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(54) **Ionization apparatus**

(57) The invention relates to an ionization apparatus comprising a housing (1) and at least partly within in the housing (1) a high voltage power supply arrangement (2) with a ion emitting electrode (3-6) connected thereto. It is proposed that the housing (1) comprises an outer casing (7) which is at least partly, preferably for the most part, made of conducting material and an inner casing

(8) inserted into the outer casing (7) which is at least partly, preferably for the most part, made of non conducting material, that the outer casing (7) provides at least part of the outer surface of the housing (1) and that the high voltage supply arrangement (2) with the ion emitting electrode (3-6) connected thereto is at least partly situated in the inner casing (8).

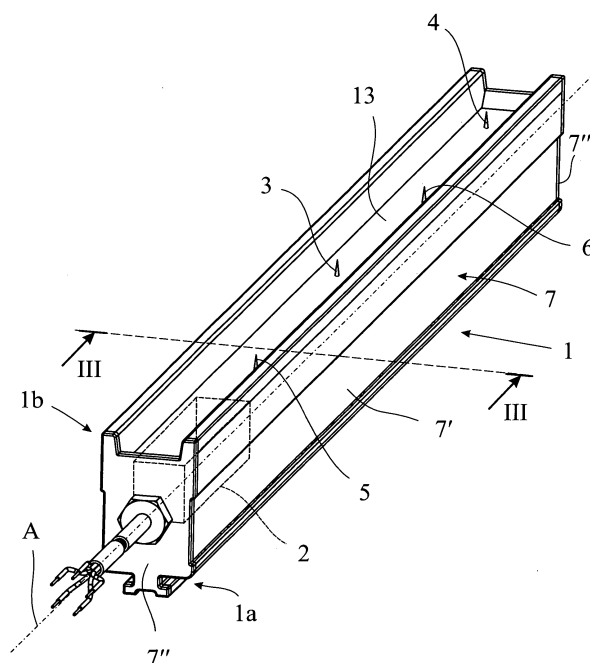


Fig. 1

Description

[0001] The invention is directed to a ionization apparatus according to the general part of claim 1 and to a method for the assembly such a ionization apparatus according to the general part of claim 13.

[0002] The ionization apparatus in question has its application in controlling the charge of a target area. In particular, this includes the neutralization of a target area which is often required when plastic films are being processed in the bag-making industry or the like.

[0003] A known ionization apparatus (EP 2 061 124 A2), which is to be considered the starting point of the invention, comprises a housing and at least partly therein a high voltage power supply arrangement with a ion emitting electrode connected thereto. The voltage power supply arrangement supplies a bipolar voltage against ground potential to a so called ionizer bar. Such a ionizer bar normally comprises a number of ion emitting electrodes that are supplied with the voltage of the high voltage power supply arrangement.

[0004] Challenges for the known ionization apparatus arise when the ionization apparatus is being used in areas that are susceptible to explosions based on static sparking.

[0005] The problem underlying the invention is to improve the known ionization apparatus such that it may safely be operated in areas that are susceptible to explosion, which improvement shall be cost-effective especially in the view of production.

[0006] The above noted problem is solved by a ionization apparatus according to the characterizing part of claim 1.

[0007] First of all the proposed solution is based on the finding that the outer surface of the housing should be made of conducting material, such that, when connected to ground potential, no static charge will be left on the respective housing surface. Accordingly it is proposed that the housing comprises an outer casing at least partly made of conducting material which outer casing provides at least part of the outer surface of the housing.

[0008] Especially in view of easy production, second of all, it is proposed that the housing comprises an inner casing inserted into the outer casing, which inner casing is at least partly, preferably for the most part, made of non-conducting material. The high voltage supply arrangement with at least one ion emitting electrode connected thereto is at least partly situated in the inner casing.

[0009] If the proposed inner casing would not be provided, during the assembly, all components inside the housing including the high voltage power supply arrangement would have to be preliminarily held in place until they were fixed, for example in a potting process or the like. This would be necessary as a predefined distance between the conducting outer casing and any high voltage component is to be kept in any case. Accordingly, without the inner casing, costly fixing appliances would

be necessary for assembly. In this regard the proposed solution is particularly interesting for the preferred embodiment according to claim 8, which is directed to potting of at least part of the inside of the housing with casting resin.

