that, with such a configuration, the hair can be protected from damage caused by active oxygen.

CITATION LIST

PATENT LITERATURE

[0004]

Patent Literature 1: Japanese Patent Unexamined Publication No. 2008-23063

SUMMARY OF INVENTION

[0005] In the hair dryer in Patent Literature 1, the voltage is applied to the electrodes, whereby ions of the transition metal are generated together with the microparticles of the transition metal. A generation amount of the ions at this time largely depends on the voltage applied to the electrodes. Among the ions, negative ions can maintain an amount of moisture in the hair at a high state if an amount thereof is appropriate. Therefore, the hair dryer in Patent Literature 1 can give moisture and smooth feeling to the hair of a user, and can achieve improvement of hair quality of the user. However, when the amount of the negative ions is large, a charge amount of the hair is increased. In this case, there has been a problem that pieces of the hair of the user repels one another and expand. Moreover, also in the case of positive ions, there has been a problem that the pieces of the hair of the user are charged and expand in a similar way. Voltage application conditions for generating an appropriate amount of the transition metal particles in the hair do not always coincide with conditions for generating an appropriate amount of the ions. Therefore, the hair dryer in Patent Literature 1 has had a problem that there is a problem that the pieces of the hair of the user may expand to thereby deteriorate a state of the hair.

[0006] The present invention has been made in consideration of the above-described conventional example. It is an object of the present invention to provide a metal microparticle generator capable of appropriately controlling the ions generated by applying the voltage to the electrodes, and to provide a hair care device including the metal microparticle generator.

[0007] In order to solve the above-described problems, a metal microparticle generator according to a first aspect of the present invention includes: a first electrode portion to which a voltage is applied; a second electrode portion that is connected to a ground, makes a pair with the first electrode portion, generates a discharge with the first electrode portion, and thereby serves for emitting metal from the first electrode portion, the metal being converted into microparticles; and an ion adsorption portion for capturing a part of ions generated in a vicinity of the first electrode portion by applying the voltage to the first electrode portion.

[0008] With such a configuration, a part of the generated ions can be captured by the ion adsorption portion, and an amount of the ions can be controlled.

[0009] It is preferable that the ion adsorption portion is arranged on a front side in which the metal converted into the microparticles is emitted from the first electrode portion.

[0010] With such a configuration, the ions can be captured by the ion adsorption portion at an appropriate position on the front side in which the metal converted into the microparticles is emitted.

[0011] At this time, the ion adsorption portion may be arranged so as to surround a space in front of the first electrode portion.

[0012] With such a configuration, the generated ions can be efficiently captured by the ion adsorption portion.

[0013] The ion adsorption portion may be connected to the ground.

[0014] With such a configuration, capture efficiency for the ions by the ion adsorption portion can be prevented from being lowered by the fact that the ion adsorption portion is charged.

[0015] The ion adsorption portion may be composed of a third electrode portion formed of a pair of electrodes. In this case, one of the electrodes of the third electrode portion is connected to the ground, the other of the electrodes of the third electrode portion is connected to a power supply for applying a voltage, and the power supply applies the voltage to the other electrode of the third electrode portion, and thereby generates a potential difference between the electrodes of the third electrode portion.

[0016] With such a configuration, an electric field is generated between the electrodes of the third electrode portion, and the generated ions are attracted thereto, and can be thereby captured by the third electrode portion.

[0017] The metal microparticle generator may further include: an ammeter for sensing a current generated by applying the voltage to the third electrode portion; and a control unit for controlling the voltage, which is to be applied to the third electrode portion by the power supply, in response to the current sensed by the ammeter.

[0018] With such a configuration, in response to the current sensed by the ammeter, the potential difference between the electrodes of the third electrode portion can be controlled by the power supply, and the generated ions can be captured by the third electrode portion.

[0019] The metal microparticle generator may further include: an ion sensor for sensing an amount of ions in a vicinity of the third electrode portion; and a control unit for controlling the voltage, which is to be applied to the third electrode portion by the power supply, in response to the amount of ions, the amount being sensed by the ion sensor.

[0020] With such a configuration, in response to the amount of ions, which is sensed by the ion sensor, the potential difference between the electrodes of the third electrode portion can be controlled by the power supply, and the generated ions can be captured by the third electrode portion.

[0021] The metal microparticle generator may further include: a metal microparticle sensor for sensing an amount of the metal converted into the microparticles in a vicinity of the third electrode portion; and a control unit for controlling the voltage, which is to be applied to the third electrode portion by the power supply, in response to the amount of metal converted into the microparticles, the amount being sensed by the metal microparticle sensor.

[0022] With such a configuration, in response to the amount of metal converted into the microparticles, which is sensed by the metal microparticle sensor, the potential difference between the electrodes of the third electrode portion can be controlled by the power supply, and the generated ions can be captured by the third electrode portion.

[0023] A hair care device according to a second aspect of the present invention includes: the metal microparticle generator according to the first aspect of the present invention.

[0024] With such a configuration, the hair care device can be provided, which is capable of appropriately keeping an adhered amount of the ions onto the hair, and of keeping the hair in a unified state without electrifying the hair.

BRIEF DESCRIPTION OF DRAWING

[0025]

[Fig. 1] FIG. 1 is a side view illustrating a metal microparticle generator of Embodiment 1.

[Fig. 2] FIG. 2 is a front view illustrating the metal microparticle generator of Embodiment 1.

[Fig. 3] FIG. 3 is a side view illustrating a metal microparticle generator of another mode of Embodiment 1.

[Fig. 4] FIG. 4 is a front view illustrating the metal microparticle generator of the another mode of Embodiment 1.

[Fig. 5] FIG. 5 is a side view illustrating a metal microparticle generator of Embodiment 2.

[Fig. 6] FIG. 6 is a side view illustrating a metal microparticle generator of Embodiment 3.

[Fig. 7] FIG. 7 is a side view illustrating a metal microparticle generator of Embodiment 4.

[Fig. 8] FIG. 8 is an inner configuration diagram of a control unit of the metal microparticle generator of Embodiment 4.

[Fig. 9] FIG. 9 is a side view illustrating a metal microparticle generator of Embodiment 5.

[Fig. 10] FIG. 10 is an inner configuration diagram of a control unit of the metal microparticle generator of Embodiment 5.

[Fig. 11] FIG. 11 is a side view illustrating a metal microparticle generator of Embodiment 6.

[Fig. 12] FIG. 12 is an inner configuration diagram of a control unit of the metal microparticle generator of Embodiment 6.

[Fig. 13] FIG. 13 is a configuration view of a hair dryer of Embodiment 7.

DESCRIPTION OF EMBODIMENTS

(Embodiment 1)

[0026] FIGS. 1 and 2 illustrate a metal microparticle generator K of Embodiment 1 of the present invention. The metal microparticle generator K includes: a first electrode portion 1 to which a voltage is applied; and a second electrode portion 2, which is connected to the ground, and makes a pair with the first electrode portion 1. Then, a discharge is generated between the first electrode portion 1 and the second electrode portion 2, whereby metal converted into microparticles is emitted from the first electrode portion 1. Moreover, the metal microparticle generator K further includes an ion adsorption portion 3 for capturing a part of ions generated in the vicinity of the first electrode portion 1 by the fact that the voltage is applied to the first electrode portion 1.

[0027] The first electrode portion 1 has a long and substantially columnar shape, has one end fixed to an electrode holder 4, and is connected to a first power supply 6 through a lead wire 5. The first electrode portion 1 is made of metal. As this metal, there are used: transition metal such as gold, nickel, platinum, rhodium, palladium, silver and copper; and zinc. In particular, gold or platinum has an anti-oxidation function. Therefore, if gold or platinum is used as the first electrode portion 1, then gold or platinum, which is converted into microparticles, is emitted from the first electrode portion 1, and the anti-oxidation function by the microparticles is expected. In a similar way, if silver or copper is used as the first electrode portion 1, then an anti-bacterial effect is expected. Moreover, zinc is an essential clement of a living body. Therefore, if zinc is used as the first electrode portion 1, and zinc converted into microparticles is brought in to hair, then zinc influences cuticles of the hair, and a split hair prevention effect is obtained. In a similar way, if zinc converted into microparticles is brought in to the scalp, then a hair growth effect is obtained. Furthermore, a configuration may be adopted, in which the first electrode portion 1 is not composed of single metal, but composed of two or more types of metals by plating, using an alloy, and the like, and the respective effects of the above-mentioned metals are enabled to be simultaneously exerted.

