



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<p>(21) International Application Number: PCT/NL97/00389</p> <p>(22) International Filing Date: 7 July 1997 (07.07.97)</p> <p>(30) Priority Data: 1003543 8 July 1996 (08.07.96) NL</p> <p>(71) Applicant (for all designated States except US): B.V. OPTISCHE INDUSTRIE "DE OUDE DELFT" [NL/NL]; Postbus 72, NL-2600 MD Delft (NL).</p> <p>(72) Inventors; and (75) Inventors/Applicants (for US only): LÖFFLER, Edgar, German [DE/DE]; Bresserbergstrasse 72, D-47533 Kleve (DE). VISSCHER, Arie, Luite [NL/NL]; W. Banninglaan 33, NL-3972 SJ Driebergen (NL).</p> <p>(74) Agent: VAN DER BURG, Louis; B.V. Optische Industrie "De Oude Delft", Postbus 72, NL-2600 MD Delft (NL).</p>		<p>(81) Designated States: CN, JP, US, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).</p> <p><b>Published</b> <i>With international search report.</i> <i>In English translation (filed in Dutch).</i></p>
<p>(54) Title: CAPSULE FOR USE IN BRACHYTHERAPY AND A COMBINATION OF A CAPSULE FOR BRACHYTHERAPY AND A GUIDEWIRE</p>		
<p>(57) Abstract</p> <p>A capsule for taking up at least one radioactive source for application in brachytherapy and to be connected to a guidewire, the capsule having a cylindrical mantle that can be closed on the proximal end by means of a coupling element, and the capsule having a rounded top section at its distal end, the mantle and the inner surface of the top section defining a substantially straight circular-cylindrical cavity, in which the operation at least one radioactive source is placed, the inner surface of the top section, at least in a peripheral area thereof, being curved in distal direction and the cavity continuing somewhat in the top section, and the end of that least one radioactive source, which is located near the inner surface of the top section, is finished in a complementary curved fashion.</p>		

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CAPSULE FOR USE IN BRACHYTHERAPY AND A COMBINATION OF A CAPSULE FOR BRACHYTHERAPY AND A GUIDEWIRE

The invention relates to a capsule for taking up  
5 at least one radioactive source for application in  
brachytherapy and to be connected to a guidewire, the  
capsule having a cylindrical mantle that can be closed on  
the proximal end by means of a coupling element, and the  
capsule having a rounded top section at its distal end, and  
10 the mantle and the inner surface of the top section  
defining a substantially straight circular-cylindrical  
cavity, in which in operation at least one radioactive  
source is placed.

The invention also relates to a combination of a guidewire  
15 and such a capsule.

Such a combination is known in practice and  
described, for instance, in U.S. patent no. 4,861,520,  
which is herewith incorporated by reference.

For local radioactive radiation treatment of a  
20 specific internal area of the human body, such as a tumor,  
or a wall section of a blood vessel, it is possible, as  
described in U.S. patent no. 4,861,520, to deliver a  
capsule with a radioactive source, via a tubular guiding  
device, such as, for instance, a hollow needle, a flexible  
25 tube or a catheter or the like, to the area to be treated.  
For this purpose, normally the so-called "after loading"  
technique is employed. First, the catheter or the like is  
placed in the body and then the capsule attached to the  
distal end of a guidewire is delivered with the help of a  
30 remotely controlled device to the treatment area.

In order to deliver the capsule to the area to be  
treated in a reliable and safe manner via the tubular  
guiding device, even when the tubular guiding device is  
forming sharp curves, the capsule should be as short as  
35 possible and its front have a smooth shape without sharp

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transitions.

In the combination known from U.S. patent no. 4,861,520, the capsule has at the front, that is to say the end facing away from the guidewire, a closed, almost semi-spherical solid end that forms a whole together with the cylindrical mantle of the capsule forms a whole. At the end facing the guidewire, the connection between the capsule and the guidewire is formed by a connecting device (coupling element), partly extending in the cylindrical mantle and connected through welding to the distal end of the guidewire and the cylindrical mantle. This makes possible a considerably shorter capsule with regard to the prior art, according to which the cylindrical mantle was provided at the front with a solid plug extending partly in the cylindrical mantle with a semi-spherical end. The obtained length advantage was on the order of 25% with the application of seven miniature radioactive source elements. With a capsule with an original length of 7.2 mm and a diameter of 1.1 mm, a length reduction to a length of 5.5 mm was realized.

