US005716377A

United States Patent [19]

Rise et al.

[11] **Patent Number:** 5,716,377

[45] **Date of Patent:** Feb. 10, 1998

[54] **METHOD OF TREATING MOVEMENT DISORDERS BY BRAIN STIMULATION**

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[21] Appl. No.: **637,366**

[22] Filed: **Apr. 25, 1996**

[51] **Int. Cl.^{6}** **A61N 1/00**
[52] **U.S. Cl.** **607/2**
[58] **Field of Search** 607/1, 2, 3, 43, 607/45, 46, 6, 72

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,850,161	11/1974	Liss .
4,702,254	10/1987	Zabara .
4,867,164	9/1989	Zabara .
5,025,807	6/1991	Zabara .
5,293,879	3/1994	Vonk et al. .

OTHER PUBLICATIONS

Andy "Thalemic Stimulation for Control of Movement Disorders" Applied Nucrophysiology, Dec. 83 pp. 107–111.
Benabid et al "Vim and STN stimulation in Parkinsons Disease" Abstracts of the Intl Congress of Movement Disorders, 1994 paper.
Capellos–Lefebure D. et al "Chronic thalamic stimulation improves tremors and levodope induced dyskinesics in Parkinson's disease" J Neurol Neurosurg Psychietry, 1993, J6: 268–73.

van Horne et al., "Multichannel Semiconductor–Based Electrodes for In Vivo Electrochemical and Electrophysiological Studies in Rat CNS", *Neuroscience Letters*, 120, pp. 249–252 (1990).
Alexander et al., "Basal Ganglia–Thalamocortical Circuits: Parallel Substrates for Motor, Oculomotor, 'Prefrontal' and 'Limbic' Functions", *Progress in Brain Research*, vol. 85: 119–146 (1990).
Bergman et al., "Reversal of Experimental Parkinsonism by Lesions of the Subthalamic Nucleus", *Science*, vol. 249: 1436–1438 (Sep. 21, 1990).
Benabid et al., "Long term Suppression of Tremor by Cchronic Stimulation of the Ventral Intermediate Thalamic Nucleus", *The Lancet*, vol. 337: 403–406 (Feb. 16, 1991).
Limousin et al., "Effect on Parkinsonian Signs and Symptoms of Bilateal Subthalamic Nucleus Stimulation", The Lancet, vol. 345: 91–95 (Jan. 14, 1995).
Benabid et al., "Chronic Electrical Stimulation of the Ventralis Intermedius Nucleus of the Thalamus as a Treatment of Movement Disorders", J. Neurosurg., vol. 84: pp. 203–214 (Feb. 1996).

