

LINEARLY MOVABLE DRIVING DEVICE AND THE SAME FOR PICKER UNIT AND TRANSFER EQUIPMENT

FIELD OF THE INVENTION

5 The present invention relates to a linear movable driving device and the same for at least one picker unit and transfer equipment which reduce configuration cost, eliminate transmission noises, compensate engagement accuracy and assembly error, and prolong service life.

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BACKGROUND OF THE INVENTION

 With reference to FIG. 1, a conventional testing and sorting machine for electronic components contains a picker unit, and the picker unit has a movable arm 11 moving linearly in a first
15 horizontal direction (X axis) along a first rail 10. The movable arm 11 has a first transmission belt 13 located above the movable arm 11 and driven by a first motor 12, a slider 14 connected on and driven by the first transmission belt 13 so as to move linearly in a
second horizontal direction (Y axis) along a second rail 15. The first
20 slider 14 has a second transmission belt 17 disposed thereon and driven by a second motor 16, and a second slider 18 is coupled on the second transmission belt 17 and is connected with a first picker 19, wherein the second slider 18 is driven by the second transmission belt 17 so as to move linearly on the first slider 14 in a
25 vertical direction (X axis) along a third rail 20. A third transmission

belt 22 is driven by a third motor 21, a third slider 23 is connected on the third transmission belt 22 and is coupled with a second picker 24, wherein the third slider 23 is driven by the third transmission belt 22 so as to linearly move on the first slider 14 in
5 the vertical direction (Z axis) along a fourth rail 25. Thereby, the first picker 19 or the second picker 24 linearly moves in the second horizontal direction (Y axis) and in the vertical direction (Z axis) by using the motors and a pulley set.

Referring to FIG. 2, a delivery unit of the testing and
10 sorting machine contains a transmission belt 31 driven by a motor 30 so as to drive a slider 32 to move in a horizontal direction (X axis or Y axis) along a rail 33, wherein the slider 33 has a first carrier 34 and a second carrier 35 which are configured to accommodate and carry electronic components in the horizontal
15 direction. Thereby, the first carrier 34 or the second carrier 34 linearly moves in the horizontal direction by using the motor and a pulley set.

However, the motor(s) and the pulley set have defects as follows:

20 1. The pulley set is comprised of a driving pulley, a driven pulley, and an annular transmission belt, thus increasing configuration cost.

2. The annular transmission belt has two flexible ends which do not matingly contact with a surface of a holding element
25 configured to hold the annular transmission belt, thus reducing

transmission stability of the annular transmission belt.

To overcome above-mentioned defects, a gear and a rack are employed to drive the picker unit and the delivery unit. However, the gear and the rack have following disadvantages:

5 1. The gear and the rack are too hard to reduce collision and noises.

 2. The gear and the rack are engaged together in high accuracy and are manufactured at expensive production cost.

 3. The abrasion between the gear and the rack increases
10 greatly, thus reducing service life of the gear and the rack.

The present invention has arisen to mitigate and/or obviate the afore-described disadvantages.

SUMMARY OF THE INVENTION

The primary objective of the present invention is to
15 provide a linear movable driving device and the same for at least one picker unit and transfer equipment in which the transmission gear engages with the linear toothed belt and drives the linear toothed belt to move linearly so as to simplify related parts and to reduce configuration cost.

20 Secondary objective of the present invention is to provide a linear movable driving device and the same for at least one picker unit and transfer equipment in which the linear toothed belt matingly contacts with the mating member so as to avoid distortion of the linear toothed belt.

25 Third objective of the present invention is to provide a

linear movable driving device and the same for at least one picker unit and transfer equipment in which the transmission gear engages with the linear toothed belt, and the multiple teeth of the linear toothed belt deform slightly so as to absorb collision of the transmission gear and to eliminate noises of the transmission gear.

Further objective of the present invention is to provide a linear movable driving device and the same for at least one picker unit and transfer equipment in which the transmission gear engages with the linear toothed belt, and the multiple teeth of the linear toothed belt deform slightly so as to compensate engagement accuracy and assembly error and to decrease manufacture cost.

Another objective of the present invention is to provide a linear movable driving device and the same for at least one picker unit and transfer equipment in which the transmission gear engages with the linear toothed belt, and the multiple teeth of the linear toothed belt deform slightly so as to absorb collision of the transmission gear and to compensate abrasion by way of the deformation of the multiple teeth, thus prolonging service life of the linear toothed belt.

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BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a picker unit of a conventional testing and sorting machine for electronic components.

