(19) DANMARK

(10) **DK/EP 3205186 T3**

Patent- og
Varemærkestyrelsen

(12) Oversættelse af
europæisk patentskrift

(51) Int.Cl.: ***H 05 H 1/24 (2006.01)***

(45) Oversættelsen bekendtgjort den: **2022-02-28**

(80) Dato for Den Europæiske Patentmyndigheds
bekendtgørelse om meddelelse af patentet: **2021-12-08**

(86) Europæisk ansøgning nr.: **15788342.2**

(86) Europæisk indleveringsdag: **2015-10-09**

(87) Den europæiske ansøgnings publiceringsdag: **2017-08-16**

(86) International ansøgning nr.: **EP2015073484**

(87) Internationalt publikationsnr.: **WO2016055654**

(30) Prioritet: **2014-10-09 DE 102014220488**

(84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

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(54) Benævnelse: **Indretning til at generere kold plasma med atmosfærisk tryk**

(56) Fremdragne publikationer:
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DEVICE FOR GENERATING A COLD ATMOSPHERIC PRESSURE PLASMA

The invention relates to a device for generating a cold atmospheric pressure plasma for the treatment of human and/or animal surfaces according to claim 1 and to a system according to claim 10. In plasma medicine, promising applications in the treatment of living tissue have been developed in recent years, from the collaboration of classical plasma physics and the life sciences. Central to plasma applications has been the use of non-thermal atmospheric pressure plasmas for decontamination to sterilization of living tissue, i.e., the killing of pathogens on or in a living tissue. However, plasma treatment is not limited to disinfection and sterilization. Other applications that take advantage of the special properties of plasma can also be of beneficial effects to medicine.

One possible use of plasma is to promote healing of wounds, such as chronic and/or postoperative wounds, but also the treatment of burns, abrasions, eye and mucous membrane infections, etc. In addition, use for disinfection, wrinkle treatment and/or other cosmetic treatments is also conceivable. Chronic wounds in particular, e.g. diabetes-induced wounds, generate a high degree of suffering for the patients concerned and are often associated with high stress for the patient. In many cases, conventional therapeutic approaches do not lead to the desired healing of the wounds, so that often only the status quo is maintained. A promising approach to the therapy of chronic wounds is the use of cold plasmas, so-called atmospheric pressure plasmas.

DE 10 2008 030 913 A1 discloses a quick wound dressing, which enables efficient sterilization by means of plasma.

US 2012/271225 A1 discloses a device for treating human or animal skin surfaces using a cold atmospheric pressure plasma.

Plasma is considered the fourth state of matter and consists of ionized gas with physical peculiarities. Plasma is electrically charged gas and conducts electric current. It also contains a variety of radicals, such as free electrons, ions, and/or other excited species. Furthermore, plasma radiates UV and visible light as well as other electromagnetic fields.

Due to the development of body-compatible plasmas with temperatures below 40°C, a new, highly topical field of research has emerged - plasma medicine. These "cold plasmas" are the basis of many different applications in plasma medicine. Known, available plasma sources have proven their performance in clinical studies in connection with the therapy of various skin diseases and/or the treatment of chronic wounds. However, a major drawback of known plasma sources is that, to date, only small wound areas can be treated because the known plasma sources are relatively small. In addition, known plasma sources are difficult to control, i.e. difficult to dose and handle.

Therefore, there exists a need for an improved, large-area plasma source for atmospheric pressure plasmas, especially for the treatment of human and/or animal surfaces.

The object of the present invention is to provide a device for generating a cold atmospheric pressure plasma for the treatment of human and/or animal surfaces, wherein a large-area plasma source, in particular about 400 cm^2 in size, is to be provided. Furthermore, the plasma source is to adapt flexibly to the topology of the surfaces to be treated, in particular to the different sizes and shapes of the field of use and application. It is also the task of the invention to provide a system for operating a (plasma-) device for generating a large-area, cold atmospheric pressure plasma for the treatment of human and/or animal surfaces.

The preceding object is solved according to the invention by a device for generating a cold atmospheric pressure plasma for the treatment of human and/or animal surfaces according to claim 1, as well as a system according to claim 10. Objects according to the dependent subclaims describe preferred embodiments of the invention.

A first aspect of the invention relates to a device, in particular a plasma device, for generating a cold atmospheric pressure plasma for the treatment of human and / or animal surfaces, comprising a flexible, planar multilayer system with a side facing the surface to be treated and a side facing away from the surface to be treated, wherein the multilayer system comprises the following layers, namely a first electrode layer on the side facing away from the multilayer system, a second electrode layer at the facing side of the multilayer system, wherein the second electrode layer has a plurality of recesses or is formed in a grid-like or meander-like manner, a dielectric layer arranged between the first electrode layer and the second electrode layer, a first insulating layer, arranged adjacent to the first electrode layer on the side of the multilayer system facing away from the surface to be treated, a second insulating layer, arranged adjacent to the second electrode layer on the side of the multilayer system facing the surface to be treated and a spacer layer, arranged above on the second insulating layer on the facing side of the multilayer system and is further configured to provide a sufficient gas volume to ignite the plasma.

In the following, the concept of the invention is described by way of example without limiting the invention. The device according to the invention, in particular the plasma device, essentially serves for the treatment of human and / or animal surfaces, in particular the treatment of wounds, such as, for example, chronic and / or postoperative wounds. In addition, it is also used for the treatment of burns, abrasions, eye and mucous membrane infections, etc. The use for disinfection, wrinkle treatment and / or other cosmetic treatments is also conceivable. The device makes use of a special, flexible (possibly elastic) electrode arrangement with at least two electrode layers, namely a high-voltage electrode and a ground electrode, for generating an extensive plasma, in particular a cold atmospheric pressure plasma, with the aid of a dielectric layer between the two electrodes. The device according to the invention is thereby configured to adapt flexibly, in particular positively, to arbitrarily curved surfaces, for example in the face of a patient, and thus also to make - for known and inflexible plasma sources - inaccessible skin regions, such as, for example, the fingers or toes accessible for a plasma treatment. The device produces an extensive plasma on one side of the device and is then placed with this side on the surface to be treated, in particular on the wound, so that the advantageous effects / properties of the plasma can act on the surface or interact with it.

For providing a flexible, large-area, dielectrically hindered surface discharge, at least four layers are provided: two or three flexible electrodes, namely a first and a second electrode layer in a respective electrode plane, e.g. copper foils or other conductive materials, a flexible layer with a flexible and/or non-flexible functional dielectric between the respective electrodes, e.g. silicone, Kapton, PVDF, ETFE, and a spacer layer. Preferably, the functional dielectric is designed to be flexible. However, non-flexible, but then flexibly interconnected, materials can also be used. Preferably, but without limitation, a polymer is used. In other embodiments, elastomers, textile fabrics or, for example, ceramics embedded in a silicone matrix or open-pored foams, such as chitinous materials, such as chitosan or chitosan patches, are used.

