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(54) **MECHANICAL WALKING DEVICE WITH STEP SIZE ADJUSTMENT**

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(57) **ABSTRACT**

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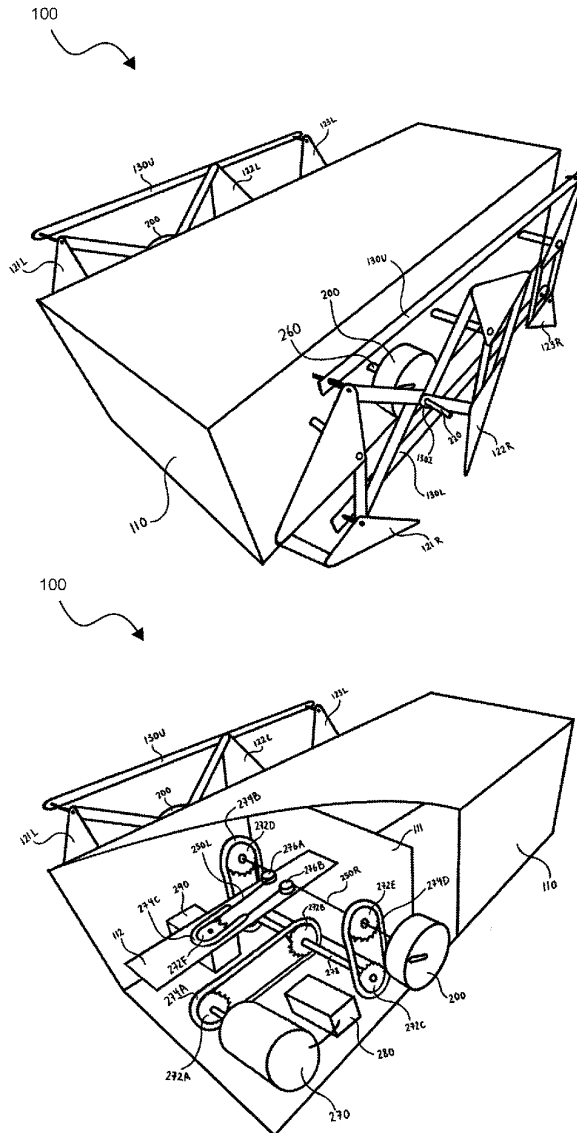
A mechanical walker has at least three legs on each side, and relative step sizes on the left and right sides can be modified to alter directional movement of the walker. Walkers can be powered in any suitable manner, including using human and/or electrical power. Walkers preferably have an upper linkage between first and third legs, a lower linkage between first and third legs, and an intermediate linkage between second and third legs. Stepping motions on each side are executed by moving the intermediate linkage in a circular motion having a variable radius. The intermediate linkage includes a pin carried on a crank wheel to provide the circular motion, and moving the pin radially with respect to an axle of the crank wheel alters the step size.

