CLAIMS

1. A system for modulation of spinal neurons associated with regulation of effector organ activity in a vertebrate being, the system comprising:

a first stimulation component configured to provide stimulation of a nerve associated with a target effector organ, and

a second stimulation component configured to provide spinal direct current stimulation associated with modulation of said target effector organ.

2. The system of claim 1 wherein the second stimulation component is configured to provide spinal non-varying continuous direct current electrical stimulation.

3. The system of claim 2 wherein the first stimulation component is configured to provide direct current electrical stimulation.

4. The system of claim 2 wherein the first stimulation component is configured to provide non-varying continuous direct current electrical stimulation.

5. The system of claim 3 further comprising a controller component configured to simultaneously control the range of current supplied by the first and second stimulation components and establishing the upper limit of current of the first component at not greater than a current at the second stimulation component.

6. The system of claim 3 further comprising a controller component configured to simultaneously control the range of current supplied by the first and second stimulation components and establishing the upper limit of current of the first component at not greater than the current at the second stimulation component and dynamically adjusting the upper limit simultaneously with adjustment of the second current.

7. The system of claim 5 further comprising a first current component configured to provide continuous non-varying direct current for stimulation of the nerve associated with a target effector organ.

8. The system of claim 5 further comprising a first electrical source with positive and negative terminals providing stimulation current to stimulation electrodes, including two electrodes disposed for stimulation of a nerve associated with a target effector organ, one electrode operatively connected to the positive terminal and another electrode operatively connected to the negative terminal; each one of the two electrodes being electrically insulated from the other one of the two electrodes.

9. The system of claim 8 wherein the two electrodes are configured to be attached across a section of a nerve associated with a muscle of interest to provide non-varying continuous direct current electrical stimulation to the muscle nerve section.

10. The system of claim 9 further comprising

a second electrical source having a second positive terminal and a second negative terminal;

a first electrode disposed to be placed at a spinal cord location; and

a second electrode disposed to be placed at a location selected from another location at the spinal column or a location distal from the spine; one of the first and second electrodes operatively connected to the second positive terminal and another one of the first and second electrodes operatively connected to the second negative terminal.

11. The system of claim 10 wherein the first electrical source and the second electrical source are a same electrical source; and wherein the same electrical source is a source producing non-varying direct current.

12. The system of claim 1 wherein said direct current for spinal stimulation ranges from about 2 ma to about 5mA for treatment of muscle tone in humans.

13. The system of claim 12 wherein the two electrodes are implanted.

14. The system of claim 5 wherein the first electrical source is also implanted; and wherein the controller component is operatively connected to the first electrical source by a wireless connection.

15. The system of claim 14 wherein the controller component is disposed in a wearable housing.

16. The system of claim 15 wherein the second electrical source is also disposed in the wearable housing.

17. The system of claim 16 wherein the controller component and the same electrical source are disposed in a wearable housing.

18. The system of claim 2 wherein the first stimulation component is configured to provide pulsed electrical stimulation.

19. A method for modulation of spinal neurons associated with regulation of effector organ activity in a vertebrate being, comprising the steps of:

applying a source of direct current to a portion of a nerve associated with a target effector organ,

applying another source of direct current to a spinal location associated with said nerve associated with a target effector organ , and

simultaneously controlling a range of current supplied to each of said nerve portion and spinal location for establishing the upper limit of said peripheral current at not greater than said spinal current.

20. The method of claim 19 wherein applying the source of direct current to the portion of a nerve associated with a target effector organ comprises providing, from a first electrical source with positive and negative terminals, stimulation current to stimulation electrodes, the stimulation electrodes including two electrodes disposed for stimulation of the nerve associated with the target effector organ, one electrode operatively connected to the positive terminal and another electrode operatively connected to the negative terminal, each one of the two electrodes being electrically insulated from another one of the two electrodes.

21. The method of claim 20 wherein the two electrodes are located noninvasively and wherein the two electrodes are skin-surface electrodes.

22. The method of claim 20 wherein the two electrodes are implanted electrodes.

23. The method of claim 22 wherein the first electrical source is also implanted; and wherein simultaneously controlling the range of current supplied comprises using a controller component operatively connected to the first electrical source by a wireless connection.

24. The method of claim 20 wherein applying said another source of direct current to the spinal location comprises providing, from a second electrical source with second positive and second negative terminals, stimulation current to a first electrode and a second electrode, the first electrode disposed to be placed at a spinal cord location, the second electrode disposed to be placed at a location distal from the spine, one of the first and second electrodes operatively connected to the second positive terminal and another one of the first and second electrodes operatively connected to the second negative terminal.

25. The method of claim 24 wherein the two electrodes are located noninvasively and wherein the two electrodes are skin-surface electrodes.

26. The method of claim 24 wherein simultaneously controlling the range of current supplied comprises using a controller component operatively connected to the first and second electrical sources.

27. The method of claim 26 wherein the control component and the first and second electrical sources are located in a wearable housing.