To ignite the plasma, a high voltage is applied to one of the two electrodes, with the second electrode then being at ground or earth potential and thus forming a counter-electrode for the high-voltage electrode. A high-voltage field then lies between the two electrodes, whereby a short circuit in the form of an electric arc between the electrodes is prevented or suppressed by the dielectric layer. Instead, a large-area, dielectrically hindered atmospheric pressure plasma is formed. Since the plasma properties are strongly dependent on the gas space thickness, in particular on the gas volume between the ground electrode and the surface to be treated, in particular the skin, a spacer layer is provided which permits reliable and reproducible provision of a sufficient quantity of gas for producing a plasma with defined plasma properties. The gas to be ionized is either a supplied working gas or gas mixture and/or the ambient or outside air. The spacer layer can - without limiting the invention - be designed here in a variety of ways, for example with webs, recesses, nubs, foams of conventional wound dressings and/or a conventional wound dressing, etc., which can then each have different shapes and thicknesses. For example, the spacer layer can also be in the form of a self-adhesive rim edge with which the device is attached to the patient.

The electrodes are preferably formed with conductive materials, in particular metals, for example in the form of thin metal layers, foils, grids and/or with conductive polymer layers.

These and further preferred embodiments of the invention are subject matter of the subclaims and indicate in detail advantageous possibilities how the invention is to be realized or designed within the scope of the object as well as with regard to further advantages.

Preferably, one embodiment provides that the spacer layer is formed with at least one polymer, in particular an elastomer, and/or a textile fabric and with thicknesses of 0.5 mm to 5 mm.

The multilayer system of the present invention additionally comprises a first insulating layer, wherein the first insulating layer is arranged adjacent to the first electrode layer on the side of the multilayer system facing away from the surface to be treated. The first insulating layer is arranged on the side of the multilayer system facing away from the surface to be treated and has, in a preferred further continuation, a thickness of between 0.5 mm and 5 mm, preferably of 2 mm. The first insulating layer essentially serves to electrically insulate the first electrode layer, which is preferably formed as a high-voltage electrode layer, i.e. as an electrode layer to which a high voltage is applied. In a further continuation of this embodiment, the first electrode layer is insulated on several sides, in particular on insulated on all sides.

The multilayer system of the present invention additionally has a second insulating layer, wherein the second insulating layer is arranged adjacent to the second electrode layer on the side of the multilayer system facing the surface to be treated. Preferably, it is provided here that the second insulating layer has a thickness between 10 µm to 300 µm.

A further continuation may provide that the multilayer system additionally has a third insulating layer, wherein the third insulating layer is arranged adjacent to the spacer layer on the side of the multilayer system facing the surface to be treated. Preferably, the insulating layer is formed with a material compatible with the skin and/or wounds, preferably with antiseptic and/or atraumatic properties. In a further advantageous embodiment the third insulating layer has a thickness between 50 µm to 300 µm, preferably of 200 µm.

In one embodiment, the multilayer system has dimensions having a length and a width ranging from 5 cm to 25 cm, respectively.

A particularly advantageous embodiment relates to a multilayer system, wherein the first electrode layer is formed continuously or with a plurality of recesses.

In one practical embodiment it is provided that the recesses in the first and/or in the second electrode layer between the conductive structures are formed in the shape of holes, strips, meanders, honeycombs, circles and/or squares. For example, the circular and/or honeycomb-shaped recesses may be formed as holes having a diameter of 3 mm to 5 mm, which are then arranged next to each other in rows and/or in an offset manner. In another embodiment, square recesses with dimensions of 3 mm x 3 mm to 5 mm x 5 mm, preferably 4 mm x 4 mm, are provided, wherein the webs between the recesses can have a width of between 0.1 mm and 5 mm. Again in another embodiment, strip-shaped recesses with a width of between 1 mm and 10 mm, preferably with a width of 6 mm, are used. The strip-shaped recesses are then, for example arranged in a parallel, circular, semicircular, spiral and/or meander-shaped.

A preferred continuation provides that the device comprises an information carrier, for example a chip or a tag or a label or another information and storage medium, on which operating parameters for operating the device are stored. Particularly in the case of multiple use of the device, it is advantageous that the device-specific data, in particular the operating parameters for operating the device, are filed or stored in an information and storage medium, for example a microchip, on or at the device, so that they can be read out before and/or during operation of the device. Possible data that is preferably stored may include data on a treatment regimen, the duration of use, lifetime, pulse pattern, intensity (amplitude of supply voltage), an ID or serial number of the device, the number of previous applications, hygiene status (non-sterile, used, disinfected, sterile, etc.), errors or error messages during use of the device (e.g. use of the device (e.g. punctures or short circuits, fluctuations in the or short circuits, variations in operating parameters), usability/usage status (e.g., valid or invalid).

The information carrier or storage medium can be read out, for example, by cable, optically or by means of radio technology. In addition, such an information carrier also provides a security element that, for example, enables operation of the device only if the necessary conditions are met. The information carrier can also be used to prevent multiple uses of a device, for example if a device may only be used once for hygienic reasons. For such single-use devices, a barcode or QR code solution is preferable for cost reasons. In this case, for example, the treatment parameters (operating parameters and a permissible indication) would have to be coded so that, for example, the authenticity (originality) of the device can be verified. This functionality can be realized by means of an encoded number range.

A first aspect of the disclosure not covered by the claimed invention relates to a cable for connecting to a device according to the first aspect of the invention, the cable comprising a plug configured to provide a pluggable high voltage connection between the device and the cable.

On the one hand, the cable serves to connect the (plasma-) device according to the first aspect of the invention, on the other hand, the cable is preferably also formed to transmit control signals between a supply unit and the device. The signals are to be conducted bi-directionally, for example from the plasma device to a supply/control unit and vice versa.

However, the essential task of the cable is to transmit the high voltage required to generate a plasma from a high-voltage generator to the device. The essential function of the cable is the safe transmission of the high voltage, the safe insulation to the outside (protection against contact) and to the inside (dielectric strength). In addition, the cable must be flexible. The cable thus provides an electrical high-voltage connection between the device and the high-voltage generator, wherein the cable comprises at least one HV conductor, an insulator and a ground line. Preferably, for reasons of electrical safety and EMC, an additional shield is provided, which is either identical to the ground line or independently connected to the protective conductor (PC). The type of shielding depends primarily on the interference that occurs. Particularly good shielding performance can be achieved with double shielding (metallic or metallized foil and a braided shield). For the outer insulation of the high-voltage cable, a biocompatible, disinfectable material is preferred, since in practice the cable is often fixed to the patient's body by means of a plaster. In addition, further electrical (control) lines can be provided, for example a data line for communication with a memory chip integrated in the device. In addition or alternatively, double shielding and/or ferrite cores for EMC improvement, gas line(s) for the supply of working gases, such as humidified air and/or noble gas(es) as well as special gas mixtures or for the removal (exhaust lines) of unwanted gas components, such as ozone, can also be provided. To improve the EMC characteristics, it may be necessary to integrate one or more further electronic components, such as coils, capacitors and filters. Furthermore, between the device and the HV cable, the above-mentioned measures to improve electrical safety and EMC may be provided.

