Claims

1. A device for providing active assistance to a body joint between a first portion and a second portion of a body, the device comprising:

a first attachment part configured to hold the device to the first portion of the body;

a second attachment part configured to hold the device to the second portion of the body; and

at least one spring module interconnecting the first attachment part and the second attachment part, the at least one spring module comprises

a first elongate link member coupled to the first attachment part;

a second elongate link member coupled to the second attachment part, wherein the first elongate link member and the second elongate link member are pivotably coupled to each other at a pivot joint with a pivoting axis perpendicular to the first and second elongate link members; and

a coil spring extending longitudinally between the first and second elongate link members and across the pivot joint, wherein a first end of the coil spring is coupled to the first elongate link member and a second end of the coil spring is coupled to the second elongate link member,

wherein the at least one spring module further comprises a slidable coil-spring-retaining-member at the first elongate link member, the coil- spring-retaining-member being slidable relative to the first elongate link member in a manner so as to vary a portion of a length of the coil spring, from the first end of the coil spring towards the second end, engaged and retained by the coil-spring-retaining-member to vary an effective length of the coil spring.

2. The device as claimed in claim 1, wherein the coil spring of the at least one spring module is configured to provide a torque, based on a lateral stiffness of the coil spring, against a relative pivoting motion about the pivot joint between the first and second

elongate link members from a longitudinally aligned disposition of the first and second elongate link members.

3. The device as claimed in claim 1 or 2, wherein the coil spring comprises a rectangular-shaped coil spring, a pill-shaped coil spring, or a wedged-shape coil spring.

4. The device as claimed in any one of claims 1 to 3, wherein the coil-spring-retaining-member comprises a coil-spring-retaining-insert slidable relative to the first elongate link member in a manner so as to vary a length of the coil-spring-retaining-insert, from a free end of the coil-spring-retaining-insert towards an opposite end, slidably inserted within the coil spring from the first end thereof to vary the portion of the length of the coil spring engaged and retained by the coil-spring-retaining-insert to vary the effective length of the coil spring.

5. The device as claimed in any one of claims 1 to 3, wherein the coil-spring-retaining-member comprises a coil-spring-retaining-bracket slidable relative to the first elongate link member in a manner so as to vary the length of the coil spring, from the first end of the coil spring towards the second end, engaged and retained within the coil-spring-retaining-bracket to vary the effective length of the coil spring.

6. The device as claimed in any one of claims 1 to 5, wherein the at least one spring module further comprises a locking mechanism to lock the slidable coil-spring-retaining-member to the first elongate link member.

7. The device as claimed in any one of claims 1 to 6,

wherein a longitudinal end portion of the first elongate link member comprises a diagonal arm extending therefrom,

wherein a longitudinal end portion of the second elongate link member comprises a diagonal arm extending therefrom,

wherein a tip portion of the diagonal arm of the first elongate link member is pivotably coupled to a tip portion of the diagonal arm of the second elongate link member in a manner so as to form the pivot joint immediately adjacent a mid-segment of the coil spring when the coil spring is aligned with the first and second elongate link members.

8. The device as claimed in any one of claims 1 to 7,

wherein the first elongate link member comprises a hollow frame wherein the first end of the coil spring is inserted into the first elongate link member and coupled to an inner wall surface of the first elongate link member, and

wherein the second elongate link member comprises a hollow frame wherein the second end of the coil spring is inserted into the second elongate link member and coupled to an inner wall surface of the second elongate link member.

9. The device as claimed in claim 8 in combination with claim 4,

wherein the coil-spring-retaining-insert is slidable inside the hollow frame of the first elongate link member,

wherein the first elongate link member comprises a longitudinal slot along a wall portion of the hollow frame, and

wherein the coil-spring-retaining-insert comprises a protrusion extending from the coil-spring-retaining-insert and through the longitudinal slot.

10. The device as claimed in any one of claims 1 to 9, wherein each of the first attachment part and the second attachment part comprises a curved-bracket having a curvature extending from a first end to a second end, the curvature of the curved-bracket being shaped to correspond to a transverse contour of the first portion and the second portion of the body respectively.

11. The device as claimed in claim 10,

wherein the at least one spring module interconnects the first end of the curved-bracket of the first attachment part and the first end of the curved-bracket of the second attachment part,

wherein the first elongate link member is coupled directly to the first end of the curved- bracket of the first attachment part,

wherein the second elongate link member is coupled directly to the first end of the curved-bracket of the second attachment part, and

wherein the device is free of other components interconnecting the first end of the curved-bracket of the first attachment part and the first end of the curved-bracket of the second attachment part.

12. The device as claimed in claim 10 or 11, further comprising a linkage assembly interconnecting the second end of the curved-bracket of the first attachment part and the second end of the curved-bracket of the second attachment part, the linkage assembly comprises

a first link rod coupled to the second end of the curved-bracket of the first attachment part; and

a second link rod coupled to the second end of the curved-bracket of the second attachment part,

wherein the first link rod and the second link rod are pivotably coupled to each other at a pivot joint which is coaxial with the pivot joint between the first and second elongate link members of the at least one spring module.

13. The device as claimed in claim 10 or 11, wherein the device comprises

a first spring module interconnecting the first end of the curved-bracket of the first attachment part and the first end of the curved-bracket of the second attachment part, and

a second spring module interconnecting the second end of the curved-bracket of the first attachment part and the second end of the curved-bracket of the second attachment part.

14. The device as claimed in claim 13, wherein the device is free of other components interconnecting the first attachment part and the second attachment part.

15. The device as claimed in any one of claims 1 to 14, wherein the at least one spring module is removably coupled to the first attachment part and the second attachment part.