

DESCRIPTION

Title of Invention: Linear Motion Guide Unit

5 Technical Field

[0001] The present disclosure relates to a linear motion guide unit.

Background Art

[0002] A linear motion guide device that includes a pinion and a rack that guide a retainer retaining rolling elements is known (see, for example, Patent Literature 1). Such a linear
10 motion guide device can appropriately guide the retainer using a rack and pinion structure, thereby reducing the risk of misalignment of the retainer.

Citation List

Patent Literature

[0003] Patent Literature 1: Japanese Patent Application Laid-Open No. 2002-327742

15 Summary of Invention

Technical Problem

[0004] According to the linear motion guide device disclosed in Patent Literature 1, a pinion holder for holding the pinion has a configuration divided into two, and holds the pinion by catching the same with the two independent parts. This pinion holder is then
20 attached to the retainer. For attachment, a projection formed on the pinion holder side is fitted into a dovetail groove formed on the retainer side. However, with such a configuration, particularly in the case of attempting size reduction, the projection will have an extremely narrow width, which increases the risk of breakage of the projection during production or assembly. Furthermore, the width of the dovetail groove will also become
25 small, making assembly difficult. As a result, productivity cannot be improved.

[0005] In view of the foregoing, one of the objects is to provide a linear motion guide unit for which productivity can be improved.

Solution to Problem

[0006] A linear motion guide unit according to the present disclosure includes a first
30 raceway member extending in a first direction that is a longitudinal direction, and a second

raceway member extending in the first direction and arranged opposite the first raceway member in a second direction that is a direction orthogonal to the first direction, wherein the second raceway member performs linear motion relative to the first raceway member in the first direction. The linear motion guide unit includes: a plurality of rollers arranged spaced apart in the first direction such that rolling axes thereof are alternately orthogonal to each other; a retainer arranged between the first raceway member and the second raceway member in the second direction to retain the plurality of rollers, the retainer having a plurality of pockets provided spaced apart in the first direction, each pocket accommodating the corresponding roller; a pinion having a plurality of external teeth provided at an outer periphery thereof, the pinion being arranged between the first raceway member and the second raceway member in the second direction and rotatably supported; a first rack attached to an outer peripheral surface of the first raceway member, the first rack having a plurality of first rack teeth that mesh with the external teeth; and a second rack attached to an outer peripheral surface of the second raceway member, the second rack having a plurality of second rack teeth that mesh with the external teeth. The retainer includes a roller holding region that holds the plurality of rollers, and a pinion holding region arranged adjacent to the roller holding region in the first direction, the pinion holding region having a pinion accommodating portion that accommodates the pinion such that the external teeth mesh with the second rack teeth. The roller holding region and the pinion holding region are configured as one piece. The linear motion guide unit includes a pinion cover attached to the pinion holding region such that the pinion is caught between the pinion holding region and the pinion cover and such that the external teeth mesh with the first rack teeth.

Advantageous Effects of Invention

[0007] The linear motion guide unit described above can be improved in productivity.

Brief Description of Drawings

[0008] [FIG. 1] FIG. 1 is a schematic perspective view of a linear motion guide unit in Embodiment 1 of the present disclosure.

[FIG. 2] FIG. 2 is a schematic plan view of the linear motion guide unit shown in FIG. 1.

[FIG. 3] FIG. 3 is a schematic side view of the linear motion guide unit shown in FIG. 1.

[FIG. 4] FIG. 4 is a schematic front view of the linear motion guide unit shown in FIG. 1.

5 [FIG. 5] FIG. 5 is a schematic cross-sectional view when cut in a cross section indicated by V-V in FIG. 2.

[FIG. 6] FIG. 6 is a schematic perspective view of the linear motion guide unit 10a, with a second raceway member, which will be described later, removed.

10 [FIG. 7] FIG. 7 is an enlarged, schematic perspective view of a portion of a retainer.

[FIG. 8] FIG. 8 is a schematic cross-sectional view of a portion of the retainer shown in FIG. 7.

[FIG. 9] FIG. 9 is a view of a portion of the retainer shown in FIG. 7, as seen from a window portion side of a pocket.

15 [FIG. 10] FIG. 10 is a schematic perspective view illustrating a process of producing a portion of the retainer.

[FIG. 11] FIG. 11 is a schematic perspective view showing the external view of a first rack.

20 [FIG. 12] FIG. 12 is an enlarged, schematic perspective view of a portion of the first rack shown in FIG. 11.

[FIG. 13] FIG. 13 is an enlarged, schematic perspective view of a portion of the retainer in an exploded perspective view of the linear motion guide unit.

[FIG. 14] FIG. 14 is a schematic plan view of a pinion cover.

[FIG. 15] FIG. 15 is a schematic side view of the pinion cover.

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Description of Embodiments

[0009] [Outline of Embodiments]

30 A linear motion guide unit of the present disclosure includes a first raceway member extending in a first direction that is a longitudinal direction, and a second raceway member extending in the first direction and arranged opposite the first raceway member in

a second direction that is a direction orthogonal to the first direction, wherein the second raceway member performs linear motion relative to the first raceway member in the first direction. The linear motion guide unit includes: a plurality of rollers arranged spaced apart in the first direction such that rolling axes thereof are alternately orthogonal to each other; a retainer arranged between the first raceway member and the second raceway member in the second direction to retain the plurality of rollers, the retainer having a plurality of pockets provided spaced apart in the first direction, each pocket accommodating the corresponding roller; a pinion having a plurality of external teeth provided at an outer periphery thereof, the pinion being arranged between the first raceway member and the second raceway member in the second direction and rotatably supported; a first rack attached to an outer peripheral surface of the first raceway member, the first rack having a plurality of first rack teeth that mesh with the external teeth; and a second rack attached to an outer peripheral surface of the second raceway member, the second rack having a plurality of second rack teeth that mesh with the external teeth. The retainer includes a roller holding region that holds the plurality of rollers, and a pinion holding region arranged adjacent to the roller holding region in the first direction, the pinion holding region having a pinion accommodating portion that accommodates the pinion such that the external teeth mesh with the second rack teeth. The roller holding region and the pinion holding region are configured as one piece. The linear motion guide unit includes a pinion cover attached to the pinion holding region such that the pinion is caught between the pinion holding region and the pinion cover and such that the external teeth mesh with the first rack teeth.

