The invention relates to a device (1) for skin treatment comprising a non-circular symmetrical outer electrode and at least two inner electrodes (20; 22) surrounded by the outer electrodes. An RF generator (16) is arranged to supply an RF voltage between the inner electrodes and the outer electrode. If the outer electrode has two or more axes of symmetry, then each of the inner electrodes (20; 22) is at an equal minimum distance from the outer electrode and an equal distance from a common point of intersection of all axes of symmetry and is positioned, with respect to each of the respective axes of symmetry, either on said respective axis of symmetry or at a distance from said respective axis of symmetry and symmetrically relative to one of the other inner electrodes. This electrode configuration provides improved uniformity in simultaneously created lesions.

FIG. 4
Radio frequency skin treatment device

FIELD OF THE INVENTION

The invention relates a device for skin treatment, in particular for radio frequency (RF) treatment of human skin. The device is primarily suitable for skin tightening and/or skin rejuvenation, in particular for fractional RF skin treatment. The invention also relates to the use of such a skin treatment device for both therapeutic and non-therapeutic purposes.

BACKGROUND OF THE INVENTION

Radio frequency (RF) is conventionally used in both the professional and home-use aesthetic market for skin tightening. The ability to heat a large volume at dermal skin level has made the radio frequency technology the standard for skin tightening and for treating skin laxity. Compared to laser treatments, RF devices have a relatively lower cost price and can provide larger-volume and deeper tissue contraction. Additionally, RF energy dissipation does not rely on absorption of light by chromophores, so that tissue pigmentation or the vascular network does not interfere with the delivery of energy.

The basic principle of RF energy delivery at the skin surface and from there to tissue is that an alternating current is applied in a closed circuit with the skin. Tissue impedance directly affects the extent of the heating: RF propagates more easily through tissues with high conductivity (low electrical resistance), while tissues with high electrical resistance (high impedance, low conductance) are poor conductors of RF energy. RF energy takes the path of least resistance through skin tissue and is dissipated as thermal energy primarily due to molecular vibrations.

A growing application for RF beyond skin tightening is skin rejuvenation. In most RF skin rejuvenation devices, fractional thermal lesions in the skin are created simultaneously using small electrodes. Recently, different professional devices have been launched onto the aesthetic market to address skin rejuvenation with a radio frequency device. Skin rejuvenation is a combination of different consumer benefits such as: even skin tone, reduction of pigmentation spots, improved radiance and texture and reduction of fine lines. Here the energy is used primarily to damage the stratum corneum and the epidermis.
(including the dermal-epidermal junction) and possibly the top part of the dermis.
Traditionally, skin rejuvenation treatments are done by ablative or non-ablative settings of a laser wavelength which is highly absorbed by water, whereby the ablative treatments vaporize the skin and create hollow pillars in the skin and non-ablative treatments heat the skin to 65-100°C to initiate cell necrosis and collagen denaturation and contraction and eventually collagen remodeling.

RF fractional skin treatment devices that use electrode configurations having a plurality of electrodes to simultaneously create a plurality of fractional thermal lesions have the disadvantage of inconsistency in RF energy delivery by the individual electrodes, resulting in the generation of non-uniform fractional thermal lesions. Non-uniformity of the thermal lesions in RF fractional skin treatments is due to a number of factors including variation in local tissue properties, e.g. skin impedance inhomogeneity, non-uniformity in electrode-skin contact, and inherent impedance variation due to the electrode configuration.

US 2013/0226269 discloses an apparatus for personal aesthetic skin treatment by RF voltage. The apparatus includes an RF voltage supply and a disposable patch with an assembly of individual electrodes operative to contact segments of the skin and deliver to each contact RF voltage. In one embodiment a rectangular patch is used comprising arrays of active RF electrodes arranged between elongated return electrodes. An another embodiment a circular patch is used comprising annular arrays of active RF electrodes surrounded by annular return electrodes.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a device for RF skin treatment, in particular RF fractional skin treatment, that results in improved uniformity of the lesions. For this purpose, according to a first aspect of the invention, a device for radio frequency (RF) based skin treatment is provided comprising a non-circular outer electrode arranged on an operational side of the device and having at least one axis of symmetry. The device comprises at least two inner electrodes arranged on the operational side of the device, each of the inner electrodes having an equally shaped and equally dimensioned skin contact surface having an equal orientation relative to the operational side. An RF generator is arranged to supply an RF voltage between each of the at least two inner electrodes and the outer electrode. The outer electrode surrounds the at least two inner electrodes, and each of the at least two inner electrodes has an equal minimum distance to the outer electrode.
In case the outer electrode has only one axis of symmetry, the at least two inner electrodes are arranged so as to be symmetrically spaced from said one axis of symmetry.