28. The method of claim 27 wherein the first and second electrical sources are a same electrical source.

29. The method of claim19 wherein establishing the upper limit includes dynamically adjusting the upper limit simultaneously with adjustment of the spinal current.

30. A method for modulating muscle tone in humans, the method comprising:

applying a source of electrical stimulation along a nerve that provides neural control of a specific muscle requiring modulation of muscle tone; and

applying a source of direct current to a spinal location associated with efferent neural outflow to the specific muscle requiring modulation of muscle tone.

31. The method of claim 30 further comprising simultaneously controlling a range of electrical stimulation applied along said nerve and a range of direct current applied to the spinal location.

32. The method of claim 30 wherein applying a source of electrical stimulation along said nerve comprises providing, from a first electrical source with positive and negative terminals, stimulation current to stimulation electrodes, the stimulation electrodes including two electrodes disposed for stimulation of said nerve, one electrode operatively connected to the positive terminal and another electrode operatively connected to the negative terminal, each one of the two electrodes being electrically insulated from another one of the two electrodes.

33. The method of claim 32 wherein electrical stimulation comprises pulsed electrical stimulation.

34. The method of claim 33 wherein the pulsed electrical stimulation comprises pulsed DC simulation.

35. The method of claim 33 wherein the pulsed electrical stimulation comprises pulsed AC stimulation.

36. The method of claim 32 wherein electrical stimulation comprises direct current electrical stimulation.

37. The method of claim 32 further comprising simultaneously controlling a range of electrical stimulation applied along said nerve and the range of direct current applied to the spinal location.

38. The method of claim 37 wherein the two electrodes are located noninvasively and where in the two electrodes are skin-surface electrodes.

39. The method of claim 37 wherein the two electrodes are implanted electrodes.

40. The method of claim 39 wherein the first electrical source is also implanted; and wherein simultaneously controlling the range of current supplied comprises using a controller component operatively connected to the first electrical source by a wireless connection.

41. The method of claim 32 wherein applying said source of direct current to the spinal location comprises providing, from a second electrical source with second positive and second negative terminals, direct stimulation current to a first electrode and a second electrode, the first electrode disposed to be placed at a spinal cord location, the second electrode disposed to be placed at a location selected from another location at the spinal column or a location distal from the spine, one of the first and second electrodes operatively connected to the second positive terminal and another one of the first and second electrodes operatively connected to the second negative terminal.

42. The method of claim 41 wherein the two electrodes are located noninvasively and wherein the two electrodes are skin-surface electrodes.

43. The method of claim 41 further comprising simultaneously controlling a range of electrical stimulation applied along said nerve and a range of direct current applied to the spinal location.

44. The method of claim 43 wherein simultaneously controlling the range of current supplied comprises using a controller component operatively connected to the first and second electrical sources.

45. The method of claim 44 wherein the control component and the first and second electrical sources are located in a wearable housing.

46. A method for modulating function of the autonomic nervous system in vertebrate beings, the method comprising:

applying a source of electrical stimulation along a nerve that provides neural control of a specific effector organ requiring modulation of function; and

applying a source of direct current to a spinal location associated with sympathetic or parasympathetic efferent neural outflow to a specific effector organ requiring modulation of function.

47. The method of claim 46 further comprising simultaneously controlling a range of electrical stimulation applied along said nerve and a range of direct current applied to the spinal location.

48. The method of claim 47 wherein applying a source of electrical stimulation along said nerve comprises providing, from a first electrical source with positive and negative terminals, stimulation current to stimulation electrodes, the stimulation electrodes including two electrodes disposed for stimulation of said nerve, one electrode operatively connected to the positive terminal and another electrode operatively connected to the negative terminal, each one of the two electrodes being electrically insulated from another one of the two electrodes.

49. The method of claim 48 wherein electrical stimulation comprises pulsed electrical stimulation.

50. The method of claim 49 wherein the pulsed electrical stimulation comprises pulsed DC simulation.

51. The method of claim 49 wherein the pulsed electrical stimulation comprises pulsed AC stimulation.

52. The method of claim 48 wherein electrical stimulation comprises direct current electrical stimulation.

53. The method of claim 48 further comprising simultaneously controlling a range of electrical stimulation applied along said nerve and the range of direct current applied to the spinal location.

54. The method of claim 53 wherein the two electrodes are located noninvasively and wherein the two electrodes are skin-surface electrodes.

55. The method of claim 53 wherein the two electrodes are implanted electrodes.

56. The method of claim 55 wherein the first electrical source is also implanted; and wherein simultaneously controlling the range of current supplied comprises using a controller component operatively connected to the first electrical source by a wireless connection.

57. The method of claim 48 wherein applying said source of direct current to the spinal location comprises providing, from a second electrical source with second positive and second negative terminals, direct stimulation current to a first electrode and a second electrode, the first electrode disposed to be placed at a spinal cord location, the second electrode disposed to be placed at a location selected from another location at the spinal column or a location distal from the spine, one of the first and second electrodes operatively connected to the second positive terminal and another one of the first and second electrodes operatively connected to the second negative terminal.

