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(71) Applicant: **RENALSENSE LTD.** [IL/IL]; 3 Hamarpe Street, 9777403 Jerusalem (IL).

(72) Inventors: **ADLER, Michael**; 78 Hazav Street, 2514700 Kfar Vradim (IL). **GRINSTEIN, Mor**; 15/6 Karkom Street, 7171553 Modi'in (IL). **MANTINBAND, Jack Yehoshua**; 31 Ezra Street, 9043500 Efrata (IL).

(74) Agents: **LUZZATTO & LUZZATTO** et al.; P.O. Box 5352, 8415202 Beer Sheva (IL).

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(54) Title: AN UNRAVELABLE CATHETER

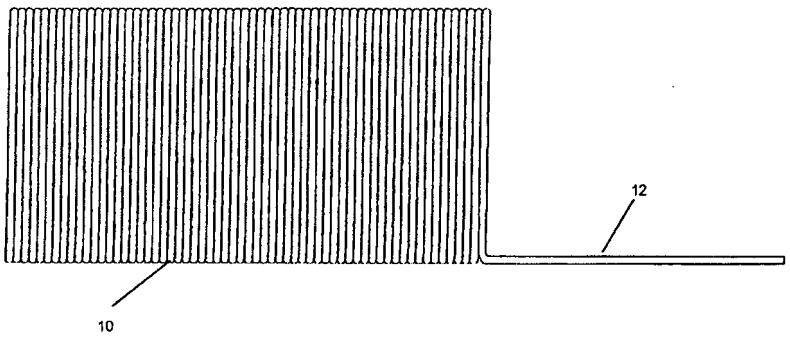


Fig. 1

(57) Abstract: The invention is a catheter, which is formed from flexible material and has two basic configurations: An initial configuration, in which the catheter is supplied to the surgeon for insertion into the lumen of a patient, resembles a tension coil spring and a final configuration, which is an essentially linear configuration that is much longer and has a considerably smaller outer diameter than when it is in its initial configuration. The catheter is adapted to undergo a transformation from the initial configuration to the final configuration as it is pulled from its proximal end in order to withdraw it from the lumen of the patient.

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# AN UNRAVELABLE CATHETER

## Field of the Invention

The present invention relates to the field of medical devices. More particularly, the present invention relates to catheters.

## Background of the Invention

Catheters are thin tubes which are widely used in medicine for a wide range of procedures. Catheters can be inserted in the body (body cavity, duct, or vessel) to treat diseases or perform surgical procedures (e.g. drainage, administration of fluids, or insertion of stents) in urological, gastrointestinal, neurovascular, ophthalmic, cardiovascular and other applications.

Insertion of a catheter is typically carried out by coating the catheter with a medical lubricating gel allowing it to be quickly and smoothly inserted with minimal pain to the patient. Since the diameter of the catheter is normally only marginally smaller than that of the lumen into which it is inserted, friction between the wall of the catheter and the tissue of the lumen frequently causes pain to the patient when the catheter is removed, even after a short period of time. For example, removal of a catheter that has been introduced into the bladder of a patient through the urethra is generally very painful to the patient. Another cause of pain to the patient is the growth of bacteria between the outer wall of the catheter and the wall of the body lumen. This bacteria forms a mucous that has adhesive properties, so that the catheter "sticks" to the wall of the body lumen, as though glued. On removal, this can cause great pain and trauma to the patient, including tearing of the lumen and bleeding.

It is therefore a purpose of the present invention to provide a catheter which after insertion, is easily removed from the body of a patient.

It is a further purpose of the present invention to provide a catheter which reduces the pain and trauma to the patient caused by the removal of the catheter.

Further purposes and advantages of this invention will appear as the description proceeds.

Summary of the Invention

The invention is an unravelable catheter, which is formed from flexible material. The unravelable catheter has two basic configurations: an initial configuration, which has a shape resembling a tension coil spring, and a final configuration, which is essentially linear. The unravelable catheter is adapted to undergo a transformation from the initial configuration to the final configuration as the catheter is pulled out of a body lumen from its proximal end.