In case the outer electrode has more than one axis of symmetry, each inner electrode is at an equal distance from a common point of intersection of all axes of symmetry and is positioned, with respect to each of the respective axes of symmetry, either on said respective axis of symmetry or at a distance from said respective axis of symmetry and symmetrically relative to one of the other inner electrodes.

The proposed electrode configuration creates, simultaneously, uniform thermal lesions in the skin tissue close to the individual inner electrodes. The lesions are uniform because the inner electrodes each deliver RF energy with the same RF current density and with the same RF field profile as a result of the symmetrical geometry of the electrode configuration. Depending on the temperature generated close to the inner electrodes, non-ablative thermolysis or tissue ablation is achieved close to the inner electrodes, while at other positions within the electrode configuration the skin temperature remains below the pain threshold. The electrodes may operate in a bipolar mode wherein the inner electrodes act as active electrodes and the outer electrode acts as a return electrode.

It is noted that the inner electrodes each have a skin contact surface with an equal shape and equal dimensions, and with an equal orientation relative to the operational side of the device. With "equal orientation" is meant an equal angular orientation relative to the operational side of the device, in particular relative to an outer skin contact surface of the device on which the electrodes are provided. Preferably the skin contact surfaces of the inner electrodes are parallel to the outer skin contact surface of the device, but alternatively the skin contact surfaces of the inner electrodes may have an equal inclination relative to the outer skin contact surface of the device.

In an embodiment, the outer electrode has \( n \) axes of symmetry, and surrounds at most \( 2n \) inner electrodes, where \( n \) is a positive integer.

In an embodiment, the outer electrode surrounds \( n \) inner electrodes, where \( n \) is greater than 1. For example, if the outer electrode is rectangular in shape, it will have 2 axes of symmetry and the outer electrode will then surround 2 inner electrodes. These 2 inner electrodes may lie on the axes of symmetry.

In another embodiment, the outer electrode surrounds \( 2n \) inner electrodes. Note that in this embodiment \( n \) can be 1 as well. In case the outer electrode only has 1 axis of symmetry, it will surround 2 inner electrodes. If the outer electrode has 2 axes of symmetry it
will surround 4 inner electrodes. In this embodiment, all the inner electrodes are spaced from
the axes of symmetry.

In an embodiment, the at least two inner electrodes have annular or
disc-shaped skin contact surfaces. The term annular is to be taken to mean: circular having a
certain width, and the term disc-shaped is to be taken to mean: a filled circle. Such electrodes
are easy to manufacture. Furthermore, such electrodes do not have a favoured direction, so
the shape does not locally influence the direction of the current passing through the skin. In a
further embodiment, the at least two inner electrodes have rectangular or oval skin contact
surfaces. In this embodiment an outer diameter of the skin contact surfaces of the inner
electrodes may be in a range between 100 and 2000 µm, preferably in a range between 200
and 500 µm.

A contour of the outer electrode may be rectangular, triangular or oval. Other
shapes are possible. The outer electrode will have at least one axis of symmetry.

In an embodiment, a skin contact surface of the outer electrode is at least 10
times larger than a total of the skin contact surfaces of all the inner electrodes. Such relative
dimensions of the skin contact surfaces of the electrodes gave favorable results, wherein
close to the outer electrode there was a minimal increase in skin temperature and no skin
damage.