A problem with the known combination is that the wall thickness of the capsule in front at the place of the semispherical end is greater than that at the place of the cylindrical mantle. Thus, the capsule is still longer than necessary. Moreover, the greater wall thickness in the distal end of the capsule disturbs the radiation pattern, since, viewed from the source, more radiation is absorbed in the axial direction than in the radial direction.

The invention intends to remove the outlined problem and in general make available an improved capsule for brachytherapy. For this purpose, according to the invention, a capsule with the described type is characterized in that the inner surface of the top section, at least in a peripheral area there of, is curved in distal direction, and in that the cavity continues somewhat in the top section, and that the end of the at least one radioactive source, which is located near the inner surface

of the top section, is finished in a complementary curved fashion.

The invention will be described in more detail in the following, with reference to the attached drawing.

5           Figure 1 shows schematically a longitudinally cross-sectional diagram of an example of a guidewire with a capsule provided with a radiation source according to the prior art; and

10           Figure 2 shows schematically a longitudinally cross-sectional diagram of an example of a combination of a guidewire (partially shown) and a capsule with a radiation source according to the invention.

15           Figure 1 shows a cross-sectional diagram of an example of a guidewire 1 that is provided at its distal end with a capsule 2 for one or more radiation sources 3. The proximal end of the guidewire is provided with coupling means 4 or the like, in order to operate the guidewire. The capsule is closed at its distal end and has there a semi-spherical top section 5. From the top section 5, a cylindrical mantle 6 extends backward. The proximal end of the mantle is sealed with a solid coupling element 7 that has a part 8 extending in the mantle, with a reduced diameter, and a part 9, located in the extension of the mantle, having a diameter essentially the same as the  
20           mantle. The coupling element 7 is connected preferably through welding, for instance, laser welding, with both the guidewire 1 and the mantle 6. Such welds are indicated schematically at 10 and 11. The capsule 2 has in longitudinal cross-section an elongate rectangular cavity  
25           bounded the top section by the mantle, the coupling element and the inner surface of the top section in which one or more radiation sources may be placed. In the example shown, a single rod-shaped radiation source, for example a small Iridium rod, is applied having also a rectangular shape.

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Figure 1 clearly shows that the semi-spherical top section of the capsule forms a much thicker wall section

than the mantle. Thus, viewed from the source, radiation emitted in the axial direction is absorbed to a higher degree than radiation emitted in the radial direction so that near the front end of the capsule, an irregular radiation pattern occurs.

Figure 2 again shows an example of a combination according to the invention. Figure 2 again shows a capsule 20 for incorporating one or more radiation sources 21 for brachytherapy. As an example, it is shown that the capsule may be connected, if desired, although not necessary, via a short thin cable or thread 22 with the guidewire 1, which normally and substantially has the same diameter as the capsule. The coupling element 23 has a shape adapted thereto. A combination with a thin cable or thread between the capsule and the guidewire is described in the related Dutch patent application No. 1003528.

The capsule 20 in Figure 2 differs from the capsule shown in Figure 1 in that the end surface 24 of the cavity in the capsule, i.e., the inner surface of the top section, has, at least in the area along the periphery of the end surface, a certain curvature, which viewed from the cavity extends outward to the top. Thus, the distance "d" between the top of the capsule and the center of the end surface is considerably less than is the case with the known capsule. By implementing the rod-shaped radiation source 21, or in the case of several radiation sources, the front radiation source, with an adapted convex end surface, the distance between the front end of the capsule and the radiation center of gravity 25 may be reduced, as well.

A further improvement is possible by flattening the top section of the capsule somewhat.

A combination with a capsule according to the invention therefore provides an improved radiation pattern and, moreover, makes a shorter capsule possible.

It should be noted that according to the abovementioned, various modifications are obvious to a person skilled in the art. For instance, the at least one

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radiation source may be curved at the other end in a corresponding manner. This especially provides an advantage if a single rod-shaped source is applied.

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## CLAIMS

1. A capsule for taking up at least one radioactive source for application in brachytherapy and to be connected to a guidewire, the capsule having a cylindrical mantle that can be closed on the proximal end by means of a coupling element and the capsule having a rounded top section at its distal end, and the mantle and the inner surface of the topsection defining a substantially straight circular-cylindrical cavity, in which in operation at least one radioactive source is placed, characterized in that the inner surface of the top section at least in an peripheral area thereof is curved in distal direction and in that the cavity continues somewhat in the top section, and in that the end of the at least one radioactive source which is located near the inner surface of the top section is finished in a complementary curved fashion.
2. A capsule according to Claim 1, characterized in that the top of the capsule is somewhat flattened on the outside.
3. A combination of a guidewire with a capsule according to Claims 1 or 2.
4. A combination according to Claim 3, characterized in that, between the capsule and the guidewire, a relatively short thread or cable with reduced diameter is placed.
5. A combination according to Claims 3 or 4, characterized in that a single rod-shaped radiation source having a curved a shape at both ends is applied.

