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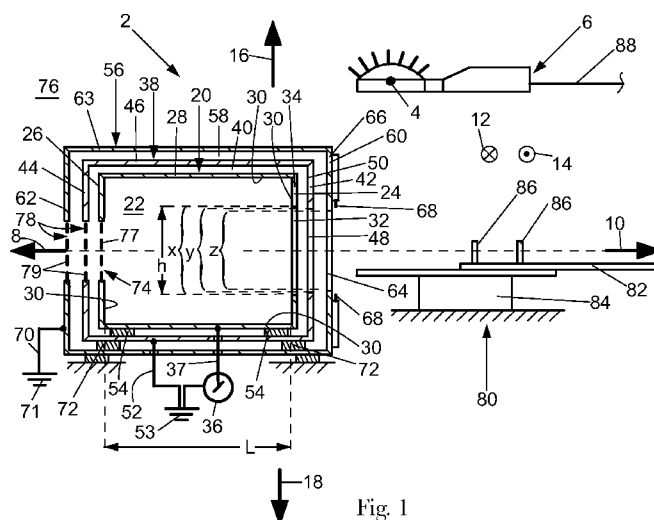


Fig. 1

(57) **Abstract:** The present invention relates to an apparatus (2) for counting the number of ions emitted by an ion source (4) of a handheld domestic appliance (6) comprising a collector housing (20) for collecting ions impinging on the inner surface (30) of the collector housing (20) and determining means (36) being coupled with the collector housing (20) in order to determine the number of ions collected by the collector housing (20), said collector housing (20) having an input opening (32). The input opening (32) is dimensioned such that the domestic appliance (6) is at least partially, preferably completely, insertable into the collector housing (20) via input opening (32). The present invention is further related to a method for counting the number of ions emitted by an ion source (4) of a handheld domestic appliance (6) and to a use of the apparatus (2) and method, respectively.

APPARATUS FOR COUNTING IONS, METHOD FOR COUNTING IONS AND USE OF THE APPARATUS AND THE METHOD

FIELD OF THE INVENTION

5 The present invention relates to an apparatus for counting the number of ions emitted by an ion source of a handheld domestic appliance comprising a collector housing for collecting ions impinging on the inner surface of the collector housing and determining means being coupled with the collector housing in order to determine the number of ions collected by the collector housing, said collector housing having an input opening. The present invention
10 further relates to a method for counting the number of ions emitted by an ion source of a handheld domestic appliance. The present invention further relates to the use of the apparatus and the method.

BACKGROUND OF THE INVENTION

15 According to the state of the art it is known to provide domestic appliances, especially hair care devices, comprising an ion source for emitting ions. Recently, hair care devices, e.g. hairdryers, hairbrushes or curling irons, having the function to expel ionized particles, i.e. negatively ionized air or positively ionized air, have enjoyed increasing popularity. These devices make it possible to obtain the effect of treating the hair, making it more
20 manageable and giving it more body, by expelling towards the hair the negatively or positively ionized air while drying, brushing or curling the hair.

 It is further known to provide apparatuses, which are able to count ions emitted by an ion source. Usually, such apparatuses count the number of ions and measure the concentration
25 of ions, respectively, in a gas medium by means of electric current detection with an electrometer or another current detecting device. Such apparatuses usually comprise a so-called Faraday cup being made of a conductive material and having a relatively small input opening. In order to count the ions, the Faraday cup is positioned such that a narrow ion beam, which may for example be expelled by a directional ion source, enters the cup via the input opening.
30 Alternatively, air of the environment could be sucked through the input opening, so that the ions in the surrounding gas medium are sucked into the Faraday cup as well. Inside the Faraday cup the ions, which carry an electric charge, impinge on its inner surface such that a current could be measured by means of the electrometer which is coupled with the Faraday cup. The measured current is directly proportional to the number of ions and number of charges per ion, such that it

could be used to determine the number of ions emitted by an ion source and collected by the Faraday cup.

The known apparatuses for counting the number of ions emitted by an ion source
5 have proved themselves insofar as the number of ions emitted by a directional ion source could be reliably determined by leading the ion beam of a directional ion source directly through the input opening into the Faraday cup. However, it has been found out that the result of the measurement is less accurate if the ions are emitted by a non-directional ion source and have to be taken up through the input opening by sucking the environmental air of the non-directional ion
10 source through the input opening.

It is therefore an object of the present invention to provide an apparatus for counting the number of ions emitted by an ion source of a handheld domestic appliance permitting an accurate and reliable counting of the emitted ions independent of the type of ion
15 source. It is a further object of the present invention to provide a method for counting the number of ions emitted by an ion source of a handheld domestic appliance permitting an accurate and reliable counting of the emitted ions independent of the type of ion source. Above this, it is an object of the present invention to provide an advantageous use of the apparatus and the method according to the invention.

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SUMMARY OF THE INVENTION

The above-mentioned problem is solved by a subject-matter with the features described in claims 1, 12 and 15, respectively. Preferred and advantageous embodiments of the invention are described in the sub-claims.

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The present invention is directed to an apparatus for counting the number of ions emitted by an ion source of a handheld domestic appliance. The handheld domestic appliance may for example be a hair care device, like a hairdryer, a hairbrush or a curling iron. The apparatus comprises a collector housing for collecting ions impinging on the inner surface of the
30 collector housing. The collector housing may for example be a well-known Faraday cup. Further, there are provided determining means being coupled with the collector housing in order to determine the number of ions collected by the collector housing. The determining means are preferably composed of an electrometer, however, also other current detecting means could be used. The collector housing further has an input opening. The input opening is dimensioned such

that the domestic appliance is at least partially, preferably completely, insertable into the collector housing via input opening.

While the input opening in the Faraday cup of apparatuses according to the state
5 of the art is very small, so that only the ions of the environment may be lead into the Faraday cup via the input opening, the input opening in the collector housing according to the invention is enlarged to such an extent that the domestic appliance with its ion source could at least partially, preferably completely, inserted into the collector housing via input opening. Thus, the apparatus according to the invention permits an accurate and reliable counting of the ions emitted by the
10 domestic appliance independent of the type of ion source, i.e. it doesn't matter if the ion source is a directional ion source or a non-directional ion source.

In one embodiment of the apparatus according to the invention the input opening has a width and a height of at least 8 cm. An input opening of such a width and height is big
15 enough to insert many of the known domestic appliances, especially many of the known hair care devices, into the collector housing via the input opening. In order to increase the number of domestic appliances which could be tested by the apparatus, the input opening preferably has a width and a height of at least 12 cm. More preferably the input opening has a width and a height of at least 16 cm, so that the apparatus could be used for most of the common hair care devices. It
20 has further been found out, that the best measurement results are achieved, if the input opening is circular, so that the afore-mentioned minimum sizes could be regarded as the diameter of the input opening in this preferred embodiment.