[0028] The second electrode portion 2 is composed of a conductor, and is connected to the ground through the lead wire 5. Here, the conductor refers to, for example, the one in which surface specific resistance is relatively lower among metals and conductive resins. The second electrode portion 2 has a tabular shape, in which a substantially circular opening is formed in a substantial center portion. The opening is formed so that a diameter thereof can be larger than a diameter of circles of the columnar first electrode portion 1, the circles appearing on two surfaces on both ends of a long side thereof. The second electrode portion 2 is fixed to the electrode holder 4 in such a way that a tabular flat surface thereof perpendicularly intersects a longitudinal direction of the first electrode portion 1, and further, that the flat surface is arranged so as to be opposite to a tip end of the first electrode portion 1 at a fixed distance therefrom, the tip end being on a side opposite with a side fixed to the electrode holder 4. At this time, the opening of the second electrode portion 2 is located in front of the first electrode portion 1 in the longitudinal direction. Then, the metal converted into the microparticles, which is emitted from the first electrode portion 1, passes through the opening formed in the second electrode portion 2.

[0029] The ion adsorption portion 3 is composed of a pair of tubular conductors. Here, the conductors refer to the ones in which surface specific resistance is relatively lower among metals and conductive resins. The ion adsorption portion 3 is fixed to the electrode holder 4 in such a way that a direction of flat surfaces of the tubular conductors and the longitudinal direction of the first electrode portion 1 substantially coincide with each other, and that the tubular conductors are arranged on a front side in which the metal converted into the microparticles is emitted from the first electrode portion 1 (that is, an opposite side of the second electrode portion 2 with the first electrode portion 1) so as to be located outside of the first electrode portion 1. That is to say, the pair of conductors of the ion adsorption portion 3 are arranged in the vicinity of the second electrode portion 2 so as to be opposite to each other and in a manner of sandwiching the opening formed in the second electrode portion 2.

[0030] Next, a description is made of operations in the case of applying a high voltage to the first electrode portion 1 by the first power supply 6. When the high voltage is applied to the first electrode portion 1, the discharge is generated between the first electrode portion 1 and the second electrode portion 2. Then, the metal converted into the microparticles is emitted from the first electrode portion 1. The metal converted into the microparticles, which is emitted at this time, passes through the opening formed in the second electrode portion 2, and moves in a direction toward the ion adsorption portion 3. Moreover, when the high voltage is applied to the first electrode portion 1, the ions are generated in the vicinity of the first electrode portion 1. At this time, in a similar way to the metal converted into the microparticles, the ions pass through the opening formed in the second electrode portion 2, and move in the direction toward the ion adsorption portion 3. The ions which have passed through the second electrode portion 2 are captured by the ion adsorption portion 3 made of the conductors. Hence, in accordance with the metal microparticle generator K of Embodiment 1, since the ion adsorption portion 3 is provided, an amount of the generated ions can be controlled by capturing a part of the ions concerned. Moreover, the ion adsorption portion 3 is arranged in front of the side where the metal converted into the microparticles is emitted from the first electrode portion 1, that is, arranged on the opposite side of the second electrode portion 2 with the first electrode portion 1. Therefore, the ions can be captured by the ion adsorption portion 3 on such a front side of the emission of the metal converted into the microparticles.

[0031] Moreover, in the above-mentioned Embodiment 1, the pair of tubular conductors are arranged as the ion adsorption portion 3; however, the ion adsorption portion 3 may be arranged so as to surround a space in front of the side where the metal converted into the microparticles is emitted from the first electrode portion 1. That is to say, a plurality of the tubular conductors are arranged, whereby the space in front of the first electrode portion 1 may be surrounded. Moreover, as illustrated in FIGS. 3 and 4, the ion adsorption portion 3 may be formed into a frame shape to thereby surround the space in front of the first electrode portion 1. As described above, the ion adsorption portion 3 is arranged so as to surround the space in front of the first electrode portion 1, whereby an area of the ion adsorption portion 3 becomes large, and the ions generated radially forward from the first electrode portion 1 can be captured more efficiently.

(Embodiment 2)

[0032] Next, a description is made of Embodiment 2 based on FIG. 5. Note that the same reference numerals are assigned to similar components to those of the metal microparticle generator K of Embodiment 1, and a description thereof is omitted. In the metal microparticle generator K of Embodiment 2, the ion adsorption portion 3 is connected to the ground through the lead wires 5.

[0033] Hence, charges by the ions captured by the ion adsorption portion 3 are dissipated to the ground. Accordingly, capture efficiency for the ions by the ion adsorption portion 3 can be prevented from being lowered by the fact that the ion adsorption portion 3 is charged by the captured ions.

(Embodiment 3)

[0034] Next, a description is made of Embodiment 3 based on FIG. 6. Note that the same reference numerals are assigned to similar components to those of the metal microparticle generator K of Embodiment 1, and a description thereof is omitted. In Embodiment 3, the ion adsorption portion 3 is composed of a pair of third electrode portions 3a and 3b. The third electrode portion 3a as one in the pair is connected to the ground through the lead wire 5. The third electrode portion 3b as the other in the pair is connected to a second power supply 7 through the lead wire 5. In this case, the second power supply 7 applies a voltage to the third electrode portion 3b as the other in the pair, whereby a potential difference occurs between the pair of third electrode portions 3a and 3b. Then, an electric field is generated between the third electrode portions 3a and 3b, and accordingly, the generated ions are attracted thereto. As a result, the ions can be captured more efficiently by the third electrode portions 3a and 3b as the ion adsorption portion 3.

(Embodiment 4)

[0035] Next, a description is made of Embodiment 4 based on FIGS. 7 and 8. Note that the description is made of Embodiment 4 based on such a metal microparticle generator K of Embodiment 3 described above, the same reference numerals are assigned to similar components to those of the metal microparticle generator K of Embodiment 3, and a description thereof is omitted.

[0036] The metal microparticle generator K of Embodiment 4 further includes: an ammeter 20 for sensing a current generated by applying the voltage between the third electrode portions 3a and 3b; and a control unit 21 for controlling the voltage, which is to be applied between the third electrode portions 3a and 3b by the second power supply 7, in response to the current sensed by the ammeter 20. The third electrode portions 3a and 3b is composed of a pair of electrodes. The third electrode portion 3a as one in the pair is connected to the ground through the lead wire 5. The third electrode portion 3b as the other in the pair is connected to the ammeter 20 and the second power supply 7 through the lead wire 5.

[0037] The ammeter 20 is composed of an existing ammeter, is inserted between the third electrode portion 3b as the other in the pair and the second power supply 7, and is connected individually thereto through the lead wires 5. Moreover, the ammeter 20 is also connected to the control unit 21 through the lead wire 5. The second power supply 7 is connected to the ammeter 20 through the lead wire 5, and in addition, is also connected to the control unit 21 through the lead wire 5. The control unit 21 includes a current value reader 22 and a voltage controller 23. The current value reader 22 is connected to the ammeter 20 and the first power supply 6 through the lead wires 5, automatically acquires a measured value of the current, which is measured by the ammeter 20, and outputs the acquired measured value of the current. The voltage controller 23 acquires such a measured current value outputted from the current value reader 22, compares the measured current value with a set current value set and stored in advance therein, and varies a voltage of the second power supply 7 so that the measured current value can be the set current value.

[0038] In Embodiment 4, the ions generated in the vicinity of the first electrode portion 1 are captured by the third electrode portions 3a and 3b. Then, the third electrode portions 3a and 3b are charged by the captured ions. When the third electrode portions 3a and 3b are charged, the current flows through the lead wires 5 connected to the third electrode portions 3a and 3b. Then, this current is sensed as the measured current value by the ammeter 20. At this time, if an amount of the ions captured by the third electrode portions 3a and 3b is small, then the measured current value measured by the ammeter 20 is reduced. Then, the control unit 21 increases the voltage, which is to be applied to the second power supply 7, so that the measured current value thus reduced can be the set current value, and makes control to capture more ions and to allow the measured current value to coincide with the set current value. On the contrary, if the amount of ions captured by the third electrode portions 3a and 3b is large, then the measured current value measured by the ammeter 20 is increased. Then, the control unit 21 reduces the voltage, which is to be applied to the second power supply 7, so that the measured current value thus increased can be the set current value, and makes control to allow the measured current value and the set current value to coincide with each other. As described above, the control unit 21 controls the second power supply 7 so that the measured current value can be the set current value set in advance, whereby the third electrode portions 3a and 3b can capture the generated ions in response to the amount thereof.

