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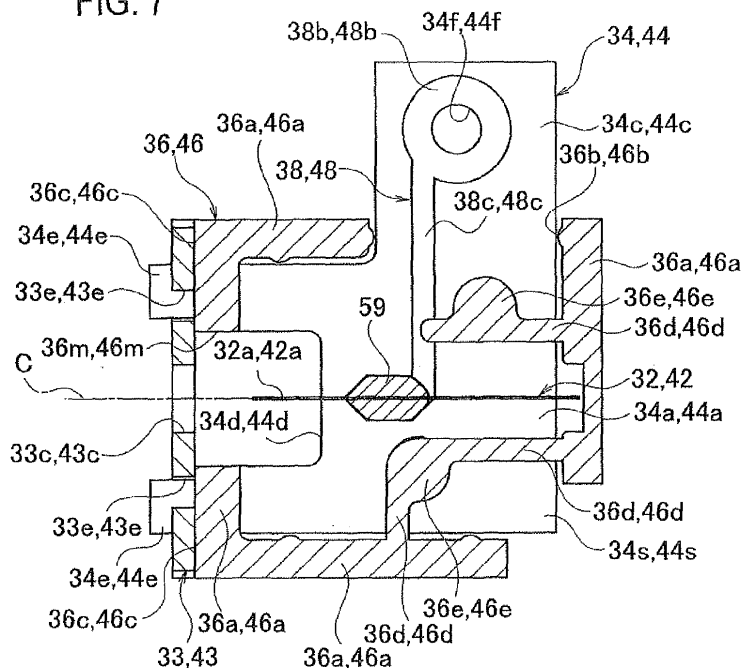
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(54) **Hair care device comprising metallic microparticle generation units**

(57) A hair care device (1) includes metallic microparticle generation units (30,40) each of which has a first electrodes (32,42) containing metal and disperses the metal into microparticles by discharge. The first electrode

(32) of one of the metallic microparticle generation units contains a different kind of metal from the first electrode (42) of another of the metallic microparticle generation units. According to the hair care device, a hair care effect can be enhanced.

FIG. 7



Description

FIELD

[0001] The present invention relates to a hair care device such as a hair dryer.

BACKGROUND

[0002] As a conventional hair care device, known is a hair dryer that has a discharger (metallic microparticle generation device) that disperses metal contained in electrodes into microparticles by discharge (e.g. Japanese Patent Application Laid-Open No. 2008-23063: Patent Document 1).

[0003] According to the hair dryer disclosed in the Patent Document 1, various kinds of microparticles are generated by including various kinds of metals in the electrodes to make the various kinds of microparticles attached onto hair.

SUMMARY

[0004] However, in the hair dryer disclosed in the Patent Document 1, the various kinds of microparticles are generated by including different kinds of metals in a pair of electrodes. According to the configuration in which the various kinds of metals are discharged by a single discharger (the pair of electrodes), it is hard to adjust each generated amount of metallic microparticle. Therefore, it is hard to enhance its hair care performance.

[0005] An object of the present invention is to provide a hair care device that can enhance a hair care effect.

[0006] An aspect of the present invention provides a hair care device that includes three or more ion generation units each of which generates ions. At least two of the ion generation units also function as metallic microparticle generation units and each of which has a first electrode containing metal that is to be dispersed into microparticles by discharge. The first electrode of one of the metallic microparticle generation units contains a different kind of metal from the first electrode of another of the metallic microparticle generation units.

[0007] According to the aspect of the present invention, it becomes possible to adjust each generated amount of metallic microparticles with respect to each of the metallic microparticle generation units. As a result, a hair care effect can be improved.

[0008] It is preferable that the metallic microparticle generation units include dischargers that disperse metals contained in the electrodes into microparticles by discharge, respectively, and one of the dischargers has a different configuration from another of the dischargers.

[0009] According to this configuration, it becomes easier to adjust each generated amount of metallic microparticles.

[0010] It is preferable that the metallic microparticle generation units include discharge circuits, respectively,

and communally have a single voltage application circuit for the discharge circuits, and circuit characteristics of the discharge circuits are differentiated from each other.

[0011] According to this configuration, it becomes possible to adjust each generated amount of metallic microparticles together with simplification of configuration and cost reduction.

[0012] It is preferable that each of the metallic microparticle generation units further include a second electrode, and the second electrode of the one of the metallic microparticle generation units and the second electrode of the other of the metallic microparticle generation units are communally formed of a single member.

[0013] According to this configuration, configurations of the second electrodes can be simplified and costs for the second electrodes can be reduced.

[0014] It is preferable that the first electrode of the one of the metallic microparticle generation units is distanced from the first electrode of the other of the metallic microparticle generation units with a distance larger than any of diameters of the first electrodes of the one and the other of the metallic microparticle generation units.

[0015] According to this configuration, discharge at the metallic microparticle generation units can be made stable, so that reduction of ejection performance of the metallic microparticle generation units can be restricted.

[0016] It is preferable that at least one of the ion generation units is a mist generation unit that disperses mists.

[0017] According to this configuration, in addition to a hair care effect due to mists generated by the mist generation unit, the mists help metallic microparticles reach to hair. As a result, a hair care effect can be further enhanced.

[0018] It is preferable that the one of the metallic microparticle generation units and the other of the metallic microparticle generation units are arranged parallel.

[0019] According to this configuration, it becomes possible that metallic microparticles of different kinds of metals are mixed and then attached to hair. Therefore, it can be prevented that the metallic microparticles attach to hair nonuniformly. As a result, a hair care effect can be further improved.

[0020] Here, it is further preferable that a distance between the first electrodes of the one and the other of the metallic microparticle generation units is set shorter than a distance between a first electrode of the mist generation unit and any of the first electrodes of the one and the other of the metallic microparticle generation units.

[0021] According to this configuration, it becomes possible that metallic microparticles of the different kinds of metals are mixed unfaillingly and then attached to hair. Therefore, it can be prevented that the metallic microparticles attach to hair without mixture of at least one of the different kinds of metals with the mists. As a result, a hair care effect can be further improved.

[0022] It is preferable that a case is provided at a downstream side of ions generated by the ion generation units, and distances between first electrodes of the ion gener-

ation units and the case are set based on potential differences applied to the ion generation units.

[0023] According to this configuration, it becomes possible to restrict charged ions from attaching to the case with respect to each of the ion generation units. In other words, it becomes possible to adjust an amount of ions to be attached to hair with respect to each of the ion generation units. As a result, the ions can be attached to hair with an appropriate mixture ratio of respective kinds of ions.

[0024] It is preferable that each ion ejection port of the ion generation units is provided independently.

[0025] According to this configuration, it can be restricted that charged ions of a kind interfere with the ion generation unit that generates ions of another kind, so that reduction of ion ejection performance can be restricted. Especially, in a case where the ions are ejected by use of airflows, it becomes possible to form ion ejection paths for the respective kinds of ions by use of the airflows. As a result, it can be restricted more effectively that charged ions of a kind interfere with the ion generation unit that generates ions of another kind.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026]

FIG. 1 is a cross-sectional view showing a hair dryer as a hair care device according to one embodiment; FIG. 2 is a front view of the hair dryer viewed from a side of its air inlet;

FIG. 3 is an enlarged cross-sectional plan view showing a section on which metallic microparticle generation units and a mist generation unit are provided in a main body of the hair dryer;

FIG. 4A is a perspective view showing the two metallic microparticle generation units;

FIG. 4B is a front view showing the two metallic microparticle generation units viewed from a side of their opposite discharge electrodes;

FIG. 4C is a cross-sectional view taken along a line IVB - IVB shown in FIG. 4B;

FIG. 5 is an enlarged perspective view showing the metallic microparticle generation unit;

FIG. 6 is an enlarged front view showing the metallic microparticle generation unit viewed from a side of its opposite discharge electrode;

FIG. 7 is an enlarged cross-sectional view taken along a line VII - VII shown in FIG. 6;

FIG. 8 is an enlarged side view showing a substrate in the metallic microparticle generation unit;

FIG. 9 is an enlarged side view showing the metallic microparticle generation unit;

FIG. 10 is an enlarged cross-sectional view taken along a line X - X shown in FIG. 9;

FIG. 11A is an enlarged cross-sectional view showing dischargers of the metallic microparticle generation units that have different configuration (example

1);

FIG. 11B is an enlarged cross-sectional view showing dischargers of the metallic microparticle generation units that have different configuration (example 2);

FIG. 11C is an enlarged cross-sectional view showing dischargers of the metallic microparticle generation units that have different configuration (example 3);

FIG. 12 is a schematic diagram showing discharge circuits of the metallic microparticle generation units; FIG. 13 is an enlarged cross-sectional front view showing a section on which the metallic microparticle generation units and the mist generation unit are provided in the main body of the hair dryer;

FIG. 14 is an enlarged cross-sectional front view showing ion outlets on the main body of the hair dryer;

FIG. 15A is an enlarged front view showing a modified example of the opposite discharge electrodes in the dischargers of the metallic microparticle generation units; and

FIG. 15B is an enlarged cross-sectional side view of the modified example of the opposite discharge electrodes.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0027] Hereinafter, a hair care device (specifically, a hair dryer) 1 according to an embodiment will be explained with reference to the drawings.

[0028] The hair dryer (hair care device) 1 in the present embodiment has a handle grip 1a to be held by a user's hand, and a main body 1b connected with the handle 1a along so along a crossing direction therewith. The hair dryer 1 has a T-shaped or L-shaped appearance (T-shaped in the present embodiment) when used due to the handle 1a and the main body 1b. An electrical cord 2 is led out from an end of the handle 1a. In addition, the handle 1a is segmented into a base 1c on the main body 1a and a grip 1d. The base 1c and the grip 1d are rotatably coupled with each other via a joint portion 1e. The grip 1d can be folded to a position parallel to the main body 1a.

[0029] A case 3 composing an outer shell of the hair dryer 1 is configured by coupling plural segmented parts. A cavity is formed within the case 3, and various electrical components are housed in the cavity.

[0030] An air channel 4 is formed within the main body 1a. The air channel 4 is formed along a longitudinal direction of the main body 1a (a horizontal direction in FIG. 1) from an inlet opening 4a on one side (right side) to an outlet port 4b. Airflow W is generated by rotating a fan 5 housed in the air channel 4. Namely, air (the airflow W) flows into the inside of the air channel 4 from outside through the inlet opening 4a, and is discharged from the outlet port 4b through the inside of the air channel 4.

[0031] An inner tube 6 that has a cylindrical shape and its both ends are opened is provided within an outer tube

3a of the case 3. The airflow W flows inside the inner tube 6. The fan 5, a motor 7 for driving the fan 5, and a heater 8 as a heating unit are provided in the inside of the inner tube 6 in this order from upstream. When heater 8 is operated, warm air is blown out from the outlet port 4b. Note that, in the present embodiment, a belt- and wave-shaped electrical resistor is wound along an inner circumference of the inner tube 6 to configure the heater 8. But the configuration of the heater 8 is not limited to this.

[0032] Metallic microparticle generation units 30 and 40, a mist generation unit 50, and a voltage application circuit 12 that applies voltage to the mist generation unit 50 are provided in a cavity 9 in the main body 1a. The cavity 9 is formed between the case 3 and the inner tube 6. In addition, a voltage application circuit 14 that applies voltage to the metallic microparticle generation units 30 and 40, and a switch 15 by which hot air/cold air is switched over and operation modes are changed are provided in a cavity 13 formed within the base 1c of the handle 1b.

[0033] Another switch 16 by which power-on/off is switched over and operation modes are changed are provided in a cavity formed within the grip 1d of the handle 1b. These electrical components are connected with each other via lead wires (not shown) that is composed of a core wire(s) made of metallic conductor or the like and a sheath made of insulating resin or the like for covering the core wire. Note that the switches 15 and 16 can change open/close states of their internal contact points by operating the operation knobs 17 and 18 exposed on a surface of the handle 1b.

[0034] As shown in FIG. 2, an operation knob 19 is exposed on a side surface of the base 1c (the case 3). On/off of the metallic microparticle generation units 30 and 40 or the mist generation unit 50 can be changed by operating the knob 19.

[0035] As shown in FIG. 1, the voltage application circuits 12 and 14 are preferably arranged in the handle 1a or in an area extended from the handle 1a within the main body 1a. Due to this arrangement, rotational moment can be reduced due to masses of the voltage application circuits 12 and 14 when a user holds the handle 1b. As a result, a load applied to a user's hand can be deduced.

[0036] In addition, in the present embodiment, the voltage application circuits 12 and 14 are provided so as to arrange them on opposed side to each other with interposing the inner tube 6 therebetween. Namely, by interposing the inner tube 6 between the voltage application circuits 12 and 14, troubles can be restricted such as voltage reduction or voltage fluctuation due to mutual interference of the voltage application circuits 12 and 14.

[0037] The inner tube 6 includes a tubular portion 6a, plural support ribs 6b (only one is shown in FIG. 1) and a flange 6c. The support ribs 6b radially extend outward from the tubular portion 6a. The flange 6c is connected with the tubular portion 6a via the support ribs 6b and radially extends outward from the tubular portion 6a. A gap g1 is formed between the tubular portion 6a and the

flange 6c. Some volume of the airflow W is branched to be flown into the inside of the cavity 9 via the gap g1 and forms branched flow Wp. Note that the gap g1 as an induction port of the branched flow Wp into the cavity 9 is located downstream of the fan 5 and upstream of the heater 8. Therefore, the branched flow Wp is relatively cool airflow before heated by the heater 8.