In an embodiment, an RF voltage supplied by the RF generator across each of
the at least two inner electrodes and the outer electrode has a value and duration such as to
cause, in use, localized thermolysis in the skin in the vicinity of the at least two inner
electrodes at a temperature higher than 65°C. In another embodiment, the RF voltage
supplied by the RF generator across each of the at least two inner electrodes and the outer
electrode has a value and duration such as to cause localized non-ablative thermolysis in the
vicinity of the at least two inner electrodes at a temperature between 65°C and 100°C. In
these embodiments, suitable values and durations of the RF voltage to cause the intended
localized thermolysis effect can be determined experimentally. Alternatively, a skin
temperature sensor can be applied to measure the local skin temperature, and a feed back
control system can be applied to control the RF voltage depending on the measured skin
temperature. Such methods to determine and/or control the RF voltage are well-known to the
skilled person and can be applied by the skilled person in a straight-forward manner.

In an embodiment, the device comprises a plurality of inner electrodes and a
plurality of outer electrodes, each of the plurality of outer electrodes surrounding at least two
of the plurality of inner electrodes. By arranging a plurality of inner electrodes and
surrounding them by outer electrodes, a larger surface can be treated at one time as compared to when only one outer electrode is used. At least some of the plurality of outer electrodes may be electrically connected to each other. The at least some of the plurality of outer electrodes may border each other, so as to form a lattice structure.

According to a second aspect, the invention relates to the use of the device as described above in the treatment of skin.

Further preferred embodiments of the device and method according to the invention are given in the appended claims, disclosure of which is incorporated herein by reference.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects of the invention will be apparent from and elucidated further with reference to the embodiments described by way of example in the following description and with reference to the accompanying drawings, in which

Fig. 1 is a schematic cross section of a device for skin treatment according to an embodiment;

Figs. 2A-2I show different embodiments of the electrodes;

Figs. 3 and 4 show embodiments wherein the device comprises a plurality of inner electrodes and plurality of outer electrodes.

The figures are purely diagrammatic and not drawn to scale. In the Figures, elements which correspond to elements already described may have the same reference numerals.

DETAILED DESCRIPTION OF EMBODIMENTS

Fig. 1 is a schematic cross section of a device 1 for skin treatment according to an embodiment. The device 1 comprises at least two inner electrodes 12 to be placed on the skin 6 of a user. It is noted that in this cross section only one inner electrode 12 is visible. The device 1 further comprises a surrounding (or outer) electrode 14 to be placed on the skin 6 of the user. The outer and inner electrodes are arranged on an operational side 15 of the device 1, forming an outer skin contact surface of the device 1. In use, the operational side 15 will face the skin of a user.

The outer electrode 14 is non-circular and is configured so as to surround the at least two inner electrodes 12. The outer electrode 14 has one or more axes of symmetry, as will be explained with reference to Figs. 2A-2I. Fig. 1 also shows an RF generator 16 arranged to supply an RF voltage across each of the at least two inner electrodes 12 and the
outer electrode 14. The RF generator 16 may be arranged to supply an RF voltage of 10-400V at a frequency of 0.2-300 MHz. In an embodiment, the RF voltage supplied by the RF generator across each of the inner electrodes and the outer electrode has a value and duration such as to cause, in use, localized thermolysis in the skin in the vicinity of the at least two inner electrodes at a temperature higher than 65°C. The value and duration of the RF voltage may be chosen so as to cause localized non-ablative thermolysis in the vicinity of the at least two inner electrodes at a temperature between 65°C and 100°C.

The at least two inner electrodes 12 are surrounded by the non-circular outer electrode 14. Many different configurations are possible where the outer electrode 14 has at least one axis of symmetry. Figs. 2A-2I show different possible configurations of the electrodes on the operational side 15 of the device 1.

Fig. 2A shows two inner electrodes 22 surrounded by a triangular outer electrode 23. The triangular outer electrode 23 has one axis of symmetry 24. The two inner electrodes 22 are at an equal minimum distance from the outer electrode 23. The minimum distance between an inner electrode 22 and the outer electrode 23 is determined by measuring the distance between points lying on an outer edge of the inner electrode 22 and points lying on an inner edge of the outer electrode 23. The minimum value of all these measured distances is the minimum distance mentioned.

Furthermore, the two inner electrodes 22 are symmetrically arranged relative to the axis of symmetry 24 and accordingly are at an equal distance from the one axis of symmetry 24. The distance between an inner electrode 22 and the axis of symmetry is defined as the minimum distance among all distances between points on an outer edge of the inner electrode 22 and the axis of symmetry 24.

