INTRACRANIAL WATER-CONTENT AND PRESSURE MEASURING PROBE

Abstract: A method and system to determine brain stiffness is disclosed. A probe to measure tissue water content is inserted through an aperture (burr hole) in the cranium into brain tissue. The probe has two electrically isolated plate conductors with a dielectric which forms a capacitor plane. One conductor has a surface mount resistor to allow exact impedance matching to the core of a coaxial cable. The other conductor attaches electrically to the shield of the coaxial cable. The probe is stabilized in the brain tissue through a plastic ventriculostomy bolt which has been secured by screw tapping into the cranium. The coaxial cable connects to a spectrum analyzer. Brain water content and blood congestion alter the resonant frequency of the probe, allowing a realtime readout of apparent tissue water content. By monitoring the momentary shift in center resonant frequency or, alternatively, the standing wave ratio slightly off resonant frequency, a beat-to-beat pulsatile waveform is derived relating to the perfusion of the brain. A strain gauge intracranial pressure sensor (ICP) is separately affixed through the bolt and adjacent to the water content probe. By comparing the phase angle or lag time difference between the pressure tracing and the perfusion tracing, a realtime measurement of organ stiffness or compliance is derived.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7  A61B5/05  A61B5/03  A61B5/00

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 7  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, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<tr>
<td>X</td>
<td>US 6 201 980 B1 (LEE ABRAHAM P ET AL) 13 March 2001 (2001-03-13)</td>
<td>1-3,7,43</td>
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<td>US 4 893 630 A (BRAY JR ROBERT S) 16 January 1990 (1990-01-16)</td>
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<td>column 5, line 14-35; figures 1,2</td>
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Further documents are listed in the continuation of box C.

Date of the actual completion of the international search

6 June 2003

Date of mailing of the international search report

27/06/2003

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2 NL-5207 AS Hiemsteyn Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3018

Authorized officer

Rivera Pons, C

Form PCT/ISA/29(c) (record sheet) (July 1992)
<table>
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| A        | US 4 127 110 A (BULLARA LEO A)  
28 November 1978 (1978-11-28)  
column 2, line 25-43  
column 3, line 34-66  
column 5, line 21 -column 6, line 48;  
figure 6 | 1,6 |

Form PCT/ISA/210 (continuation of second sheet) (July 1992)
INTERNATIONAL SEARCH REPORT

Box I  Observations where certain claims were found unsearchable (Continuation of item 1 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.: 16-42
   because they relate to subject matter not required to be searched by this Authority, namely:
   Rule 39.1(iv) PCT – Method for treatment of the human or animal body by surgery

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 II  Observations where unity of invention is lacking (Continuation of item 2 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 fee, this Authority did not invite payment of any additional fee.

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 claim Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant’s protest.

☐ No protest accompanied the payment of additional search fees.

Form PCT/WA/210 (continuation of first sheet (1)) (July 1998)
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