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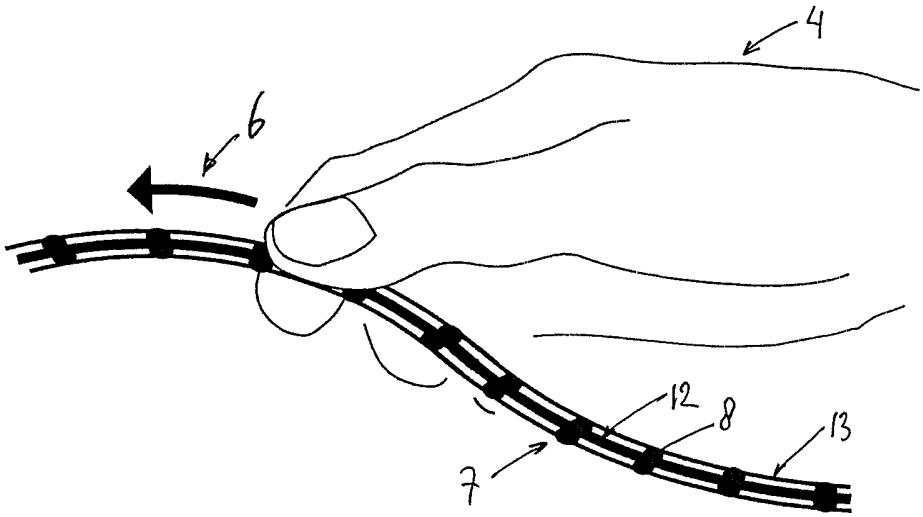
(54) **Title:** APPARATUS FOR SIMULATING A VASCULAR INTERVENTIONAL PROCEDURE



(57) **Abstract:** The invention relates to an apparatus (1) for simulating a vascular interventional procedure, comprising a wire-like element (7) representing an instrument to be inserted into a vascular tree, which wire-like element can be received in a holder (3), and wherein a sensor (12, 13) is provided for locating a position of the wire-like element, wherein the sensor is an electronic sensor incorporated in the wire-like element and the electronic sensor is touch-sensitive.

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Apparatus for simulating a vascular interventional procedure

The invention relates to an apparatus for simulating a vascular interventional procedure, comprising a wire-like element representing an instrument to be inserted into a vascular tree, which wire-like element can be received in a holder, and wherein a sensor is provided for locating a position of the wire-like element.

Such an apparatus is known from the international patent application WO 02/071369 and is used for training vascular interventionists.

In the known apparatus, the sensor for locating the position of the wire-like element is embodied as a magnetically sensitive organ comprising a first portion forming part of the wire-like element, and a second portion that is received in the holder for the wire-like element. The apparatus is further embodied such that the same is capable of determining a longitudinal position of the wire-like element as well as a rotational position of the wire-like element. The holder further possesses a drive to provide the known apparatus with a power feedback which, depending on the position given to the wire-like element, allows the user to feel a resisting force.

A drawback of the known apparatus is its complex construction and its relatively large number of components, while it is not proven that the provision of the power feedback leads to better training results. The known apparatus is directed at the simulation of a rigid wire-like element.

An apparatus of the kind mentioned in the preamble of similar complexity and comprising many components, is known from the international patent application WO 2005/090921. This apparatus is concerned with the determination of a longitudinal and a rotational position of a wire-like flexible element. To this end, an optical recorder is used that works together with a bead coupled with the wire-like element by magnetic means.

From the international patent application WO 2005/096249 an apparatus is known for the simulation of a vascular intervention, comprising a catheter and a needle movable

through the catheter, as well as a sensor for obtaining data indicating the position of the needle.

The object of the invention is to provide an alternative apparatus, with which the training of a vascular interventional procedure provides at least equally good results, while the costs of the apparatus can be kept relatively low. A further object is to be able to use the apparatus for the simulation of a flexible wire-like element.

To this end the apparatus according to the invention is characterized by one or several of the appended claims.