In a further embodiment of the apparatus according to the invention the collector
25 housing surrounds a chamber, i.e. a chamber in which the domestic appliance is at least partially arranged during measuring. The chamber preferably has a length of at least 35 cm in its feeding direction, so that many of the known domestic appliances, especially many of the known hair care devices, could be completely inserted into the chamber of the collector housing. The feeding direction is the direction in which the domestic appliance is fed or moved during the insertion of
30 the domestic appliance through the input opening into the chamber. The length of the chamber in feeding direction is preferably at least 45 cm in order to increase the number of domestic appliances which could be completely inserted into the chamber. More preferably the length of the chamber in feeding direction is at least 55 cm, so that most of the common hair care devices could be completely inserted into the chamber, thereby increasing the accuracy of the measuring.

In an useful embodiment of the apparatus according to the invention the collector housing is arranged within an outer housing, the outer housing being grounded and the collector housing being separated from the outer housing by insulating means. The outer housing serves to shield the collector housing from external influences, especially ions in the environmental air could be absorbed by the outer housing so that they could not impinge on the surface of the collector housing where they would influence the measurement results.

In a further embodiment of the apparatus according to the invention the collector housing is arranged within an additional housing, the additional housing being grounded and placed within the outer housing, the collector housing as well as the outer housing being separated from the additional housing by insulating means. It has been found out that by providing the additional housing the shielding of the collector housing from external influences could be enhanced so that environmental aspects do no longer have an influence on the measurement results. Thus, this embodiment of the apparatus permits an accurate and reliable counting of the ions emitted by the ion source of the domestic appliance inside the collector housing. In this embodiment it is further useful that the additional housing can be grounded to the reference ground of the determining means. Due to the fact, that the additional housing is protected against environmental influences by the outer housing as well, it can serve as a reasonable reference for the measurement carried out by the determining means. Thus, this embodiment of the apparatus permits a very accurate counting of the ions. Further, it is preferred if the outer housing and the additional housing are grounded via separate conductors, since the accuracy of the measurement could be further enhanced by implementing this action.

In a yet further embodiment of the apparatus according to the invention the conductor via which the outer housing is grounded, the conductor via which the additional housing is grounded and a conductor connecting the collector housing with the determining means form a triaxial cable, the conductor leading to the determining means forming the inner conductor, the conductor grounding the additional housing forming the inner tubular conductor and the conductor grounding the outer housing forming the outer tubular conductor of the triaxial cable. With this embodiment an extremely accurate measuring could be carried out, while environmental influences essentially do not play a role.

Basically, the collector housing as well as the other mentioned housings of the apparatus according to the invention should be made of highly conductive materials, e. g. of metals. In a further advantageous embodiment of the apparatus according to the invention the collector housing and the additional housing are made of copper, in order to achieve an accurate counting of ions impinging on the surface of the collector housing on the one hand and an enhanced shielding of the collector housing by way of the additional housing on the other hand. It has further been found out that the afore-mentioned shielding effect accomplished by combining the outer housing with the additional housing is further enhanced, if the outer housing is made of aluminium.

In a further embodiment of the apparatus according to the invention the outer housing and – if an additional housing is provided - the additional housing has an opening, the opening or openings being aligned with the input opening of the collector housing. This way the domestic appliance and hair care device, respectively, could be easily inserted into the collector housing via the opening or openings and the input opening. It is preferred, if the opening in the outer housing or/and the additional housing is smaller than the input opening of the collector housing, so that a further enhanced shielding of the collector housing by way of the outer or/and additional housing could be achieved, said enhanced shielding leading to accurate and reliable measurement results. The opening in the outer housing or/and additional housing more preferably has a width and a height of at least 8 cm, preferably at least 12 cm, more preferably at least 16 cm, so that common domestic appliances and hair care devices, respectively, could completely or at least partially be inserted via the opening or openings as already described before.

By providing a relative large input opening in the collector housing and a relative large opening in the outer or/and additional housing, it is possible to insert the domestic appliance into the collector housing, however, there is a risk that ions in the environmental air may enter the collector housing and impinge on its inner surface, thereby influencing the measurement results. In order to avoid this influence, in a further preferred embodiment of the apparatus according to the invention there is provided a cover for altering the size of the opening of the outer housing or/and additional housing. Thus, after inserting the domestic appliance through the opening in the outer or/and additional housing and the input opening into the collector housing, the size of the opening could be decreased in order to prevent ions in the environmental air from entering the collector housing during measuring. In this embodiment it is

further preferred if the cover is an iris diaphragm, so that a uniform downsizing of the opening could be achieved.

In a further embodiment of the apparatus according to the invention a projection
5 of the opening in the outer housing or/and additional housing in the feeding direction is completely arranged within a projection of the input opening in the feeding direction. In this way an excellent shielding of the collector housing by way of the outer housing or/and additional housing even in the border area of the input opening is achieved.

10 Some of the domestic appliances and hair care devices, respectively, do not only expel ions but also generate heat or discharge heated air. This is for example the case, if the domestic appliance is a curling iron or a hair dryer. In such cases, the measurement result is negatively influenced by the heated air retained inside the collector housing. In order to eliminate this interference factor the collector housing further comprises an outlet opening for releasing air
15 from the inside of the collector housing to the environment of the apparatus in a further useful embodiment of the apparatus according to the invention.

According to a further embodiment of the invention the outlet opening is smaller than the input opening so that an escape of ions emitted by the ion source of the domestic
20 appliance through the outlet opening is widely avoided. Alternatively or additionally the outlet opening is separated from the input opening. This is especially helpful, if a cover for altering the size of the opening in the outer housing or/and additional housing is provided. Alternatively or additionally the outlet opening is disposed on the opposite side of the input opening.

25 In a further embodiment of the apparatus according to the invention the outlet opening is covered with an electroconductive mesh which is connected to the collector housing for collecting ions. Thus, the air inside the collector housing may be discharged to the environment via the gaps in the mesh, but the ions expelled by the handheld domestic appliance may be collected by the mesh so that in spite of the outlet opening an accurate and reliable
30 counting of the ions emitted by the domestic appliance is possible.

In a further embodiment of the apparatus according to the invention the wall of the outer housing or/and the additional housing comprises an opening for leading the air from the outlet opening of the collector housing to the environment of the apparatus. It is preferred, if the

opening in the wall of the outer housing or/and the additional housing is aligned with the outlet opening of the collector housing. The opening in the wall of the outer housing or/and the additional housing is preferably covered with an electroconductive mesh being connected to the wall of the respective outer or additional housing, said meshes serving to protect the collector housing from external influences.