58. The method of claim 57 wherein the two electrodes are located noninvasively and wherein the two electrodes are skin-surface electrodes.

59. The method of claim 57 further comprising simultaneously controlling a range of electrical stimulation applied along said nerve and a range of direct current applied to the spinal location.

60. The method of claim 59 wherein simultaneously controlling the range of current supplied comprises using a controller component operatively connected to the first and second electrical sources.

61. The method of claim 60 wherein the control component and the first and second electrical sources are located in a wearable housing.

62. A method for modulating bladder function in vertebrate beings, the method comprising:

applying a source of electrical stimulation along a nerve provides neural control of bladder muscles; and

applying a source of direct current to a spinal location associated with efferent neural outflow to the bladder.

63. The method of claim 62 wherein modulating bladder function is treating urinary retention.

64. The method of claim 63, wherein the efferent neural outflow is sympathetic or parasympathetic.

65. The method of claim 64, wherein the efferent neural outflow is sympathetic; and wherein the efferent neural outflow is at spinal levels of T11-L2.

66. The method of claim 64, wherein the efferent neural outflow is parasympathetic; and wherein the efferent neural outflow is at spinal levels of S2-S4.

67. The method of claim 63, wherein direct current stimulation is cathodal stimulation; wherein the cathodal stimulation is applied to the spinal location between S2-S4; and wherein the nerve stimulated is a pelvic nerve; and wherein nerve stimulation is applied using implanted electrodes.

68. The method of claim 63, wherein direct current stimulation is anodal stimulation; wherein the anodal stimulation is applied to the spinal location between S2-S4; and wherein the nerve stimulated is a pudental nerve; and wherein nerve stimulation is applied using implanted electrodes.

69. The method of claim 63, wherein direct current stimulation is cathodal stimulation; wherein the cathodal stimulation is applied to the spinal location between S2-S4; and wherein the nerve stimulated is a pudental nerve; and wherein nerve stimulation is applied using implanted electrodes.

70. The method of claim 63, wherein the bladder function being modulated comprises modulation of a bladder detrusor muscle and a sphincter vesicae muscle.

71. The method of claim 63, wherein the bladder function being modulated comprises modulation of an external urethral sphincter.

72. The method of claim 62 wherein modulating bladder function is treating urinary incontinence.

73. The method of claim 72, wherein the efferent neural outflow is sympathetic or parasympathetic.

74. The method of claim 73, wherein the efferent neural outflow is sympathetic; and wherein the efferent neural outflow is at spinal levels of T11-L2.

75. The method of claim73, wherein the efferent neural outflow is parasympathetic; and wherein the efferent neural outflow is at spinal levels of S2-S4.

76. The method of claim 72, wherein direct current stimulation is anodal stimulation; wherein the anodal stimulation is applied to the spinal location between S2-S4; and wherein the nerve stimulated is a pelvic nerve; and wherein nerve stimulation is applied using implanted electrodes.

77. The method of claim 72, wherein direct current stimulation is cathodal stimulation; wherein the cathodal stimulation is applied to the spinal location between S2-S4; and wherein the nerve stimulated is a pudental nerve; and wherein nerve stimulation is applied using implanted electrodes.

78. The method of claim 72, wherein the bladder function being modulated comprises modulation of a bladder detrusor muscle and a sphincter vesicae muscle.

79. The method of claim 72, wherein the bladder function being modulated comprises modulation of an external urethral sphincter.

80. The method of claim 62 further comprising simultaneously controlling a range of electrical stimulation applied along said nerve and a range of direct current applied to the spinal location.

81. The method of claim 80 wherein applying a source of electrical stimulation along said nerve comprises providing, from a first electrical source with positive and negative terminals, stimulation current to stimulation electrodes, the stimulation electrodes including two electrodes disposed for stimulation of said nerve, one electrode operatively connected to the positive terminal and another electrode operatively connected to the negative terminal, each one of the two electrodes being electrically insulated from another one of the two electrodes.

82. The method of claim 62 wherein electrical stimulation comprises pulsed electrical stimulation.

83. The method of claim 81 wherein the pulsed electrical stimulation comprises pulsed DC simulation.

84. The method of claim 81 wherein the pulsed electrical stimulation comprises pulsed AC stimulation.

85. The method of claim 62 wherein electrical stimulation comprises direct current electrical stimulation.

86. The method of claim 81 wherein the two electrodes are located noninvasively and where in the two electrodes are skin-surface electrodes.

87. The method of claim 81 wherein the two electrodes are implanted electrodes.

88. The method of claim 87 wherein the first electrical source is also implanted; and wherein simultaneously controlling the range of current supplied comprises using a controller component operatively connected to the first electrical source by a wireless connection.