(Embodiment 5)

[0039] Next, a description is made of Embodiment 5 based on FIGS. 9 and 10. Note that the description is made of Embodiment 5 based on the metal microparticle generator K of Embodiment 3 described above, the same reference numerals are assigned to similar components to those of the metal microparticle generator K of Embodiment 3, and a description thereof is omitted.

[0040] A metal microparticle generator K of Embodiment 5 further includes: an ion sensor 30 for sensing the amount of ions in the vicinities of the third electrode portions 3a and 3b; and a control unit 31 for controlling the voltage to be applied to the third electrode portion 3b as the other in the pair. The control unit 31 controls the voltage, which is to be applied to the third electrode portion 3b as the other in the pair by the second power supply 7, in response to the amount of ions sensed by the ion sensor 30. The third electrode portions 3a and 3b are composed of a pair of electrodes. The third electrode portion 3a as one in the pair is connected to the ground through the lead wire 5. The third electrode portion 3b as the other in the pair is connected to the second power supply 7 through the lead wire 5. The ion sensor 30 induces and outputs an electrostatic voltage by the same principle as electrostatic induction, and can measure the amount of ions in a non-contact manner. The ion sensor 30 is arranged in front of the first electrode portion 1 and in the vicinities of the third electrode portions 3 a and 3b.

[0041] The control unit 31 is connected to the ion sensor 30 and the second power supply 7 through the lead wires 5. The control unit 31 includes an ion amount reader 32 and a voltage controller 33. The ion amount reader 32 automatically acquires a measured amount of the ions, which is measured by the ion sensor 30, and outputs the acquired measured amount of ions. The voltage controller 33 acquires such a measured ion amount outputted from the ion amount reader 32, compares the measured ion amount with a set ion amount set and stored in advance therein, and varies the second power supply 7 so that the measured ion amount can be the set ion amount.

[0042] In the metal microparticle generator K of Embodiment 5, in the case where the measured ion amount measured by the ion sensor 30 is larger than the set ion amount, the control unit 31 increases the voltage, which is to be applied to the second power supply 7, and makes control to capture more ions and to allow the measured ion amount to coincide with the set ion amount. On the contrary, if the measured ion amount measured by the ion sensor 30 is smaller than the set ion amount, the control unit 31 reduces the voltage, which is to be applied to the second power supply 7, reduces a captured amount of the ions, and makes control to allow the measured ion amount and the set ion amount to coincide with each other. Hence, the control unit 31 controls the potential difference between the pair of third electrode portions 3a and 3b by the second power supply 7 in response to the amount of ions sensed by the ion detector 30, and can thereby capture the ions generated by the third electrode portions 3a and 3b.

(Embodiment 6)

[0043] Next, a description is made of Embodiment 6 based on FIGS. 11 and 12. Note that the description is made of Embodiment 6 based on the metal microparticle generator K of Embodiment 3 described above, the same reference numerals are assigned to similar components to those of the metal microparticle generator K of Embodiment 3, and a description thereof is omitted.

[0044] A metal microparticle generator K of Embodiment 6 further includes: a metal microparticle sensor 40 for sensing an amount of the metal converted into the microparticles in the vicinities of the third electrode portions 3a and 3b; and a control unit 41 for controlling the voltage to be applied to the third electrode portion 3b as the other in the pair. The control unit 41 controls the voltage, which is to be applied to the third electrode portion 3b as the other in the pair by the second power supply 7, in response to the amount of metal converted into the microparticles and sensed by the metal microparticle sensor 40. The third electrode portions 3a and 3b are composed of a pair of electrodes. The third electrode portion 3a as one in the pair is connected to the ground through the lead wire 5. The third electrode portion 3b as the other in the pair is connected to the second power supply 7 through the lead wire 5. The metal microparticle sensor 40 electrostatically collects, to a quartz oscillator, the metal converted into the microparticles, and senses the amount of metal, which is converted into the microparticles, based on a change of the quartz oscillator. The metal microparticle sensor 40 is arranged in front of the first electrode portion 1 and in the vicinities of the third electrode portions 3a and 3b. Moreover, as a method of quantitating the metal, the metal microparticle sensor 40 may adopt, for example, besides the one mentioned above: a method of quantitating the metal converted into the microparticles in such a manner that light, a laser or a radiation with a specific wavelength is irradiated onto the metal converted into the microparticles, and fluorescence emitted by the metal converted into the microparticles, scattering intensity thereof or the like is quantitated; and a method in which the metal converted into the microparticles is introduced into a specific solvent, light is irradiated thereonto, and absorbance of the metal is measured.

[0045] The control unit 41 is connected to the metal microparticle sensor 40 and the second power supply 7 through the lead wires 5. The control unit 41 includes: a metal microparticle amount reader 42; and a voltage controller 43 for varying the second power supply 7. The metal microparticle amount reader 42 automatically acquires an amount of the metal converted into the microparticles, the amount being measured by the metal microparticle sensor 40, and outputs the measured amount of the metal microparticles, which is thus acquired. The voltage controller 43 acquires the measured amount of the metal microparticles, which is outputted from the metal microparticle amount reader 42, and compares the measured amount of the metal microparticles with a reference amount of the metal microparticles, which is set and stored in advance therein. Then, in the case where the measured amount of the metal microparticles is larger than the reference amount of the metal microparticles, the voltage controller 43 increases the voltage to be applied by the second power supply 7. Meanwhile, in the case where the measured amount of the metal microparticles is smaller than the reference amount of the metal microparticles, the voltage controller 43 reduces the voltage to be applied by the second power supply 7.

[0046] Here, when the voltage to be applied to the first electrode portion 1 rises, the amount of the metal converted into the microparticles and emitted from the first electrode portion 1 is increased, and in addition, the amount of the ions generated in the vicinity of the first electrode portion 1 is also increased.

[0047] Hence, in the metal microparticle generator K in Embodiment 6, in the case where the measured amount of the metal microparticles, which is measured by the metal microparticle sensor 40, is larger than the reference amount of the metal microparticles, it is considered that many ions are generated. In this case, the control unit 41 increases the voltage, which is to be applied to the second power supply 7, and captures more ions. On the contrary, in the case where the measured amount of the metal particles, which is measured by the metal microparticle sensor 40, is smaller than the reference amount of the metal microparticles, the control unit 41 reduces the voltage, which is to be applied to the second power supply 7, and reduces the captured amount of ions.

[0048] Hence, in Embodiment 6, in response to the amount of metal converted into the microparticles and sensed by the metal microparticle sensor 40, the control unit 41 controls the difference between the potentials applied to the third electrode portions 3a and 3b by the second power supply 7. In such a way, the third electrode portions 3a and 3b can capture the generated ions.

(Embodiment 7)

[0049] Next, a description is made of a hair care device of Embodiment 7 based on FIG. 13. The hair care device of Embodiment 7 is a hair dryer that mounts thereon the metal microparticle generator K described in any of Embodiments 1 to 6 mentioned above. However, a usage purpose of the metal microparticle generator K is not limited to the hair dryer, and for example, the metal microparticle generator K may be used for a hair care device such as a hair iron and a hair brush.

[0050] As illustrated in FIG. 13, the hair dryer of Embodiment 7 includes a body case 53 in which an intake port 51 and discharge port 52 of air are arranged. In an inside of the body case 53, there are provided: an air blower unit 54 that discharges, from the discharge port 52, the air sucked from the intake port 51; and a heating unit 55 for heating the air that is provided on a downstream side of the air blower unit 54. At predetermined spots of the body case 53, there are provided: the metal microparticle generator K; a microparticle flow passage 57 through which there flows the metal converted into the microparticles, the metal being generated in the metal microparticle generator K; a microparticle discharge port 58 that discharges therefrom the metal converted into the microparticles; and an introduction passage 59 for introducing the air from the air blower unit 54 to the microparticle flow passage 57. With such a configuration, the metal converted into the microparticles is discharged from the microparticle discharge port 58 by the introduced air.