[0010] With the proposed solution it is now possible to place all components including the high voltage power supply arrangement into the inner casing which due to its non-conducting property is isolated against the outer casing. The inner casing may even provide a fixing arrangement for some of the components according to claim 12 which allows a perfectly exact positioning especially of the ion emitting electrodes.

[0011] Another teaching according to claim 13 is directed to a method for the assembly of an above noted ionization apparatus.

[0012] It is of major importance for the proposed method that a potting step is performed after the inner casing has been inserted into the outer casing and after the high voltage power supply arrangement and the ion emitting electrode or electrodes have been inserted into the inner casing. Although at first view it seems a bit redundant to provide an inner, non-conducting casing in addition to potting the inside of the housing with casting resin, the above noted benefits in view of an easy placing of the respective components into the inner casing have been proven to be convincing.

[0013] In the following the invention is explained referring to only one embodiment shown in the drawings. The drawings show in

Fig. 1 a ionization apparatus according to the invention in a perspective view,

Fig. 2 housing components of the ionization apparatus according to Fig. 1 in an exploded view,

Fig. 3 a sectional view of the ionization apparatus according to Fig. 1 along line III-III.

[0014] The ionization apparatus shown in Fig. 1 may be applied in various areas as explained in the general part of the specification. The main area of application for the displayed ionization apparatus is the neutralization which is not to be understood as a restriction.

[0015] The ionization apparatus comprises a housing 1 and at least partly within the housing 1 a voltage power supply arrangement 2 with altogether four ion emitting electrodes 3-6 connected thereto. Generally there may be only one ion emitting electrode. In the following, however, all explanations are directed on the existence of multiple ion emitting electrodes 3-6. All explanations given are fully applicable to an embodiment with only one ion emitting electrode.

[0016] According to the proposed solution the housing 1 comprises an outer casing 7 which is for the most part made of conducting material. In the embodiment shown the outer casing 7 comprises a central part 7' that is

closed to the sides by two side caps 7'',7'''. The central part 7' is made of conducting material like aluminium, while preferably only the two side caps 7'',7''' are made of non conducting material like PVC, PUR, ABS or Nylon.

[0017] The housing 1 further comprises an inner casing 8 inserted into the outer casing 7, which inner casing 8 is at least partly, preferably for the most part, made of non-conducting material. Here and preferably the inner casing 8 is made completely of non conducting material.

[0018] Due to the fact that the outer casing 7 provides at least part of the outer surface of the housing 1, by connecting the outer casing 7 to ground potential, it is possible to guarantee that no or very few static charge is present on the housing surface.

[0019] If designed accordingly it is possible that the outer casing 7 is not completely made of conducting material as noted above with respect to the side caps 7'',7''' and that the inner housing 8 is not completely made of non-conducting material. The main important aspect here is the reduction of static charge on the outer surface of the housing 1 on the one hand and the isolation of the inner components of the ionization apparatus against the outer casing 7 on the other hand. The system design would have to guarantee that the conducting parts of the inner casing 8 and the outer casing 7 would not come into electrical contact even when the inner casing 8 was inserted into the outer casing 8.

[0020] In a preferred embodiment the outer casing 7 is at least partly, preferably for the most part, made of metal as noted above, here and preferably of aluminium. In addition or as an alternative the inner casing 8 is at least partly, preferably for the most part, made of a plastic material, preferably of PVC, PUR, ABS or Nylon.

[0021] There are various designs possible for the ion emitting electrodes 3-6. In the shown embodiment the electrodes 3-6 are each of needle design. It may well be possible, however, that the electrodes 3-6 bolt head design. Each electrode in the shown embodiment comprises a needle-like head portion 3a,6a and a PCB-portion 3b,6b that basically serves as a carrier.

[0022] As noted above, according to the shown and preferred embodiment, multiple ion emitting electrodes 3-6 are provided, that are arranged along the housing axis A.

[0023] Preferably, during ionization the first electrode-group of ion emitting electrodes 3,4 emits positive ions and a second electrode-group of ion emitting electrodes 5,6 emits negative ions. In order to prevent, that those positive and negative ions neutralize each other in the vicinity of the electrodes 3-6 it is preferably provided that the first electrode-group and the second electrode-group emit respective ions in an alternating manner. This means that positive ions and negative ions are produced successively.