The cable may be connected to the device either permanently or via a plug-in system. The plug-in variant allows easy replacement of the cable in case of defects and/or for cleaning/disinfection purposes. Furthermore, all possible cable lengths from 1 m to 20 m are provided.

Preferably, one embodiment provides that the cable comprises a clamping device, wherein the clamping device is displaceable between an open position and a closed position, and in the closed position the device is electrically connected to the cable and in the open position the device is electrically disconnected from the cable. Preferably, the cable and the clamping device are designed as a (high-voltage) disposable product, whereby invalidation of the disposable product is provided after treatment, for example if it may only be used once for hygienic reasons.

Preferably, the connector of the cable has a ground contact and a high-voltage contact laterally offset next to each other.

A second aspect of the disclosure, not covered by the claimed invention, relates to a generator unit for providing a high voltage for producing a cold atmosphere atmospheric pressure plasma with a device according to the first aspect of the invention for treating human and/or animal surfaces, wherein the generator unit is configured to control the device.

The generator unit represents a central control unit for the (plasma) device and is primarily used to provide the high voltage for the device by means of a high-voltage generator. The generator unit comprises a high-voltage generator with control unit and at least one connection for the (plasma) device's (supply) cable as well as a mains connection with mains switch (main switch) and, if necessary, integrated mains filter and a cooler for cooling the electronics. Optionally, a gas connection is provided with a gas flow controller and/or a compressor and/or an exhaust device. In addition, further control units are preferably provided, micro-controllers, circuit boards, displays, in particular touchscreen displays, membrane keyboards, etc. are provided for operating the generator unit.

In a practical embodiment, it may be provided that the generator unit is additionally configured to automatically read out operating parameters for controlling the device from an information carrier, in particular a chip, a tag and/or another information and storage medium, in or on the device. Depending on the type of device connected, in particular depending on the size and/or specific treatment parameters, the corresponding operating parameters are then read from an information carrier and provided to the generator unit. These can then, for example, also be shown on the display, in particular the touchscreen display, of the generator unit.

A second aspect of the invention relates to a system comprising a device according to the first aspect of the invention, a cable according to the first aspect of the disclosure, and a generator unit according to the second aspect of the disclosure.

Exemplary embodiments of the invention are described below with reference to the figures. These are not necessarily intended to represent the embodiments to scale, rather the figures are in schematic and/or slightly distorted form.

Here, identical and/or similar features with identical or similar function are provided with the same reference signs where useful. Further advantages, features and details of the invention will be apparent from the following description of the preferred exemplary embodiments as well as on the basis of the figures.

The scope of protection of the present invention however, is determined by the patent claims.

In detail:

FIG. 1: shows a perspective, schematic representation of a device for producing a cold atmospheric pressure plasma for the treatment of surfaces;

FIG. 2: shows an exploded view of the device shown in FIG. 1;

FIG. 3: shows a schematic representation of a preferred embodiment for a cable with a plug;

FIG. 4: a schematic representation of an embodiment for a plug housing;

FIG. 5: a perspective, schematic representation of a device for treating surfaces and a plug;

FIG. 6: a preferred embodiment for a clamping device for a plug;

FIG. 7: a preferred embodiment for a generator;

FIG. 8: a schematic representation for a preferred embodiment for a system with a device, a generator and a cable for connecting the device to the generator, and

FIG. 9: preferred embodiments, in particular recesses in the electrode layer, for a device for treating surfaces.

FIG. 1 shows a perspective view of a device 1 for producing a cold atmospheric pressure plasma. The illustrated device 1, also called plasma patch, is a large-area plasma source for the treatment of human and / or animal surfaces, in particular for treating wounds and promoting the healing of wounds. The device makes use of a special, flexible electrode arrangement with two electrode layers, namely a high-voltage electrode and a ground electrode, for producing an extensive plasma by means of a dielectric layer between the two electrodes, wherein the device is configured to be flexibly placed on arbitrarily curved surfaces and thus suitable for the plasma treatment of diseased / damaged skin areas. In this case, the device 1 produces an extensive plasma on one side of the device, wherein the device is then placed with this side on the surface to be treated, in particular on a wound, so that the advantageous effects / properties of the plasma can take effect on the surface.

The device 1 comprises a flexible, extensive multilayer system 2 with a side 3 facing the surface to be treated and a side 4 facing away from the surface to be treated. The multilayer system 2 is thereby formed with several layers, which are described in detail in FIG. 2. The outer dimensions, in particular the dimensions of the multilayer system 2, have a length L2 and a width B2 between 5 cm to 25 cm, preferably 20 cm × 20 cm. Without limiting the invention, however, other shapes, not only square shapes, can also be provided. Preferably, they then fit positively to the surface, for example, the face of a patient. Also provided are devices in the form of cuffs, pads, bed covers, bed sheets or the like.

FIG. 2 shows an exploded view of the device 1 shown in FIG. 1, with a multilayer system 2. The multilayer system 2 comprises the following layers, namely (from below):

- a first insulating layer 11,
- a first electrode layer 12,
- a dielectric layer 13,
- a second electrode layer 14,
- a second insulating layer 15,
- a spacer layer 16, and
- a third insulating layer 17.

The first insulating layer 11 is arranged on the side 4 of the multilayer system 2 facing away from the surface to be treated and has a thickness of between 0.5 mm and 4 mm, preferably of 2 mm. The first insulating layer 11 is essentially for insulating the first electrode layer 12, which is preferably formed as a high-voltage layer, that is, an electrode layer to which a high voltage is applied.

The dielectric layer 13 is arranged between the first electrode layer 12 and the second electrode layer 14, the second electrode layer 14 preferably being designed as a ground electrode layer. The dielectric layer 13 essentially prevents a short circuit between the first and second electrode layer, in particular in the form of an electrical arc.

Furthermore, in a preferred embodiment, on the second electrode layer 14 a second insulating layer 15 is arranged that has a thickness of between 10 µm and 300 µm.

Above the second electrode layer 14 or the second insulating layer 15, that is to say on the side 3 of the multilayer system 2 facing the surface to be treated, the spacer layer 16 is then arranged, which ensures that sufficient gas volumes are provided so that a plasma can ignite.

Finally, a third insulating layer 17 is arranged on the side 3 of the multilayer system 2 facing the surface to be treated and above the spacer layer 16. The third insulating layer 17 has a thickness of between 100 µm and 300 µm, preferably of 200 µm, and is in direct contact with the surface to be treated. Preferably, the third insulating layer 17 is then formed with a skin- and / or wound-compatible material, preferably with antiseptic and / or atraumatic properties.

In the present case, as shown in FIG. 2, the second electrode layer 14 is formed with a plurality of recesses, in particular grid-like. Without restricting the invention, however, the recesses can also be designed in the form of holes, strips, meanders, honeycomb, circular and / or square.

