

AXLE FOR USE IN GAUGE-CHANGEABLE WHEELSET, AND GAUGE-CHANGEABLE WHEELSET

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority to Chinese application No. 202010737193.4 filed on July 28, 2020, entitled “Axle for Use in Gauge-Changeable Wheelset, and Gauge-Changeable Wheelset”.

FIELD OF TECHNOLOGY

[0002] The present application relates to the technical field of railway vehicle gauge changing, and in particular, to an axle for a gauge-changing wheelset and a gauge-changing wheelset.

BACKGROUND

[0003] Transnational passenger and cargo transportation has grown rapidly in recent years. However, different rail gauges of various countries have seriously hindered the transnational rail transportation. In order to solve the problem that the different rail gauges of various countries seriously hinder the transnational railway transportation, a gauge-changing train is proposed, when the train runs on the railway of another country, a distance between wheels on an axle is changeable so as to adapt to the gauge of other countries' railways.

[0004] However, traditional wheel and axle have complex connection structure, and the gauge-changing operation has low reliability.

SUMMARY

[0005] The present application is intended to address at least one of the technical problems in the prior art. The present application provides an axle for a gauge-changing wheelset having an ingenious structural design, which provides simple connection structure between the axle and the wheel, and highly reliable gauge-changing operation.

[0006] The present application further provides a gauge-changing wheelset.

[0007] According to an embodiment of an aspect of the present application, an axle for a gauge-changing wheelset is provided. A central through hole is provided along an axial direction of the axle, an outer circumference of the axle close to a middle portion thereof is provided with

a section of an outer spline extending along the axial direction of the axle, an outer circumference of the axle is provided with two sections of first non-self-locking thread having opposite directions of rotation at both axial sides of the outer spline respectively, and an oblong hole radially penetrating through the axle is provided at the outer spline of the axle and the oblong hole has a longitudinal direction coinciding with the axial direction of the axle; and

[0008] at least one first raceway circumferentially disposed around the axle is provided at a position between one of second non-self-locking threads and the outer spline of the axle.

[0009] According to an embodiment of the present application, the at least one first raceway comprises two first raceways, and the two first raceways are arranged side by side and disposed close to the outer spline.

[0010] According to an embodiment of the present application, each first raceway has a cross section of concave semicircle.

[0011] According to an embodiment of the present application, an annular flange is formed at a position of the axle where the first raceway is constructed, and the annular flange has an outer diameter larger than an outer diameter of the remaining part of the axle such that stop end surfaces are formed at both axial ends of the annular flange.

[0012] According to an embodiment of the present application, a distance between the outer spline and a first non-self-locking thread adjacent to the outer spline is equal to a distance between the annular flange and a first non-self-locking thread adjacent to the annular flange, and both of the distances are equal to half of the gauge to be changed.

[0013] According to an embodiment of the present application, the first non-self-locking thread is a trapezoidal thread.

[0014] According to an embodiment of the present application, the axle is configured to be a stepped axle with both ends each having a smaller diameter than that of a middle portion of the stepped axle, and two end portions of the stepped axle are configured to mount an axle-box body.

[0015] According to an embodiment of the present application, an intermediate portion of the stepped axle is provided with a sliding section between each first non-self-locking thread and an end of the intermediate portion of the stepped axle.

[0016] According to an embodiment of another aspect of the present application, a

gauge-changing wheelset is provided, including an axle and a pair of wheels, the axle is the axle for a gauge-changing wheelset mentioned above;

[0017] the gauge-changing wheelset further including an outer sleeve and a pair of axle sleeves;

[0018] wherein the pair of wheels are mounted on the axle through the axle sleeves, each wheel is fastened on an outer circumference of a first end of each axle sleeve, and an inner circumference of the axle sleeve is provided with two sections of second non-self-locking threads that are matched to form a non-self-locking thread pair with the first non-self-locking thread;

[0019] an outer circumference of a second end of the axle sleeve is provided with an outer spline; and

[0020] the outer sleeve is sleeved outside the axle, an inner circumference of the outer sleeve is provided with a second raceway corresponding to the first raceway, the second raceway is provided with a rolling element mounting hole in snap-fit with the first raceway to form a rolling space in which a rolling element matched therewith is mounted through the rolling element mounting hole such that the outer sleeve is rotatably connected outside the axle, and an inner spline matched with the outer spline on the axle sleeve is provided on both axial sides of the second raceway inside the outer sleeve and located at predetermined distances from the second raceway.

