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Inventor(s)	Wang; Jun et al.

Ankle joint device with a foot support featuring adjustable initial angle

Abstract

An ankle joint device comprises a base, an angle adjusting assembly, and a foot support member; the angle adjusting assembly comprises a rotation member and an anti-rotation member, wherein the rotation member is rotationally mounted on the base, and the anti-rotation member is slidably and detachably locked to the rotation member along the axial direction defined by the rotation member; the foot support member is mounted to the anti-rotation member, after the anti-rotation member slides away from the rotation member in the axial direction by a predetermined distance, the foot support member is allowed to rotate at a predetermined angle, and the foot support member is locked to the rotation member to rotate with the rotation member relative to the base after the anti-rotation member slides close to the rotation member in the axial direction by a predetermined distance in a state of being maintained at the predetermined angle.

Inventors:	**Wang; Jun (Jiangsu, CN), Wang; Tongchen (Shanghai, CN), Xiao; Danping (Jiangxi, CN), Gu; Jie (Shanghai, CN), Li; Chong (Shanghai, CN)**
Applicant:	**SHANGHAI FOURIER INTELLIGENCE CO., LTD** (Shanghai, CN)
Family ID:	**1000008748924**
Assignee:	**SHANGHAI FOURIER INTELLIGENCE CO., LTD (Shanghai, CN)**

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Primary Examiner: Baker; Adam

Attorney, Agent or Firm: HAUPTMAN HAM, LLP

Background/Summary

FIELD OF TECHNOLOGY

(1) The present invention relates to an ankle joint mechanism, in particular to an ankle joint device with a foot support featuring adjustable initial angle.

BACKGROUND

(2) Nowadays, medical devices are gradually used to assist users in rehabilitation training. As different parts of the human body have different bone structures, medical devices with different structures are needed to assist. The ankle joint is an important part of the human body, which directly determines whether people can walk normally.

(3) For some users with damaged ankle joints, in order to prevent their damaged ankle joints from being damaged by walking before recovery, they usually need to wear an ankle joint mechanism. A patent application with the publication number CN110900569A discloses an ankle joint mechanism without a power source.

(4) The ankle joint of the exoskeleton comprises the shank connecting rod, a heel block, a rotating shaft, an oil-free bushing, an end cap, a sole support, a flip connecting member, and a sole. This kind of ankle joint can only rotate, which can neither limit the range of ankle motion nor play a buffering role. However, different users have different ankle joint damage. Therefore, when training through the ankle joint of the exoskeleton, the training range is different. That is to say, since different users have different ankle joint damage, when they usually need plantarflexion and dorsiflexion, a starting angle between the foot support and the shank connecting member is correspondingly different. Otherwise, in the process of walking, it is easy to cause secondary damage due to the error of starting angle.

(5) Further, in the patent with the publication number of CN110900569A, the range of motion of the ankle joint exoskeleton is not limited. In this way, it is easy to cause secondary damage to the ankle of some users whose ankle joints cannot be plantarflexed and dorsiflexed excessively because the range of motion of the ankle joint is not limited.

(6) Further, a patent application with the publication number CN105616113A discloses a passive energy storage foot mechanism of an exoskeleton assisting lower limbs. The exoskeleton ankle joint has a limiting device and a passive energy storage mechanism including a spring, which can store and release energy to realize buffering, damping and automatic return when users walk. This kind of mechanism is small in size, simple in structure, and low in cost. However, when people walk, their ability to bear weight and support is poor. In an initial state of the ankle joint, a starting angle between the foot support and the shank connecting member is 90°, which is unadjustable. In addition, for users with weak leg muscle strength, the natural angle between plantar and shank is not 90°. In this case, if the user wears this rehabilitation device, it is prone to discomfort and ankle fatigue.

(7) A patent application with the publication number of CN107042502A discloses “A CLOSED CHAIN CONNECTING ROD TYPE UNDERACTUATED LOWER EXTREMITY EXOSKELETON MECHANISM”. The exoskeleton uses a single power source and a multi-linkage mechanism to connect and drive the hip joint, knee joint and ankle joint, thus reducing the overall weight of the exoskeleton. However, for users with different heights and body types, it is necessary to design different connecting rod lengths, which cannot solve the problems that the starting angle of the ankle joint cannot be adjusted and the range of ankle motion cannot be limited, so the applicable user scope is limited.

