

[DESCRIPTION]**[Invention Title]****A TRANSMISSION DEVICE FOR CONVERTING A TORQUE****[Technical Field]**

5 The present invention relates to a power transmission device, and more particularly, to a power transmission device which has a simple structure and thus can lower the installation height when installed so that it can be easily applied to compact equipments, and which reduces the use of
10 complicated peripheral components differently from conventional devices, and which further significantly reduces the frequency of maintenance and cleaning work as compared with conventional devices, to thereby prevent a process delay.

15 [Background Art]

 A power transmission device roughly consists of a rack and a pinion for converting rotational motion to linear motion or linear motion to rotational motion, and a gear train for transmitting only rotational motion and changing
20 rotating speed and torque.

 A power transmission system of a power transmission device generally employs gear-teeth based on an involute curve, and rarely employs gear-teeth based on a cycloid curve, and pin gears.

25 The above-mentioned power transmission device has been

widely used in a variety of industrial machines such as semiconductor equipment and the like.

Fig. 1 is a side structural view illustrating the use of a conventional power transmission device.

5 As shown in Fig. 1, a conventional power transmission device 1 is, for example, partially coupled to a slider 3 so as to linearly move slider 3 (denoted as a hatched area in Fig. 1) coupled via a rail 4 structure, with respect to a base plate 2.

10 For linear motion of slider 3 with respect to base plate 2, the power transmission device 1 connected to slider 3 is provided with a pinion 6 which is teeth-engaged with a rack 5 fixed in the area of base plate 2.

Pinion 6 is coupled to an end of a shaft 7 extending
15 outwardly from power transmission device 1, and teeth-engaged with rack 5 when the device 1 is assembled as shown in Fig. 1.

With the above-described structure, when motor 8 of power transmission device 1 rotates, shaft 7 rotates in accordance with the interaction between built-in components of power
20 transmission device 1, and then pinion 6 also rotates.

Here, as pinion 6 is teeth-engaged with rack 5 which is fixed in base plate 2, the rotating pinion 6 linearly moves along the lengthwise direction of rack 5, thereby realizing linear motion of slider 3 with respect to base plate 2, and
25 thus the linear motion of desired components or apparatuses,

when loaded on slider 3, can be accomplished.

Such a structure of power transmission device shown in Fig. 1 has been most widely used in the field. However, power transmission device 1 shown in Fig. 1 is configured in that shaft 7 is protruded outwardly and pinion 6 is coupled to an end of shaft 7, and therefore, the footprint of power transmission device 1, particularly, installation height H of power transmission device 1 inevitably increases, thus making it difficult to apply power transmission device 1 to compact equipment. Further, conventional power transmission device 1 has disadvantages in that complicated peripheral components such as a gear box, shrink fitting coupling and the like are required, a lubricant applied to an outer surface of pinion 6 causes contamination in a peripheral area of equipment, and maintenance and cleaning work which should be frequently performed due to the structure of conventional power transmission device 1 may result in a process delay. Therefore, needs are required for improved structures in view of the above-enumerated problems.

[Disclosure of the Invention]

[Technical Problem]

Accordingly, it is an object of the present invention to provide a power transmission device which has a simple structure and thus can lower the installation height when

installed so that it can be easily applied to compact equipments, and which reduces the use of complicated peripheral components differently from conventional devices, and which further significantly reduces the frequency of maintenance and cleaning work as compared with conventional devices, to thereby prevent a process delay.

[Technical Solution]

According to one aspect of the present invention, there is provided a power transmission device comprising:

10 an input gear which is connected to a motor in such a manner as to be rotatable in forward and reverse directions by the motor;

 a planetary gear train which is brought into contact with an outer surface of the input gear around the input gear
15 so as to be rotated in connection with the rotation of the input gear;

 a ring gear an inner surface of which is contacted with the planetary gear train, and which rotates by the planetary gear train relatively to the planetary gear;

20 a main frame which has a plurality of rollers coupled thereto in a circumferential direction such that the rollers are rotated relatively to a rack, and which is coupled to the ring gear at the periphery of the ring gear;

 a non-rotatable rear side fixture which is arranged in
25 the area where the input gear is located; and

a non-rotatable front side fixture which is arranged oppositely from the non-rotatable rear side fixture with the ring gear and the main frame interposed there between, and which is coupled to the non-rotatable rear side fixture.

5 The main frame may comprise a front frame unit having a plurality of first roller insertion holes for insertion of the plurality of rollers; a rear frame unit which has a plurality of second roller insertion holes communicated with the first roller insertion holes, and which is arranged in
10 parallel with the front frame unit; and a connection unit for interconnecting the front frame unit and the rear frame unit.

The interior of the connection unit may be further provided with a ring gear connection rib to which the ring gear is connected.

15 The interior of each of the rollers may be provided with a lubricant flow hole through which a lubricant flows in the lengthwise direction of the rollers.

The side wall of each of the rollers may be provided with a lubricant outlet and a lubricant inlet which is
20 communicated with the lubricant flow hole, and through which the lubricant flows in and out.

The lubricant outlet and the lubricant inlet may be arranged in opposite sides along the radial direction of the roller in both end areas of the lubricant flow hole.