[0024] In more detail, preferably, for ionization the high voltage power supply arrangement 2 supplies modulated, preferably pulsed, positive high DC-voltage to the first electrode-group of the ion emitting electrodes 3,4

and modulated, preferably pulsed, negative high DC-voltage to the second electrode-group of ion emitting electrodes 5,6. Further preferably, those DC-voltages are each supplied against ground potential.

[0025] The housing structure is of major importance for the invention and will be described in more detail in the following:

[0026] As may be taken from the drawings the housing 1 is of oblong design and accordingly extends along the housing axis A. The outer casing 7 and the inner casing 8 are of the basic structure of an U-profile. This means that in sectional view according to Fig. 3 the outer casing 7 and the inner casing 8 are provided with a base portion 7a,8a situated at the bottom 1a of the housing 1 and two leg portions 7b,c and 8b,c extending from the bottom 1a into the direction of the top 1b of the housing 1. Fig. 3 shows that the ion emitting electrodes 3-6 are located in the area of the top 1b of the housing 1.

[0027] In some applications it might be advantageous to provide only one of the outer casing 7 and the inner casing 8 in an U-profile. In order to achieve a simple overall structure, however, in the preferred embodiment both casings 7,8 are designed as U-profiles. Fig. 3 shows that the leg portions 8b,c of the inner casing 8a is shorter than the leg portions 7b,c of the outer casing 7. Here and preferably the leg portions 8b,c of the inner casing 8 are shorter than the leg portions 7b,c of the outer casing 7 by at least 10%, preferably at least 25% of the length of the leg portions 7b,c of the outer casing 7.

[0028] The free ends of the leg portions 7b,c of the outer casing 7 provide a rim 9 as may be seen best in the exploded view according to fig. 2. To prevent the ions emitted from the ion emitting electrodes 3-6 being neutralized by the ground potential of the outer casing 7, a rim isolation 10 is attached to the rim 9. In the shown embodiment the rim isolation 10 is designed as a strip like component, which, for isolation purposes, is made of non-conducting material. Generally it is possible as well that the rim isolation 10 is only partly designed as such a strip like component.

[0029] The rim isolation 10 may easily be assembled due to a form fit connection. In further detail the rim isolation 10 has a profile 11 that is in form fit connection with the rim 9 provided by the free ends of the leg portions 7b,7c of the outer casing 7.

[0030] It may be seen from fig. 3 that for demounting at least a part 10a of the rim isolation 10 is to be moved towards the inside of the housing 1 laterally with respect to the leg portions 7b,c. This direction of movement is depicted with reference number 12 in fig. 3. Especially interesting is the fact that this demounting movement 12 is not possible as it is blocked by casting resin 13 to be explained in the following.

[0031] Fig. 3 shows that the inside of the housing 1 is at least partly potted with casting resin 13 like epoxy resin from the bottom 1a of the housing 1 upwards up to a potting level 14.

[0032] Fig. 3 further shows that the potting level 14 is

higher than the leg portions 8b,c of the inner casing 8. This high potting level 14 guarantees a good isolation and at the same time a good mechanical fixture of the inner casing 8.

[0033] An interesting aspect is further the fact that the potting level 14 is even higher than the bottom of the rim isolation 10. This means that the potting level 14 is higher than the lower part 10a of the rim isolation 10 which has to perform the movement 12 in order to be demounted. Accordingly the casting resin 13 locks the rim isolation 10 against demounting the rim isolation 10 from the rim 9. In addition this "overlap" between the casting resin 13 and the rim isolation 10 guarantees perfect isolation against the leg portions 7b,7c of the outer casing 7.

[0034] Fig. 2 and 3 in combination show that the inner casing 8 at least along a part of its oblong extension provides an additional separation wall 15 that extends from the base portion 8a into the direction of the top 1b of the housing 1. Here and preferably the additional separation wall 15 extends basically to the top of the inner casing 8. With this separation wall 15 two chambers 15a, 15b are defined which may receive the above noted ion emitting electrodes 3-6. Preferably, two above noted groups of ion emitting electrodes are located on opposites of the separation wall 15. In further detail, the ion emitting electrodes 3,4 of the first electrode-group are located on the left side of the separation wall 15 and the ion emitting electrodes 5,6 of the second electrode-group are located on the right side of the separation wall 15 (fig. 3).