Due to the fact, that the collector housing and the determining means connected thereto are interference-prone components of the apparatus, a contact or a collision between the collector housing and the domestic appliance to be inserted into the collector housing should implicitly be avoided. Therefore, in a further useful embodiment of the apparatus according to the invention a feeding system for feeding the domestic appliance into the collector housing is provided, reducing the risk of a contact or collision between the domestic appliance and the collector housing. In this embodiment, it is preferred if the domestic appliance may be fed by a translational movement, more preferably by an exclusive translational motion. The feeding system preferably comprises a movable carrier for carrying the domestic appliance. The carrier more preferably comprises fixing means for immobilizing the domestic appliance with respect to the carrier. By immobilizing the domestic appliance with respect to the carrier a contact between the collector housing and the domestic appliance – especially during the movement of the carrier - is reliably prevented.

The present invention is further directed to a method for counting the number of ions emitted by an ion source of a handheld domestic appliance. The method according to the invention comprises the following procedural steps. First, an apparatus according to the invention as described before is provided. Afterwards, the domestic appliance is completely or at least partially inserted into the collector housing of the apparatus. Then, the number of ions impinging on the inner surface of the collector housing is determined. The afore-described advantages of the apparatus according to the invention apply accordingly to the method according to the invention, so that it is referred to the description above. The method according to the invention especially permits an accurate and reliable counting of the emitted ions independent of the type of ion source, i.e. even if the ion source is a non-directional ion source.

In one embodiment of the method according to the invention the opening of the outer housing or/and additional housing is completely or at least partially covered in order to alter the size of the opening after the domestic appliance has been inserted into the collector

housing, thereby preventing ions in the environmental air from entering the collector housing during measuring. Thus, the measuring leads to an accurate and reliable result.

In a further embodiment of the method according to the invention air from the
5 inside of the collector housing is released to the environment of the apparatus, preferably by means of an outlet opening in the collector housing, said outlet opening more preferably being separated from the input opening. This embodiment of the method according to the invention is especially be useful, if the domestic appliances and hair care devices, respectively, also generate heat or discharge heated air. This is for example the case, if the domestic appliance is a curling
10 iron or a hair dryer. By releasing the heated air from the inside of the collector housing, the interference factor of heated air retained inside the collector housing is eliminated. The outlet opening is preferably covered with an electroconductive mesh connected to the collector housing for collecting ions, so that a loss of ions leaving the collector housing through the outlet opening could be avoided while the air may leave the collector housing.

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The present invention is further directed to a use of the apparatus according to the invention or the method according to the invention for counting the number of ions emitted by an ion source of a handheld domestic appliance, said ion source being a non-directional ion source, said handheld domestic appliance preferably being a hair care device, more preferably a
20 hairdryer, a hairbrush or a curling iron.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the present invention will now be described, by way of example only, with reference to the drawings in which

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Fig. 1 shows a schematic and partially cross-sectional side-view of an embodiment of the apparatus according to the invention before the domestic appliance is fixed to the feeding system,

Fig. 2 shows the apparatus according to Fig. 1 after the domestic appliance has
30 been fixed to the feeding system,

Fig. 3 shows the apparatus according to Fig. 2 after the domestic appliance has been inserted into the collector housing and

Fig. 4 shows the apparatus according to Fig. 3 after the opening in the outer housing has been covered and during measuring.

DETAILED DESCRIPTION OF THE INVENTION

Fig. 1 shows a schematic and partially cross-sectional side-view of an embodiment of the apparatus 2 for counting the number of ions emitted by an ion source 4 of a handheld domestic appliance 6. While the domestic appliance 6 will be described later, in fig. 1 the opposing longitudinal directions 8, 10, the opposing lateral directions 12, 14 and the opposing vertical directions 16, 18 of the apparatus 2 are indicated by corresponding arrows. The longitudinal direction 8 is further called the feeding direction of the apparatus 2.

The apparatus 2 comprises a collector housing 20, which is made of copper. The collector housing 20 surrounds a chamber 22, said chamber 22 preferably being a cylindrical chamber. The chamber 22 is limited in the longitudinal direction 10 by a front wall 24, in the longitudinal or feeding direction 8 by a back wall 26 and in the lateral and vertical directions 12, 14, 16, 18 by a tubular side wall 28 of the collector housing 28. Said walls 24, 26, 28 comprise an inner surface 30 facing the chamber 22. The chamber 22 has a length L in the longitudinal direction 8, 10, said length L at least being 35 cm. Preferably the chamber has a length L of at least 45 cm, more preferably at least 55 cm, so that most of the common domestic appliances 6, especially hair care devices, could be completely inserted into the chamber 22.

In the front wall 24 of the collector housing 20 there is provided an input opening 32, said input opening 32 being dimensioned such that the domestic appliance 6 could at least partially, preferably completely, inserted into the collector housing 28 in the longitudinal or feeding direction 8 via input opening 32 as will be described later. In order to achieve this, the width in the lateral direction 12, 14 and the height h in the vertical direction 16, 18 of the input opening 32 is at least 8 cm. In Fig. 1 only the height h of input opening 32 is indicated due to the fact that in the shown embodiment the input opening 32 is circular, so that the height h could also be regarded as the width or diameter of the input opening 32. An input opening 32 of such a width and height h is big enough to insert many of the known domestic appliances 6, especially many of the known hair care devices, in the feeding direction 8 into the collector housing 20 via the input opening 32. In order to increase the number of domestic appliances 6 which could be tested by the apparatus 2, the input opening 32 preferably has a width and a height h of at least 12 cm. More preferably the input opening 32 has a width and a height h of at least 16 cm, so that the apparatus 2 could be used for most of the common domestic appliances 6 and hair care devices, respectively. Further, the input opening 32 is provided in the front wall 24 such that a collar 34 of

the front wall 24 is left, which surrounds the input opening 32. It has been found out that such a collar 34 helps to increase the accuracy of the measuring.

The collector housing 20 is electrically coupled with determining means 36 via conductor 37. The determining means 36 serve to determine the number of ions collected by the collector housing and impinging on the inner surface 30 of the collector housing 20, respectively. The determining means 36 are preferably composed of an electrometer, however, also other current detecting means could be used.

