

(19) World Intellectual Property Organization
International Bureau



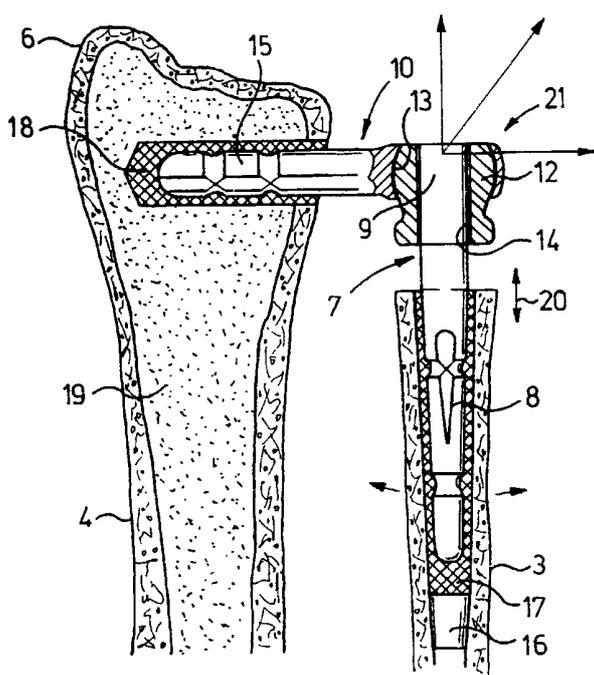
(43) International Publication Date
11 January 2001 (11.01.2001)

PCT

(10) International Publication Number
WO 01/01892 A1

- (51) International Patent Classification⁷: A61F 2/42
- (21) International Application Number: PCT/NL00/00463
- (22) International Filing Date: 3 July 2000 (03.07.2000)
- (25) Filing Language: Dutch
- (26) Publication Language: English
- (30) Priority Data:
1012491 2 July 1999 (02.07.1999) NL
- (71) Applicant (for all designated States except US): VAN STRATEN RESEARCH & DEVELOPMENT B.V. [NL/NL]; P.O. Box 440, NL-3440 AK Nieuwegein (NL).
- (71) Applicant and
(72) Inventor: SCHUURMAN, Arnold, Herman [NL/NL]; Meerkoetlaan 11, NL-3645 JJ Vinkeveen (NL).
- (74) Agent: JORRITSMA, Ruurd; Nederlandsch Octrooibureau, Scheveningseweg 82, P.O. Box 29720, NL-2502 LS The Hague (NL).
- (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
- (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
- Published:**
— With international search report.
— Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: DISTAL RADIOULNAR JOINT PROSTHESIS



(57) Abstract: The invention relates to a distal radioulnar joint prosthesis comprising: a support (10), a ball joint (11) and an ulna shaft (7). The one end (9) of the ulna shaft (7) and the support (10) can be joined via the ball joint (11) in a manner which allows them to hinge relative to one another. The other end (8) of the ulna shaft (7) is intended to be attached to the distal end of the ulna (3). The support (10) is intended to be attached to the side of the distal radius (6). The ball (12) of the ball joint (11) is provided with a recess in which the one end (9) of the ulna shaft (7) can be accommodated such that it is slidable in the longitudinal direction (20) thereof. Preferably the recess (14) extends through the entire ball (12) of the ball joint (11) in the form of a passage (14). With this arrangement the ulna shaft (7) can then be so constructed that it can be inserted completely through the passage (14) from one side.

WO 01/01892 A1

Distal radioulnar joint prosthesis

The invention relates to a distal radioulnar joint prosthesis (abbreviated as DRU joint prosthesis), comprising:

- 5 - a support;
- a ball joint; and
- an ulna shaft,

the one end of the ulna shaft and the support being joinable via the ball joint in a manner which allows them to hinge relative to one another. With this arrangement the other end of
10 the ulna shaft will be intended to be attached to the distal end of the ulna and the support will be intended to be attached to the distal part of the radius.