[0038] Note that it is preferable that lead wires connected to the metallic microparticle generation unit 30, lead wires connected to the metallic microparticle generation unit 40 and lead wires connected to the mist generation unit 50 are not crossed with each other and are spaced with each other as much as possible. According to this configuration, troubles can be restricted such as voltage reduction and voltage fluctuation in the units 30, 40 and 50 due to mutual interference of electrical current flowing along the lead wires.

[0039] An ellipsoidal through hole 3b is formed at a side of the outlet port 4b of the cavity 9. The through hole 3b is covered by a cover 20 made of an insulating synthetic resin. Metallic microparticle ejection ports 20a and 20b and a mist ejection port 20c are formed separately on the cover 20. It is preferable that conductivity of the cover 20 is made lower than that of the case 3 in order to prevent the cover 20 from being electrically charged due to metallic microparticles and mists. If the cover 20 is electrically charged, electrically charged metallic microparticles and mists become hard to be ejected from the units 30, 40 and 50 due to the electrical charge of the cover 20. Note that the cover 20 composes the outer shell of the hair dryer 1 at this portion.

[0040] The metallic microparticle generation units 30 and 40 includes discharge electrodes (first electrodes) 32 and 42, and opposite discharge electrodes (second electrodes) 33 and 43. The voltage application circuit 14 applies high voltage (-1 kV to -3 kV in the present embodiment) between the discharge electrodes 32 and 42 and the opposite discharge electrodes 33 and 43 to provoke discharge (such as corona discharge), so that metallic microparticles (such as metal molecules or ions) are ejected from the discharge electrodes 32 and 42 and the opposite discharge electrodes 33 and 43 due to the provoked discharge.

[0041] As shown in FIGs. 4A to 4C, the metallic microparticle generation units 30 and 40 have the almost the same shape. One of the metallic microparticle generation units 30 and 40 is rotated upside down around its center axis C (see FIG. 7) and coupled with another and then the coupled units 30 and 40 are installed in the cavity 9. The metallic microparticle generation units 30 and 40 are aligned parallel in a width direction V (see FIG. 2) of the hair dryer 1. Note that the metallic microparticle generation units 30 and 40 may have different shapes.

[0042] Hereinafter, detailed configurations of the metallic microparticle generation unit 30 (40) will be explained.

[0043] As shown in FIG. 5, the metallic microparticle generation unit 30 (40) includes a casing 35 (45) that is

composed of a box-shaped first member 36 (46) and a plate-shaped second member 37 (47). The discharge electrode 32 (42) is fixed on a substrate (support member) 34 (44) held between the first member 36 (46) and the second member 37 (47).

[0044] The discharge electrode 32 (42) is configured as an ultrafine wire, and its width (diameter) is set to 10 to 400 μm (preferably 30 to 300 μm , more preferably 50 to 200 μm). Note that its cross-sectional shape may have various shapes such as a circular shape, an ellipsoidal shape and a polygonal shape.

[0045] In addition, the discharge electrode 32 (42) is made of simple substance or alloy of transition metal (such as gold, silver, copper, platinum, zinc, titanium, rhodium, palladium, iridium, ruthenium and osmium) or material plated with transition metal, for example. In a case where metallic microparticles ejected from the metallic microparticle generation unit 30 (40) include gold, silver, copper and so on, antibacterial effect emerges by the metallic microparticles. In a case where metallic microparticles include platinum, zinc, titanium and so on, anti-oxidation effect emerges by the metallic microparticles. Note that it is known that platinum microparticles emerges extremely high antioxidation effect.

[0046] Further, the metallic microparticle generation unit 30 (40) may take another configuration. For example, the metallic microparticle generation unit 30 (40) generates ions (for example, minus ions such as NO_2^- and NO_3^-) due to electrical discharge and then generates metallic microparticles by striking the minus ions to the discharge electrode 32 (42), the opposite discharge electrode 33 (43), another member including a metallic material or a metallic component, or the like. Namely, the opposite discharge electrode 33 (43) and the other member may be made of the above-mentioned transition metal in order to eject metallic microparticles from them.

[0047] As shown in FIGs. 6 and 7, the discharge electrode 32 (42) is fixed (soldered) on a wiring pattern 38 (48) formed on a surface 34s (44s) of the substrate 34 (44) using solder 9.

[0048] As shown in FIGs. 7 and 8, the substrate 34 (44) is formed by cutting a plate-shaped printed substrate into a desired shape(s). The substrate 34 (44) includes a rectangular base portion 34a (44a) and an extending portion 34c (44c) extending upward (in FIGs. 7 and 8) from the base portion 34a (44a). In addition, an almost rectangular cutout 43d (44d) is formed on a left section (in FIGs. 7 and 8) of the base portion 34a (44a) so as to form a pair of extending portions 34e (44e).

[0049] The wiring pattern 38 (48) made of electrically conductive material is formed on the surface 34s (44s) of the substrate 34 (44). The wiring pattern 38 (48) includes a land portion 38a (48a), a terminal portion 38b (48b), and a lead portion 38c (48c). The discharge electrode 32 (42) formed as a wire is soldered on the land portion 38a (48a). A lead wire (not shown) is electrically connected to the terminal portion 38b (48b). The lead portion 38c (48c) electrically connects the land portion

38a (48a) with the terminal portion 38b (48b).

[0050] As shown in FIG. 8, angulated ends 38d and 38e (48d and 48e) are formed at both left and right end (in FIG. 8) of the land portion 38a (48a). The center axis C indicates a center axis of an opening 33c (43c) (see also FIGs. 5 and 6) formed on the opposite discharge electrode 33 (43). The angulated ends 38d and 38e (48d and 48e) is set at positions that overlap the center axis C as shown in FIG. 8. Therefore, the discharge electrode 32 (42) can be set along the center axis C accurately as shown in FIG. 7 by putting the discharge electrode 32 (42) as a wire along the angulated ends 38d and 38e (48d and 48e) and then soldering the discharge electrode 32 (42) on the land portion 38a (48a). In other words, the angulated ends 38d and 38e (48d and 48e) function as markers for locating the discharge electrode 32 (42). In the present embodiment, the discharge electrode 32 (42) is fixed in a state where its distal end 32a (42a) protrudes into the cutout 34d (44d).

[0051] The terminal portion 38b (48b) is formed annularly so as to surround a through hole 34f (44f). The through hole 34f (44f) is formed on the extending portion 34c (44c) so as to penetrate from the surface 34s (44s) to another surface 34b (44b). The lead wire (not shown) that is passed through the through hole 34f (44f) is soldered to the terminal portion 38b (48b). Note that it is preferable that the wiring pattern 38 (48) is made of material that forms eutectic connection with the solder 59 (for example, nickel, stainless steel plated with tin nickel alloy, or the like).

[0052] As shown in FIG. 6, the opposite discharge electrode 33 (43) includes a rectangular base portion 33a (43a), and a terminal portion 33b (43b) extending leftward (in FIG. 6) from the base portion 33a (43a). The terminal portion 33b (43b) extends outward from the casing 35 (45).

[0053] The circular opening 33c (43c) as an ejection port of metallic microparticles is formed at an almost center of the base portion 33a (43a). As shown in FIG. 6, the discharge electrode 32 (42) is located at an almost center of the opening 33c (43c) when viewed from front. In addition, a through hole 33d (43d) is formed on the terminal portion 33b (43b). A lead wire (not shown) is inserted into the through hole 33d (43d) and then electrically connected with the opposite discharge electrode 33 (43).

[0054] Rectangular cutouts 33e (43e) are formed on both upper and lower edges (in FIGs. 5 and 6) of the opposite discharge electrode 33 (43), respectively. The extending portions 34e (44e) (see FIG. 8) of the substrate 33 (43) are coupled with the cutouts 33e (43e), respectively. In addition, two circular through holes 33f (43f) are formed on the base portion 33a (43a) of the opposite discharge electrode 33 (43) as shown in FIG. 6.

[0055] On the other hand, two projections 36g (46g) associated with the through holes 33f (43f) are formed on a front side surface 36c (46c) of the first member 36 (46) composing the casing 35 (45). When attaching the opposite discharge electrode 33 (43) onto the first mem-

ber 36 (46), the projections 36g (46g) are inserted into the through holes 33f (43f) and then ends of the projections 36g (46g) projecting through the through holes 33f (43f) are heated to form head portions 36h (46h) [i.e. heat staking].

[0056] As shown in FIGs. 9, 10 and 7, the first member 36 (46) composing the casing 35 (45) includes a rectangular bottom portion 36i (46i), sidewall portions 36a (46a) projecting from circumference edges of the bottom portion 36i (46i), ribs 36d (46d) (see FIG. 7) projecting from the bottom portion 36i (46i), and two projections 36e (46) projecting from the bottom portion 36i (46i) and integrally provided with the ribs 36d (46d). Note that an opening 36m (46m) (see FIG. 7) associated with the opening 33c (43c) of the opposite discharge electrode 33 (43) is formed on a sidewall portion 36a (46a) contacting with the opposite discharge electrode 33 (43). In addition, a rectangular cutout 37a (47a) and two through holes 37b (47b) are formed on the second member 37 (47) that is another member composing the casing 35.

[0057] The substrate 34 (44) is fixed between the first member 36 (46) and the second member 37 (47). When fixing the substrate 34 (44), the substrate 34 (44) is laid on upper surfaces 36k (46k) of the ribs 36d (46d), a bottom surface of a cutout 36b (46b) (see FIG. 5) formed on the sidewall portion 36a (46a) and so on as shown in FIG. 10 and 7, and then the second member 37 (47) is further laid on the substrate 34 (44). At this time, the substrate 34 (44) is in a state where its surface 34s (44s) on which the discharge electrode 32 (42) is fixed faces to the bottom portion 36i (46i) and a space is formed between the surface 34s (44s) and the bottom portion 36i (46i). In addition, the discharge electrode 32 (42) is located along the center axis C of the opening 33c (43c) as shown in FIG. 10.

[0058] In the state where the substrate 34 (44) and the second member 37 (47) are stacked on the first member 36 (46), the projections 36e (46) of the first member 36 (46) are inserted into through holes 34m (44m) (see FIG. 8) and the through holes 37b (47b) (see FIG. 9) of the second member 37 (47), respectively. Then, ends of the projections 36e (46e) projecting through the through holes 37b (47b) are heated to form head portions 36f (46f) as shown in FIGs. 5, 9 and 10 [i.e. heat staking].

[0059] In this manner, the substrate 34 (44) is integrated so as to be housed in the casing 35 (45) and the discharge electrode 32 (42) fixed on the substrate 34 (44) is surrounded by the casing 35 (45). It is preferable that each shape of the head portions 36f (46f) is differentiated according to a kind of metal contained in the discharge electrode 32 (42) as shown in FIGs. 4A and 4B. According to this, it is easy to determine the kind of metal contained in the discharge electrode 32 (42).

[0060] In addition, openings O are formed on the casing 35 (45) at lateral positions of the distal end 32a (42a) of the discharge electrode 32 (42) as shown in FIGs. 5, 9 and 10. As shown in FIG. 10, the openings O are formed as rectangular openings o1 and o2 (o3 and o4). The

opening o1 (o3) is formed by a cutout 36j (46j) formed on the bottom portion 36i (46i) of the first member 36 (46) and the opposite discharge electrode 33 (43). The opposite discharge electrode 33 (43) closes an open end of the cutout 36j (46j) to form the opening o1 (o3). Similarly, The opening o2 (o4) is formed by the cutout 37a (47a) formed on the second member 37 (47) and the opposite discharge electrode 33 (43). The opposite discharge electrode 33 (43) closes an open end of the cutout 37a (47a) to form the opening o2 (o4). Areas of the openings o1 and o2 (o3 and o4) overlap with each other in a direction (upper - lower direction in FIG. 10) vertical to an extending direction of the discharge electrode 32 (42).

[0061] As described above, the discharge electrode 32 (42) is composed of a wire. Since a wire generally has a uniform diameter along its length, a curvature radius of the distal end 32a (42a) can be easily kept in an almost constant value according to the diameter of the wire. As a result, concentration ratio of electrical field can be easily kept strong, and thereby performance reduction of metallic microparticle generation can be restricted. Note that the same advantage can be obviously achieved in a case where the opposite discharge electrode 33 (43) is formed as a wire. In addition, plural wire may be provided, and both of the discharge electrode and the opposite discharge electrode may be formed so as to have a wire.

[0062] In the present embodiment, the discharge electrode 32 (42) as a wire is soldered on the wiring pattern 38 (48) formed on the substrate 33 (43) as a support member. Therefore, the discharge electrode 32 (42) can be easily fixed and a load applying to the discharge electrode 32 (42) can be made lower than a load in other fixing method. The finer a wire is, the more easily the wire bend. Therefore, fixture by soldering is extremely effective in terms of assurance of positional accuracy of a wire (the discharge electrode 32 (42) in the present embodiment).

[0063] In the present embodiment, the substrate 34 (44) that supports the discharge electrode 32 (42) is integrated with the casing 35 (45) that protects at least the distal end 32a (42a) of the discharge electrode 32 (42). Since the discharge electrode 32 (42) is efficiently protected by the casing 35 (45), the metallic microparticle generation unit 30 (40) can be easily handled when conveyed or installed in the hair dryer (hair care device) 1.