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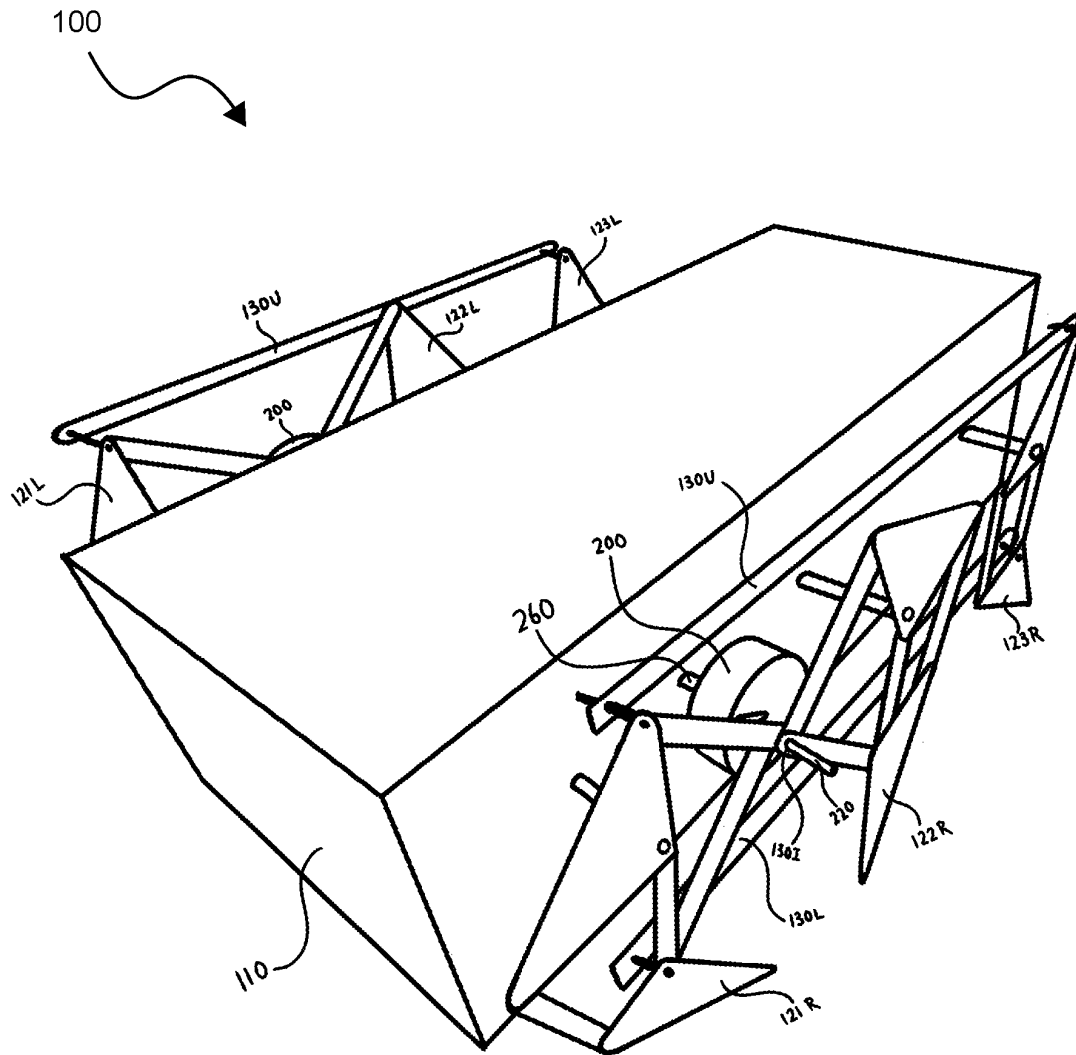