(8) Further, generally, the foot support of the ankle joint mechanism needs to be rotationally mounted on a base, so that the foot support can freely rotate relative to the base with the plantarflexion or dorsiflexion of the user's foot when the user is using the ankle joint mechanism. In order to realize the adjustable initial angle of the foot support relative to the base, the angle of the foot support relative to the base needs to be adjusted and maintained in the corresponding adjusted state, and the foot support needs to be fixed in the adjusted state. This conflicts with the need for

free rotation of the foot support relative to the base to some extent.

SUMMARY

(9) Another purpose of the present invention is to provide an ankle joint device with a foot support featuring adjustable initial angle, wherein the initial angle between the foot support and the shank connecting member can be adjusted while being maintained in an adjusted state, and the foot support can be freely rotated.

(10) A purpose of the present invention is to provide an ankle joint device with a foot support featuring adjustable initial angle, which can be applied to users with different ankle damage degrees.

(11) Another purpose of the present invention is to provide an ankle joint device with a foot support featuring adjustable initial angle, when the foot support of the ankle joint device with a foot support featuring adjustable initial angle rotates relative to the shank connecting member, a rotation angle thereof can be limited to a predetermined range, thereby preventing the ankle joint of a user whose ankle joint cannot be excessively moved from secondary damage due to excessive rotation.

(12) Another purpose of the present invention is to provide an ankle joint device with a foot support featuring adjustable initial angle, which can provide a buffering effect when a user walks, thereby preventing the ankle joint of the user from rotating rapidly and causing the secondary damage.

(13) In order to realize at least one purpose of the present invention, the present invention provides an ankle joint device with a foot support featuring adjustable initial angle, which comprises: a base; an angle adjusting assembly, which comprises a rotation member and an anti-rotation member, wherein the rotation member is rotationally mounted on the base, wherein the anti-rotation member is slidably and detachably locked to the rotation member along the axial direction defined by the rotating shaft of the rotation member; and a foot support member, which is mounted to the anti-rotation member, after the anti-rotation member slides away from the rotation member in the axial direction by a predetermined distance, the foot support member is allowed to rotate at a predetermined angle as the anti-rotation member is separated from the rotation member, and the foot support member is locked to the rotation member to rotate with the rotation member relative to the base after the anti-rotation member slides close to the rotation member in the axial direction by a predetermined distance in a state of being maintained at the predetermined angle.

(14) According to an embodiment of the present invention, the angle adjusting assembly includes an anti-rotation structure; the anti-rotation structure comprises a set of anti-rotation holes and a set of anti-rotation columns, which are respectively arranged on the circumference of the same diameter, wherein the anti-rotation hole is disposed on the rotation member, the anti-rotation column is disposed on the anti-rotation member, and the anti-rotation column is correspondingly inserted into the anti-rotation hole to lock the anti-rotation member to the rotation member.

(15) According to an embodiment of the present invention, the angle adjusting assembly includes an anti-rotation structure, which comprises a set of anti-rotation holes and a set of anti-rotation columns, which are respectively arranged on the circumference of the same diameter, wherein the anti-rotation hole is disposed on the anti-rotation member, and the anti-rotation column is disposed on the rotation member and correspondingly inserted into the anti-rotation hole to lock the anti-rotation member to the rotation member.

(16) According to an embodiment of the present invention, the foot support member is integrally formed toward one side of the rotation member to form the anti-rotation member.

