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(71) Applicant *(for all designated States except US)*: **THE MEDICAL RESEARCH, INFRASTRUCTURE AND HEALTH SERVICES FUND OF THE TEL AVIV MEDICAL CENTER** [IL/IL]; 6 Weizmann Street, 64239 Tel-Aviv (IL).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **MAIMON, Shimon** [IL/IL]; 9 HaShahar Street, 18321 Afula (IL).

(74) Agents: **G.E. EHRLICH (1995) LTD.** et al.; 11 Menachem Begin Road, 52681 Ramat Gan (IL).

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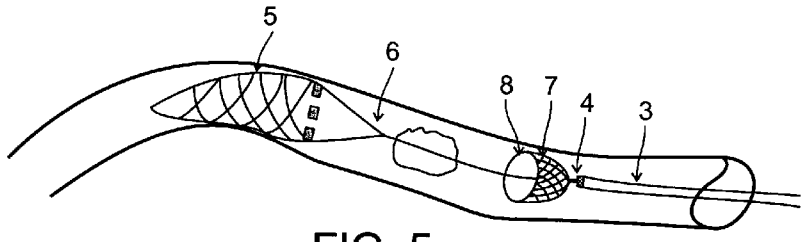

FIG. 5

(57) Abstract: A catheter apparatus comprising an elongated tubular guiding member, an emboli collecting element, an emboli pushing element and one or more maneuvering wires in order to capture and remove, in particular but not exclusively, emboli particles or an embolism from vessels is disclosed herein.

DEVICE OF REMOVING EMBOLISMS

FIELD AND BACKGROUND OF THE INVENTION

The present invention, in some embodiments thereof, ,relates to methods and devices of removing embolisms and, more particularly, but not exclusively, to catheter apparatus and method of methods and devices of removing embolisms using a catheter.

The removal of emboli particles from the blood stream is often a necessary medical procedure used in order to prevent the occlusion of blood vessels within a body lumen. An embolism occurs when an embolism (embolus) or other particle in the blood circulation creates blockage, for example a pulmonary arterial blockage. An embolism, such as pulmonary embolism can be a life-threatening condition since the embolism could cut off the body's oxygen supply.

In order to minimize the likelihood of an embolism from occurring, a thrombectomy device or a vascular filter can be inserted into a blood vessel or other large vein, as to capture and remove embolisms before they reach other vasculatures. For example, such devices can be used for treating patients suffering from deep vein thrombosis (DVT) which is a condition wherein an embolism (thrombus) is formed in the leg and subsequently breaks free (now an embolus) and migrates into the cardio-pulmonary vasculature.

Example of such a device is provided in US Patent No. 5,885,258 which discloses a retrieval basket for catching small particles, made from a slotted tube preferably made of Nickel Titanium, a titanium nickel shaped memory alloy. The pattern of the slots allows expansion of the Nickel Titanium basket and by shape setting (heat treatment in the desired unconstrained geometry) this basket can expand and collapse by means of moving it out or into a surrounding delivery tube.

Another example of such a device is given in US Patent Application No. 10/304,067 filed on Nov. 26, 2002 which describes a medical device such as a vascular filter, composed of a reinforced membrane unit. This unit is composed of a thin filter membrane and fibers of reinforcement material embedded in the membrane to strengthen the filter and securely attach the fibers to the membrane.

SUMMARY OF THE INVENTION

According to some embodiments of the present invention there is provided a catheter apparatus that is designed to capture and remove emboli particles of an embolism from a body lumen. Optionally, the catheter apparatus is a delivery catheter based device having an emboli collecting element and an emboli pushing element which are guided via a catheter and manipulated by one or more maneuvering wires. These elements are optionally separately manipulated to form a closed space that confines the embolism. This delivery catheter based device is used to capture and remove, in particular but not exclusively, emboli particles from vessels, such as brain vessels.

The emboli collecting element and the emboli pushing element are designed to contract into the catheter upon insertion and optionally retraction and expand upon deployment into a blood vessel. For example, the emboli collecting element and/or the emboli pushing element are made of a memory shape material, such as Nickel Titanium.

According to some embodiments of the present invention there is provided a catheter apparatus of removing an embolism from an intravascular space. The catheter comprises an elongated tubular guiding member sized and shaped for being guided along a blood vessel, toward an intravascular treating space, and having an inner lumen, proximal and distal ends, a collecting element having a compressed state for being placed in the inner lumen and a deployed state for being deployed in a frontal area of the intravascular treating space, a pushing element sized and shaped for being deployed in a rear area of the intravascular treating space, and at least one maneuvering wire treaded in the lumen and adapted for directing the pushing element toward the collecting element in a deployed state so as to enclose a space therebetween.

Optionally, the pushing element has a compressed state for being placed in the inner lumen and a deployed state for being deployed in the rear area, the at least one maneuvering wire treaded being adapted for directing the pushing element in a deployed state toward the collecting element.

Optionally, the collecting element comprising a conical shaped mesh having an angular base facing the pushing element shape

Optionally, the collecting element comprising a tubular shaped element.

Optionally, the pushing element comprising a conical shaped mesh having an angular base facing the collecting element.

Optionally, the size of holes of the mesh is less than 1mm.

Optionally, the pushing element having inward curling lips directed toward the collecting element in the deployed state.

Optionally, the collecting element having inward curling lips directed toward the pushing element in the deployed state.

Optionally, at least one of the collecting element and pushing element are made of a memory shape material.

Optionally, the catheter comprises a conduit for conducting embolism releasing material via a tip of the elongated tubular guiding member.

According to some embodiments of the present invention there is provided a method of removing an embolism from an intravascular space. The method comprises guiding a collecting element and a pushing element to an intravascular treatment space, placing the collecting element in a frontal area of the intravascular treatment space and the pushing element in a rear area of the intravascular treatment space, directing the pushing element toward the collecting element so as to enclose at least one emboli particle or an embolism located in the intravascular space, and retracting the collecting element and the pushing element from the intravascular treatment space so as to remove the at least one emboli particle therefrom.