[0021] According to an embodiment of the present application, the gauge-changing wheelset further includes a locking slip ring, a thrust pin, an elastic piece and a thrust rod;

[0022] the locking slip ring is slidably sleeved at the outer spline of the axle, and the locking slip ring is provided therein with an inner spline matched with the outer spline of the axle, and provided externally with an outer spline matched with the inner spline of the outer sleeve; an inner wall of the locking slip ring is radially provided with a pair of open slots having openings communicated with an end of the locking slip ring; the thrust pin passes through the oblong hole, and both ends of the thrust pin protrude from the oblong hole and both ends of the thrust pin protruding from the oblong hole are embedded inside the pair of the open slots by the openings of the open slots; the locking elastic piece is sleeved on the axle, having an end abutted against an outer wall of the first raceway, and the other end abutted against an end of the locking slip ring away from the open slot; and when the locking elastic piece is in a natural state, the outer

spline of the locking slip ring is at least partially located in the inner spline of a corresponding side of the outer sleeve to lock the rotation of the outer sleeve; and

[0023] the thrust rod has an end penetrating through the central through hole of the axle and abutted against a side of the thrust pin on which the open slot is located and another end extending to an end portion of the axle.

[0024] According to an embodiment of the present application, the gauge-changing wheelset further includes an unlocking mechanism mounted on an end of the axle where the thrust rod is located; and

[0025] an axle-box body is mounted at each end of the axle located outside the pair of wheels, and the unlocking mechanism includes a mounting base and a pushing head penetrating axially through the mounting base. The mounting base is fixedly mounted outside the axle-box body and the pushing head is disposed opposite to the thrust rod.

[0026] According to an embodiment of the present application, the second non-self-locking thread has a length greater than the length of the first non-self-locking thread is equal to half of the gauge to be changed;

[0027] an inner circumference of the outer sleeve is provided with an annular boss at the second raceway, and after the outer sleeve is connected to the axle, a pair of mounting spaces for the axle sleeves are formed between the outer sleeve and the axle at both axial sides of the rolling space; and

[0028] the elastic piece is a locking spring.

[0029] One or more technical solutions in the embodiments of the present application mentioned above have at least one of the following technical effects.

[0030] For the axle for a gauge-changing wheelset according to an embodiment of the present application, a central through hole is provided along the axial direction of the axle, an outer circumference of the axle close to a middle portion thereof is provided with a section of an outer spline extending along an axial direction of the axle, an outer circumference of the axle is provided with two sections of first non-self-locking thread having opposite directions of rotation at both axial sides of the outer spline respectively, and an oblong hole radially penetrating through the axle is provided at the outer spline of the axle and the oblong hole has a

longitudinal direction coinciding with the axial direction of the axle; and at least one first raceway circumferentially disposed around the axle is provided a position between one of second non-self-locking threads and the outer spline of the axle; such that the axle has an ingenious structural design, which ensures simple connection structure between the axle and the wheel, and highly reliable gauge-changing operation.

[0031] For the gauge-changing wheelset according to the embodiment of the present application, by providing the axle for the gauge-changing wheelset mentioned above, no complex gauge-changing mechanisms need to be provided, which simplifies the structure of other matching components outside the axle, so that the gauge-changing wheelset can have simple overall structure, convenient mounting, and reliable gauge-changing operation.

[0032] The additional aspects and advantages of the present application will be partially given in the following description, and some thereof will be obvious from the following description, or be understood through the practice of the present application.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033] In order to more clearly illustrate technical solutions disclosed in the embodiments of the present application or the prior art, the drawings used in the descriptions of the embodiments or the prior art will be briefly described below. Obviously, the drawings in the following description are only certain embodiments of the present application, and other drawings can be obtained according to the drawings without any creative work for those skilled in the art.