Furthermore, the spacer layer 16 can also be formed in the form of a honeycomb, wherein the spacer layer 16 can also be realized by means of projections or webs without restriction of the invention. Possible materials for the spacer layer 16 are polymers, elastomers and / or silicones or the like. In principle, a large number of possible materials can be used, such as, for example, inorganic or organic materials, in particular natural and / or synthetic materials, such as thermoplastics, thermosets and / or elastomers. For further possible materials reference is also made, for example, to the book "Kunststoff-Taschenbuch" (28th edition) by Karl Oberbach and Hansjürgen Saechtling. In a preferred embodiment, the spacer layer is formed with projections and / or webs, which have a height between 0.5 mm and 10 mm.

Overall, the multilayer system shown in FIG. 2 has a thickness D2 of between 2 mm and 15 mm. Here, it is provided that the layers, which are in direct contact with the surface to be treated, are formed from a heat-resistant, biocompatible and chemically stable plastics.

FIG. 3 shows a schematic representation of a preferred embodiment for a cable 5 with a plug 30. The essential task of the cable 5 is to transmit the high voltage necessary for the generation of a plasma from a high voltage generator (not shown) to the device, wherein the cable comprises at least one HV conductor, an insulator and a ground line (not shown). The connection of the cable to the device can optionally be fixed or via a plugging system, whereby the plug variant permits a simple replacement of the cable in the event of defects and / or for cleaning / disinfecting purposes. Furthermore, all possible cable lengths from 1 m to 20 m are provided.

The embodiment shown in FIG. 3 shows a cable with a possible plug, the plug 30 comprising a lower plug housing 31, an upper plug housing 32 and a clamping device 33. In addition, the plug 30 comprises a first connection 34 for the first electrode of the device (not shown), a second connection 36 for a second electrode of a device, and a further connection 35 for control signals and or, for example, for reading operational parameters for the device that are for example stored on a chip in the device.

The illustrated clamping device 33 of the plug 30 is displaceable between a first open position and a second closed position. Here, the device (not shown) is electrically connected to the cable 5 in the closed position, and in the open position the device is then electrically disconnected from the cable 5.

FIG. 4 shows a possible embodiment of the interior of a plug 30, as is shown and described, for example, in FIG. 3. The connector, in particular the lower plug housing 31, comprises a first clamping tongue 37 and a second clamping tongue 38 each configured to connect the first or second electrode of the device (not shown) to a high voltage connection 39 or a ground connection 40 of the cable (not shown), wherein the cable is connected to the plug 30 via the cable connection 41. Furthermore, the plug 30 comprises at least one joint 42. By means of the joint 42, the clamping device 33 can be displaced from the open to the closed position and vice versa. Here, the clamping device interacts with the first clamping tongue 37 and the second clamping tongue such that, in the closed position, the first and / or second electrode of the device is electrically connected to the high-voltage connection 39 or the ground connection 40 of the cable. In the open position of the clamping device, the clamping tongues release the respective electrodes so that they are no longer electrically connected to the cable.

Plugs and clamping devices are designed in such a way that they meet high voltage requirements.

FIG. 5 shows a perspective, schematic representation of a device 1 for treating surfaces, as is illustrated and described, for example, in FIG. 1, together with a plug 30, as is shown and described, for example, in FIGS. 3 and 4.

FIG. 6 shows a preferred embodiment for a clamping device 33 for a plug (not shown) as is described in FIGS. 3 and 4. Schematically shown is the displacement movement of the clamping device 33 from the open position A to the closed position B, the arrow indicating the direction of movement of the clamping device during the displacement.

FIG. 7 shows a preferred embodiment for a generator unit 70 for providing a high voltage for operating a device, as is illustrated and described, for example, in FIGS. 1 and 2. The generator unit 70 serves primarily to provide the high voltage by means of a high voltage generator for the device. For this purpose, the generator unit 70 comprises a high-voltage generator with a control unit and at least one connection for the (supply) cable of the (plasma) device and a mains connection with mains switch (not shown). Optionally, a gas connection is provided with a gas flow controller and / or a compressor and / or a filter and / or a suction device. Furthermore, a display 71, further control units, microcontrollers, boards, etc., are preferably provided for operating the generator unit.

The generator unit 70 is also configured to interact with a device, in particular to automatically read out the operating parameters of a particular device which are stored, for example, on a chip 80 (see also FIG. 8) in the device. Based on the read-out operating parameters, the generator unit can then be set automatically without having to set the parameter setting manually by a user at the generator unit. The operating parameters can then also be displayed on the display or screen 71 of the generator unit 70.

FIG. 8 shows a schematic representation of a preferred embodiment for a system 100 with a device, as shown, for example, in FIGS. 1 and 2, of a generator unit as described in FIG. 7, wherein the device and generator unit are controllably connected by means of a Cable 5.

FIG. 9 shows various embodiments, in particular recesses in the first and second electrode layer of a device for treating surfaces, as is shown and described, for example, in FIGS. 1 and 2. Various embodiments are shown, each having a first electrode 12, a second electrode 14, and a dielectric layer 13 between the first and second electrode 12, 14. Various shapes for recesses 90 in the second electrode 14 are shown, for example, hole-shaped 91, strip-shaped 92, meandering 95, honeycomb-shaped 94, circular 96 and / or square recesses 93. Without restricting the invention, it may also be provided that both the first and second electrodes 12, 14 are formed with recesses 90 in various shapes.

Reference list

1 device

2 Multilayer system

3 Facing side of the device 1

4 Facing away side of device 1

5 Cable

11 First insulating layer

12 First electrode layer, in particular high-voltage electrode layer

13 Dielectric layer

14 Second electrode layer, in particular ground electrode layer

15 Second insulating layer

16 Spacer layer

17 Third insulating layer

30 Plug

31 Lower plug housing

32	Top plug housing
33	Clamping device
34	Connection for the second electrode layer 14
35	Additional Connection
36	Connection for the first electrode layer 12
37	First clamping tongue
38	Second clamping tongue
39	High voltage connection
40	Ground connection
41	Cable connection
42	Joint
70	Generator unit
71	Display
80	Information carriers
90	Recess in the first and / or second electrode layer
91	Hole-shaped recess
92	Strip-shaped recess
93	Square recess
94	Honeycomb-shaped recess
95	Meandering recess
96	Circular and / or semi-circular recess

100	System
A	Open position of the clamping device 33
B	Closed position of the clamping device 33
D2	Thickness of the multilayer system 2
L2	Length of the multilayer system 2
B2	Width of the multilayer system 2

Patentkrav

1. Indretning (1) til fremstilling af et koldt atmosfærisk trykplasma til behandling af menneske- og/eller dyreoverflader, omfattende et fleksibelt, plant flerlagssystem (2) med en side (3) mod overfladen, der skal behandles, og en side (4) væk fra overfladen, der skal behandles, idet flerlagssystemet (2) omfatter følgende lag:

- et første elektrodelag (12) ved siden (4) af flerlagssystemet (2),

- et andet elektrodelag (14) ved den modstående side (3) af flerlagssystemet (2), hvor det andet elektrodelag (14) har en flerhed af fordybninger (90) eller er formet på en gitterlignende eller bugtende måde,

- et dielektrisk lag (13) anbragt mellem det første elektrodelag (12) og det andet elektrodelag (14),

- et første isoleringslag (11), hvor det første isoleringslag (11) er anbragt ved siden af det første elektrodelag (12) ved siden (4) af flerlagssystemet (2), der vender væk fra overfladen, der skal behandles,

- et afstandslag (16), hvor afstandslaget (16) er konfigureret til at tilvejebringe et tilstrækkeligt gasvolumen til at antænde plasmaet,

kendetegnet ved, at

flerlagssystemet (2) yderligere omfatter et andet isoleringslag (15), hvor det andet isoleringslag (15) er anbragt ved siden af det andet elektrodelag (14) ved siden (3) af flerlagssystemet (2), der vender mod overfladen, der skal behandles,

og ved, at

afstandslaget (16) er anbragt over det andet isoleringslag (15) i forhold til den modstående side (4) af flerlagssystemet (2).

2. Indretningen (1) ifølge krav 1, **kendetegnet ved, at** det andet isolerende lag (15) ikke er integrabelt udformet med afstandslaget (16).

3. Indretningen (1) ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** det andet isolerende lag (15) har en tykkelse på mellem 10 μm og 300 μm.

4. Indretningen (1) ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** flerlagssystemet (2) yderligere har et tredje isoleringslag (17), hvor det tredje isoleringslag (17) er anbragt ved siden af afstandslaget (16) på siden (3) af flerlagssystemet (2), der vender mod overfladen, der skal behandles.

5. Indretningen (1) ifølge krav 4, **kendetegnet ved, at** det tredje isolerende lag (17) har en tykkelse på mellem 50 μm og 300 μm, fortrinsvis 200 μm.

6. Indretningen (1) ifølge mindst et af de foregående krav, **kendetegnet ved, at** det første elektrodelag (12) er formet kontinuerligt eller med en flerhed af fordybninger.

7. Indretningen (1) ifølge mindst et af de foregående krav, **kendetegnet ved, at** fordybningerne (90) i det andet elektrodelag (14) er hulformede (91), strimmelformede (92), formet på en bugtende måde (95), honeycomb-formede (94), cirkulære (96), og/ eller kvadratiske (93).

8. Indretningen (1) ifølge krav 6, **kendetegnet ved, at** fordybningerne i det første elektrodelag (12) er hulformede (91), strimmelformede (92), formet på en bugtende måde (95), honeycomb-formede (94), cirkulære og/eller firkantede.

9. Indretningen (1) ifølge mindst et af de foregående krav, **kendetegnet ved, at** indretningen (1) omfatter en informationsbærer (80), fortrinsvis en chip, en etikette og/eller et andet informations- og lagringsmedium, hvorpå mindst én driftsparameter til betjening af indretningen (1) er lagret.

10. Et system (100) med en indretning (1) ifølge mindst et af kravene 1 til 9, et kabel (5) til at forbinde indretningen (1), hvor kablet (5) har et stik (30), der er konfigureret til at give en plug-in højspændingsforbindelse mellem indretningen (1) og kablet (5), og en generatorenhed (70) til at tilvejebringe en højspænding til at generere et koldt atmosfærisk trykplasma med indretningen (1), hvor generatorenheden (70) er konfigureret til at styre indretningen (1) og til at udlæse driftsparametre til styring af indretningen (1) fra en informationsbærer (80), fortrinsvis en chip, en etikette og/eller et andet informations- og lagermedium, i eller på enheden (1).

11. Systemet ifølge krav 10, **kendetegnet ved, at** kablet (5) har en spændeindretning (33), og spændeindretningen (33) kan forskydes mellem en åben position (A) og en lukket position (B), hvor indretningen (1) i den lukkede position (B) er elektrisk forbundet til kablet (5), mens indretningen (1) i den åbne position (A) er elektrisk afbrudt fra kablet (5).