(17) According to an embodiment of the present invention, the angle adjusting assembly includes a mounting member, which is disposed between the rotation member and the anti-rotation member; the foot support member is fixed to the mounting member; at least a set of through holes is disposed on the mounting member, the through hole is arranged on the circumference having a diameter equal to that of the circumference where the anti-rotation hole or the anti-rotation column is; the anti-rotation column is inserted into the anti-rotation hole through the through hole on the mounting member, and the anti-rotation column slides away from the anti-rotation hole after the

anti-rotation member slides away from the rotation member along the axial direction for a predetermined distance.
(18) According to an embodiment of the present invention, a perforation is formed in the middle part of the base, a shaft hole is formed in the middle part of the rotation member, and the middle part of the anti-rotation member extends toward the base along the axial direction to form an extension shaft, which passes through the shaft hole and the perforation successively to form an end portion.
(19) According to an embodiment of the present invention, the ankle joint device with a foot support featuring adjustable initial angle includes an elastic member, which is connected to the anti-rotation member in such a manner that the anti-rotation member tends to move in the axial direction toward the rotation member.
(20) According to an embodiment of the present invention, the elastic member is disposed between the anti-rotation member and the mounting member in a compressed manner.
(21) According to an embodiment of the present invention, the angle adjusting assembly includes at least an angle limiting structure, which comprises at least a limiting pin and an arc-shaped limiting groove, one side of the rotation member facing the base extending toward the base to form the limiting pin, the arc-shaped limiting groove being disposed on the base facing the side of the rotation member, and the limiting pin being inserted into the arc-shaped limiting groove.
(22) According to an embodiment of the present invention, the angle adjusting assembly includes at least an angle limiting structure, which comprises at least a limiting pin and an arc-shaped limiting groove, one side of the base extending toward the rotation member to form the limiting pin, the arc-shaped limiting groove being disposed at the side of the rotation member facing the base, and the limiting pin being inserted into the arc-shaped limiting groove.
(23) According to an embodiment of the present invention, the angle adjusting assembly includes at least an angle limiting structure, which comprises at least a limiting pin and an arc-shaped limiting groove, one side of the mounting member facing the base extending toward the base to form the limiting pin, the arc-shaped limiting groove being disposed on the side of the base facing the rotation member, and the limiting pin extending into the arc-shaped limiting groove over the rotation member.
(24) According to an embodiment of the present invention, the central angle of the circumference formed by the arc-shaped limiting groove of the angle limiting structure minus the central angle of the arc-shaped limiting groove occupied by the limiting pin is implemented as 60°-80°.
(25) According to an embodiment of the present invention, the ankle joint device with a foot support featuring adjustable initial angle includes a buffering assembly, which is disposed between the base and the rotation member in such a manner that when the rotation member is rotated relative to the base and deviates from the set initial angle, the buffering assembly maintains a restoring force applied to the rotation member before returning to rotating.
(26) Further purposes and advantages of the present invention will be fully embodied by understanding the following description.
(27) These and other purposes, features and advantages of the present invention are fully embodied in the following detailed description.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) FIG. **1** shows a perspective view of an ankle joint device with a foot support featuring adjustable initial angle of the present invention.
(2) FIGS. **2**A and **2**B respectively show exploded views at different angles of the ankle joint device with a foot support featuring adjustable initial angle of an embodiment of the present invention.

(3) FIGS. **3**A and **3**B respectively show exploded views at different angles of the ankle joint device with a foot support featuring adjustable initial angle of another embodiment of the present invention.
(4) FIG. **4** shows an assembly view of a portion of the structure of the ankle joint device with a foot support featuring adjustable initial angle of the second embodiment of the present invention.
(5) FIG. **5** shows a cross-sectional view of one angle of the ankle joint device with a foot support featuring adjustable initial angle of the present invention.
(6) FIG. **6** shows a cross-sectional view of one angle of the ankle joint device with a foot support featuring adjustable initial angle of the second embodiment of the present invention.
(7) FIG. **7** shows an assembly view between a rotation member and a torsion spring in the ankle joint device with a foot support featuring adjustable initial angle of the second embodiment of the present invention.
(8) FIG. **8** shows an exploded view between the rotation member and the torsion spring in the ankle joint device with a foot support featuring adjustable initial angle of the second embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