[0034] FIG. 1 is a front schematic structural diagram showing an axle for a gauge-changing wheelset according to an embodiment of the present application;

[0035] FIG. 2 is a perspective schematic structural diagram showing an axle sleeve of a gauge-changing wheelset according to an embodiment of the present application;

[0036] FIG. 3 is an axial sectional schematic structural diagram of a gauge-changing wheelset according to an embodiment of the present application; and

[0037] FIG. 4 is an axial sectional schematic structural diagram of another gauge-changing wheelset according to an embodiment of the present application;

[0038] Reference numerals:

10. axle; 11. outer spline of the axle; 12. oblong hole; 13. first raceway; 14. first non-self-locking thread; 15. central through hole; 20. axle sleeve; 21. second non-self-locking thread; 22. outer spline of axle sleeve; 30. wheel; 40. outer sleeve; 41. second raceway; 50. axle-box body; 60. locking slip ring; 70. locking spring; 80. thrust pin; 90. thrust rod; 100. unlocking mechanism; 110. sliding bearing; 120. gear box; 130. brake disc.

DETAILED DESCRIPTION

[0039] Embodiments of the present application are further described in detail below in conjunction with the drawings and embodiments. The following embodiments are intended to illustrate the present application, but are not intended to limit the scope of the present application.

[0040] In the description of the embodiments of the present application, it is to be noted that the orientation or positional relationships indicated by terms such as “center”, “longitudinal”, “lateral”, “upper”, “lower”, “front”, “rear”, “left”, “right”, “vertical”, “horizontal”, “top”, “bottom”, “inside”, “outside”, etc. are based on the orientation or positional relationship shown in the drawings, and are merely for the convenience of describing the embodiments of the present application and simplifying the description, rather than indicating or implying that the device or component stated must have a particular orientation, is constructed and operated in a particular orientation, and thus is not to be construed as limiting the embodiments of the present application. Moreover, the terms “first”, “second”, “third”, and the like are used for descriptive purposes only and are not to be construed as indicating or implying relative importance.

[0041] In the description of the embodiments of the present application, it is to be noted that unless explicitly stated and defined otherwise, the terms “connected with”, and “connected” shall be understood broadly, for example, it may be either fixedly connected or detachably connected, or can be integrated; it may be mechanically connected, or electrically connected; it may be directly connected, or indirectly connected through an intermediate medium. The specific meanings of the terms above in embodiments of the present application can be understood by a person skilled in the art in accordance with specific conditions.

[0042] In the embodiments of this application, unless otherwise clearly stated and defined, the first feature being located “on” or “under” the second feature means that the first feature is in direct contact with the second feature or the first feature is in contact with the second feature by an intervening media. Also, the first feature being located “on”, “above” and “on top of” the

second feature may mean that the first feature is directly on or above the second feature, or it simply means that the level of the first feature is higher than the second feature. The first feature being located “under”, “below” and “on bottom of” the second feature may mean that the first feature is directly under or below the second feature, or it simply means that the level of the first feature is lower than the second feature.

[0043] In the description of this specification, descriptions with reference to the terms “one embodiment”, “some embodiments”, “examples”, “specific examples”, or “some examples” etc. mean that specific features, structure, materials or characteristics described in conjunction with the embodiment or example are included in at least one embodiment or example of the embodiments of the present application. In this specification, the schematic expressions of the above terms do not necessarily refer to the same embodiment or example. Also, the described specific features, structures, materials or characteristics can be combined in any one or more embodiments or examples in a suitable manner. In addition, those skilled in the art may integrate and combine the different embodiments or examples and the features of the different embodiments or examples described in this specification without contradicting each other.

[0044] As shown in FIGS. 1 to 4, an embodiment of the present application provides an axle for a gauge-changing wheelset and a gauge-changing wheelset.

[0045] In order to introduce the technical solution of the present application clearly, the axle for a gauge-changing wheelset is described by combining the gauge-changing wheelset.

