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Inventor(s)	Bezjak; Erwin et al.

Toothed belt axis with a clamping apparatus

Abstract

A toothed belt axis with a toothed belt, a toothed belt disk, a deflector, a profile body extending along a motion axis, a slide and a clamping apparatus. The slide includes a first front surface, into which first front surface a first reception opening extending along the motion axis for receiving the clamping apparatus is inserted. The profile body is configured for linearly movable guidance of the slide, the toothed belt can be driven by means of the toothed belt disk and can be deflected by means of the deflector, the slide being movable in the profile body by means of the toothed belt. The clamping apparatus includes a clamping body, a pressure plate, an annularly configured support body and a pressure member, the clamping body having a front side a back side, a reception room configured as a slot and a support portion.

Inventors: **Bezjak; Erwin (Ostfildern, DE), Konermann; Rainer (Nürtingen, DE)**

Applicant: **Festo SE & Co. KG** (Esslingen, DE)

Family ID: **1000008765641**

Assignee: **Festo SE & Co. KG (Esslingen, DE)**

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Primary Examiner: Cook; Jake

Attorney, Agent or Firm: HSML P.C.

Background/Summary

BACKGROUND OF THE INVENTION

(1) The invention relates to a toothed belt axis with a clamping apparatus.

(2) For toothed belt axes, which are known from the prior art, a force-transmitting connection between an end portion of a toothed belt and a slide by means of a clamping apparatus is known. The clamping apparatus can be used to transmit the tensile forces applied to the toothed belt by a drive unit to the slide, which is accommodated in a profile body for linear movement. A known clamping apparatus comprises a clamping body which is provided with a slot for receiving the end portion of the toothed belt, wherein the toothed belt can be received in the slot in a force-fit and/or form-fit manner. Furthermore, a connecting member is provided to attach the clamping body to the slide.

SUMMARY OF THE INVENTION

(3) The object of the present invention is to provide a toothed belt axis which is easy to handle and inexpensive to manufacture.

(4) The object is solved by a toothed belt axis with the features listed below:

(5) The toothed belt axis according to the invention comprises a toothed belt, a toothed belt disk, a deflector, a profile body extending along a motion axis, a slide and a clamping apparatus, wherein the slide comprises a first front surface, into which first front surface a first reception opening extending along the motion axis for receiving the clamping apparatus is inserted, wherein the profile body is configured for linearly movable guidance of the slide, wherein the toothed belt can be driven by means of the toothed belt disk and can be deflected by means of the deflector, the slide being movable in the profile body by means of the toothed belt, the clamping apparatus comprising a clamping body, a pressure plate, an annularly configured support body and a pressure member, the clamping body having a front side a back side, a reception room configured as a slot and a support portion, wherein the reception room extends from the front side along the motion axis and passes through the clamping body transversely to the motion axis, wherein the reception room comprises a first inner surface and a second inner surface opposite the first inner surface, wherein the pressure plate comprises a pressure plate upper side with toothing and a pressure plate lower side, wherein the toothed belt comprises a toothed belt inner side with toothing, a toothed belt outer side and at least one end portion, wherein the pressure plate and the end portion are received in the reception room in such a way that the toothed belt outer side faces the second inner surface, the pressure plate lower side faces the first inner surface and the toothed belt inner side faces the pressure plate upper side, wherein the toothing of the pressure plate upper side is configured complementary to the toothing of the toothed belt inner side, wherein the pressure plate is pressed against the toothed belt by the pressure member resting on the pressure plate lower side in order to press the toothed belt outer side against the second inner surface, wherein the support body surrounds the support portion in order to prevent the reception room from widening, in particular induced by the pressure member.
(6) A widening of the clamping body can lead to the toothed belt slipping out of the reception room, which would compromise the operational safety of the toothed belt axis. Furthermore, a widening of the clamping body could lead to the clamping apparatus jamming in the reception opening, so that easy removal of the clamping apparatus from the slide would be compromised and damage to the slide and/or the clamping apparatus could occur.
(7) The widening of the reception room occurs as an increase in the distance between the first inner surface and the second inner surface and is prevented according to the invention by the fact that a force flow introduced into the clamping body by the pressure member and the pressure plate is diverted from the support ring by means of the support ring, so that this force flow does not cause deformation of the clamping body.
(8) By providing the first reception opening, the clamping apparatus can be inserted at least partially into the slide, thereby reducing the required installation space. In addition, the clamping apparatus can be inserted into the first reception opening to such an extent that the support ring, starting from a functional position in which it surrounds the support portion, does not run the risk of slipping off the support portion, which would compromise the function of the support ring. The front side is the side of the clamping body that faces away from the slide during operation and via which the toothed belt can be inserted into the reception room. The back side is the side of the clamping body that faces to the slide during operation, i.e., the side that enters the first reception opening first when the clamping apparatus is inserted into it. The toothed belt inner side is the side of the toothed belt that is in contact with the toothed belt disk during operation. The toothed belt outer side is the side of the toothed belt that faces away from the toothed belt disk during operation. By pressing the pressure plate against the toothed belt, the positive fit between the toothed belt and the clamping body is reinforced, which reduces the risk of the toothed belt slipping out.
(9) The support body can preferably be moved into the functional position by sliding it on, but also by screwing or pressing it on. A clearance fit is preferably provided between the outer contour of the clamping apparatus and the inner contour of the first reception opening. The length of the support ring extending along the motion axis and/or a thickness of the support ring can be selected