[0035] It may be seen in fig. 3 that the PCB-portion 3b,6b of the ion emitting electrodes 3,6 is located besides the separation wall 15 while the needle-like head portions 3a,6a of the ion emitting electrodes 3,6 are sticking out of the casting resin 13 above the separation wall 15.

[0036] The inner casing 8 comprises another interesting constructional feature that may be seen in fig. 3 as well. The inner casing 8 provides a fixing arrangement 16 for the ion emitting electrodes 3-6 for fixing the ion emitting electrodes 3-6 before the housing 1 has been potted with casting resin 13. In further detail, fig. 3 shows that the fixing arrangement 16 comprises two clamping tongues 17,18 for clamping the ion emitting electrodes 3-6. There are various possibilities for realization of the clamping process. Here and preferably the clamping takes place basically between the clamping tongues 17,18 and the separation wall 15. In the shown embodiment those clamping tongues 17,18 are realized as bars that extend along the separation wall 15.

[0037] Another interesting aspect regarding the construction of the inner casing 8 is the fact that the separation wall 15 as well as the fixing arrangement 16 is not extending along the complete extension of the housing 1. With this a section 19 is provided with a free cross-section for inserting all components of the high voltage power supply arrangement 2.

[0038] According to another teaching a method for the assembly of the above noted ionization apparatus is claimed.

[0039] According to the claimed method the inner casing 8 is being inserted into the outer casing 7 and before or after inserting the inner casing 8 the high voltage power supply arrangement 2 and the ion emitting electrodes 3-6 are being inserted into the inner casing 8. It is of major importance now that after inserting the inner casing 8 and after inserting the high voltage power supply arrangement 2 and the ion emitting electrodes 3-6, the inside of the housing 1 is at least partly potted with casting resin 13 from the bottom 1a of the housing 1 upwards up to a potting level 14. It has been explained with regard to the proposed ionization apparatus already that with this way of assembly the use of costly holding appliances is not necessary. This is especially true when the above noted fixing arrangement 16 is provided such that the ion emitting electrodes 3-6 may be clamped to the inner casing 8 using the above noted clamping tongues 17,18 of the fixing arrangement 16.

[0040] Preferably, the potting is done such that the potting level 14 is higher than the leg portions 8b,8c of the inner casing 8. The benefits of this high potting level 14 have been explained further above.

[0041] It is particularly preferred that the free ends of the leg portions 8b,c of the outer casing 8 provide a rim 9 and that a rim isolation 10 is being attached to the rim 9 before potting of the inside of the housing 1 such that the casting resin 13 locks the rim isolation 10 against demounting the rim isolation 10 from the rim 9. Again this has been explained in detail further above.

[0042] Finally it may be pointed out that there are various possibilities for inserting the inner casing 8 into the outer casing 7. For example, the inner casing 8 may be slid into the outer casing 8 along the housing axis A. Here and preferably, however, it is provided that the inner casing 8 is inserted into the housing 7 with a movement 20 that is directed to the inside of the outer casing 7 and that is also directed laterally to the housing axis A. For this insertion of the inner casing 8 a snap-fit-connection is provided between the inner casing 8 and the outer casing 7. In further detail the inner casing is provided with a snap section 20 which interacts with a corresponding counter snap section 21 at the outer casing 7. This snap-fit-connection allows a safe preliminary fixture of the inner casing 8 in the outer casing 7 before the casting resin is being potted in the inside of the housing 1.