[0046] Referring to FIGS. 1 to 4, the gauge-changing wheelset includes an axle for a gauge-changing wheelset, an outer sleeve 40, a pair of axle sleeves 20 and a pair of wheels 30.

[0047] Specifically, as shown in FIG. 1, the axle 10 is provided with a central through hole 15 along the axial direction thereof, an outer circumference of the axle 10 close to a middle portion thereof is provided with a section of outer spline extending in the axial direction of the axle 10, and both axial sides of the outer spline at the outer circumference thereof are provided with a pair of first non-self-locking threads 14 having opposite direction of rotation, that is, the axle 10 is further provided with two sections of first non-self-locking thread 14 having opposite direction of rotation disposed at both axial sides of the outer spline. In an embodiment, there is a spacing between each section of first non-self-locking thread 14 and the outer spline. The outer spline of the axle 10 is provided with an oblong hole 12 radially extending through the outer spline. That is, the oblong hole 12 and the outer spline are overlapped, and the oblong hole 12 has a

longitudinal direction coinciding with the axial direction of the axle, that is, the oblong hole 12 has a longitudinal direction consistent with the extending direction of the outer spline.

[0048] In the present embodiment, the oblong hole 12 has a length slightly less than the length of the outer spline. In addition, the central through hole 15 provided on the axle 10 is beneficial to reduce the weight of the axle.

[0049] Further, a part of the axle 20 between one of the first non-self-locking thread 14 and the outer spline is provided with at least one first raceway 13 circumferentially disposed around the axle 10 and the first raceway 13 is disposed close to the outer spline.

[0050] In the present embodiment, the first raceway 13 has a cross section of concave semicircle.

[0051] Specifically, the pair of wheels 30 are mounted at both axial ends of the axle 10 through the axle sleeves 20 and fastened outside first ends of the axle sleeves 20. For example, the wheels 30 may be press-fitted at the outer circumference of a first end of the axle sleeve 20 so that they are in interference fit with each other. The inner circumference of a second end of the axle sleeve 20 is provided with a second non-self-locking thread 21 that forms a non-self-locking thread pair together with the first non-self-locking thread 14. The second non-self-locking thread 21 has a length greater than the length of the first non-self-locking thread 14, and the length difference is equal to half of the gauge to be changed, so that both wheels 30 can move half of the gauge to be changed relative to the axle 10 during the rotation by following respective axle sleeves 20 so that a sum of the distances both wheels 30 move is equal to the distance of the desired gauge to be changed.

[0052] The outer sleeve 40 is sleeved outside the axle 10, an inner circumference of the outer sleeve 40 is provided with a second raceway 41 corresponding to the first raceway 13 having the same size and shape as those of the first raceway 13. The second raceway 41 is provided with a rolling element mounting hole and in snap fit with the first raceway 13 to form a circular rolling space in which a rolling element is mounted through the rolling element mounting hole. The rolling element, which may be a rolling ball filled with the rolling space, has an outer diameter matched with an inner diameter of the rolling space. By connecting the outer sleeve 40 with the axle 10 through the rolling element, the outer sleeve 40 is rotatably connected outside the axle 10, in other words, the outer sleeve 40 has rotational degree of freedom, but is restricted the movement degree of freedom, that is, the outer sleeve 40 can rotate relative to the axle 10 but

cannot move.

[0053] The outer circumference of the second end of the axle sleeve 20 is provided with outer splines. After being mounted, the second end of the axle sleeve 20 is located inside the wheel 30 and faces the outer sleeve 40; inner splines matched with the outer splines on the axle sleeve 20 are respectively disposed on an inner circumference of the outer sleeve at positions on both axial sides of the second raceway 42 and at a predetermined interval from the second raceway 41. The axle sleeve 20 and the outer sleeve 40 are connected through the inner splines and the outer splines such that the axle sleeve 20 can rotate together with the outer sleeve 40, or the axle sleeve 20 can move axially relative to the outer sleeve 40.