The apparatus 2 further comprises an additional housing 38, which is also made of copper. The additional housing surrounds a second chamber 40 in which the collector housing 28 is arranged, i.e. the collector housing 20 is arranged within the additional housing 38. The second chamber 40 is limited in the longitudinal direction 10 by a front wall 42, in the longitudinal or feeding direction 8 by a back wall 44 and in the lateral and vertical directions 12, 14, 16, 18 by a surrounding side wall 46 of the additional housing 38.

In the front wall 42 of the additional housing 38 there is provided an opening 48, said opening 48 being dimensioned such that the domestic appliance 6 could at least partially, preferably completely, inserted into the collector housing 20 in the longitudinal or feeding direction 8 via opening 48 and input opening 32 as will be described later. In order to achieve this, the width in the lateral direction 12, 14 and the height in the vertical direction 16, 18 of the opening 48 is at least 8 cm, preferably at least 12 cm, more preferably at least 16 cm. The opening 48 is also circular and provided in the front wall 42 such that a collar 50 of the front wall 42 is left, which surrounds the opening 48.

The opening 48 is aligned with the input opening 32 in the longitudinal or feeding direction 8 and has a smaller size, i.e. height and width of the opening 48 and/or the diameter of the opening 48 is smaller than the height h and width of the input opening 32 and/or the diameter of the input opening 32. Further, a projection y of the opening 48 in the longitudinal or feeding direction 8 is completely arranged within a projection x of the input opening 32 in the longitudinal or feeding direction 8, as indicated in Fig. 1.

The additional housing 38 is grounded by way of a first conductor 52 to the reference ground 53 of the determining means 35. Further, there are provided insulating means

54 to avoid direct contact between the collector housing 20 and the additional housing 38 and to electrically insulate the collector housing 20 from the additional housing 38. Thus, the additional housing 38 serves to shield the collector housing 20, such that accurate and reliable measurement results could be achieved.

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The apparatus 2 further comprises an outer housing 56, which is made of aluminium. The outer housing 56 surrounds a third chamber 58 in which the additional housing 38 is placed, i.e. the additional housing 38 together with the collector housing 20 surrounded by the additional housing 38 is placed within the outer housing 56. The third chamber 58 is limited
10 in the longitudinal direction 10 by a front wall 60, in the longitudinal or feeding direction 8 by a back wall 62 and in the lateral and vertical directions 12, 14, 16, 18 by a surrounding side wall 63 of the outer housing 56.

In the front wall 60 of the outer housing 56 there is provided an opening 64, said
15 opening 64 being dimensioned such that the domestic appliance 6 could at least partially, preferably completely, inserted into the collector housing 20 in the longitudinal or feeding direction 8 via opening 64, opening 48 and input opening 32 as will be described later. In order to achieve this, the width in the lateral direction 12, 14 and the height in the vertical direction 16, 18 of the opening 64 is at least 8 cm, preferably at least 12 cm, more preferably at least 16 cm. The
20 opening 64 is also circular and provided in the front wall 60 such that a collar 66 of the front wall 60 is left, which surrounds the opening 64.

The opening 64 is aligned with the input opening 32 in the longitudinal or feeding direction 8 and has a smaller size, i.e. the height and width of the opening 64 and/or the diameter
25 of the opening 64 is smaller than the height h and width of the input opening 32 and/or the diameter of the input opening 32. It is further preferred, if the opening 64 has a smaller size than the opening 48, i.e. the height and width of the opening 64 and/or the diameter of the opening 64 is smaller than the height and width of the opening 48 and/or the diameter of the input opening 48. Further, a projection z of the opening 64 in the longitudinal or feeding direction 8 is
30 completely arranged within the projection x of the input opening 32 in the longitudinal or feeding direction 8, as indicated in Fig. 1. It is further preferred, if the projection z of the opening 64 in the longitudinal or feeding direction 8 is completely arranged within the projection y of the opening 48 in the longitudinal or feeding direction 8.

The size of the opening 64, e. g. its width or/and height or its diameter, in the outer housing 56 may be altered, i.e. the size may be enlarged or decreased. For this purpose a movable cover 68 is provided at the front wall 60 of the outer housing 56. In the shown embodiment, the cover 68 is a so-called iris diaphragm. It should further be mentioned that the cover 68 may alternatively or additionally provided at the additional housing 38, so that the size of the opening 48 could be altered, however, the cover 68 should in no case be electrically connected with the collector housing 20. In order to simplify the construction of the apparatus 2 as well as its handling, the movable cover 68 should be provided at the outer housing 56, as shown in the figures.

The outer housing 56 is grounded by way of a second conductor 70 to a ground 71, said ground 71 being separated from the reference ground 53 of the determining means 36. The second conductor 70 is separated from the first conductor 52 for grounding the additional housing 38. Further, there are provided insulating means 72 to avoid direct contact between the additional housing 38 and the outer housing 56 and to electrically insulate the additional housing 38 from the outer housing 56. Thus, the collector housing 20 is separated from the outer housing 56 by way of the insulating means 54 and the insulating means 72. It has been found out that by providing the outer housing 56 together with the additional housing 38 the shielding of the collector housing 20 from external influences could be considerably enhanced so that environmental aspects do no longer have an influence on the measurement results.

As can be seen from the figures, there is further provided an outlet opening 74 for releasing air from the inside of the collector housing 20, i.e. from its chamber 22, to the environment 76 of the apparatus 2. The outlet opening 74 is disposed on the opposite side of the input opening 32, i.e. the outlet opening 74 is provided within the back wall 26 of the collector housing 20 and thus separated from the input opening 32. Further, the outlet opening 74 is smaller than the input opening. Providing the outlet opening 74 is especially useful if the domestic appliance 6 generates heat or discharges heated air. This is for example the case, if the domestic appliance 6 is a curling iron or a hairdryer. The outlet opening 74 eliminates the interference factor of heated air retained inside the collector housing 20. In order to avoid that ions emitted by the domestic appliance 6 leave the collector housing 20 through the outlet opening 74, the outlet opening 74 is covered with an electroconductive mesh 77 connected to the collector housing 20 for collecting ions. Further, there are provided openings 78, 78 in the walls 62, 44 of the outer housing 56 and the additional housing 38 for leading the air from the outlet

opening 74 to the environment 76 of the apparatus 2, said openings 78, 78 preferably being covered with an electroconductive mesh 79, 79 as well, each of said meshes 79, 79 being connected to the corresponding wall 62 and 44, respectively.

5 The apparatus further comprises a feeding system 80 for feeding the domestic appliance 6 into the collector housing 20. The feeding system 80 comprises a movable carrier 82 for carrying the domestic appliance 6. The movable carrier 82 may be moved in the longitudinal direction 8, 10 with respect to a base 84 of the feeding system 80 and the collector housing 20. The carrier 82 further comprises fixing means 86 for immobilizing the domestic appliance with
10 respect to the carrier 82.