(9) The preferred embodiments in the following description are by way of example only and other obvious variations are conceivable to those skilled in the art. The basic principles of the present invention as defined in the following description may be applied to other embodiments, variations, modifications, equivalents, and other technical solutions that do not depart from the essence and scope of the present invention.
(10) As will be appreciated by those skilled in that art, in the disclosure of the present invention, the terms “longitudinal”, “transverse”, “up”, “down”, “front”, “back”, “left”, “right”, “vertical”, “horizontal”, “top”, “bottom”, “inside”, “outside” and the like indicate an orientation or positional relationship based on the orientation or positional relationship shown in the drawings, they are intended only for the convenience of describing the present invention and simplifying the description, and are not intended to indicate or imply that the devices or elements referred to must have a particular orientation, be constructed and operate in a particular orientation. Therefore, the terms described above cannot be construed as limit to the present invention.
(11) Combining with FIGS. **1** to **8**, an ankle joint device with a foot support featuring adjustable initial angle according to a preferred embodiment of the present invention will be described in detail below, wherein the ankle joint device with a foot support featuring adjustable initial angle is suitable for providing rehabilitation training for a user with ankle joint damage, thereby limiting a rotation angle of the ankle joint of the user while ensuring that no secondary damage is caused to the ankle joint of the user.
(12) Specifically, the ankle joint device with a foot support featuring adjustable initial angle comprises a foot support member **10**, an angle adjusting assembly **20** and a base **30**. The foot support member **10** is rotationally mounted on the base **30** so that when the user uses the ankle joint device with a foot support featuring adjustable initial angle, the foot support member **10** can be rotated together with the foot of the user as the foot is plantarflexed or dorsiflexed.
(13) The angle adjusting assembly **20** is disposed between the foot support member **10** and the base **30** to adjust and maintain an initial angle formed between the foot support member **10** and the base **30**.
(14) Referring to FIGS. **1**, **2**A, and **2**B, in an embodiment, the angle adjusting assembly **20** comprises a rotation member **21**A, an anti-rotation structure **22**A, and an anti-rotation member **23**A. The anti-rotation member **23**A is slidably and detachably locked to the rotation member **21**A along the axial direction defined by the rotating shaft of the rotation member **21**A. The anti-rotation member **23**A is formed integrally extending from the foot support member **10** toward one side of the rotation member **21**A. The anti-rotation member **23**A on the foot support member **10** is rotatably and lockably mounted to the rotation member **21**A through the anti-rotation member **22**A.

The rotation member **21**A is rotatably mounted on the base **30** so that the foot support member **10** can rotate relative to the base **30**.

(15) Thus, when it is necessary to adjust the initial angle formed between the foot support member **10** and the base **30**, the foot support member **10** is rotated relative to the rotation member **21**A, and the foot support member **10** is maintained in the rotated position by the anti-rotation structure **22**A so that the initial angle between the foot support member **10** and the base **30** is adjusted.

(16) The anti-rotation structure **22**A includes a set of anti-rotation columns **221**A and a set of anti-rotation holes **222**A, which are respectively arranged on the circumference of the same diameter size.

(17) In an embodiment, the anti-rotation columns **221**A are provided on one side of the anti-rotation member **23**A of the foot support member **10** facing the rotation member **21**A, and the anti-rotation columns **221**A extend in the axial direction of the rotating shaft of the anti-rotation member **23**A. The anti-rotation holes **222**A are disposed on the rotation member **21**A, and the anti-rotation holes **222**A are provided in alignment with the anti-rotation columns **221**A so that when the anti-rotation member **23**A moves toward the base **30** in the axial direction of the rotating shaft of the foot support member **10**, the anti-rotation columns **221**A are inserted into the anti-rotation holes **222**A, so that the anti-rotation member **23**A is fixed relative to the rotation member **21**A, and the foot support member **10** is maintained in the corresponding state.

(18) In a modified embodiment of the present embodiment, the anti-rotation columns **221**A are disposed on one side of the rotation member **21**A facing the foot support member **10**. The anti-rotation holes **222**A are disposed in the anti-rotation member **23**A of the foot support member **10**.

(19) In any of the above embodiments, when it is necessary to adjust the initial angle of the foot support member **10** relative to the base **30**, it only needs to move the anti-rotation member **23**A in a direction away from the base **30** in the axial direction of the rotating shaft of the foot support member **10**, so that the anti-rotation columns **221**A of the anti-rotation structure **22**A slide away from the anti-rotation holes **222**A, thereby enabling the foot support member **10** to be rotated relative to the rotation member **21**A. After the foot support member **10** is rotated by a predetermined angle relative to the rotation member **21**A, the anti-rotation member **23**A is moved in a direction close to the base **30** in the axial direction of the rotating shaft of the anti-rotation member **23**A, so that the anti-rotation columns **221**A are reinserted into the anti-rotation holes **222**A, and the foot support member **10** is fixed in the adjusted state by the anti-rotation member **22**A.