Optionally, the method comprises injecting embolism releasing material through the tubular guiding member to free the embolism from the intravascular treatment space before the directing.

More optionally, the method comprises locking the collecting element to the pushing element before the retracting.

Optionally, the guiding is performed in an elongated tubular guiding member sized and shaped for being guided along a blood vessel further comprising inserting the collecting element and the pushing element into the tubular guiding member before the retracting.

Optionally, the directing comprising forming a space sealed by the pushing element and the collecting element in the intravascular space, the space bound the at least one emboli particle.

Optionally, the method comprises inserting the collecting element and the pushing element into an elongated tubular guiding member used for guiding the collecting element and the pushing element before the retracting and after the directing.

Unless otherwise defined, all technical and/or scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which the invention pertains. Although methods and materials similar or equivalent to those described herein can be used in the practice or testing of embodiments of the invention, exemplary methods and/or materials are described below. In case of conflict, the patent specification, including definitions, will control. In addition, the materials, methods, and examples are illustrative only and are not intended to be necessarily limiting.

BRIEF DESCRIPTION OF THE DRAWINGS

Some embodiments of the invention are herein described, by way of example only, with reference to the accompanying drawings. With specific reference now to the drawings in detail, it is stressed that the particulars shown are by way of example and for purposes of illustrative discussion of embodiments of the invention. In this regard, the description taken with the drawings makes apparent to those skilled in the art how embodiments of the invention may be practiced.

In the drawings:

FIG. 1 is a schematic illustration of a catheter apparatus device for capturing and removing emboli particles from a body lumen, according to some embodiments of the present invention;

FIG. 2 is a schematic illustration of a flowchart describing a method for capturing and removing an embolism from a body lumen, according to some embodiments of the present invention;

FIG. 3 is a schematic illustration of running the catheter's tip through the embolism and positioning it in front of the embolism.

FIG. 4 is a schematic illustration of deploying the emboli collecting element from the distal end of the catheter's tip into the blood vessel and retracting the catheter's tip to the rear side of the embolism, according to some embodiments of the present invention;

FIG. 5 is a schematic illustration of deploying the emboli pushing element at the distal end of the catheter's tip such that the embolism is positioned between the pushing element and the collecting element, according to some embodiments of the present invention;

FIG. 6 is a schematic illustration of confining the emboli collecting element by means of pushing the emboli pushing element towards it after the one or more emboli particles or embolism have been trapped within the emboli collecting element, according to some embodiments of the present invention;

FIG. 7 is a schematic illustration of the emboli collecting element, according to some embodiments of the present invention;

FIG. 8 is a schematic illustration of the emboli pushing element, according to some embodiments of the present invention; and

FIG. 9 is a schematic illustration of a tubular collecting element, according to some embodiments of the present invention.

DESCRIPTION OF SPECIFIC EMBODIMENTS OF THE INVENTION

The present invention, in some embodiments thereof, relates to methods and devices of removing embolisms and, more particularly, but not exclusively, to catheter apparatus and method of methods and devices of removing embolisms using a catheter.

According to some embodiments of the invention there is provided a delivery catheter device having an emboli collecting element and an emboli pushing element treaded by one or more guide wires in a catheter. The emboli collecting element and/or the emboli pushing element are optionally conical or semi conical tubular shaped mesh elements which are set to contract upon insertion into the catheter. This allows conducting these elements in the distal end of the catheter, via body cavities such as the blood vessels, to an intravascular treating space. Optionally, the emboli collecting element and the emboli pushing element are made of memory shape material so that when they are released at the distal end of the catheter they expand from a compressed state to a deployed state. The emboli collecting element and the emboli pushing element are controlled by means of maneuvering wires which go through the catheter.

According to some embodiments of the invention there is provided a method of removing emboli particles. First, emboli collecting and emboli pushing elements, such as the ones previously outlined and described below,, are conducted using a catheter apparatus to an intravascular treating space wherein one or more emboli particles of an embolism, such as a brain embolism, are set to be captured and removed. Then, the emboli collecting and emboli pushing elements are respectively deployed in front and behind the embolism, such as the one or more emboli particles. For example, a catheter is used to conduct the emboli collecting element to a frontal area of the intravascular treating space.Subsequently, the catheter's tip which is the distal end of the tubular guiding member is retracted so that its distal end is placed in a rear area of the intravascular treating space. This allows deploying the pushing element in the rear area so that the emboli particles are between the pushing and collecting elements. Now, the emboli pushing element is pushed toward the emboli collecting element, for example by manipulating one or more maneuvering wires which are connected thereto. Namely, the emboli pushing element is pushed using a maneuvering guiding element toward the emboli collecting element whereby it pushes one or more emboli particles toward the emboli collecting element. Once the emboli pushing element is in touch with, and optionally attached to, the emboli collecting element, a closed space is formed therebetween. In order to prevent any emboli particles trapped within the closed space from escaping it upon retraction, the collecting and pushing elements are retracted into the aforementioned catheter's tip before being retracted from the intrabody lumen. Optionally, the emboli pushing element and/or the collecting element may exhibit locking elements, such as inward curling lips, which are set to clutch the other of the emboli pushing element and/or the collecting element. In such a manner, the closed space formed between the emboli collecting element and the emboli pushing element is sustained when the locking elements prevent a possible detachment. By means of the aforementioned maneuvering wires, the elements containing the trapped emboli particles are retracted back into the catheter's tip and once placed within the catheter, the catheter apparatus can be safely extracted out of the body together with said emboli particles.

Before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not necessarily limited in its application to the details set

forth in the following description or exemplified by the Examples. The invention is capable of other embodiments or of being practiced or carried out in various ways.