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[57] **ABSTRACT**

Techniques for stimulating the brain to treat movement disorders resulting in abnormal motor behavior by means of an implantable signal generator and electrode. A sensor is used to detect the symptoms resulting from the motion disorder. A microprocessor algorithm analyzes the output from the sensor in order to regulate the stimulation delivered to the brain.
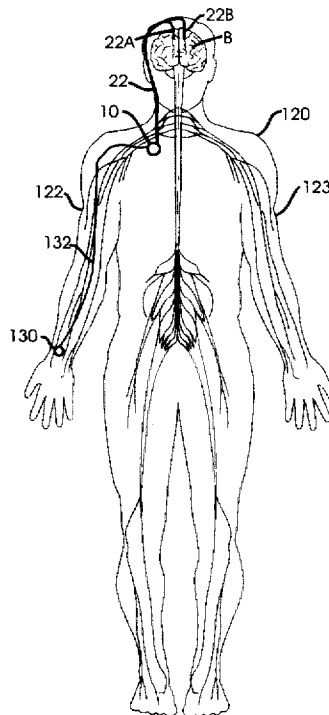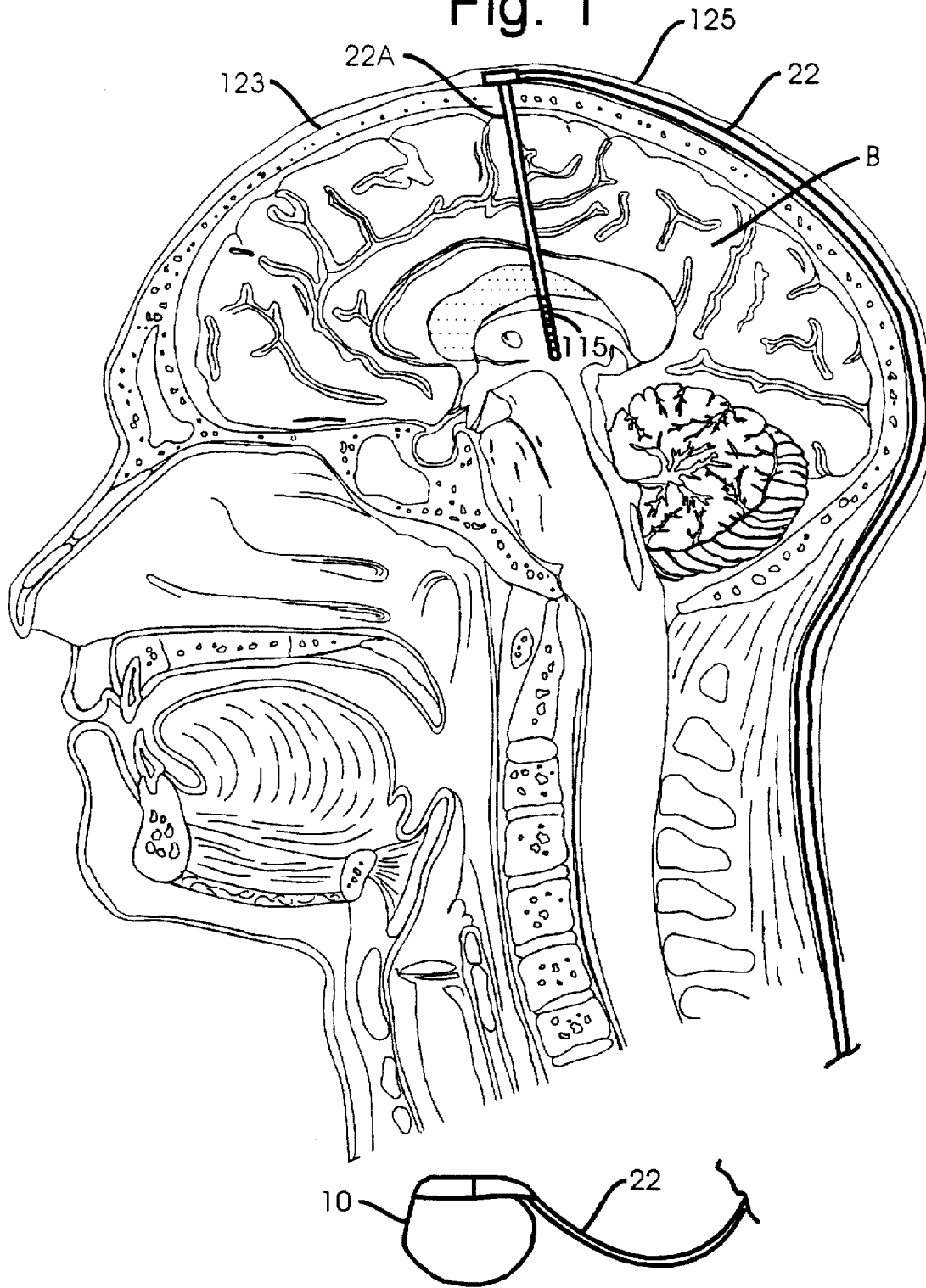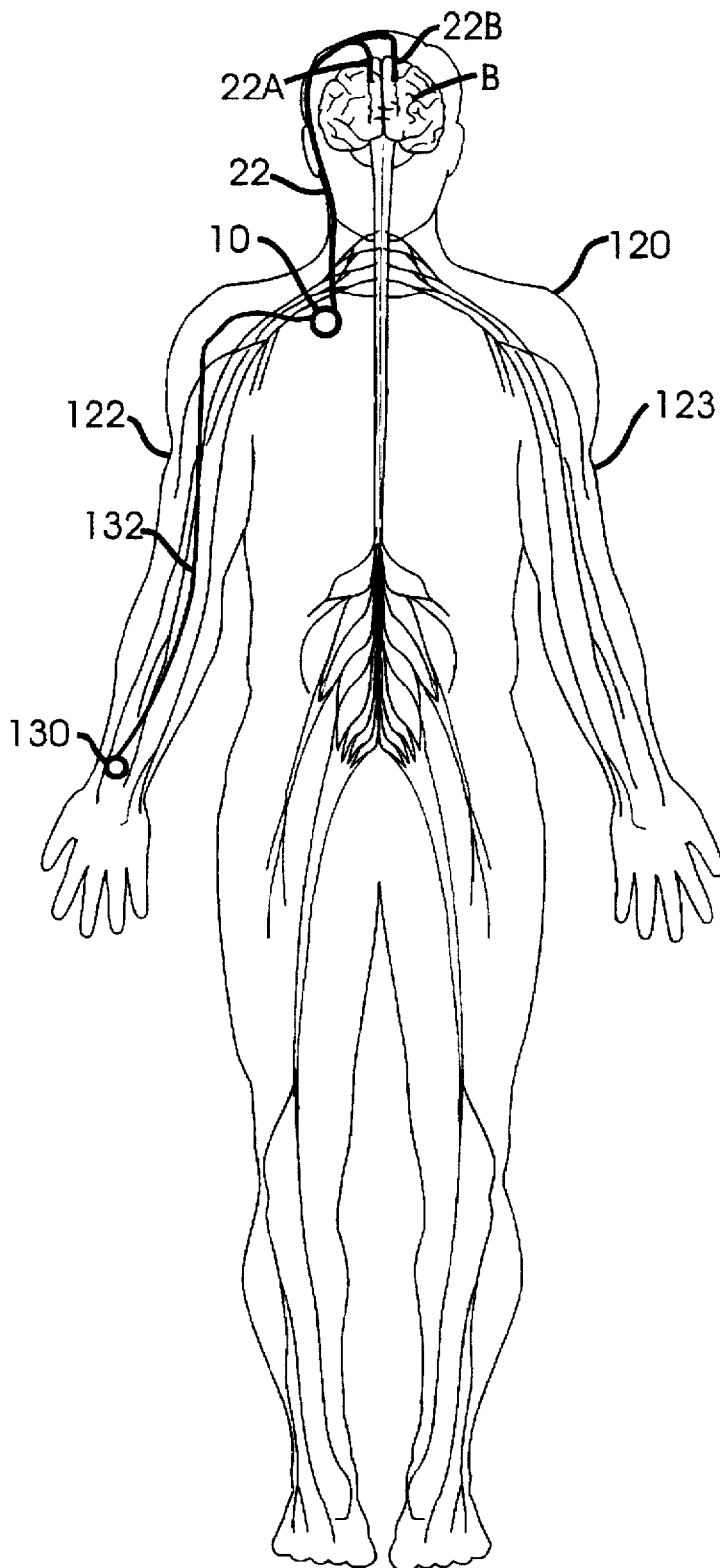
18 Claims, 8 Drawing Sheets

