



(12) **United States Patent**  
**Whitehurst et al.**

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(54) **FULLY IMPLANTABLE  
MICROSTIMULATOR FOR SPINAL CORD  
STIMULATION AS A THERAPY FOR  
CHRONIC PAIN**

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2000.

(51) Int. Cl.<sup>7</sup> ..... **A61N 1/18**

(52) U.S. Cl. .... **607/46; 607/72**

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607/108, 58-62, 133, 116-118, 92, 148,  
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377; 604/20

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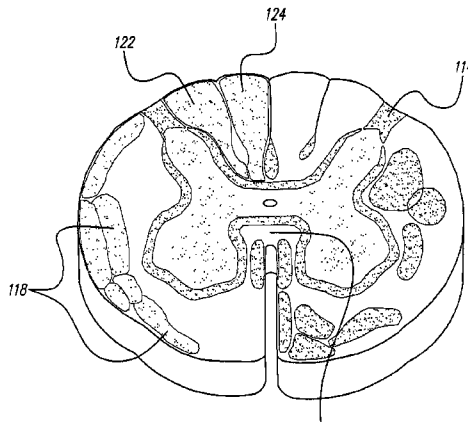
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(57) **ABSTRACT**

An implantable stimulator(s), small enough to be located near or within an area of the spine responsible for sensations in a region experiencing chronic pain uses a power source/storage device, such as a rechargeable battery. Periodic recharging of such a power source/storage device is accomplished, for example, by inductive coupling with an external appliance. The small stimulator provides a means of stimulating a nerve(s) or other tissue when desired, without the need for external appliances during the stimulation session. When necessary, external appliances are used for the transmission of data to and/or from the stimulator(s) and for the transmission of power, it necessary. In a preferred embodiment, the system is capable of open- and closed-loop operation. In closed-loop operation, at least one implant includes at least one sensor, and the sensed condition is used to adjust stimulation parameters.

**18 Claims, 8 Drawing Sheets**



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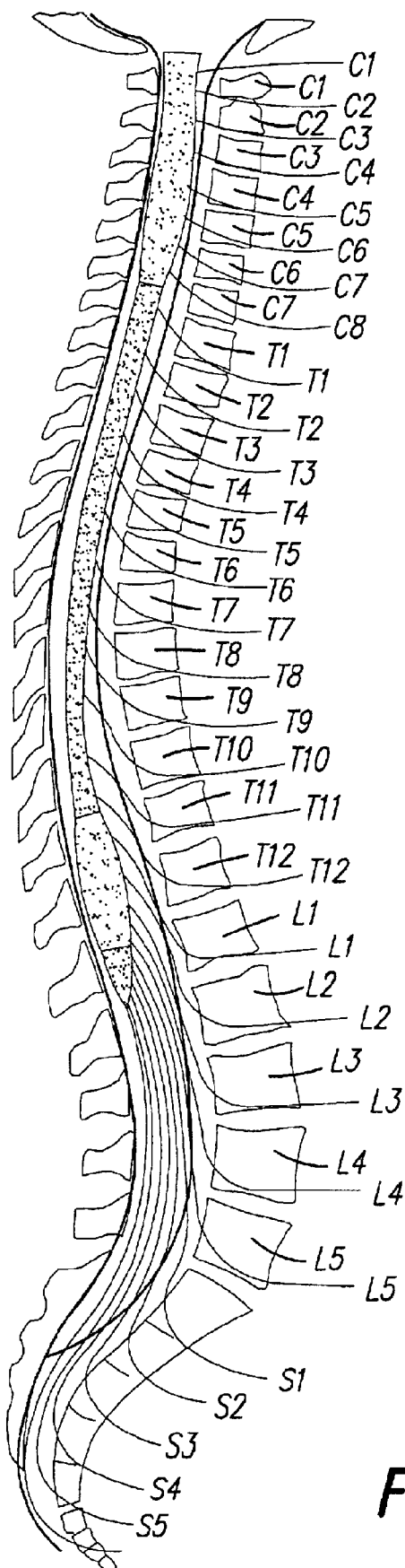
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**FIG. 1A**