Referring now to the drawings, FIG. 1 is a schematic illustration of a catheter apparatus having mechanism for pushing emboli particles into a collecting element, according to some embodiments of the present invention

The catheter apparatus 100 includes an elongated tubular guiding member 3, such as a microcatheter, that is sized and shaped for being guided along the longitudinal axis of a blood vessel, such as a cerebral blood vessel (not shown). As used herein, the catheter apparatus may be any device that is designed for treatment of a site at a blood vessel. Optionally, the elongated tubular guiding member 3 is reinforced, for example, by using a helical coil that is stretched therealong, or by using composite stiffeners which are intertwined therein or otherwise attached thereto and/or any other element that affects its stiffness and/or elasticity coefficients. In such a manner, the catheter apparatus 100 may be guided in a soft tissue comprising narrow blood vessels, such as brain vessels, and passed through ever-narrower regions of the vascular system until the catheter reaches a treating site. The reinforcement allows passing via pathways which may interlace in a looped path or a multi-looped path.

In use, the catheter apparatus 100 may be maneuvered using maneuvering wires 6 that allow gaining access to blood vessels, as known in the art. In such an embodiment, the tubular guiding member 3 is advanced into the vasculature over the maneuvering wires 6. The catheter fits over and slides along the maneuvering wires 6 as it passes through the vasculature.

The maneuvering wires and/or the tubular guiding member 3 are maneuvered by the surgeon using a guiding system, such as a known image guided catheter navigation system for guiding a catheter through a designated treatment area. The guiding is optionally performed manually, for example, by using a control unit such as a handle 101, for allowing a user to hold and/or control the insertion tube 102. Alternatively, the guiding is optionally performed by making use of maneuvering wires 6, as to manipulate the insertion tube 102 within the vessel, and/or to angulate the tip 4 of the catheter apparatus 100.

Described in relation to FIG. 1, reference is now made to FIG. 2, which is a flowchart description of a method for using the catheter apparatus in order to capture and

remove emboli particles of an embolism from a body lumen, according to some embodiments of the present invention. As used herein emboli particles means any portion of an embolism.

Firstly, as shown at 20, the catheter apparatus 100 is guided to a designated treatment area in which an embolism is set to be captured and removed. Then, as shown at 21 and illustrated in FIG. 3, the catheter's tip 4 is guided and positioned by the catheter's handle 101 or by the maneuvering wires 6 to a frontal area of the embolism.

As shown at 22, the compressed collecting element 5 is pushed out of the elongated tubular guiding member 3 by using one or more maneuvering wires 6 and expands to a deployed state, for example a conical shaped mesh having an angular base as illustrated in FIG. 4. After the collecting element 5 has been deployed, the catheter's tip 4 is retracted to the rear side of the embolism.

As shown at 23, a check may be made to verify whether the deployed collecting element 5 is placed in front of the embolism, for example by using imaging techniques. If the deployed collecting element 5 is not positioned as required, then, as shown at 26, the maneuvering wires 6 are used to maneuver and reposition the deployed collecting element 5 in front of the embolism. Such an action may require retracting the collecting element into the elongated tubular guiding member 3 and redeploying it in a new location. Now, the pushing element 7, which is optionally in a compressed state, is pushed out of the elongated tubular member 3 into the treatment area such that it is placed and/or deployed rear to the embolism, as shown at 27. This may be done by directing maneuvering wires 6 as illustrated in FIG. 5.

Now, as shown at 28, the pushing element 7 is pushed toward the deployed collecting element 5 by using the abovementioned maneuvering wires 6. This action encloses the emboli particles of the embolism in a closed space between the collecting and pushing elements 5, 7, as illustrated in FIG. 6. As shown at 20, a check whether all particles of the embolism are trapped in the space formed by the collecting element and the pushing element 5, 7 is made, for example by imaging techniques. Such a check allows verifying that no emboli particles are left in the treatment area.

When the collecting and pushing elements 5, 7 are attached, inward curling lips 8 which are optionally connected to the pushing element intertwine in the mesh of the collecting element. This intertwining substantially seals the space formed by the

collecting an pushing elements 5, 7 after trapping the emboli particles of the embolism, thus assuring that the confined space formed between the collecting and pushing elements 5, 7 secures the trapped embolism throughout the procedure as illustrated in FIG. 6. This is followed by pulling out and removing the trapped particles of the embolism from the vessel as shown at 34 and 35. Optionally, the collecting and pushing element 5, 7, which are optionally intertwined, are retracted, at least partly, into the tubular guiding member 3. In such a manner, the diameter of the collecting and pushing elements 5, 7 which hold the emboli particles may be reduced, facilitating the retraction process.

The method described herein allows capturing and removing embolisms from a designated treatment area with a low probability of any emboli particles escaping from the confined space formed between the collecting element and the pushing element 5, 7. This differs from methods which do not include a pushing element 7 for securing emboli particles upon removal from a designated treatment vessel, and therefore some emboli particles in such methods may be released to the blood circulation during the embolism removal procedure.

Furthermore, the pushing element 7 described herein assists in directing the emboli particles into the collecting element as opposed to methods where this is an impossible feat due to the absence of an element set to push against the retraction direction.

According to some embodiments of the present invention, an embolism releasing material such as tissue plasminogen activator (tPA), may be used to release emboli particles of the embolism in the treated area.

In such embodiments, the device further includes conducting a tube which is placed along the elongated tubular guiding member 3. In such an embodiment, the embolism releasing material may be released when the embolism is bounded by the collecting and pushing elements, for example as shown in FIG. 5. In such a manner, the emboli particles released from the embolism in response to the embolism releasing material action are not washed to the blood circulation but remain in the bounded area between the collecting element 5 and pushing element 7.