[0051] Moreover, the air blower unit 54 builds therein: a motor 60; and a fan 61 connected to the motor 60. A cover 67 is provided on a downstream side of the heating unit 55 and above the body case 53. In the cover 67, the metal microparticle generator K is housed. On a downstream side of the metal microparticle generator K, the microparticle flow passage 57 is formed, through which there flows the metal converted into the microparticles, the metal being generated by the metal microparticle generator K. On a tip end of the microparticle flow passage 57, the microparticle discharge port 58 is provided, from which the metal converted into the microparticles is discharged. The metal microparticle generator K is arranged so that the first electrode portion 1 can be located on the introduction passage 59 side, and that the second electrode portion 2 can be located on the microparticle discharge port 58 side.

[0052] Under the body case 53, a handle unit 63 to be gripped by a user is provided. A control unit 64 is arranged in an inside of the handle unit 63. To the control unit 64, a power supply cord 65 is connected, which supplies a power supply for applying a high voltage to the metal microparticle generator K. On a side portion of the control unit 64, a switch 66 is provided, which is to be operated by the user to drive or stop the hair dryer.

[0053] Next, a description is made of operations of the hair dryer of Embodiment 7. When the user grips the handle 63 provided under the body case 53 and operates the switch 66, the motor 60 is driven in the air blower unit 54, and the fan 62 connected to the motor 60 rotates. When the fan 61 rotates, the air is sucked from the intake port 51, and the air thus sucked passes through the heating unit 55 provided on the downstream side of the air blower unit 54. Here, when the switch 66 is further operated, a heater 62 in the heating unit 55 is driven. Therefore, after being heated, the air that passes through the heating unit 55 flows through an air flow passage 68, and is discharged from the discharge port 52 to the outside.

[0054] A part of the air that flows through the air flow passage 68 is introduced into the introduction passage 59 provided in an upper portion of the body case 53, and passes through the metal microparticle generator K arranged in the cover 67. Here, when the switch 66 is further operated, a high voltage is applied by the first power supply 6 to the first electrode portion 1 arranged in the metal microparticle generator K. Therefore, a discharge is formed between the first electrode portion 1 and the second electrode portion 2. When the discharge is formed, a part of the first electrode portion 1 made of the metal is converted into the microparticles by energy of the discharge. As a result, the metal converted into the microparticles is discharged from the first electrode portion 1, and in addition, the ions are generated in the vicinity of the first electrode portion 1. The metal, which is converted into the microparticles, and the ions pass through the microparticle flow passage 57 together with the air introduced from the introduction passage 59, and thereafter, are discharged from the microparticles discharge port 58, and are supplied to the hair. However, a part of the generated ions is captured in the ion adsorption portion 3 of the metal microparticle generator K, and the rest of ions are then supplied to the hair after excessive ions are removed therefrom. Hence, in accordance with the hair dryer of Embodiment 7, the metal converted into the microparticles can be brought in to the hair, and in addition, excessive ions are removed, and an appropriate amount of the ions can be supplied to the hair. As a result, the user can suppress expansion of the hair owing to the ions, and can obtain a state of the hair that is full of moisture and is fully unified.

Claims

1. A metal microparticle generator, comprising:

a first electrode portion to which a voltage is applied;
a second electrode portion that is connected to a ground, makes a pair with the first electrode portion, generates a discharge with the first electrode portion, and thereby serves for emitting metal from the first electrode portion, the metal being converted into microparticles; and
an ion adsorption portion for capturing a part of ions generated in a vicinity of the first electrode portion by applying the voltage to the first electrode portion.

2. The metal microparticle generator according to claim 1, wherein the ion adsorption portion is arranged on a front side in which the metal converted into the microparticles is emitted from the first electrode portion.

3. The metal microparticle generator according to claim 2, wherein the ion adsorption portion is arranged to surround a space in front of the first electrode portion.

4. The metal microparticle generator according to claim 1, wherein the ion adsorption portion is connected to the ground.

5. The metal microparticle generator according to claim 1, wherein
the ion adsorption portion is composed of a third electrode portion formed of a pair of electrodes,
one of the electrodes of the third electrode portion is connected to the ground,
the other of the electrodes of the third electrode portion is connected to a power supply for applying a voltage, and
the power supply applies the voltage to the other electrode of the third electrode portion, and thereby generates a potential difference between the electrodes of the third electrode portion.

6. The metal microparticle generator according to claim 5, further comprising:

an ammeter for sensing a current generated by applying the voltage to the third electrode portion; and
a control unit for controlling the voltage, which is to be applied to the third electrode portion by the power supply, in response to the current sensed by the ammeter.

7. The metal microparticle generator according to claim 5, further comprising:

an ion sensor for sensing an amount of ions in a vicinity of the third electrode portion; and
a control unit for controlling the voltage, which is to be applied to the third electrode portion by the power supply, in response to the amount of ions, the amount being sensed by the ion sensor.

8. The metal microparticle generator according to claim 5, further comprising:

a metal microparticle sensor for sensing an amount of the metal converted into the microparticles in a vicinity of the third electrode portion; and
a control unit for controlling the voltage, which is to be applied to the third electrode portion by the power supply, in response to the amount of metal converted into the microparticles, the amount being sensed by the metal microparticle sensor.