[0010] In a linear motion guide unit in which the second raceway member performs linear motion relative to the first raceway member, a mechanism allowing smooth linear motion is required. The linear motion guide unit described above can prevent misalignment of the retainer retaining the rollers by utilizing the pinion, the first rack, and the second rack. Therefore, it is possible to appropriately guide the linear motion. Here, the external teeth of the pinion are positioned between the first raceway member and the second raceway member, and the first rack and the second rack are attached to the outer peripheral surfaces of the first raceway member and the second raceway member, respectively. With this configuration adopted, the pinion can be arranged in a so-called

vertical orientation. This can increase the contact length between the raceway surfaces of the raceway members and the rollers, thereby increasing the load capacity.

[0011] Here, according to the linear motion guide unit of the present disclosure, the retainer includes a roller holding region that holds the rollers, and a pinion holding region provided with a pinion accommodating portion. The roller holding region and the pinion holding region are configured as one piece. This eliminates the need to form a projection and a dovetail groove when incorporating a mechanism for holding the pinion into the retainer. Thus, there is no damage to the projection, and the work of fitting the projection into the dovetail groove is unnecessary, leading to improved productivity. Particularly in the case of producing a linear motion guide unit of a small size with rollers having the diameter of less than 4 mm, for example, more improvement in productivity can be achieved. Additionally, since the pinion is held in the retainer by being caught by the pinion cover, the risk of the pinion being disengaged from or falling out of the retainer can be greatly reduced. Therefore, according to such a linear motion guide unit, productivity can be improved.

[0012] In the linear motion guide unit described above, the pinion holding region may be arranged at a center in the first direction. A pair of the roller holding regions may be arranged at both ends in the first direction, sandwiching the pinion holding region therebetween. In this manner, with the pinion holding region positioned at the center of the first direction, which is the longitudinal direction, the retainer can be guided in a balanced manner in the longitudinal direction. Additionally, the portions where the roller holding regions are located are prevented from becoming unbalanced in the longitudinal direction, which allows the first raceway member and the second raceway member to appropriately bear the load.

[0013] In the linear motion guide unit described above, the pinion cover may be attached to the pinion holding region in a snap-fit manner. In this manner, when attaching the pinion cover in such a way to catch the pinion, the elastic deformation of the material can be utilized. Therefore, favorable assembly is ensured with a simpler configuration, resulting in improved productivity.

[0014] In the linear motion guide unit described above, at least one of the first rack and

the second rack may be plate-shaped. In this manner, at least one of the first rack and the second rack can be simplified in shape, which can improve productivity.

[0015] In the linear motion guide unit described above, at least one of the first rack teeth and the second rack teeth may be provided so as to protrude in the second direction. This facilitates the meshing of at least one of the first rack teeth provided in the first rack and the second rack teeth provided in the second rack with the external teeth of the pinion in the second direction. Therefore, the retainer can be guided by enabling appropriate meshing between the external teeth of the pinion and the rack teeth, while achieving size reduction and shape simplification.

[0016] In the linear motion guide unit described above, the retainer may include a pair of side stays, a plurality of pillar portions arranged apart from each other in the first direction and connecting the pair of side stays to form the pocket, and a retaining claw that, as viewed from a side where a window portion of the pocket is open, is continuous with a side wall surface of one of the pair of side stays and a side wall surface of the pillar portion and protrudes toward the window portion to prevent the roller from falling out of the pocket. In this manner, when housing a roller in the pocket over the retaining claw, which can prevent the roller housed in the pocket from falling out, the force pushing against the retaining claw can more easily be distributed in the first and second directions. Therefore, the mechanical load on the retaining claw when housing the roller is reduced, which reduces the risk of damage to the retaining claw.

[0017] In the linear motion guide unit described above, a pair of the retaining claws may be provided, one on each of the side stays. In this manner, the mechanical load on each retaining claw can be further reduced, which can further reduce the risk of damage to the retaining claws.

[0018] In the linear motion guide unit described above, the retaining claw may include a flat surface that is continuous with the side wall surface of one of the pair of side stays and the side wall surface of the pillar portion. In this manner, the retaining claw can be made relatively simple in shape, while providing a relatively large region that hooks onto the roller, which greatly reduces the risk of the roller falling out of the pocket.

[0019] In the linear motion guide unit described above, as viewed from the side where

the window portion of the pocket is open, the retaining claw may have an isosceles triangular shape with equal sides corresponding to a portion continuous with the side wall surface of the side stay and a portion continuous with the side wall surface of the pillar portion. In this manner, when incorporating a roller into the pocket, the load capacity can be more easily distributed equally to the side stay side and the pillar portion side. Therefore, productivity can be improved by achieving better incorporation.

[0020] In the linear motion guide unit described above, the first raceway member and the second raceway member may be identical in shape. This enables the sharing of components, resulting in improved productivity.