Fig. 1

Fig. 2

Fig. 3

Fig. 4

400

READ PARAMETERS
(1)BLOCK OR INCREASE NEURAL ACTIVITY AT
STIMULATION SITE
(2) INCREASE IN SENSOR ACTIVITY = INCREASE OR
DECREASE IN STIMULATION TARGET ACTIVITY
(3) PULSE WIDTH MINIMUM AND MAXIMUM
(4) AMPLITUDE MINIMUM AND MAXIMUM
(5) FREQUENCY MINIMUM AND MAXIMUM
(6) PRIORITY OF PARAMETER CHANGES

STORE VALUES IN MEMORY — 406

415

RESET TIMER

READ FEEDBACK SENSOR — 410

CHANGE PARAMETERS

414

PARAMETER CHANGE NEEDED? — 411

YES

NO

TIMER ELAPSED? — 412

NO

YES

REDUCE PARAMETERS — 413

DOCKET ALARM
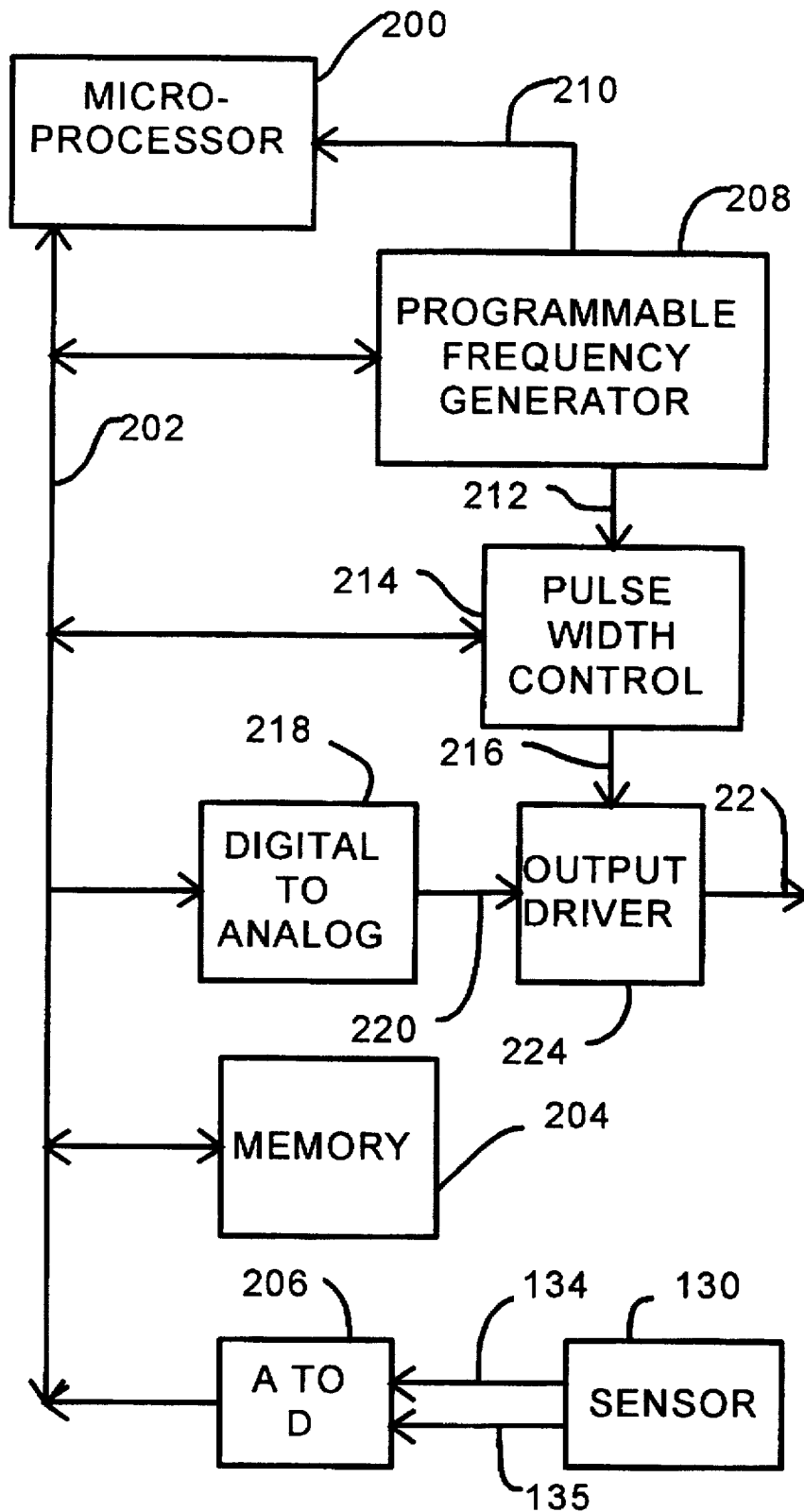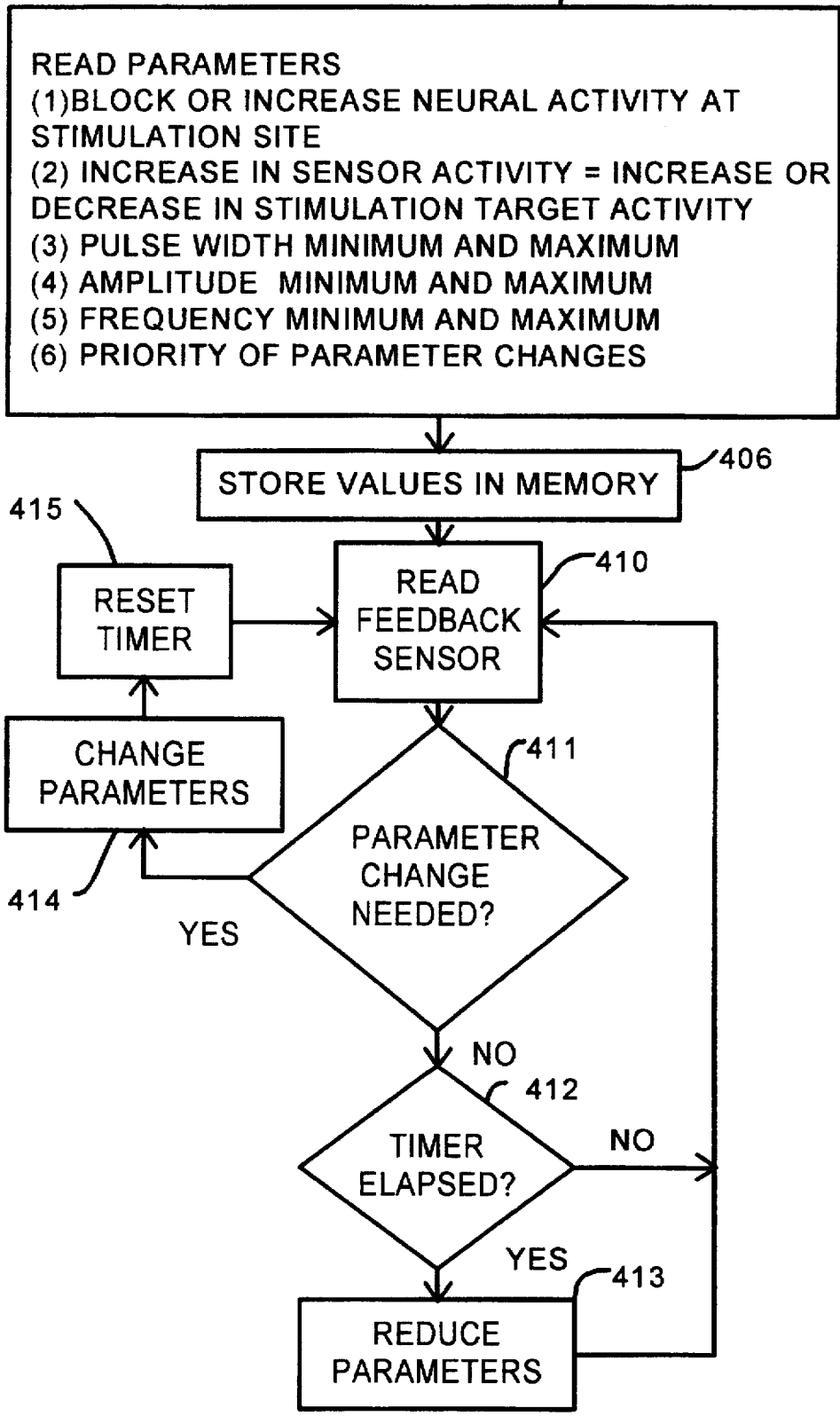
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