depending on the expected load on it. For example, a short support ring with a small thickness can be provided for low loads and a long support ring with a large thickness for high loads.
(10) Preferably, the pressure member is configured as a screw, in particular as a space-saving grub screw, and the clamping body comprises a thread for screwing in the screw. The thread extends transversely to the motion axis from an outer circumferential surface of the clamping body, which is configured in particular as a circular cylinder, into the reception room.
(11) Preferably, the deflector is configured as a deflection roller or toothed belt disk.
(12) Preferably, the support body is configured in the shape of a circular ring. This means that the support body can be mounted on the support portion in any direction of rotation.
(13) Preferably, the support portion is configured to be at least partially annular, in particular at least partially circular.
(14) Preferably, the first inner surface and the second inner surface are aligned parallel to each other.
(15) Preferably, a first stop projects outwards in the radial direction from the outer circumferential surface, which first stop is positioned between the front side and the support portion. The first stop comprises an outer diameter that is larger than the inner diameter of the support body, at least in some areas. This can prevent the support body from slipping off the support portion in the direction of the front side. Furthermore, the clamping body is configured in such a way that the support body can be moved along the motion axis via the back side to the support portion.
(16) Preferably, a second stop projects from the first inner surface in the direction of the second inner surface, the second stop in particular being adjacent to the front side. The second stop is configured in such a way that, when the toothed belt and the pressure plate are received in the reception room, the pressure plate is prevented from slipping out in the axial direction along the motion axis.
(17) Preferably, the toothed belt axis comprises a tensioning screw, wherein the clamping body further comprises a through bore extending from the front side to the back side for receiving the tensioning screw and the slide further comprises a tensioning thread which extends from the first reception opening along the motion axis, wherein the tensioning screw can be screwed into the tensioning thread in order to adjust the tension of the toothed belt. Furthermore, the toothed belt tension can be kept within the required range during operation when carrying out maintenance work on the toothed belt axis by actuating the tensioning screw. Preferably, the tensioning screw and the tensioning thread are configured in such a way that screwing the tensioning screw into the tensioning thread increases the toothed belt tension and unscrewing the tensioning screw from the tensioning thread reduces the toothed belt tension.
(18) Preferably, the through bore comprises a counterbore, in particular a circular cylindrical counterbore, into which the head of the tensioning screw can be accommodated, thus avoiding that elements protrude from the front side which pose a risk of injury and/or damage.
(19) Preferably, the first reception opening comprises a guiding contour and the clamping body comprises a guiding area which is complementary to the guiding contour. As an example, the reception opening comprises a non-circular profiling in a cross-sectional plane aligned transversely to the motion axis and the clamping body comprises a corresponding profiling at least in sections. This provides a predetermined spatial orientation between the slide and clamping body and, as a result, an anti-rotation apparatus for the toothed belt held on the clamping body. The corresponding profiles can be configured as flat surfaces, for example.
(20) Preferably, the clamping body is made of a light metal, in particular of aluminum. Thus, the mass moved during operation can be reduced, which can lower the energy requirement.
(21) In addition, manufacturing costs can be reduced in this way. Any loss of strength associated with the use of light metal, in particular aluminum, compared to the use of stainless steel can be compensated for by the support body, which is used to absorb the loads described above.
(22) Alternatively, the clamping body can be made of a plastic, wherein the aforementioned with