Hereinafter, the functionality of the apparatus 2 and a preferred embodiment of the method according to the invention will be described with reference to Fig. 1 to 4.

15 The apparatus 2 and the method are especially useful, if the ion source 4 of the handheld domestic appliance 6 is a non-directional ion source, so that the ions are expelled in different directions and not uniformly in a predetermined direction in order to form an ion beam. In the present embodiment, the domestic appliance 6 is a hair care device. Even if the hair care device in Fig. 1 to 4 is a hairbrush, it could also be another hair care device, e. g. a hairdryer or a
20 curling iron.

As can be seen in Fig. 2, the domestic appliance 2 is fixed to the carrier 82 of the feeding system 80 by way of the fixing means 86 first, so that the domestic appliance 6 is immobilized with respect to the carrier 82. Afterwards, the carrier 82 is moved in the longitudinal
25 or feeding direction 8, so that the domestic appliance 6 fixed thereto is inserted completely into the collector housing 20 via opening 64, opening 48 and input opening 32 as can be seen in Fig. 3. After that, the opening 64 in the outer housing 56 is at least partially covered by way of the cover 68, so that the size of the opening 64 is altered and reduced, respectively, after the domestic appliance 6 has been inserted into the collector housing 20 (Fig. 4).

30 Then, the domestic appliance 6 is turned on, e. g. by plugging in the not shown plug of the power cord 88 of the domestic appliance 6, said power cord 88 being at least partially positioned outside the housings 20, 38 and 56. The non-directional ion source 4 expels ions which impinge on the inner surface 30 of the collector housing 20, while the determining means

36 determine the number of ions impinging on the inner surface 30 of the collector housing 20. During this procedural step, the air inside the chamber 22 of the collector housing 20, which is heated by the domestic appliance 6, is at least partially released to the environment 76 by means of the outlet opening 74 and the outlet conduit 78, respectively, in order to avoid the negative
5 influence of heated air retained inside the collector housing 20.

Even if not explicitly shown in the figures, the conductor 70 via which the outer housing 56 is grounded, the conductor 52 via which the additional housing 38 is grounded and the conductor 37 connecting the collector housing 20 with the determining means 36 form a
10 triaxial cable. In this triaxial cable the conductor 37 leading to the determining means 36 forms the inner conductor, the conductor 52 grounding the additional housing 38 forms the inner tubular conductor and the conductor 70 grounding the outer housing 56 forms the outer tubular conductor of the triaxial cable. With this triaxial cable a very accurate measuring could be carried out.

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The dimensions and values disclosed herein are not to be understood as being strictly limited to the exact numerical values recited. Instead, unless otherwise specified, each such dimension is intended to mean both the recited value and a functionally equivalent range surrounding that value. For example, a dimension disclosed as “40 mm” is intended to mean
20 “about 40 mm.”

CLAIMS

What is claimed is:

1. Apparatus (2) for counting the number of ions emitted by an ion source (4) of a handheld domestic appliance (6) comprising a collector housing (20) for collecting ions impinging on the inner surface (30) of the collector housing (20) and determining means (36) being coupled with the collector housing (20) in order to determine the number of ions collected by the collector housing (20), said collector housing (20) having an input opening (32), wherein the input opening (32) is dimensioned such that the domestic appliance (6) is at least partially, preferably completely, insertable into the collector housing (20) via input opening (32).
2. Apparatus (2) according to claim 1, wherein the input opening (32) has a width and a height (h) of at least 8 cm, preferably at least 12 cm, more preferably at least 16 cm, the input opening (32) preferably being circular.
3. Apparatus (2) according to one of claims 1 or 2, wherein the collector housing (20) surrounds a chamber (22), said chamber (22) preferably having a length (L) of at least 35 cm, preferably at least 45 cm, more preferably at least 55 cm, in its feeding direction (8).
4. Apparatus (2) according to one of the preceding claims, wherein the collector housing (20) is arranged within an outer housing (56), the outer housing (56) being grounded and the collector housing (20) being separated from the outer housing (56) by insulating means (54, 72).
5. Apparatus (2) according to claim 4, wherein the collector housing (20) is arranged within an additional housing (38), the additional housing (38) being grounded and placed within the outer housing (56), the collector housing (20) as well as the outer housing (58) being separated from the additional housing (38) by insulating means (54, 72), the additional housing (38) preferably being grounded to a reference ground (53) of the determining means (36), the outer housing (56) and the additional housing (38) preferably being grounded via separate conductors (70, 52).
6. Apparatus (2) according to claim 5, wherein the collector housing (20) and the additional housing (38) are made of copper, the outer housing (56) preferably being made of aluminium.
7. Apparatus (2) according to one of claims 4 to 6, wherein the outer housing (56) or/and the additional housing (38) has an opening (64, 48), the opening (64, 48) being aligned with

the input opening (32) of the collector housing (20), the opening (64, 48) preferably being smaller than the input opening (32) of the collector housing (20), the opening (64, 48) more preferably having a width and a height of at least 8 cm, preferably at least 12 cm, more preferably at least 16 cm.