In a first aspect of the invention the apparatus is characterized in that the sensor is an electronic sensor incorporated in the wire-like element, with the electronic sensor being touch-sensitive. This makes it possible to generate a signal, which signal depends on where the sensor is being touched, and with which the simulation of the vascular interventional procedure is performed. Furthermore, the construction may be embodied to be very compact with the costs of the construction being low, while the apparatus provided is nevertheless robust and reliable. This will be further clarified in the following discussion.

It is noted that from the American patent application US 2003/0091967 an apparatus for the simulation of urological endoscopy is known, which apparatus comprises a wire-like element that is guided through a simulated urological organ system and wherein a sensor is provided for locating a position of the wire-like element. The apparatus known from this publication is, however, not suitable for the simulation of a vascular interventional procedure, nor is the sensor embodied as an electronic sensor that is touch-sensitive.

The apparatus is suitably embodied such that the wire-like element is an electrically conductive wire, around which a hollow sleeve is provided. This embodiment admits several possibilities for a practical realization.

A first preferred embodiment in which the apparatus may be realized is characterized in that the electrically conductive wire is live, and that when touching the element, an electrical contact can be made between the hollow sleeve and the electrically conductive wire, with the voltage imparted on the hollow sleeve depending on the position of touch. This em-

bodiment can be embodied very reliably and failure-resistant by applying principles well-known in electrotechnical engineering. Alternatively the hollow sleeve may be live and a voltage, which depends on the position of touch, may be imparted on the electrically conductive wire.

A second preferred embodiment of the apparatus is characterized in that the electrically conductive wire and the hollow sleeve form a measuring capacity whose value depends on a position at which the hollow sleeve is being touched. This embodiment may be similarly optimally realized by using the principles well-known in electrotechnical engineering.

The simulation can be designed simply and effectively, especially on the basis of the two preferred embodiments of the apparatus according to the invention mentioned above.

To this end it is further desirable for the electrical sensor to be connected to a converter for the conversion of an analogue electrical signal from the sensor into a digital signal that is usable for processing in a computer.

The converter is preferably connected with, or in an alternative embodiment may be part of a computer which, depending on sensor signals forms one or several images for display on a monitor connected with the computer, with which the training of the interventionist can be put into practice.

Hereinafter the invention will be further elucidated by way of an exemplary embodiment that does not limit the appended claims and with reference to the drawing.

The drawing shows in

Figure 1 a schematic presentation of an apparatus ready to be used for simulation of a vascular interventional procedure;

Figure 2 a detail of the wire-like element used with the apparatus shown in Figure 1; and

Figures 3a and 3b a further detail of the wire-like element of the apparatus shown in Figure 1.

Identical reference numerals in the figures refer to similar components.

Figure 1 shows a fully equipped apparatus 1 ready to be used for the simulation of a vascular interventional procedure.

This apparatus 1 comprises a wire-like element 7 to be operated by an interventionist 2 undergoing a training which wire-like element represents a surgical instrument to be inserted into a vascular tree of a patient. This surgical instrument is, for example, a catheter or a guide wire. At a side facing away from the interventionist 2, the wire-like element 7 is received in a holder 3, and may be relatively short.

The interventionist 2 operates the wire-like element 7 in a manner corresponding with that of feeding through a catheter or a guide wire. To this end the interventionist 2 operates the outside of the wire-like element 7 using one hand, whereby the wire-like element 7 is being touched and simultaneously a pushing-through movement is carried out.

The apparatus 1 according to the invention is based on the understanding that the simulation of these vascular interventional procedures can be carried out by accurately registering at which position the interventionist 2 touches the wire-like element 7 and, in accordance therewith, feed back information to the interventionist 2. In order to register this touch position, the sensor to be further elucidated hereinafter, is incorporated in the wire-like element 7, and embodied as electronic sensor.

The above explained movement carried out by the interventionist 2 with his hand 4 on the wire-like element 7 is represented by arrow 6, shown in Figure 2.

Figure 3b shows that the wire-like element 7 comprises an electrically conductive internal wire 12 surrounded with a hollow sleeve 13.