9. A hair care device, comprising: the metal microparticle generator according to claim 1.

FIG. 1

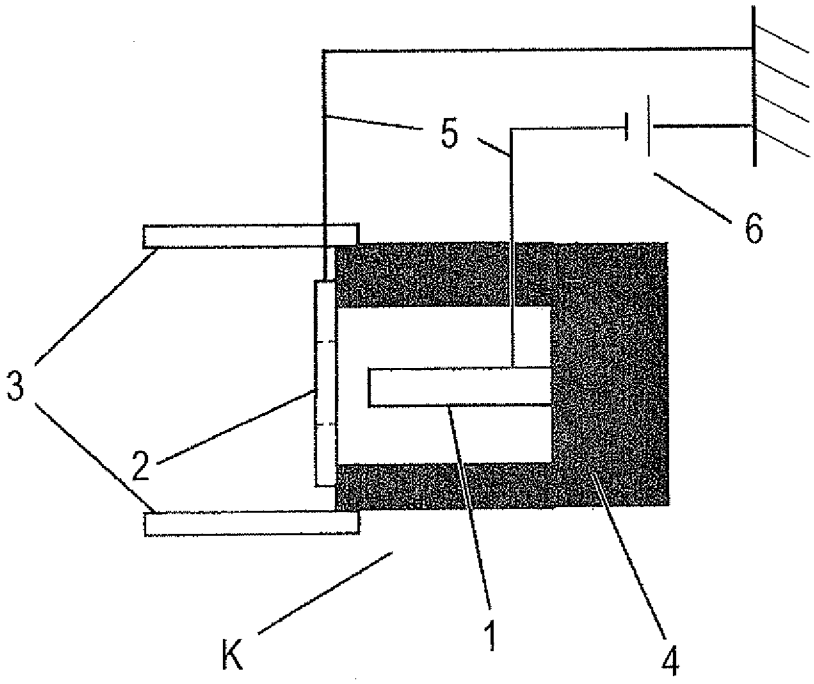


FIG. 2

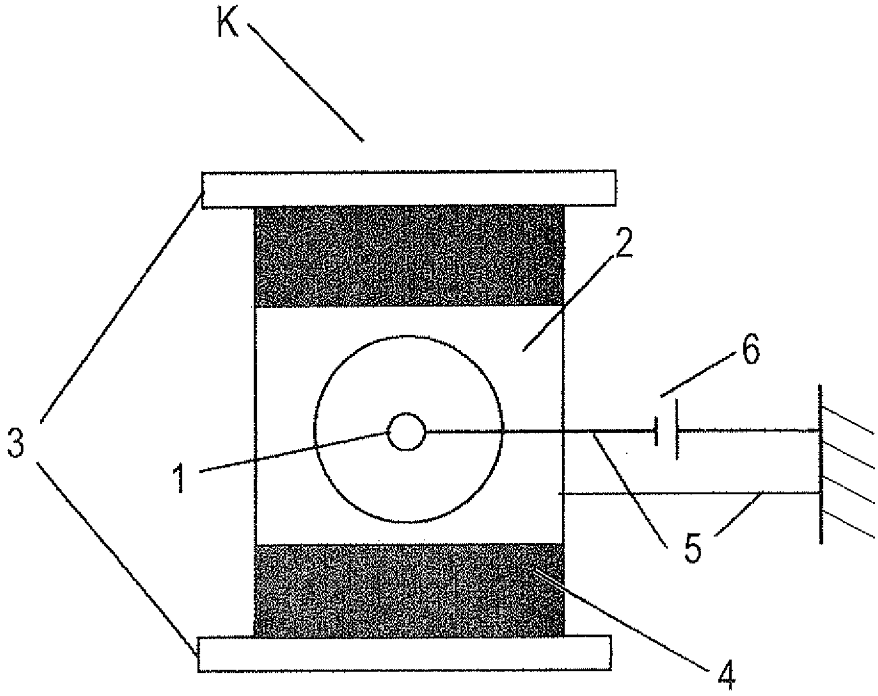


FIG. 3

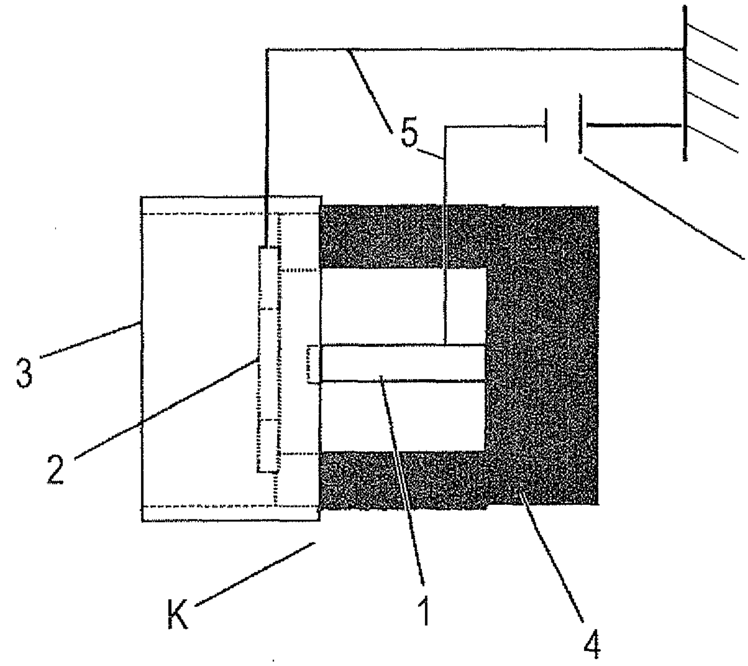


FIG. 4

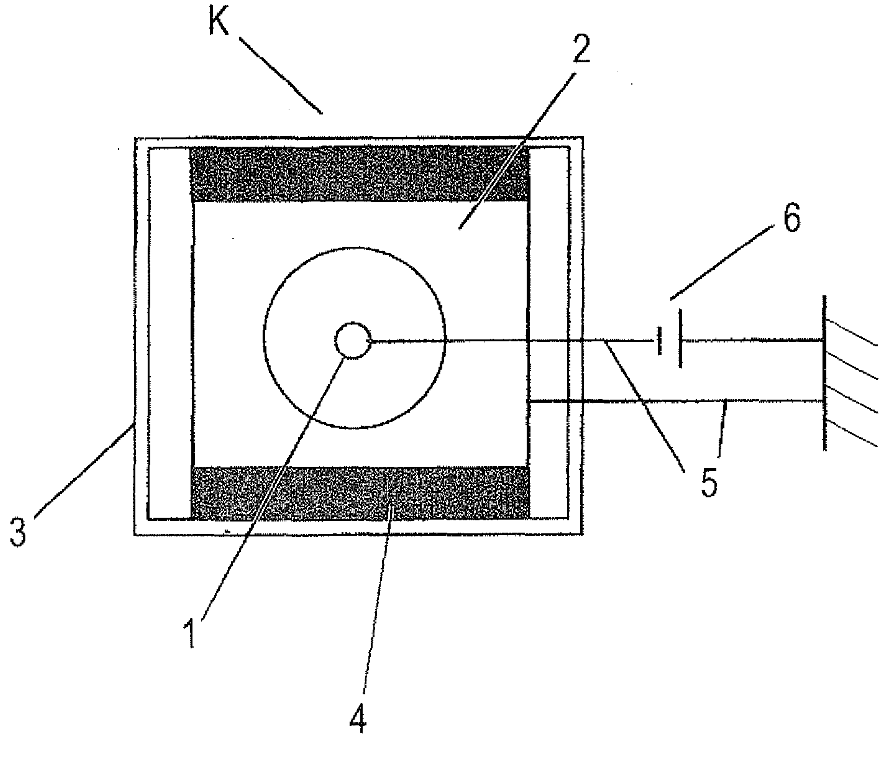


FIG. 5