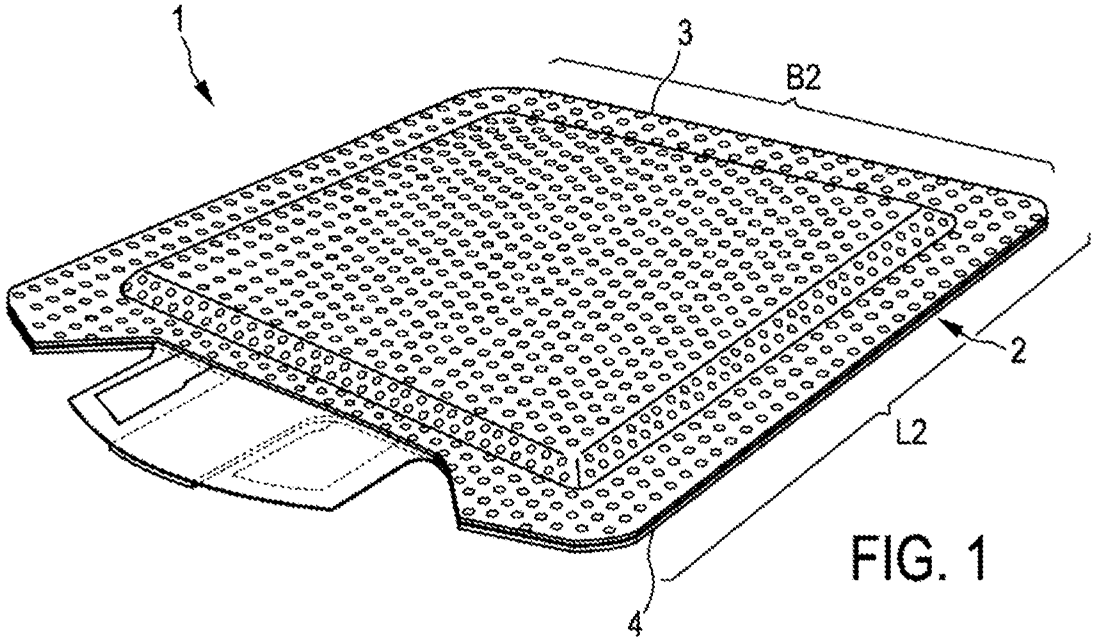

FIG. 1

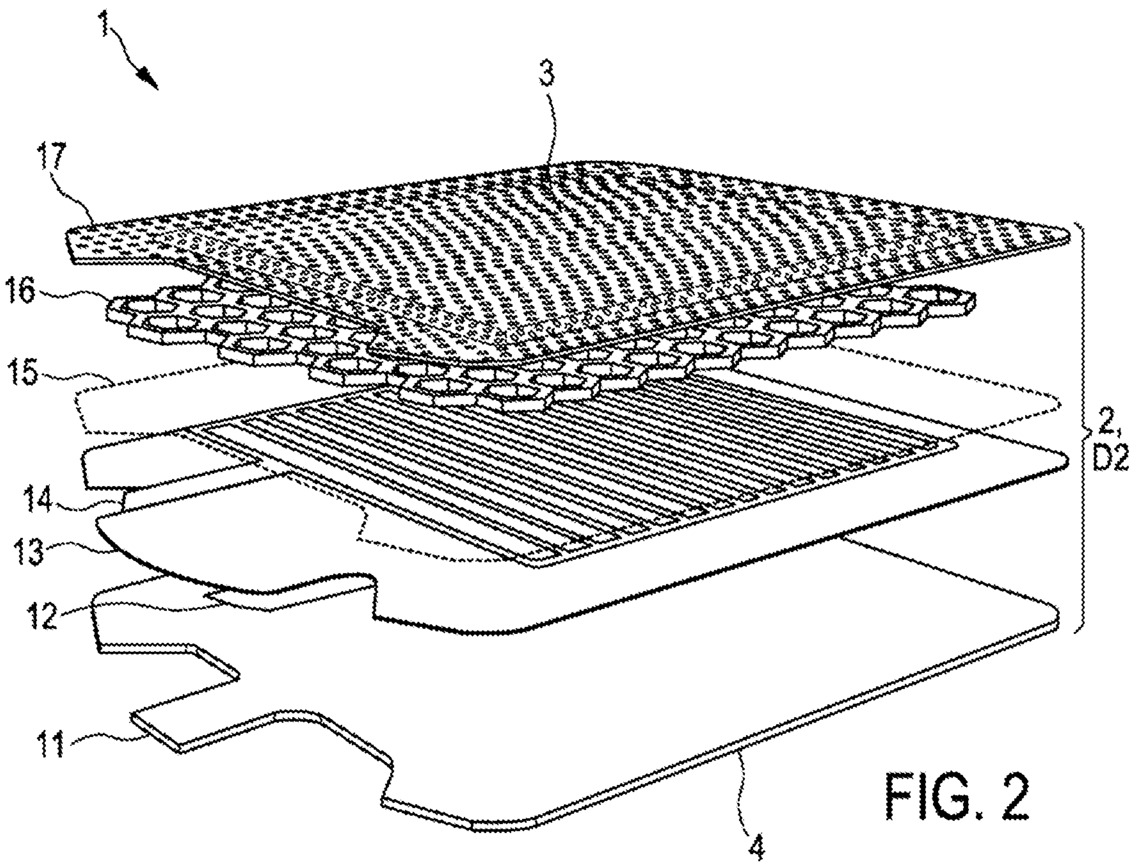

FIG. 2

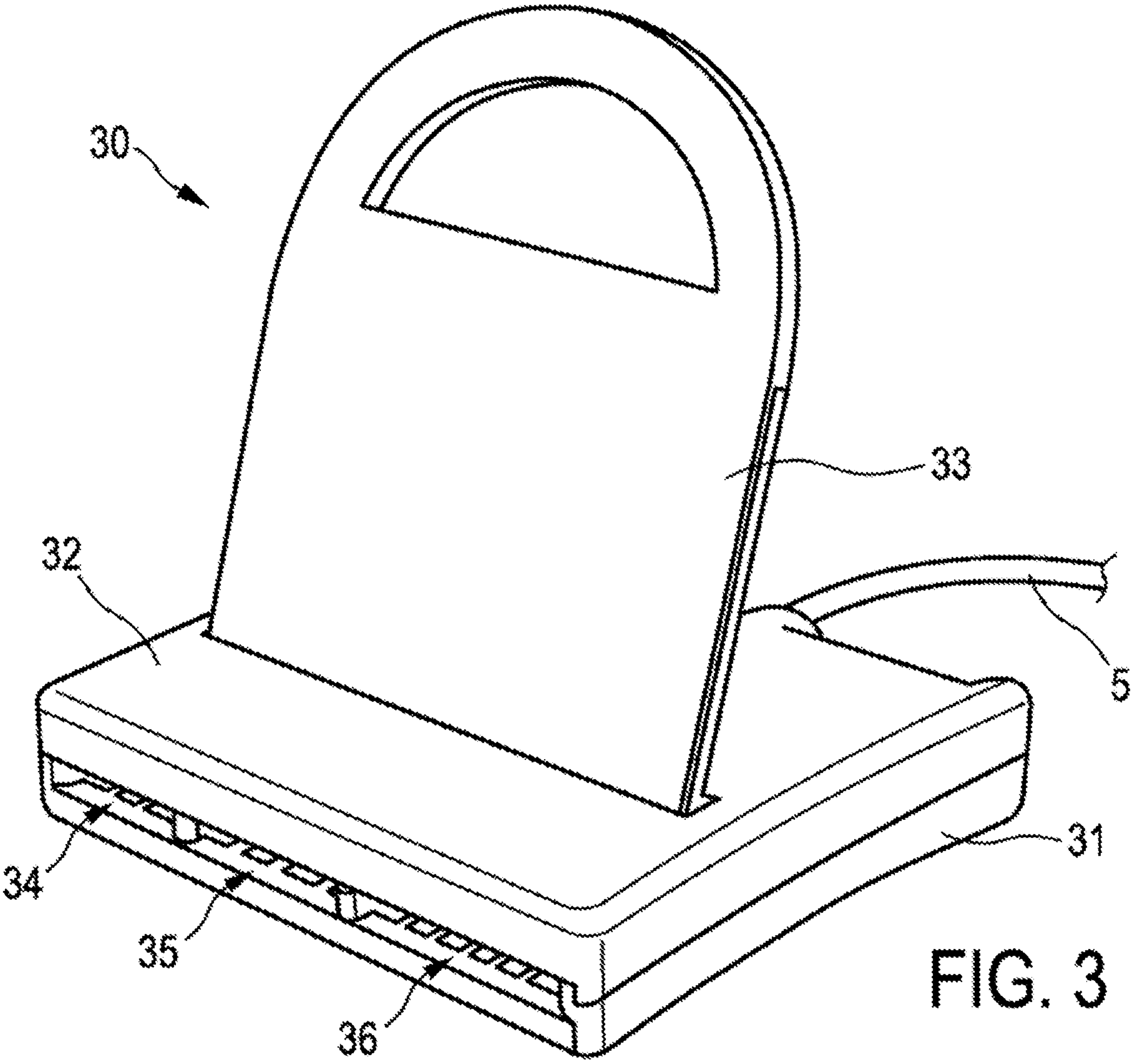

FIG. 3