Described in relation to FIG. 1, reference is now made to FIG. 5 which depicts the elements responsible for capturing an embolism within a vessel, according to some

embodiments of the present invention. FIG. 5 depicts an emboli collecting element 5 which is set for capturing emboli particles and/or an embolism within a blood vessel situated possibly in a brain tissue. This collecting element 5 is geometrically designed in particular, but not exclusively to have a conical shaped mesh. FIG. 5 also depicts inward curling lips 8 which are optionally an additional feature of the emboli pushing element 7 to be described subsequently, and are sized and shaped to substantially seal the aforementioned emboli collecting element 5. Furthermore, an elongated tubular member 3 which is sized and shaped to be guided within a blood vessel, such as a brain vessel, until the catheter's tip 4 at the distal end of it reaches a designated treatment area is also shown in FIG. 5. The catheter's tip 4 is optionally controlled by a control unit such as the catheter's handle 101 of FIG. 1. In addition, FIG. 5 illustrates one or more maneuvering wires 6 which allow gaining access to blood vessels and are maneuvered by using a guiding system, such as a known image guided catheter navigation system. FIG. 5 illustrates an emboli pushing element 7 that is set for pushing, directing and trapping the emboli particles into the aforementioned emboli collecting element 5. This pushing element 7 is geometrically designed in particular, but not exclusively to have a conical shaped mesh.

The elements illustrated in FIG. 5 may be used, for example, in various medical procedures whereby an occlusion of a blood vessel, due to emboli particles, has been formed and needs to be removed so that normal blood flow can resume. Presumably, if the obstruction is not removed, the supply of oxygen to cells may be significantly reduced and may eventually result in a fatality or irreversible damage, such as brain damage.

Referring to the schematic illustration of FIG. 6 and its associated elements, their technical specifications are provided hereto: The collecting element 5 has a compressed state and a deployed state. Due to the small physical dimensions of the elongated tubular guiding member 3, the collecting element 5 needs to be compressed in order to fit into it and is therefore in a compressed state. However, when the catheter is inserted into the body and the tubular guiding member 3 is maneuvered to the designated treating space, the collecting element 5 is then deployed out of the elongated guiding member 3 to the treatment area. It then expands to its full size, optionally having a conical shape, and is therefore in a deployed state.

For example, in a compressed state the diameter of the collecting element 5 is smaller than the inner diameter of the tubular guiding member 3. Optionally, the guiding member 3 has an inner diameter of about 0.6mm and the collecting element 5 has a diameter smaller than about 0.6mm. However, the collecting element's diameter and length in a deployed state may vary between 2.5mm-3mm and 15mm-20mm respectively.

The pushing element 7, similar to the collecting element 5, ,may also have a compressed state in order to accommodate the physical restrictions imposed by the catheter apparatus as described previously, and similarly a deployed state, optionally having a conical shape, when deployed out to the treatment area. Optionally, the diameter of the pushing element 7 is no more than 0.6mm in a compressed state. Whereas in a deployed state, its diameter and length may vary between 1.5mm and 2mm and 10mm and 15mm respectively. In addition, the collecting element 5 and the pushing element 7 are optionally made of Nickel Titanium, Cobalt or Platinum.

Locking elements, such as inward curling lips 8 are optionally an added feature attached to the pushing element 7 and/or collecting element 5 are also optionally made of Nickel Titanium, Cobalt, Platinum or any other memory shape material and are designed to abut the collecting element 5 and consequently prevent a possible detachment between the collecting element 5 and the pushing element 7.

Reference is now also made to FIG. 7 and FIG. 8, which are schematic illustrations which separately depict the collecting element 5 and the pushing element 7 according to some embodiments of the present invention.

As depicted in FIG. 7, the collecting element 5 may have a conical shape. This collecting element 5 is optionally attached to a circular ring with a diameter varying between 2.5mm-3mm. For example, a design of such a collecting element 5 is made by mesh such as a "Leo" type mesh and/or a "Solitare" type mesh. Optionally, the length of the collecting element 5 is designed to bind an embolism of between about 10mm and 15mm.

Alternatively, as shown in FIG. 9, the elongated tubular guiding member 3 includes a tubular shaped mesh 9. The tubular shaped mesh is composed of cells having a diameter between about 0.5mm and about 1mm. The mesh is optionally made of Nickel Titanium or Cobalt. This tubular shaped mesh 9 once deployed in the vessel may

collect emboli particles which are caught in its mesh. The particles, when in touch with the tubular shaped mesh 9, are essentially attached to it due to their viscose nature.

The pushing element 7 as illustrated in FIG. 8 is optionally a conical shaped basket made of Nickel Titanium or Cobalt. The pushing element of FIG. 8 is optionally attached to a circular ring with a diameter varying between 1.5mm-2mm. The force applied for maneuvering the wires which are used for maneuvering the pushing element is limited so as to minimize friction.

It is expected that during the life of a patent maturing from this application many relevant methods and systems will be developed and the scope of the term tube, catheter, and control unit is intended to include all such new technologies *a priori*.

As used herein the term "about" refers to ± 10 %.

The terms "comprises", "comprising", "includes", "including", "having" and their conjugates mean "including but not limited to".

The term "consisting of means "including and limited to".

The term "consisting essentially of" means that the composition, method or structure may include additional ingredients, steps and/or parts, but only if the additional ingredients, steps and/or parts do not materially alter the basic and novel characteristics of the claimed composition, method or structure.

As used herein, the singular form "a", "an" and "the" include plural references unless the context clearly dictates otherwise. For example, the term "a compound" or "at least one compound" may include a plurality of compounds, including mixtures thereof.