Figure 1A

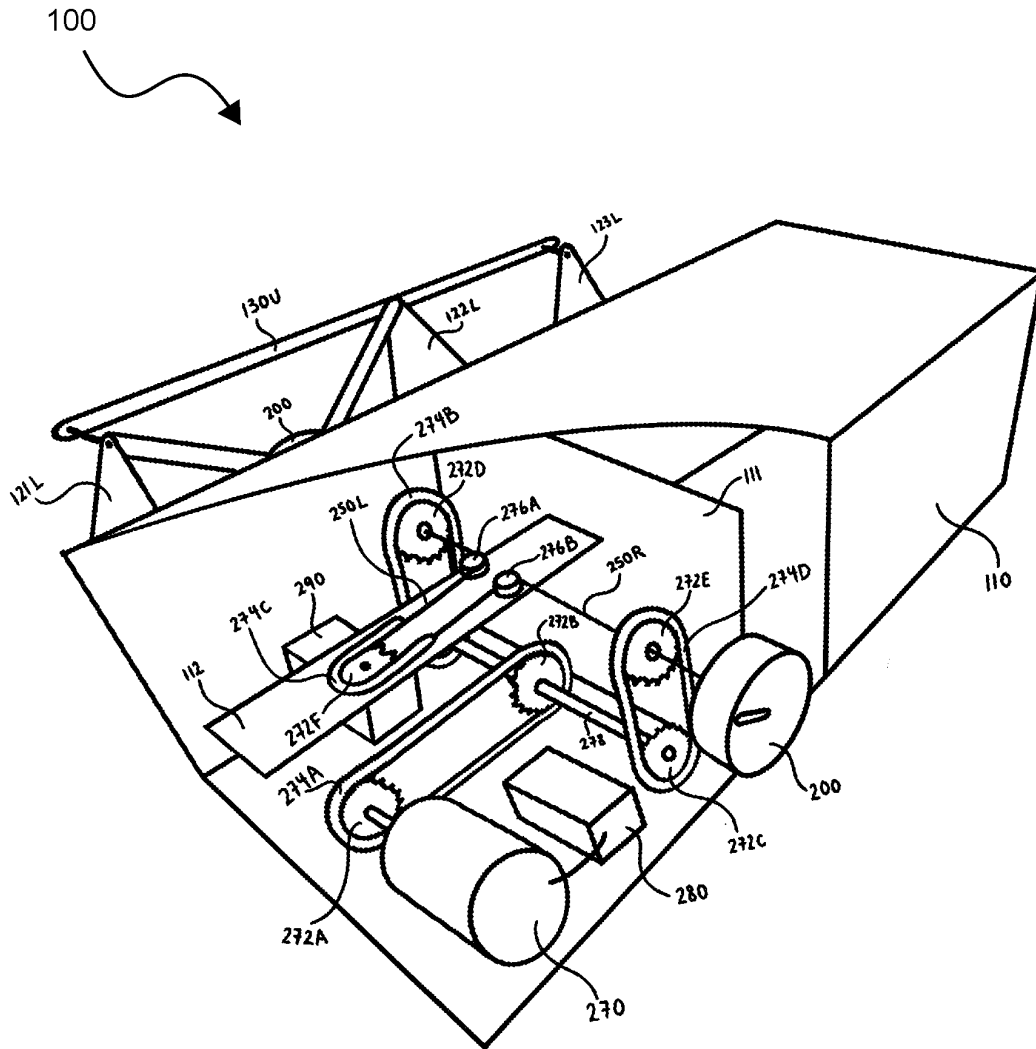


Figure 1B

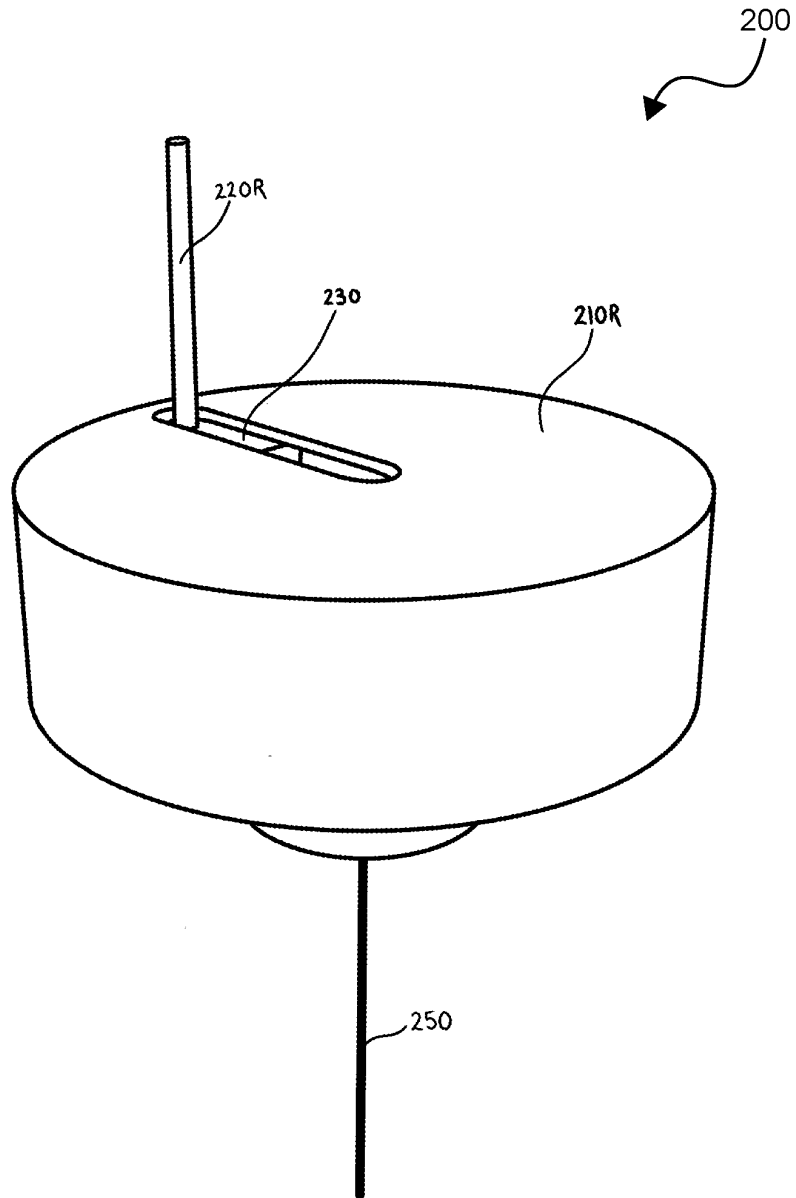


Figure 2A

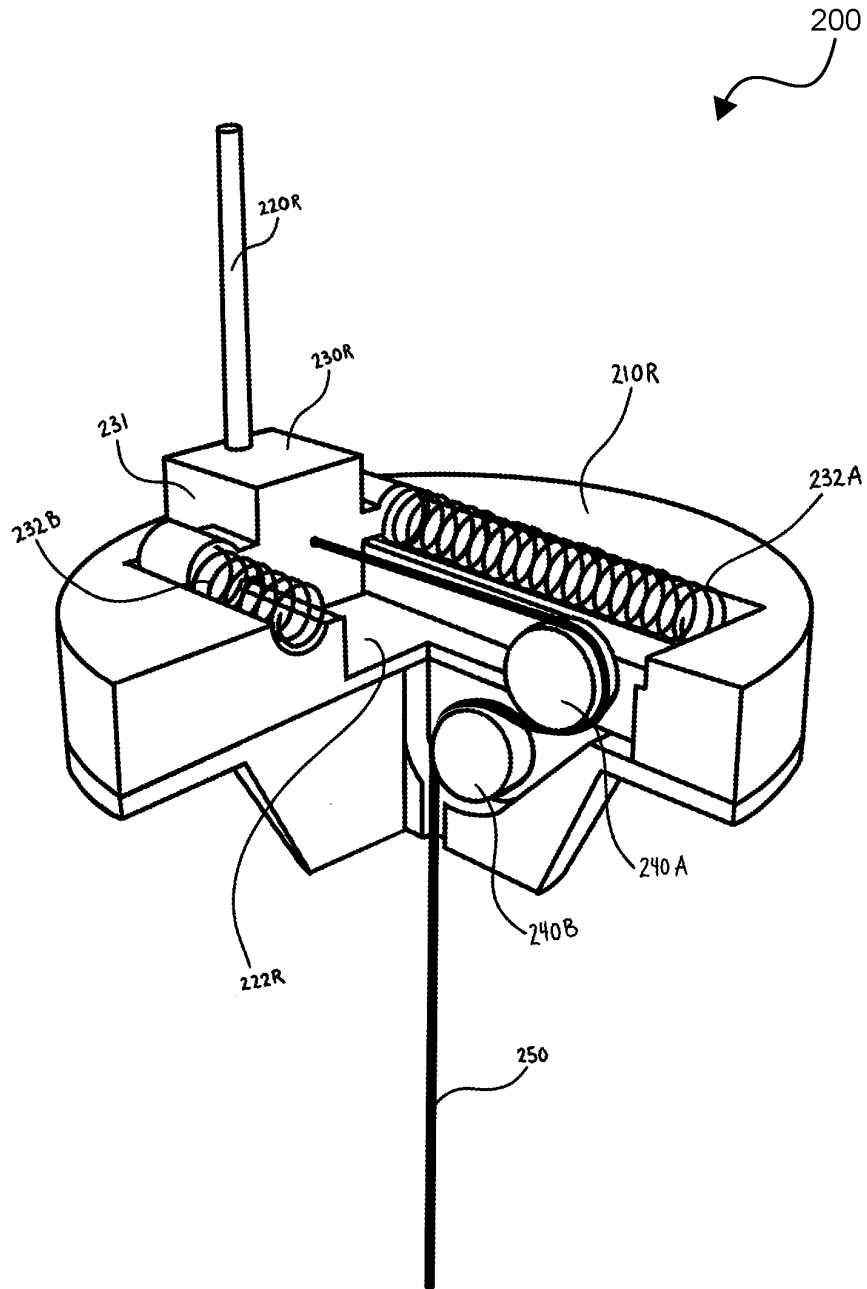


Figure 2B

## MECHANICAL WALKING DEVICE WITH STEP SIZE ADJUSTMENT

### FIELD OF THE INVENTION

**[0001]** The field of the invention is multi-leg mechanical walking devices for uneven terrain.

### BACKGROUND

**[0002]** The background description includes information that may be useful in understanding the present invention. It is not an admission that any of the information provided herein is prior art or relevant to the presently claimed invention, or that any publication specifically or implicitly referenced is prior art.

