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MOUNTING METHOD FOR ANTI-DETACHMENT ELASTIC RETAINING RING

Abstract

A mounting method for an anti-detachment elastic retaining ring is provided. A mounting device includes a guide sleeve and a target mounting shaft that is provided with a groove; the guide sleeve includes a conical section; the conical section includes a narrow end with a radial dimension less than a locking diameter of a retaining ring body and a wide end with a radial dimension greater than the locking diameter of the retaining ring body; the guide sleeve is coaxially coupled with a front end of the groove of the target mounting shaft; the wide end of the conical section faces the groove; the mounting device further includes a pressing sleeve; the pressing sleeve is fitted outside the guide sleeve and moveable axially along the guide sleeve; and a side of the pressing sleeve close to the target mounting shaft is provided with a release protrusion.

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Background/Summary

CROSS-REFERENCE TO THE RELATED APPLICATIONS [0001] This application is the national phase entry of International Application No. PCT/CN2024/085131, filed on Apr. 1, 2024, which is based upon and claims priority to Chinese Patent Application No. 202310808663.5, filed on Jul. 4, 2023, the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

[0002] The present disclosure relates to the technical field of automatic mounting of anti-detachment elastic retaining rings, and in particular to a mounting method for an anti-detachment elastic retaining ring.

BACKGROUND

[0003] As shown in FIGS. 1 to 3, the anti-detachment elastic retaining ring is in a locked state in its original state. When the anti-detachment elastic retaining ring expands outward, the locking fitting surfaces of the limiting protrusions at two ends are fitted with each other to prevent the anti-detachment elastic retaining ring from continuing to expand outward. The anti-detachment elastic retaining ring is mounted on a high-speed shaft. When the shaft speed reaches a certain value, the retaining ring body expands outward from the locked state. When the retaining ring body expands outward to a certain extent, the two locking fitting surfaces are fitted and interlocked with each other, thereby preventing the retaining ring body from expanding outward to a detached state. Therefore, the anti-detachment elastic retaining ring is suitable for high-speed shafts and has good reliability.

[0004] When the elastic retaining ring is assembled into the groove of a target mounting shaft, an unlocking operation is required to release the elastic retaining ring from the locked state to the detached state, such that the elastic retaining ring passes through the shaft section at the front end of the groove. The unlocking operation can be performed using a clamping part to keep the two ends of the elastic retaining ring separated. This method needs two steps of mounting and removing the clamping part on the elastic retaining ring, which is highly complex and not suitable for automatic mounting. Therefore, the unlocking method is not suitable for mass assembly of elastic retaining rings and the design of automated assembly lines.

SUMMARY

[0005] To overcome the above-mentioned shortcomings of the prior art, the present disclosure provides a mounting method for an anti-detachment elastic retaining ring. The present disclosure achieves automatic unlocking of the elastic retaining ring, suiting for automated production and improving production efficiency.

[0006] The above objective of the present disclosure is achieved by the following technical solutions: [0007] A mounting device for an anti-detachment elastic retaining ring, configured to mount a retaining ring body into a groove of a target mounting shaft, where a ratio of a thickness of the retaining ring body to a width of the groove is greater than or equal to 1:2; the mounting device includes a guide sleeve and a target mounting shaft; the guide sleeve includes a conical section; the conical section includes a narrow end with a radial dimension less than a locking diameter of the retaining ring body and a wide end with a radial dimension greater than the locking diameter of the retaining ring body; the guide sleeve is coaxially coupled with a front end of the groove of the target mounting shaft; and the wide end of the conical section faces the groove; [0008] the mounting device further includes a pressing sleeve; the pressing sleeve is fitted outside the guide

sleeve and moveable axially along the guide sleeve; and a side of the pressing sleeve close to the target mounting shaft is provided with a release protrusion; [0009] the pressing sleeve is able to push the retaining ring body clamped on the conical section to move towards the groove; and during the process, the release protrusion pushes an end at a side of the opening of the retaining ring body, causing two ends at the opening of the retaining ring body to offset from each other axially. In this way, the present disclosure achieves axial unlocking of the retaining ring. Therefore, the mounting device for an anti-detachment elastic retaining ring in the present disclosure can achieve automatic unlocking of the elastic retaining ring, is suitable for automated production, and improves production efficiency.

[0010] It should be noted that, when the retaining ring body expands outward from the locked state until the two locking fitting surfaces interlock with each other, the diameter of the retaining ring body is the locking diameter, which is the maximum diameter of the retaining ring body in the locked state. When the retaining ring body is in the axially unlocked state, if the retaining ring body expands outward, the two locking fitting surfaces will not come into contact with each other. Therefore, in this state, the retaining ring body can continue to expand outward to a detached state. In addition, the present disclosure defines the case where the guide sleeve includes the conical section, so it is not ruled out that an extension section with a radial dimension greater than the locking diameter and less than the radial dimension of the wide end of the conical section may be provided between the wide end of the conical section and the groove of the guide sleeve.

[0011] Further, in the mounting device for an anti-detachment elastic retaining ring, the release protrusion is located on an axial end surface of the retaining ring body. In a preferred solution of the present disclosure, according to the above structure, when the pressing sleeve presses the release protrusion, there is no need to perform circumferential positioning of the pressing sleeve, achieving simple control.