[0021] Another linear motion guide unit of the present disclosure includes a first raceway member extending in a first direction that is a longitudinal direction, and a second raceway member extending in the first direction and arranged opposite the first raceway member in a second direction that is a direction orthogonal to the first direction, wherein the second raceway member performs linear motion relative to the first raceway member in the first direction. The linear motion guide unit includes: a plurality of rollers arranged spaced apart in the first direction such that rolling axes thereof are alternately orthogonal to each other; a retainer arranged between the first raceway member and the second raceway member in the second direction to retain the plurality of rollers, the retainer having a plurality of pockets provided spaced apart in the first direction, each pocket accommodating the corresponding roller; a pinion having a plurality of external teeth provided at an outer periphery thereof, the pinion being arranged between the first raceway member and the second raceway member in the second direction and rotatably supported; a first rack attached to an outer peripheral surface of the first raceway member, the first rack having a plurality of first rack teeth that mesh with the external teeth; and a second rack attached to an outer peripheral surface of the second raceway member, the second rack having a plurality of second rack teeth that mesh with the external teeth. The retainer includes a pair of side stays, a plurality of pillar portions arranged apart from each other in the first direction and connecting the pair of side stays to form the pocket, and a retaining claw that, as viewed from a side where a window portion of the pocket is open, is continuous with a side wall surface of one of the pair of side stays and a side wall surface of the pillar portion

and protrudes toward the window portion to prevent the roller from falling out of the pocket.

[0022] According to such a linear motion guide unit, when housing a roller in the pocket over the retaining claw, which can prevent the roller housed in the pocket from falling out, the force pushing against the retaining claw can more easily be distributed in the first direction and the direction perpendicular thereto. Therefore, the mechanical load on the retaining claw when housing the roller is reduced, which reduces the risk of damage to the retaining claw.

[0023] [Specific Embodiments]

Specific embodiments of the linear motion guide unit of the present disclosure will be described below with reference to the drawings. In the drawings referenced below, the same or corresponding portions are denoted by the same reference numerals and the description thereof will not be repeated.

[0024] (Embodiment 1)

An embodiment of the present disclosure, Embodiment 1, will be described first. FIG. 1 is a schematic perspective view of a linear motion guide unit in Embodiment 1 of the present disclosure. FIG. 2 is a schematic plan view of the linear motion guide unit shown in FIG. 1. FIG. 2 is a view as seen in the direction of arrow II shown in FIG. 1. FIG. 3 is a schematic side view of the linear motion guide unit shown in FIG. 1. FIG. 3 is a view as seen in the direction of arrow III shown in FIG. 1. FIG. 4 is a schematic front view of the linear motion guide unit shown in FIG. 1. FIG. 4 is a view as seen in the direction of arrow IV shown in FIG. 1. FIG. 5 is a schematic cross-sectional view when cut in a cross section indicated by V-V in FIG. 2. FIG. 6 is a schematic perspective view of the linear motion guide unit 10a, with a second raceway member, which will be described later, removed. In FIG. 1 and subsequent figures, the direction indicated by arrow Y is a longitudinal direction, the direction indicated by arrow X is a lateral direction, and the direction indicated by arrow Z is a thickness direction.

[0025] Referring to FIGS. 1, 2, 3, 4, 5, and 6, the linear motion guide unit 10a of Embodiment 1 includes a first raceway member 11a, a second raceway member 12a, a plurality of rollers 13a, a retainer 14a, a pinion 15a, a first rack 16a, and a second rack 17a.

The first raceway member 11a and the second raceway member 12a each have a shape that

extends in a first direction (Y direction) that is the longitudinal direction. The first raceway member 11a and the second raceway member 12a are identical in shape. That is, the lengths of the first raceway member 11a in the X, Y, and Z directions are equal to the lengths of the second raceway member 12a in the X, Y, and Z directions, respectively. The
5 second raceway member 12a corresponds to a member obtained by inverting the first raceway member 11a in the Z direction and the X direction.

[0026] The second raceway member 12a is arranged opposite the first raceway member 11a in a second direction (X direction) that is a direction orthogonal to the first direction. The linear motion guide unit 10a is a linear motion guide unit in which the second raceway
10 member 12a performs linear motion relative to the first raceway member 11a in the first direction.

[0027] The first raceway member 11a includes a first raceway surface 21a and a second raceway surface 22a on which the rollers 13a roll. The first raceway surface 21a and the second raceway surface 22a are each configured with a flat surface extending in the
15 longitudinal direction. The first raceway surface 21a is inclined at 45 degrees with respect to each of the X-Y plane and the Y-Z plane (see FIGS. 3 and 5 in particular). The second raceway surface 22a is also inclined at 45 degrees with respect to each of the X-Y plane and the Y-Z plane. The second raceway surface 22a is inclined at 90 degrees with respect to the first raceway surface 21a. A groove-shaped relief portion 23a extending in the Y
20 direction is provided between the first raceway surface 21a and the second raceway surface 22a.

[0028] One surface 24a in the X direction of the first raceway member 11a on the side where the first raceway surface 21a and the second raceway surface 22a are provided is parallel to the Y-Z plane and is arranged to face a surface 34a of the second raceway
25 member 12a, which will be described later. Each end surface 25a in the longitudinal direction of the first raceway member 11a has a recess 26a that is recessed in a round hole shape. The first raceway member 11a has a plurality of through holes 27a of a round hole shape that are provided at intervals in the longitudinal direction and penetrate in the thickness direction (Z direction). In the present embodiment, there are a total of seven
30 through holes 27a. The first raceway member 11a has a plurality of recesses 29a provided

around regions where the corresponding through holes 27a are located as viewed in the thickness direction (Z direction), which recesses are recessed in the thickness direction from one surface 28a in the thickness direction. In the present embodiment, there also are a total of seven recesses 29a. Each recess 29a includes a wall surface of a semicircular arc shape as viewed in the thickness direction, and is configured to reach another surface 30a in the X direction. The first raceway member 11a is also provided with a plurality of mounting holes that are recessed from the surface 28a in the thickness direction, which holes are utilized when mounting the first rack 16a. In the present embodiment, a total of four mounting holes are provided at intervals in the longitudinal direction. The mounting holes are positioned to avoid the recesses 29a.