Figs. 2B and 2C show examples of further possible electrode configurations with an outer electrode having one axis of symmetry, wherein two inner electrodes are arranged so as to be symmetrically spaced from the one axis of symmetry.

Figs. 2D, 2E and 2F show examples of possible electrode configurations with an outer electrode having two axes of symmetry. In the case of two axes of symmetry, the number of inner electrodes can be two or four. Fig. 2F shows an example of an electrode configuration with four inner electrodes 20 surrounded by an oval outer electrode 21. The outer electrode 21 has two axes of symmetry 25 and 26. The four inner electrodes 20 are at an equal distance (see line 28) from an intersection 27 of the two axes of symmetry. Furthermore, the four inner electrodes 20 are at an equal minimum distance (see line 29) from the outer electrode 21. In the embodiments of Fig. 2D and Fig. 2E, the two inner
electrodes are each positioned on one of the two axis of symmetry, and the two inner
electrodes are symmetrically arranged relative to the other of the two axis of symmetry. In
the embodiment of Fig. 2F, each of the four inner electrodes 20 is positioned, with respect to
each of the two axes of symmetry 25, 26, at a distance from said axis of symmetry 25, 26 and
symmetrically relative to one of the other inner electrodes 20.

As can be seen from Fig. 2D, the outer electrode may be rectangular. Alternatively, the outer electrode may be triangular, as shown in Fig. 2A. Further possible electrode configurations with an equilateral triangular outer electrode are shown in Figs. 2G, 2H and 2I. In each of these embodiments, the equilateral triangular outer electrode has three
axes of symmetry. In the embodiments of Fig. 2G and Fig. 2H, three inner electrodes are
provided which are each positioned on a respective one of the three axes of symmetry at an
equal distance from the common point of intersection of the three axes of symmetry. In the
embodiment of Fig. 2I, six inner electrodes are provided, wherein each inner electrode is at
an equal distance from the common point of intersection of the three axes of symmetry, and
wherein each inner electrode is positioned, with respect to each of the three respective axes of
symmetry, at a distance from the respective axis of symmetry and symmetrically relative to
one of the other inner electrodes.

According to an embodiment, the outer electrode has \( n \) axes of symmetry, and
surrounds at most \( 2n \) inner electrodes, where \( n \) is a positive integer. So if, for example, the
outer electrode is square-shaped, it will have 4 axes of symmetry and will surround at most 8
inner electrodes.

According to a particular embodiment, the outer electrode has \( n \) axes of
symmetry, and the outer electrode surrounds \( n \) inner electrodes, where \( n \) is a positive integer
greater than 1, such as 2, 3, 4, etc. So, if the number of axes is 2 then the number of inner
electrodes is 2 as well. Examples of this embodiment are shown in Figs. 2D and 2E. If the
number of axes is 3, the number of inner electrodes is 3, see for example Figs. 2G and 2H.

According to another embodiment, the outer electrode surrounds \( 2n \) inner
electrodes, where \( n \) is a positive integer. If the number of axis is 1, the number of electrodes
is 2, see for example Figs. 2A, 2B and 2C. If the number of axes is 2, the number of inner
electrodes is 4, see for example Fig. 2F. If the number of axes is 3, the number of inner
electrodes is 6, see for example Fig. 2I.

The at least two inner electrodes have equally shaped and equally dimensioned
skin contact surfaces, and the skin contact surfaces of the at least two inner electrodes have
an equal orientation relative to the operational side 15, i.e. relative to the outer skin contact
surface of the device. As a result, the contact impedance of the inner electrodes will be approximately equal for all inner electrodes, resulting in approximately equal electrical currents through the electrodes as a result of the symmetrical arrangement of the inner electrodes relative to the surrounding outer electrode as described in the embodiments here before. This will result in almost equal amounts of generated energy at the inner electrodes and thus more uniform lesions.

The inner electrodes 20, 22, 30 may have annular or disc-shaped skin contact surfaces. Such shapes of the inner electrodes are relatively easy to manufacture. It is noted however that other shapes are possible, such as rectangular or oval.