[0012] Further, in the mounting device for an anti-detachment elastic retaining ring, the release protrusion is located on an end surface of the pressing sleeve. In a preferred solution of the present disclosure, the release protrusion is provided on the retaining ring body in two cases. In the first case, the release protrusion is mounted in separate parts on the retaining ring body. In this case, after pressing the retaining ring body into the groove, an additional takt is required to remove the release protrusion, which affects the assembly efficiency. In the second case, the release protrusion extends onto the retaining ring body, increasing the manufacturing complexity of the retaining ring body, resulting in high manufacturing costs of the retaining ring body, and affecting the compactness of the axial mounting of the retaining ring body. The release protrusion is located on the pressing sleeve, overcoming the disadvantage of providing the release protrusion on the retaining ring body.

[0013] Further, in the mounting device for an anti-detachment elastic retaining ring, a side of the release protrusion extends helically along circumferential and axial directions of the pressing sleeve to form a transition fitting surface. In a preferred solution of the present disclosure, when the release protrusion pushes an end of the opening of the retaining ring body, the retaining ring body is fully fitted with the transition fitting surface, improving the stability of the retaining ring body being pushed by the pressing sleeve.

[0014] Further, in the mounting device for an anti-detachment elastic retaining ring, the pressing sleeve is rotatable in a circumferential direction of the target mounting shaft. In a preferred solution of the present disclosure, after the step S41 is completed, if the other end of the retaining ring body cannot automatically be inserted into the groove by its own rebound force after one end is pressed into the groove, the step S42' is performed. The pressing sleeve rotates at an inner side in the circumferential direction at the one end of the retaining ring body pressed into the pressing groove. At this point, the release protrusion presses the portion not inserted into the groove into the groove, ensuring that the two ends of the retaining ring body are inserted into the groove.

[0015] A usage method of the mounting device for an anti-detachment elastic retaining ring

includes the following steps: [0016] step S11: axial unlocking: fitting the retaining ring body from the narrow end of the conical section onto the conical section; moving the pressing sleeve towards the retaining ring body; pushing, by the release protrusion, one end of the retaining ring body to move, such that the retaining ring body enters the axially unlocked state; [0017] step S12: radial unlocking: pushing, by the pressing sleeve, the retaining ring body to move towards the wide end of the conical section until the retaining ring body enters the detached state; [0018] step S2': expansion: pushing, by the pressing sleeve, the retaining ring body to move towards the wide end of the conical section; and expanding the retaining ring body until an inner diameter of the retaining ring body is greater than or equal to a diameter at the front end of the groove of the target mounting shaft, where it should be noted that the diameter of a journal at the front end of the groove is greater than the locking diameter of the retaining ring body; [0019] step S3': movement: continuously pushing, by the pressing sleeve, the retaining ring body to move, so the retaining ring body moves axially until a front end of the retaining ring body is located at an axial outer side of the groove, where specifically, when a tail end of the guide sleeve is located at and fitted to an outer edge of the groove, the retaining ring body is integrally fitted onto the guide sleeve; [0020] step S41: one end insertion: continuously pushing, by the pressing sleeve, the retaining ring body to move until the one end of the retaining ring body pushed by the release protrusion is inserted into the groove; and [0021] step S42: overall insertion: enabling, following the one end of the retaining ring body inserted into the groove, the other end of the retaining ring body to be inserted into the groove due to the rebound force. It should be noted that the automatic insertion of the other end into the groove is the result of the combined action of the axial and circumferential elastic forces of the retaining ring body. The prerequisite for achieving this effect is related to the depth of the groove and the dimension parameters of the journal at the outer end of the groove.

[0022] As can be seen from the above technical solutions, the present disclosure has the following beneficial effects: [0023] 1. The present disclosure provides a mounting method for an anti-detachment elastic retaining ring. The present disclosure can achieve automatic unlocking of the elastic retaining ring, is suitable for automated production, and improves production efficiency.

[0024] 2. In the mounting method for an anti-detachment elastic retaining ring in the present disclosure, the ratio of a thickness of the retaining ring body to a width of the groove is greater than or equal to 1:2. Therefore, after one end of the retaining ring body is pressed into the groove, due to the limit of the groove, the other end of the retaining ring body cannot be directly pressed into the groove by the pressing sleeve. However, the other end of the retaining ring body can follow the one end to be inserted into the groove by the axial rebound force of the retaining ring body. Therefore, the mounting method for an anti-detachment elastic retaining ring in the present disclosure overcomes the technical bias of traditional retaining ring mounting, which requires the retaining ring to be pressed into the groove as a whole through the pressing sleeve. The present disclosure achieves an unexpected technical effect for those skilled in the art, and has the advantage of high overall mounting efficiency.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] FIG. 1 is a structural diagram of an anti-detachment elastic retaining ring capable of springing back for self-locking in an original state according to an embodiment of the present disclosure;

[0026] FIG. 2 is a detail of an opening shown in FIG. 1;

[0027] FIG. 3 is a schematic diagram showing that locking fitting surfaces of the anti-detachment elastic retaining ring capable of springing back for self-locking in a locked state are locked and

fitted with each other;

[0028] FIG. 4 is a schematic diagram of the anti-detachment elastic retaining ring capable of springing back for self-locking in a detached state;

[0029] FIG. 5 is a schematic diagram of inclined guide surfaces that are flat surfaces;

[0030] FIG. 6 is a structural diagram of a mounting device for an anti-detachment elastic retaining ring according to an embodiment of the present disclosure (a release protrusion is located on a retaining ring body);

[0031] FIG. 7 is a structural diagram of the mounting device for an anti-detachment elastic retaining ring according to an embodiment of the present disclosure (the release protrusion is located on a pressing sleeve);

[0032] FIG. 8 is a structural diagram of the pressing sleeve of the mounting device for an anti-detachment elastic retaining ring according to an embodiment of the present disclosure;

[0033] FIG. 9 is a structural diagram of the mounting device for an anti-detachment elastic retaining ring according to an embodiment of the present disclosure;

[0034] FIG. 10 is a schematic diagram of step S11 of a usage method of the mounting device for an anti-detachment elastic retaining ring according to an embodiment of the present disclosure;

[0035] FIG. 11 is a schematic diagram of step S12 of the usage method of the mounting device for an anti-detachment elastic retaining ring according to an embodiment of the present disclosure;

[0036] FIG. 12 is a schematic diagram of step S41 of the usage method of the mounting device for an anti-detachment elastic retaining ring according to an embodiment of the present disclosure;

[0037] FIG. 13 is a schematic diagram showing that the retaining ring body is fully inserted into a groove; and

[0038] FIG. 14 is a section view based on FIG. 13.