A distal radioulnar joint prosthesis of this type is disclosed in the publication entitled "An Original Prosthesis of the Distal Radioulnar Joint" by Adalbert I. Kapandji (copy enclosed when filing this application). This publication shows a distal radioulnar joint
15 prosthesis on page 330 in Figure 12. In order to fix this distal radioulnar joint prosthesis the distal ulna is removed and replaced by a prosthesis. The prosthesis comprises a support component that is screwed tightly to the side edge of the distal ulna. The ball of the ball joint is immovably integrated with this support. The prosthesis further consists of an ulna shaft, one end of which is inserted in the longitudinal direction into the ulna in order for the other
20 end to bear on the latter. The ulna shaft inserted into the ulna is then fixed to the ulna by screwing. The socket of the ball joint is immovably integrated with the other end of the ulna shaft. In the implanted position, the socket and the ball engage in one another in order to permit rotation in three orthogonal directions. This DRU prosthesis from the article by Kapandji thus consists of two rigid components which, in turn, are rigidly fixed to, on the one
25 hand, the distal radius and, on the other hand, the distal end of the ulna. In particular, shortening of the ulna is not possible. Lengthening of the ulna is at most possible if ball and socket are able to move apart, which, however, is at least associated with the risk of the ball permanently popping out of the socket.

In the natural position without a prosthesis the distal end of the ulna and the distal end
30 of the radius are not rigidly coupled to one another. These ends are essentially located more or less separately alongside one another and the distal end of the smaller ulna is kept in place relative to the distal end of the radius by the triangular fibrocartilaginous complex. On moving the wrist and the hand the ulna and radius are thus able to execute fairly complex

movements or, in other words, in the natural position ulna and radius have a high freedom of movement relative to one another. The ulna and radius can move relative to one another in the longitudinal direction. The ulna and radius can turn relative to one another, for example in the sense that the ulna and radius which in the initial position run parallel to one another come into a position in which they cross one another or in the sense that the ulna rotates about its longitudinal axis. The types of movement which the ulna and radius, in particular at the distal ends thereof, are able to undergo are known per se to those skilled in the art. In the case of the DRU joint prosthesis disclosed in the article by Kapandji the freedom of movement is appreciably restricted, in particular as a consequence of the mutually rigid fixing of the distal ends of ulna and radius.

The aim in the case of the so-called "Swanson ulnar head prosthesis" is to keep the freedom of movement of ulna and radius intact as far as possible by replacing the distal ulnar head by an ulnar head prosthesis and holding this, as it were, alongside the distal radius by means of an artificial fitted band. The relative movement of ulna and radius in the longitudinal direction can be maintained in this way. However, this Swanson ulnar head prosthesis again has the disadvantage that it is made of silicone and thus disintegrates in the course of time. Moreover, the DRU joint has no stability.

The aim of the present invention is to provide a distal radioulnar joint prosthesis (DRU joint prosthesis) with which, on the one hand, the freedom of movement of the distal end of the ulna relative to the distal radius is kept intact as far as possible and with which, on the other hand, the distal end of the ulna and the distal end of the radius are mechanically fixed to one another.

This aim is achieved according to the invention with a distal radioulnar joint prosthesis of the type mentioned in the preamble, in that the ball of the ball joint is provided with a recess in which the one end of the ulna shaft can be accommodated such that it is slidable in the longitudinal direction thereof. The ball joint of the DRU joint prosthesis according to the invention thus has a translational freedom in the longitudinal direction of the ulna in addition to the rotational freedom in three orthogonal directions. In other respects the distal end of the radius and the ulna are mechanically fixed to one another, in particular in the lateral direction. In particular the translational freedom in the longitudinal direction of the ulna increases the freedom of movement of the wrist and the hand, so that the impedance on the freedom of movement as a consequence of the DRU joint prosthesis is appreciably, if not completely, eliminated.