(20) In this embodiment, a perforation **301** is formed in the middle part of the base **30**. A shaft hole **2101**A is formed in the middle part of the rotation member **21**A. The middle part of the anti-rotation member **23**A extends toward the base **30** in the axial direction of the rotating shaft of the foot support member **10** to form an extension shaft **2301**A, which passes through the shaft hole **2101**A and the perforation hole **301** successively to form an end portion, so as to allow a user to slide and rotate the foot support member **10** in the axial direction of the rotating shaft of the foot support member **10** by manually locking the end portion of the extension shaft **2301**A.

(21) Referring to FIGS. **1**, **3**A, and **3**B, in another embodiment, the angle adjusting assembly **20** comprises a rotation member **21**, an anti-rotation structure **22**, and an anti-rotation member **23**. The anti-rotation member **23** is slidably and detachably locked to the rotation member **21** along the axial direction defined by the rotating shaft of the rotation member **21**.

(22) The anti-rotation structure **22** includes a set of anti-rotation columns **221** and a set of anti-rotation holes **222**, which are respectively arranged on the circumference of the same diameter size.

(23) In this embodiment, the anti-rotation columns **221** are provided on one side of the anti-rotation member **23** of the foot support member **10** facing the rotation member **21**, and the anti-rotation columns **221** extend in the axial direction of the rotating shaft of the anti-rotation member **23**. The anti-rotation holes **222** are disposed on the rotation member **21** and provided in alignment with the anti-rotation columns **221** so that when the anti-rotation member **23** moves toward the base **30** in

the axial direction of the rotating shaft of the foot support member **10**, the anti-rotation columns **221** are inserted into the anti-rotation holes **222**, so that the anti-rotation member **23** is fixed relative to the rotation member **21**, and the foot support member **10** is maintained in the corresponding state.

(24) Also, as a modified embodiment, the anti-rotation columns **221** are disposed on one side of the rotation member **21** facing the foot support member **10**. The anti-rotation holes **222** are disposed in the anti-rotation member **23**A of the foot support member **10**. In order to enable those skilled in the art to understand the present invention, at least an embodiment and the accompanying drawings of the present invention are set forth only by the example that the anti-rotation columns **221** are disposed on the side of the anti-rotation member **23** of the foot support member **10** facing the rotation member **21**, and the anti-rotation holes **222** are disposed on the rotation member **21**.

(25) The angle adjusting assembly **20** includes a mounting member **24**, which is provided between the rotation member **21** and the anti-rotation member **23**. The foot support member **10** is fixed to the mounting member **24**. The anti-rotation member **23** is axially movable between the rotation member **21** and the foot support member **10**.

(26) The mounting member **24** is provided with at least a set of through holes **2401**, which are arranged on the circumference equal in diameter to the circumference of the anti-rotation holes **222** or the anti-rotation columns **221**. The anti-rotation columns **221** are inserted into the anti-rotation holes **222** through the through hole **2401** in the mounting member **24** to lock the anti-rotation member **23** and the mounting member **24** to the rotation member **21**.

(27) In an embodiment, after the anti-rotation member **23** slides away from the rotation member **21** in the axial direction by a predetermined distance, the anti-rotation columns **221** slide away from the anti-rotation holes **222**, so that when the anti-rotation member **23** is subsequently rotated, the mounting member **24** is driven to rotate the predetermined angle together so that the foot support member **10** mounted on the mounting member **24** can be adjusted to the predetermined angle with the mounting member **24**.

(28) Preferably, in an embodiment, after the anti-rotation member **23** slides axially away from the rotation member **21** by a predetermined distance, the anti-rotation columns **221** slide away from the anti-rotation holes **222** and are maintained in the through hole **2401**.