[0039] Reference Numerals: 1. retaining ring body; 10. opening; 11. first end; 111. first connecting extension; 112. first limiting protrusion; 12. second end; 121. second connecting extension; 122. second limiting protrusion; 13. hook; 130. locking fitting surface; 14. inclined guide surface; 15. disassembly hole; 151. first disassembly hole; and 152. second disassembly hole;

[0040] 2. guide sleeve; and 21. conical section;

[0041] 3. pressing sleeve;

[0042] 4. target mounting shaft; and 41. groove; and

[0043] 5. release protrusion; and 51. transition fitting surface.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0044] The embodiments of the present disclosure are described below in detail. Examples of the embodiments are shown in the drawings. The same or similar numerals represent the same or similar elements or elements having the same or similar functions throughout the specification. The embodiments described below with reference to the drawings are exemplary, and are intended to explain the present disclosure, rather than to limit the present disclosure.

[0045] It should be understood that in the description of the present disclosure, the terms such as “central”, “longitudinal”, “transverse”, “length”, “width”, “thickness”, “upper”, “lower”, “front”, “back”, “left”, “right”, “vertical”, “horizontal”, “top”, “bottom”, “inner”, “clockwise”, and “anticlockwise” are intended to indicate orientation or positional relations shown in the drawings. It should be noted that these terms are merely intended to facilitate a simple description of the present disclosure, rather than to indicate or imply that the mentioned apparatus or elements must have the specific orientation or be constructed and operated in the specific orientation. Therefore, these terms may not be construed as a limitation to the present disclosure.

[0046] Moreover, the terms such as “first” and “second” are used only for the purpose of description and should not be construed as indicating or implying a relative importance, or implicitly indicating a quantity of indicated technical features. Thus, features defined with “first” and “second” may explicitly or implicitly include one or more of the features. In the description of the present disclosure, unless otherwise specifically defined, “a plurality of” means two or more.

[0047] In the present disclosure, unless otherwise clearly specified and defined, the terms “mounted”, “connected with”, “connected to”, and “fixed” should be understood in a broad sense. For example, the connection may be a fixed connection, a detachable connection or an integrated connection, may be a mechanical connection or an electrical connection, may be a direct connection or an indirect connection with use of an intermediate medium, or may be intercommunication between two components. Those of ordinary skill in the art may understand specific meanings of the above terms in the present disclosure based on a specific situation.

[0048] In the present disclosure, unless otherwise expressly specified, when it is described that a first feature is “above” or “under” a second feature, it may indicate that the first feature is in direct contact with the second feature, or that the first feature and the second feature are not in direct contact with each other but are in contact via another feature between them. In addition, that the first feature is “over”, “above”, and “on” the second feature includes that the first feature is directly above and diagonally above the second feature, or simply indicates that a horizontal height of the first feature is larger than that of the second feature. “A first feature is under and below a second feature” includes “the first feature is directly under or obliquely under the second feature” or simply means that “the first feature is lower than the second feature”.

Embodiment 1

[0049] As shown in FIGS. 1 and 2, an anti-detachment elastic retaining ring capable of springing back for self-locking includes retaining ring body 1. The retaining ring body 1 is provided with opening 10. Corresponding to two sides of the opening 10, two ends of the retaining ring body 1 respectively form first end 11 and second end 12.

[0050] When the retaining ring body 1 is in an original state, the first end 11 and the second end 12 interlock with each other. Corresponding to interlocking front end positions of the first end 11 and the second end 12, front ends of the first end 11 and the second end 12 are respectively provided with first connecting extension section 111 and second connecting extension section 121. The first connecting extension section 111 and the second connecting extension section 121 extend laterally to form first limiting protrusion 112 and second limiting protrusion 122, respectively. The first limiting protrusion 112 and the second limiting protrusion 122 are located at an inner side of each other in a circumferential direction of the retaining ring body 1. Adjacent sides of the first limiting protrusion 112 and the second limiting protrusion 122 are provided with locking fitting surfaces 130. A side of the first limiting protrusion 112 away from the second limiting protrusion 122 and/or a side of the second limiting protrusion 122 away from the first limiting protrusion 112 is provided with inclined guide surface 14. In this embodiment, the first limiting protrusion 112 and the second limiting protrusion 122 are respectively provided with inclined guide surfaces 14. The first limiting protrusion 112 and the second limiting protrusion 122 are respectively located at front ends of the first connecting extension section 111 and the second connecting extension section 121.

[0051] When the retaining ring body 1 expands outward from a locked state, the two locking fitting surfaces 130 are fitted and interlocked with each other, preventing the retaining ring body 1 from expanding outward to a detached state.

[0052] Through the inclined guide surface 14, the retaining ring body 1 is reset to the locked state from the detached state by its own rebound force.