In order to counteract lateral movement of the end of the ulna shaft accommodated in the recess, and thus wearing away of the recess and/or wear of the end of the ulna shaft accommodated in the recess, it is advantageous according to the invention if the one end of the ulna shaft can be accommodated transversely to the longitudinal direction thereof such that it fits in the recess. More or less uncontrolled lateral movement of the ulna shaft in the recess and wear caused as a result are then prevented. In order to make it possible for the ulna to make a translational movement relative to the radius without in so doing exerting a moment on the ball joint, it is advantageous according to the invention if the recess has a longitudinal axis which extends through the centre of the ball joint.

10 According to the invention it is particularly advantageous if the recess is a passage extending through the entire ball of the ball joint. This counteracts formation of a cavity in the ball joint, the volume of which cavity increases or decreases on translation of the ulna relative to the radius. Especially in the case of decrease in the volume, this would impede the translation of the ulna, since material present in this volume then has to be driven out.

15 Fitting, or to put it more accurately implantation, of the DRU joint prosthesis according to the invention can be appreciably facilitated if the recess is a passage extending through the entire ball of the ball joint and if the cross-section of the passage and of the ulna shaft are made such that the other end of the ulna shaft can be inserted in the passage and can then be inserted through the passage until the one end is in the passage. Thus, during implantation, after the support has been attached to the distal radius head the ulna shaft can first be inserted from the hand side of the support by its other end (which is intended to be accommodated in the ulna) into and through the passage until the one end (which is intended to be accommodated in the passage through the ball joint) is in the passage.

20 So that the ball of the ball joint can not pop out of the socket it is advantageous according to the invention if the ball is enclosed in the socket of the ball joint.

25 According to a further advantageous embodiment the other end of the ulna shaft will have been constructed such that it can be accommodated in the marrow cavity of the ulna and can be cemented therein, preferably using so-called bone cement, or can become fixed therein by in-growth by providing the other end of the ulna with a suitable coating, such as a hydroxyapatite coating.

30 According to a further advantageous embodiment of the invention the support will have been provided with a pin for cementing into the distal radius.

The present invention will now be explained in more detail below with reference to the

drawings. In the drawings:

Figure 1 shows, diagrammatically, a plan view, partially in section, of a hand and wrist, showing the natural position of the distal radioulnar joint;

Figure 2 shows, diagrammatically, partially in plan view and partially in section, the fitting or implantation of the DRU joint according to the invention;

Figure 3 shows, diagrammatically, the DRU joint according to the invention in the implanted position, the freedoms of movement of the DRU joint prosthesis according to the invention also being indicated.

To define the concept, Figure 1 shows a hand 1, a wrist 2 and part of a lower arm, in which the distal end of the ulna 3 and the distal end of the radius 4 have been drawn. The distal ulnar head is indicated by 5 and the distal radius by 6. In the natural position the distal ulnar head 5 and distal radius 6 are located as it were alongside one another and are held in this position with respect to one another by the tissue, in particular relatively soft tissue. The distal ulnar head 5 and distal radius 6 are thus not mechanically fixed to one another.

There are a wide variety of reasons which can make it necessary to replace the ulnar head 5 by a so-called DRU prosthesis. The distal ulnar head 5 can have come into the incorrect position as a consequence of a fracture, can have been impaired as a consequence of disease, for example rheumatism, can display a congenital abnormality or can have been impaired or display an abnormality as a result of surgery or trauma. These, but also many other causes, such as, for example, irritation as a consequence of pressure exerted on the bones of the hand by the distal ulnar head, can give rise to implantation of a DRU prosthesis.

Figures 2 and 3 show, diagrammatically, a DRU joint prosthesis according to the invention, Figure 2 as it were illustrating the method of fitting and Figure 3 showing the fitted position.