(29) A perforation **301** is formed in the middle part of the base **30**. A shaft hole **2101** is formed in the middle part of the rotation member **21**. The middle part of the anti-rotation member **23** extends toward the base **30** in the axial direction of the rotating shaft of the foot support member **10** to form an extension shaft **2301**, which passes through the shaft hole **2101** and the perforation hole **301** successively to form an end portion, so as to allow a user to slide and rotate the foot support member **10** in the axial direction of the rotating shaft of the foot support member **10** by manually locking the end portion of the extension shaft **2301**.

(30) In another embodiment, the middle part of the mounting member **24** is formed with a mounting hole **2402** for the extension shaft **2301** to pass through.

(31) The ankle joint device with a foot support featuring adjustable initial angle includes an elastic member **40**, which is connected to the anti-rotation member **23** in such a manner that the anti-rotation member **23** tends to move in the axial direction toward the rotation member **21**.

(32) Preferably, the ankle joint device with a foot support featuring adjustable initial angle further includes a sliding bearing **800**, which is sleeved on the perforation **301** of the base **30**, and when the extension shaft **2301** passes through the perforation **301** of the base **30**, the sliding bearing **800** is maintained between the extension shaft **2301** and the perforation **301** of the base **30**, to reduce friction between the extension shaft **2301** and the base **30**.

(33) In an embodiment shown in FIGS. **2**A and **2**B, the elastic member **40** is maintained between the rotation member **21**A and the anti-rotation member **23**A in a stretched manner. Preferably, the elastic member **40** is implemented as a hook spring. One end of the elastic member **40** is hooked to the rotation member **21**A, and the other end of the elastic member **40** is hooked to the anti-rotation

member **23**A. More notably, both ends of the elastic member **40** are hooked to one end of a pin **900**, respectively, wherein the pin **900** fixed to the rotation member **21**A is rotatable relative to the rotation member **21**A, and the pin **900** fixed to the anti-rotation member **23**A is rotatable relative to the anti-rotation member **23**A. It will be appreciated that the pin **900** may be provided with a hole to hook the elastic member **40**.

(34) In an embodiment, the elastic member **40** is disposed between the anti-rotation member **23** and the foot support member **10** in a compressed manner. Preferably, the extension shaft **2301** of the anti-rotation member **23** forms a mounting cavity **2302** and a mounting opening **2303** communicating with the mounting cavity **2302**. After the foot support member **10** is mounted and fixed to the mounting member **24** from the mounting opening **2303**, the elastic member **40** is accommodated in the mounting cavity **2302** in a compressed manner.

(35) Further, the angle adjusting assembly **20** also includes at least an angle limiting structure **25**, which is disposed between the rotation member **21** and the base **30**, to limit an angle at which the rotation member **21** rotates relative to the base **30**.

(36) Specifically, the angle limiting structure **25** includes at least a limiting pin **251** and an arc-shaped limiting groove **252**. The limiting pin **251** is inserted into the arc-shaped limiting groove **252**.

(37) In an embodiment, the side of the rotation member **21** facing the base **30** extends toward the base **30** to form the limiting pin **251**. The arc-shaped limiting groove **252** is disposed on the side of the base **30** facing the rotation member **21**.

(38) In a modified embodiment of the present embodiment, the side of the base **30** facing the base **30** extends toward the rotation member **21** to form the limiting pin **251**, and the arc-shaped limiting groove **252** is disposed on the side of the rotation member **21** facing the base **30**.

(39) In another embodiment, the side of the mounting member **24** facing the base **30** extends toward the base **30** to form the limiting pin **251**. The arc-shaped limiting groove **252** is disposed on the side of the base **30** facing the rotation member **21**. Accordingly, the limiting pin **251** extends beyond the rotation member **21** into the arc-shaped limiting groove **252**.

(40) In a modified embodiment of the present embodiment, the side of the base **30** facing the rotation member **21** extends toward the rotation member **21** to form the limiting pin **251**, and the arc-shaped limiting groove **252** is disposed on the side of the rotation member **21** facing the base **30**.

(41) Preferably, in the present embodiment, an arc-shaped avoidance opening **2102** is formed on a circumference of the rotation member **21**, and the limiting pin **251** is inserted into the arc-shaped limiting groove **252** through the arc-shaped avoidance opening **2102**. With this arrangement, when the angle adjusting assembly **20** and the foot support member **10** are rotated together relative to the base **30**, the limiting pin **251** is not blocked by the rotation member **21** and cannot be rotated.