25 A lubricant flow channel may be further formed between

the first roller insertion holes or between the second roller insertion holes to allow flow of the lubricant.

The lubricant flow channel may be provided in the front frame unit and connected to the first roller insertion holes.

5 The power transmission device may further comprise oil seals fitted respectively to the both end areas of the roller to maintain air tight at the respective relevant sites; and centrifugal bearings coupled respectively to the both ends of the roller with the oil seals there between to promote the
10 rotation of the rollers.

 The power transmission device may further comprise at least one main bearing interposed between the non-rotating rear side fixture and the main frame or between the main frame and the non-rotating front side fixture to promote the
15 rotation of the main frame.

 The main bearing may comprise a rear main bearing interposed between the non-rotating rear side fixture and the main frame; and a front main bearing interposed between the main frame and the non-rotating front side fixture.

20 The non-rotating front side fixture may be provided with a plurality of protrusions extending toward the non-rotating rear side fixture, and each of the protrusions is coupled to a needle bearing and connected to the planetary gear train.

25 The power transmission device may further comprise a

rear side sealing cover arranged outside the non-rotating rear side fixture to support the non-rotating rear side fixture; and a front side sealing cover arranged outside the non-rotating front side fixture to support the non-rotating front side fixture.

Auxiliary rings may be further arranged between the rear side sealing cover and the non-rotating rear side fixture and between the front side sealing cover and the non-rotating front side fixture, respectively.

The power transmission device may further comprise an input gear support member for supporting the input gear; a motor adapter for accommodating the motor; and at least one connector for connecting the input gear support member to the motor adapter such that the input gear support member is rotatable.

The connector may comprise a connection ring fitted to the input gear support member and connected to a flange area of the input gear support member; a clamp fitted to the input gear support member together with the connection ring; and a holder fixed at an end of the input gear support member to fix a motor shaft of the motor to the input gear support member.

The planetary gear train may include three planetary gears which are teeth-engaged with an outer surface of the input gear and with an inner surface of the ring gear to

rotate in connection with the rotation of the input gear.

【Advantageous Effects】

The power transmission device according to embodiments of the present invention is simple in structure, and thus can be applied to compact equipment in an easy manner, and reduces use of various peripheral components, and further significantly reduces the frequency of maintenance and cleaning work as compared with conventional devices, to thereby prevent a process delay.

10 **【Description of Drawings】**

Fig. 1 is a side structural view illustrating the use of a conventional power transmission device;

Fig. 2 is a perspective view illustrating a power transmission device according to one embodiment of the present invention;

Fig. 3 is an exploded perspective view where a motor adapter of the power transmission device is disassembled from Fig. 2;

Fig. 4 is an exploded perspective view of the power transmission device shown in Fig. 2;

Fig. 5 is an expanded view of portion A of the power transmission device shown in Fig. 4;

Fig. 6 is a perspective view illustrating the use of the power transmission device according to one embodiment of the present invention;

Fig. 7 is a side view illustrating the power transmission device shown in Fig. 6;

Fig. 8 is a perspective view illustrating another use of the power transmission device according to one embodiment
5 of the present invention;

Fig. 9 is a side view illustrating the power transmission device shown in Fig. 8; and

Fig. 10 to Fig. 12 is perspective views illustrating various uses of the power transmission device according to
10 one embodiment of the present invention.

[Detailed Description of the Embodiments of the Invention]

The present invention, operational advantages of the present invention and objects accomplished by the embodiment of the present invention will best be understood by making
15 reference to the accompanying drawings showing preferred embodiments of the present invention and detailed description made with reference to the accompanying drawings.

The present invention will be described hereinafter in detail by means of a description of preferred embodiments
20 with reference to the accompanying drawings. The same reference numerals in each drawing denote the same components.

Fig. 2 is a perspective view illustrating a power transmission device according to one embodiment of the present invention. Fig. 3 is an exploded perspective view
25 where a motor adapter of the power transmission device is

disassembled from Fig. 2. Fig. 4 is an exploded perspective view of the power transmission device shown in Fig. 2. Fig. 5 is an expanded view of portion A of the power transmission device shown in Fig. 4.

5 As shown in Fig. 2 to Fig. 5, a power transmission device 100 according to the embodiment of the present invention includes input gear 20 which is connected to a motor 10 (refer to Fig. 6 and Fig. 7) in such a manner as to be rotatable in forward and reverse directions by motor 10; a
10 planetary gear train 30 which is brought into contact with an outer surface of input gear 20 and is rotated in connection with the rotation of the input gear 20; a ring gear 40 an inner surface of which contacts the planetary gear train 30, and which relatively rotates by the planetary gear train 30;
15 a main frame 50 which has a plurality of rollers 60 coupled thereto in a circumferential direction such that rollers 60 are rotatable relatively to a rack 15 (refer to Fig. 6 and Fig. 7), and which is coupled to a periphery of ring gear 40; a non-rotatable rear side fixture 70 which is arranged in the
20 area where input gear 20 is located; and a non-rotatable front side fixture 80 which is arranged oppositely from non-rotatable rear side fixture 70 with ring gear 40 and main frame 50 interposed there between, and which is coupled to non-rotatable rear side fixture 70.