Throughout this application, various embodiments of this invention may be presented in a range format. It should be understood that the description in range format is merely for convenience and brevity and should not be construed as an inflexible limitation on the scope of the invention. Accordingly, the description of a range should be considered to have specifically disclosed all the possible subranges as well as individual numerical values within that range. For example, description of a range such as from 1 to 6 should be considered to have specifically disclosed subranges such as from 1 to 3, from 1 to 4, from 1 to 5, from 2 to 4, from 2 to 6, from 3 to 6 etc., as well as individual numbers within that range, for example, 1, 2, 3, 4, 5, and 6. This applies regardless of the breadth of the range.

Whenever a numerical range is indicated herein, it is meant to include any cited numeral (fractional or integral) within the indicated range. The phrases "ranging/ranges

between" a first indicate number and a second indicate number and "ranging/ranges from" a first indicate number "to" a second indicate number are used herein interchangeably and are meant to include the first and second indicated numbers and all the fractional and integral numerals therebetween.

It is appreciated that certain features of the invention, which are, for clarity, described in the context of separate embodiments, may also be provided in combination in a single embodiment. Conversely, various features of the invention, which are, for brevity, described in the context of a single embodiment, may also be provided separately or in any suitable subcombination or as suitable in any other described embodiment of the invention. Certain features described in the context of various embodiments are not to be considered essential features of those embodiments, unless the embodiment is inoperative without those elements.

Although the invention has been described in conjunction with specific embodiments thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, it is intended to embrace all such alternatives, modifications and variations that fall within the spirit and broad scope of the appended claims.

All publications, patents and patent applications mentioned in this specification are herein incorporated in their entirety by reference into the specification, to the same extent as if each individual publication, patent or patent application was specifically and individually indicated to be incorporated herein by reference. In addition, citation or identification of any reference in this application shall not be construed as an admission that such reference is available as prior art to the present invention. To the extent that section headings are used, they should not be construed as necessarily limiting.

WHAT IS CLAIMED IS:

1. A catheter apparatus of removing an embolism from an intravascular space, comprising:

an elongated tubular guiding member sized and shaped for being guided along a blood vessel, toward an intravascular treating space, and having an inner lumen, proximal and distal ends;

a collecting element having a compressed state for being placed in said inner lumen and a deployed state for being deployed in a frontal area of said intravascular treating space;

a pushing element sized and shaped for being deployed in a rear area of said intravascular treating space; and

at least one maneuvering wire treaded in said lumen and adapted for directing said pushing element toward said collecting element in a deployed state so as to enclose a space therebetween.

2. The catheter apparatus of claim 1, wherein said pushing element has a compressed state for being placed in said inner lumen and a deployed state for being deployed in said rear area, said at least one maneuvering wire treaded being adapted for directing said pushing element in a deployed state toward said collecting element.

3. The catheter apparatus of claim 1, wherein said collecting element comprising a conical shaped mesh having an angular base facing said pushing element shape.

4. The catheter apparatus of claim 1, wherein said collecting element comprising a tubular shaped element.

5. The catheter apparatus of claim 1, wherein said pushing element comprising a conical shaped mesh having an angular base facing said collecting element.

6. The catheter apparatus of claim 1, wherein the size of holes of said mesh is less than 1mm.

7. The catheter apparatus of claim 1, wherein said pushing element having inward curling lips directed toward said collecting element in said deployed state.

8. The catheter apparatus of claim 1, wherein said collecting element having inward curling lips directed toward said pushing element in said deployed state.

9. The catheter apparatus of claim 1, wherein at least one of said collecting element and pushing element are made of a memory shape material.

10. The catheter apparatus of claim 1, further comprising a conduit for conducting embolism releasing material via a tip of said elongated tubular guiding member.

11. A method of removing an embolism from an intravascular space, comprising:

guiding a collecting element and a pushing element to an intravascular treatment space;

placing said collecting element in a frontal area of said intravascular treatment space and said pushing element in a rear area of said intravascular treatment space;

directing said pushing element toward said collecting element so as to enclose at least one emboli particle or an embolism located in said intravascular space; and

retracting said collecting element and said pushing element from said intravascular treatment space so as to remove said at least one emboli particle therefrom.

12. The method of claim 11, further comprising injecting embolism releasing material through said tubular guiding member to free said embolism from said intravascular treatment space before said directing.

13. The method of claim 11, further comprising locking said collecting element to said pushing element before said retracting.

14. The method of claim 11, wherein said guiding is performed in an elongated tubular guiding member sized and shaped for being guided along a blood vessel further

comprising inserting said collecting element and said pushing element into said tubular guiding member before said retracting.

15. The method of claim 11, wherein said directing comprising forming a space sealed by said pushing element and said collecting element in said intravascular space, said space bound said at least one emboli particle.

16. The method of claim 11, further comprising inserting said collecting element and said pushing element into an elongated tubular guiding member used for guiding said collecting element and said pushing element before said retracting and after said directing.