[0064] In the present embodiment, although the openings 33c, 36m (43c, 46m) and O are formed, almost entire length of the discharge electrode 32 (42) is surrounded (protected) by the casing 35 (45). But it is sufficient that at least the distal end 32a (42a) of the discharge electrode 32 (42) that is projected outward from the substrate 34 (44) is surrounded (protected) by the casing 35 (45). A support member (the substrate 34 (44) in the present embodiment) or an electrode that is not formed as a wire (the opposite discharge electrode 33 (43) in the present embodiment) may compose a portion of the casing 35 (45).

[0065] In the present embodiment, the openings O are

formed on the casing 35 (45) at lateral positions of the distal end 32a (42a) of the discharge electrode 32 (42). When the discharge electrode 32 (42) is formed as an ultrafine wire, stiffness of the discharge electrode 32 (42) is reduced and easily bent due to a force applied by a tool at its attaching work. If such a situation occurs in the present embodiment, a position and a condition of the discharge electrode 32 (42) can be easily adjusted through the openings O. As a result, discharge can be done efficiently.

[0066] In the present embodiment, the metallic microparticle generation units 30 and 40 are aligned parallel in the width direction V (see FIG. 2) of the hair dryer 1. Here, a distance D3 between the discharge electrodes 32 and 42 of the metallic microparticle generation units 30 and 40 is made larger than any of diameters of the discharge electrodes 32 and 42 as shown in FIG. 4B. Since the metallic microparticle generation units 30 and 40 are arranged so as to distance one [32] of the discharge electrodes (first electrodes) 32 and 42 away from another [42] of the discharge electrodes (first electrodes) 32 and 42 with the distance D3 larger than any of diameters of the discharge electrodes 32 and 42 as described above, stable discharge can be done.

[0067] Many investigations were done with the above-described metallic microparticle generation units. From results of the investigations, it was found that, when emerging antioxidant effect to hair by supplying platinum microparticles to the hair to recover damages of the hair, damages of hair could be effectively recovered by supplying zinc microparticles in addition to platinum microparticles to the hair.

[0068] Therefore, platinum is contained in the discharge electrode 32 of the metallic microparticle generation unit 30, and zinc is contained in the discharge electrode 42 of the metallic microparticle generation unit 40. Note that it may be possible that platinum is contained in the discharge electrode 42 and zinc is contained in the discharge electrode 32.

[0069] In a case where kinds of metals contained in the discharge electrodes 32 and 42 are differentiated as described above, it is preferable that configurations of discharge portions 31 and 41 of the discharge electrodes 32 and 42 are differentiated. Note that the discharge portion 31 and 41 are portions that disperse metals contained in the discharge electrodes 32 and 42 into microparticles by discharge. Here, the configuration of discharge portion 31 or 41 indicates shapes, lengths, diameters, materials and/or distance between electrodes of the discharge electrode (the first electrode) and the opposite discharge electrode (the second electrode), especially, shapes of their distal ends. In the present embodiment, the discharge portion 31 (41) is composed of the discharge electrode 32 (42) and the opposite discharge electrode 33 (43).

[0070] Examples of differentiation of the configurations of the discharge portions 31 and 41 are shown in FIGs. 11A to 11C. In FIG. 11A, diameters a and b of the dis-

charge electrodes 32 and 42 are differentiated. In FIG. 11B, distances d and c between the discharge electrodes 32 and 42 and the opposite discharge electrodes 33 and 43 are differentiated. In FIG. 11C, opening inner diameters f and e of the opposite discharge electrodes 33 and 43 are differentiated.

[0071] Note that configuration for differentiation is not limited to the examples shown in FIGs. 11A to 11C. It can be done with arbitrary combination among the above three configuration. Alternatively, configurations of the discharge portions 31 and 41 may be differentiated with other methods. Note that examples are shown in FIGs. 11A to 11C in which $b > a$, $d > c$, and $e > f$. However, their inequality relationships may be reversed ($b < a$, $d < c$, and $e < f$).

[0072] In the present embodiment, the metallic microparticle generation units 30 and 40 communally have the single voltage application circuit 14 as their discharge circuits. But circuit characteristics of their discharge circuits are differentiated.

[0073] Specifically, the metallic microparticle generation unit 30 is connected to the voltage application circuit 14 via resistors R31 and R32 each is almost 5 to 30 MΩ as shown in FIG. 12. The metallic microparticle generation unit 40 is connected to the voltage application circuit 14 via resistors R41 and R42 each is almost 5 to 30 MΩ. According to these configurations, high voltage is applied to the metallic microparticle generation units 30 and 40.

[0074] The discharge electrode 32 is connected with a negative terminal of the voltage application circuit 14 via the resistor R31 and negative high voltage is applied thereto. The opposite discharge electrode 33 is connected with a ground terminal of the voltage application circuit 14 via the resistor R32. Note that the opposite discharge electrode 33 is held at ground potential when a resistance value of the resistor R32 is set to zero, and thereby functions as a ground terminal.

[0075] Each of the resistors R31 and R32 is a circuit component that functions as a resistive element and may be a resistive member that takes a desired resistance value. For example, a housing member that houses the discharge portions 31 may function as the resistor R31 or R32. Resistance values of the resistor R31 and R32 are preliminarily set to arbitrary values independently and separately so as to apply discharge voltage suitable for generating a preset amount of ions (negative ions) between the discharge electrode 32 and the opposite discharge electrode 33. Therefore, the resistance values of the resistor R31 and R32 are set differently (to the same value in a certain case).

[0076] The discharge electrode 42 is connected with a negative terminal of the voltage application circuit 14 via the resistor R41 and negative high voltage is applied thereto. The opposite discharge electrode 43 is connected with a ground terminal of the voltage application circuit 14 via the resistor R42. Note that the opposite discharge electrode 43 is held at ground potential when a resistance value of the resistor R42 is set to zero, and thereby func-

tions as a ground terminal.

[0077] Each of the resistors R41 and R42 is a circuit component that functions as a resistive element and may be a resistive member that takes a desired resistance value. For example, a housing member that houses the discharge portions 41 may function as the resistor R41 or R42. Resistance values of the resistor R41 and R42 are preliminarily set to arbitrary values independently and separately so as to apply discharge voltage suitable for generating a preset amount of ions (negative ions) between the discharge electrode 42 and the opposite discharge electrode 43. Therefore, the resistance values of the resistor R41 and R42 are set differently (to the same value in a certain case), and can be set to values different from the resistance value of the resistors R31 and R32.

[0078] The voltage application circuit 14 is configured with an igniter or the like that generates DC high voltage, for example. The voltage application circuit 14 applies preset negative DC high voltage to the discharge portions 31 and 41 of the metallic microparticle generation units 30 and 40 communally and concurrently. Note that voltage application circuit 14 may additionally have a function to apply voltage to only any one of the discharge portions 31 and 41 selectively.

[0079] Alternatively, the voltage application circuit 14 may be configured to generate AC high voltage. In this case, a rectifying diode (not shown) is provided between the resistor R31 and the voltage application circuit 14, and the opposite discharge electrode 33 is connected to the grand terminal of the voltage application circuit 14 via the resistor R32. According to this configuration, ions (negative ions) can be generated similarly to the configuration shown in FIG. 12 by applying negative high voltage from the voltage application circuit 14 to the discharge portion 31.

[0080] Note that the voltage application circuit 14 may generate positive high voltage and apply it to the discharge portions 31 and 41. In this case, the discharge portions 31 and 41 can generate positive ions.

[0081] In the above embodiment, two of the discharge portions 31 and 41 are provided. However, three or more of the discharge portions may be provided. In this case, it is preferable that at least one of the discharge portions has a configuration different from configurations of others of the discharge portions.

[0082] According to the configuration described above, it can be possible to supply electrical power suitable for discharge to each of the discharge portions 31 and 41 from a single electrical power source (the voltage application circuit 14) by providing the resistors R31 and R32 between the voltage application circuit 14 and the discharge portions 31 and 41 and adjusting the resistance values of them independently and separately. Therefore, it is possible to discharge at the discharge portions 31 and 41 with different discharge efficiencies independently suitable for the discharge portions 31 and 41. As a result, a different amount of ions can be generated by each of the discharge portions 31 and 41 to gen-

erate an optimal amount of ions.

[0083] In addition, the voltage application circuit 14 can be shared, and thereby downsizing and cost-reduction can be achieved. Further, conventional discharge units can be utilized by combining them to build the above-described units 30 and 40. Therefore, it is not needed to develop a new discharge unit, and thereby production cost can be reduced.

[0084] Note that an amount of ions to be generated can be adjusted by differentiating the configurations of the discharge portions as well as the circuit characteristics of the discharge circuits thereof.

[0085] Hereinafter, other components of the hair dryer 1 other than the metallic microparticle generation units 30 and 40 will be explained.

[0086] As shown in FIG. 3, the mist generation unit 50 includes a discharge electrode (first electrode) 51a and an opposite discharge electrode (second electrode) 51b that are made of electrically conductive material. The secondary voltage application circuit 12 applies high voltage (-3 kV to -5 kV in the present embodiment) between the discharge electrode 51a and the opposite discharge electrode 51b to provoke discharge (such as corona discharge). Specifically, the discharge electrode 51a is formed so as to have a needle-shaped, and the opposite discharge electrode 51b is formed so as to have an annular and platy shape. The opposite discharge electrode 51b is located on a distal end side of the discharge electrode 51a with distanced from the discharge electrode 51a.

[0087] The mist generation unit 50 includes a Peltier element (not shown) and a cooling plate as a cooling unit. The cooling plate is made of thermally conductive material (e.g. metallic component or the like). Dew condensation water is generated by condensing moisture in air on the cooling plate cooled by the Peltier element. Cooling fins 51c are provided at an upstream side of the mist generation unit 50 in order to radiate heat generated at the Peltier element when cooling the cooling plate. According to this configuration, supplied water, i.e. the dew condensation water, is dispersed into microparticles due to electrical discharge, so that extremely small nanometer-size mists (negatively-charged mists including negative ions) are generated. In the present embodiment, the Peltier element and the cooling plate correspond to a water supply portion.

[0088] The mist generation unit 50 is fixed on a printed substrate (base portion) 52 (see FIG. 3) by soldering, swaging or the like. The printed substrate 52 is laid on a fixing rib (fixing member) 6g (see FIG. 13) projected from an upper wall 6f of the inner tube 6, so that mist generation unit 50 is fixed above the inner tube 6.

[0089] Note that airflow direction/volume through the cavity (branched flow path) 9 can be adjusted to desired direction/volume by varying a shape and a projected position of the fixing rib 6g. Namely, the fixing rib 6g can be utilized as a control means for controlling airflow direction/volume through the cavity (branched flow path) 9.

[0090] With respect to the mist generation unit 50, the nearer to one side end (right end in FIG. 13) of the hair dryer 1 in the width direction V it is, the shorter a distance between the printed board 52 and the upper wall 6f of the inner tube 6 is made. The mist generation unit 50 is arranged in this manner.

[0091] In other word, the printed board 52 is fixed with inclined so as to make its one side (right side in FIG. 13) positioned downward as shown in FIG. 13 when the hair dryer 1 (in a position where the main body 1b is positioned upper and the handle 1a is extended downward) is viewed from a side of the outlet port 4b. By inclining the printed board 52 as described above, the branched flow Wp flowing into the cavity 9 from the gap g1 is further branched into a branched flow flowing through the cooling fins 51c on the printed board 52 and another branched flow through a space between the printed board 52 and the upper wall 6f of the inner tube 6.

[0092] By further branching the branched flow Wp as described above, both of the branched flow mainly utilized for cooling (radiating heat) and the other branched flow mainly utilized for dispersing mists can be created. In addition, more airflow volume of the other branched flow for dispersing mists can be created by making the space between the printed board 52 and the upper wall 6f wider, so that the mist dispersion can be made stable.

[0093] Note that each of the metallic microparticle generation units 30 and 40 and the mist generation unit 50 corresponds to an ion generation portion that generates ions. The metallic microparticle generation unit may take a configuration with a steam generation mechanism that generates steam by heating water. The mist generation unit may take a configuration with a metallic solution atomization mechanism that generates metallic microparticles by atomizing metallic solution.

[0094] In the present embodiment, the metallic microparticle generation units 30 and 40 and the mist generation unit 50 are aligned in the cavity 9 along the width direction of the hair dryer 1. Here, the metallic microparticle generation units 30 and 40 are arranged so as to make a distance D5 between their discharge electrodes 32 and 42 smaller than a distance D4 between the discharge electrode 51a of the mist generation unit 50 and one of the discharge electrodes 32 and 42 (the distance D4 is a smaller one of a distance between discharge electrodes 32 and 51a, and a distance between discharge electrodes 42 and 51a) (see FIG. 13). According to this configuration it is restricted that any one of the metallic microparticle generation units 30 and 40 (the metallic microparticle generation units 30 in the present embodiment) is too distanced from the mist generation unit 50. As a result, it is restricted that any one of different kinds of metallic microparticles (platinum particles in the present embodiment) is not mixed with mist before they reach to hair.