[0054] According to an embodiment of the present application, an annular flange is formed at a position of the axle 10 where the first raceway 13 is constructed, and the annular flange has an outer diameter larger than the outer diameter of the remaining part of the axle 10 such that stop end surfaces are formed at both axial ends of the annular flange.

[0055] Specifically, both ends of the axle 10 beyond the pair of wheels 30 are respectively mounted with axle-box bodies 50.

[0056] According to an embodiment of the present application, the gauge-changing wheelset further includes a locking slip ring 60, a thrust pin 80, an elastic piece and a thrust rod 90.

[0057] In an embodiment, the locking slip ring 60 is slidably sleeved at the outer spline 11 of the axle, and the locking slip ring is provided therein with an inner spline matched with the outer spline 11 of the axle, and provided externally with an outer spline matched with the inner spline of the outer sleeve 40. An inner wall of the locking slip ring 60 is radially provided with a pair of open slots having openings communicated with an end of the locking slip ring 60. The thrust pin 80 passes through the oblong hole 12, and both ends of the thrust pin 80 protrude from the oblong hole 12 and both ends of the thrust pin 80 protruding from the oblong hole 12 are embedded inside the pair of the open slots by the openings of the open slots. The thrust pin 80 has a length same as a distance between the top walls of a pair of open slots, and both ends of the thrust pin 80 abut against the top walls of the open slot. In addition, the thrust pin 80 has a width consistent with widths of the open slots such that the thrust pin 80 and the locking slip ring 60 have reliable connection.

[0058] In order to facilitate the axial movement of the thrust pin 80 along the oblong hole 12,

the thrust pin 80 has a width smaller than the length of the oblong hole 12, and a thickness less than or equal to the width of the oblong hole 12. In addition, the width of the locking slip ring 60 should not be too wide to ensure that the locking slip ring 60 can have an amount of movement in the space between the second raceway 41 of the outer sleeve 40 and the inner spline.

[0059] The elastic piece, for example, an elastic spring 70, is sleeved on the axle, and has an end abutted against an outer wall, i.e., a stop end surface of the first raceway 13, and the other end abutted against an end of the locking slip ring 60 away from the open slot. When the elastic piece is in a natural state, the outer spline outside the locking slip ring 60 are at least partially located in the inner spline of a corresponding side of the outer sleeve 40 to lock the rotation of the outer sleeve 40 for fixing the outer sleeve relative to the axle 10.

[0060] The thrust rod 90 has an end penetrating the central through hole 15 of the axle 10 and abutted against a side of the thrust pin 80 where an open slot is located. For example, the thrust pin 80 may be provided with a connecting shaft extending to a side, and the thrust rod 90 is designed to be hollow and sleeved on the connecting shaft of the thrust pin 80 to fix the two. The connecting shaft can also be provided with an outer thread, and an inner hole at an end of the thrust rod 90 is provided with an inner thread for forming a threaded connection with the outer thread. The thrust rod 90 has the other end extending to the end of the central through hole 15. Preferably, the outer end of the thrust rod 90 is substantially flush with the end of the central through hole 15. The axle box body 50 may be lifted by an unlocking rail and thus the wheels 30 are unloaded, a thrust is applied to the thrust pin 80 by the thrust rod 90 to drive the locking slip ring 60 to compress the elastic piece on the axle 10 to move away from the inner spline of the outer sleeve 40 to disengage from the inner spline of the outer sleeve 40 key and thus the rotational degree of freedom of the outer sleeve 40 is unlocked. In this case, when the wheels 30 are pushed, since the axle sleeve 20 is connected with the axle 10 through the non-self-locking thread pair, the wheels 30 and the axle sleeve 20 will rotate together around the axle 10, the second non-self-locking thread 21 of the axle sleeve 20 moves along the first non-self-locking thread 14 of the axle 10 during the rotation, so that the wheel 30 moves along with the axle sleeve 20 during the rotation. When the pair of wheels 30 is pushed inward or outward at the same time after the wheels 30 are unloaded, due to the non-self-locking thread pair having opposite directions of rotation, the pair of wheels 30 may move closer to each other or away from each other when they rotate in the same direction until they move to a set gauge-changing position, so as to change the gauge.