89. The method of claim 81 wherein applying said source of direct current to the spinal location comprises providing, from a second electrical source with second positive and second negative terminals, direct stimulation current to a first electrode and a second electrode, the first electrode disposed to be placed at a spinal cord location, the second electrode disposed to be placed at a location selected from another location at the spinal column or a location distal from the spine, one of the first and second electrodes operatively connected to the second positive terminal and another one of the first and second electrodes operatively connected to the second negative terminal.

90. The method of claim 89 wherein the two electrodes are located noninvasively and wherein the two electrodes are skin-surface electrodes.

91. The method of claim 89 wherein simultaneously controlling the range of current supplied comprises using a controller component operatively connected to the first and second electrical sources.

92. The method of claim 91 wherein the control component and the first and second electrical sources are located in a wearable housing.

93. A method for modulating renal function in vertebrate beings, the method comprising:

applying a source of electrical stimulation along a nerve that provides neural control of a kidney; and

applying a source of direct current to a spinal location associated with efferent neural outflow to the kidney.

94. The method of claim 93 wherein modulating renal function is treating hypertension.

95. The method of claim 94, wherein the efferent neural outflow is sympathetic.

96. The method of claim 95 wherein the efferent neural outflow is at the spinal levels of T10-L1.

97. The method of claim 94, wherein direct current stimulation is anodal stimulation; wherein the anodal stimulation is applied to the spinal location between T10-L1; and wherein the nerve stimulated is a renal nerve; and wherein nerve stimulation is applied using implanted electrodes.

98. The method of claim 94, wherein direct current stimulation is cathodal stimulation; wherein the cathodal stimulation is applied to the spinal location between T10-L1; and wherein the nerve stimulated is a renal nerve; and wherein nerve stimulation is applied using implanted electrodes.

99. The method of claim 94 wherein the nerve stimulator is a renal nerve; and wherein the renal nerve supply the kidney and the blood vessels, glomeruli and tubules associated with the kidney.

100. The method of claim 94 wherein modulating renal function is treating congestive heart failure.

101. The method of claim 100, wherein the efferent neural outflow is sympathetic.

102. The method of claim 101 wherein the efferent neural outflow is at the spinal levels of T10-L1.

103. The method of claim 100, wherein direct current stimulation is anodal stimulation; wherein the anodal stimulation is applied to the spinal location between T10-L1; and wherein the nerve stimulated is a renal nerve; and wherein nerve stimulation is applied using implanted electrodes.

104. The method of claim100, wherein direct current stimulation is cathodal stimulation; wherein the cathodal stimulation is applied to the spinal location between T10-L1; and wherein the nerve stimulated is a renal nerve; and wherein nerve stimulation is applied using implanted electrodes.

105. The method of claim 100 wherein the nerve stimulator is a renal nerve; and wherein the renal nerve supply the kidney and the blood vessels, glomeruli and tubules associated with the kidney.

106. The method of claim 93 further comprising simultaneously controlling a range of electrical stimulation applied along said nerve and a range of direct current applied to the spinal location.

107. The method of claim 106 wherein applying a source of electrical stimulation along said nerve comprises providing, from a first electrical source with positive and negative terminals, stimulation current to stimulation electrodes, the stimulation electrodes including two electrodes disposed for stimulation of said nerve, one electrode operatively connected to the positive terminal and another electrode operatively connected to the negative terminal, each one of the two electrodes being electrically insulated from another one of the two electrodes.

108. The method of claim 107 wherein electrical stimulation comprises pulsed electrical stimulation.

109. The method of claim 108 wherein the pulsed electrical stimulation comprises pulsed DC simulation.

110. The method of claim 108 wherein the pulsed electrical stimulation comprises pulsed AC stimulation.

111. The method of claim 106 wherein electrical stimulation comprises direct current electrical stimulation.

112. The method of claim 106 wherein the two electrodes are located noninvasively and where in the two electrodes are skin-surface electrodes.

113. The method of claim 106 wherein the two electrodes are implanted electrodes.

114. The method of claim 113 wherein the first electrical source is also implanted; and wherein simultaneously controlling the range of current supplied comprises using a controller component operatively connected to the first electrical source by a wireless connection.

115. The method of claim 106 wherein applying said source of direct current to the spinal location comprises providing, from a second electrical source with second positive and second negative terminals, direct stimulation current to a first electrode and a second electrode, the first electrode disposed to be placed at a spinal cord location, the second electrode disposed to be placed at a location selected from another location at the spinal column or a location distal from the spine, one of the first and second electrodes operatively

connected to the second positive terminal and another one of the first and second electrodes operatively connected to the second negative terminal.

116. The method of claim 115 wherein the two electrodes are located noninvasively and wherein the two electrodes are skin-surface electrodes.

117. The method of claim 115 wherein simultaneously controlling the range of current supplied comprises using a controller component operatively connected to the first and second electrical sources.

118. The method of claim 117 wherein the control component and the first and second electrical sources are located in a wearable housing.