**[0003]** The known walking devices, including for example the various Jansen walking devices, <https://www.instructables.com/theo-jansen-machine/>, and CN114475849A, have difficulty maintaining stability while steering (changing direction). These known devices change direction by increasing the speed of leg movement on one side relative to the other, but produce instability in the process. The solution has been to provide a large number of legs on each side, in some cases eight or more, but that causes even more problems because the legs tend to become asynchronous.

**[0004]** It appears that no one has devised a good solution for walking devices with at least three legs on each side.

**[0005]** All publications herein are incorporated by reference to the same extent as if each individual publication or patent application were specifically and individually indicated to be incorporated by reference. Where a definition or use of a term in an incorporated reference is inconsistent or contrary to the definition of that term provided herein, the definition of that term provided herein applies and the definition of that term in the reference does not apply.

**[0006]** As used in the description herein and throughout the claims that follow, the meaning of “a,” “an,” and “the” includes plural reference unless the context clearly dictates otherwise. Also, as used in the description herein, the meaning of “in” includes “in” and “on” unless the context clearly dictates otherwise.

**[0007]** The recitation of ranges of values herein is merely intended to serve as a shorthand method of referring individually to each separate value falling within the range. Unless otherwise indicated herein, each individual value is incorporated into the specification as if it were individually recited herein. All methods described herein can be performed in any suitable order unless otherwise indicated herein or otherwise clearly contradicted by context. The use of any and all examples, or exemplary language (e.g. “such as”) provided with respect to certain embodiments herein is intended merely to better illuminate the invention and does not pose a limitation on the scope of the invention otherwise claimed. No language in the specification should be construed as indicating any non-claimed element essential to the practice of the invention.

**[0008]** Thus, there is still a need for a mechanical walker with variable step sizes.

### SUMMARY OF THE INVENTION

**[0009]** The inventive subject matter provides apparatus, systems and methods in which a mechanical walker is controlled by modifying relative step sizes of the legs of the walker. Walkers have at least three legs on each side, and the

relative step sizes on the left and right sides can be modified to alter directional movement of the walker. Walkers can be powered in any suitable manner, including using human and/or electrical power.

**[0010]** In preferred embodiments, the walker on each side has an upper linkage between first and third legs, a lower linkage between first and third legs, and an intermediate linkage between second and third legs. Stepping motions on each side are executed by moving the intermediate linkage in a circular motion having a variable radius.

**[0011]** In particularly preferred embodiments, the intermediate linkage includes a pin carried on a crank wheel to provide the circular motion, and moving the pin radially with respect to an axle of the crank wheel alters the step size. A cord through the axle can advantageously be used to move the pin radially with respect to the axle.

**[0012]** Various objects, features, aspects and advantages of the inventive subject matter will become more apparent from the following detailed description of preferred embodiments, along with the accompanying drawing figures in which like numerals represent like components.

### BRIEF DESCRIPTION OF THE DRAWING

**[0013]** FIG. 1A is a perspective view of a multi-leg walker having variable step sizes.

**[0014]** FIG. 1B is a partial cutaway of the multi-leg walker of FIG. 1A.

**[0015]** FIG. 2A is perspective view of the right crank wheel of the multi-leg walker of FIG. 1A, having a variable radius pin.

**[0016]** FIG. 2B is schematic of the right crank wheel of FIG. 2A.

### DETAILED DESCRIPTION

**[0017]** In FIGS. 1A and 1B a walker **100** generally comprises a partial cut open housing **110**, right legs **121R**, **122R**, **123R**, left legs **121L**, **122L**, **123L**, upper linkage **130U**, lower linkage **130L**, and intermediate linkage **130I**, crank wheel **200**, crank pin **220**, and crank axle **260**, motor **270** and drive sprocket **272**, drive chain **274**, and power supply **280**.

**[0018]** In operation, power supply **280** powers motor **270**, which turns sprocket **272** and moves drive train **274** to turn crank axle **260**. Rotation of crank axle **260** rotates crank wheel **200** which moves crank pin **220** in a circular motion. Motion of crank pin drives intermediate linkage **130I**, which moves right legs **122R** and **123R**, and movement of right leg **123R** moves upper linkage **130U** and lower linkage **130L**. Movement of the upper linkage **130U** and lower linkage **130L** move right leg **121R**. Although not shown, there are corresponding linkages for the left legs **121L**, **122L**, **123L**.

**[0019]** Servo **290** operates opposing left and right cords **250L**, **250R** through steering sprocket **292**. The left cord **250L** control step sizes of the left legs **121L**, **122L**, **123L**, and the right cord **250R** control step sizes of the right legs **121R**, **122R**, **123R**.