regard to light metals applies analogously.
(23) Preferably, the support portion comprises a larger outer diameter than the remaining outer circumferential surface. Thus, the application of the support body to the support portion can be facilitated, which can increase the ease of handling. In addition, it can be prevented in this way that, in addition to a fit provided in relation to the support portion, such a fit must also be provided in relation to the outer circumferential surface extending up to the support portion, which can reduce the manufacturing costs.
(24) Preferably, the outer diameter of the support portion and the inner diameter of the support body have the same size. This can further prevent the reception room from widening, which can increase operational safety. A fit is also preferably provided between the support portion and the support body. This fit is even more preferably a transition fit in order to enable low-resistance sliding and at the same time minimize the clearance between the support body and the support portion.
(25) Preferably, the clamping body is configured to be rotationally symmetrical at least in certain sections. Thus, cost-effective manufacturing processes can be used, e.g. turning processes, which can reduce production costs.
(26) Preferably, the toothed belt axis further comprises a further clamping apparatus, wherein the slide further comprises a further front surface into which further front surface a second reception opening positioned opposite the first reception opening is inserted for receiving the further clamping apparatus, wherein the toothed belt comprises a further end portion which further end portion is received in the reception room of the further clamping apparatus.
(27) The toothed belt can be clamped and preferably tensioned as follows: first, an end portion of the toothed belt is inserted into the reception room of a clamping body. The corresponding pressure plate is then inserted into the reception room, preferably via the openings of the slot on the outer circumferential surface. Alternatively, the pressure plate can be inserted into the reception room first and then the end portion of the toothed belt.
(28) The support body is then placed on the support portion. The pressure plate is then pressed against the toothed belt with the pressure member resting on the pressure plate lower side, whereby the toothed belt outer side is pressed against the second inner surface. The clamping apparatus is then positioned in a reception opening, i.e. inserted into it and fastened in it, preferably by means of the tensioning screw. Finally, the tension of the toothed belt can be adjusted by screwing the tensioning screw into or out of the tensioning thread.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) An advantageous embodiment of the invention is shown in the drawings. It shows:
(2) FIG. **1** a toothed belt axis according to the invention,
(3) FIG. **2** a profile body and a slide of the toothed belt axis shown in FIG. **1**,
(4) FIG. **3** an abstract sectional view of a toothed belt axis according to the invention,
(5) FIG. **4** the slide shown in FIG. **2** and a clamping apparatus of the toothed belt axis shown in FIG. **1** in an perspective exploded view,
(6) FIG. **5** an abstract representation of a clamping apparatus with a support body surrounding a support portion,
(7) FIG. **6** the clamping apparatus shown in FIG. **5** with a support body positioned next to a clamping body.
DETAILED DESCRIPTION
(8) FIG. **1** shows a toothed belt axis **200** according to the invention with a slide **300** and a profile body **230**. The profile body **230** is aligned along a motion axis **500** and is configured to guide the

slide **300** linearly along this motion axis **500**. The slide **300** is driven by means of a toothed belt **210** (see FIG. **3**). The toothed belt **210** is driven via a toothed belt disk **220** (see FIG. **3**), which is accommodated in a deflection housing **232** attached to the end of the profile body **230**. The toothed belt disk **220** is connected to a motor flange **250** (see FIG. **3**), on which, for example, an electric motor can be provided to drive the toothed belt disk **220**. The toothed belt disk **220** rotates about a first axis of rotation **510**. On the side of the profile body **230** opposite the toothed belt disk **220**, a deflector **240** (cf. FIG. **3**) is provided in a further deflector housing **234** attached to the end of the profile body **230**, with which the toothed belt **210** is deflected. The deflector **240** rotates about a second axis of rotation **520**. The profile body **230** shown in FIG. **1** preferably comprises a cover in order to protect the toothed belt **210** from soiling and damage.