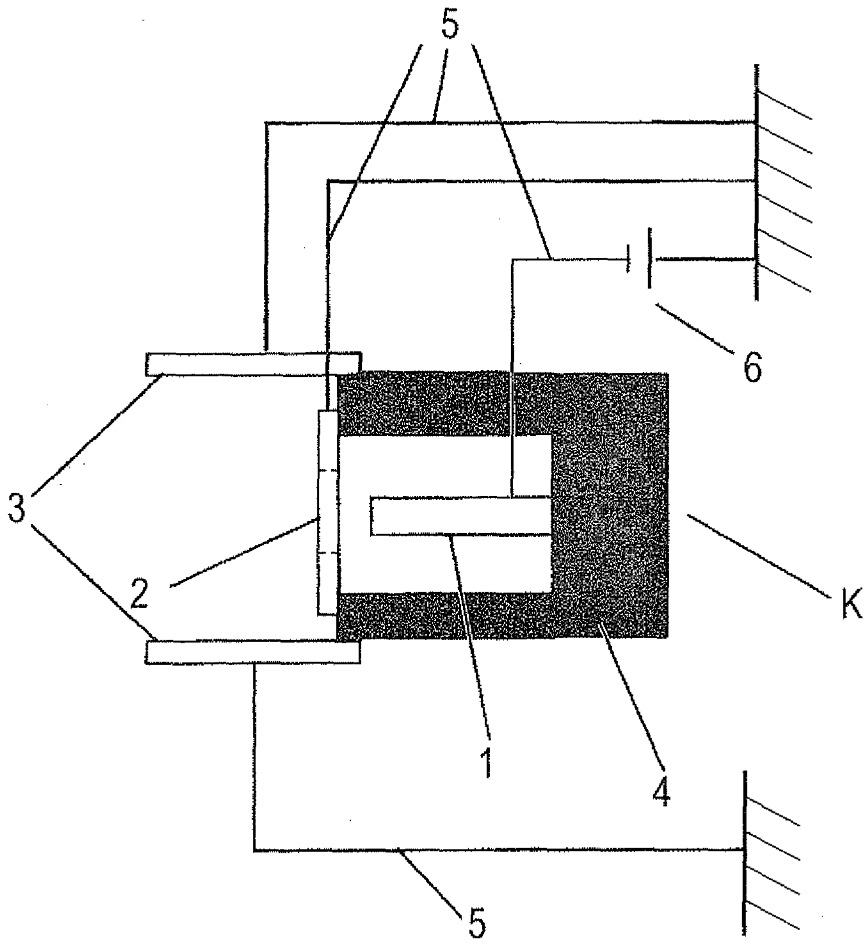


FIG. 6

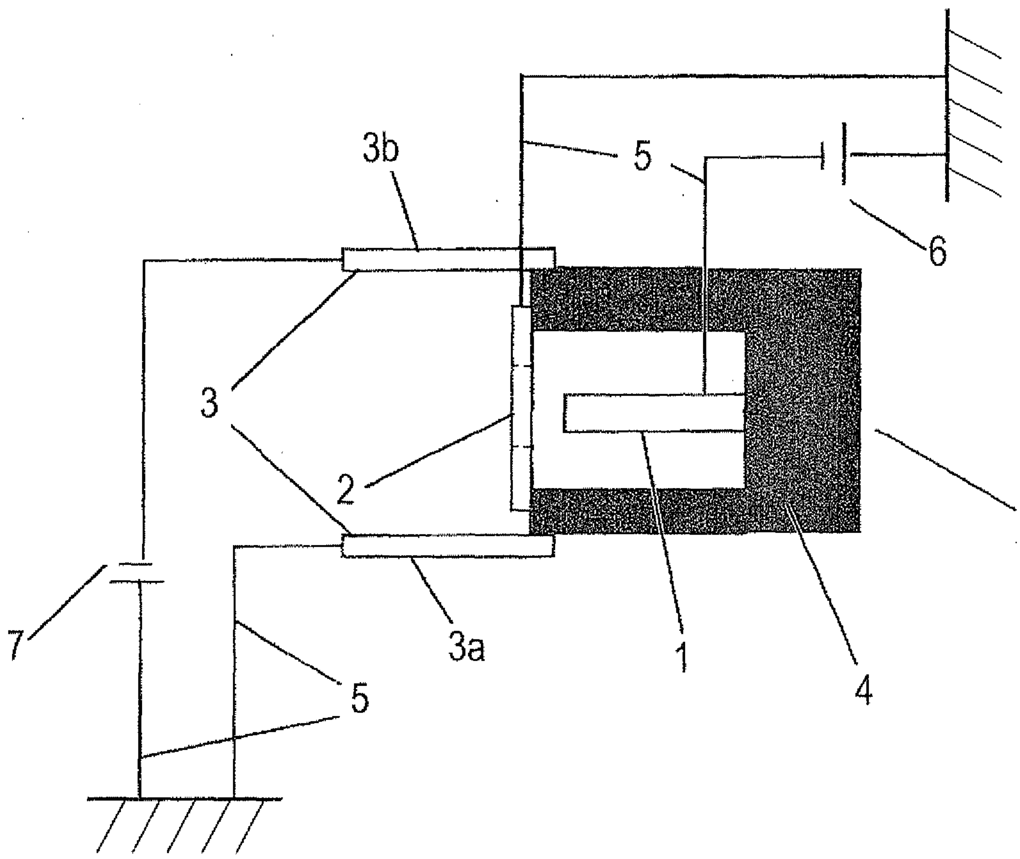


FIG. 7

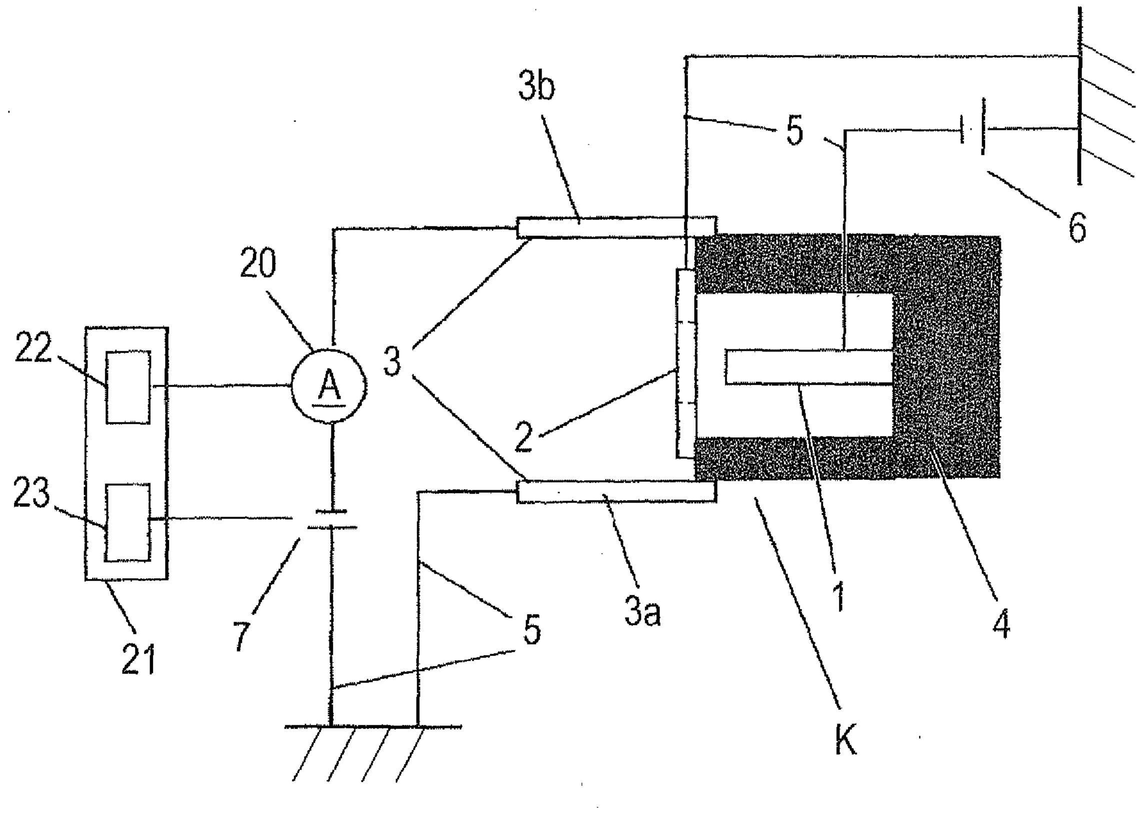
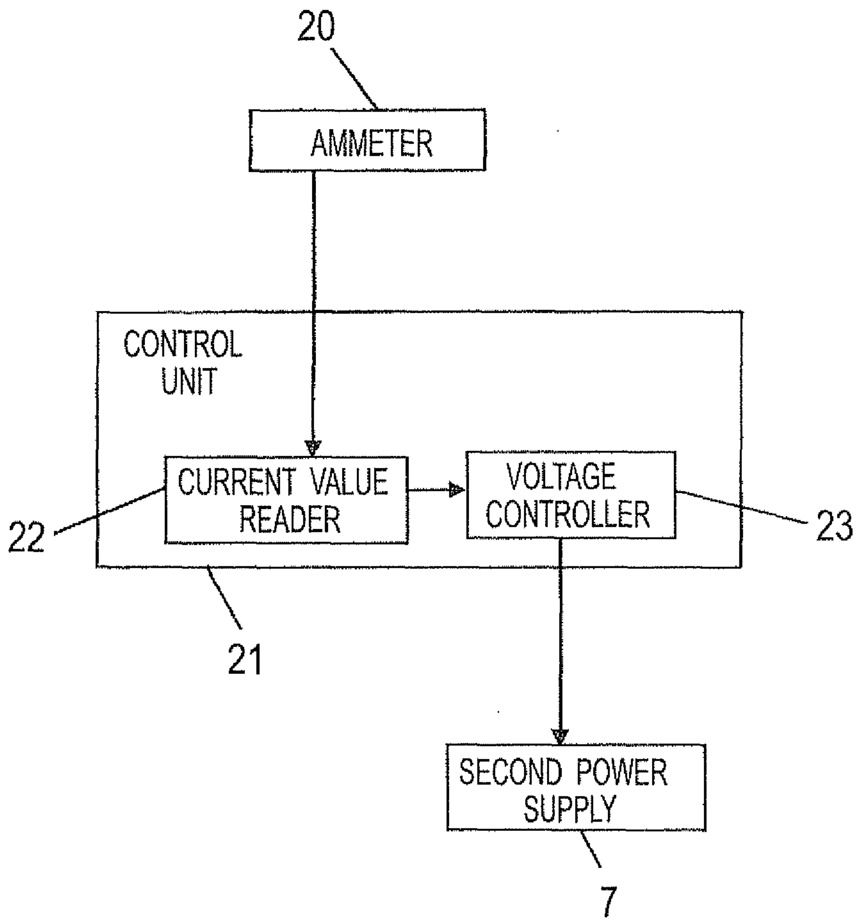


FIG. 8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AMMETER
CONTROL UNIT
CURRENT VALUE READER
VOLTAGE CONTROLLER
22
23
21
SECOND POWER SUPPLY
7

