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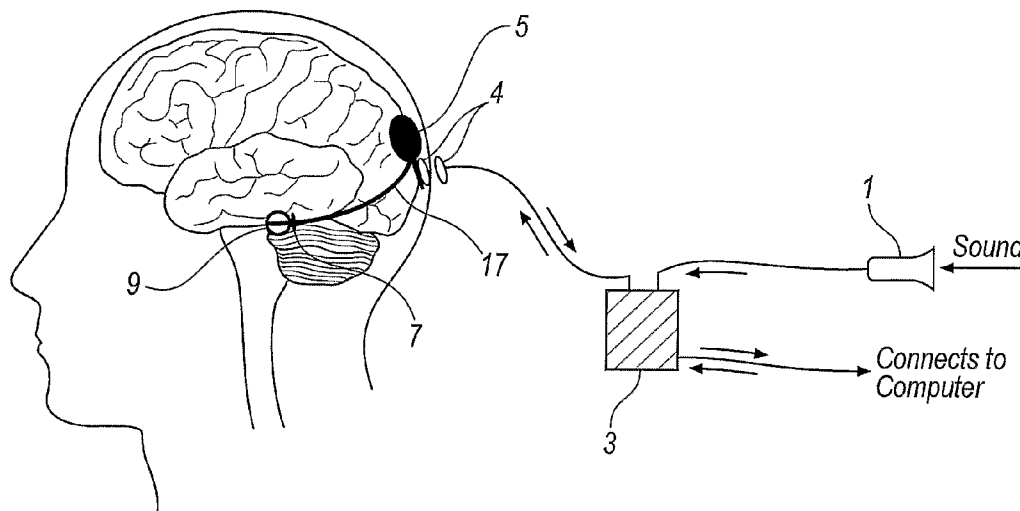
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[Continued on next page]

(54) Title: SYSTEMS AND METHODS FOR INDUCING INTELLIGIBLE HEARING



(57) Abstract: The present invention comprises systems and methods for inducing auditory sensations in patients by stimulating the inferior colliculus of the mammalian midbrain. In some embodiments, the invention comprises an auditory prosthesis system comprising a microphone, a sound processor, a current stimulator, and one or more stimulating electrodes disposed in the inferior colliculus of a mammal. At least one of the stimulating electrodes may be comprised of one or more shanks, each shank comprised of one or more stimulation sites. In some embodiments, without limitation, the invention comprises methods of inducing auditory sensation in a mammal, comprising the steps of providing a microphone, a sound processor, and a current stimulator; providing one or more stimulating electrodes each comprised of two or more shanks, each shank comprised of one or more stimulation sites; disposing at least one stimulating electrode in the inferior colliculus of a mammal; and stimulating at least one isofrequency lamina of the inferior colliculus by applying an electrical signal through at least one of the stimulation sites.



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**Declarations under Rule 4.17:**

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*
- *of inventorship (Rule 4.17(iv))*

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INTERNATIONAL SEARCH REPORT

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PCT/US05/09046

**A. CLASSIFICATION OF SUBJECT MATTER**

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According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

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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)  
 IEEE Explore

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P	Lim, Hubert H. Feasibility Experiments for the Development of a Midbrain Auditory Prosthesis. 1st International IEEE EMBS Conference on Neural Engineering, March 20-23, 2003, pages 193-196	1,13,1,16,24,29,39,40
X --- Y	US 2005/0033377 (Milojevic et al. ) 10 February 2005 (10.02.2005), paragraphs 0035-0050, 0056,0244-0247)  Cheung, Karen C. Implantable Multichannel Electrode Array Based on SOI Technology. Journal of Microelectromechanical Systems, VOL. 12, NO. 2, April 2003, pages 179-184.	1,2,13,15,16,24,29,39,40 0 ----- 2
X --- Y	US 2005/0033377 (Milojevic et al.) 10 February 2005 (10.02.2005), paragraphs 0035-0050,0056,0244-0247)  Bai, Q. et al. A High-Yield Microassembly Structure For Three-Dimensional Microelectrode Arrays. IEEE Transactions on Biomedical Engineering, VOL. 47, NO. 3, March 2000	1,2,13,15,16,24,29,39,40 0 ----- 3-8,19,32

Further documents are listed in the continuation of Box C.  See patent family annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance	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
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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	"&" document member of the same patent family

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## INTERNATIONAL SEARCH REPORT

## C. (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 2005/0033377 (Milojevic et. al.) 10 February 2005 (10.02.2005), paragraphs 0035-0050,0056,0244-0247	1,2,13,15,16,24,29,39, 40 ----- 3-4
	Hetke, J. et al. Design Ranges for Silicon Multichannel Neural Probes. 18th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, Amsterdam 1996	
X --- Y	US 2005/0033377 (Milojevic et al. ) 10 February 2005 (10.02.2005), paragraphs 0035-0050,0056,0244-0247	1,2,13,15,16,24,29,39, 40 ----- 4-8
	Anderson, D. et al. Batch-Fabricated Thin-Film Electrodes for Stimulation of the Central Auditory System. IEEE Transactions on Biomedical Engineering, VOL. 36, NO. 7, July 1989	
X --- Y	US 2005/0033377 (Milojevic et al.) 10 February 2005 (10.02.2005), paragraphs 0035-0050,0056,0244-0247	1,2,13,15,16,24,29,39, 40 ----- 20,33
	Wise, K.D. et al. Wireless Implantable Microsystems: High-Density Electronic Interfaces to the Nervous System. Proceedings of the IEEE, VOL. 92, NO. 1, January 2004	
X --- Y	US 2005/0033377 (Milojevic et al.) 10 February 2005 (10.02.2005), paragraphs 0035-0050,0056,0244-0247	1,2,13,15,16,24,29,39, 40 ----- 14
	US 6,381,336 (Lesinski et al.) 30 April 2002 (30.04.2002), Figure 6, column 7, lines 25-40	
A --- A	US 2005/0004627 (Gibson et al.) 06 January 2005 (06.01.2005)	
	US 4,261,372 (Hansen et al.) 14 April 1981 (14.04.1981)	