[0095] With respect to the ion generation units 30, 40 and 50, distances D6 and D7 between their discharge electrodes 32, 42 and 51a and an upper case 3c are set

based on potential differences to be applied to the ion generation units 30, 40 and 50 (see FIG. 13). Here, the upper case 3c is a portion of the case 3. The upper case 3c is located at a downstream side (left side in FIG. 1) of the units 30, 40 and 50 in an ion ejection direction, and locates outside the cavity 9 in which the units 30, 40 and 50 are provided. The upper case 3c composes an outer shell of the hair dryer 1 at a downstream side from the metallic microparticle ejection ports 20a and 20b and the mist ejection port 20c in the ion ejection direction.

[0096] In the present embodiment, the single voltage application circuit 14 is communally used by the metallic microparticle generation units 30 and 40, and the separate voltage application circuit 12 is used by the mist generation unit 50. Then, a potential difference applied to the mist generation unit 50 is made larger than that communally applied to the metallic microparticle generation units 30 and 40. Therefore, the metallic microparticle generation units 30 and 40 are arranged so as to make their above-explained distances D6 equivalent to each other. Mists ejected from the mist generation unit 50 to which a larger potential difference is applied are charged more than the metallic microparticles. Therefore, the mist generation unit 50 is arranged so as to make the above-explained distance D7 larger than the distance D6.

[0097] By setting the distances D6 and D7 based on the potential differences applied to the ion generation units 30, 40 and 50 as described above, it is restricted that ions ejected from the units 30, 40 and 50 are drawn toward the upper case 3a. As a result, it can be restricted that a hair care effect is degraded. In addition, it becomes possible to adjust an amount of ions to be attached to hair with respect to each of the ion generation units 30, 40 and 50.

[0098] In the present embodiment, the upper case 3a has a flat surface as shown in FIG. 13. In a case where the upper case 3a has a curved surface, each minimum distance between the discharge electrodes 32, 42 and 51a and the upper case 3c may be set based on potential differences to be applied to the ion generation units 30, 40 and 50.

[0099] In the present embodiment, each inner diameter of the metallic microparticle ejection ports 20a and 20b is made smaller than that of the mist ejection port 20c as shown in FIG. 14. Therefore, it can be done easily to maintenance the mist generation unit 50 and to confirm condition of the mist generation unit 50, via the mist ejection port 20c. In addition, it can be prevented that fingers, tools or the like are improperly inserted into the metallic microparticle ejection ports 20a and 20b.

[0100] In addition, the hair dryer 1 according to the present embodiment has an illuminant (light emitting portion) 21. The illuminant 21 includes a light source 21a provided in the cavity 9 such as an LED (light emitting diode) or the like and a light guiding member 21b formed of translucent synthetic resin such as acrylic. As shown in FIG. 2, an ellipse hole 20d is formed vertically between the mist ejection port 20c and a pair of the metallic mi-

croparticle ejection ports 20a and 20b on the cover 20. An emitting end 21c of the light guiding member 21b at a side opposed to the light source 21a is inserted into the hole 20d, so that the emitting end 21c is exposed outside of the cover 20. Therefore, light emitted from the light source 21a is guided through the light guiding member 21b, and then emitted from the emitting end 21c to the outside of the cover 20. According to this configuration, the emitting end 21c faces to a user's head when the hair dryer 1 is used.

[0101] The illuminant 21 can be used as a display means for indicating operation modes of the hair dryer 1. For example, the illuminant 21 changes its color to red while hot air is blown out by using the heater 8, to green while cool air is blown out without using the heater 8, to yellow while metallic microparticles are ejected by operating the metallic microparticle generation units 30 and 40, to blue while mists are ejected by operating the mist generation unit 50, and so on. For example, a control circuit (not shown) embedded on an identical substrate on which the voltage application circuit 12 and so on are embedded can control emission of light from the light source 21a according to operation conditions of the components. In this case, plural light sources 21a associated with plural colors are provided and the control circuit controls the light sources 21a according to operation conditions of the components. Note that the control circuit is operable to blink the light source (s) 21a, to control blinking intervals, and to vary emission intensity. These emission modes of the light source(s) 21a can be set according to the various operation modes of the hair dryer 1.

[0102] In addition, it is also possible to provoke some effects on human body by light emitted from the illuminant 21. For example, in a case where a high intensity LED with 415 nm wavelength is used as the light source 21a, confirmed are a fungicidal effect due to bacterial destruction, and a preventive effect of acne due to pore closing or reduction of sebum secretion, by a blue light emitted from the light source 21a. In a case where a high intensity LED with almost 630 nm wavelength is used as the light source 21a, confirmed are effects such as activation of metabolism due to blood circulation promotion or neoangiogenesis, and promotion of creation of collagen and elastin, by a red light emitted from the light source 21a. Further, when emissions of the red light are repeated, confirmed are remediation of photo-aged skin such as fine wrinkles, mottles, dullness, pore opening or the like, and remediation of cicatrix after acne. Note that these effects may vary between individuals.

[0103] Furthermore, it is also possible to use the illuminant 21 as an emitting means for emitting the metallic microparticle generation units 30 and 40 and/or the mist generation unit 50. According to this, it is easy to confirm conditions of the units 30, 40 and/or 50. In addition, operation efficiency can also be improved because their visibilities are enhanced at their maintenance such as cleaning.

[0104] In the hair dryer (hair care device) 1 according

to the present embodiment, the metallic microparticle generation units 30 and 40 and the mist generation unit 50 are housed within the same space (i.e. the cavity 9). If mists generated by the mist generation unit 50 reached to the metallic microparticle generation units 30 and 40, the metallic microparticle generation units 30 and 40 would be charged. If this occurs, voltage and/or electrical fields may change, so that it is feared that generation of metallic microparticles may become unstable and metallic portions of the units 30 and 40 may become eroded due to moisture.

[0105] However, in the present embodiment, the metallic microparticle generation units 30 and 40 are provided in an outer area from a mist dispersion area A_{mi} through which mists generated the mist generation unit 50 are dispersed, as shown in FIG. 3. Specifically, the metallic microparticle generation units 30 and 40 are separated from the mist generation unit 50 in a direction D_n perpendicular to a mist dispersion direction D_p within the mist dispersion area A_{mi} . Since the mists flow from the mist generation unit 50 along the mist dispersion direction D_p , it is hard for the mist to reach to the metallic microparticle generation units 30 and 40 distanced from the mist generation unit 50 in the direction D_n perpendicular to the mist dispersion direction D_p . Therefore, the metallic microparticle generation units 30 and 40 are hardly affected by the mist flowing from the mist generation unit 50 according to the above-described configuration.

[0106] In the present embodiment, in the cavity 9, the metallic microparticle generation units 30 and 40 are arranged with opposed to the metallic microparticle ejection ports 20a and 20b, and the mist generation unit 50 is arranged with opposed to the mist ejection port 20c at a position relatively near the mist ejection port 20c. In addition, as shown in FIG. 3, a distance D_1 between the mist generation unit 50 and the cover 20 is made shorter than a distance D_2 between mist generation unit 50 and the metallic microparticle generation units 30 and 40. Further, in the cavity 9, the branched flow W_p flowing from the gap g_1 is discharged from the metallic microparticle ejection ports 20a and 20b and the mist ejection port 20c to the outside.

[0107] Therefore, metallic microparticles generated by the metallic microparticle generation units 30 and 40 are relatively smoothly discharged from the metallic microparticle ejection ports 20a and 20b, and mists generated by the mist generation unit 50 are relatively smoothly discharged from the mist ejection port 20c. In other words, constructed is a configuration in which the metallic microparticles generated by the metallic microparticle generation units 30 and 40 hardly flows toward a side of the mist generation unit 50, and the mists generated by the mist generation unit 50 hardly flows toward a side of the metallic microparticle generation units 30 and 40. Note that the branched flow W_p contributes to discharge of the metallic microparticles and the mists. However, if the branched flow W_p were not created, the metallic mi-

croparticles and the mists could be discharged from the associated ejection ports 20a to 20c.

[0108] In addition, it is restricted more firmly for the mists to reach to the metallic microparticle generation units 30 and 40 by providing a partition wall in the cavity 9 in the present embodiment. The light guiding member 21b and a fixing member 6d (see FIGs. 1 and 13) for fixing the metallic microparticle generation units 30 and 40 on the inner tube 6 are utilized as the partition wall.

[0109] The light guiding member 21b has a plate shape and is arranged so as to align its width direction along a circumferential direction of the inner tube 6. The light guiding member 21b functions as the partition wall in the cavity 9. A metallic microparticle dispersion area Ame (i.e. a left side area relative to the metallic microparticle generation units 30 and 40 in FIG. 3) and the mist dispersion area Ami (i.e. a left side area relative to the mist unit 50 in FIG. 3) are segmented by the light guiding member 21b.

[0110] The fixing member 6d is projected outward in a radial direction from the tubular portion 6a of the inner tube 6 and attaches the metallic microparticle generation units 30 and 40 on the inner tube 6. The fixing member 6d includes a partitioning portion 6e extending from a side of the metallic microparticle generation units 30 and 40 toward the metallic microparticle ejection ports 20a and 20b. Since the partitioning portion 6e is provided inevitably in the vicinity of the metallic microparticle generation units 30 and 40, it can be effectively prevent mists from reaching to the metallic microparticle generation units 30 and 40 with its relatively small-sized configuration.

[0111] Since a gap g2 (see FIG. 3) is further formed between the partitioning portion 6e of the partition wall 6d and the cover 20, metallic microparticles are restricted from reaching to the metallic microparticle generation units 30 and 40. As a result, it is restricted that generation of metallic microparticles by the metallic microparticle generation units 30 and 40 is inhibited. Note that a low-conductive or insulating member may be interposed between the fixing member 6d and the cover 20 in place of the gap g2.

[0112] The light guiding member 21b and the fixing member 6d (partitioning portion 6e) that function as the partition wall are aligned parallel in direction Dn perpendicular to the mist dispersion direction Dp and extend along the mist dispersion direction Dp. As a result, it can be effectively prevent mists from reaching to the metallic microparticle generation units 30 and 40 with its relatively small-sized configuration.

[0113] In the present embodiment, the kinds of metals contained in the discharge electrodes 32 and 42 of the metallic microparticle generation units 30 and 40 are differentiated as described above. In other words, at least one of kinds of metals contained in the first electrodes of the plural metallic microparticle generation units is differentiated from the other kinds of metals contained in the remaining first electrodes of the plural metallic micropar-

ticle generation units. Therefore, it becomes possible to adjust each generated amount of metallic microparticles (platinum and zinc in the present embodiment) with respect to each of the metallic microparticle generation units 30 and 40. As a result, a hair care effect can be improved.

[0114] In addition, it becomes possible to adjust each generated amount of metallic microparticles easily by differentiating shapes of the discharge portions 31 and 41 according to the present embodiment.

[0115] In addition, it becomes possible to adjust each generated amount of metallic microparticles together with simplification of configuration and cost reduction by differentiating the circuit characteristics of the discharge circuits by communal use of the voltage application circuit 14 according to the present embodiment.

[0116] In addition, the (plural) metallic microparticle generation units 30 and 40 are arranged so as to locate one [32] of the discharge electrodes (first electrodes) 32 and 42 from another [42] of the discharge electrodes (first electrodes) 32 and 42 with the distance D3 (see FIG. 4B) larger than any of diameters of the discharge electrodes 32 and 42 in the present embodiment. Therefore, discharge at the metallic microparticle generation units 30 and 40 can be made stable, so that reduction of ejection performance of the metallic microparticle generation units 30 and 40 can be restricted.

[0117] In addition, in addition to a hair care effect due to mists generated by the mist generation unit 50, the mists help metallic microparticles reach to hair according to the present embodiment. Therefore, the hair care effect can be further enhanced.

[0118] In the present embodiment, the metallic microparticle generation units 30 and 40 have the discharge electrodes (first electrodes) 32 and 42 to which different kinds of metals contained and arranged parallel. Therefore, it becomes possible that metallic microparticles of the different kinds of metals are mixed and then attached to hair. Therefore, it can be prevented that the metallic microparticles attach to hair nonuniformly. As a result, a hair care effect can be further improved.

[0119] In the present embodiment, the metallic microparticle generation units 30 and 40 arranged parallel and have the discharge electrodes (first electrodes) 32 and 42 to which different kinds of metals contained. Therefore, it becomes possible that metallic microparticles of the different kinds of metals are mixed unfailingly and then attached to hair. Therefore, it can be prevented that the metallic microparticles attach to hair without mixture of at least one of the different kinds of metals with the mists. As a result, a hair care effect can be further improved.

[0120] In the ion generation units 30, 40 and 50 according to the present embodiment, the distances D6 and D7 between the discharge electrodes 32, 42 and 51a and the upper case 3c are set based on the potential differences to be applied to the ion generation units 30, 40 and 50. By setting the distances as described above, it

becomes possible to restrict charged ions from attaching to the upper case 3c with respect to each of the ion generation units 30, 40 and 50. In other words, it becomes possible to adjust an amount of ions to be attached to hair with respect to each of the ion generation units 30, 40 and 50. As a result, the ions can be attached to hair with an appropriate mixture ratio of respective kinds of ions.

[0121] In the present embodiment, ion outlets for respective kinds of ions (the metallic microparticle ejection ports 20a and 20b and the mist ejection port 20c) are provided independently. Therefore, it can be restricted that charged ions of a kind interfere with the ion generation unit that generates ions of another kind, so that reduction of ion ejection performance can be restricted. Especially, in a case where the ions are ejected by use of airflows, it becomes possible to form ion ejection paths for the respective kinds of ions by use of the airflows. As a result, it can be restricted more effectively that charged ions of a kind interfere with the ion generation unit that generates ions of another kind.