Embodiments of the unravelable catheter of the invention are manufactured by winding a long narrow piece of biocompatible polymer around a mandrel.

Embodiments of the unravelable catheter of the invention are manufactured by molding a biocompatible polymer into the shape of a tube having a wall comprised of two parallel spirals, one having relatively thick and the other having relatively thin wall thickness.

Embodiments of the catheter of the invention comprise at least one of the following: at least one balloon and a separate lumen for inflating it, an integral temperature sensor, a coating of antibacterial gel on its outer surface, a silver or copper wire looped around part or its entire outer surface.

Embodiments of the unravelable catheter of the invention comprising at least one safety feature to prevent accidental unraveling of the catheter.

All the above and other characteristics and advantages of the invention will be further understood through the following illustrative and non-limitative description of embodiments thereof, with reference to the appended drawings.

Brief Description of the Drawings

— Fig. 1 schematically shows a catheter of the invention in its initial coiled configuration;
— Fig. 2 and Fig. 3 schematically show two intermediate stages of the unraveling of the catheter of the invention; and
— Fig. 4 schematically the final linear configuration of the catheter of the invention.

Detailed Description of Embodiments of the Invention

The invention is an unravelable catheter, which is formed from flexible material and has two basic configurations: An initial configuration, in which the catheter is supplied to the surgeon for insertion into the lumen of a patient, resembles a tension coil spring and a final configuration, which is an essentially linear configuration that is much longer and has a considerably smaller outer diameter than when it is in its initial configuration. The catheter is adapted to undergo a transformation from the initial configuration to the final configuration as it is pulled from its proximal end in order to withdraw it from the lumen of the patient.

Fig. 1 schematically illustrates an embodiment of the invention, showing the catheter in its initial coiled configuration. In an embodiment the catheter of the invention is manufactured by winding a long narrow piece of biocompatible polymer (see Fig. 4) around a mandrel. The long narrow piece

of polymer can be, for example, a thin ribbon, a cord, a string, or a small diameter tube made of, for example silicone rubber, nylon, polyurethane, or latex. The adjacent coils of material are weakly glued or welded together to maintain the catheter in its coiled configuration and also to provide a hermetic seal so that, when it is in its initial configuration, fluids can flow through the interior of the catheter after it is slid off the mandrel. In this embodiment, if the catheter is formed from a small-diameter tube, the interior of the small-diameter tube can also be used for various purposes, for example to transfer fluids, for example air or liquid to inflate an anchor balloon at the distal end of the catheter or to provide a conduit for passage of wires connected to a temperature sensor.

In another embodiment the catheter of the invention is manufactured by molding the biocompatible polymer into the shape of a tube having a wall comprising two parallel spirals, one having relatively thick and the other having relatively thin wall thickness.

In its initial configuration the catheter of the invention is similar to that of conventional catheters and can be used for any application in which a conventional catheter is used. The catheter of the invention formed by either method, i.e. winding or molding, can have all the same characteristics as a conventional prior-art catheter, including a balloon and a separate lumen for inflating it, an integral temperature sensor, coating its outer surface with antibacterial gel, looping a silver or copper wire around it to provide long-term antibacterial action, etc.

As the catheter 10 is pushed into a body lumen, e.g. the urethra, each loop is pushed against the loop that is distal to it, thereby maintaining the initial configuration of the catheter. When it is desired to remove catheter 10 from the lumen, the free proximal end of material 12 is pulled proximally by a nurse or doctor. Because of friction between the outer wall of the catheter

and the inner wall of the lumen there will be a resistance to pulling the catheter out of the lumen and the force exerted by the person removing the catheter will be great enough to break the glue or weld bonds holding the coils of the catheter together and the catheter will begin to unravel. Two intermediate stages of the unraveling of the catheter are symbolically shown in Fig. 2 and Fig. 3 and the final linear configuration is symbolically shown in Fig. 4. As the catheter unravels from its proximal end, its diameter is reduced and it "falls away" from the wall of the lumen enabling the catheter to be removed with ease and causing minimal discomfort to the patient.