[0029] The second raceway member 12a has a configuration similar to that of the first raceway member 11a. This enables the sharing of components, resulting in improved productivity. Specifically, the second raceway member 12a includes a first raceway surface 31a and a second raceway surface 32a on which the rollers 13a roll. The second raceway member 12a is also provided with a relief portion 33a having a configuration similar to the relief portion 23a. One surface 34a in the X direction of the second raceway member 12a on the side where the first raceway surface 31a and the second raceway surface 32a are provided is parallel to the Y-Z plane and is arranged to face the surface 24a. Each end surface 35a in the longitudinal direction of the second raceway member 12a has a recess 36a that is recessed in a round hole shape. The second raceway member 12a has a total of seven through holes 37a of a round hole shape that are provided at intervals in the longitudinal direction and penetrate in the thickness direction. The second raceway member 12a has a total of seven recesses 39a provided around regions where the corresponding through holes 37a are located as viewed in the thickness direction, which recesses are recessed in the thickness direction from one surface 38a in the thickness direction. Each recess 39a includes a wall surface of a semicircular arc shape as viewed in the thickness direction, and is configured to reach another surface 40a in the X direction.

[0030] The configuration of the rollers 13a and the retainer 14a will now be described. Each roller 13a has a solid cylindrical shape. The roller 13a includes a rolling surface 41a and a pair of end surfaces 42a. The direction connecting the centers of the pair of end

surfaces 42a is a rolling axis direction of the roller 13a. All of the rollers 13a are identical in shape. The plurality of rollers 13a are arranged spaced apart in the longitudinal direction, which is the first direction, such that their rolling axes are alternately orthogonal to each other. In the present embodiment, the linear motion guide unit 10a includes 22 rollers 13a.

[0031] The retainer 14a has a shape extending in the longitudinal direction, which is the first direction. The retainer 14a retains the rollers 13a such that the rollers can roll. The retainer 14a is made of a resin. The retainer 14a is arranged between the first raceway member 11a and the second raceway member 12a in the lateral direction (X direction), which is the second direction.

[0032] FIG. 7 is an enlarged, schematic perspective view of a portion of the retainer 14a. FIG. 8 is a schematic cross-sectional view of the portion of the retainer 14a shown in FIG. 7. FIG. 8 is a cross-sectional view of the portion of the retainer shown in FIG. 7 when cut in a plane that includes the center in the rolling axis direction of one roller 13a and is orthogonal to the rolling axis direction of the roller 13a. FIG. 9 is a view of a portion of the retainer 14a shown in FIG. 7, as seen from a window portion 45a side of a pocket 44a. FIG. 9 is a view from the direction in which the rolling surface 41a of the roller 13a accommodated in the pocket 44a is exposed. FIG. 9 is a view from the direction perpendicular to the rolling axis direction of the roller 13a accommodated in the pocket 44a. In FIG. 9, for ease of understanding, the external shape of the roller 13a accommodated in the pocket 44a is shown in a long dashed short dashed line.

[0033] Referring to FIGS. 7, 8, and 9 together, the retainer 14a has a plurality of pockets 44a, each accommodating a roller 13a, provided spaced apart in the longitudinal direction, which is the first direction. In the present embodiment, there are 22 pockets 44a, corresponding to the number of the rollers 13a. Adjacent pockets 44a are arranged such that the directions in which the rolling surfaces 41a of the rollers 13a accommodated therein are exposed are orthogonal to each other. That is, the pockets 44a are formed such that the opening directions of the window portions 45a of the pockets 44a, through which the rollers 13a are inserted, are alternately orthogonal to each other in adjacent pockets 44a.

[0034] The retainer 14a includes a pair of side stays 51a and 52a, and a plurality of pillar

portions 53a connecting the pair of side stays 51a and 52a to form the pockets 44a. The side stays 51a and 52a are flat plate-shaped, and have through holes 54a provided at the center. The through holes 54a are utilized for allowing lubricant to flow in and out and for removing sink marks in the resin during molding. The side stays 51a and 52a are positioned at 90-degree angles in adjacent pockets 44a. The plurality of pillar portions 53a are arranged apart from each other in the longitudinal direction (Y direction), which is the first direction.

[0035] Here, the retainer 14a includes retaining claws 55a and 56a that prevent a roller 13a from falling out of the pocket 44a. The retaining claws 55a and 56a are provided as a pair, on one side stay 51a side and the other side stay 52a side, respectively. As viewed from the side where one window portion 45a of the pocket 44a is open (see FIG. 9 in particular), the retaining claw 55a is continuous with a side wall surface 57a of the side stay 51a and a side wall surface 59a of the pillar portion 53a and protrudes toward the window portion 45a. As viewed from the side where the one window portion 45a of the pocket 44a is open, the retaining claw 56a is continuous with a side wall surface 58a of the side stay 52a and the side wall surface 59a of the pillar portion 53a and protrudes toward the window portion 45a. The retaining claws 55a and 56a are each provided in a tapered shape as viewed from the side where the one window portion 45a of the pocket 44a is open. The retaining claws 55a and 56a include flat surfaces 61a and 62a, respectively, which are continuous with the corresponding side wall surfaces 57a and 58a of the pair of side stays 51a and 52a and with the pillar portion 53a. As viewed from the side where the one window portion 45a of the pocket 44a is open, the retaining claws 55a and 56a each have an isosceles triangular shape, with the portion continuous with the side wall surface 57a, 58a of the side stay 51a, 52a and the portion continuous with the side wall surface 59a of the pillar portion 53a being equal sides. It should be noted that the portions corresponding to the equal sides of the isosceles triangle of the retaining claw 55a are shown in broken lines in FIG. 9. On the side where the one window portion 45a of the pocket 44a is open, there are no retaining claws on the longitudinally opposing pillar portion 53a side. On the side where the other window portion 46a of the pocket 44a is open, retaining claws 63a and 64a are formed that are continuous with a side wall surface 59a of the pillar portion 53a

that opposes the pillar portion 53a on which the retaining claws 55a and 56a are provided and with the respective side wall surfaces 57a and 58a of the pair of side stays 51a and 52a, and protrude toward the window portion 46a.