(42) Due to the design of the arc-shaped limiting groove **252**, when the foot support member **10** rotates with the rotation member **21** relative to the base **10**, the rotation angle of the foot support member **10** and the angle adjusting assembly **20** relative to the base **30** will be limited.

(43) Preferably, the angle adjusting assembly **20** includes at least two angle limiting structures **25**, and the limiting pins **251** in the angle limit structures **25** are symmetrically disposed on one circumference.

(44) Preferably, the central angle of the circumference formed by the arc-shaped limiting groove **252** of the angle limiting structures **25** minus the central angle of the arc-shaped limiting groove **252** occupied by the limiting pin **251** is implemented as 60°-80°, which allows the foot support member **10** to rotate at an ergonomic angle.

(45) Further, the ankle joint device with a foot support featuring adjustable initial angle also includes a buffering assembly **50**, which is disposed between the base **30** and the rotation member **21**. When the rotation member **21** is rotated relative to the base **30** and deviates from the set initial angle, the buffering assembly **50** maintains a restoring force applied to the rotation member **21** at

all times, so that the foot support member **10** tends to return to the set initial angle and maintains balance.
(46) Understandably, when a user uses the ankle joint device with a foot support featuring adjustable initial angle, the foot of the user is supported on the foot support member **10**, and when the user's foot is plantarflexed or dorsiflexed, the rotation member **21** on which the foot support member **10** is mounted is rotated relative to the base **30** and deviates from the initial angle. Accordingly, the buffering assembly **50** will generate a predetermined amount of restoring force, thereby reducing the amount of rotation of the foot of the user with the foot support member **10** per unit time, and thus avoiding the aggravation of damage caused by rapid rotation of the ankle of the user. In other words, the buffering assembly **50** is capable of playing a predetermined buffering role.
(47) Further, since the angle limiting structure **25** is provided, the angle at which the rotation member **21** rotates with the foot support member **10** relative to the base **30** can be limited to a predetermined range, thereby preventing a user's foot damage from aggravating due to excessive rotation of the foot support member **21**.
(48) Specifically, the buffering assembly **50** includes a torsion spring **51** and at least a pair of force-applying arms **52**.
(49) The torsion spring **51** is disposed between the base **30** and the rotation member **21**, and when the rotation member **21** rotates relative to the base **30**, the torsion spring **51** is forced to the force-applying arm **52** in a radially expandable manner.
(50) In an embodiment, the rotation member **21** extends toward the base **30** to form a bump, which is defined as the force-applying arm **52**. Both ends of the torsion spring **51** are fixed respectively. The torsion spring **51** is mounted on the force-applying arm **52**, the diameter of the circumference of the force-applying arm **52** is larger than the cross-sectional diameter of the torsion spring **51** in the state of no force, so as to form an expansion space of a predetermined size between the torsion spring **51** and the side wall of the force-applying arm **52**, thereby allowing the torsion spring **51** to expand in an annular mounting groove **302** provided on the base **30** after being pressed by the force-applying arm **52**.
(51) In a modified embodiment of the present embodiment, the base **30** extends toward the rotation member rotor **21** to form the bump, which is defined as the force-applying arm **52**. Both ends of the torsion spring **51** are fixed respectively. The torsion spring **51** is mounted on the force-applying arm **52**, the diameter of the circumference of the force-applying arm **52** is larger than the cross-sectional diameter of the torsion spring **51** in the state of no force, so as to form an expansion space of a predetermined size between the torsion spring **51** and the side wall of the force-applying arm **52**, thereby allowing the torsion spring **51** to expand in an annular mounting groove **302** after being pressed by the force-applying arm **52**.
(52) Further, the ankle joint device with a foot support featuring adjustable initial angle includes an end cap **60**, and an end hole **601** is provided in the middle part of the end cap **60** for the extension shaft **2301** to pass through. The end cap **60** covers the perforation **301** of the base **30**.
(53) It will be understood by those skilled in the art that the embodiments of the present invention shown in the above description are by way of example only, and the present invention is not limited thereto. The purpose of the present invention has been fully and effectively achieved. The functional and structural principles of the present invention have been shown and explained in the embodiments, and any variations or modifications may be made to the embodiments of the present invention without departing from the principles.