Claims

1. Ionization apparatus comprising a housing (1) and at least partly within in the housing (1) a high voltage power supply arrangement (2) with at least one ion emitting electrode (3-6) connected thereto, characterized in that the housing (1) comprises an outer casing (7) which is at least partly, preferably for the most part, made of conducting material and an inner casing (8) inserted into the outer casing (7) which is at least

- partly, preferably for the most part, made of non conducting material, that the outer casing (7) provides at least part of the outer surface of the housing (1) and that the high voltage supply arrangement (2) with the ion emitting electrode (3-6) connected thereto is at least partly situated in the inner casing (8).
2. Ionization apparatus according to claim 1, **characterized in that** the outer casing (7) is for the most part made of metal, preferably of aluminium, and/or, that the inner casing (8) is for the most part made of a plastics material, preferably of PVC, PUR, ABS or Nylon.
 3. Ionization apparatus according to claim 1 or 2, **characterized in that** multiple ion emitting electrodes (3-6) are provided, that are arranged along a housing axis (A), preferably, that during ionization a first electrode-group of ion emitting electrodes (3,4) emits positive ions and a second electrode-group of ion emitting electrodes (5,6) emits negative ions, preferably, that the first electrode-group and the second electrode-group emit respective ions in an alternating manner, further preferably, that for ionization the high voltage power supply arrangement (2) supplies modulated, preferably pulsed, positive high DC-voltage to the first electrode-group and modulated, preferably pulsed, negative high DC-voltage to the second electrode-group.
 4. Ionization apparatus according to one of the preceding claims, **characterized in that** the housing (1) is of oblong design and extends along a housing axis (A) and that the outer casing (7) and/or the inner casing (8) is/are of the basic structure of an U-profile with a base portion (7a,8a) situated at the bottom (1a) of the housing (1) and two leg portions (7b,c,8b,c) extending from the bottom (1a) into the direction of the top (1b) of the housing (1), preferably, that the ion emitting electrode/electrodes (3-6) is/are located in the area of the top (1b) of the housing (1).
 5. Ionization apparatus according to one of the preceding claims, **characterized in that** the leg portions (8b,c) of the inner casing (8) are shorter than the leg portions (7b,c) of the outer casing (7), preferably, that the leg portions (8b,c) of the inner casing (8) are shorter than the leg portions (7b,c) of the outer casing (7) by at least 10%, preferably by at least 25%.
 6. Ionization apparatus according to one of the preceding claims, **characterized in that** the free ends of the leg portions (7b,c) of the outer casing (7) provide a rim (9) and that a rim isolation (10) is attached to the rim (9), preferably, that the rim isolation (10) is at least partly designed as a strip like component made of non conducting material.
 7. Ionization apparatus according to one of the preceding claims, **characterized in that** the rim isolation (10) has a profile that is in form fit connection with the rim (9) provided by the free ends of the leg portions (7b,c) of the outer casing (7), preferably, that for its demounting at least a part of the rim isolation (10) is to be moved towards the inside of the housing (1) laterally with respect to the leg portions (7b,c).
 8. Ionization apparatus according to one of the preceding claims, **characterized in that** the inside of the housing (1) is at least partly potted with casting resin (13) from the bottom (1a) of the housing (1) upwards up to a potting level (14).
 9. Ionization apparatus according to claim 8, **characterized in that** the potting level (14) is higher than the leg portions (8b,c) of the inner casing (8).
 10. Ionization apparatus according to one of the preceding claims, **characterized in that** the potting level (14) is higher than the bottom of the rim isolation (10), preferably, that the casting resin (13) locks the rim isolation (10) against demounting the rim isolation (10) from the rim (9).
 11. Ionization apparatus according to one of the preceding claims, **characterized in that** the inner casing (8) at least along a part of its oblong extension provides an additional separation wall (15) that extends from the base portion (8a) into the direction of the top (1b) of the housing (1), preferably basically to the top of the inner casing (8), further preferably, that two groups of ion emitting electrodes (3-6) are located on opposite sides of the separation wall (15).
 12. Ionization apparatus according to one of the preceding claims, **characterized in that** the inner casing (8) provides a fixing arrangement (16) for the ion emitting electrode/electrodes (3-6) for fixing the ion emitting electrode/electrodes (3-6) before the housing (1) has been potted with casting resin (13), preferably, that the fixing arrangement (16) comprises at least one clamping tongue (17, 18) for clamping a ion emitting electrode (3-6).
 13. Method for the assembly of a ionization apparatus according to one of the preceding claims, **characterized in that** the inner casing (8) is being inserted into the outer casing (7), that before or after inserting the inner casing (8) the high voltage power supply arrangement (2) and the ion emitting electrode (3-6) or electrodes (3-6) are being inserted into the inner casing (8) and that after inserting the inner casing (8) and after inserting the high voltage power supply arrangement (2) and the ion emitting electrode (3-6) or electrodes (3-6) the inside of the housing (1) is at least partly potted with casting resin (13) from the

bottom (1a) of the housing (1) upwards up to a potting level (14).