[0036] It should be noted that such retaining claws 55a and 56a are produced, for example, in the following manner. FIG. 10 is a schematic perspective view illustrating a process of producing a portion of the retainer 14a. Referring to FIG. 10 together, for forming such retaining claws 55a and 56a, a jig 67a shaped to have flat surfaces 65a and 66a recessed in shapes corresponding to the flat surfaces 61a and 62a constituting the retaining claws 55a and 56a is prepared. With this jig 67a positioned in a pocket 44a, a resin is poured in to perform molding. As a result, the retaining claws 55a and 56a configured with the flat surfaces 61a and 62a are formed in the portions facing the flat surfaces 65a and 66a. In this case, the flat surfaces 65a and 66a provided on the jig 67a can be formed by chamfering the corners, making production relatively easy. Furthermore, since the configuration allows the resin to easily flow in, the retaining claws 55a and 56a having the above-described shapes can be reliably formed even when the size is reduced.

[0037] The configuration of the pinion 15a and the first rack 16a will now be described. Referring particularly to FIGS. 5 and 6, the pinion 15a has a plurality of external teeth 71a provided on an outer periphery thereof. The pinion 15a includes rotation shafts 72a and 73a. The pinion 15a is held by the retainer 14a and is supported rotatably about the rotation shafts 72a and 73a.

[0038] FIG. 11 is a schematic perspective view showing the external view of the first rack 16a. FIG. 12 is an enlarged, schematic perspective view of a portion of the first rack 16a shown in FIG. 11. Referring to FIGS. 11 and 12 together, the first rack 16a has a plate shape, more specifically a flat plate shape. The first rack 16a is formed, for example, by punching a piece of steel plate along the outer shape of the first rack 16a and providing through holes and first rack teeth.

[0039] The first rack 16a has a plurality of through holes 74a, four in the present embodiment, formed at intervals in the longitudinal direction to penetrate in the thickness direction, i.e., the Z direction. The through holes 74a are utilized to attach the first rack

16a to an outer peripheral surface of the first raceway member 11a, which is the surface 28a of the first raceway member 11a in the present embodiment, by means of bolts 76a. The first rack 16a is provided with a plurality of notches 75a, three in the present embodiment, which are recessed in the X direction. The three notches 75a are positioned
5 such that the through holes 27a and the recesses 29a are exposed when the first rack 16a is attached to the surface 28a of the first raceway member 11a. Forming these notches 75a allows the first raceway member 11a to be fixed in a predetermined position utilizing the through holes 27a, even after the first rack 16a is attached to the surface 28a of the first raceway member 11a.

[0040] The first rack 16a has a plurality of first rack teeth 77a that mesh with the external teeth 71a of the pinion 15a. The plurality of first rack teeth 77a are comb-shaped. The plurality of first rack teeth 77a are provided so as to protrude in the X direction, which is the second direction. That is, the first rack teeth 77a are provided to protrude in the X direction from a side surface of the first rack 16a in the X direction. The first rack teeth
15 77a are provided so as to be narrower in width on their side meshing with the external teeth 71a of the pinion 15a in the Z direction. In the longitudinal direction, groove portions 78a adjacent to the first rack teeth 77a are provided so as to be wider in width on their side meshing with the external teeth 71a of the pinion 15a. Side wall surfaces constituting the first rack teeth 77a are tapered as viewed in the X direction. The first rack teeth 77a with
20 such a shape are formed by press working or etching, for example. According to such first rack teeth 77a, the thickness of the first rack 16a is equal to the height of the first rack teeth 77a, so the teeth can be reduced in height. The first rack 16a may be made of a resin, although it may be made of a metal, e.g., a steel plate, in consideration of strength.

[0041] The second rack 17a has a configuration similar to that of the first rack 16a, so the description thereof will be omitted. The second rack 17a includes second rack teeth 79a. The second rack 17a is attached and fixed to the second raceway member 12a.

[0042] The configuration of the retainer 14a will be described again. FIG. 13 is an enlarged, schematic perspective view of a portion of the retainer 14a in an exploded perspective view of the linear motion guide unit 10a. Referring to FIG. 13 together, the
30 retainer 14a includes roller holding regions 81a and 82a that hold the rollers 13a, and a

pinion holding region 83a that holds the pinion 15a. In the present embodiment, a pair of roller holding regions, 81a and 82a, are provided. The roller holding regions 81a, 82a and the pinion holding region 83a are arranged adjacent to each other in the longitudinal direction, which is the first direction. The pinion holding region 83a is arranged at the center in the first direction. The pair of roller holding regions 81a and 82a are arranged at both ends in the first direction, sandwiching the pinion holding region 83a therebetween. Each of the roller holding regions 81a and 82a is provided with 11 pockets 44a.

[0043] The pinion holding region 83a is provided with a pinion accommodating portion 84a. The pinion accommodating portion 84a is recessed in a groove shape in the Z direction from a surface 85a. The pinion accommodating portion 84a is also provided with rotation shaft accommodating portions 86a and 87a that accommodate the rotation shafts 72a and 73a. The pinion accommodating portion 84a penetrates in the Z direction, except for the regions where the rotation shaft accommodating portions 86a and 87a are provided. This configuration of the pinion accommodating portion 84a exposes the external teeth 71a of the accommodated pinion 15a in the Z direction, allowing the exposed external teeth 71a of the pinion 15a to mesh with the second rack teeth 79a of the second rack 17a.