FIG. 9

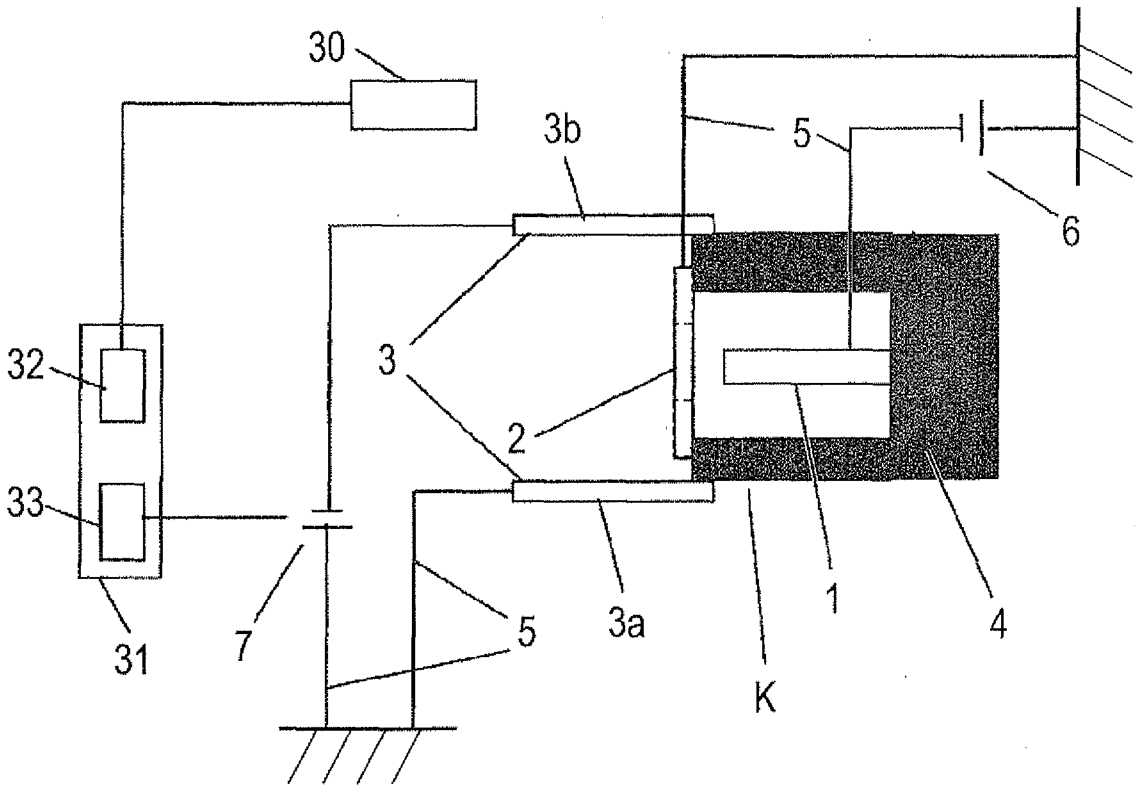
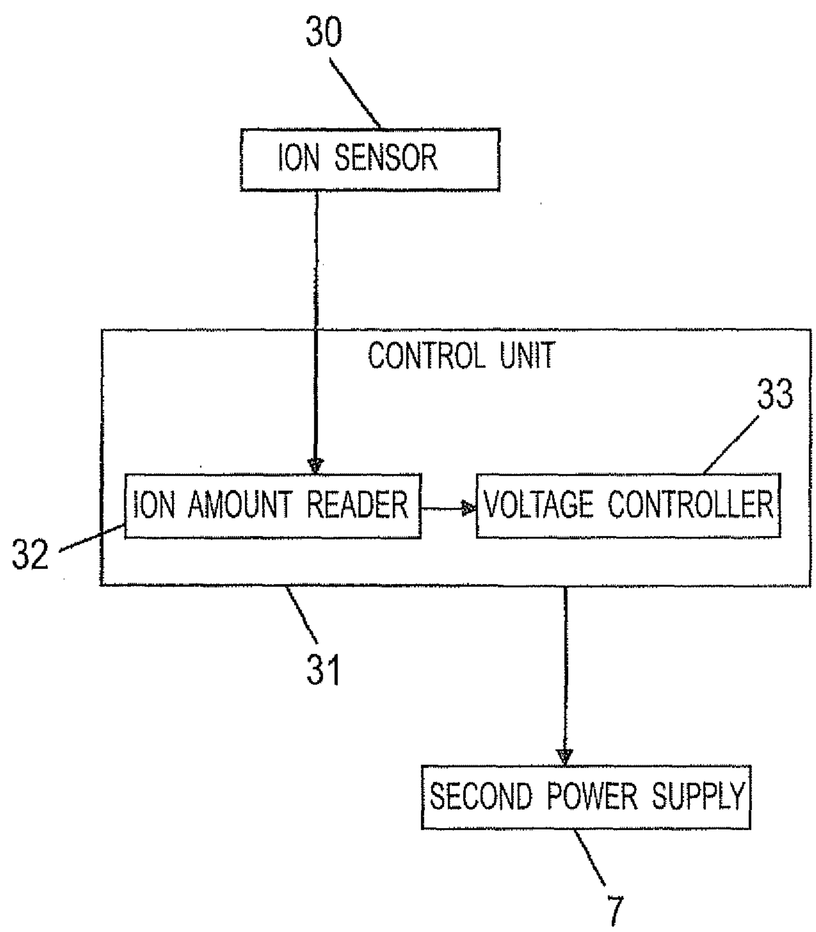


FIG. 10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ION SENSOR
CONTROL UNIT
33
ION AMOUNT READER
VOLTAGE CONTROLLER
32
31
SECOND POWER SUPPLY
7