119. A method for modulating gastrointestinal function in vertebrate beings, the method comprising:

applying a source of electrical stimulation along a nerve that provides neural control of a gastrointestinal system; and

applying a source of direct current to a spinal location associated with efferent neural outflow to the gastrointestinal system.

120. The method of claim 119 wherein modulating gastrointestinal function is treating gastrointestinal motility disorders.

121. The method of claim 119, wherein the efferent neural outflow is sympathetic or parasympathetic.

122. The method of claim 121, wherein the efferent neural outflow is sympathetic; and wherein the efferent neural outflow is at spinal levels of T6-L2.

123. The method of claim 121, wherein the efferent neural outflow is parasympathetic; and wherein the efferent neural outflow is at spinal levels of S2-S4.

124. The method of claim 120, wherein direct current stimulation is anodal stimulation; wherein the anodal stimulation is applied to the spinal location between T6-L2; and wherein the nerve stimulated is a nerve in post-ganglionic fibers distal to the celiac ganglion, superior mesenteric ganglion or inferior mesenteric ganglion; and wherein nerve stimulation is applied using implanted electrodes.

125. The method of claim 120, wherein direct current stimulation is cathodal stimulation; wherein the cathodal stimulation is applied to the spinal location between S2-S4;

and wherein the nerve stimulated is preganglionic pelvic nerves; and wherein nerve stimulation is applied using implanted electrodes.

126. The method of claim 120, wherein direct current stimulation is cathodal stimulation; wherein the cathodal stimulation is applied to the spinal location between T6-L2; and wherein the nerve stimulated is a nerve in post-ganglionic fibers in and distal to the hypogastric plexus; and wherein nerve stimulation is applied using implanted electrodes.

127. The method of claim 120, wherein direct current stimulation is anodal stimulation; wherein the anodal stimulation is applied to the spinal location between S2-S4; and wherein the nerve stimulated is preganglionic pelvic nerves; and wherein nerve stimulation is applied using implanted electrodes.

128. The method of claim 120 wherein the gastrointestinal functions being modulated are gastrointestinal functions related to esophagus, stomach, small intestines, large intestines or rectum.

129. The method of claim 120 wherein the gastrointestinal motility disorders being treated include chronic intestinal pseudo-obstruction, irritable bowel syndrome, constipation, gastroesophageal reflux disease, dumping syndrome, intestinal dysmotility, diabetic gastroparesis, Hirschsprung's disease, gastroparesis, achalasia, small bowel bacterial overgrowth, diarrhea, functional heartburn, functional dysphagia, functional dyspepsia, post-prandial distress syndrome, epigastric pain syndrome, aerophagia, functional vomiting, chronic idiopathic nausea, functional bloating, functional abdominal pain disorder, functional sphincter of Oddi disorder, and other functional disorders.

130. The method of claim 119 wherein modulating gastrointestinal function is treating inflammatory immune-mediated gastrointestinal disorders.

131. The method of claim 130, wherein the efferent neural outflow is sympathetic or parasympathetic.

132. The method of claim 131, wherein the efferent neural outflow is sympathetic; and wherein the efferent neural outflow is at spinal levels of T6-L2.

133. The method of claim 131, wherein the efferent neural outflow is parasympathetic; and wherein the efferent neural outflow is at spinal levels of S2-S4.

134. The method of claim 130, wherein direct current stimulation is anodal stimulation; wherein the anodal stimulation is applied to the spinal location between T6-L2;

and wherein the nerve stimulated is a nerve in post-ganglionic fibers distal to the celiac ganglion, superior mesenteric ganglion or inferior mesenteric ganglion; and wherein nerve stimulation is applied using implanted electrodes.

135. The method of claim 130, wherein direct current stimulation is cathodal stimulation; wherein the cathodal stimulation is applied to the spinal location between S2-S4; and wherein the nerve stimulated is preganglionic pelvic nerves; and wherein nerve stimulation is applied using implanted electrodes.

136. The method of claim 130, wherein direct current stimulation is cathodal stimulation; wherein the cathodal stimulation is applied to the spinal location between T6-L2; and wherein the nerve stimulated is a nerve in post-ganglionic fibers in and distal to the hypogastric plexus; and wherein nerve stimulation is applied using implanted electrodes.

137. The method of claim 130, wherein direct current stimulation is anodal stimulation; wherein the anodal stimulation is applied to the spinal location between S2-S4; and wherein the nerve stimulated is preganglionic pelvic nerves; and wherein nerve stimulation is applied using implanted electrodes.

138. The method of claim 130 wherein the gastrointestinal functions being modulated are gastrointestinal functions related to esophagus, stomach, small intestines, large intestines or rectum.

139. The method of claim 130, wherein the inflammatory immune-mediated gastrointestinal disorders being treated include inflammatory bowel disease, Crohn's disease, ulcerative colitis, pediatric inflammatory bowel disease, eosinophilic esophagitis, celiac disease, and autoimmune hepatitis.

140. The method of claim 119 further comprising simultaneously controlling a range of electrical stimulation applied along said nerve and a range of direct current applied to the spinal location.