[0061] After the gauge is changed, the thrust of the thrust rod 90 on the thrust pin 80 is removed, and the thrust pin 80 will follow the slip ring 60 to return to its original position under the elastic reset action of the locking elastic piece, that is, the outer splines of the slip ring 60 are re-inserted into the outer splines of the outer sleeve 40 to lock the rotational degree of freedom of the outer sleeve 40. In this case, the axle sleeve 20 and the outer sleeve 40 cannot rotate relative to the axle 10, the axle sleeve 20 and the outer sleeve 40 can only rotate together with the axle 10, that is, the axle sleeve 20 and the outer sleeve 40 are locked on the axle 10.

[0062] The gauge-changing wheelset according to the embodiment has convenient and reliable gauge-changing operation, and simple overall structure.

[0063] In an embodiment, the first non-self-locking thread 14 is a trapezoidal thread, and correspondingly, the second non-self-locking thread 21 is a trapezoidal thread matching the trapezoidal thread of the first non-self-locking thread 14, resulting in reliable performance.

[0064] It should be noted that the elastic piece may also be other elastic sleeves with certain elasticity.

[0065] In order to directly apply a thrust to the thrust rod 90 by means of an external force when changing gauge, according to an embodiment of the present application, an unlocking mechanism 100 is further included, and the unlocking mechanism 100 is installed at an end of the axle 10 where the thrust rod 90 is located, that is, the unlocking mechanism 100 only needs to be mounted on an end of the axle 10.

[0066] Specifically, the unlocking mechanism 100 includes a mounting base and a pushing head penetrating axially through the mounting base, the mounting base is fixedly mounted outside the axle box body 50, the pushing head and the thrust rod 90 are disposed opposite to each other, or may be arranged coaxially, and a gap can be reserved between the pushing head and the thrust rod 90. When an axial thrust is applied from the side wall of the ground gauge-changing facility to the pushing head, the pushing head pushes the thrust rod 90 for unlocking, that is, pushes the thrust pin 80 to drive the locking slip ring 60 to move such that outer splines outside the locking slip ring 60 are disengaged from the inner splines of the outer sleeve 40, and the unlocking is completed.

[0067] After the gauge is changed, the thrust pin 80 recovers and pushes out the thrust rod 90 under the action of the restoring force of the locking spring 70, and pushes out of the pushing

head by the thrust rod 90, then the gauge-changing process ends, the wheelset is completely locked, and the normal operation state is re-entered.

[0068] According to an embodiment of the present application, an inner circumference of the outer sleeve 40 is provided with an annular boss at the second raceway 41. After the outer sleeve 40 and the axle 10 are connected by a rolling ball, a pair of mounting spaces for the axle sleeves 20 are formed between the outer sleeve 40 and the axle 10 at both axial sides of the rolling space. The axle sleeve 20 firstly slides from each end of the axle 10 respectively and sleeved on the axle 10 and then is inserted into the outer sleeve 40; the outer spline 22 of the axle sleeve moves axially relative to the inner spline of the outer sleeve 40 until the second non-self-locking thread 21 of the axle 20 is in contact with the first non-self-locking thread 14 of the axle 10, the axle 20 is rotated such that the second non-self-locking thread 21 is screwed into the first non-self-locking thread 14.

[0069] For a gauge-changing wheelset for motor vehicle, a gearbox 120 is mounted outside the outer sleeve 40, and for a gauge-changing wheelset for trailer, a plurality of brake discs 130 are mounted outside the outer sleeve 40.

[0070] In order to improve the reliability of the connection between the outer sleeve 40 and the axle 10, according to an embodiment of the present application, there are two first raceways 13 arranged side by side.

[0071] Further, the axle 10 is divided into a main half shaft and an auxiliary half shaft by each first raceway 13, and the axle 10 provided with the outer splines and the oblong hole 12 is the main half shaft. The locking slip ring 60 is mounted on the main half shaft, and the open slot of the locking slip ring 60 faces towards the free end of the main half shaft, and the locking spring 70 is mounted between the stop end surface of the annular flange and the locking slip ring 60.