[0122] Although a preferred embodiment is explained above, the present invention is not limited to the above embodiment and can be take various modifications.

[0123] For example, the metallic microparticle generation units 30 and 40 and the mist microparticle generation unit 50 may be arranged reversely.

[0124] In addition, the partitioning portion 6e may be integrated with a fixing member of the mist generation unit 50.

[0125] In addition, it is not essential to form the ejection ports 20a to 20c on the cover provided separately from the case 3. The ejection ports 20a to 20c may be formed on the case 3. Further, an insulating member may be interposed between the partitioning portion 6e (fixing member 6d) and the outer shell (cover 20 in the above embodiment) in place of the gap g2.

[0126] In the above-described embodiment, the second electrodes of the plural metallic microparticle generation units are provided separately. However, the second electrodes for at least two of the plural metallic microparticle generation units may be formed of a single member 60 as shown in FIGs. 15A and 15B. By forming the plural second electrodes with the single member 60, configurations of them can be simplified and costs for them can be reduced. Note that, in FIGs. 15A and 15B, diameters ϕ of the first electrodes 32 and 34, distances D between the distal ends of the first electrodes 32 and 34 and the second electrodes (member 60), and inner diameters of the openings 33c and 43c are made identical, respectively. However, at least any of them may be made differentiated.

[0127] In the above-described embodiment, the first electrode and the second electrode are opposed to each other. However, it is not need that the first electrode and the second electrode are opposed to each other. In a case where the first electrode and the second electrode are not opposed to each other, it is not needed to form

the opening on the second electrode.

[0128] The hair care device according to the present invention can be applied to devices other than a hair dryer, such as a hairbrush and a hair iron.

[0129] In addition, detailed specifications (e.g. shape, size, layout and so on) of the first and second electrode, the ion generation units and other components can be modified arbitrarily within a scope of the present invention.

Claims

1. A hair care device (1) comprising:

three or more ion generation units (30, 40, 50) each of which generates ions, wherein at least two of the ion generation units (30, 40, 50) also function as metallic microparticle generation units (30, 40) and each of which has a first electrode (32, 42) containing metal that is to be dispersed into microparticles by discharge, and the first electrode (32) of one (30) of the metallic microparticle generation units (30, 40) contains a different kind of metal from the first electrode (42) of another (40) of the metallic microparticle generation units (30, 40).

2. The hair care device according to claim 1, wherein the metallic microparticle generation units (30, 40) include dischargers (31, 41) that disperse metals contained in the electrodes (32, 42) into microparticles by discharge, respectively, and one (31) of the dischargers (31, 41) has a different configuration from another (41) of the dischargers (31, 41).

3. The hair care device (1) according to claim 1 or 2, wherein the metallic microparticle generation units (30, 40) include discharge circuits, respectively, and communally have a single voltage application circuit (14) for the discharge circuits, and circuit characteristics of the discharge circuits are differentiated from each other.

4. The hair care device (1) according to claim 1 or 2, wherein each of the metallic microparticle generation units (30, 40) further include a second electrode, and the second electrode of the one (30) of the metallic microparticle generation units (30, 40) and the second electrode of the other (40) of the metallic microparticle generation units (30, 40) are communally formed of a single member (60).

5. The hair care device (1) according to claim 1 or 2, wherein

the first electrode (32) of the one (30) of the metallic microparticle generation units (30, 40) is distanced from the first electrode (42) of the other (40) of the metallic microparticle generation units (30, 40) with a distance (D3) larger than any of diameters of the first electrodes (32, 42) of the one (30) and the other (40) of the metallic microparticle generation units (30, 40). 5

6. The hair care device (1) according to claim 1 or 2, wherein at least one of the ion generation units (30, 40, 50) is a mist generation unit (50) that disperses mists. 10

7. The hair care device (1) according to claim 1 or 2, wherein the one (30) of the metallic microparticle generation units (30, 40) and the other (40) of the metallic microparticle generation units (30, 40) are arranged parallel. 15 20

8. The hair care device (1) according to claim 6, wherein a distance (D5) between the first electrodes (32, 42) of the one (30) and the other (40) of the metallic microparticle generation units (30, 40) is set shorter than a distance (D4) between a first electrode (51a) of the mist generation unit (50) and any of the first electrodes (32, 42) of the one (30) and the other (40) of the metallic microparticle generation units (30, 40). 25 30

9. The hair care device (1) according to claim 1 or 2, wherein a case (3a) is provided at a downstream side of ions generated by the ion generation units (30, 40, 50), and distances (D6, D7) between first electrodes (32, 42, 51a) of the ion generation units (30, 40, 50) and the case (3a) are set based on potential differences applied to the ion generation units (30, 40, 50). 35 40

10. The hair care device (1) according to claim 1 or 2, wherein each ion ejection port (20a, 20b, 20c) of the ion generation units (30, 40, 50) is provided independently. 45