Fig. 3 shows an embodiment wherein the device comprises a plurality of inner electrodes 56 and a plurality of outer electrodes 57, 59. Each of the plurality of outer electrodes surrounds at least two of the plurality of inner electrodes. The configuration of each of the outer electrodes 57, 59 together with the associated inner electrodes 56 fulfills the constraints explained with reference to Figs. 2G, 2H or 2I. By arranging a plurality of inner electrodes and surrounding them by a plurality of outer electrodes, a larger surface can be treated at one time as compared to embodiments having only one outer electrode. In an embodiment, at least some of the plurality of outer electrodes are electrically connected to each other or partly border each other. This will require less wiring from the RF generator to the outer electrodes. Furthermore, more electrodes can be arranged on the same surface as compared to separate outer electrodes. Fig. 4 shows an embodiment wherein a plurality of inner electrodes 61 is surrounded by a plurality of square-shaped outer electrodes 60, wherein the outer electrodes 60 border each other. Each of the outer electrodes 60 surrounds four inner electrodes 61. As can be seen from Fig. 4, the outer electrodes 60 border each other so as to form a single lattice structure. In this case, only one electrical connection is needed for the outer electrode(s).

The invention also relates to the use of the device according to the embodiments described above in the treatment of skin. The device may be used for therapeutic or non-therapeutic (e.g. cosmetic) treatment. The device is especially useful for rejuvenation of the skin, but may just as well be used for skin tightening.

It is noted that in this document the word 'comprising' does not exclude the presence of elements or steps other than those listed and the word 'a' or 'an' preceding an element does not exclude the presence of a plurality of such elements, and it is also noted that any reference signs do not limit the scope of the claims. Further, the invention is not limited
to the embodiments, and the invention lies in each and every novel feature or combination of features described above or recited in mutually different dependent claims.
CLAIMS:

1. A device (1) for radio frequency (RF) based skin treatment comprising:
   a non-circular outer electrode (21; 23; 32) arranged on an operational side of
   the device and having at least one axis of symmetry (24; 25; 33);
   at least two inner electrodes (20; 22; 30) arranged on the operational side of
   the device, each of the inner electrodes having an equally shaped and equally dimensioned
   skin contact surface having an equal orientation relative to the operational side;
   an RF generator (16) arranged to supply an RF voltage between each of the at
   least two inner electrodes and the outer electrode,
   wherein the outer electrode surrounds the at least two inner electrodes, and wherein each of
   the at least two inner electrodes is at an equal minimum distance from the outer electrode, and
   wherein:
   - in case the outer electrode has only one axis of symmetry (24), the at least two
     inner electrodes (22) are arranged so as to be symmetrically spaced from said one axis of
     symmetry (24), and
   - in case the outer electrode has more than one axis of symmetry (25,26), each
     inner electrode is at an equal distance from a common point of intersection of all axes of
     symmetry and is positioned, with respect to each of the respective axes of symmetry, either
     on said respective axis of symmetry or at a distance from said respective axis of symmetry
     and symmetrically relative to one of the other inner electrodes.

2. The device according to claim 1, wherein the outer electrode has \( n \) axes of
   symmetry, the outer electrode surrounding at most \( 2n \) inner electrodes, where \( n \) is a positive
   integer.

3. The device according to claim 2, wherein the outer electrode surrounds \( n \) inner
   electrodes, where \( n \) is greater than 1, and wherein each of the inner electrodes is arranged on
   a respective one of the axes of symmetry.
4. The device according to claim 2, wherein the outer electrode surrounds 2n inner electrodes.

5. The device according to any one of the preceding claims, wherein the at least two inner electrodes have annular or disc-shaped skin contact surfaces.

6. The device according to any one of the claims 1 to 4, wherein the at least two inner electrodes have rectangular or oval skin contact surfaces.

7. The device according to any one of the preceding claims, wherein a contour of the outer electrode is rectangular, triangular or oval.

8. The device according to any one of the preceding claims, wherein a skin contact surface of the outer electrode is at least 10 times larger than a total of the skin contact surfaces of all the inner electrodes.

9. The device according to any one of the preceding claims, wherein the RF voltage supplied by the RF generator across each of the at least two inner electrodes and the outer electrode has a value and duration such as to cause, in use, localized thermolysis in the skin in the vicinity of the at least two inner electrodes at a temperature higher than 65°C.