(9) FIG. **2** shows the profile body **230** and the slide **300** of the toothed belt axis **200** shown in FIG. **1**. The profile body **230** is preferably configured with a constant profiling along the motion axis **500**, in particular as an extruded aluminum profile.

(10) The slide **300** comprises a cuboid carrier body **302**, the upper side **304** of which can be used to hold a workpiece or workpiece carrier. Starting from an underside **305** facing away from the upper side **304**, a coupling body **307** extends, with which the slide **300** projects into a recess **236** defined by the profile body **230**. Below the upper edge of the profile body **230**, which is located at the top in the embodiment, a first reception opening **312** extending along the motion axis **500** is provided on the coupling body **307** in a first front surface **310** of the coupling body **307**, which is aligned purely by way of example in the axial direction. This first reception opening **312** serves to receive a clamping apparatus **100**, as will be described in more detail below.

(11) FIG. **3** shows an abstract sectional view of a toothed belt axis **200** according to the invention. Based on the representations of FIGS. **1** and **2**, it can be seen in FIG. **3** that the slide **300** with the carrier body **302** is arranged at least in some areas outside the profile body **230**, which is only shown in dashed lines, while the coupling body **307** is accommodated in the recess **236** of the profile body **230**. The toothed belt disk **220** and the deflector **240**, which can also be configured as a toothed belt disk, are each mounted for rotational movement about the first or second axis of rotation **510**, **520** in the respective deflector housings **232**, **234** attached to the end of the profile body **230**.

(12) The toothed belt disk **220** and the deflector **240** are each wrapped around in regions by a toothed belt **210**, which extends from a first clamping apparatus **100** to a further clamping apparatus **100**. For the following description, it is assumed that the first clamping apparatus **100** and the further clamping apparatus **100** are configured identically, so that a separate description of the further clamping apparatus **100** is unnecessary.

(13) The two clamping apparatuses **100** are each inserted in opposite reception openings (cf. FIGS. **2** and **4**) of the coupling body **307**.

(14) The toothed belt **210** comprises two end portions **216**, of which one end portion **216** is clamped in each of the two clamping apparatuses **100**. The toothed belt **210** shown in FIG. **3** comprises a lower run **218** in the lower region, which is located between the toothed belt disk **220** and the deflector **240**, and two upper runs **219** in the upper region, which are located on the one hand between the toothed belt disk **220** and the left clamping apparatus **100** and on the other hand between the deflector **240** and the right clamping apparatus **100**. The two upper runs **219** and the lower run **218** are aligned along the motion axis **500**.

(15) The slide **300** can be moved to the right along the motion axis **500** by means of the toothed belt **210**. For this purpose, the toothed belt disk **220** is driven in a clockwise direction. In addition, the slide **300** can be moved to the left along the motion axis **500** by means of the toothed belt **210**, for which purpose the toothed belt disk **220** is driven counterclockwise.

(16) FIG. **4** shows the slide **300** shown in FIG. **2** and the clamping apparatus **100** of the toothed belt axis **200** shown in FIG. **1** in an perspective exploded view.

(17) A first reception opening **312** extending along the motion axis **500** is formed in the first front

surface **310**. The first reception opening **312** comprises along the motion axis **500**, starting from the first front surface **310**, successively a first, circular and upwardly open section, a second front surface **311** and a second section comprising a guiding contour **324**. The first section comprises a larger inner diameter than the second section. In addition, the inner diameter of the first section is larger than an outer diameter D**5** of the support body **140** (see FIG. **6**), so that the support body **140** can be accommodated in the first section. Furthermore, the outer diameter D**5** of the support body **140** is larger than the inner diameter of the second section, so that the support body **140** can be supported on the second front surface **311** without penetrating into the second section. This support only occurs if the support body **140** should slip off the clamping body **110**, described in more detail below, in an undesirable manner.