14. Method according to claim 13, **characterized in that** the potting level (14) is higher than the leg portions (8b,c) of the inner casing (8). 5

15. Method according to claim 13 or 14, **characterized in that** the free ends of the leg portions (7b,c) of the outer casing (7) provide a rim (9) and that a rim isolation (10) is being attached to the rim (9) before potting of the inside of the housing (1) such that the casting resin (13) locks the rim isolation (10) against demounting the rim isolation (10) from the rim (9). 10

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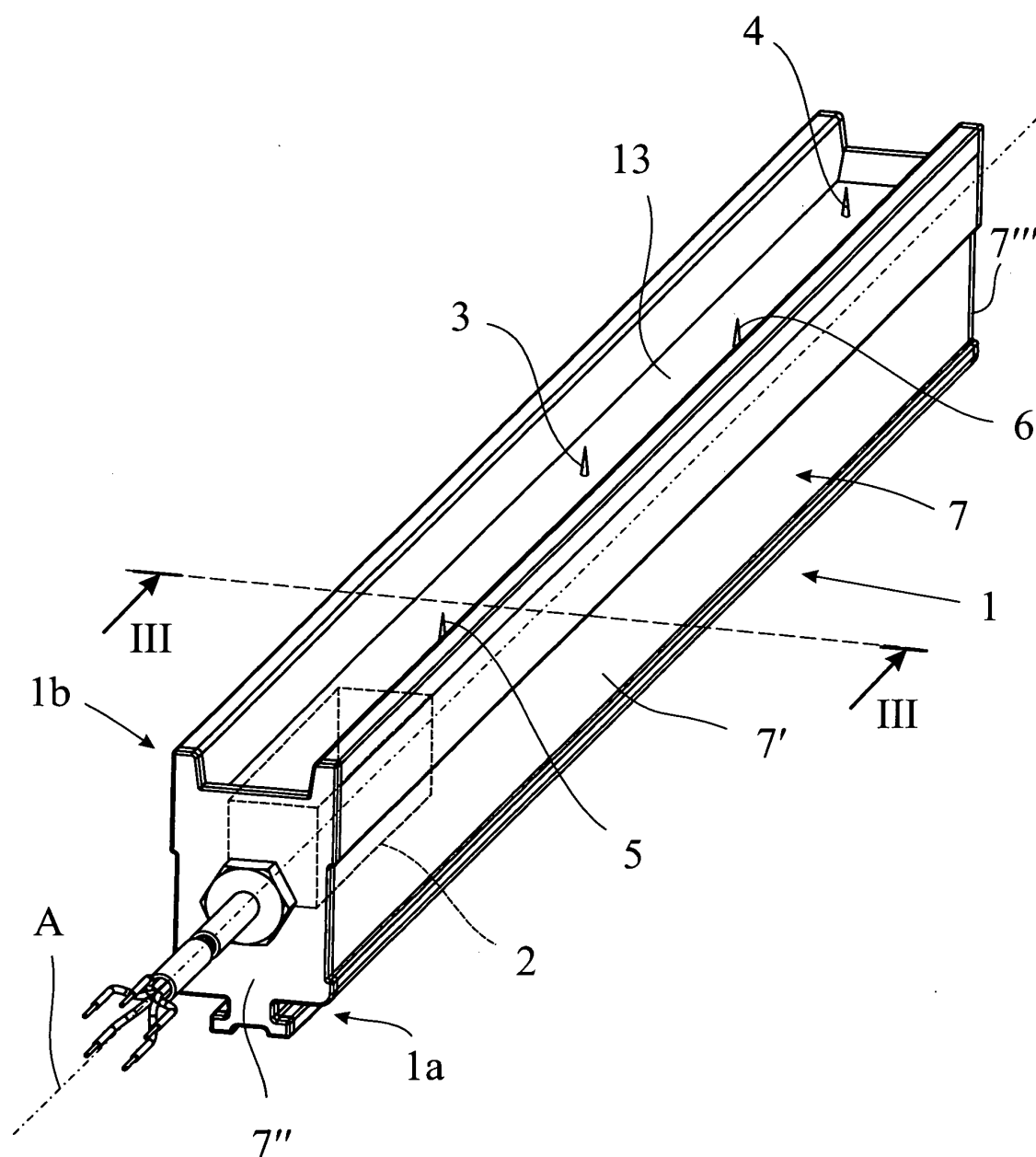


