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[54] **SYSTEM FOR THE PREDICTION, RAPID DETECTION, WARNING, PREVENTION, OR CONTROL OF CHANGES IN ACTIVITY STATES IN THE BRAIN OF A SUBJECT**

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[51] **Int. Cl.**⁶ **A61B 5/04**

[52] **U.S. Cl.** **600/544; 600/545; 600/300**

[58] **Field of Search** **600/544, 300, 600/545, 546; 607/45**

[56] References Cited

U.S. PATENT DOCUMENTS

3,850,161	11/1974	Liss	128/2.1
4,702,254	10/1987	Zabara	128/419
4,867,164	9/1989	Zabara	.
5,215,086	6/1993	Terry et al.	128/421
5,222,503	6/1993	Ives et al.	.
5,269,302	12/1993	Swartz et al.	.
5,269,303	12/1993	Wernicke et al.	.
5,299,569	4/1994	Wernicke et al.	607/45
5,349,962	9/1994	Lockard et al.	128/732
5,626,627	5/1997	Krystal et al.	607/45

OTHER PUBLICATIONS

Thomas L. Babb, Elmo Mariani and Paul H. Crandall; "An Electronic Circuit for Detection of EEG Seizures Recorded With Implanted Electrodes," *Electroencephalography and Clinical Neurophysiology*, (1974); vol. 37, pp. 305-308.

J. Gotman and P. Gloor; "Automatic Recognition and Quantification of Interictal Epileptic Activity in the Human Scalp EEG," *Electroencephalography and Clinical Neurophysiology*, (1976); vol. 41, pp. 513-529.

J. Gotman, J.R. Ives and P. Gloor; "Automatic Recognition of Inter-Ictal Epileptic Activity in Prolonged EEG Recordings," *Electroencephalography and Clinical Neurophysiology*, (1979); vol. 46, pp. 510-520.

Armand Siegel, Cheryl L. Grady and Allan F. Mirsky, "Prediction of Spike-Wave Bursts in Absence Epilepsy by EEG Power-Spectrum Signals," *Epilepsia*, (Feb., 1982); vol. 23, pp. 47-60.

J. Gotman; "Automatic Recognition of Epileptic Seizures in the EEG," *Electroencephalography and Clinical Neurophysiology*, (1982); vol. 54, pp. 530-540.

J. Gotman; "Automatic Seizure Detection: Improvements and Evaluation," *Electroencephalography and Clinical Neurophysiology*, (1990); vol. 76, pp. 317-324.

J. Gotman and L.Y. Wang, "State-Dependent Spike Detection: Concepts and Preliminary Results," *Electroencephalography and Clinical Neurophysiology*, (1991); vol. 79, pp. 11-19.

(List continued on next page.)

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[57] ABSTRACT

A system (10) analyzes signals representative of a subject's brain activity in a signal processor (12) for information indicating the subject's current activity state and for predicting a change in the activity state. One preferred embodiment uses a combination of nonlinear filtering methods to perform real-time analysis of the electro-encephalogram (EEG) or electro-corticogram (ECoG) signals from a subject patient for information indicative of or predictive of a seizure, and to complete the needed analysis at least before clinical seizure onset. The preferred system then performs an output task for prevention or abatement of the seizure, or for recording pertinent data.

52 Claims, 15 Drawing Sheets

Microfiche Appendix Included
(1 Microfiche, 20 Pages)