[0053] In the above structure, as shown in FIG. 2, the first connecting extension section 111 and the second connecting extension section 121 interlock with each other. That is, the first connecting extension section 111 is located at a side of the second connecting extension section 121, and the front end of the first connecting extension section 111 extends to a position between an end and a root of the second connecting extension section 121. In other words, the first connecting extension section 111 and the second connecting extension section 121 interlock with each other in the circumferential direction of the retaining ring body 1. The first limiting protrusion 112 and the second limiting protrusion 122 are located at the inner side of each other in the circumferential direction of the retaining ring body 1. The first limiting protrusion 112 is located at a side of the

second limiting protrusion **122** away from an outer end of the second connecting extension **121**. When the first limiting protrusion **112** and the second limiting protrusion **122** are located at an outer side of each other in the circumferential direction of the retaining ring body **1**, the first limiting protrusion **112** is located at a side of the second limiting protrusion **122** close to the outer end of the second connecting extension **121**. In this embodiment, the first limiting protrusion **112** and the second limiting protrusion **122** are located at adjacent sides of the first connecting extension section **111** and the second connecting extension section **121**, and extend in opposite directions to each other. The first limiting protrusion **112** and the second limiting protrusion **122** interlock with each other in the extension directions. Specifically, the inclined guide surface **14** is located at an outer side of a front end of the limiting protrusion in the extension direction. In this embodiment, the inclined guide surface **14** is a curved surface with a rounded corner.

[0054] The principle of the anti-detachment elastic retaining ring capable of springing back for self-locking is as follows. As shown in FIGS. 2 and 3, when the two locking fitting surfaces **130** are facing each other, the first limiting protrusion **112** and the second limiting protrusion **122** are located at the inner side of each other in the circumferential direction of the retaining ring body **1**, and the retaining ring body **1** is in a locked state. As shown in FIG. 4, when the two locking fitting surfaces **130** are facing away from each other, especially when the first limiting protrusion **112** and the second limiting protrusion **122** are located at the outer side of each other in the circumferential direction of the retaining ring body **1**, the retaining ring body **1** is in a detached state. Therefore, the retaining ring body **1** is in a locked state in its original state. When the retaining ring body **1** is mounted in a shaft groove, the retaining ring body **1** is in a locked state. The retaining ring body **1** will not detach due to its own elastic force and has the advantage of good stability. The retaining ring body is mounted on a high-speed shaft. When the shaft speed reaches a certain value, the retaining ring body **1** expands outward from the locked state. When the retaining ring body expands outward to a certain extent, the two locking fitting surfaces **130** are fitted and interlocked with each other to prevent the retaining ring body **1** from expanding outward to a detached state. Therefore, the anti-detachment elastic retaining ring capable of springing back for self-locking described in the present disclosure is suitable for high-speed shafts and features integrated design, simple structure, low manufacturing cost, and good reliability. When the retaining ring body **1** is in a detached state due to external force, the first limiting protrusion **112** and the second limiting protrusion **122** are located at the outer side of each other. At this point, the inclined guide surface **14** is located between the first limiting protrusion **112** and the second limiting protrusion **122**. When the external force acting on the retaining ring body **1** is reduced or eliminated, due to the rebound force of the retaining ring body **1** itself and the interlocking of the first limiting protrusion **112** and the second limiting protrusion **122**, the first limiting protrusion **112** and the second limiting protrusion **122** come into contact with each other at the outer side. At this point, due to the action of the inclined guide surface **14**, the first connecting extension section **111** and the second connecting extension section **121** move away from each other in, causing the first limiting protrusion **112** and the second limiting protrusion **122** to move to the inner side of each other in the circumferential direction of the retaining ring body **1**. In this way, the retaining ring body automatically resets to the locked state by the rebound force. Based on the above principle, the anti-detachment elastic retaining ring capable of springing back for self-locking described in the present disclosure can eliminate the execution mechanism for locking operation during automated assembly, and even eliminate the takt of locking operation, thereby improving assembly efficiency and suiting for automated production.

[0055] In this embodiment, the retaining ring body **1** is in a sheet-like shape as a whole in its original state. Therefore, the anti-detachment elastic retaining ring capable of springing back for self-locking described in the present disclosure can be directly formed from a sheet material through a one-time machining process such as wire cutting or stamping. It has the advantages of low manufacturing cost and economy. Specifically, in this embodiment, the retaining ring body **1** is

in the shape of a ring platform as a whole, and two axial end surfaces of the retaining ring body **1** are flat. The retaining ring body can be made of a spring steel sheet through a one-time machining process such as stamping or wire cutting. The above structure is different from the elastic retaining ring for a shaft of electric vehicle reducer disclosed in Chinese patent document 202121468092.8. In this disclosure, the elastic retaining ring is in a spiral shape in its original state, resulting in complex manufacturing and high costs.

[0056] As shown in FIGS. **1** and **2**, in this embodiment, when the retaining ring body **1** is in its original state, the second connecting extension section **121** is located at the outer side of the first connecting extension section **111** in a radial direction of the retaining ring body **1**.

[0057] The first connecting extension section **111** and the second connecting extension section **121** are spaced radially apart. The spaced-apart design relative to an axial direction is convenient for processing and ensures low manufacturing costs. On the other hand, it has low requirements for the width of the groove for mounting the retaining ring body **1**, that is, the axial movement space of the retaining ring body **1** mounted is small.