141. The method of claim 140 wherein applying a source of electrical stimulation along said nerve comprises providing, from a first electrical source with positive and negative terminals, stimulation current to stimulation electrodes, the stimulation electrodes including two electrodes disposed for stimulation of said nerve, one electrode operatively connected to the positive terminal and another electrode operatively connected to the negative terminal,

each one of the two electrodes being electrically insulated from another one of the two electrodes.

142. The method of claim 141 wherein electrical stimulation comprises pulsed electrical stimulation.

143. The method of claim 142 wherein the pulsed electrical stimulation comprises pulsed DC stimulation.

144. The method of claim 142 wherein the pulsed electrical stimulation comprises pulsed AC stimulation.

145. The method of claim 141 wherein electrical stimulation comprises direct current electrical stimulation.

146. The method of claim 141 wherein the two electrodes are located noninvasively and where in the two electrodes are skin-surface electrodes.

147. The method of claim 141 wherein the two electrodes are implanted electrodes.

148. The method of claim 147 wherein the first electrical source is also implanted; and wherein simultaneously controlling the range of current supplied comprises using a controller component operatively connected to the first electrical source by a wireless connection.

149. The method of claim 141 wherein applying said source of direct current to the spinal location comprises providing, from a second electrical source with second positive and second negative terminals, direct stimulation current to a first electrode and a second electrode, the first electrode disposed to be placed at a spinal cord location, the second electrode disposed to be placed at a location selected from another location at the spinal column or a location distal from the spine, one of the first and second electrodes operatively connected to the second positive terminal and another one of the first and second electrodes operatively connected to the second negative terminal.

150. The method of claim 149 wherein the two electrodes are located noninvasively and wherein the two electrodes are skin-surface electrodes.

151. The method of claim 149 wherein simultaneously controlling the range of current supplied comprises using a controller component operatively connected to the first and second electrical sources.

152. The method of claim 151 wherein the control component and the first and second electrical sources are located in a wearable housing.

153. A method for modulating anal sphincter function in vertebrate beings, the method comprising:

applying a source of electrical stimulation along a nerve that provides neural control of an anal sphincter; and

applying a source of direct current to a spinal location associated with efferent neural outflow to the anal sphincter.

154. The method of claim 153 wherein modulating anal sphincter function comprises treating fecal incontinence.

155. The method of claim 154, wherein the efferent neural outflow is sympathetic or parasympathetic.

156. The method of claim 155, wherein the efferent neural outflow is sympathetic; and wherein the efferent neural outflow is at spinal levels of L1-L2.

157. The method of claim 155, wherein the efferent neural outflow is parasympathetic; and wherein the efferent neural outflow is at spinal levels of S2-S4.

158. The method of claim 154, wherein direct current stimulation is anodal stimulation; wherein the anodal stimulation is applied to the spinal location between S2-S4; and wherein the nerve stimulated is one or more of parasympathetic preganglionic pelvic nerves; and wherein nerve stimulation is applied using implanted electrodes.

159. The method of claim 154, wherein direct current stimulation is cathodal stimulation; wherein the cathodal stimulation is applied to the spinal location between S2-S4; and wherein the nerve stimulated is a pudental nerve; and wherein nerve stimulation is applied using implanted electrodes.

160. The method of claim 154, wherein direct current stimulation is cathodal stimulation; wherein the cathodal stimulation is applied to the spinal location between L1-L2; and wherein the nerve stimulated is one or more of post-hypogastric plexus pelvic nerves; and wherein nerve stimulation is applied using implanted electrodes.

161. The method of claim 154 wherein the anal sphincter functions being modulated are the anal sphincter functions related to internal anal sphincter and the external anal sphincter.

162. The method of claim 153 further comprising simultaneously controlling a range of electrical stimulation applied along said nerve and a range of direct current applied to the spinal location.

163. The method of claim 162 wherein applying a source of electrical stimulation along said nerve comprises providing, from a first electrical source with positive and negative terminals, stimulation current to stimulation electrodes, the stimulation electrodes including two electrodes disposed for stimulation of said nerve, one electrode operatively connected to the positive terminal and another electrode operatively connected to the negative terminal, each one of the two electrodes being electrically insulated from another one of the two electrodes.

164. The method of claim 163 wherein electrical stimulation comprises pulsed electrical stimulation.

165. The method of claim 164 wherein the pulsed electrical stimulation comprises pulsed DC simulation.

166. The method of claim 164 wherein the pulsed electrical stimulation comprises pulsed AC stimulation.

167. The method of claim 163 wherein electrical stimulation comprises direct current electrical stimulation.

168. The method of claim 163 wherein the two electrodes are located noninvasively and where in the two electrodes are skin-surface electrodes.

169. The method of claim 168 wherein the two electrodes are implanted electrodes.

170. The method of claim 169 wherein the first electrical source is also implanted; and wherein simultaneously controlling the range of current supplied comprises using a controller component operatively connected to the first electrical source by a wireless connection.

