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**Balkin et al.**

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(54) **SYSTEM AND METHOD FOR PREDICTING HUMAN COGNITIVE PERFORMANCE USING DATA FROM AN ACTIGRAPH**

5,304,212 4/1994 Czeisler et al. .  
5,348,370 9/1994 Fukuoka .  
5,433,223 7/1995 Moore-Ede et al. .

(List continued on next page.)

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**OTHER PUBLICATIONS**

Theodore R. Colburn et al., "An Ambulatory Activity Monitor with Solid State Memory," paper presented at the 13<sup>th</sup> Annual Rocky Mountain Bioengineering Symposium and 13<sup>th</sup> International ISA Biomedical Sciences Instrumentation Symposium (Instrument Society of America), May 3-5, 1976, p. 117-122.

D.F. Kripke et al., "Wrist Actigraphic Measures of Sleep and Rhythms," *Electroencephalography and Clinical Neurophysiology*, 1978, vol. 44, pp. 674-676.

Daniel P. Redmond et al., "Observations on the Design and Specification of a Wrist-Worn Human Activity Monitoring System," *Behavior Research Methods, Instruments, & Computers*, 1985, vol. 17, Issue 6, pp. 659-669.

G. Belenky et al., "Sustaining Performance During Continuous Operations: The U.S. Army's Sleep Management System," *Proceedings of the Army Science Conference*, 1996, pp. 1-5.

(List continued on next page.)

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(57) **ABSTRACT**

A system and a method for providing a determination of predicted cognitive performance of an individual based the time of day and on factors including sleep history based on activity data from an actigraph. The system and the method provide a numerical representation of the predicted cognitive performance. Both may be used to optimize the work schedule of the actigraph wearer to maximize the cognitive capacity during working hours.

**53 Claims, 22 Drawing Sheets**

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

4,893,291 1/1990 Bick et al. .  
5,006,985 4/1991 Ehret et al. .  
5,197,489 3/1993 Colan .  
5,259,390 11/1993 Maclean .