25 FIG. 2 is a perspective view of a delivery unit of the

conventional testing and sorting machine for the electronic components.

FIG. 3 is a perspective view showing the exploded components of a linear movable driving device according to a preferred embodiment of the present invention.

FIG. 4 is a perspective view showing the assembly of the linear movable driving device according to the preferred embodiment of the present invention.

FIG. 5 is a cross sectional view showing the assembly of the linear movable driving device according to the preferred embodiment of the present invention.

FIG. 6 is a perspective view showing the operation of the linear movable driving device in a first linear motion mode according to the preferred embodiment of the present invention.

FIG. 7 is a perspective view showing the operation of the linear movable driving device in a second linear motion mode according to the preferred embodiment of the present invention.

FIGS. 8 is a cross sectional view showing the operation of a part of the linear movable driving device according to the preferred embodiment of the present invention.

FIG. 9 is a perspective view showing the exploded components of a part of the linear movable driving device applicable for a picker unit according to the preferred embodiment of the present invention.

FIG. 10 is a perspective view showing the assembly of the

linear movable driving device applicable for the picker unit according to the preferred embodiment of the present invention.

FIG. 11 is a perspective view showing the operation of the linear movable driving device applicable for the picker unit
5 according to the preferred embodiment of the present invention.

FIG. 12 is a top plane view showing the assembly of the linear movable driving device applicable for transfer equipment according to the preferred embodiment of the present invention.

10 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to FIGS. 3-5, a linear movable driving device according to a preferred embodiment of the present invention comprises: a drive source 41 mounted on a holding
15 pedestal 40 and connected with a transmission gear 42 so as to drive the transmission gear 42 to rotate. In this embodiment, the drive source 41 is a servo motor and has an output shaft connected with the transmission gear 42. The driving device also comprise a mating member 43 which includes a first face 431 facing the transmission
20 gear 42 and includes a second face 432 opposite to the first face 431. The mating member 43 also has a linear toothed belt 44 secured on the first face 431 and engaging with and driven by the transmission gear 42. In this embodiment, the linear toothed belt 44 has multiple teeth 441, wherein a shape and a pitch of each tooth 441
25 corresponds to the transmission gear 42 so that the transmission

gear 42 engages with and drives the linear toothed belt 44. In this embodiment, the linear toothed belt 44 matingly contacts with the first face 431 of the mating member 43, and a first end and a second end of the linear toothed belt 44 are fixed on a first end and a second end of the first face 431 of the mating member 43 respectively, wherein the first end of the linear toothed belt 44 is fixed on the first end of the first face 431 of the mating member 43 by a first press block 45, and the first press block 45 is screwed by a first screw bolt 46. The second end of the linear toothed belt 44 is fixed on the second end of the first face 431 of the mating member 43 by a second press block 47, and the second press block 47 is screwed by a second screw bolt 48. To adjust tension of the linear toothed belt 44 so that the linear toothed belt 44 matingly contacts with the first face 431 of the mating member 43, an adjustment member 49 is defined between the second press block 47 and the second end of the linear toothed belt 44, wherein the adjustment member 49 has a hook portion 491 configured to hook the linear toothed belt 44 and has an adjustable threaded bolt 492 opposite to the second end of the mating member 43, hence after the first press block 45 and the first screw bolt 46 fix the first end of the linear toothed belt 44 on the first face 431 of the mating member 43, the adjustable threaded bolt 492 is rotated to abut against the mating member 43, and the hook portion 491 hooks the linear toothed belt 44 so as to adjust the tension of the linear toothed belt 44. Thereafter, the second screw bolt 48 inserts through the second

press block 47 and the adjustment member 49 so as to fix the second end of the linear toothed belt 44 on the first face 431 of the mating member 43. Furthermore, a contacting member 50 is arranged on the holding pedestal 40 opposite to the drive source 41 and abuts against the mating member 43. In this embodiment, the contacting member 50 abuts against the second face 432 of the mating member 43, the mating member 50 is a linear guideway, and the contacting member 50 is a linear slide corresponding to and contacting with the linear guideway which is locked on a holder 501. In this embodiment, the holder 501 is secured on the holding pedestal 40 opposite to the drive source 41 so that the contacting member 50 is arranged on the holding pedestal 40 by using the holder 501. The holding pedestal 40 further includes a break sensor 51 disposed thereon, and a light shield 52 is arranged on the first press block 45 or the second press block 47 so that when the light shield 52 shields the break sensor 51, a signal is triggered to indicate the drive source 41 to stop operation, thus avoiding a linear motion over a predetermined position and preventing collision.