The DRU joint prosthesis according to the invention consists of a support 10 which can be fixed laterally to the radius 6. This fixing could be effected by screwing the support 10 by means of a location onto the outside of the radius head (not shown). In the embodiment shown support 10 is, however, fixed to the radius 6 by making a hole in the latter, which hole is filled with bone cement 18 and into which hole a pin formed on the support 10 is inserted. Such a bone cement 18 sets relatively quickly, for example by means of polymerisation. For fixing the support 10 to the radius 6 it suffices merely to hold the support 10 still during polymerisation.

The support 10 is furthermore provided with a socket 13 in which a ball 12 is

accommodated. As can be seen from Figure 3, this ball 12 is enclosed in the socket 13 so that the ball 12 is not able to detach from the socket 13 or to pop out of the latter. As is shown in Figure 3 by means of three orthogonal, double-headed arrows, the ball 12 of the ball joint 11 has three orthogonal freedoms of rotation.

5 As should be clear from Figures 2 and 3, the ball 12 is provided with a passage 14 extending from the one side to the other side, the middle of which passage 14 along the axis intersects the centre of the ball 12.

The DRU joint prosthesis according to the invention further comprises an ulna shaft 7, which has a so-called one end 9, hereinafter termed hinge end 9, and a so-called other end 8, hereinafter termed ulna end 8. The ulna end 8 is intended to be accommodated in the distal end of the ulna 3, as is shown in Figure 3. The hinge end 9 is intended to be accommodated in the passage 14 in the ball 12. The ulna end 8 is of reduced cross-section compared with the cross-section of the passage 14, so that the ulna shaft 7 can easily be inserted in accordance with arrow 18 (Figure 2) from the hand side through the passage 14 until the hinge end 9 is located in the passage 14 (Figure 3). As will be clear to a person skilled in the art, this appreciably facilitates fitting of the ulna shaft 7 in its correct position in the distal end 3 and the ball 12 of the ball joint 11, since the support 10 can first be fitted relatively easily and the ulna shaft 7 can then be inserted through the passage 14 into the distal end of the ulna 3 from the little finger side, which can be made adequately accessible during an operation. To anchor the ulna shaft 7 by the ulna end 8 in the ulna 3 the cavity delimited by the ulna 3 is filled from the distal end with a bone cement 17. To prevent the ulna end 8 dropping down too deeply into the ulna 3, both during implantation and later on, the bottom of the cavity in the ulna is closed off by means of a plug or bung 16. The material used for bone cement 17 can be the same as that used for bone cement 18. Such bone cement is again able to set relatively quickly, for example by means of polymerisation. It can suffice to hold still, on the one hand, the ulna 3 and, on the other hand, the ulna shaft 7 fixed to one another until adequate polymerisation has taken place.

20 Viewed in the transverse direction, the hinge end 9 is tightly accommodated in the passage 14. In this context tightly accommodated is understood to mean that movement of the hinge end 9 of the ulna pin 7 in the transverse direction of the ulna shaft 7 is prevented, whilst, on the other hand, movement of the ulna end 9 in the longitudinal direction of the ulna shaft 7, as is shown by double-headed arrow 20 in Figure 3, is not impeded, or at least is not prevented. The hinge end 9 of the ulna shaft will then be able to make a to and fro

translational movement in the ball 12 in accordance with the double-headed arrow 20.

The DRU joint prosthesis according to the invention thus has four freedoms of movement, specifically three orthogonal freedoms of rotation, as shown by the set of double-headed arrows 21 in Figure 3, and a to and fro translational freedom, as shown by the double-headed arrow 20 in Figure 3. As a consequence of these four degrees of freedom, the freedom of movement of wrist and hand is barely impeded, compared with the natural position indicated in Figure 1, or at least is appreciably less impeded than in the case of comparable prostheses from the prior art, whilst the distal end of the ulna 3 and the distal end of the radius 6 are mechanically coupled. This mechanical coupling has the advantage that instabilities in the DRU joint are completely precluded.