Claims

1. An ankle joint device with a foot support featuring an adjustable initial angle, characterized in comprising: a base; an angle adjusting assembly, which comprises a rotation member, an anti-

rotation structure, a mounting member, an angle limiting structure and an anti-rotation member; wherein the rotation member is rotationally mounted on the base; wherein the anti-rotation member is slidably and detachably locked to the rotation member along an axial direction defined by a rotating shaft of the rotation member; wherein the anti-rotation structure comprises a set of anti-rotation holes and a set of anti-rotation columns, which are respectively arranged on a circumference of the same diameter, wherein the set of anti-rotation holes is disposed on the rotation member, wherein the set of anti-rotation columns is disposed on the anti-rotation member, wherein the set of anti-rotation columns is correspondingly inserted into the set of anti-rotation holes to lock the anti-rotation member to the rotation member, wherein the mounting member is disposed between the rotation member and the anti-rotation member, wherein at least a set of through holes is disposed on the mounting member, which the set of through holes is arranged on the circumference having a diameter equal to that of the circumference where the set of anti-rotation holes or the set of anti-rotation columns, wherein the set of anti-rotation columns is inserted into the anti-rotation hole through the set of through holes on the mounting member; wherein after the anti-rotation member slides away from the rotation member along the axial direction for a predetermined distance, the set of anti-rotation columns slides away from the set of anti-rotation holes while staying in the set of through holes; wherein the angle adjusting assembly comprises at least a limiting pin and at least an arc-shaped limiting groove, wherein one side of the mounting member facing the base extends toward the base to form the limiting pin; wherein the rotation member is provided with an arc-shaped avoidance opening, the arc-shaped limiting groove is disposed on the side of the base facing the rotation member, and the limiting pin is inserted into the arc-shaped avoidance opening after passing through the arc-shaped avoidance opening; a buffering assembly, which comprises a torsion spring and at least a pair of force-applying arms; wherein the rotation member extends toward the base to form a bump, which is defined as the pair of force-applying arms; wherein the torsion spring is disposed between the base and the rotation member, and the torsion spring is disposed to the pair of force-applying arms and both end portions thereof are fixed; wherein when the rotation member rotates relative to the base, the torsion spring is compressed by the pair of force-applying arms and then expands in an annular mounting groove disposed on the base, so that when the rotation member rotates relative to the base and deviates from the set initial angle, the torsion spring maintains a restoring force applied to the rotation member to a state before rotation; a foot support member, which is fixed to the mounting member, so that after the anti-rotation member slides away from the rotation member in the axial direction by a predetermined distance, the anti-rotation member slides away from the set of anti-rotation holes, wherein the foot support member is allowed to rotate at a predetermined angle as the anti-rotation member is separated from the rotation member, and the foot support member is locked to the rotation member to rotate with the rotation member relative to the base after the anti-rotation member slides close to the rotation member in the axial direction by a predetermined distance in a state of being maintained at the predetermined angle; and an elastic member, which is disposed between the anti-rotation member and the mounting member in such a manner that the elastic member is compressed.

2. The ankle joint device with a foot support featuring an adjustable initial angle of claim 1, characterized in that a perforation is formed in a middle part of the base, a shaft hole is formed in a middle part of the rotation member, and a middle part of the anti-rotation member extends toward the base along the axial direction to form an extension shaft, which passes through the shaft hole and the perforation successively to form an end portion.

3. The ankle joint device with a foot support featuring an adjustable initial angle of claim 1, characterized in that the central angle of the circumference formed by the arc-shaped limiting groove of the angle limiting structure minus the central angle of the arc-shaped limiting groove occupied by the limiting pin is implemented as 60°-80°.

4. The ankle joint device with a foot support featuring an adjustable initial angle of claim 1,

characterized in that the angle adjusting assembly comprises at least two limiting pins and at least two arc-shaped limiting grooves, wherein the at least two limiting pins are symmetrically disposed along the axial direction, and the at least two arc-shaped limiting grooves are symmetrically disposed along the axial direction.