171. The method of claim 163 wherein applying said source of direct current to the spinal location comprises providing, from a second electrical source with second positive and second negative terminals, direct stimulation current to a first electrode and a second electrode, the first electrode disposed to be placed at a spinal cord location, the second electrode disposed to be placed at a location selected from another location at the spinal column or a location distal from the spine, one of the first and second electrodes operatively

connected to the second positive terminal and another one of the first and second electrodes operatively connected to the second negative terminal.

172. The method of claim 171 wherein the two electrodes are located noninvasively and wherein the two electrodes are skin-surface electrodes.

173. The method of claim 163 wherein simultaneously controlling the range of current supplied comprises using a controller component operatively connected to the first and second electrical sources.

174. The method of claim 173 wherein the control component and the first and second electrical sources are located in a wearable housing.

175. A method for treating restless leg syndrome in humans, the method comprising:

applying a source of electrical stimulation along a nerve that provides neural control of a muscle affected by restless leg syndrome; and

applying a source of direct current to a spinal location associated with spinal circuits related to restless leg syndrome.

176. The method of claim 175 further comprising simultaneously controlling a range of electrical stimulation applied along said nerve and a range of direct current applied to the spinal location.

177. The method of claim 175 wherein applying said source of direct current to the spinal location comprises providing, from an electrical source with second positive and second negative terminals, direct stimulation current to a first electrode and a second electrode, the first electrode disposed to be placed at a spinal cord location, the second electrode disposed to be placed at another location distal from the spine, one of the first and second electrodes operatively connected to the second positive terminal and another one of the first and second electrodes operatively connected to the second negative terminal.

178. The method of claim 177 wherein direct stimulation current is supplied to a first electrode located at the spinal location at T11.

179. The method of claim 178, wherein direct stimulation current results from anodal stimulation.

180. The system of claim 177 wherein the second electrode is located at a ventral neck surface.

181. The method of claim 177 wherein the electrical source is located in a wearable housing; and wherein the first and second electrodes are located noninvasively and wherein the first and second electrodes are skin-surface electrodes.

182. A method for treating pain in humans, the method comprising:

applying a source of electrical stimulation along a nerve that provides neural control of an effector organ giving rise to pain; and

applying a source of direct current to a spinal location associated with efferent neural pathways associated with pain.

183. The method of claim 182 further comprising simultaneously controlling a range of electrical stimulation applied along said nerve and a range of direct current applied to the spinal location.

184. The system of claim 1 wherein the target effector organ is an effector organ innervated by an autonomic nervous system; and wherein the spinal direct current stimulation is provided to a spinal location associated with efferent neural outflow to the autonomic nervous system.

185. The system of claim 1 wherein the nerve is a nerve that provides neural control of bladder muscles; and wherein the spinal direct current stimulation is provided to a spinal location associated with efferent neural outflow to the bladder.

186. The system of claim 1 wherein the nerve is the nerve that provides neural control of a kidney; and wherein the spinal direct current stimulation is provided to a spinal location associated with efferent neural outflow to the kidney.

187. The system of claim 1 wherein the nerve is the nerve that provides neural control of a gastrointestinal system; and wherein the spinal direct current stimulation is provided to a spinal location associated with efferent neural outflow to the gastrointestinal system.

188. The system of claim 1 wherein the nerve is the nerve that provides neural control of an anal sphincter; and wherein the spinal direct current stimulation is provided to a spinal location associated with efferent neural outflow to the anal sphincter.

189. The system of claim 5 further comprising a sensor configured to detect a predetermined parameter and configured to provide a sensed value of the predetermined parameter to the controller component; and wherein the controller component is further

configured to initiate stimulation, initiation of stimulation determined by whether the sensed value exceeds a predetermined value.

190. The system of claim 5 further comprising a sensor configured to detect a predetermined parameter and configured to provide a sensed value of the predetermined parameter to the controller component; and wherein the controller component is further configured to initiate stimulation, initiation of stimulation determined by whether the sensed value is less than a predetermined value.

191. The method of claim 93 wherein modulating renal function is treating obesity.

192. The method of claim 93 wherein direct current stimulation is cathodal stimulation; wherein the cathodal stimulation is applied to the brainstem with electrodes at T1-T2 and at the cranial apex; and wherein the nerve stimulated is the vagus nerve; and wherein nerve stimulation is applied using implanted electrodes.

193. The method of claim 119 wherein direct current stimulation is cathodal stimulation; wherein the cathodal stimulation is applied to the brainstem with electrodes at T1-T2 and at the cranial apex; and wherein the nerve stimulated is the vagus nerve; and wherein nerve stimulation is applied using implanted electrodes.