50

55

FIG. 1

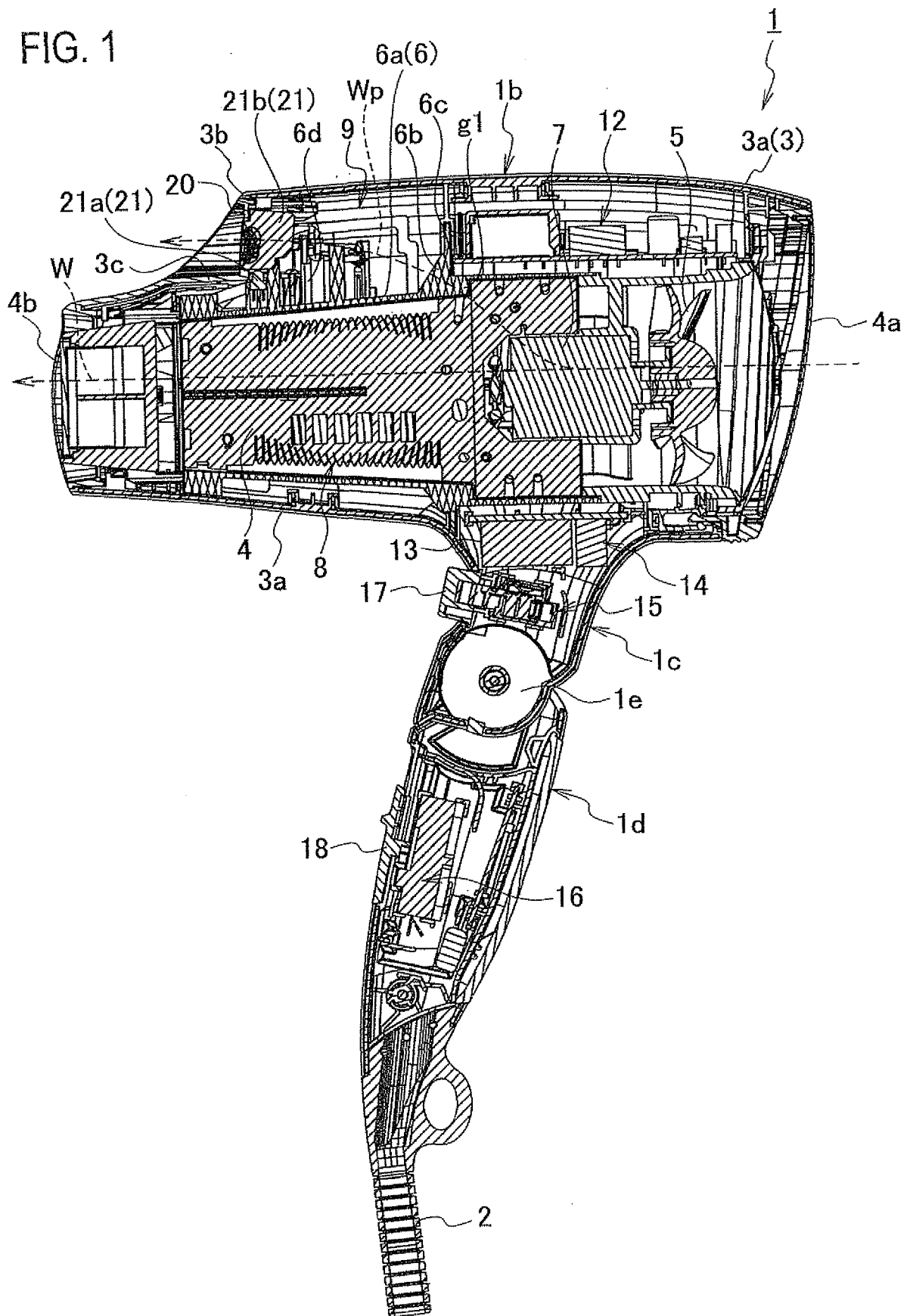


FIG. 2

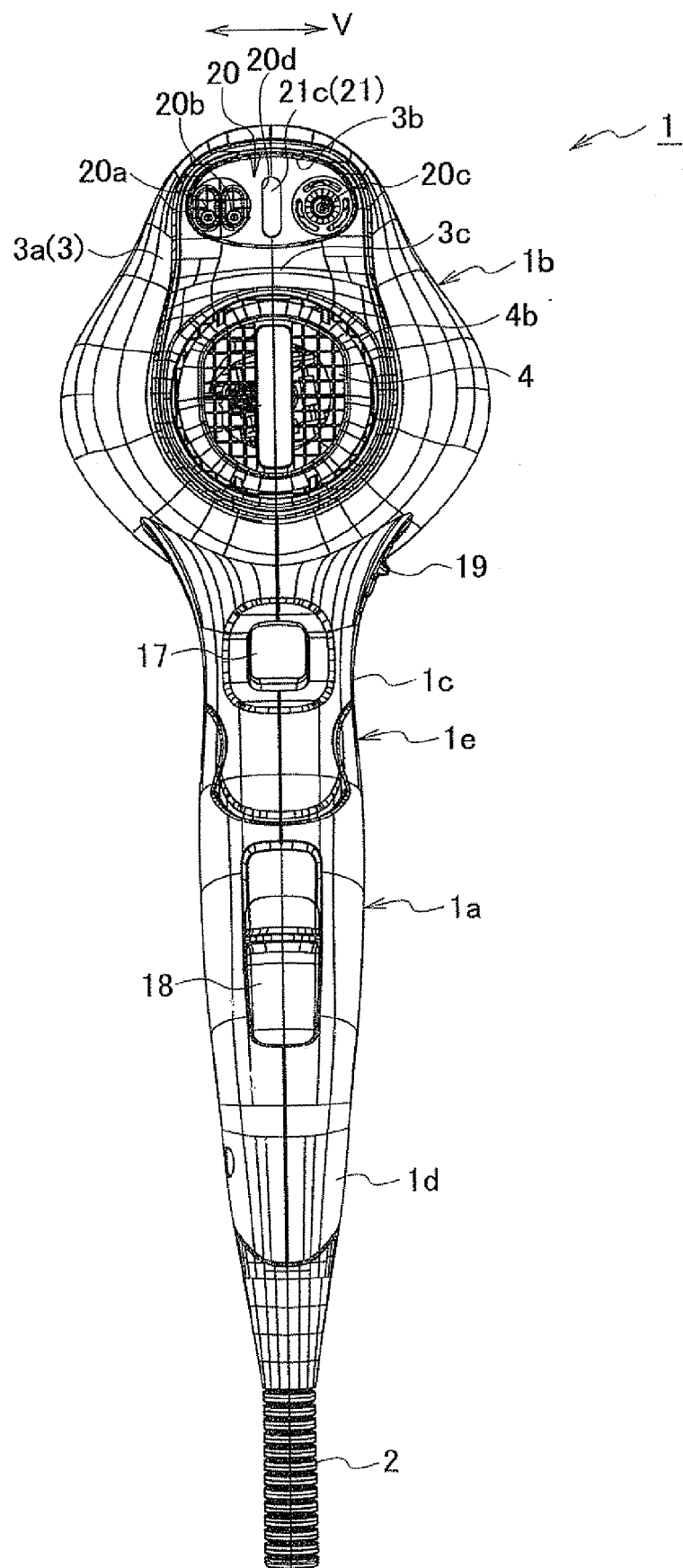


FIG. 3

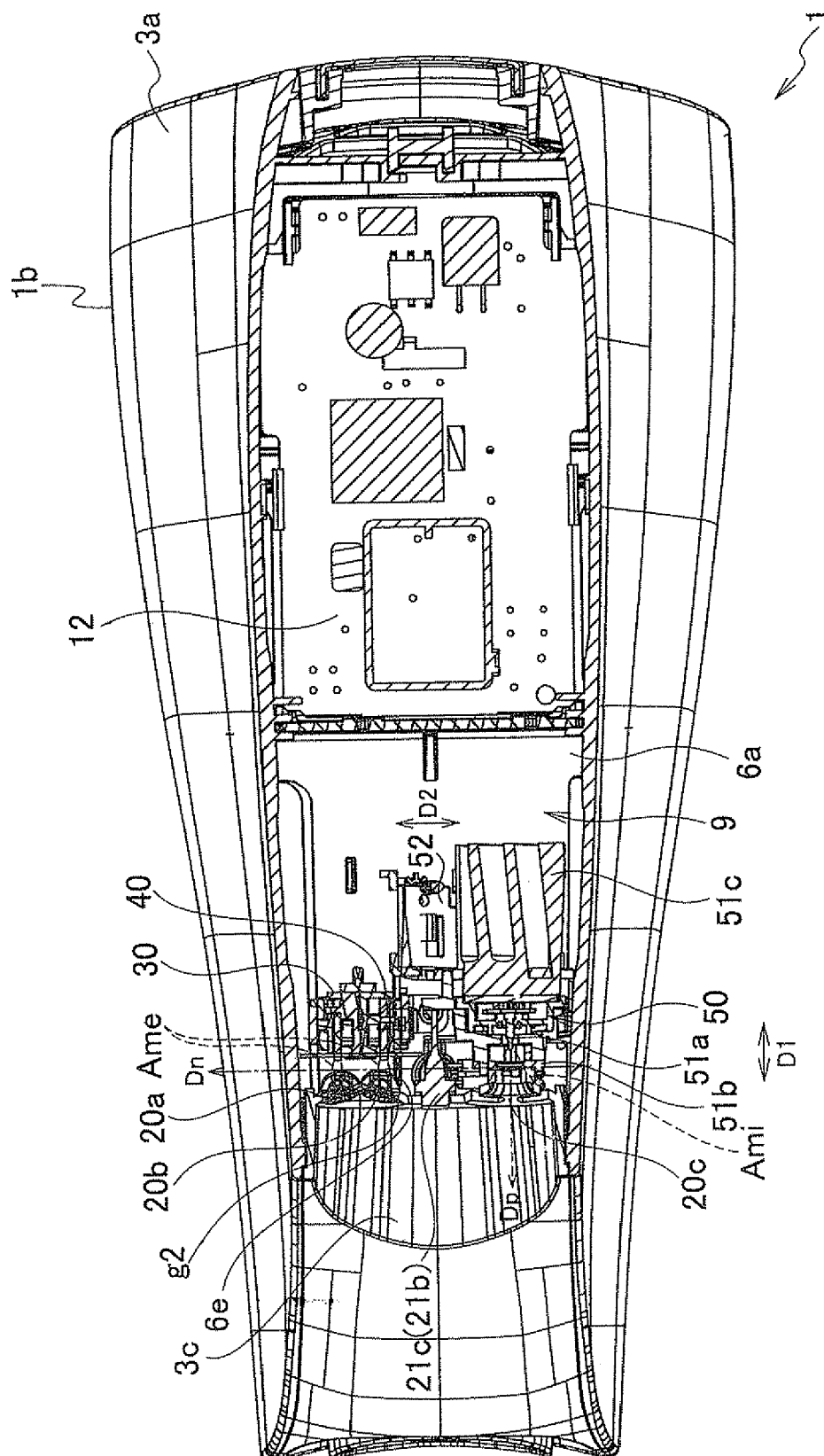


FIG. 4A

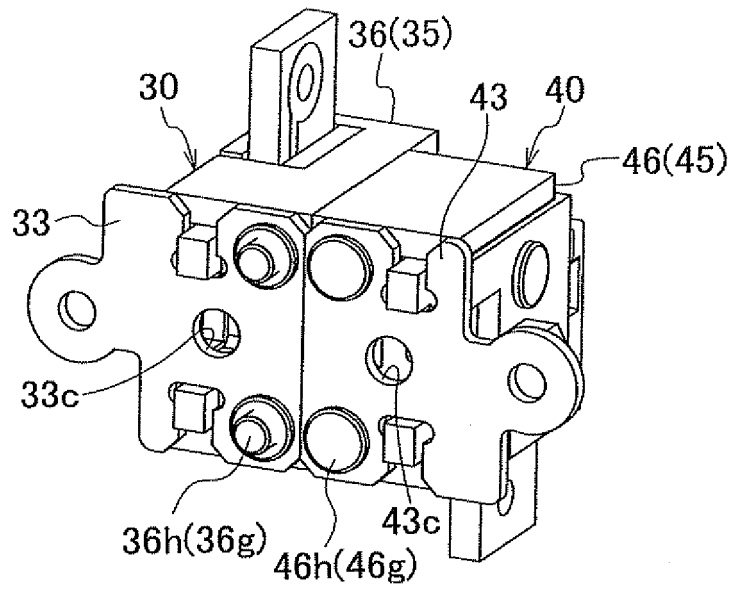


FIG. 4B

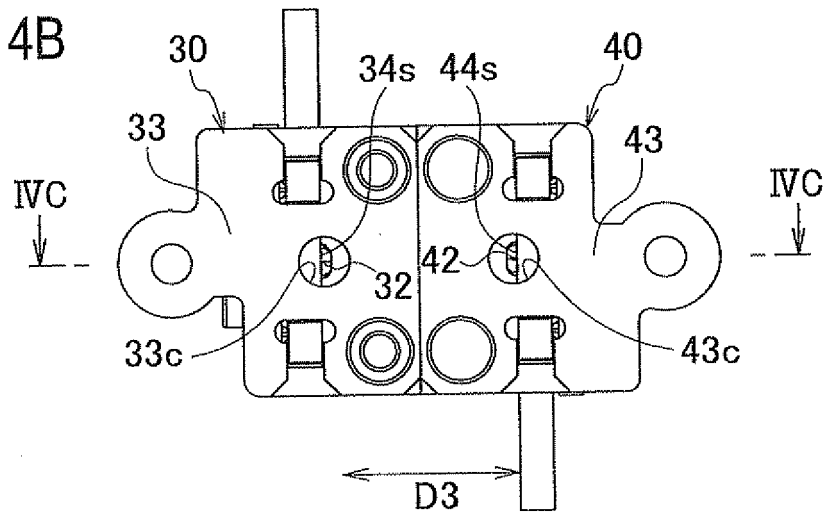


FIG. 4C

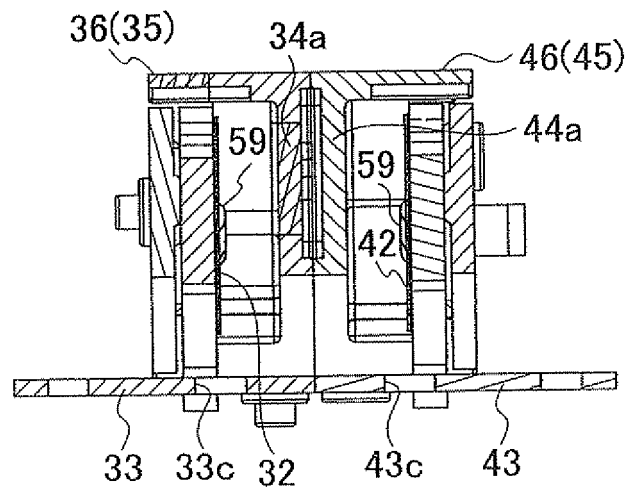


FIG. 5

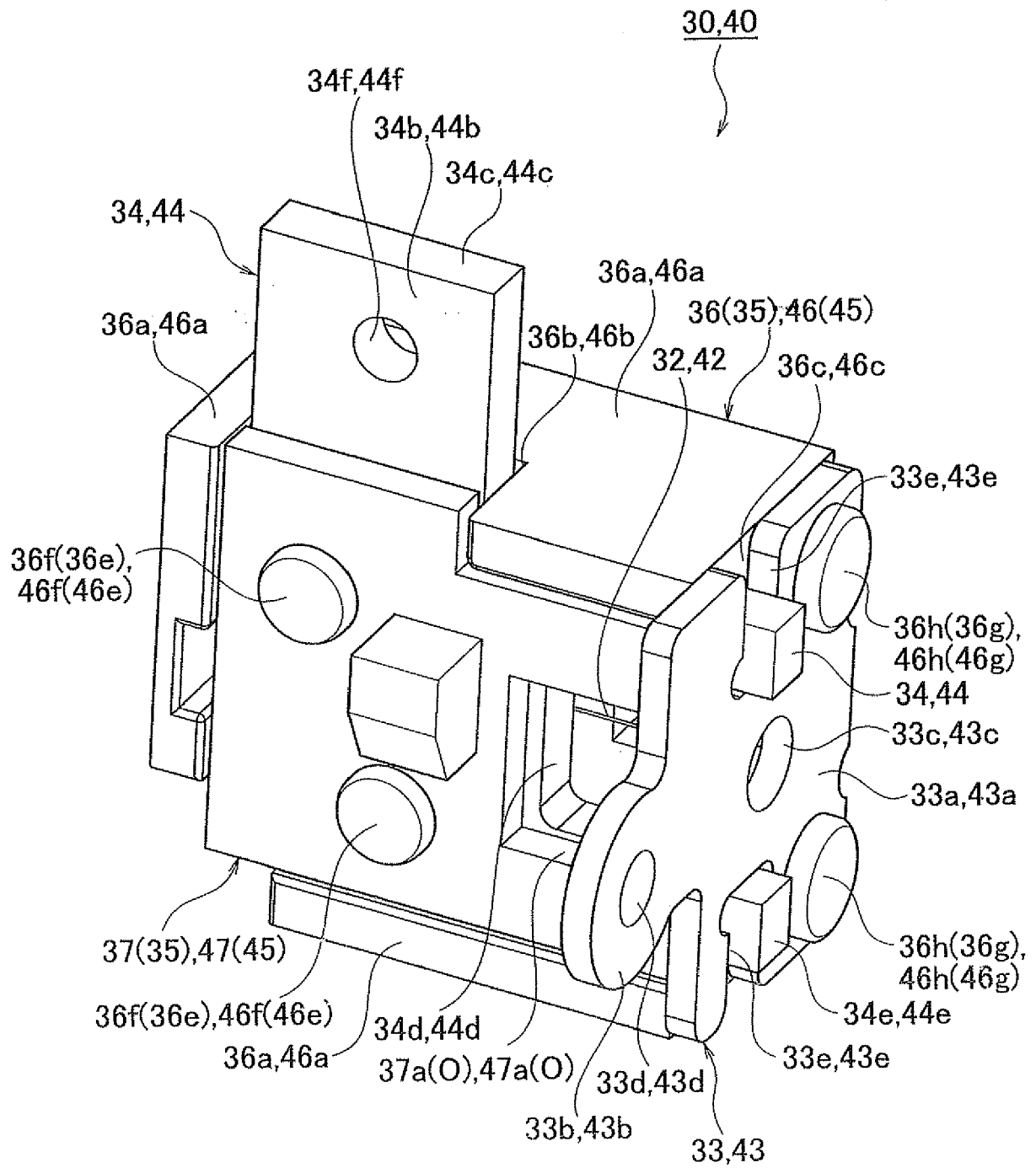


FIG. 6

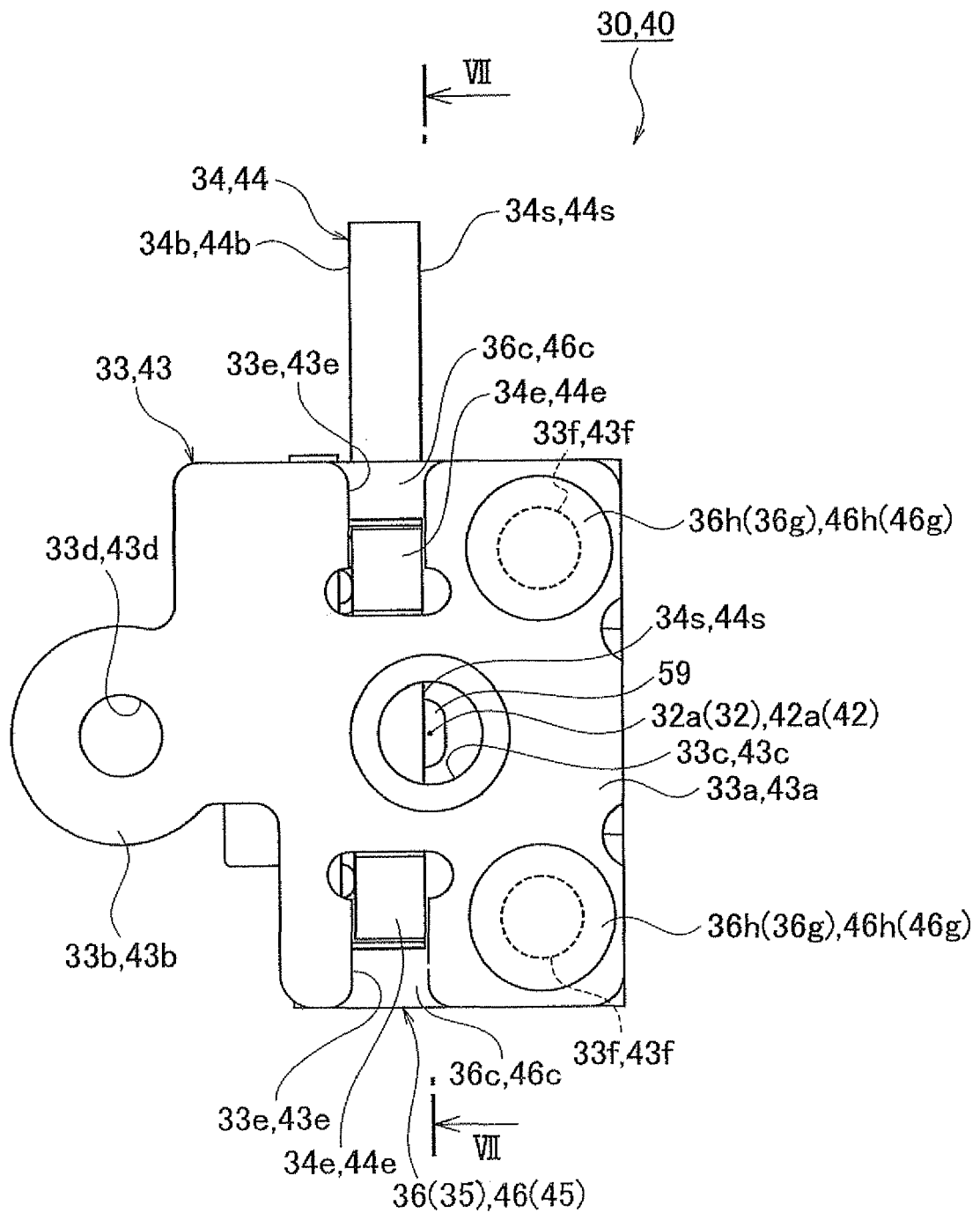


FIG. 7

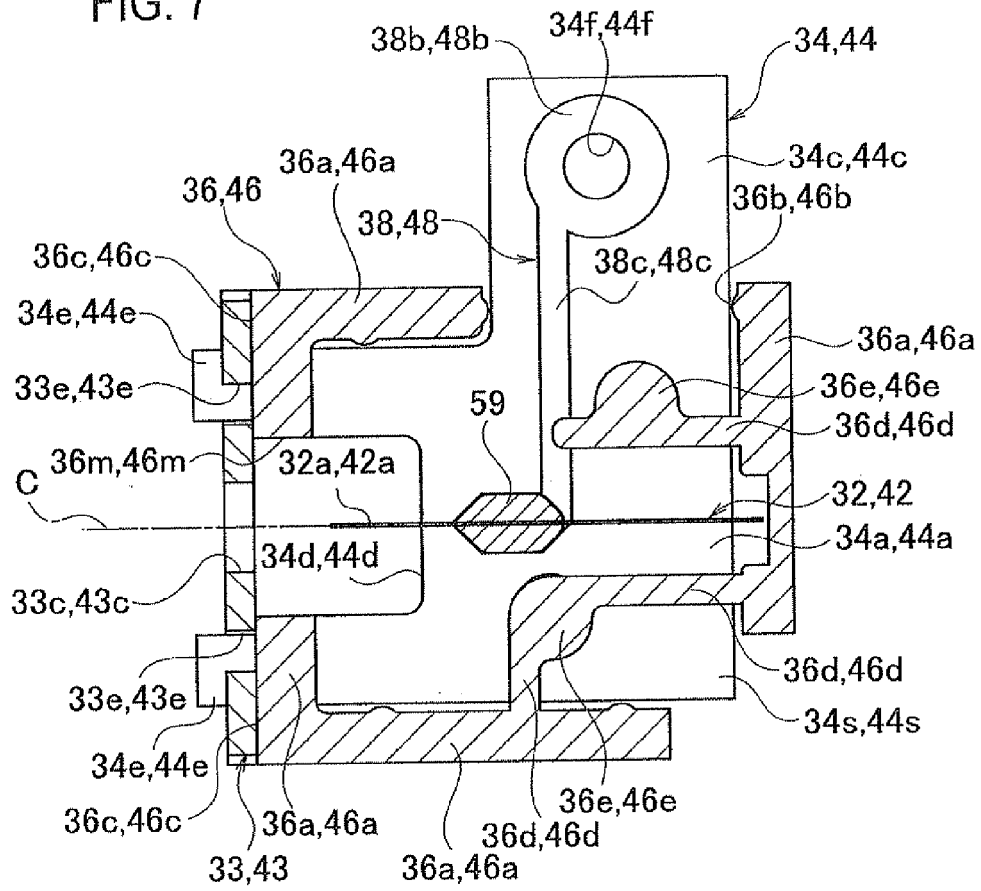


FIG. 8

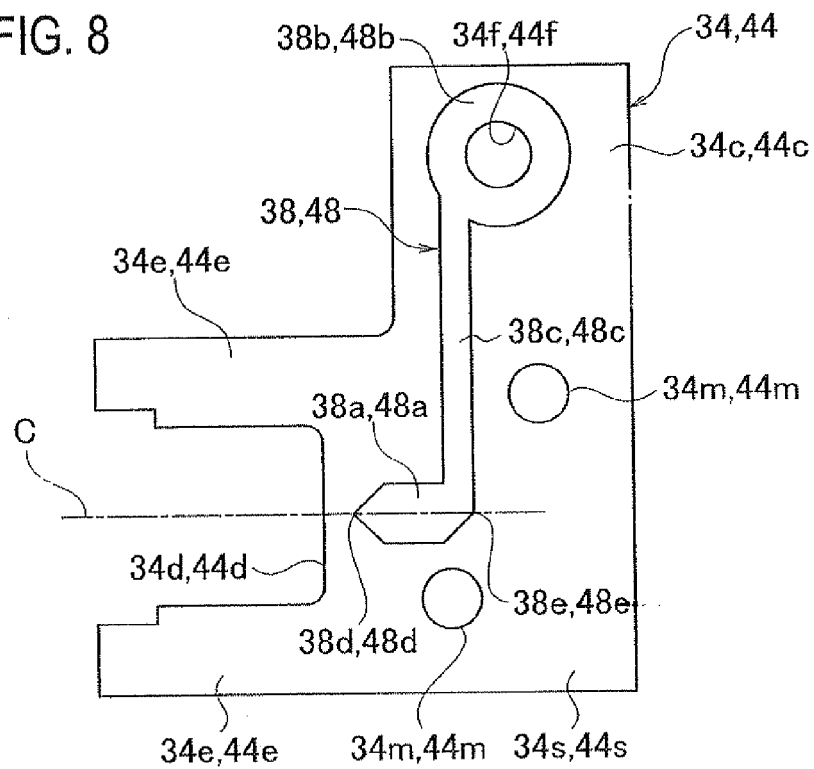


FIG. 9