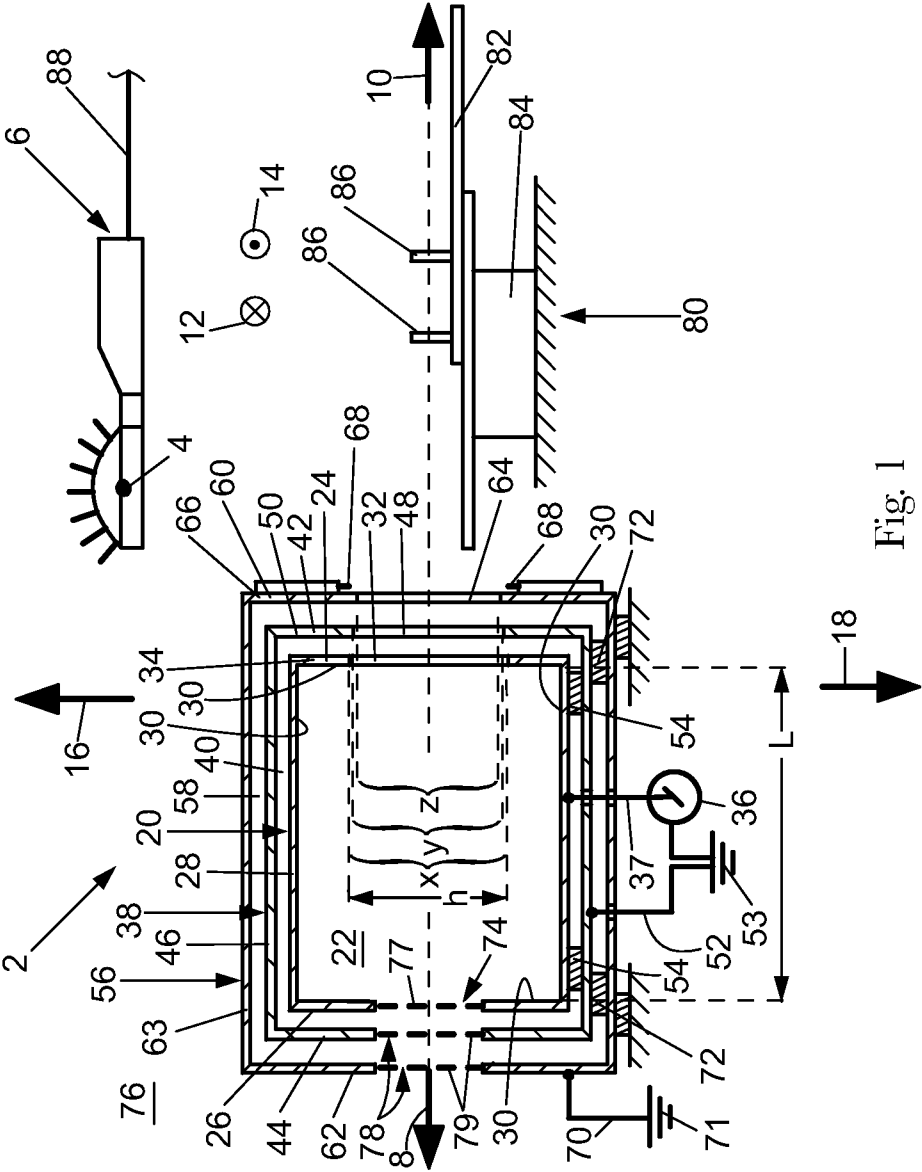
8. Apparatus (2) according to claim 7, wherein there is provided a cover (68) for altering the size of the opening (64, 48) of the outer housing (56) or/and additional housing (38), said cover (68) preferably being an iris diaphragm.
9. Apparatus (2) according to one of claims 7 or 8, wherein a projection (z, y) of the opening (64, 48) in the feeding direction (8) is completely arranged within a projection (x) of the input opening (32) in the feeding direction (8).
10. Apparatus (2) according to one of the preceding claims, wherein the collector housing (20) further comprises an outlet opening (74) for releasing air from the inside of the collector housing (20) to the environment (76) of the apparatus (2), the outlet opening (74) preferably being smaller than the input opening (32), being separated from the input opening (32), being disposed on the opposite side of the input opening (32) or/and being covered with an electroconductive mesh (77) connected to the collector housing (20) for collecting ions, the wall (62, 44) of the outer housing (56) or/and the additional housing (38) more preferably comprising an opening (78, 78) for leading the air from the outlet opening (74) to the environment (76) of the apparatus (2), said opening (78, 78) preferably being covered with an electroconductive mesh (79, 79) being connected to the respective wall (62, 44).
11. Apparatus (2) according to one of the preceding claims, wherein a feeding system (80) for feeding the domestic appliance (6) into the collector housing (20) is provided, the feeding system (80) preferably comprising a movable carrier (82) for carrying the domestic appliance (6), the carrier (82) more preferably comprising fixing means (86) for immobilizing the domestic appliance (6) with respect to the carrier (82).
12. Method for counting the number of ions emitted by an ion source (4) of a handheld domestic appliance (6) comprising the steps of

providing an apparatus (2) according to one of the preceding claims,

inserting the domestic appliance (6) completely or at least partially into the collector housing (20) and

determining the number of ions impinging on the inner surface (30) of the collector housing (20).

13. Method according to claim 12 with the further step of completely or at least partially covering the opening (64, 48) in the outer housing (56) or/and the additional housing (38) in order to alter the size of the opening (64, 48) after the domestic appliance (6) has been inserted into the collector housing (20).
14. Method according to one of claims 12 or 13 with the further step of releasing air from the inside of the collector housing (20) to the environment (76) of the apparatus (2), preferably by means of an outlet opening (74) in the collector housing (20), said outlet opening (74) more preferably being separated from the input opening (32) or/and being covered with an electroconductive mesh (77) connected to the collector housing (20) for collecting ions.
15. Use of the apparatus (2) according to one of claims 1 to 11 or the method according to one of claims 12 to 14 for counting the number of ions emitted by an ion source (4) of a handheld domestic appliance (6), said ion source (4) being a non-directional ion source (4), said handheld domestic appliance (6) preferably being a hair care device, more preferably a hairdryer, a hairbrush or a curling iron.