[0044] The pinion holding region 83a is also provided with a pair of fitting grooves 88a and 89a. The fitting grooves 88a and 89a are spaced apart in the longitudinal direction to sandwich the pinion accommodating portion 84a therebetween. The fitting grooves 88a and 89a are arranged adjacent to the pair of roller holding regions 81a and 82a, respectively.

[0045] Here, the linear motion guide unit 10a includes a pinion cover 91a. FIG. 14 is a schematic plan view of the pinion cover 91a. FIG. 15 is a schematic side view of the pinion cover 91a. Referring to FIGS. 14 and 15 together, the pinion cover 91a is attached to the pinion holding region 83a. The pinion cover 91a is made of a resin, for example, and can easily be elastically deformed. The pinion cover 91a includes a cavity portion 92a that has a shape extending in the longitudinal direction and accommodates a portion of the pinion holding region 83a therein, an opening 93a that penetrates in the Z direction, and hook-shaped fitting claws 94a and 95a that are provided at both ends of the pinion cover 91a in the longitudinal direction. The pinion cover 91a is attached to the pinion holding

region 83a by elastically deforming the fitting claws 94a and 95a and fitting the claws into the fitting grooves 88a and 89a. The fitting claws 94a and 95a are attached to the pinion holding region 83a in a snap-fit manner. At this time, a portion of the pinion holding region 83a enters the cavity portion 92a, and the pinion 15a is caught between the pinion holding region 83a and the pinion cover 91a. Consequently, the external teeth 71a of the pinion 15a are exposed from the opening 93a. The exposed external teeth 71a mesh with the first rack teeth 77a of the first rack 16a.

[0046] According to the linear motion guide unit 10a with the above configuration, misalignment of the retainer 14a retaining the rollers 13a can be prevented by utilizing the pinion 15a, the first rack 16a, and the second rack 17a. Therefore, it is possible to appropriately guide the linear motion. Here, the external teeth 71a of the pinion 15a are positioned between the first raceway member 11a and the second raceway member 12a, and the first rack 16a and the second rack 17a are attached to the outer peripheral surfaces of the first raceway member 11a and the second raceway member 12a, respectively. With this configuration adopted, the pinion 15a can be arranged in a so-called vertical orientation. This can increase the contact length between the raceway surfaces of the raceway members and the rollers 13a, thereby increasing the load capacity.

[0047] Furthermore, according to the linear motion guide unit 10a described above, the retainer 14a includes roller holding regions 81a and 82a that hold the rollers 13a, and a pinion holding region 83a provided with a pinion accommodating portion 84a. The roller holding regions 81a, 82a and the pinion holding region 83a are configured as one piece. This eliminates the need to form a projection and a dovetail groove when incorporating a mechanism for holding the pinion 15a into the retainer 14a. Thus, there is no damage to the projection, and the work of fitting the projection into the dovetail groove is unnecessary, leading to improved productivity. Particularly in the case of producing a linear motion guide unit 10a of a small size with rollers 13a having the diameter of less than 4 mm, for example, more improvement in productivity can be achieved. Additionally, since the pinion 15a is held in the retainer 14a by being caught by the pinion cover 91a, the risk of the pinion 15a being disengaged from or falling out of the retainer 14a can be greatly reduced. Therefore, according to this linear motion guide unit 10a, productivity can be

improved.

[0048] In the present embodiment, the pinion holding region 83a is positioned at the center in the first direction. The roller holding regions 81a and 82a are arranged as a pair at the ends in the first direction, sandwiching the pinion holding region 83a therebetween.

5 Thus, with the pinion holding region 83a positioned at the center of the first direction, which is the longitudinal direction, the retainer 14a can be guided in a balanced manner in the longitudinal direction. Additionally, the portions where the roller holding regions 81a and 82a are located are prevented from becoming unbalanced in the longitudinal direction, allowing the first raceway member 11a and the second raceway member 12a to
10 appropriately bear the load.

[0049] In the present embodiment, the pinion cover 91a is attached to the pinion holding region 83a in a snap-fit manner. Thus, when attaching the pinion cover 91a in such a way to catch the pinion 15a, the elastic deformation of the material can be utilized. Therefore, favorable assembly is ensured with a simpler configuration, resulting in improved
15 productivity.

[0050] In the present embodiment, the first rack 16a and the second rack 17a are both plate-shaped. Thus, both of the first rack 16a and the second rack 17a can be simplified in shape, which can improve productivity.

[0051] In the present embodiment, the first rack teeth 77a and the second rack teeth 79a
20 are both provided so as to protrude in the second direction. This facilitates the meshing of both the first rack teeth 77a provided in the first rack 16a and the second rack teeth 79a provided in the second rack 17a with the external teeth 71a of the pinion 15a in the second direction. Therefore, the retainer 14a can be guided by enabling appropriate meshing between the external teeth 71a of the pinion 15a and the rack teeth, while achieving size
25 reduction and shape simplification.

[0052] In the present embodiment, the retainer 14a includes a pair of side stays 51a and 52a, a plurality of pillar portions 53a arranged apart from each other in the first direction and connecting the pair of side stays 51a and 52a to form the pocket 44a, and retaining claws 55a and 56a that, as viewed from the side where the window portion 45a of the pocket
30 44a is open, are continuous with the respective side wall surfaces 57a and 58a of the pair

of side stays 51a and 52a and the side wall surface 59a of the pillar portion 53a and protrude toward the window portion 45a to prevent the roller 13a from falling out of the pocket 44a. Thus, when housing a roller 13a in the pocket 44a over the retaining claws 55a and 56a, which can prevent the roller 13a housed in the pocket 44a from falling out, the force pushing
5 against the retaining claws 55a and 56a can more easily be distributed in the first and second directions. Specifically, referring particularly to FIG. 9, when attempting to insert a roller 13a into the pocket 44a from the window portion 45a side, a force is generated that pushes against each of the retaining claws 55a and 56a in the direction indicated by arrow F1. However, this force F1 is distributed into force F2, indicated in the longitudinal direction,
10 which is the first direction, and force F3, indicated in the direction perpendicular thereto. In this case, the side stays 51a and 52a are prone to bending particularly in the direction indicated by force F3, so they can be deformed with a relatively small force. Therefore, the mechanical load on the retaining claws 55a and 56a when housing the roller 13a is reduced, which reduces the risk of damage to the retaining claws 55a and 56a.