Fig. 1

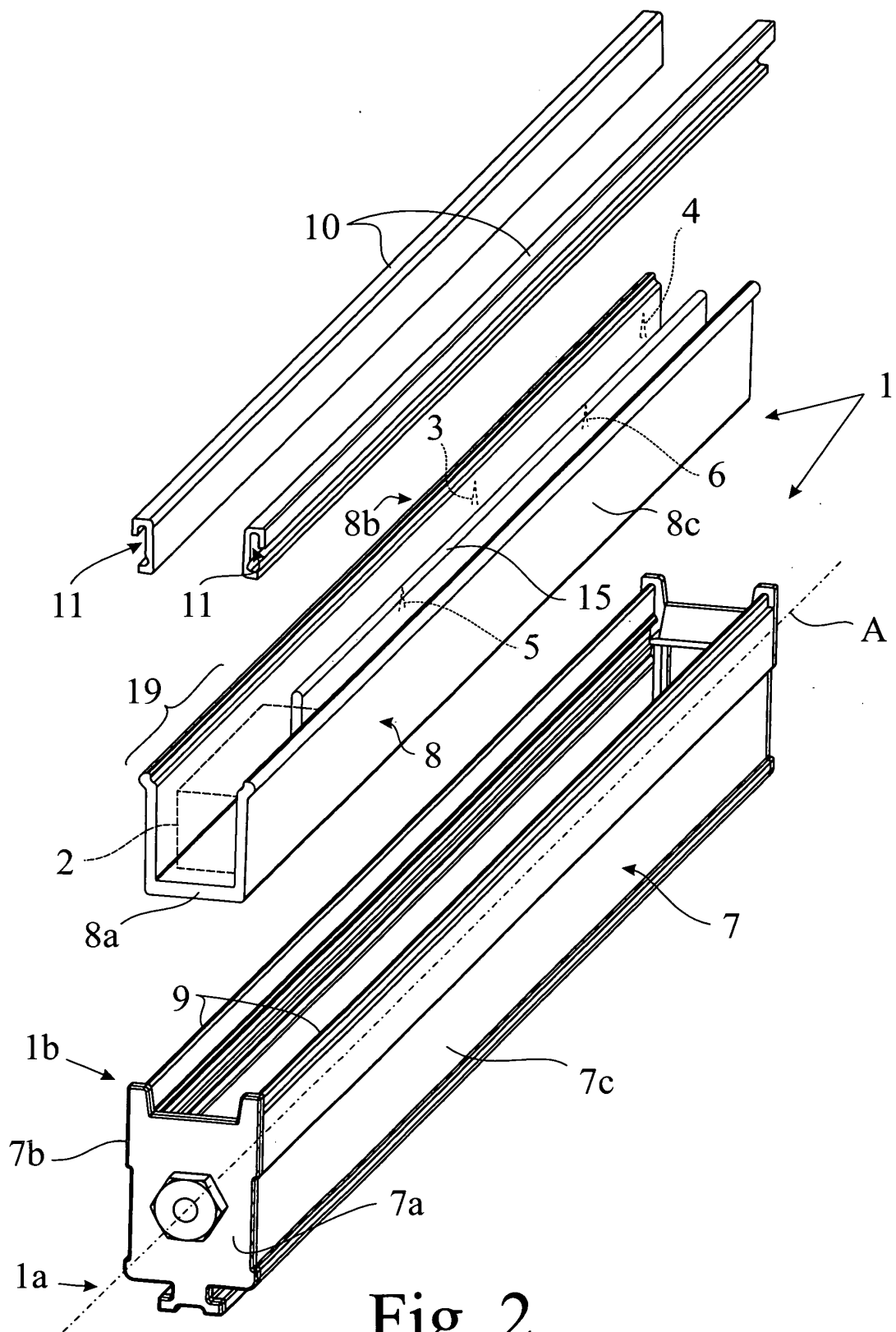


Fig. 2

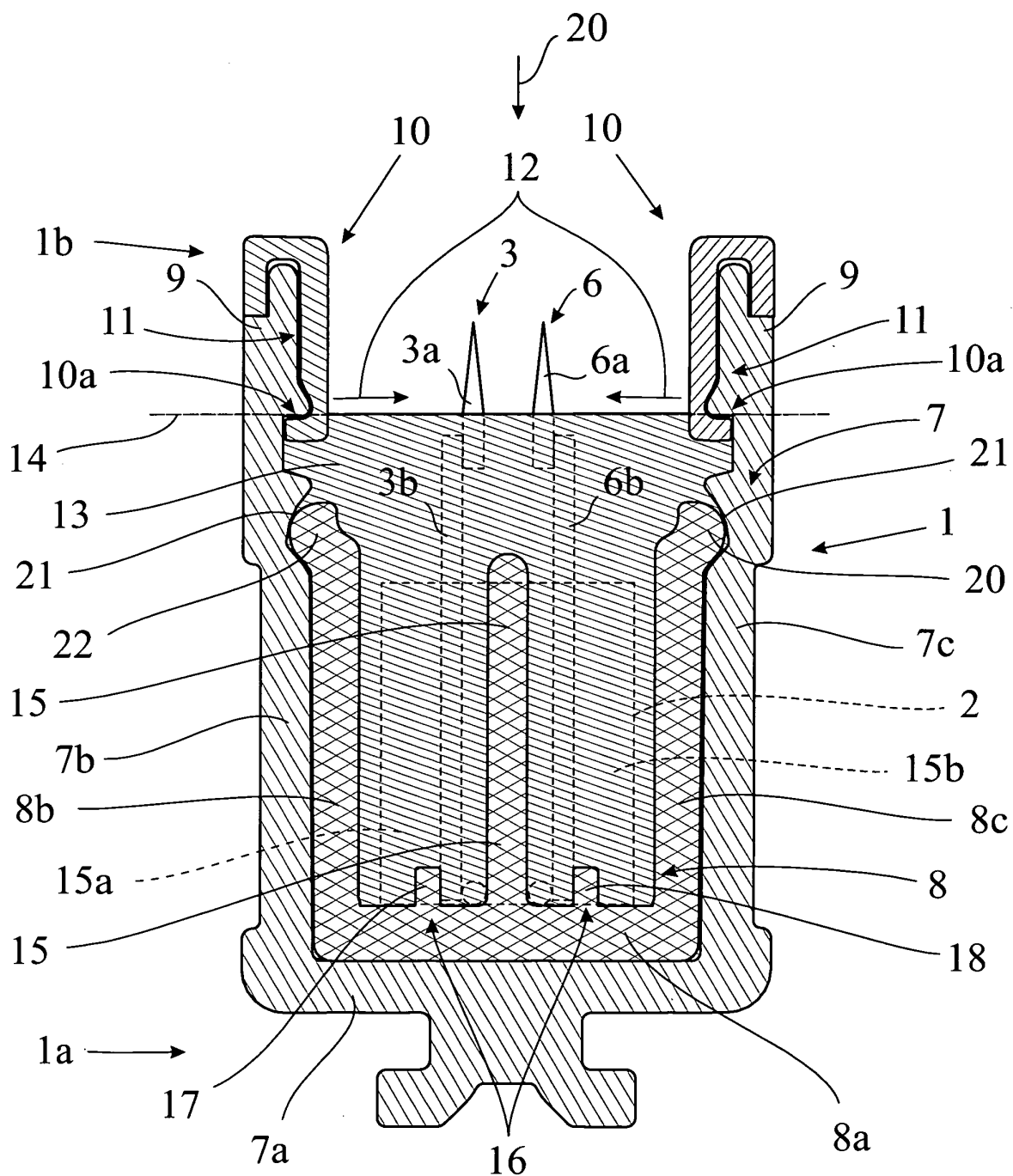


Fig. 3



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Place of search The Hague		Date of completion of the search 24 June 2013	Examiner Ruppert, Christopher
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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