2/4

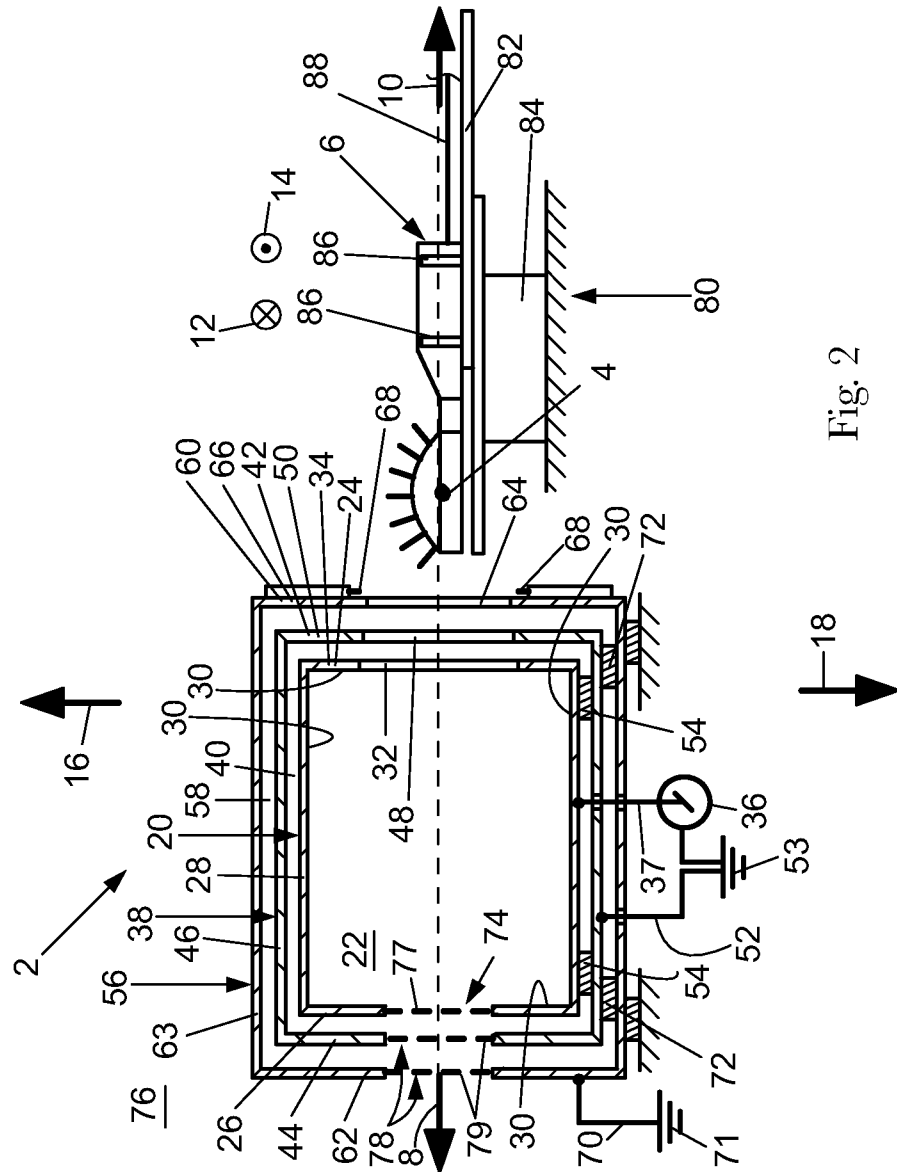


Fig. 2

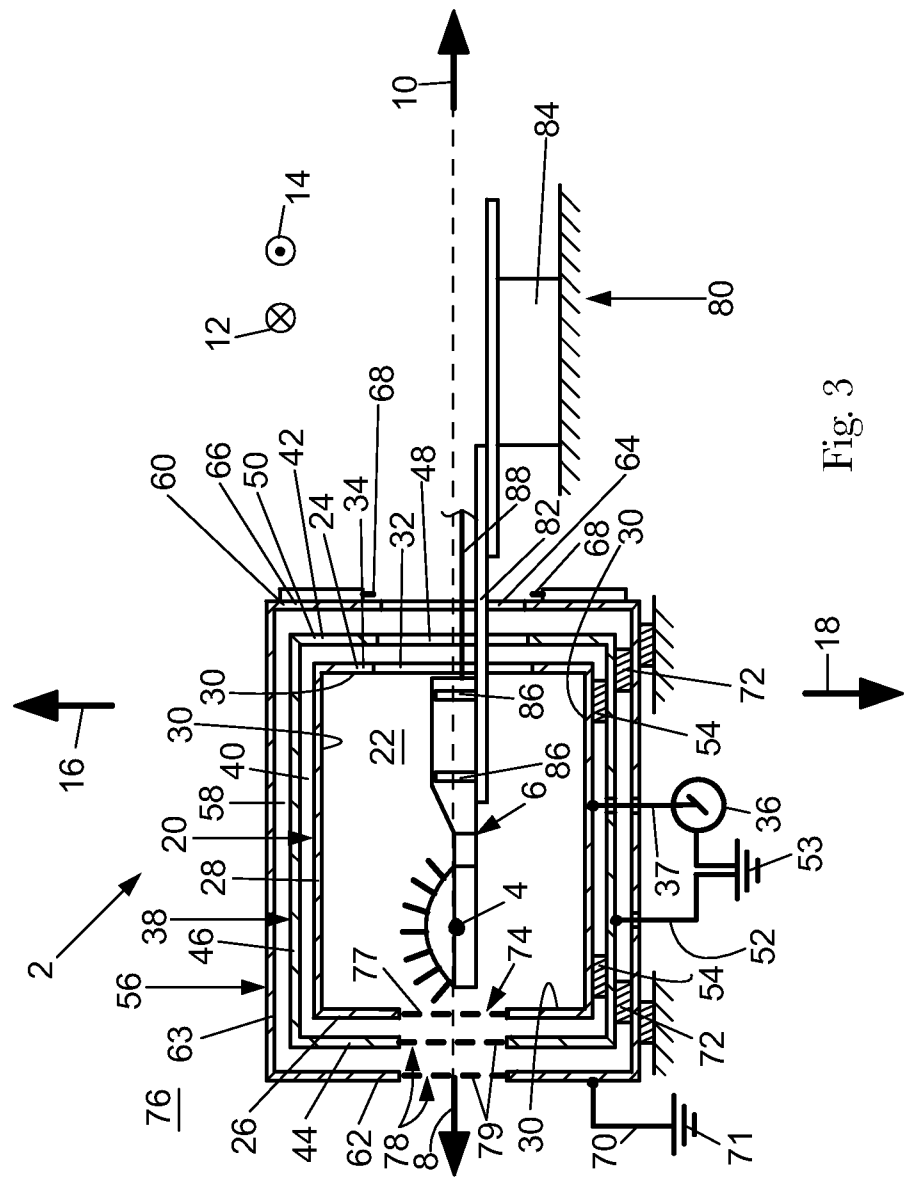


Fig. 3

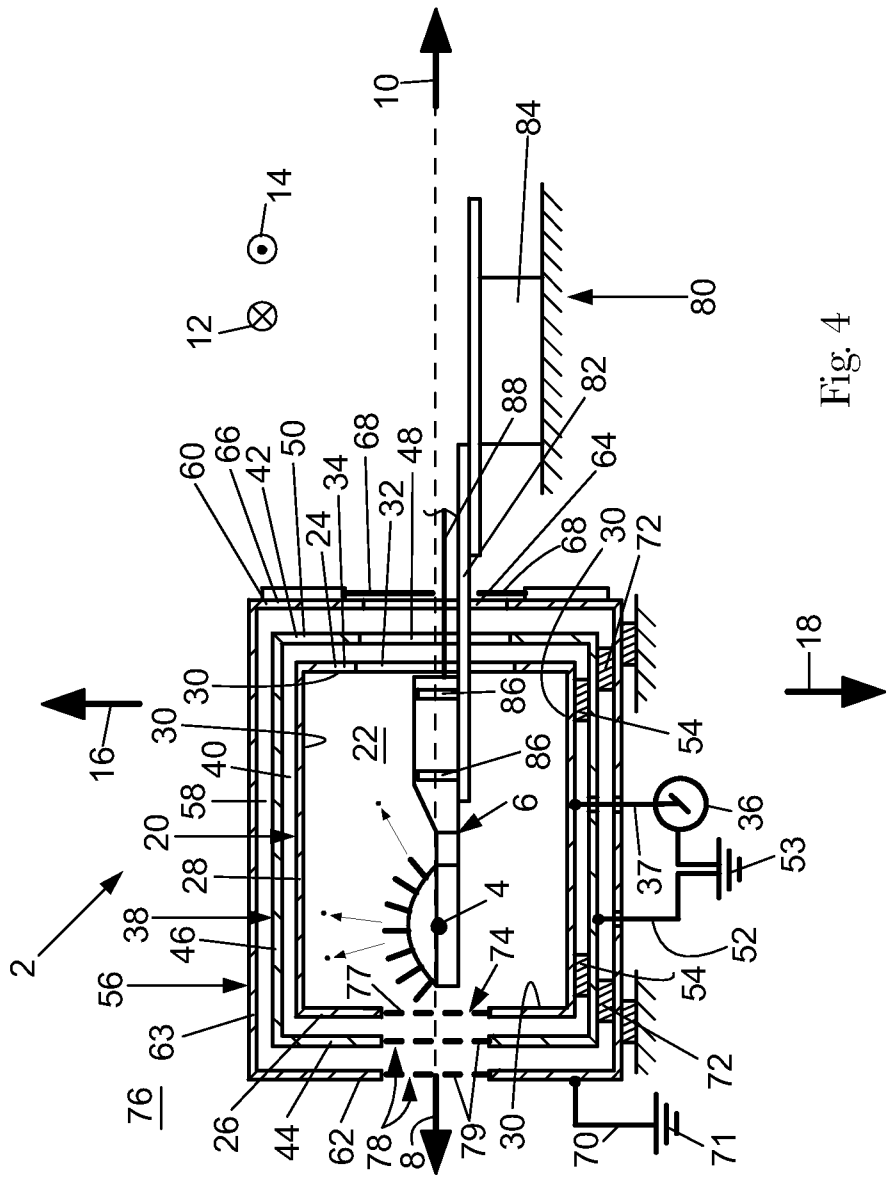


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2012/052721

A. CLASSIFICATION OF SUBJECT MATTER
INV. A45D20/12 G01N27/62 G01R29/24
ADD.

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)

A45D G01N G01R H01T

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

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

EPO-Internal, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	MATSUI M ET AL: "Improvement of the Transfer Efficiency of the Atomized Powder Coating System by Increasing the Conveying Air Speed", IEEE TRANSACTIONS ON INDUSTRY APPLICATIONS, IEEE SERVICE CENTER, PISCATAWAY, NJ, US, vol. IA-22, no. 2, 1 March 2009 (2009-03-01), pages 606-614, XP011253765, ISSN: 0093-9994 page 612, right-hand column, last paragraph - page 613, right-hand column, paragraph 1; figure 9 ----- -/--	1-4,7,10

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

19 July 2012

Date of mailing of the international search report

27/07/2012

Name and mailing address of the ISA/

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Authorized officer

Lang, Thomas

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2012/052721

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2002 005975 A (MITSUBISHI ELECTRIC CORP) 9 January 2002 (2002-01-09) abstract paragraphs [0002] - [0003], [0016] - [0027]; figures 1,5,6 -----	1-3
X	KUCEROVSKY Z ET AL: "Attrition of the Charge on a Carrier Moving Through a Gas", IEEE TRANSACTIONS ON INDUSTRY APPLICATIONS, IEEE SERVICE CENTER, PISCATAWAY, NJ, US, vol. 43, no. 6, 1 November 2007 (2007-11-01), pages 1515-1523, XP011197483, ISSN: 0093-9994, DOI: DOI:10.1109/TIA.2007.908188 page 1530, left-hand column, paragraph 1 - right-hand column, paragraph 1; figures 6,7 -----	1,3,4,7, 9,10
X	KAWAGUCHI T ET AL: "A magnetically levitated electrode ionization chamber of the noncontact measurement type", NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH, SECTION - A:ACCELERATORS, SPECTROMETERS, DETECTORS AND ASSOCIATED EQUIPMENT, ELSEVIER, AMSTERDAM, NL, vol. 481, no. 1-3, 1 April 2002 (2002-04-01), pages 317-322, XP004347516, ISSN: 0168-9002, DOI: DOI:10.1016/S0168-9002(01)01346-8 page 318, left-hand column, last paragraph - right-hand column, last paragraph; figure 1 -----	1,3,4,7, 9,11
A	US 6 640 049 B1 (LEE WILLIAM [US] ET AL) 28 October 2003 (2003-10-28) abstract column 8, line 20 - column 9, line 8; figures 1,3 -----	1,12,15