The wire-like element 7 shown in Figure 3b may be embodied in several ways.

In a first preferred embodiment, the electrically conductive internal wire 12 of the wire-like element 7 is live and, when the hollow sleeve 13 is being touched, electrical contact can be made between the electrically conductive wire 12 and the hollow sleeve 13.

Figure 3a shows that such electrical contact between the electrically conductive wire 12 and the hollow sleeve 13 is made by touching the hollow sleeve 13 with a finger 14. The wire-like element 7 must then be embodied such that the volt-

age imparted on the hollow sleeve 13 depends on the touch position of the finger 14.

A second preferred embodiment of the wire-like element 7 shown in Figure 3b is characterized in that the electrically conductive wire 12 and the hollow sleeve 13 form a measuring capacity whose value depends on the position at which the hand 4 or the finger 14 of the interventionist 2 touches the hollow sleeve 13.

In both embodiments elucidated above by way of the Figures 3a and 3b, a number of spacer rings are provided between the electrically conductive wire 12 and the hollow sleeve 13 to prevent short-circuiting between the conductive wire 12 and the hollow sleeve 13.

With further reference to Figure 1, the sensor received in the wire-like element 7 is shown to be connected with a converter 3 for the conversion of an analogue electrical signal from the sensor into a digital signal, which can be fed through via a signal line 9 for processing in a computer 5.

Although Figure 1 shows that the converter 11 is incorporated in the holder 3, the converter 11 may in another conceivable embodiment be part of the computer 5, so that the conversion into a digital signal takes place in the computer 5. In that case the signal line 9 is an analogue signal line.

The computer 5 is capable of forming images in accordance with signals from the sensor incorporated in the wire-like element 7, which are displayed on a monitor 10 to be connected with the computer 5. These images may, for example, be interventional images.

The apparatus according to the invention provides, at very low costs, a suitable and reliable instrument for training in interventional procedure techniques, more specifically for positioning catheters in a vascular tree.

CLAIMS

1. An apparatus (1) for simulating a vascular interventional procedure, comprising a wire-like element (7) representing an instrument to be inserted into a vascular tree, which wire-like element (7) can be received in a holder (3), and wherein a sensor is provided for locating a position of the wire-like element, **characterised** in that the sensor is an electronic sensor incorporated in the wire-like element, with the electronic sensor being touch-sensitive.

2. An apparatus according to claim 1, **characterised** in that the wire-like element (7) is an electrically conductive wire (12), around which a hollow sleeve (13) is provided.

3. An apparatus according to claim 2, **characterised** in that the electrically conductive wire (12) is live, and that when touching the element (7), an electrical contact can be made between the hollow sleeve (13) and the electrically conductive wire (12), with the voltage imparted on the hollow sleeve (13) depending on the position of touch.

4. An apparatus according to claim 2, **characterised** in that the electrically conductive wire (12) and the hollow sleeve (13) form a measuring capacity whose value depends on a position at which the hollow sleeve (13) is being touched.

5. An apparatus according to one of the claims 1-4, **characterised** in that the electrical sensor to be connected to a converter (11) for the conversion of an analogue electrical signal from the sensor into a digital signal that is usable for processing in a computer (5).

6. An apparatus according to claim 5, **characterised** in that the converter (11) is connected with, or is part of a computer which, depending on sensor signals forms one or several images for display on a monitor (10) connected with the computer.