[0053] In the present embodiment, a pair of the retaining claws 55a and 56a are provided, one on one side stay 51a and the other on the other side stay 52a. Thus, the mechanical load on the retaining claws 55a and 56a can further be reduced, which can further reduce the risk of damage to the retaining claws 55a and 56a.

[0054] In the present embodiment, the retaining claws 55a and 56a include flat surfaces
20 61a and 62a that are continuous with the respective side wall surfaces 57a and 58a of the pair of side stays 51a and 52a and the side wall surface 59a of the pillar portion 53a. Thus, the retaining claws 55a and 56a can be made relatively simple in shape, while providing relatively large regions that hook onto the roller 13a, which greatly reduces the risk of the roller 13a falling out of the pocket 44a.

[0055] In the present embodiment, as viewed from the side where the window portion 45a of the pocket 44a is open, the retaining claws 55a and 56a each have an isosceles triangular shape with equal sides corresponding to a portion continuous with the side wall surface 57a, 58a of the corresponding side stay 51a, 52a and a portion continuous with the side wall surface 59a of the pillar portion 53a. Thus, when incorporating a roller 13a into
30 the pocket 44a, the load capacity can be more easily distributed equally to the side stay 51a,

52a side and the pillar portion 53a side. Therefore, productivity can be improved by achieving better incorporation.

[0056] Alternatively, the linear motion guide unit 10a of the present disclosure includes a first raceway member 11a extending in a first direction that is a longitudinal direction, and a second raceway member 12a extending in the first direction and arranged opposite the first raceway member 11a in a second direction that is a direction orthogonal to the first direction, wherein the second raceway member 12a performs linear motion relative to the first raceway member 11a in the first direction. The linear motion guide unit 10a includes: a plurality of rollers 13a arranged spaced apart in the first direction such that rolling axes thereof are alternately orthogonal to each other; a retainer 14a arranged between the first raceway member 11a and the second raceway member 12a in the second direction to retain the plurality of rollers 13a, the retainer having a plurality of pockets 44a provided spaced apart in the first direction, each pocket accommodating the corresponding roller 13a; a pinion 15a having a plurality of external teeth 71a provided at an outer periphery thereof, the pinion being arranged between the first raceway member 11a and the second raceway member 12a in the second direction and rotatably supported; a first rack 16a attached to an outer peripheral surface of the first raceway member 11a and having a plurality of first rack teeth 77a that mesh with the external teeth 71a; and a second rack 17a attached to an outer peripheral surface of the second raceway member 12a and having a plurality of second rack teeth 79a that mesh with the external teeth 71a. The retainer 14a includes a pair of side stays 51a and 52a, a plurality of pillar portions 53a arranged apart from each other in the first direction and connecting the pair of side stays 51a and 52a to form the pocket 44a, and a retaining claw 55a, 56a that, as viewed from a side where a window portion 45a of the pocket 44a is open, is continuous with a side wall surface 57a, 58a of one of the pair of side stays 51a and 52a and a side wall surface 59a of the pillar portion 53a and protrudes toward the window portion 45a to prevent the roller 13a from falling out of the pocket 44a.

[0057] According to such a linear motion guide unit 10a, when housing a roller 13a in the pocket 44a over the retaining claws 55a and 56a, which can prevent the roller 13a housed in the pocket 44a from falling out, the force pushing against the retaining claws 55a and 56a can more easily be distributed in the first and second directions. Therefore, the

mechanical load on the retaining claws 55a and 56a when housing the roller 13a is reduced, which reduces the risk of damage to the retaining claws 55a and 56a.

[0058] (Other Embodiments)

While the isosceles triangular shape has been adopted in the above embodiment, the shape is not limited thereto; it may be a triangular shape with three sides of different lengths, or it may be a polygonal shape. The wall surface constituting the retaining claw may be recessed in a circular arc shape or protrude in a circular arc shape, as viewed from the side where the window portion of the pocket is open.

[0059] Furthermore, while a pair of retaining claws have been provided in the above embodiment, not limited thereto, only one retaining claw may be provided. In this case, increasing the amount of protrusion compared to the case of providing a pair of retaining claws can more reliably prevent the roller from falling out of the pocket.

[0060] While the pinion cover has been attached to the pinion holding region in a snap-fit manner in the above embodiment, not limited thereto, the pinion cover may be attached to the pinion holding region using screws or the like. Alternatively, in the snap-fit structure, the fitting claws may be provided in the pinion holding region, and the fitting grooves may be provided in the pinion cover.

[0061] It should be understood that the embodiments disclosed herein are illustrative and non-restrictive in every respect. The scope of the present invention is defined by the terms of the claims, and is intended to include any modifications within the scope and meaning equivalent to the terms of the claims.