FIG. 11

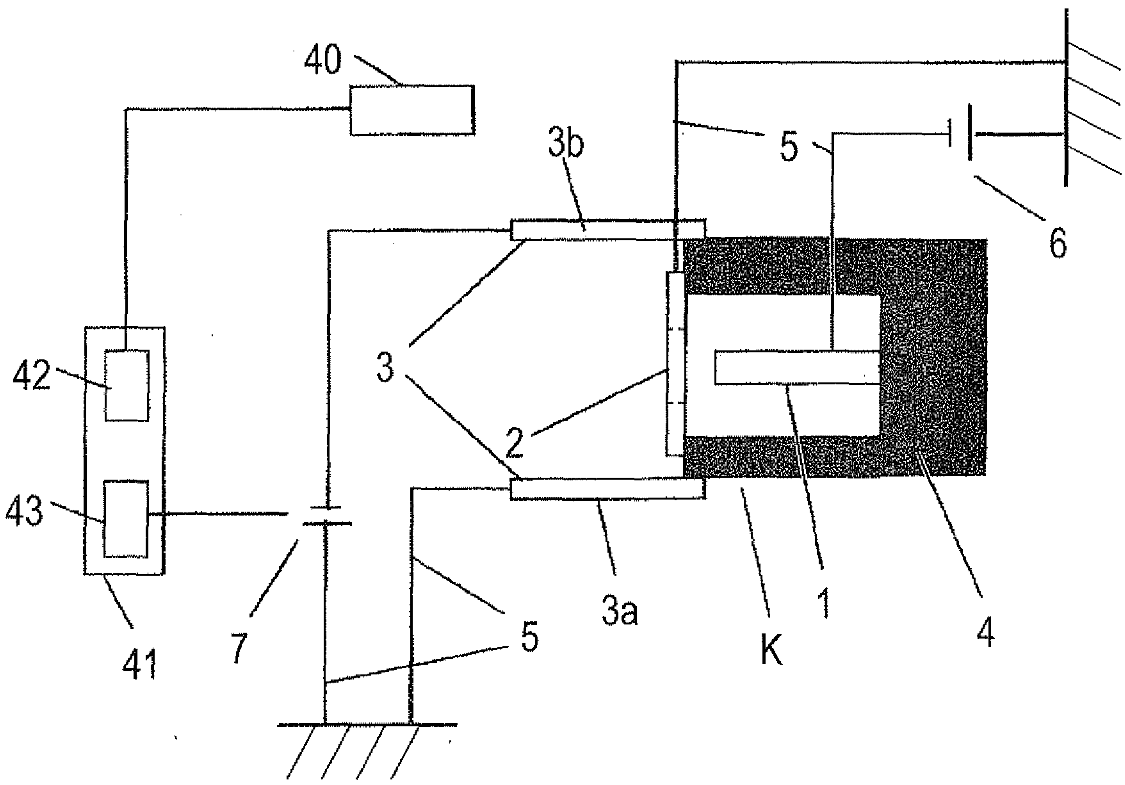


FIG. 12

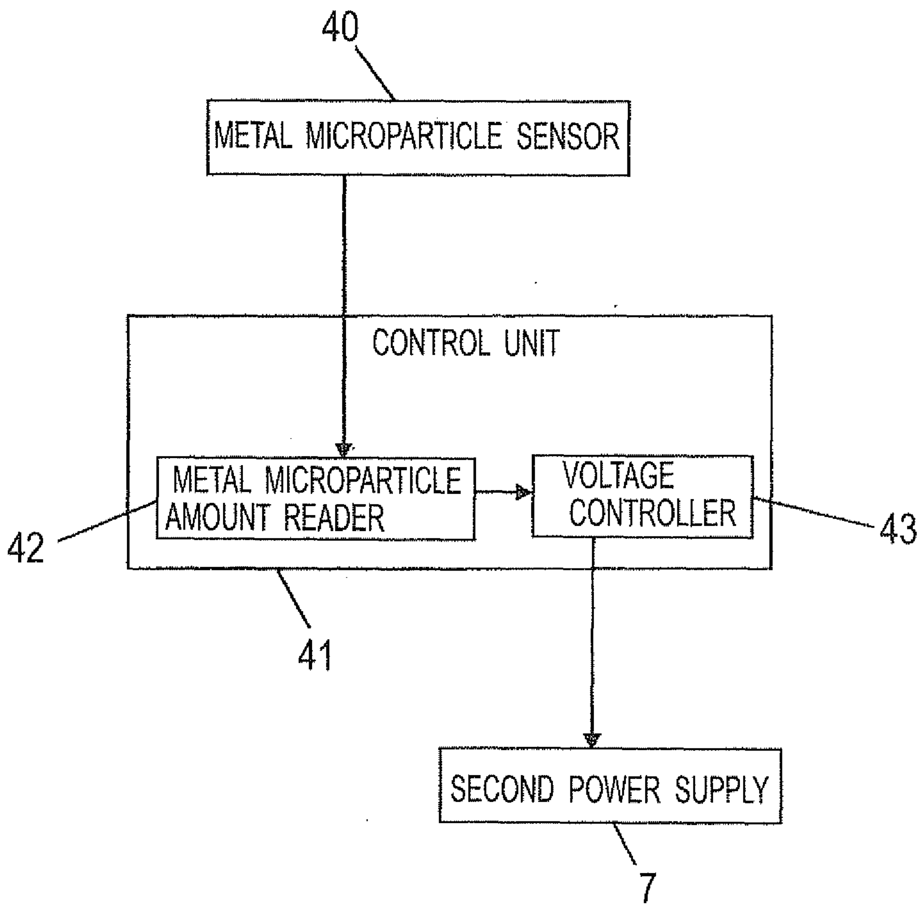
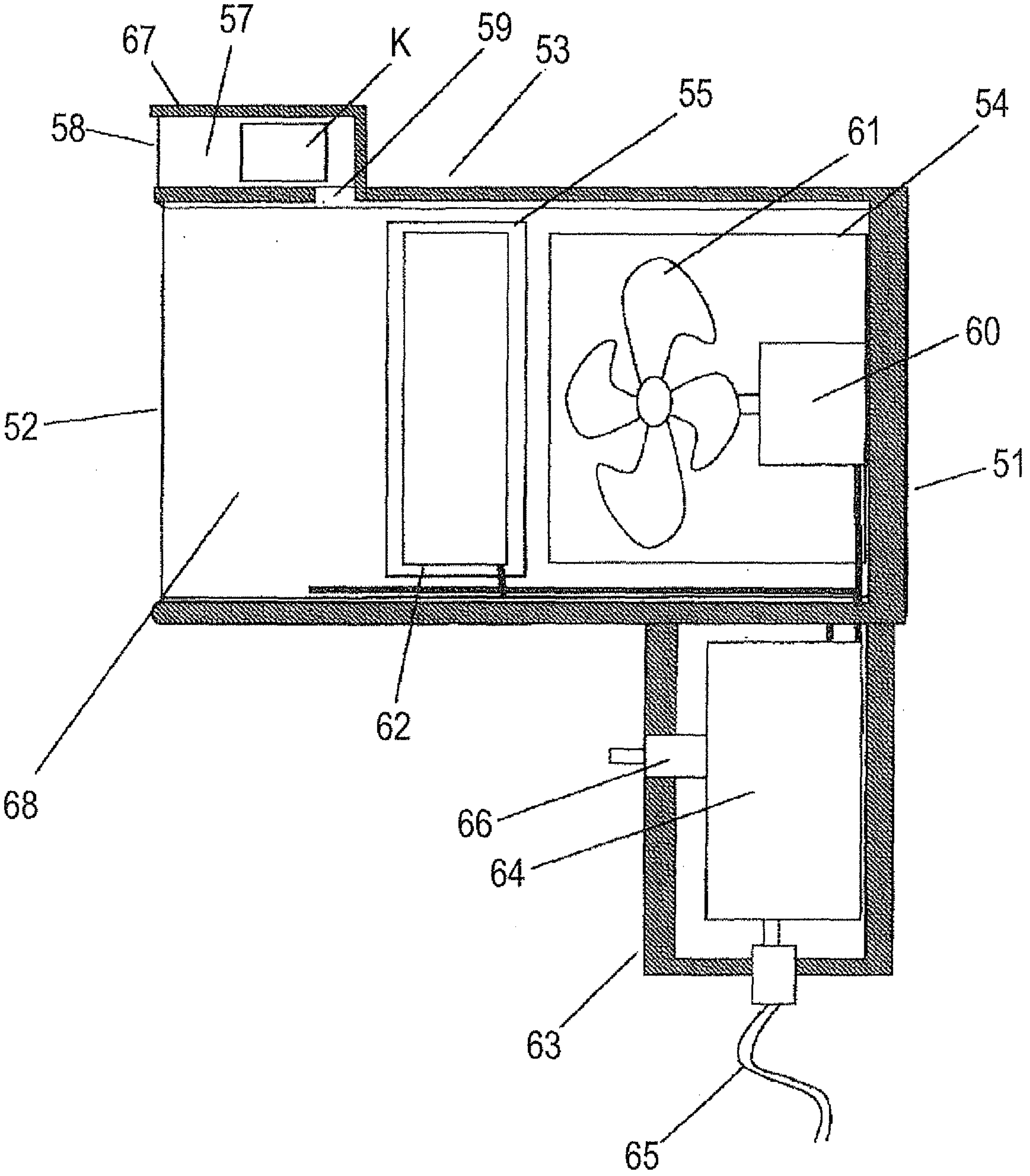

40
METAL MICROPARTICLE SENSOR
CONTROL UNIT
METAL MICROPARTICLE AMOUNT READER
VOLTAGE CONTROLLER
42
43
41
SECOND POWER SUPPLY
7

FIG. 13



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/058804

A. CLASSIFICATION OF SUBJECT MATTER
B22F9/14(2006.01)i, *A45D20/12*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B22F9/14, A45D20/12

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2010
Kokai Jitsuyo Shinan Koho	1971-2010	Toroku Jitsuyo Shinan Koho	1994-2010

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2008-023063 A (Matsushita Electric Works, Ltd.), 07 February 2008 (07.02.2008), claims (Family: none)	1-9
A	JP 2000-301025 A (Kensetsu Rubber Co., Ltd.), 31 October 2000 (31.10.2000), claims (Family: none)	1-9
A	JP 59-193158 A (Nippon Soken, Inc.), 01 November 1984 (01.11.1984), claims (Family: none)	1-9

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 August, 2010 (23.08.10)	31 August, 2010 (31.08.10)

Name and mailing address of the ISA/	Authorized officer
Japanese Patent Office	
Facsimile No.	Telephone No.

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Patent documents cited in the description

- JP 2008023063 A **[0004]**