FIG. 6 is a perspective view showing the operation of the driving device in a first linear motion mode. For example, when the holding pedestal 40 is fixed and the drive source 41 drives the transmission gear 42 to rotate, the transmission gear 42 engages with and drives the linear toothed belt 44 so that the linear tooth belt 44 actuates the mating member 43 to move linearly along the contacting member 50.

FIG. 7 is a perspective view showing the operation of the driving device in a second linear motion mode. For example, when the mating member 43 is fixed and the drive source 41 drives the transmission gear 42 to rotate, the transmission gear 42 engages with and drives the linear toothed belt 44 so that the holding pedestal 40, the holder 501, and the contacting member 50 are driven to move linearly along the mating member 43.

Referring to FIGS. 3 to 5, the transmission gear 42 engages with and drives the linear toothed belt 44 secured on the mating member 43 so that the linear toothed belt 44 moves linearly, thus simplifying the driving device. Preferably, the linear toothed belt 44 mating contacts with the first face 431 of the mating member 43 so as to prevent distortion of the linear toothed belt 44.

As shown in FIG. 8, when the transmission gear 42 engages with and drives the linear toothed belt 44, the multiple teeth 441 of the linearly toothed belt 44 deform slightly. Accordingly, when a toothed portion of the transmission gear 42 presses the multiple teeth 441 of the linear toothed belt 44, the transmission gear 42 engages with and drives the linear toothed belt 44 so that the multiple teeth 441 of the linear toothed belt 44 absorb collision of the transmission gear 42 and eliminate noises of the transmission gear 42. When the multiple teeth 441 of the linear toothed belt 44 deform slightly, engagement accuracy and assembly error of the transmission gear 42 are compensated effectively. Furthermore, the multiple teeth 441 of the linear toothed belt 44

deform slightly so as to absorb collision of the transmission gear 42 and reduce abrasion of the transmission gear 42 with the linear toothed belt 44, thus prolonging service life of the linear toothed belt 44.

5 With reference to FIGS. 9 and 10, the driving device is applicable for a picker unit, and the picker unit includes a picker 60 connected with a first end of the mating member 43 so that when the drive source 41 drives the transmission gear 42 to rotate, the transmission gear 42 engages with and drives the linear toothed belt
10 44, and the linear toothed belt 44 actuates the mating member 43 and the picker 60 to move linearly along the contacting member 50. In this embodiment, the picker 60 has a connector 61 and a suction member 62, wherein the connector 61 is in connection with the first end of the mating member 43, the suction member 62 has a
15 connection pipe 621 communicating with a first end of the suction member 62, and a second end of the suction member 62 is accommodated in the connector 61. In this embodiment, the connector 61 is in a U shape and has an accommodation seat 611 and an abutting seat 612, wherein the second end of the suction
20 member 62 inserts through the accommodation seat 611 of the connector 61 and is limited on the connector 61 by a defining bolt 622, and a first end of a resilient element 623 abuts against the abutting seat 612 of the connector 61, a second end of the resilient element 623 is biased against the second end of the suction member
25 62, hence the suction member 62 moves along the accommodation

seat 611, and the resilient element 623 buffers a movement of the suction member 62.

With reference to FIG. 11, the picker unit is fixed on and is driven by a movable arm 70 so as to move in at least one direction.

5 In this embodiment, the picker unit is fixed on the movable arm 70 by using the holding pedestal 40 on which the drive source 41 is mounted, such that the movable arm 70 actuates the picker unit to move and locate above one of multiple unprocessed components 71, and the drive source 41 drives the transmission gear 42 to engage
10 with and to drive the linear toothed belt 44 so that the linear toothed belt 44 actuates the mating member 43 and the picker 60 to linearly move downward along the contacting member 50, hence the picker 60 corresponds to the one component 71 and sucks the one component 71 by using the suction member 62. Thereafter, the
15 drive source 41 drives the mating member 43 and the picker 60 to linearly move upward along the contacting member 50, and the movable arm 70 delivers the one component 71.

As illustrated in FIG. 12, the driving device is applicable for transfer equipment, wherein the transfer equipment includes a
20 machine base 100, a feeding unit 110, a collection unit 120, an operation unit 130, at least one picker unit 140, and a central control unit (not shown). The feeding unit 110 is arranged on the machine base 100 and includes at least one supply tray 111 configured to accommodate at least one of the multiple unprocessed components.
25 The collection unit 120 is fixed on the machine base 100 and

includes at least one gathering tray 121 configured to house at least one processed component. The operation unit 130 is mounted on the machine base 100 and includes at least one operating stage 131 configured to process the multiple unprocessed component. The at least one picker unit 140 is disposed on the machine base 100 and is connected with a movable arm 141 so that the at least one picker unit 140 picks the at least one unprocessed component from the feeding unit 110 and delivers the at least one unprocessed component toward the operation unit 130. After the at least one unprocessed component is processed, it is conveyed toward the collection unit 120, and the central control unit controls and integrates operations of the feeding unit 110, the collection unit 120, the operation unit 130, and the at least one picker unit 140 so as to execute automation process.