[0058] As shown in FIG. **1**, in this embodiment, the anti-detachment elastic retaining ring further includes disassembly holes **15**. The disassembly holes **15** include first disassembly hole **151**. The first disassembly hole **151** is provided at the second end **12**. When the retaining ring body **1** is mounted in the groove, it is in a locked state. When a tool passes through the first disassembly hole **151** and applies a force to an radial outer side of the retaining ring body **1**, the second connecting extension section **121** is opened until the retaining ring body **1** is in a detached state, in order to remove the retaining ring body **1** mounted in the groove. In this embodiment, the disassembly holes **15** further include second disassembly hole **152**. The second disassembly hole **152** is provided at the first end **11**. The disassembly holes **15** are arranged in a pair at the two ends of the retaining ring body **1**, facilitating the insertion of snap ring pliers into the two disassembly holes **15** to remove the retaining ring body **1** mounted in the groove. In the present disclosure, the first disassembly hole **151** and the second disassembly hole **152** are respectively located at roots of the second end **12** and the first end **11** corresponding to the second connecting extension section **121** and the first connecting extension section **111**.

[0059] As shown in FIG. **2**, in this embodiment, the front ends of the first limiting protrusion **112** and the second limiting protrusion **122** in the extension direction extend towards the inner side of each other in the circumferential direction of the retaining ring body **1** to form a pair of interlocking hooks **13**. The locking fitting surface **130** is located at an inner side of the hook **13**. The interlocking hook structures have the advantage of reliable locking. It should be noted that the interlocking structures are not limited to the hooks **13** described in this embodiment, and can be limiting fit structures such as tooth portions that cooperate with each other or a male portion and a female portion that cooperate with each other.

[0060] As shown in FIG. **2**, in this embodiment, when the retaining ring body **1** is in its original state, the first limiting protrusion **112** and the second limiting protrusion **122** are separated by a preset distance of a . Based on the above structure, an inner diameter dimension of the retaining ring body **1** in its original state is smaller than a corresponding groove diameter. When the retaining ring body **1** is fitted inside the groove, the distance between the first limiting protrusion **112** and the second limiting protrusion **122** is less than the preset distance. Therefore, the retaining ring body **1** can generate a certain clamping force to prevent the retaining ring body **1** mounted in the groove from shaking.

[0061] As shown in FIG. **10**, in this embodiment, the first limiting protrusion **112** and the second limiting protrusion **122** are offset from each other by a preset distance in the axial direction. At this point, the retaining ring body **1** is in an axially unlocked state, so the retaining ring body **1** can be reset from the axially unlocked state to the locked state by its own rebound force.

[0062] As shown in FIGS. **10** to **13**, the retaining ring body **1** is in an axially unlocked state. At this point, when the retaining ring body **1** expands outward, the two locking fitting surfaces **130** will

not come into contact with each other. Therefore, the retaining ring body **1** can continue to expand outward to the detached state. The implementation of this function depends on the material properties and structural parameters of the retaining ring body **1**. In this embodiment, the retaining ring body **1** is made of spring steel. The overall dimensional parameters of the retaining ring body **1** refer to the open snap ring design in standard GB/T894-2017. Correspondingly, the dimensions of the mounting groove should conform to this standard to achieve the above function. In addition, the design has a wide range of applications. For special application scenarios, the dimension parameters can be adaptively modified.

[0063] Specifically, the retaining ring body **1** features an inner diameter of 45.8 mm, an outer diameter of 56 mm, a thickness of 2 mm, and is made of 60Si2Mn. When the second connecting extension section **121** is pressed down until an axial displacement of the second limiting protrusion **122** is greater than 2 mm, the retaining ring body **1** is in an axially unlocked state. The force that presses down the second connecting extension section **121** is eliminated without applying a radial force for outward expansion. Thus, the retaining ring body **1** can be reset from the axially unlocked state to the locked state by its own rebound force.

Embodiment 2

[0064] As shown in FIG. 5, this embodiment differs from Embodiment 1 in that the inclined guide surface **14** in this embodiment is a slanted plane with a chamfered shape.

Embodiment 3

[0065] As shown in FIG. 6, a mounting device for an anti-detachment elastic retaining ring includes guide sleeve **2** and target mounting shaft **4** with groove **41**. The target mounting shaft **4** is fixed by a fixing assembly (not shown in the figure). The guide sleeve **2** includes conical section **21**. A radial dimension of a narrow end of the conical section **21** is less than a locking diameter of the retaining ring body **1**, and a radial dimension of a wide end of the conical section **21** is greater than the locking diameter of the retaining ring body **1**. The guide sleeve **2** is coaxially coupled with a front end of the groove **41** of the target mounting shaft **4**. A wide end of the conical section **21** faces the groove **41**.

[0066] The mounting device further includes pressing sleeve **3**. The pressing sleeve **3** is fitted outside the guide sleeve **2** and moveable axially along the guide sleeve **2**. A side of the pressing sleeve **3** close to the target mounting shaft **4** is provided with release protrusion **5**. When applied to an automated assembly line, the pressing sleeve **3** is connected to a linear drive device (not shown in the figure) in a drive manner, and the linear drive device is configured to drive the pressing sleeve **3** to move axially.

[0067] The pressing sleeve **3** can push the retaining ring body **1** clamped on the conical section **21** to move towards the groove **41**. During this process, the release protrusion **5** can push an end of the opening **10** of the retaining ring body **1**, causing the locking fitting surfaces **130** at the two sides of the retaining ring body **1** to offset from each other axially until the retaining ring body **1** enters the axially unlocked state.