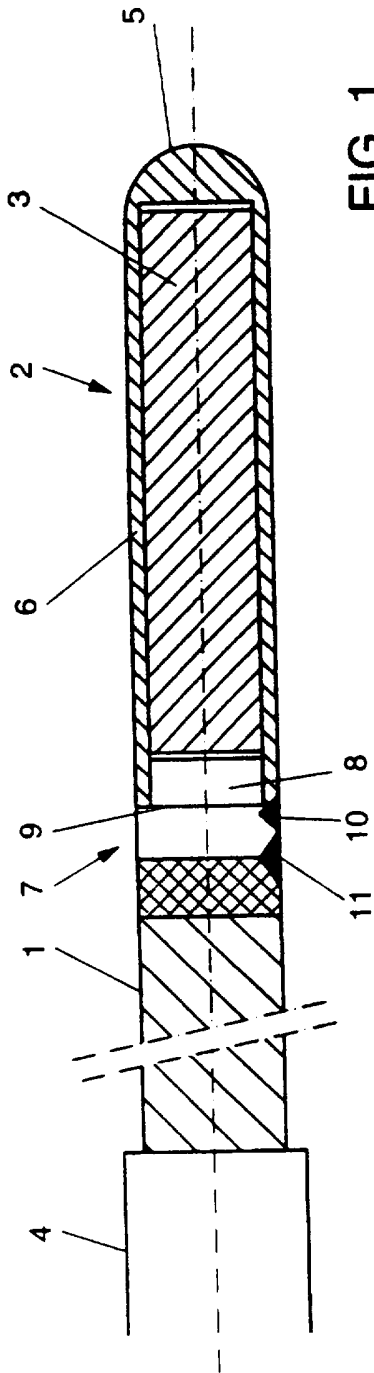


FIG. 1

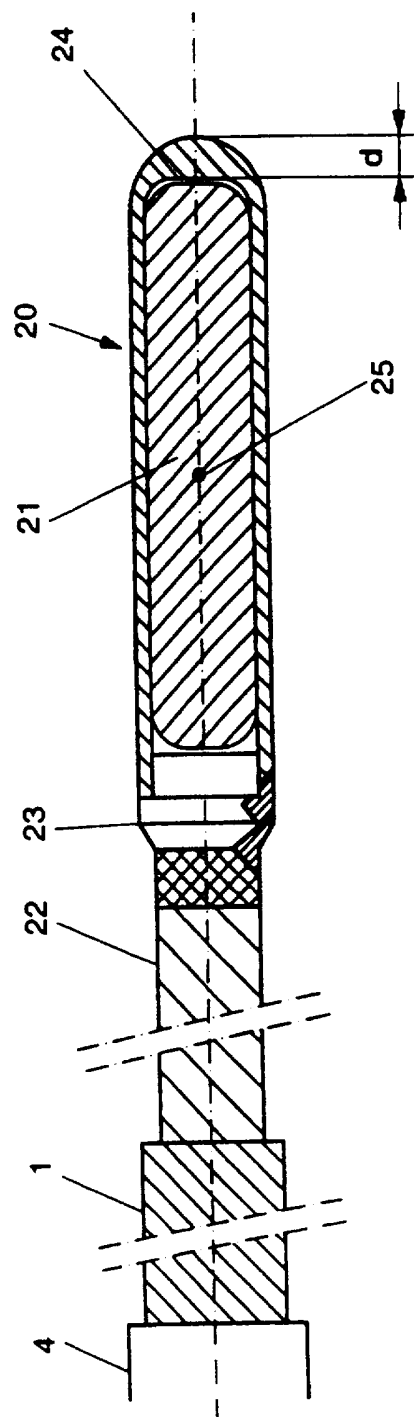


FIG. 2

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/NL 97/00389

**A. CLASSIFICATION OF SUBJECT MATTER**  
 IPC 6 A61N5/10

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 6 A61N

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)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 037 678 A (MINNESOTA MINING) 14 October 1981 see figure 1 ---	1
A	WO 90 01208 A (BEST INDUSTRIES) 8 February 1990 see page 6 ---	1
A	US 4 861 520 A (VAN'T HOOFT) 29 August 1989 cited in the application see abstract -----	1

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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1 October 1997

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/NL 97/00389

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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