10. The device according to claim 9, wherein the RF voltage supplied by the RF generator across each of the at least two inner electrodes and the outer electrode has a value and duration such as to cause localized non-ablative thermolysis in the skin in the vicinity of the at least two inner electrodes at a temperature between 65°C and 100°C.

11. The device according to any one of the preceding claims, wherein the device comprises a plurality of inner electrodes and a plurality of outer electrodes, each of the plurality of outer electrodes surrounding at least two of the plurality of inner electrodes.

12. The device according to claim 11, wherein at least some of the plurality of outer electrodes are electrically connected to each other.
13. The device according to claim 12, wherein the at least some of the plurality of outer electrodes border each other, so as to form a lattice structure.

14. Use of the device according to any one of the preceding claims in the treatment of skin.
# INTERNATIONAL SEARCH REPORT

## A. CLASSIFICATION OF SUBJECT MATTER

**INV.** A61N1/32 A61N1/04  
**ADD.** A61B18/00 A61B18/14

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

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A61N  A61B

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

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>WO 2012/023129 AI (SYNERON MEDICAL LTD [IL]; ECKHOUSE SHIMON [IL]; FLYASH LION [IL]; VAYN) 23 February 2012 (2012-02-23) paragraph [0001] - paragraph [0002]; figure 7 paragraph [0030] - paragraph [0031]; figure 1 paragraph [0039]</td>
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<tr>
<td>X</td>
<td>US 2009/118790 AI (VAN HERK JOHANNES JOHANNA [NL]) 7 May 2009 (2009-05-07) paragraph [0012] paragraph [0031]; figure 2</td>
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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) one 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.
  - "A" document member of the same patent family.

Date of the actual completion of the international search  
3 September 2015

Date of mailing of the international search report  
14/09/2015

Name and mailing address of the ISA  
European Patent Office, P.O. Box 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016

Authorized officer  
Ekstrand, Vilhelm
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<td>25 May 2001 (2001-05-25) page 1, line 3 - line 11 page 5, line 31 - line 35; figure 5</td>
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<td>US 2006/270942 Al (MCADAMS ERIC T [IE] MCADAMS ERIC THOMAS [GB])</td>
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<td>30 November 2006 (2006-11-30) figure 10b</td>
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<td>paragraph [0003] paragraph [0031]; figure 2c paragraph [0024]; figure 1</td>
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INTERNATIONAL SEARCH REPORT

International application No. PCT/EP2015/06Q938

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. **X** Claims Nos.: __4__ because they relate to subject matter not required to be searched by this Authority, namely:

   see FURTHER INFORMATION sheet PCT/ISA/210

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).

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:

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.

Form PCT/ISA/21 0 (continuation of first sheet (2)) (April 2005)
Continuation of Box III.1

Claims Nos.: 14

Claim 14 relates to an use/method of treatment of the human body by therapy and surgery. The treatment in claim 14 could be therapeutic (page 1, 12-6). Moreover, the treatment in claim 14 could be ablative (claim 10) which implicitly implies that a surgery step is performed. Thus, according to Rule 39.1 (iv) PCT and to Art 43bis.1 PCT as well as Rule 67.1 PCT, neither a search nor an international preliminary examination is required to be carried out on this claim.
<table>
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<td>EP 2605718 Al</td>
<td>26-06-2013</td>
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<td>JP 2013534167 A</td>
<td>02-09-2013</td>
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<td>KR 20140005124 A</td>
<td>14-01-2014</td>
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<td>31-10-2013</td>
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<td>us 2009118790 Al</td>
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</tr>
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<td></td>
<td>JP 2009502399 A</td>
<td>29-01-2009</td>
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<td>KR 20080027378 A</td>
<td>26-03-2008</td>
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<td></td>
<td>US 2009118790 Al</td>
<td>07-05-2009</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wo 2007017778 A2</td>
<td>15-02-2007</td>
</tr>
<tr>
<td>wo 0135823 Al</td>
<td>25-05-2001</td>
<td>AU 1527501 A</td>
<td>30-05-2001</td>
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<tr>
<td></td>
<td></td>
<td>Fi 992463 A</td>
<td>18-05-2001</td>
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