Embodiments of the invention that are manufactured by molding techniques will unravel in a similar manner, wherein the material tears along the spiral line of thinnest wall thickness when pulled in a proximal direction.

Embodiments of the catheter of the invention, whether formed by winding or molding, can be provided with a safety feature to prevent accidental unraveling of the catheter. The safety feature is provided by making the bond between at least parts of at least two of the coils that are in the proximal part of the catheter that extends outside of the body lumen stronger than the bonds between the other coils. This can be accomplished either inherently, e.g. by using a stronger glue or weld or molded thickness between the coils, or by adding an extra element such as a sticker that must be released before the catheter can be unraveled. When a safety feature is used, the initial unraveling may require an extra operation, such as removing the extra element or grasping the proximal end of the catheter with two hands to break the stronger bond.

In an embodiment of the invention, a catheter of the invention is inserted into the lumen of a thin walled conventional catheter. The catheter of the invention provides strength to allow the conventional catheter to be inserted into a body lumen of a patient and also expands the thin walled

conventional catheter pushing it against the inner wall of the body lumen. When it is desired to remove the catheter from the body lumen the catheter of the invention is first removed from the conventional catheter by pulling proximally causing the catheter of the invention to unravel. When the internal support is removed, the conventional catheter collapses and can be easily withdrawn with minimal discomfort to the patient.

Although embodiments of the invention have been described by way of illustration, it will be understood that the invention may be carried out with many variations, modifications, and adaptations, without exceeding the scope of the claims.

Claims

1. An unravelable catheter, which is formed from flexible material and has two basic configurations: an initial configuration, which has a shape resembling a tension coil spring, and a final configuration, which is essentially linear; said catheter adapted to undergo a transformation from said initial configuration to said final configuration as said catheter is pulled from its proximal end.

2. The unravelable catheter of claim 1, manufactured by winding a long narrow piece of biocompatible polymer around a mandrel.

3. The unravelable catheter of claim 1, manufactured by molding a biocompatible polymer into the shape of a tube having a wall comprised of two parallel spirals, one having relatively thick and the other having relatively thin wall thickness.

4. The unravelable catheter of claim 1, comprising at least one of the following: at least one balloon and a separate lumen for inflating it, an integral temperature sensor, a coating of antibacterial gel on its outer surface, a silver or copper wire looped around part or its entire outer surface.

5. The unravelable catheter of claim 1, comprising at least one safety feature to prevent accidental unraveling of the catheter.