[0068] It should be noted that, as shown in FIG. 3, when the retaining ring body **1** expands outward from the locked state until the two locking fitting surfaces **130** interlock with each other, the diameter of the retaining ring body is the locking diameter, which is the maximum diameter of the retaining ring body **1** in the locked state. When the retaining ring body **1** is in the axially unlocked state, if the retaining ring body **1** expands outward, the two locking fitting surfaces **130** will not come into contact with each other. Therefore, in this state, the retaining ring body **1** can continue to expand outward to a detached state. In addition, the present disclosure defines the case where the guide sleeve **2** includes the conical section **21**, so it is not ruled out that an extension section with a radial dimension greater than the locking diameter and less than the radial dimension of the wide end of the conical section **21** may be provided between the wide end of the conical section **21** and the groove **41** of the guide sleeve **2**.

[0069] In this embodiment, an outer edge of a cross-section of the conical section **21** is circular.

The axial dimension of the retaining ring body **1** is greater than the thickness of the retaining ring body **1**.

[0070] As shown in FIG. **6**, in this embodiment, the release protrusion **5** is located on an axial end surface of the retaining ring body **1**. Specifically, an end surface of the first end **11** or the second end **12** is provided with the release protrusion **5**. According to the above structure, when the pressing sleeve **3** presses the release protrusion **5**, there is no need to perform circumferential positioning of the pressing sleeve **3**, achieving simple control.

[0071] In this embodiment, the release protrusion **5** is a pin that is detachably provided and set in one of the disassembly holes **15**.

Embodiment 4

[0072] As shown in FIG. **7**, this embodiment differs from Embodiment 3 in that the release protrusion **5** is provided on an end surface of the pressing sleeve **3**.

[0073] According to Embodiment 3, the release protrusion **5** is provided on the retaining ring body **1** in two cases. In the first case, as mentioned in Embodiment 4, the release protrusion **5** is mounted in separate parts on the retaining ring body **1**. In this case, after pressing the retaining ring body **1** into the groove **41**, an additional takt is required to remove the release protrusion **5**, which affects the assembly efficiency. In the second case, the release protrusion **5** extends onto the retaining ring body **1**, increasing the manufacturing complexity of the retaining ring body **1**, resulting in high manufacturing costs of the retaining ring body **1**, and affecting the compactness of the axial mounting of the retaining ring body **1**.

[0074] In this embodiment, the release protrusion **5** is located on the pressing sleeve **3**, overcoming the disadvantage of providing the release protrusion **5** on the retaining ring body **1**. It should be noted that in order to achieve automatic assembly, the release protrusion **5** must be aligned with an end at a side of the opening **10** of the retaining ring body **1**, and the two ends cannot be pressed down at the same time, otherwise it will cause assembly failure. To ensure the implementation of the circumferential positioning, an automatic robotic arm can be used for feeding. Specifically, a robotic arm can be used to separate and remove the pre-positioned retaining ring body **1** (to achieve pre-positioning, a batch of retaining ring bodies **1** are placed in a circumferential positioning tray of a raw material tray). According to a pre-set program, the retaining ring body **1** is placed on the conical section **21** at a preset circumferential angle, and then the pressing sleeve **3** is started to move, thereby ensuring the implementation of the above function.

Embodiment 5

[0075] As shown in FIGS. **8** to **14**, based on Embodiment 4, in this embodiment, a side of the release protrusion **5** extends helically along the circumferential and axial directions of the pressing sleeve **3** to form transition fitting surface **51**.

[0076] When the release protrusion **5** pushes an end of the opening **10** of the retaining ring body **1**, the retaining ring body **1** is fully fitted with the transition fitting surface **51**, improving the stability of the retaining ring body **1** being pushed by the pressing sleeve **3**. In this embodiment, the release protrusion **5** is integrally formed with the pressing sleeve **3**. The release protrusion **5** is in the shape of a step. The transition fitting surface **51** extends helically from a front end of the release protrusion **5** to a root of the release protrusion **5**.

Embodiment 6

[0077] In the present disclosure, a mounting method for the anti-detachment elastic retaining ring capable of springing back for self-locking as described in Embodiments 1 and 2 includes the following steps.

[0078] Step S1. An unlocking operation is performed to change the retaining ring body **1** from its original state to a detached state.

[0079] Step S2. An expansion operation is performed to expand the retaining ring body **1** until its inner diameter is greater than or equal to a diameter of the target mounting shaft **4**.

[0080] Step S3. A movement operation is performed to move the retaining ring body **1** axially to an

axial outer side of the groove **41**. Specifically, in this step, the retaining ring body **1** can move axially to a journal at a front side of the groove **41** of the target mounting shaft **4**. At this point, the external support force applied to the retaining ring body **1** is removed, and the retaining ring body **1** is in a detached state, and is clamped onto the journal of the target mounting shaft **4**.

[0081] Step S4. An insertion operation is performed to move the retaining ring body **1** axially into the groove **41**. At this point, the retaining ring body **1** is reset from the detached state to the locked state due to its own rebound force, and is clamped into the groove **41**.

[0082] Based on the above method, the anti-detachment elastic retaining ring capable of springing back for self-locking described in the present disclosure can eliminate the execution mechanism for locking operation during automated assembly, and even eliminate the takt of locking operation, thereby improving assembly efficiency and suiting for automated production.

Embodiment 7

[0083] A usage method of the mounting device for the anti-detachment elastic retaining ring as described in Embodiments 3 to 5 is configured to mount the anti-detachment elastic retaining ring capable of springing back for self-locking as described in Embodiments 1 and 2. As shown in FIGS. **9** to **14** (taking Embodiment 5 as an example), the usage method includes the following steps.

[0084] Step S11. An axial unlocking operation is performed. The retaining ring body **1** is fitted from the narrow end of the conical section **21** onto the conical section **21**. The pressing sleeve **3** moves towards the retaining ring body **1**. The release protrusion **5** pushes an end of the retaining ring body **1** to move, such that the retaining ring body enters the axially unlocked state.