Reference Signs List

[0062] 10a: linear motion guide unit; 11a: first raceway member; 12a: second raceway member; 13a: roller; 14a: retainer; 15a: pinion; 16a: first rack; 17a: second rack; 21a, 31a: first raceway surface; 22a, 32a: second raceway surface; 23a, 33a: relief portion; 24a, 28a, 30a, 34a, 38a, 40a, 85a: surface; 25a, 35a, 42a: end surface; 26a, 29a, 36a, 39a: recess; 27a, 37a, 54a, 74a: through hole; 41a: rolling surface; 44a: pocket; 45a, 46a: window portion; 51a, 52a: side stay; 53a: pillar portion; 55a, 56a, 63a, 64a: retaining claw; 57a, 58a, 59a: side wall surface; 61a, 62a, 65a, 66a: flat surface; 67a: jig; 71a: external tooth; 72a, 73a:

rotation shaft; 75a: notch; 76a: bolt; 77a: first rack tooth; 78a: groove portion; 79a: second rack tooth; 81a, 82a: roller holding region; 83a: pinion holding region; 84a: pinion accommodating portion; 86a, 87a: rotation shaft accommodating portion; 88a, 89a: fitting groove; 91a: pinion cover; 92a: cavity portion; 93a: opening; and 94a, 95a: fitting claw.

CLAIMS

[Claim 1] A linear motion guide unit including a first raceway member extending in a first direction that is a longitudinal direction, and a second raceway member extending in the first direction and arranged opposite the first raceway member in a second direction that is a direction orthogonal to the first direction, the second raceway member performing linear motion relative to the first raceway member in the first direction, the linear motion guide unit comprising:

a plurality of rollers arranged spaced apart in the first direction such that rolling axes thereof are alternately orthogonal to each other;

a retainer arranged between the first raceway member and the second raceway member in the second direction to retain the plurality of rollers, the retainer having a plurality of pockets provided spaced apart in the first direction, each pocket accommodating the corresponding roller;

a pinion having a plurality of external teeth provided at an outer periphery thereof, the pinion being arranged between the first raceway member and the second raceway member in the second direction and rotatably supported;

a first rack attached to an outer peripheral surface of the first raceway member, the first rack having a plurality of first rack teeth that mesh with the external teeth; and

a second rack attached to an outer peripheral surface of the second raceway member, the second rack having a plurality of second rack teeth that mesh with the external teeth;

the retainer including

a roller holding region that holds the plurality of rollers, and

a pinion holding region arranged adjacent to the roller holding region in the first direction, the pinion holding region having a pinion accommodating portion that accommodates the pinion such that the external teeth mesh with the second rack teeth,

the roller holding region and the pinion holding region being configured as one piece,

the linear motion guide unit comprising a pinion cover attached to the pinion

holding region such that the pinion is caught between the pinion holding region and the pinion cover and such that the external teeth mesh with the first rack teeth.

[Claim 2] The linear motion guide unit according to claim 1, wherein
5 the pinion holding region is arranged at a center in the first direction, and
 a pair of the roller holding regions are arranged at both ends in the first direction,
sandwiching the pinion holding region therebetween.

[Claim 3] The linear motion guide unit according to claim 1 or 2, wherein the
10 pinion cover is attached to the pinion holding region in a snap-fit manner.

[Claim 4] The linear motion guide unit according to claim 1 or 2, wherein at least
one of the first rack and the second rack is plate-shaped.

15 [Claim 5] The linear motion guide unit according to claim 1 or 2, wherein at least
one of the first rack teeth and the second rack teeth is provided so as to protrude in the
second direction.

[Claim 6] The linear motion guide unit according to claim 1 or 2, wherein the
20 retainer includes

 a pair of side stays,
 a plurality of pillar portions arranged apart from each other in the first direction
and connecting the pair of side stays to form the pocket, and
 a retaining claw that, as viewed from a side where a window portion of the pocket
25 is open, is continuous with a side wall surface of one of the pair of side stays and a side
wall surface of the pillar portion and protrudes toward the window portion to prevent the
roller from falling out of the pocket.

[Claim 7] The linear motion guide unit according to claim 6, wherein a pair of
30 the retaining claws are provided, one on each of the side stays.

[Claim 8] The linear motion guide unit according to claim 6, wherein the retaining claw includes a flat surface that is continuous with the side wall surface of one of the pair of side stays and the side wall surface of the pillar portion.

5

[Claim 9] The linear motion guide unit according to claim 6, wherein as viewed from the side where the window portion of the pocket is open, the retaining claw has an isosceles triangular shape with equal sides corresponding to a portion continuous with the side wall surface of the side stay and a portion continuous with the side wall surface of the pillar portion.

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[Claim 10] The linear motion guide unit according to claim 1 or 2, wherein the first raceway member and the second raceway member are identical in shape.

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[Claim 11] A linear motion guide unit including a first raceway member extending in a first direction that is a longitudinal direction, and a second raceway member extending in the first direction and arranged opposite the first raceway member in a second direction that is a direction orthogonal to the first direction, the second raceway member performing linear motion relative to the first raceway member in the first direction, the linear motion guide unit comprising:

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 a plurality of rollers arranged spaced apart in the first direction such that rolling axes thereof are alternately orthogonal to each other;

 a retainer arranged between the first raceway member and the second raceway member in the second direction to retain the plurality of rollers, the retainer having a plurality of pockets provided spaced apart in the first direction, each pocket accommodating the corresponding roller;

25

 a pinion having a plurality of external teeth provided at an outer periphery thereof, the pinion being arranged between the first raceway member and the second raceway member in the second direction and rotatably supported;

30

 a first rack attached to an outer peripheral surface of the first raceway member,

the first rack having a plurality of first rack teeth that mesh with the external teeth; and

a second rack attached to an outer peripheral surface of the second raceway member, the second rack having a plurality of second rack teeth that mesh with the external teeth;

5 the retainer including

a pair of side stays,

a plurality of pillar portions arranged apart from each other in the first direction and connecting the pair of side stays to form the pocket, and

10 a retaining claw that, as viewed from a side where a window portion of the pocket is open, is continuous with a side wall surface of one of the pair of side stays and a side wall surface of the pillar portion and protrudes toward the window portion to prevent the roller from falling out of the pocket.