CLAIMS

1. A system for modulation of spinal neurons associated with regulation of effector organ activity in a vertebrate being, the system comprising:

a housing including a DC power source that provides direct current between power terminals of opposite polarity;

a first stimulation component associated with a target effector organ including a neural stimulation circuit coupled to the terminals and having an identified neural signal output connection and an identified neural reference connection, both on said housing, and that provides a constant direct current neural stimulation signal between the identified neural signal output connection and the identified neural reference, connection for stimulation of a nerve associated with a target effector organ;

a second stimulation component including a spinal stimulation circuit coupled to the power terminals and having an identified spinal signal output connection and an identified spinal reference connection, both on said housing, that provides a constant direct current spinal stimulation signal between the identified spinal signal connection and the identified spinal signal reference for spinal direct current stimulation associated with modulation of said target effector organ; and

a polarity controlling component associated with the power terminals that simultaneously establishes a neural signal output connection at a first polarity and a spinal signal output connection at an opposite polarity, for stimulation of said effector organ according to the first and opposite polarities.

2. The system of claim 1 wherein the second stimulation component is configured to provide spinal non-varying continuous direct current electrical stimulation.

3. The system of claim 2 wherein the first stimulation component is configured to provide peripheral neural continuous direct current electrical stimulation.

4. The system of claim 2 wherein the first stimulation component is configured to provide non-varying continuous direct current electrical stimulation.

5. The system of claim 3 further comprising a controller component configured to simultaneously control current applied to the first and second stimulation components and to limit a current of the first component at not greater than a current at the second stimulation component.

6. The system of claim 3 further comprising a controller component configured to simultaneously control a range of current supplied by the first and second stimulation components and to establish an upper limit of current first stimulation component at not greater than a current at the second stimulation component and to dynamically adjust the upper limits simultaneously with adjustment of the current of the second stimulation

component.

7. The system of claim 1, further comprising a first electrical source with positive and negative terminals configured to provide stimulation current to stimulation electrodes, disposed for stimulation of a nerve associated with a target effector organ; one electrode operatively connected to the positive terminal and another electrode operatively connected to the negative terminal; each one of said one electrode and said another electrode being electrically insulated from each other.

8. The system of claim 7 wherein said one electrode and said another electrode are configured to be attached across a section of a nerve associated with a muscle of interest to provide direct current electrical stimulation to the muscle nerve section.

9. The system of claim 8 further comprising:

a second electrical source having a second positive terminal and a second negative terminal;

said second electrical source configured to couple to a first electrode disposed to be placed at a spinal cord location; and

a second reference electrode disposed to he placed at a location selected from another location at the spinal column or a location distal from the spine; one of the first electrode and the second reference electrodes being operatively connected to the second positive terminal and another one of the first electrode and the second reference electrode being operatively connected to the second negative terminal.

10. The system of claim 9 wherein the first electrical source and the second electrical source are a same electrical source; and wherein the same electrical source is a source producing non-varying direct current.

11. The system of claim 1 wherein direct current for spinal stimulation ranges from about 2 ma to about 5 mA for treatment of muscle tone in humans.

12. The system of claim 10 wherein at least one of the first electrode and the second reference electrode is implanted.

13. The system of claim 9 wherein the first electrical source is implanted; and wherein the controller component is operatively connected to the first electrical source by a wireless connection.

14. The system of claim 13 wherein the controller component is disposed in a wearable housing.

15. The system of claim 14 wherein the second electrical source is also disposed in the

wearable housing.

16. The system of claim 2 wherein the first stimulation component is configured to provide pulsed electrical stimulation.

17. The system of claim 5 further comprising a sensor configured to detect a predetermined parameter and configured to provide a sensed value of the predetermined parameter to the controller component; and

wherein the controller component is further configured to initiate stimulation, initiation of stimulation determined by whether the sensed value meets a criterion selected from exceeding a predetermined value or being less than the predetermined value.

18. The system of claim 3 further comprising a controller component configured to set the first of the power terminals at one polarity and the second of the power terminals at an opposite polarity.

19. The system of claim 1 further comprising:

a controller component configured to control current applied to the first and second stimulation components and to limit the current at one of the first and second stimulation components relative to the current at one other of the first and second stimulation components; and

a sensor configured to detect a predetermined parameter and configured to provide a sensed value of the predetermined parameter to the controller component;

wherein the controller component is further configured to initiate stimulation, initiation of stimulation determined by whether the sensed value meets a criterion selected from exceeding a predetermined value or being less than the predetermined value.

20. A system for modulation of spinal neurons associated with regulation of effector organ activity in a vertebrate being, the system comprising:

a first stimulation component configured to provide stimulation of a nerve associated with a target effector organ,

a second stimulation component configured to provide spinal direct current stimulation associated with modulation of the target effector organ, and

a controller component configured to simultaneously control a range of current supplied by the first and second stimulation components and establishing an upper limit of current of the first stimulation component at not greater than a current at the second stimulation component and dynamically adjusting the upper limit simultaneously with adjustment of the current at the second stimulation component;

wherein the second stimulation component is configured to provide spinal non-varying continuous direct current electrical stimulation; and

wherein the first stimulation component is configured to provide direct current electrical stimulation.