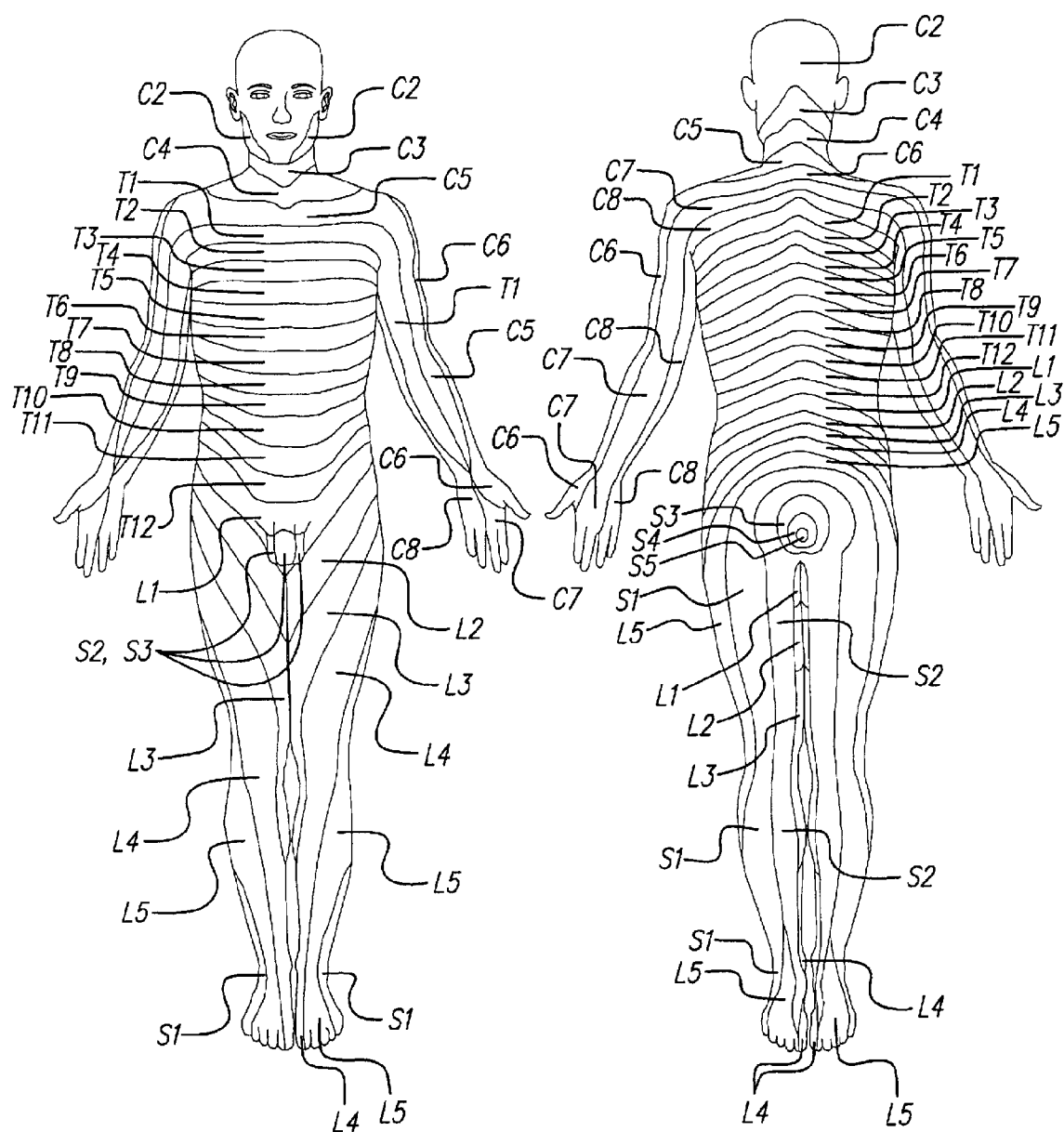
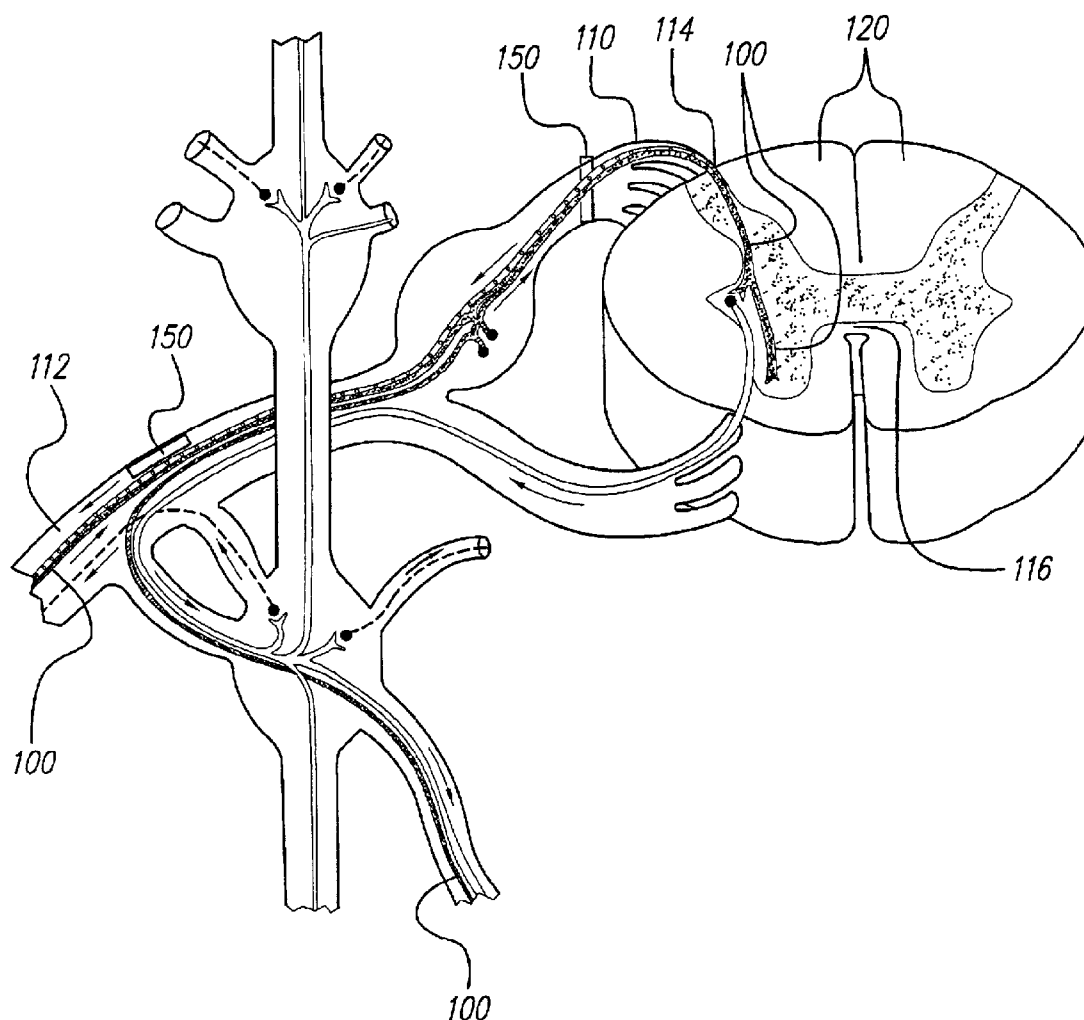


FIG. 1B

**FIG. 2A**

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