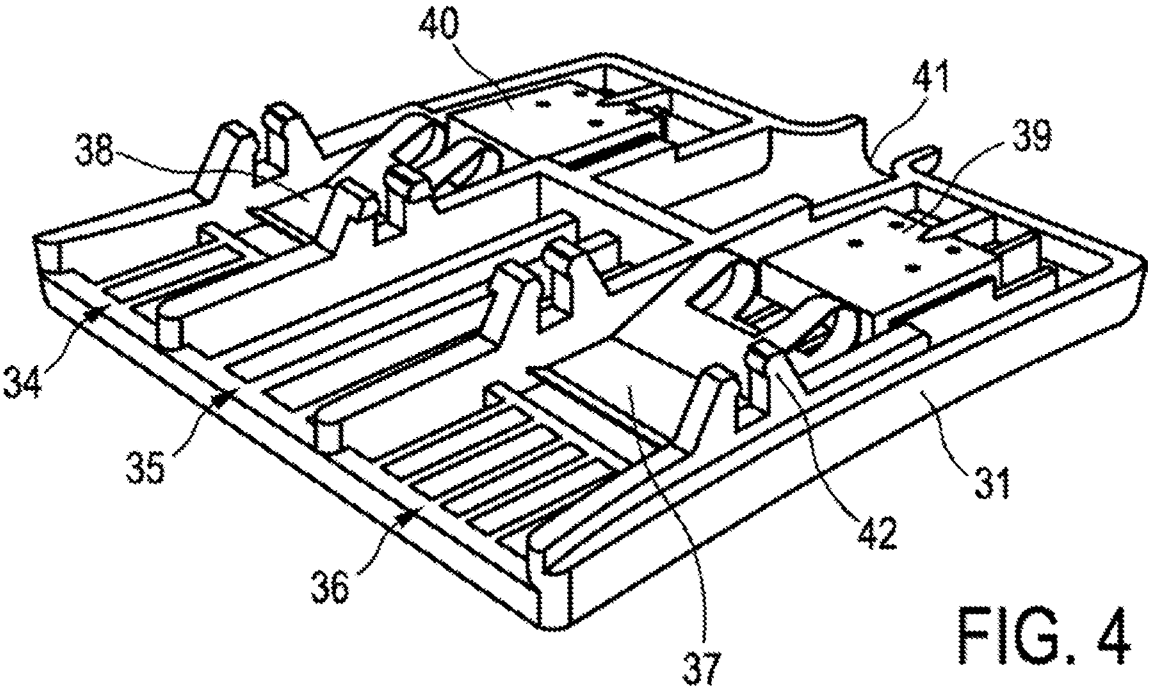

FIG. 4

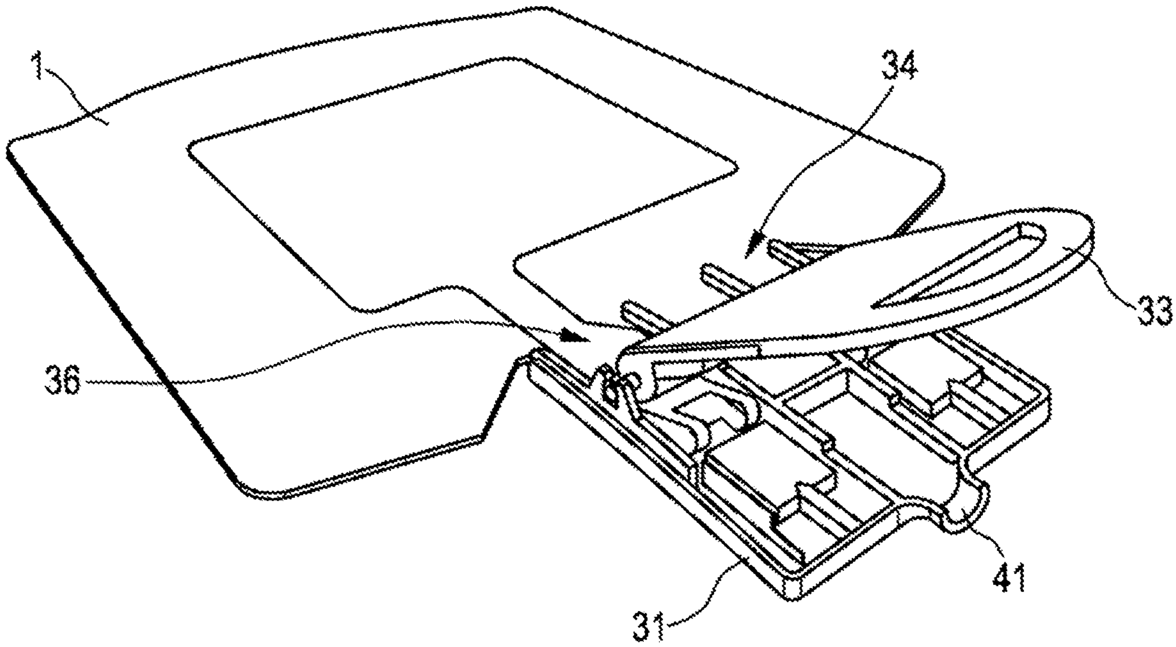

FIG. 5

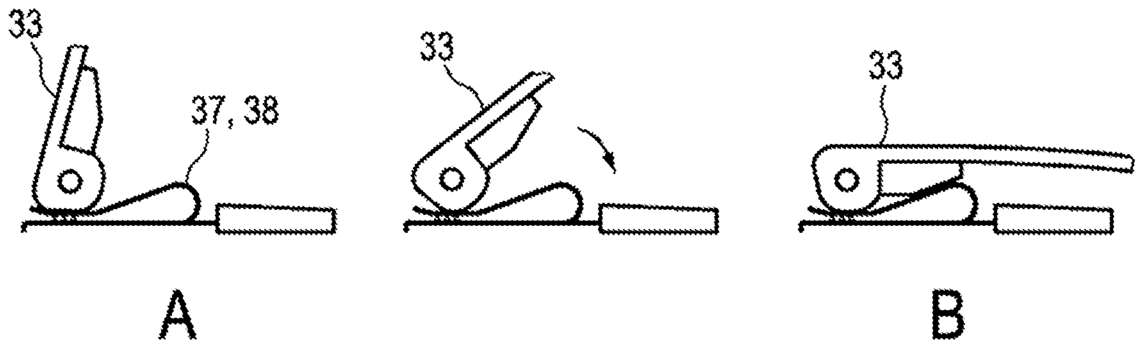

FIG. 6

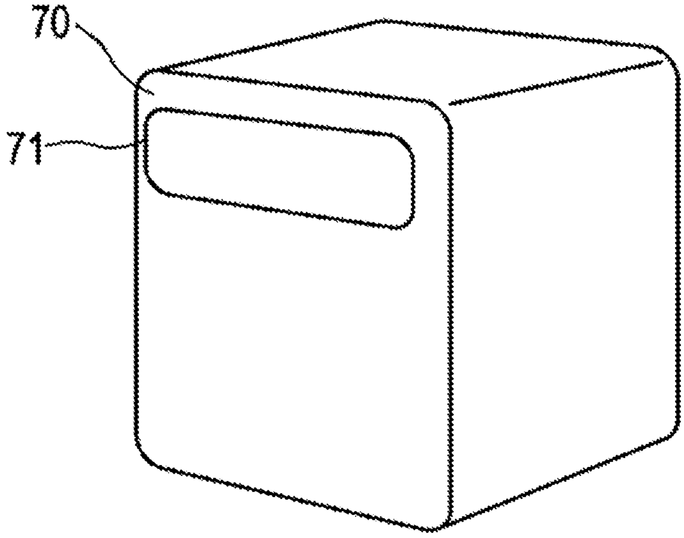