Many variants of the DRU prosthesis according to the invention are conceivable within the scope of the claims. The other end 8 of the ulna shaft 7 can, for example, be fixed to the ulna by means of screws, for example if the marrow cavity is not accessible. Furthermore it is possible to fix the support 10 to the side of the distal radius, for example by screwing instead of cementing the pin 15 therein.

Claims

1. Distal radioulnar joint prosthesis comprising:
 - a support (10);
 - 5 - a ball joint (11); and
 - an ulna shaft (7),the one end (9) of the ulna shaft (7) and the support (10) being joinable via the ball joint (11) in a manner which allows them to hinge relative to one another, the other end (8) of the ulna shaft (7) being intended to be fixed to the distal end of the ulna
10 (3); and
the support (10) being intended to be fixed to the distal part of the radius (6),
characterised in that the ball (12) of the ball joint (11) is provided with a recess (14) in which the one end (9) of the ulna shaft (7) can be accommodated such that it is slidable in the longitudinal direction (arrow 20) thereof.
- 15 2. Joint prosthesis according to Claim 1, characterised in that the one end (9) of the ulna shaft (7) can be accommodated transversely to the longitudinal direction (arrow 20) thereof such that it fits tightly in the recess (14).
3. Joint prosthesis according to one of the preceding claims, characterised in that the recess (14) has a longitudinal axis which extends through the centre of the ball joint (11).
- 20 4. Joint prosthesis according to one of the preceding claims, characterised in that the recess (14) is a passage (14) extending through the entire ball (13) of the ball joint (11).
5. Joint prosthesis according to Claim 4, characterised in that the cross-section of the passage (14) and of the ulna shaft (7) are made such that the other end (8) of the ulna shaft (7) can be inserted in the passage (14) and can then be inserted through the passage (14) until the
25 one end (9) is in the passage.
6. Joint prosthesis according to one of the preceding claims, characterised in that the ball (12) is enclosed in the socket (13) of the ball joint (11).
7. Joint prosthesis according to one of the preceding claims, characterised in that the other end (8) of the ulna shaft (7) is constructed such that it can be accommodated in the
30 marrow cavity of the ulna (3) and preferably can be cemented therein or is able to grow together with the cavity by applying a suitable coating.
8. Joint prosthesis according to one of the preceding claims, characterised in that the support (10) is provided with a pin (15) for cementing into the distal (6) of the radius (4).