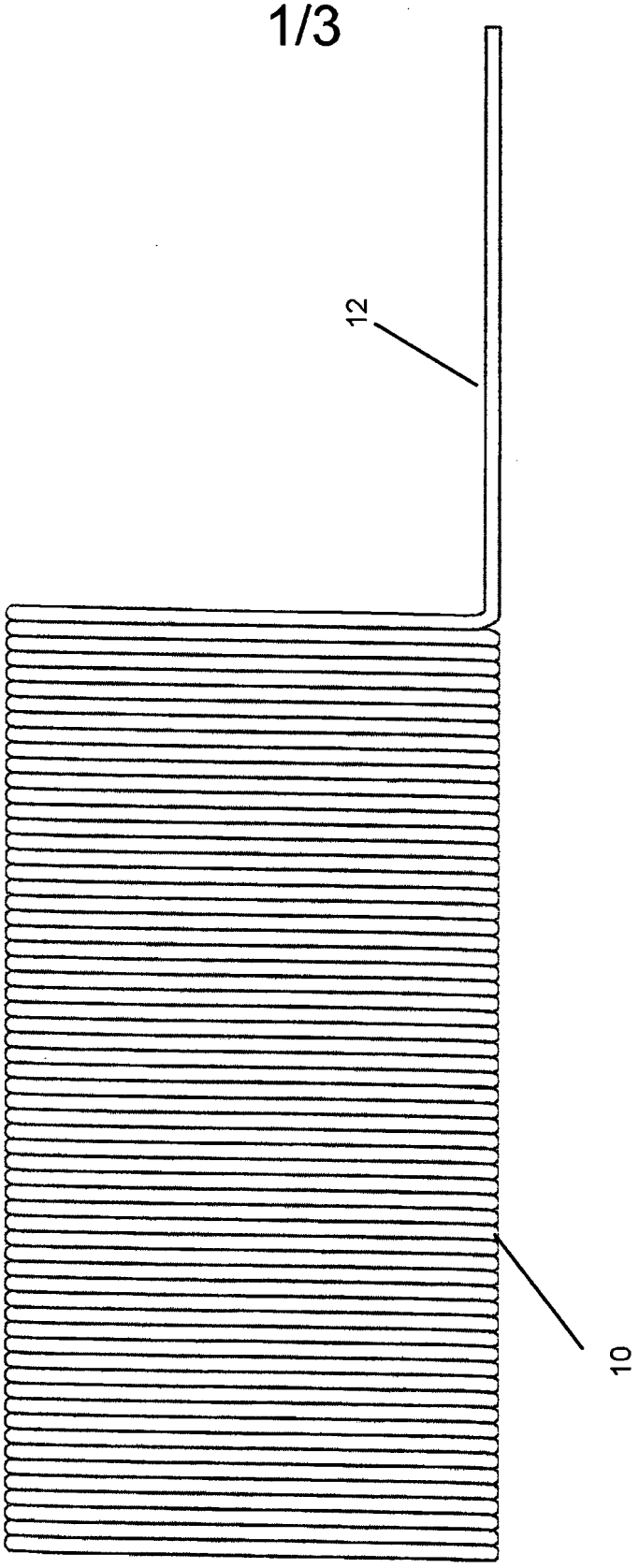


Fig. 1

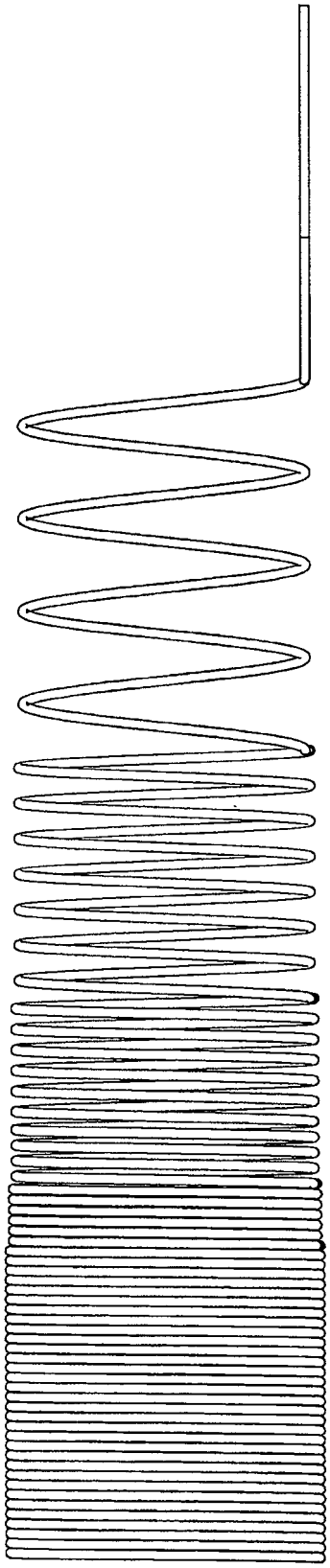

Fig. 2

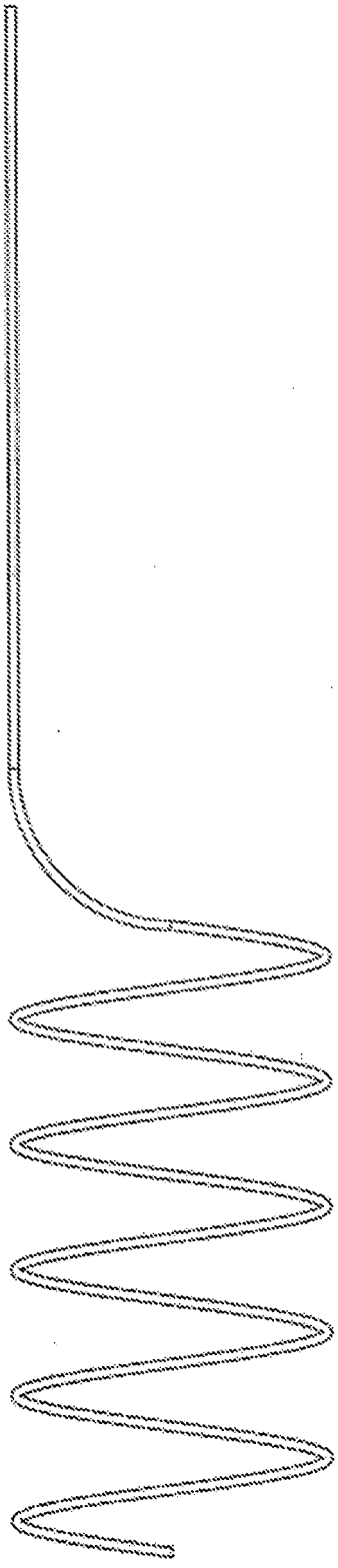

Fig. 3

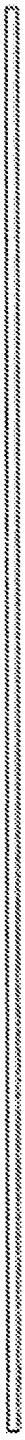

Fig. 4

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/IL2014/050645

A. CLASSIFICATION OF SUBJECT MATTER
IPC (2014.01) A61M 25/00

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)
IPC (2014.01) A61M

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)
Databases consulted: THOMSON INNOVATION, Esp@cenet, Google Patents
Search terms used: winding, winded, coil, fold, ravel, unravel, tension coil spring, helical, spiral, catheter, tube, cannula, body lumen, pull, drag, linear, straight.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
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| A | US 2005059929 A1 BOLMSJO et al.<br>17 Mar 2005 (2005/03/17)<br>* the whole document * | 1-5 |

☐ 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
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"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
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"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 30 Oct 2014 | 02 Nov 2014 |