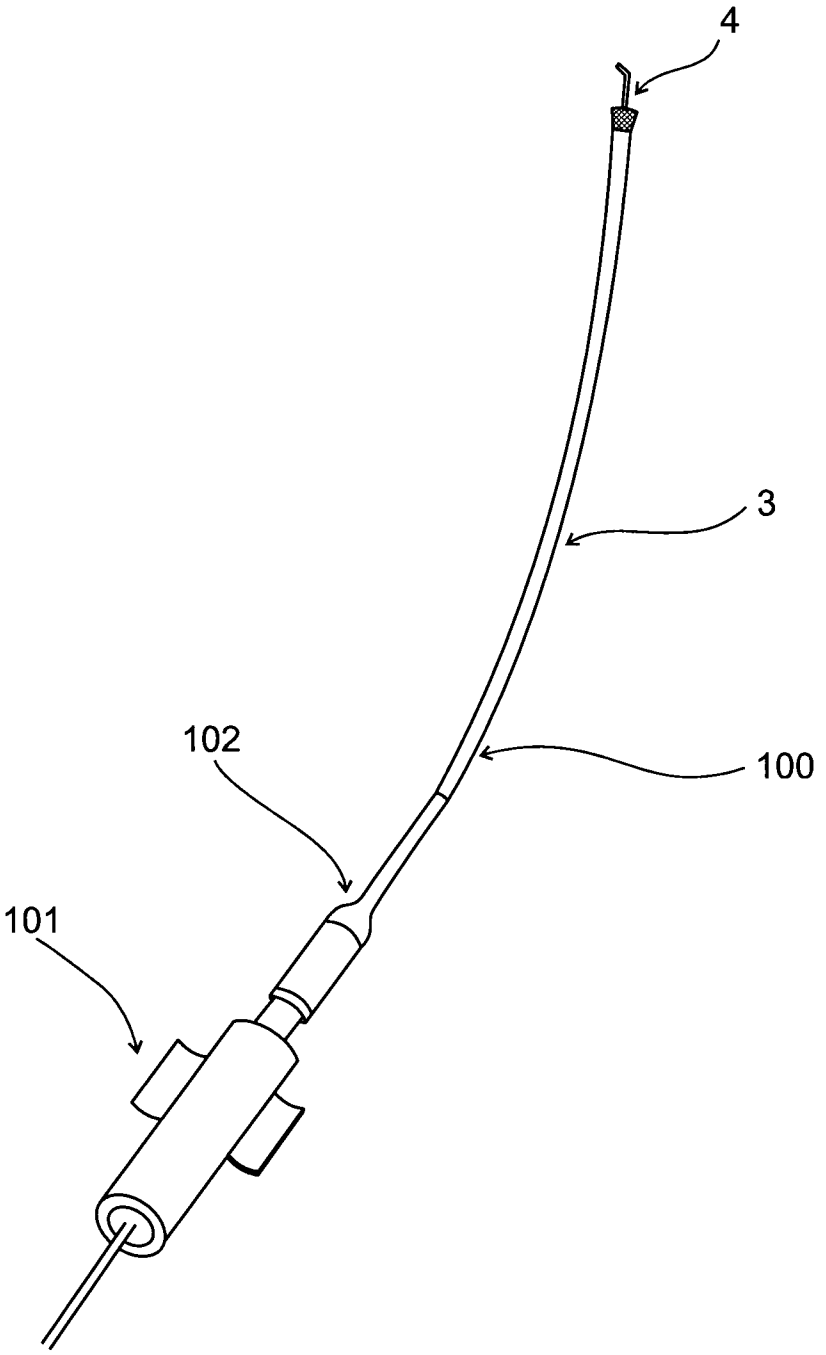

FIG. 1

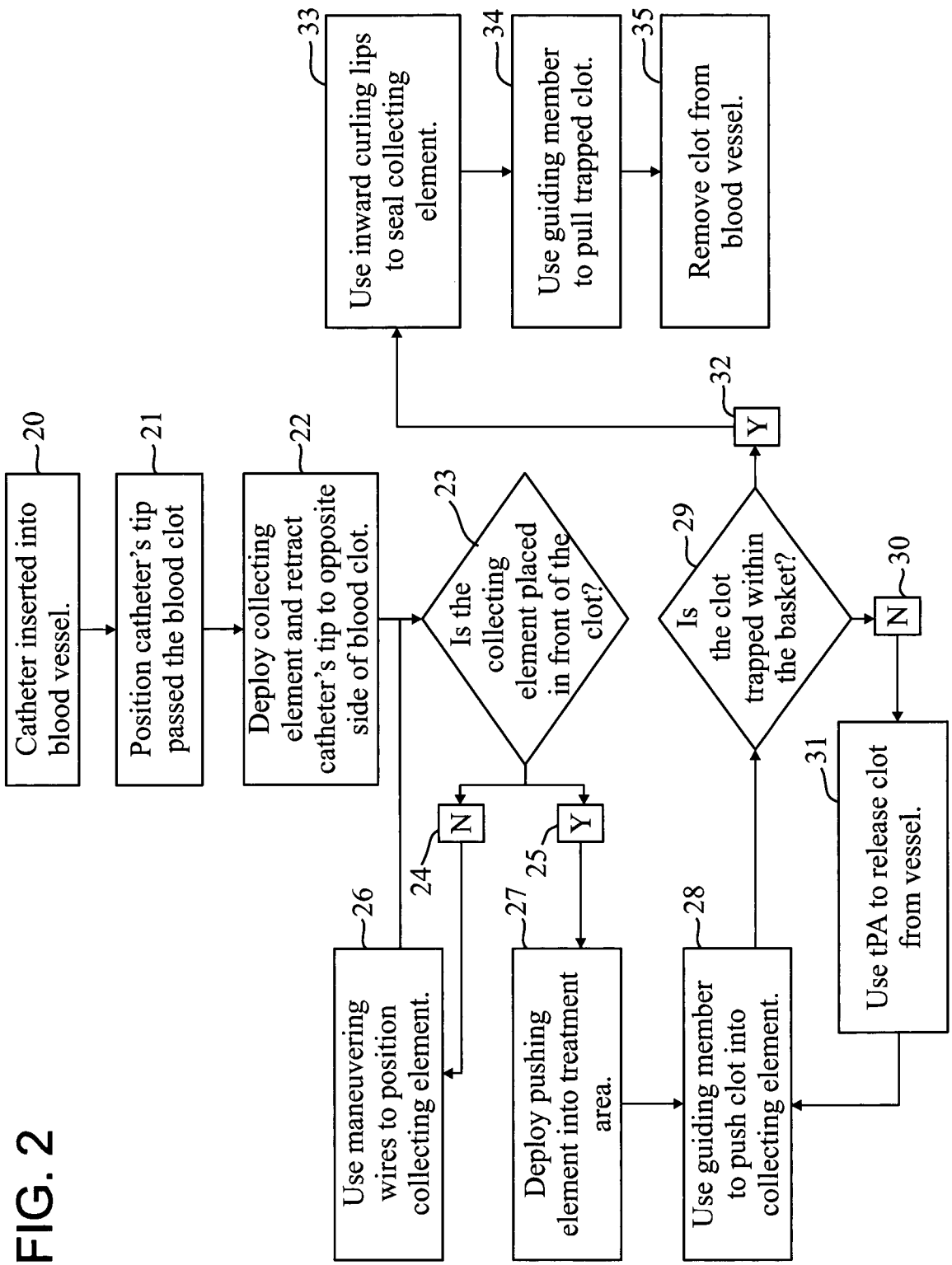
Catheter inserted into blood vessel.
20
Position catheter's tip passed the blood clot
21
Deploy collecting element and retract catheter's tip to opposite side of blood clot.
22
Is the collecting element placed in front of the clot?
23
N
24
Y
25
Use maneuvering wires to position collecting element.
26
Deploy pushing element into treatment area.
27
Use guiding member to push clot into collecting element.
28
Is the clot trapped within the basket?
29
N
30
Use tPA to release clot from vessel.
31
Y
32
Use inward curling lips to seal collecting element.
33
Use guiding member to pull trapped clot.
34
Remove clot from blood vessel.
35