[0085] Step S12. A radial unlocking operation is performed. The pressing sleeve **3** pushes the retaining ring body **1** to move towards the wide end of the conical section **21** until the retaining ring body **1** enters the detached state. The steps S11 and S12 correspond to the step S1 in Embodiment 6.

[0086] Step S2'. An expansion operation is performed. The pressing sleeve **3** pushes the retaining ring body **1** to move towards the wide end of the conical section **21**. The retaining ring body **1** expands until its inner diameter is greater than or equal to the diameter at the front end of the groove **41** of the target mounting shaft **4**. It should be noted that the diameter of the journal at the front end of the groove **41** is greater than the locking diameter of the retaining ring body **1**. In this embodiment, the step S2' corresponds to the step S2 in Embodiment 6.

[0087] Step S3'. A movement operation is performed. The pressing sleeve **3** continues to push the retaining ring body **1** to move, so the retaining ring body **1** moves axially until a front end of the retaining ring body **1** is located at the axial outer side of the groove **41**. Specifically, when a tail end of the guide sleeve **2** is located at and fitted to the outer edge of the groove **41**, the retaining ring body **1** is integrally fitted onto the guide sleeve **2**. In this embodiment, the tail end of the guide sleeve **2** is axially fitted to the journal at the front end of the groove **41**. Therefore, in this step, the retaining ring body **1** moves axially to the journal at the front side of the groove **41**. In this embodiment, the step S3' corresponds to the step S3 in Embodiment 6.

[0088] Step S41. A one end insertion operation is performed. The pressing sleeve **3** continues to push the retaining ring body **1** to move until the one end of the retaining ring body **1** pushed by the release protrusion **5** is inserted into the groove **41**.

[0089] Step S42. An overall insertion operation is performed. After one end of the retaining ring body **1** is inserted into the groove, the other end of the retaining ring body follows the one end to be inserted into the groove due to the rebound force. The steps S41 and S42 correspond to the step S4 in Embodiment 6. It should be noted that the automatic insertion of the other end into the groove is the result of the combined action of the axial and circumferential elastic forces of the retaining ring body **1**. The prerequisite for achieving this effect is related to the depth of the groove **41** and the dimension parameters of the journal at the outer end of the groove **41**. In this embodiment, the retaining ring body **1** is made of spring steel, and its overall dimension parameters, as well as the

dimension parameters of the groove **41** and the journal, refer to the provisions of the standard GB/T894-2017 for open snap rings. A sample test indicates that the effects of the steps S41 and S42 can be achieved. In the test, the retaining ring body **1** features an inner diameter of 45.8 mm, an outer diameter of 56 mm, a thickness of 2 mm, and is made of 60Si2Mn. The groove **41** features an inner diameter of 47 mm and a width of 2.15 mm. The use of a standard snap ring for the above test in the method can also achieve the effect of following the other end to be inserted into the groove as described in the step S42.

[0090] It should be noted that the method described in this embodiment overcomes the technical bias of traditional retaining ring mounting, which requires the retaining ring to be pressed into the groove as a whole through the pressing sleeve **3**. Chinese patent document CN103639980A discloses a mounting tool for a shaft retaining ring. This patent provides a solution for pressing an elastic retaining ring into a mounting groove through a pressing cylinder. In this solution, the retaining ring is parallel to the mounting groove before it is pressed into the groove, that is, the retaining ring is pressed into the mounting groove as a whole. Therefore, the effect is expected, and the retaining ring will inevitably be fully inserted into the mounting groove.

[0091] In the present disclosure, a ratio of the thickness of the retaining ring body **1** to the width of the groove **41** is greater than or equal to 1:2. Especially, according to the national standard GB/T894-2017 "Elastic Retaining Rings for Shafts", the ratio is even greater than or equal to 4:5. In this embodiment, the ratio is 2:2.15. One end of the retaining ring body **1** is pressed into the groove, and then the other end of the retaining ring body is inserted into the groove by a rebound force. This effect is difficult for those skilled in the art to predict based on the prior art.

[0092] Specifically, as shown in FIG. **12**, when one end of the retaining ring body **1** is pressed into the groove **41**, the pressing sleeve **3** is axially limited by the end surface of the groove **41** and stops moving. At this point, the end of the retaining ring body **1** not pressed into the groove cannot be directly pressed into the groove **41** by the pressing sleeve. The axial offset distance between the two ends of the retaining ring body **1** in the axially unlocked state is at least the thickness of the retaining ring body **1**. Therefore, it is unpredictable for those skilled in the art whether the other end of the retaining ring body can overcome the resistance of the conical section **21** or the target mounting shaft **4** by its own rebound force and springs back into the groove **41** after one end is inserted into the groove. Especially, as shown in FIGS. **10** and **12**, before one end of the retaining ring body is inserted into the groove, the two ends of the retaining ring body are in an axially offset state, that is, the axial rebound force of the retaining ring body itself cannot overcome the resistance of the conical section **21** or the target mounting shaft **4** to make the two ends of the retaining ring body **1** flush. Therefore, the technical solution in this embodiment overcomes the technical bias that the traditional retaining ring must be pressed as a whole into the groove through the pressing sleeve **3**.

Embodiment 8

[0093] On the basis of Embodiment 4 or 5, in this embodiment, the pressing sleeve **3** is rotatable in a circumferential direction of the target mounting shaft **4**.