| Name and mailing address of the ISA:<br>Israel Patent Office<br>Technology Park, Bldg.5, Malcha, Jerusalem, 9695101, Israel<br>Facsimile No. 972-2-5651616 | Authorized officer<br>COHEN Meytal<br><br>Telephone No. 972-2-5657820 |

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# AN UNRAVELABLE CATHETER

## ABSTRACT

The invention is a catheter, which is formed from flexible material and has two basic configurations: An initial configuration, in which the catheter is supplied to the surgeon for insertion into the lumen of a patient, resembles a tension coil spring and a final configuration, which is an essentially linear configuration that is much longer and has a considerably smaller outer diameter than when it is in its initial configuration. The catheter is adapted to undergo a transformation from the initial configuration to the final configuration as it is pulled from its proximal end in order to withdraw it from the lumen of the patient.

# 可拆开导管

## 摘要

本发明是一种导管，其由柔性材料形成并且具有两种基本配置：初始配置，其中向外科医生供应所述导管用于插入患者内腔，类似于拉伸螺旋弹簧；和最终配置，与在其呈其初始配置时相比，其是长得多并且具有显著更小外径的基本上线性配置。在所述导管从其近端拉动时，所述导管适于经历从所述初始配置转换到所述最终配置，以便从所述患者的所述内腔将其抽取。