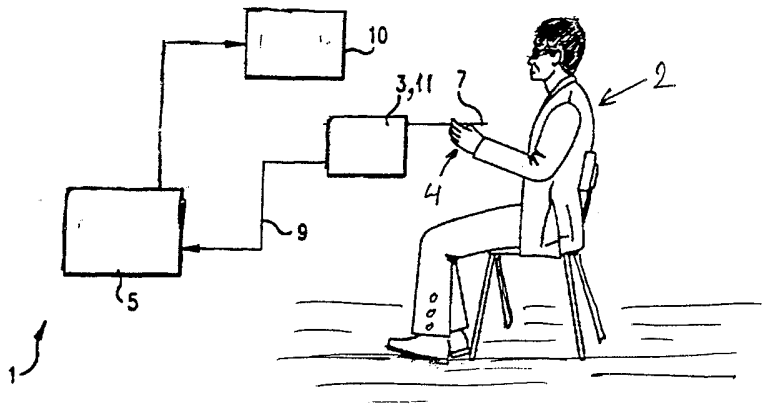

FIG. 1

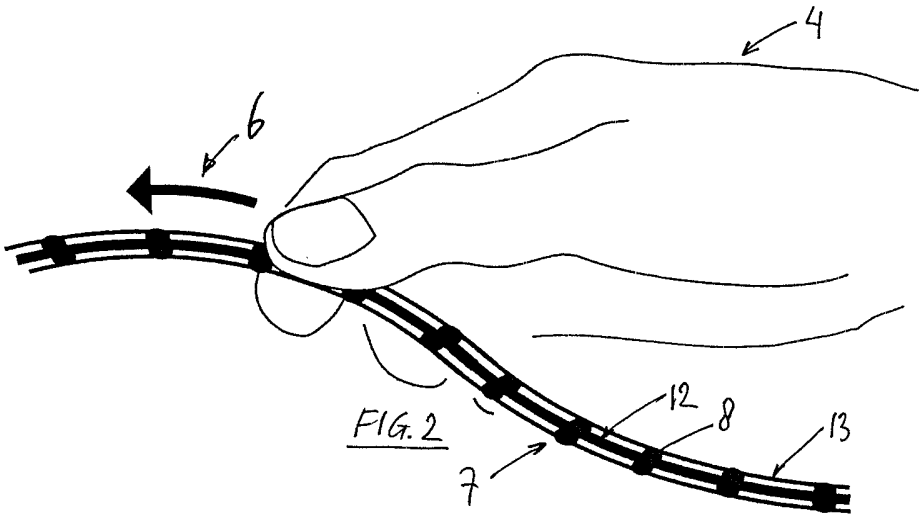

FIG. 2

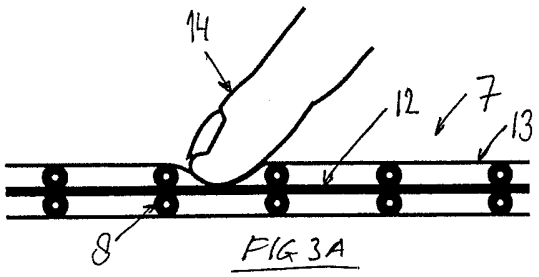

FIG 3A

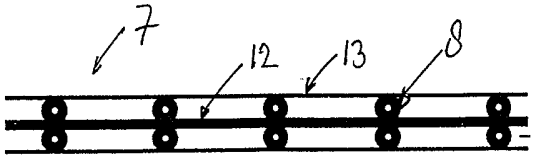

FIG 3B

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2007/050415

A. CLASSIFICATION OF SUBJECT MATTER
INV. G09B23/28

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)
G09B

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, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2005/096249 A (LAERDAL MEDICAL CORP [US]; FEYGIN DAVID [US]; HO CHIH-HAO [US]) 13 October 2005 (2005-10-13) cited in the application figures 4a,4b,5 paragraphs [0068] - [0071]	1-6
A	US 2003/091967 A1 (CHOSACK EDNA [US] ET AL) 15 May 2003 (2003-05-15) cited in the application abstract paragraphs [0085], [0119], [0124]	1-6
A	WO 02/071369 A (XITACT S A [CH]; VUILLEMIN RONALD [CH]) 12 September 2002 (2002-09-12) cited in the application the whole document	1-6

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[X] Further documents are listed in the continuation of Box C.

[X] 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

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"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

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"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
7 January 2008	14/01/2008

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No
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C(Continuation). 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 5 847 639 A (YANIGER STUART I [US]) 8 December 1998 (1998-12-08) abstract figures 3a,3b	1-3
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/NL2007/050415

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