A	WO 2010/013614 A1 (PANASONIC ELEC WORKS CO LTD [JP]; MIYATA HIROMITSU; SUDA HIROSHI; MACH) 4 February 2010 (2010-02-04) abstract; figures 1,2 -----	1,12,15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2012/052721

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 5, 6

Apparatus for counting the number of ions emitted by an ion source of a handheld domestic appliance comprising a collector housing for collecting ions impinging on the inner surface of the collector housing and determining means being coupled with the collector housing in order to determine the number of ions collected by the collector housing, said collector housing having an input opening, wherein the input opening is dimensioned such that the domestic appliance is at least partially, preferably completely, insertable into the collector housing via input opening (claim 1); wherein the collector housing is arranged within an outer housing, the outer housing being grounded and the collector housing being separated from the outer housing by insulating means (claim 4); wherein the collector housing is arranged within an additional housing, the additional housing being grounded and placed within the outer housing, the collector housing as well as the outer housing being separated from the additional housing by insulating means, the additional housing preferably being grounded to a reference ground of the determining means, the outer housing and the additional housing preferably being grounded via separate conductors (claims 5, 6).

2. claim: 8

Apparatus according to claims 4, wherein the outer housing or/and the additional housing has an opening, the opening being aligned with the input opening of the collector housing, the opening preferably being smaller than the input opening of the collector housing, the opening more preferably having a width and a height of at least 8 cm, preferably at least 12 cm, more preferably at least 16 cm (claim 7); wherein there is provided a cover for altering the size of the opening of the outer housing or/and additional housing, said cover preferably being an iris diaphragm (claim 8).

3. claims: 12-15

Method for counting the number of ions emitted by an ion source of a handheld domestic appliance by using an apparatus according to claim 1.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2012/052721

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
JP 2002005975	A	09-01-2002	NONE	

US 6640049	B1	28-10-2003	CN 1357286 A	10-07-2002
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			JP 2010035583 A	18-02-2010
			WO 2010013614 A1	04-02-2010