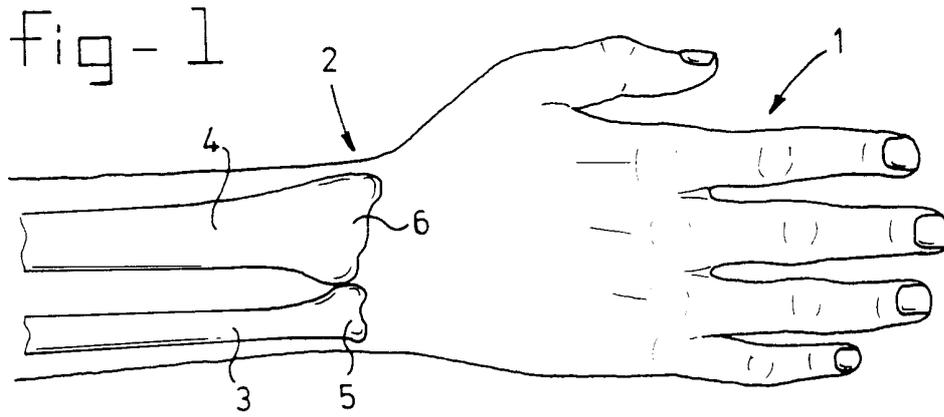
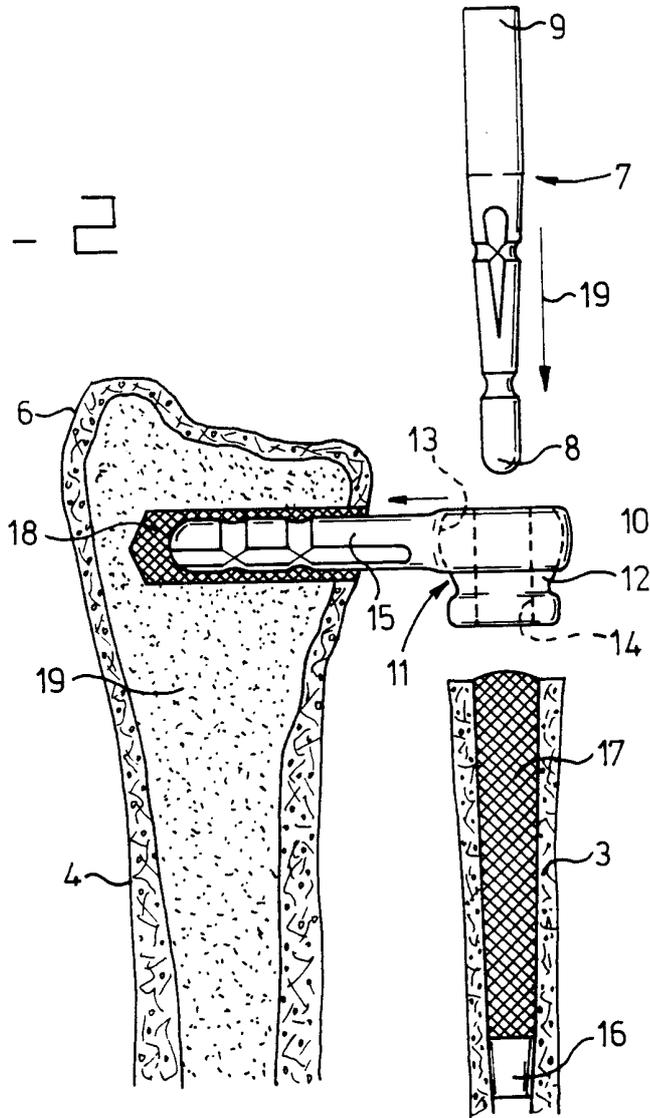


fig-2



INTERNATIONAL SEARCH REPORT

International Application No

PCT/NL 00/00463

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 A61F2/42

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 7 A61F

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.
Y	US 5 108 444 A (BRANEMARK PER-INGVAR) 28 April 1992 (1992-04-28) the whole document ---	1-4, 6
Y	GB 1 412 376 A (SULZER AG) 5 November 1975 (1975-11-05) page 2, line 8 - line 21 page 2, line 34 - line 45; figure ---	1-4, 6
A		7, 8
A	FR 2 660 856 A (KAPANDJI ADALBERT) 18 October 1991 (1991-10-18) abstract; figure 3 ---	1, 6-8
P, X	NL 1 008 880 C (SPIERINGS) 18 October 1999 (1999-10-18) the whole document ---	1-8
	-/--	

Further documents are listed in the continuation of box C.

Patent family members are listed in 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

13 October 2000

Date of mailing of the international search report

31/10/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Klein, C

INTERNATIONAL SEARCH REPORT

International Application No
PCT/NL 00/00463

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, X	US 5 951 604 A (SCHEKER LUIS R) 14 September 1999 (1999-09-14) the whole document -----	1-4, 6-8

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/NL 00/00463

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5108444 A	28-04-1992	AU 7780191 A WO 9116017 A	11-11-1991 31-10-1991
GB 1412376 A	05-11-1975	CH 551785 A AT 314069 B BE 799663 A DE 2309432 A FR 2184621 A IT 1003080 B JP 49049497 A NL 7306687 A SE 400025 B	31-07-1974 15-02-1974 19-11-1973 29-11-1973 28-12-1973 10-06-1976 14-05-1974 20-11-1973 13-03-1978
FR 2660856 A	18-10-1991	NONE	
NL 1008880 C	18-10-1999	NONE	
US 5951604 A	14-09-1999	NONE	