(18) In addition, the slide **300** comprises a further front surface aligned purely by way of example in the opposite direction to the first front surface **310** and a second reception opening **314** (concealed in FIG. **4**) formed in this further front surface. For the following description, it is assumed that the first reception opening **312** and the second reception opening **314** are configured identically, so that a separate description of the second reception opening **314** is unnecessary.

(19) The clamping apparatus **100** comprises a substantially rotationally symmetrical clamping body **110** with a circular cylindrical outer circumferential surface **119**. In addition, the clamping body **110** comprises a front side **112**, a back side **115**, a reception room **120** extending from the front side **112**, configured as a slot and extending transversely to an axis of rotational symmetry, which in the case of FIG. **4** is aligned coaxially with the motion axis **500**, and a support portion **129** configured as a circular cylinder.

(20) The clamping apparatus **100** further comprises a pressure plate **130**, a circularly configured support body **140** and a pressure member **150**. In the operating state, the support body **140** surrounds the support portion **129** and is thus in a functional position (see FIG. **5**).

(21) The reception room **120** extends from the front side **112** along the motion axis **500** and passes through the clamping body **110** perpendicular to the motion axis **500**. The reception room **120** comprises a first inner surface **123** and a second inner surface **124** opposite the first inner surface **123**.

(22) The pressure plate **130** comprises a pressure plate upper side **132** with a toothing and a pressure plate lower side **134**, wherein the toothed belt **210** (see FIGS. **3** and **5**) further comprises a toothed belt inner side **212** with a toothing (cf. FIG. **5**), and a toothed belt outer side **214** (cf. FIG. **5**). The toothing of the pressure plate upper side **132** is configured complementary to the toothing of the toothed belt inner side **212**.

(23) A first, annularly configured stop **113**, which is arranged between the front side **112** and the support portion **129**, projects radially outwards from the outer circumferential surface **119** of the clamping body **110**.

(24) A second stop **128**, in particular adjacent to the front side **112**, projects from the first inner surface **123** in the direction of the second inner surface **124**. The second stop **128** is configured such that the end portion **216** received in the reception room **120** in combination with the pressure plate **130** is secured against slipping out along the motion axis **500** in the direction of the front side **112**.

(25) The pressure member **150** is configured as a grub screw.

(26) Furthermore, a tensioning screw **400** is provided, which can be received in a through bore **127** of the clamping body **110** and can be screwed into a tensioning thread of the slide **300** in order to adjust the tension of the toothed belt **210**. The clamping body **110** further comprises a guiding area **117**, which is configured purely by way of example as a flat surface and is complementary to the guiding contour **324** of the first reception opening **312**. When the clamping apparatus **100** is received in the first reception opening **312**, the planar surface of the guiding area **117** is oriented in such a way that a surface normal of the planar surface extends transversely to the motion axis **500**. In FIG. **4**, purely by way of example, the planar surface of the guiding area **117** is also aligned

parallel to the upper surface **304** of the carrier body **302**. What has been explained with regard to the orientation of the planar surface of the guiding area **117** applies analogously to the orientation of the guiding contour **324**. Furthermore, the guiding area **117** and the guiding contour **324** can also be configured to be serrated or curved. In this way, positive locking between the clamping body **110** and the first reception opening **312** ensures a clear rotational alignment of the clamping body **110** with respect to the first reception opening **312** and thus with respect to the slide **300**. Furthermore, this ensures an anti-rotation lock for the end portion **216** of the toothed belt **130** received on the clamping body **110**.

(27) FIG. **5** shows an abstract representation of the clamping apparatus **100** with the support body **140** surrounding the support portion **129**. Accordingly, the support body **140** is in the functional position. In the configuration shown in FIG. **5**, the pressure plate **130** and the end portion **216** are received in the reception room **120** such that the toothed belt outer side **214** faces the second inner surface **124**, the pressure plate lower side **134** faces the first inner surface **123** and the toothed belt inner side **212** faces the pressure plate upper side **132**. With the pressure member **150** resting on the pressure plate lower side **134**, the pressure plate **130** is pressed against the toothed belt **210**, whereby the toothed belt outer side **214** is pressed against the second inner surface **124**. In the process, the support body **140** surrounding the support portion **129** prevents the reception room **120** from widening, in particular caused by the pressure member **150**. The back side **115** comprises a chamfer, which can simplify the mounting of the support body **140** on the clamping body **110** and the insertion of the clamping apparatus **100** into the first reception opening **312**.