While the preferred embodiments of the invention have been set forth for the purpose of disclosure, modifications of the disclosed embodiments of the invention as well as other embodiments thereof may occur to those skilled in the art. Accordingly, the appended claims are intended to cover all embodiments which do not depart from the spirit and scope of the invention.

WHAT IS CLAIMED IS:

1. A linear movable driving device comprising:
 - a drive source mounted on a holding pedestal and connected with a transmission gear;
 - 5 a mating member including a first face facing the transmission gear, and a linear toothed belt being secured on the first face and engaging with and driven by the transmission gear; and
 - a contacting member arranged around and abutting against
 - 10 the mating member.
2. The linear movable driving device as claimed in claim 1, wherein the linear toothed belt matingly contacts with the first face of the mating member.
3. The linear movable driving device as claimed in claim 2,
15 wherein a first end of the linear toothed belt is fixed on a first end of the first face of the mating member, and a second end of the linear toothed belt is fixed on a second end of the first face of the mating member.
4. The linear movable driving device as claimed in claim 3,
20 wherein the first end of the linear toothed belt is fixed on the first end of the first face of the mating member by a first press block, and the second end of the linear toothed belt is fixed on the second end of the first face of the mating member by a second press block.
- 25 5. The linear movable driving device as claimed in claim 4,

wherein an adjustment member is defined between the second press block and the second end of the linear toothed belt, the adjustment member has a hook portion configured to hook the linear toothed belt and has an adjustable threaded bolt opposite to the second end of the mating member, and the adjustable threaded bolt abuts against the second end of the mating member so as to adjust tension of the linear toothed belt, hence the linear toothed belt matingly contacts with the first face of the mating member.

6. The linear movable driving device as claimed in claim 1, wherein the mating member also includes a second face opposite to the first face, and the second face of the mating member abuts against the contacting member.

7. The linear movable driving device as claimed in claim 1, wherein the mating member is a linear guideway, and the contacting member is a linear slide corresponding to and contacting with the linear guideway which is locked on a holder.

8. The linear movable driving device as claimed in claim 7, wherein the holder is secured on the holding pedestal opposite to the drive source.

9. The linear movable driving device as claimed in claim 1, wherein the holding pedestal further includes a break sensor disposed thereon so as to trigger a signal which indicates the drive source to stop operation.

10. A picker unit comprising:
the linear movable driving device as claimed in claim 1;

a picker connected with the mating member of the driving device so that the drive source drives the picker to move linearly.

11. The picker unit as claimed in claim 10, wherein the picker has a connector and a suction member, the connector is in
5 connection with the first end of the mating member, the suction member has a connection pipe communicating with a first end of the suction member, and a second end of the suction member is accommodated in the connector.

12. The picker unit as claimed in claim 11, wherein the
10 connector has an accommodation seat and an abutting seat, the second end of the suction member inserts through the accommodation seat of the connector and is limited on the connector by a defining bolt, and a first end of a resilient element abuts against the abutting seat of the connector, a second end of the
15 resilient element is biased against the second end of the suction member, hence the suction member moves along the accommodation seat.

13. The picker unit as claimed in claim 10, wherein the picker unit is fixed on and is driven by a movable arm so as to
20 move in at least one direction.

14. The picker unit as claimed in claim 13, wherein the picker unit is fixed on the movable arm by using the holding pedestal on which the drive source is mounted.

15. Transfer equipment comprising:
25 a machine base;

a feeding unit arranged on the machine base and configured to accommodate at least one unprocessed components;

a collection unit fixed on the machine base and configured to house at least one processed component;

5 an operation unit mounted on the machine base and configured to process the at least one unprocessed component;

 at least one picker unit as claimed in claim 10 and disposed on the machine base, the at least one picker unit being connected with a movable arm so that the at least one picker unit picks and
10 delivers the at least one unprocessed component among the feeding unit, the operation unit, and the collection unit; and

 a central control unit configured to control and integrate operations of the feeding unit, the collection unit, the operation unit, and the at least one picker unit so as to execute automation process.