[0072] For optimizing the structure, the first raceway 13 is disposed close to the outer spline 11 of the axle 10.

[0073] According to an embodiment of the present application, a distance between the outer splines 11 of the axle and the adjacent first non-self-locking threads 14 is equal to a distance between the annular flange and the adjacent first non-self-locking threads 14, and both of the distances are equal to half of the changing gauge and the distance is a movement space of the second non-self-locking thread 21 of the axle sleeve 20.

[0074] According to an embodiment of the present application, the axle 10 is configured to be a stepped axle with both ends each having a smaller diameter than that of a middle portion of the stepped axle, so that both end portions of the stepped axle are used to be provided with the axle-box body 50.

[0075] According to an embodiment of the present application, an intermediate portion of the stepped axle is provided with a sliding section between each first non-self-locking thread 14 and an end of the intermediate portion of the stepped axle, so that the sliding bearings 110 of the axle sleeve 20 slides relative to the axle 10 through a sliding bearing 110.

[0076] According to an embodiment, the gauge-changing process is shown as follows.

[0077] 1. unlocking stage: the axle-box body 50 is gradually lifted by an unlocking rail, so that the wheel 30 is unloaded; after the unlocking mechanism 100 is triggered, the pushing head is pushed inward to contact the thrust rod 90, and the thrust pin 80 and the locking slip ring 60 are pushed to move inward and compresses the locking spring 70 until the locking slip ring 60 is out of contact with the inner splines of the outer sleeve 40, and the rotational constraint between the axle 10 and the axle sleeve 20 is released.

[0078] 2. gauge-changing stage: after entering the gauge-changing stage, the wheels 30 move inward (or outward) under the action of the gauge-changing lateral force, and the wheels 30 and the axle sleeve 20 rotate together around the non-self-locking thread pair to reach a target gauge.

[0079] 3. locking stage: after entering the locking stage, the unlocking rail gradually lowers and no longer plays supporting role, and the locking slip ring 60 moves outward under the thrust of the locking spring 70 and is inserted into the inner spline of the outer sleeve 40 to be re-locked; the thrust pin 80 recovers and pushes out the thrust rod 90 under the action of the restoring force of the locking spring 70, and pushes out of the pushing head by the thrust rod 90, then the gauge-changing process ends, the wheelset is completely locked, and the normal operation state is re-entered.

[0080] The implementations above are only used to illustrate the present application, but not to limit the present application. Although the present application has been described in detail with reference to the embodiments, those skilled in the art should understand that various combinations, modifications, or equivalent replacements of the technical solutions of the present application do not depart from the scope of the technical solutions of the present application, and

should all be covered by the scope of the claims of the present application.

Claims:

1. An axle for a gauge-changing wheelset, wherein a central through hole is provided along an axial direction of the axle, an outer circumference of the axle close to a middle portion thereof is provided with a section of an outer spline extending along the axial direction of the axle, an outer circumference of the axle is provided with two sections of first non-self-locking thread having opposite directions of rotation at both axial sides of the outer spline respectively, and an oblong hole radially penetrating through the axle is provided at the outer spline of the axle and the oblong hole has a longitudinal direction coinciding with the axial direction of the axle; and

at least one first raceway circumferentially disposed around the axle is provided at a position between one of second non-self-locking threads and the outer spline of the axle.

2. The axle for a gauge-changing wheelset of claim 1, wherein the at least one first raceway comprises two first raceways, and the two first raceways are arranged side by side and disposed close to the outer spline.

3. The axle for a gauge-changing wheelset of claim 2, wherein each first raceway has a cross section of concave semicircle.

4. The axle for a gauge-changing wheelset of claim 1, wherein an annular flange is formed at a position of the axle where the first raceway is constructed, and the annular flange has an outer diameter larger than an outer diameter of remaining part of the axle such that stop end surfaces are formed at both axial ends of the annular flange.