**[0020]** In FIGS. 2A and 2B a crank wheel **200R** generally comprise a housing **210R**, a crank pin **220R** movably disposed in a slot **222R**, a slider mechanism **230R**, first and second pulleys **240A**, **240B**. The crank wheel **200R** cooperates with a cord **250R** running through an crank axle **260R**, and around first and second pulleys **240A**, **240B** to slider mechanism **230R**.

**[0021]** The housing **210R** can have any suitable dimensions, including for example, 3-7 cm in diameter for a small walker, or 30-60 cm for big walker. Housing **210 R** could advantageously be about 10-15% of a height of the walker. Housing **210R** can be made of metal or any other suitably strong material.

**[0022]** Slider mechanism **230** generally comprises a slider **231** biased by springs **232A**, **232B**. The slider is mechanically interposed between the pin **220** and the cord **250**.

**[0023]** As used in the description herein and throughout the claims that follow, the meaning of “a,” “an,” and “the” includes plural reference unless the context clearly dictates otherwise. Also, as used in the description herein, the meaning of “in” includes “in” and “on” unless the context clearly dictates otherwise.

**[0024]** Unless the context dictates the contrary, all ranges set forth herein should be interpreted as being inclusive of their endpoints, and open-ended ranges should be interpreted to include only commercially practical values. Similarly, all lists of values should be considered as inclusive of intermediate values unless the context indicates the contrary.

**[0025]** The recitation of ranges of values herein is merely intended to serve as a shorthand method of referring individually to each separate value falling within the range. Unless otherwise indicated herein, each individual value with a range is incorporated into the specification as if it were individually recited herein. All methods described herein can be performed in any suitable order unless otherwise indicated herein or otherwise clearly contradicted by context. The use of any and all examples, or exemplary language (e.g., “such as”) provided with respect to certain embodiments herein is intended merely to better illuminate the invention and does not pose a limitation on the scope of the invention otherwise claimed. No language in the specification should be construed as indicating any non-claimed element essential to the practice of the invention.

**[0026]** Groupings of alternative elements or embodiments disclosed herein are not to be construed as limitations. Each group member can be referred to and claimed individually or in any combination with other members of the group or other elements found herein. One or more members of a group can be included in, or deleted from, a group for reasons of convenience and/or patentability. When any such inclusion or deletion occurs, the specification is herein deemed to contain the group as modified thus fulfilling the written description of all Markush groups used in the appended claims.

**[0027]** It should be apparent to those skilled in the art that many more modifications besides those already described are possible without departing from the inventive concepts

herein. The inventive subject matter, therefore, is not to be restricted except in the spirit of the appended claims. Moreover, in interpreting both the specification and the claims, all terms should be interpreted in the broadest possible manner consistent with the context. In particular, the terms “comprises” and “comprising” should be interpreted as referring to elements, components, or steps in a non-exclusive manner, indicating that the referenced elements, components, or steps may be present, or utilized, or combined with other elements, components, or steps that are not expressly referenced. Where the specification claims refers to at least one of something selected from the group consisting of A, B, C . . . and N, the text should be interpreted as requiring only one element from the group, not A plus N, or B plus N, etc.

What is claimed is:

1. A method of operating a mechanical walker, comprising:
  - providing the walker with a left grouping of at least first, second, and third left legs and a right grouping of at least first, second, and third right legs;
  - modifying relative step sizes between the left and right groupings.
2. The method of claim 1, further comprising using human power to operate the mechanical walker.
3. The method of claim 1, further comprising using energy stored within the walker to power the walker.
4. The method of claim 1, further comprising an upper linkage between first and third right legs, a lower linkage between first and third right legs.
5. The method of claim 4, further comprising an intermediate linkage between second and third right legs, and driving the right grouping of legs by moving the intermediate linkage in a circular motion having a radius.
6. The method of claim 1, further comprising an intermediate linkage between second and third right legs, and driving the right grouping of legs by moving the intermediate linkage in a circular motion having a radius.
7. The method of claim 6, further comprising modifying the step size of the right grouping by altering the radius.
8. The method of claim 6, further comprising using a pin on a crank wheel to provide the circular motion, and movement of the pin radially with respect to an axle of the crank wheel.
9. The method of claim 8, further comprising passing a cord through the axle to move the pin radially with respect to an axle.

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