FIG. 2

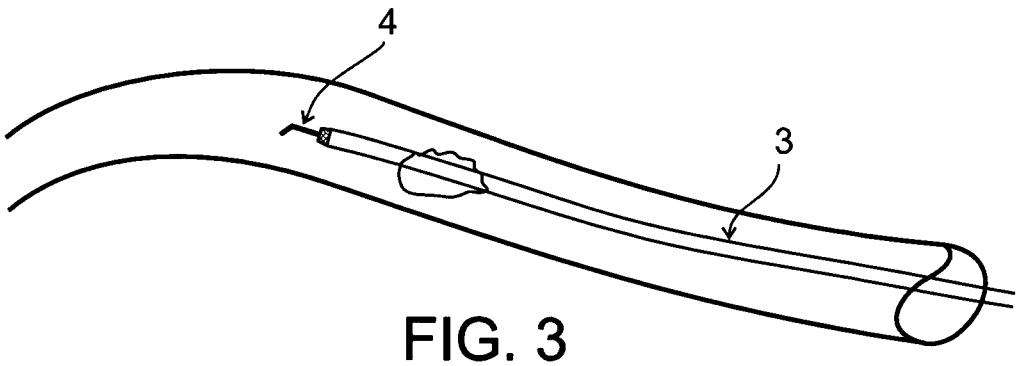

FIG. 3

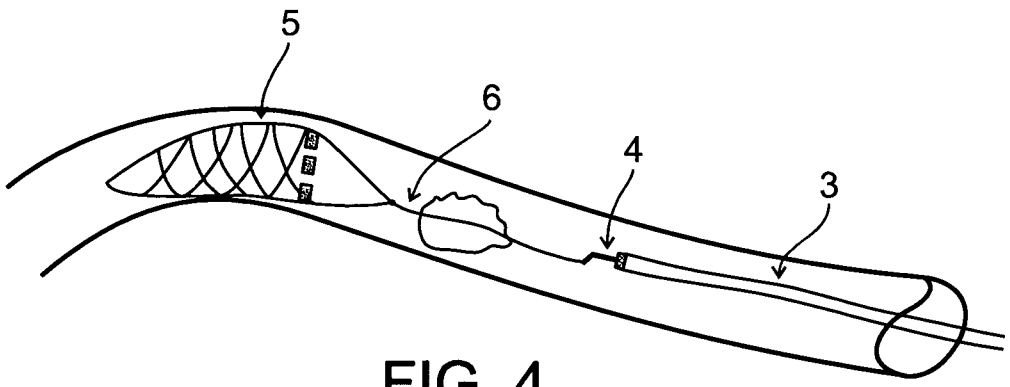

FIG. 4

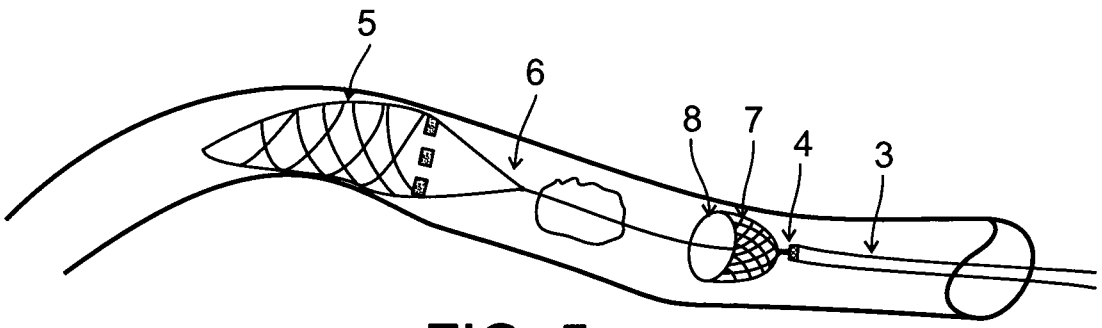

FIG. 5

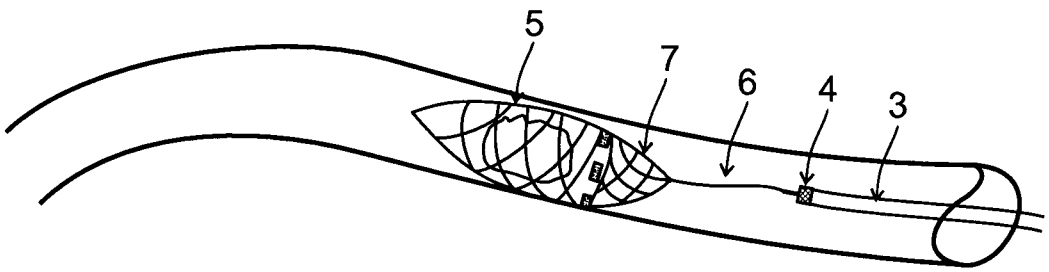

FIG. 6

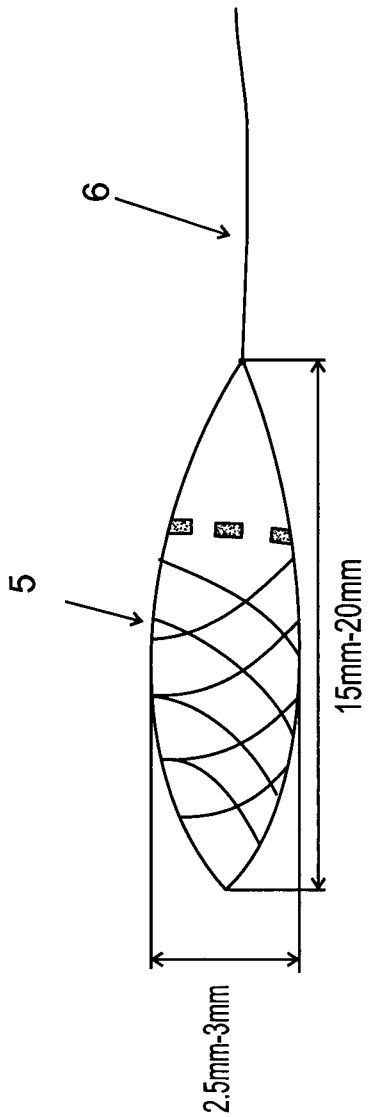

FIG. 7

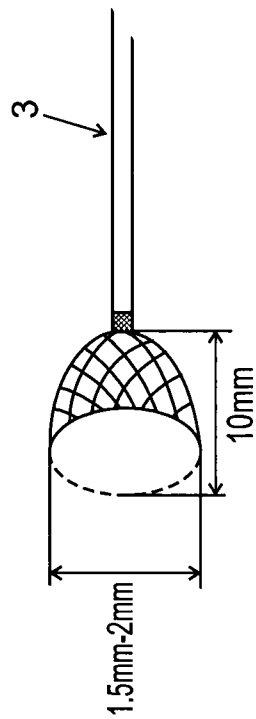

FIG. 8

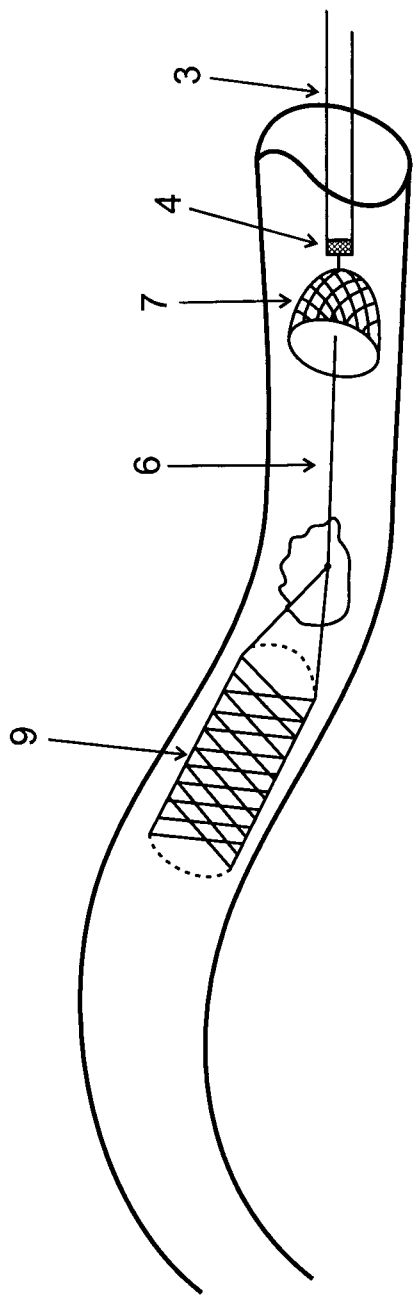

FIG. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/IL2011/000570

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B17/22 A61B17/221
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
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 practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 00/53120 A1 (MICROVENA CORP [US]; KUSLEIKA RICHARD S [US]; NGUYEN DUY [US]; ANDERSO) 14 September 2000 (2000-09-14)	1-9
Y	page 21, lines 11-25; figures 5,7-9	10
Y	US 2002/173819 A1 (LEEFLANG STEPHEN [US] ET AL) 21 November 2002 (2002-11-21)	10
A	paragraph [0050]; figures 5-9,12	1-9
A	US 5 011 488 A (GINSBURG ROBERT [US]) 30 April 1991 (1991-04-30) figures 1,2,5	1-10
A	US 6 159 230 A (SAMUELS SHAUN L W [US]) 12 December 2000 (2000-12-12) figure 3	1-10

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

☒ See patent family annex.

* Special categories of cited documents :

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 January 2012	12/01/2012

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IL2011/000570

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

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

1. [X] Claims Nos.: 11-16
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).

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

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

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.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IL2011/000570

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		CA 2364136 A1	14-09-2000
		EP 1158929 A1	05-12-2001
		JP 2002537943 A	12-11-2002
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		DE 69812589 T2	24-12-2003
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		JP 4026860 B2	26-12-2007
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		US 6159230 A	12-12-2000
		WO 9920335 A1	29-04-1999

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.1

Claims Nos.: 11-16

The subject-matter of claims 11-16 appears to constitute a surgical procedure on the human body, and therefore under Rule 39.1(iv) PCT (Method for treatment of the human or animal body by surgery), these claims have not been searched. For the same reason, the claims do not require preliminary examination, Rule 67.1 (iv) PCT.