5. The axle for a gauge-changing wheelset of claim 4, wherein a distance between the outer spline and a first non-self-locking thread adjacent to the outer spline is equal to a distance between the annular flange and a first non-self-locking thread adjacent to the annular flange, and both of the distances are equal to half of the gauge to be changed.

6. The axle for a gauge-changing wheelset of any one of claims 1 to 5, wherein the first non-self-locking thread is a trapezoidal thread.

7. The axle for a gauge-changing wheelset of any one of claims 1 to 5, wherein the axle is configured to be a stepped axle with both ends each having a smaller diameter than that of a middle portion of the stepped axle, and two end portions of the stepped axle are configured to mount an axle-box body.

8. The axle for a gauge-changing wheelset of claim 7, wherein an intermediate portion of the stepped axle is provided with a sliding section between each first non-self-locking thread and an end of the intermediate portion of the stepped axle.

9. A gauge-changing wheelset, comprising a pair of wheels and an axle for a

gauge-changing wheelset of any one of claims 1 to 8,

wherein the gauge-changing wheelset further comprises an outer sleeve and a pair of axle sleeves;

the pair of wheels are mounted on the axle through the axle sleeves, each wheel is fastened on an outer circumference of a first end of each axle sleeve, and an inner circumference of the axle sleeve is provided with two sections of second non-self-locking threads that are matched to form a non-self-locking thread pair with the first non-self-locking thread;

an outer circumference of a second end of the axle sleeve is provided with an outer spline; and

the outer sleeve is sleeved outside the axle, an inner circumference of the outer sleeve is provided with a second raceway corresponding to the first raceway, the second raceway is provided with a rolling element mounting hole and in snap-fit with the first raceway to form a rolling space in which a rolling element matched therewith is mounted through the rolling element mounting hole, such that the outer sleeve is rotatably connected outside the axle, and an inner spline matched with the outer spline on the axle sleeve is provided on both axial sides of the second raceway inside the outer sleeve and located at predetermined distances from the second raceway.

10. The gauge-changing wheelset of claim 9, further comprising a locking slip ring, a thrust pin, an elastic piece and a thrust rod;

wherein the locking slip ring is slidably sleeved at the outer spline of the axle, and the locking slip ring is provided therein with an inner spline matched with the outer spline of the axle, and provided externally with an outer spline matched with the inner spline of the outer sleeve; an inner wall of the locking slip ring is radially provided with a pair of open slots having openings communicated with an end of the locking slip ring; the thrust pin passes through the oblong hole, and both ends of the thrust pin protrude from the oblong hole and both ends of the thrust pin protruding from the oblong hole are embedded inside the pair of the open slots by the opening of the open slots; the locking elastic piece is sleeved on the axle, having an end abutted against an outer wall of the first raceway, and the other end abutted against an end of the locking slip ring away from the open slot; and when the locking elastic piece is in a natural state, the outer spline of the locking slip ring is at least partially located in the inner spline of a corresponding side of the outer sleeve to lock the rotation of the outer sleeve; and

the thrust rod has an end penetrating through the central through hole of the axle and abutted against a side of the thrust pin on which the open slot is located and the other end

extending to an end portion of the axle.

11. The gauge-changing wheelset of claim 10, further comprising an unlocking mechanism mounted on an end of the axle where the thrust rod is located; and

an axle-box body is mounted at each end of the axle located outside the pair of wheels, and the unlocking mechanism comprises a mounting base and a pushing head penetrating axially through the mounting base; the mounting base is fixedly mounted outside the axle-box body and the pushing head is disposed opposite to the thrust rod.

12. The gauge-changing wheelset of claim 10, wherein the second non-self-locking thread has a length greater than the length of the first non-self-locking thread and equal to half of the gauge to be changed;

an inner circumference of the outer sleeve is provided with an annular boss at the second raceway, and after the outer sleeve is connected to the axle, a pair of mounting spaces for the axle sleeves are formed between the outer sleeve and the axle at both axial sides of the rolling space; and

the elastic piece is a locking spring.