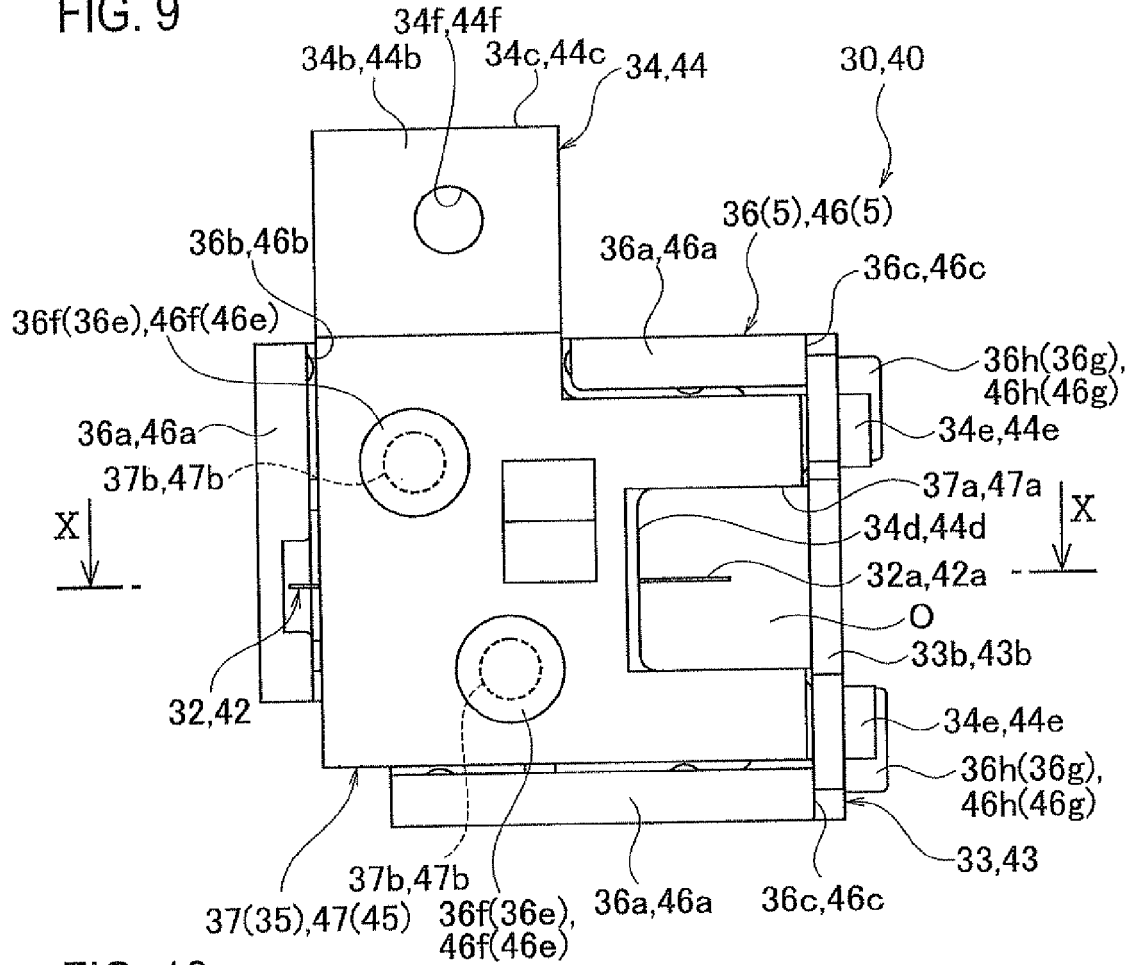


FIG. 10

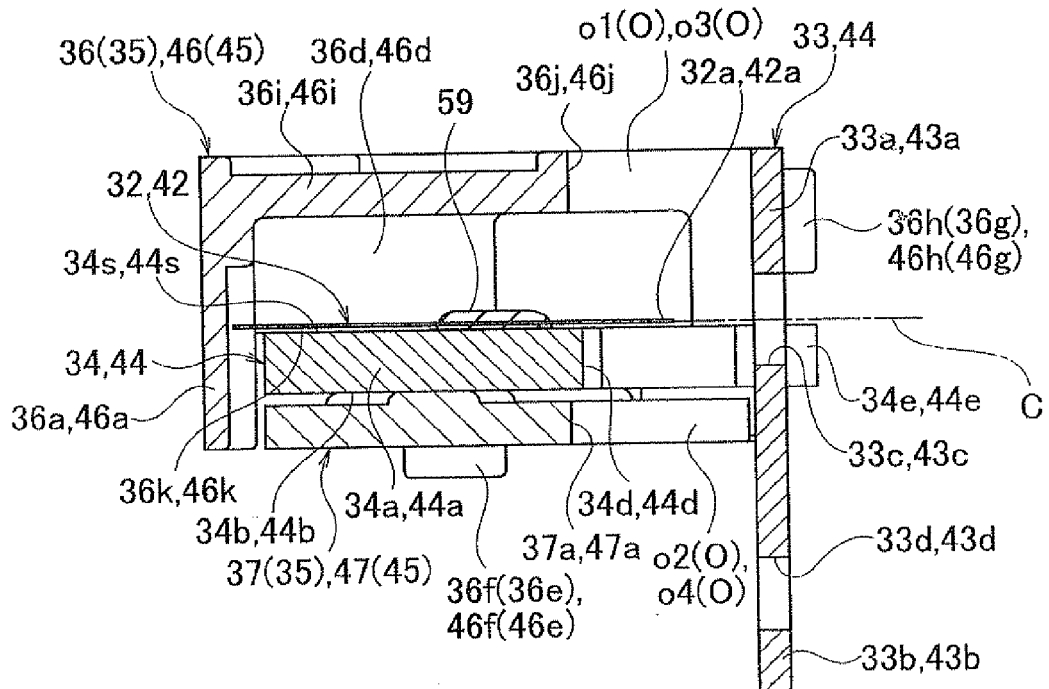


FIG. 11C

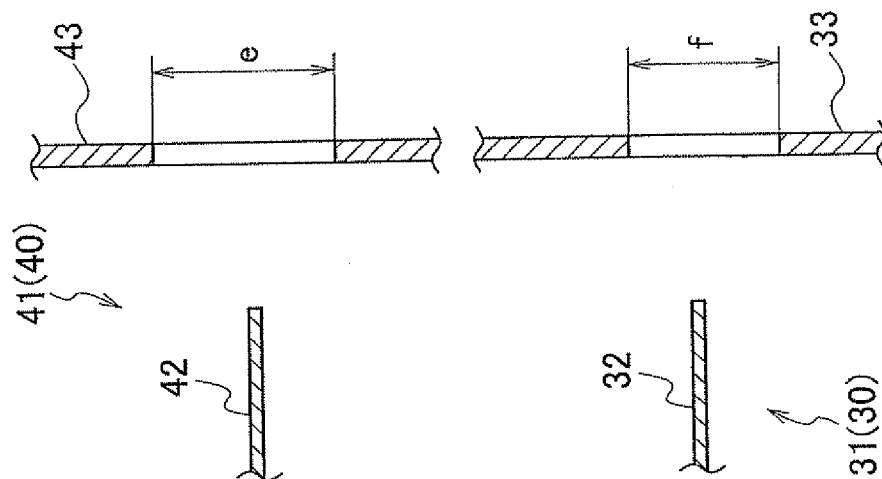


FIG. 11B

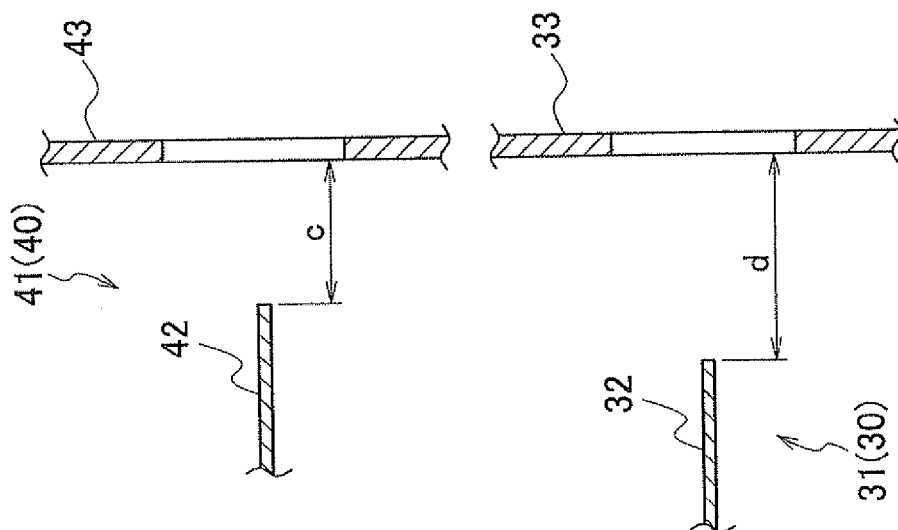
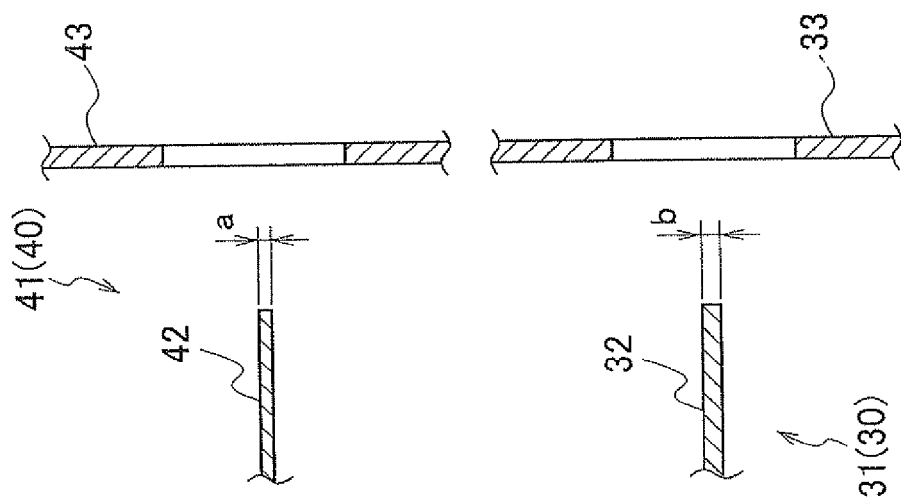


FIG. 11A



$e \neq f$

$c \neq d$

$a \neq b$

FIG. 12

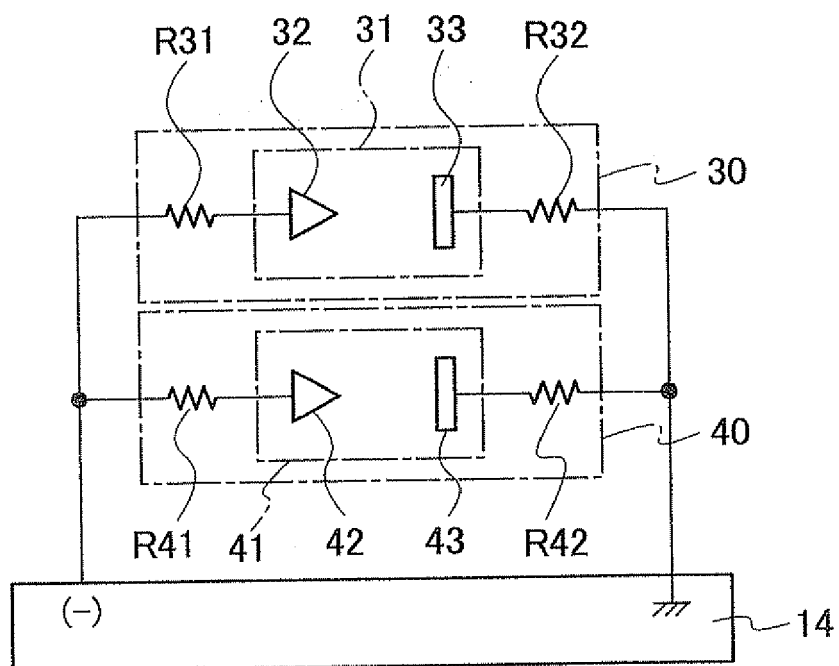


FIG. 13

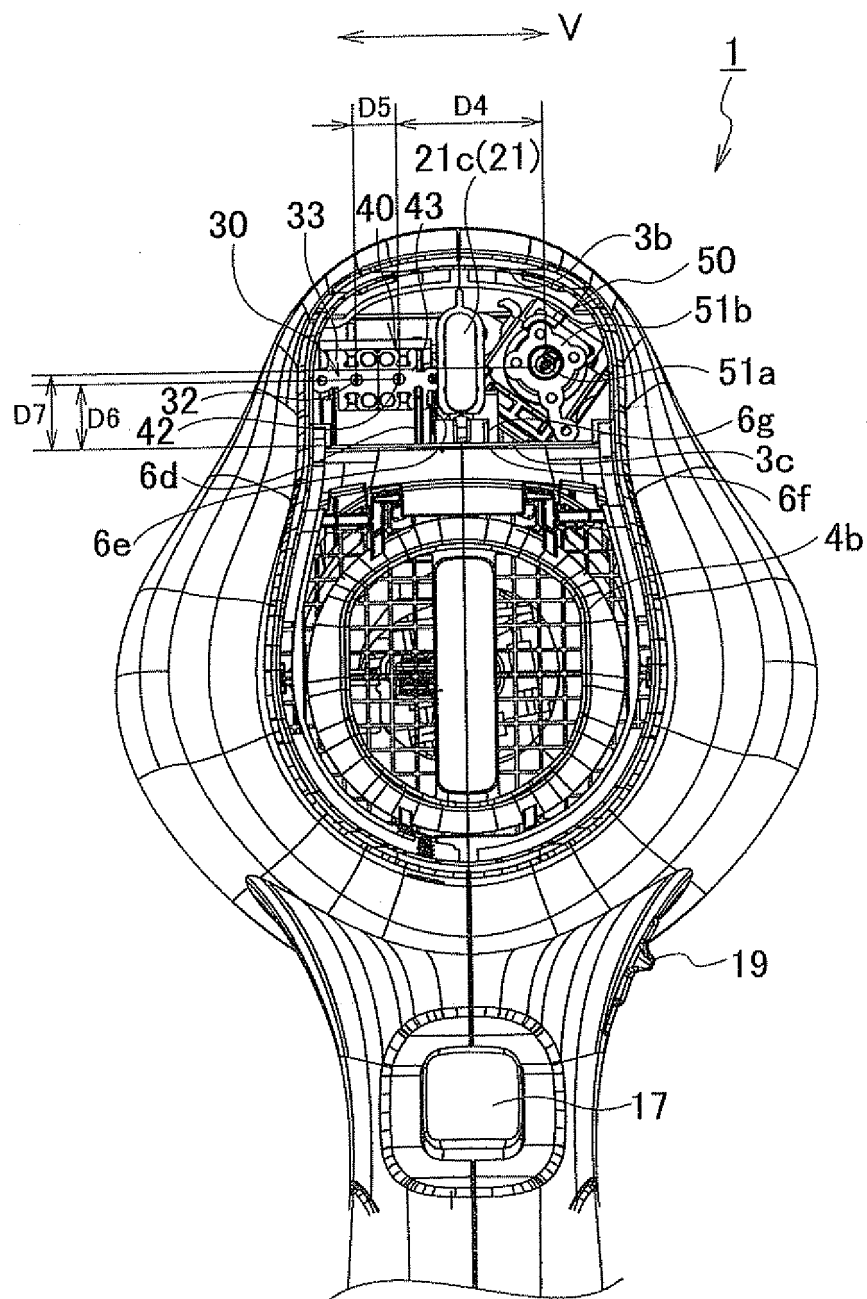


FIG. 14

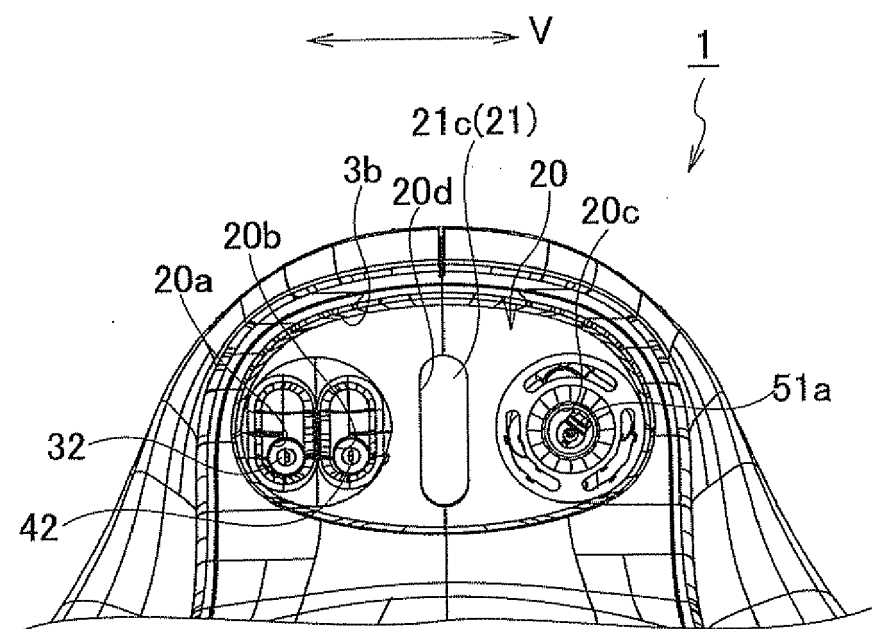


FIG. 15A

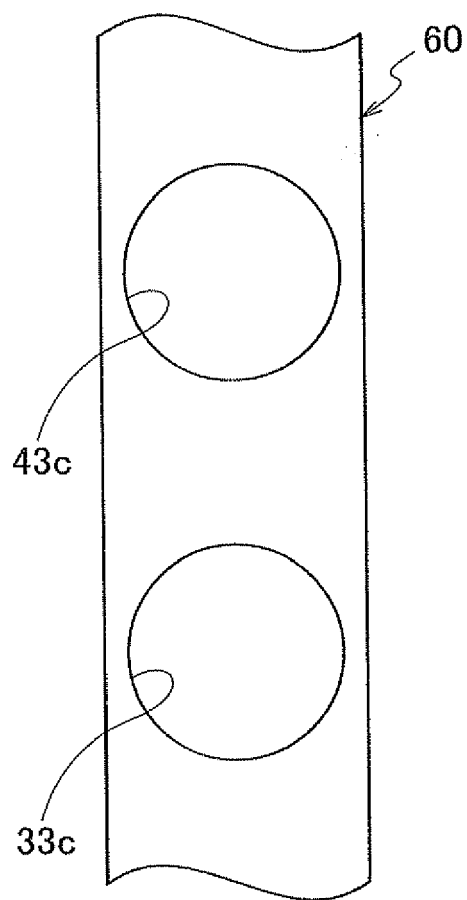
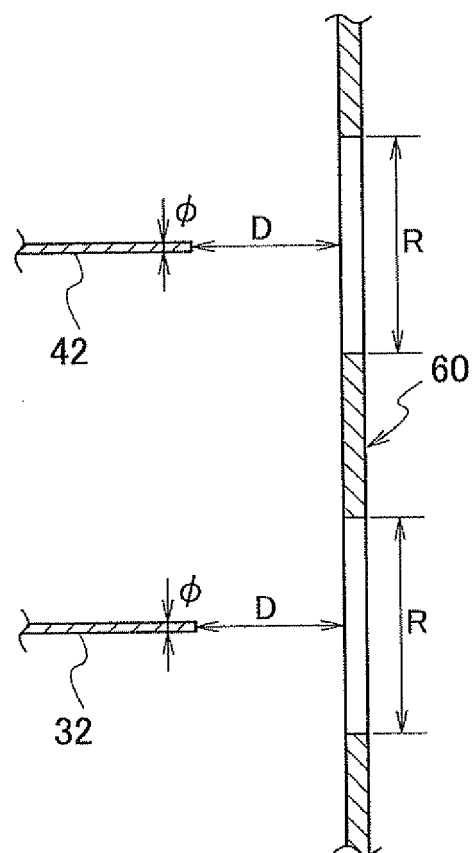


FIG. 15B





EUROPEAN SEARCH REPORT

Application Number
EP 10 18 9957

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A,P	WO 2010/013615 A1 (PANASONIC ELEC WORKS CO LTD [JP]; MIYATA HIROMITSU; SUDA HIROSHI; MACH) 4 February 2010 (2010-02-04) * paragraphs [0022] - [0031], [0 37] - [0046]; figures 1,2,7,8,15 *	1,5-7,10	
			TECHNICAL FIELDS SEARCHED (IPC)
			A45D
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 18 May 2011	Examiner Escudero, Raquel
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18-05-2011

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