FIG. 7

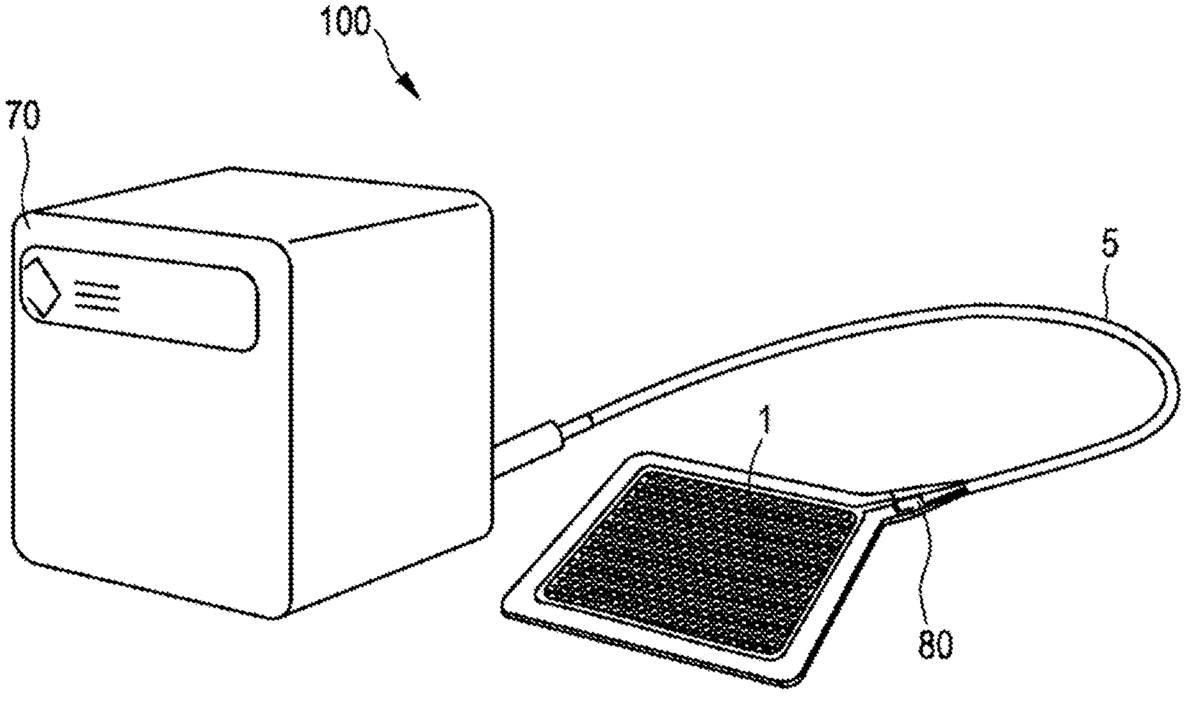

FIG. 8

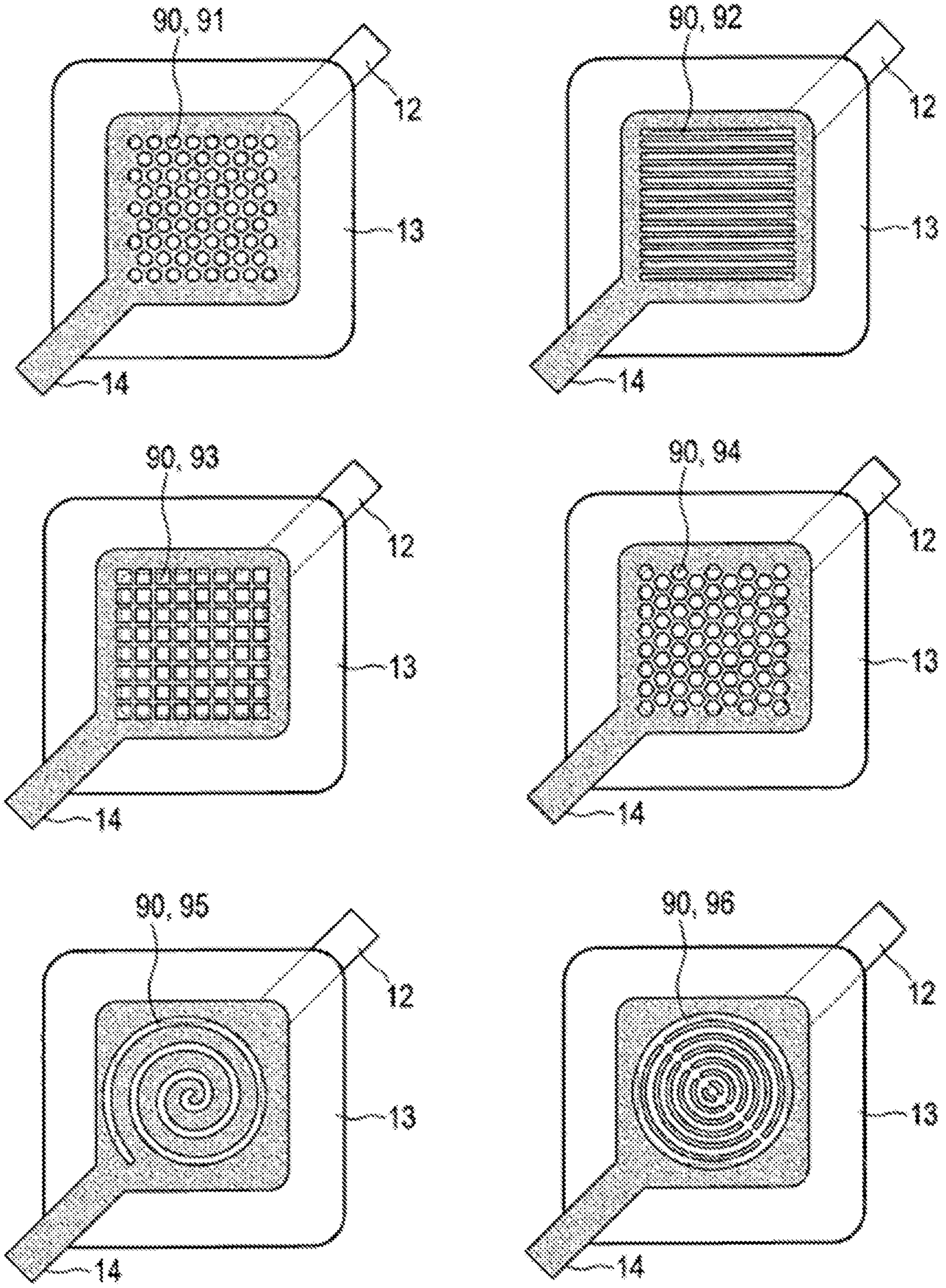
90, 91
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FIG. 9