[0094] Based on the above structure, when the usage method of the mounting device for an anti-detachment elastic retaining ring described in Embodiment 7 is implemented, after the step S41 is completed, if the other end of the retaining ring body **1** cannot automatically be inserted into the groove by its own rebound force after one end is pressed into the groove **41**, the step S42' is performed. The pressing sleeve **3** rotates at an inner side in the circumferential direction at the one end of the retaining ring body **1** pressed into the pressing groove **41**. At this point, the release protrusion **5** presses the portion not inserted into the groove **41** into the groove **41**, ensuring that the two ends of the retaining ring body **1** are inserted into the groove **41**. Therefore, in this embodiment, the steps S41 and S42' correspond to the step S4 in Embodiment 6.

Embodiment 9

[0095] In Embodiment 6, to perform the steps S1 and S2, the retaining ring body **1** can be pre-

loosened to a diameter greater than or equal to that of the target mounting shaft **4** using snap ring pliers. In the step S3, the retaining ring body **1** is fully fitted onto the journal at the front end of the groove **41** of the target mounting shaft **4**, and then the snap ring pliers are removed. The retaining ring body **1** is in a detached state, and is clamped onto the journal of the target mounting shaft **4**. Finally, the step S4 is performed.

[0096] The technical principles of the present disclosure are described with reference to the specific embodiments. The description is merely intended to explain the principles of the present disclosure, rather than to limit the protection scope of the present disclosure in any way. Therefore, those skilled in the art may derive other specific implementations of the present disclosure without creative effort, but these implementations should fall within the protection scope of the present disclosure.

Claims

1. A mounting method for an anti-detachment elastic retaining ring, configured to mount a retaining ring body into a groove of a target mounting shaft, wherein a ratio of a thickness of the retaining ring body to a width of the groove is greater than or equal to 1:2; the retaining ring body is provided with an opening; and corresponding to two sides of the opening, two ends of the retaining ring body respectively form a first end and a second end; when the retaining ring body is in an original state, the first end and the second end interlock with each other; corresponding to interlocking front end positions of the first end and the second end, front ends of the first end and the second end are respectively provided with a first connecting extension section and a second connecting extension section; the first connecting extension section and the second connecting extension section extend laterally to form a first limiting protrusion and a second limiting protrusion respectively; the first limiting protrusion and the second limiting protrusion are located at an inner side of each other in a circumferential direction of the retaining ring body; adjacent sides of the first limiting protrusion and the second limiting protrusion are provided with locking fitting surfaces; and when the retaining ring body expands outward from a locked state, the two locking fitting surfaces are fitted and interlocked with each other, preventing the retaining ring body from expanding outward to a detached state; the retaining ring body in the original state is in a sheet-like shape as a whole; a side of the first limiting protrusion away from the second limiting protrusion and/or a side of the second limiting protrusion away from the first limiting protrusion is provided with an inclined guide surface; through the inclined guide surface, the retaining ring body is reset to the locked state from the detached state by a rebound force of the retaining ring body; when the first limiting protrusion and the second limiting protrusion are offset from each other by a preset distance in an axial direction, the retaining ring body is in an axially unlocked state; and the retaining ring body is allowed to reset from the axially unlocked state to the locked state by the rebound force of the retaining ring body; the mounting method is implemented by a mounting device; the mounting device comprises a guide sleeve; the guide sleeve comprises a conical section; the conical section comprises a narrow end with a radial dimension less than a locking diameter of the retaining ring body and a wide end with a radial dimension greater than the locking diameter of the retaining ring body; the guide sleeve is coaxially coupled with a front end of the groove of the target mounting shaft; and the wide end of the conical section faces the groove; the mounting device further comprises a pressing sleeve; the pressing sleeve is fitted outside the guide sleeve and moveable axially along the guide sleeve; and a side of the pressing sleeve adjacent to the target mounting shaft is provided with a release protrusion; the pressing sleeve is allowed to push the retaining ring body clamped on the conical section to move towards the groove, wherein the retaining ring body enters the groove; and during the process, the release protrusion pushes an end at a side of the opening of the retaining ring body, causing two ends at the opening of the retaining ring body to offset from each other axially; the mounting method comprises the following

steps: step S1: axial unlocking: fitting the retaining ring body from the narrow end of the conical section onto the conical section; moving the pressing sleeve towards the retaining ring body; pushing, by the release protrusion, a first end of the retaining ring body to move, wherein the retaining ring body enters the axially unlocked state; step S2: radial unlocking: pushing, by the pressing sleeve, the retaining ring body to move towards the wide end of the conical section until the retaining ring body enters the detached state; step S3: expansion: pushing, by the pressing sleeve, the retaining ring body to move towards the wide end of the conical section; and expanding the retaining ring body until an inner diameter of the retaining ring body is greater than or equal to a diameter at the front end of the groove of the target mounting shaft; step S4: movement: continuously pushing, by the pressing sleeve, the retaining ring body to move, wherein the retaining ring body moves axially until a front end of the retaining ring body is located at an axial outer side of the groove; step S5: the first end insertion: continuously pushing, by the pressing sleeve, the retaining ring body to move until the first end of the retaining ring body pushed by the release protrusion is inserted into the groove; and step S6: overall insertion: enabling, following the first end of the retaining ring body inserted into the groove, a second end of the retaining ring body to be inserted into the groove due to the rebound force.

2. The mounting method for the anti-detachment elastic retaining ring according to claim 1, wherein the release protrusion is located on an axial end surface of the retaining ring body.

3. The mounting method for the anti-detachment elastic retaining ring according to claim 1, wherein the release protrusion is located on an end surface of the pressing sleeve.

4. The mounting method for the anti-detachment elastic retaining ring according to claim 3, wherein a side of the release protrusion extends helically along circumferential and axial directions of the pressing sleeve to form a transition fitting surface.