(28) FIG. **6** shows the clamping apparatus **100** shown in FIG. **5** with the support body **140** positioned next to the clamping body **110**. The support body **140** comprises an inner diameter D**3** which is as large as an outer circumferential surface D**1** of the support portion **129**. The outer circumferential surface **119** comprises an outer diameter D**2** which is smaller than the inner diameter D**3** and the outer diameter D**1**. The first stop **113** comprises an outer diameter D**4** that is larger than the inner diameter D**3**. In this way, the support body **140** can be prevented from slipping along the motion axis **500** in the direction of the front side **112**.

Claims

1. A toothed belt axis comprising a toothed belt, a toothed belt disk, a deflector, a profile body extending along a motion axis, a slide and a clamping apparatus, wherein the slide comprises a first front surface, into which first front surface a first reception opening extending along the motion axis for receiving the clamping apparatus is inserted, wherein the profile body is configured for linearly movable guidance of the slide, wherein the toothed belt can be driven by means of the toothed belt disk and can be deflected by means of the deflector, the slide being movable in the profile body by means of the toothed belt, the clamping apparatus comprising a clamping body, a pressure plate, an annularly configured support body and a pressure member, the clamping body having a front side a back side, a reception room configured as a slot and a support portion, wherein the reception room extends from the front side along the motion axis and passes through the clamping body transversely to the motion axis, wherein the reception room comprises a first inner surface and a second inner surface opposite the first inner surface, wherein the pressure plate comprises a pressure plate upper side with toothing and a pressure plate lower side, wherein the toothed belt comprises a toothed belt inner side with toothing, a toothed belt outer side and at least one end portion, wherein the pressure plate and the end portion are received in the reception room in such a way that the toothed belt outer side faces the second inner surface, the pressure plate lower side faces the first inner surface and the toothed belt inner side faces the pressure plate upper side, wherein the toothing of the pressure plate upper side is configured complementary to the toothing of the toothed belt inner side, wherein the pressure plate is pressed against the toothed belt by the pressure member resting on the pressure plate lower side in order to press the toothed belt

outer side against the second inner surface, wherein the support body surrounds the support portion in order to prevent the reception room from widening.

2. The toothed belt axis according to claim 1, wherein the clamping body comprises an outer circumferential surface, from which outer circumferential surface a first stop projects outwards in the radial direction and is positioned between the front side and the support portion.

3. The toothed belt axis according to claim 1, wherein a second stop projects from the first inner surface in the direction of the second inner surface.

4. The toothed belt axis according claim 1, wherein the toothed belt axis further comprises a tensioning screw, wherein the clamping body further comprises a through bore extending from the front side to the back side for receiving the tensioning screw and the slide further comprises a tensioning thread which extends from the first reception opening along the motion axis, wherein the tensioning screw can be screwed into the tensioning thread in order to adjust the tension of the toothed belt.

5. The toothed belt axis according to claim 1, wherein the first reception opening comprises a guiding contour and the clamping body comprises a guiding area which is complementary to the guiding contour.

6. The toothed belt axis according to claim 1, wherein the clamping body is made of a light metal.

7. The toothed belt axis according to claim 1, wherein the support portion comprises a larger outer diameter than the remaining outer circumferential surface.

8. The toothed belt axis according to claim 1, wherein the outer diameter of the support portion and the inner diameter of the support body have the same size.

9. The toothed belt axis according to claim 1, wherein the clamping body is configured to be rotationally symmetrical at least in certain sections.

10. The toothed belt axis according to claim 1, wherein the toothed belt axis further comprises a further clamping apparatus, wherein the slide further comprises a further front surface into which further front surface a second reception opening positioned opposite the first reception opening is inserted for receiving the further clamping apparatus, wherein the toothed belt comprises a further end portion which further end portion is received in the reception room of the further clamping apparatus.

11. The toothed belt axis according to claim 3, wherein the second stop is positioned adjacent to the front side.

12. The toothed belt axis according to claim 6, wherein the clamping body is made of aluminum.