25 Motor 10 generates rotating power when powered. Here, a

servo motor which rotates in both forward and reverse directions and which allows for ease of control can be applied. However, the scope of the invention is not limited thereto, and various types of motors other than the servo motor, for example, a step motor can be applied.

Input gear 20 receives rotating power from motor 10 and rotates in a forward or reverse direction. Therefore, input gear 20 is connected to motor 10, and the structure thereof will be explained with reference to Fig. 4.

As shown in Fig. 4, input gear 20 is supported by an input gear support member 21.

That is, in the embodiment of the present invention, input gear 20 is coupled to or integrally formed with an end of input gear support member 21 having an approximately shaft-like shape. A flange 22 having a diameter larger than those of other parts of input gear support member 21 is provided in the end area of input gear support member 21 where input gear 20 is located.

Motor 10 is loaded onto and supported by motor adapter 11, and input gear support member 21 is rotatably connected to motor adapter 11 via a connector 23.

Connector 23 has an input gear support bearing 23a fitted to input gear support member 21 and connected to the area of flange 22 of input gear support member 21; a clamp 23c fitted to the input gear support member 21 together with

input gear support bearing 23a; and an oil seal 23b fixed at an end of input gear support member 21 to prevent oil leakage between input gear support bearing 23a and clamp 23c.

Input gear support bearing 23a is connected abutting up
5 to the area of flange 22 of input gear support member 21. Clamp 23c is coupled to input gear support member 21 to be formed integrally with input gear support member 21 into a unitary body.

Here, clamp 23c is provided as a ring shape with an
10 open end. When legs 21a provided at an end of input gear support member 21 are inserted into a through hole 23d in clamp 23c, the open end of clamp 23c is fastened by a bolt P arranged at the open end, thus enabling a motor shaft (not shown) of motor 10 coupled from the side opposite to input
15 gear support member 21 to be formed integrally with input gear support member 21 into a unitary body. That is, clamp 23c serves to fasten several legs 21a inwardly when the motor shaft of motor 10 is inserted between the several legs 21a, thereby fixing the motor shaft of motor 10 between the
20 several legs 21a.

When motor 10 is connected to motor adapter 11, and the motor shaft (not shown) of motor 10 is fastened to input gear support member 21 by clamp 23c, the final assembled structure as shown in Fig. 2 can be obtained. Here, when motor 10
25 rotates in forward and reverse directions, input gear support

member 21 also rotates in connection with the rotation of motor 10, thereby rotating input gear 20 arranged at the end of input gear support member 21.

Planetary gear train 30 is brought into contact with an
5 outer surface of input gear 20 around input gear 20 and rotates in connection with the rotation of the input gear 20.

In the embodiment of the present invention, planetary gear train 30 is provided as three planetary gears 30a which are teeth-engaged with an outer surface of input gear 20 and
10 with an inner surface of ring gear 40 to rotate in connection with the rotation of input gear 20. Those three planetary gears 30a have the same shape and same structure.

Although the embodiment of the present invention employs three planetary gears 30a arranged in a plane to
15 constitute planetary gear train 30, the number and arrangement of planetary gears 30a of planetary gear train 30 may vary differently from those described in the embodiment.

For example, the number of planetary gears 30a may be decreased in order to increase the reduction gear ratio, and
20 the number of planetary gears 30a may be increased in order to obtain a strong torque output. Further, an internal-contact planetary gear train may replace the general planetary gear train, and therefore, as the structure of the internal power transmission system may vary depending on

conditions, the scope of the present invention is not limited to those shown in the drawings.

Ring gear 40 is an element an inner surface of which is contacted with planetary gear train 30 consisting of three
5 planetary gears 30a. Although, this will be explained in more detail later, when planetary gear train 30 rotates by the rotating power applied to input gear 20, ring gear 40 rotates relatively to planetary gear train 30. This is because non-rotating front side fixture 80 which is connected to
10 planetary gear train 30 is maintained at a non-rotating state, that is, at a fixed state.

In general, non-rotating front side fixture 80 rotates when planetary gear train 30 rotates by the rotating power applied to input gear 20. However, in the embodiment of the
15 present invention, ring gear 40 the inner surface of which is contacted with planetary gear train 30 rotates as non-rotating front side fixture 80 is maintained at a fixed state.

Consequently, the embodiment of the present invention has a principle that the rotating power applied to input gear
20 20 is transmitted through planetary gear train 30 to the rotational motion of ring gear 40.

Main frame 50 is an element which is coupled to ring gear 40 at the periphery of ring gear 40. As aforementioned, because rotating power applied to input gear 20 is
25 transmitted to the rotational motion of ring gear 40, main

frame 50 rotates in connection with ring gear as ring gear 40 rotates.

To such a main frame 50 are coupled several rollers 60 along a circumferential direction, which rollers are rotated
5 relatively to rack 15 (refer to Fig. 6 and Fig. 7). The gear-teeth of rack 15 are based on both a cycloid curve and a trochoid curve.

Now, the structure of main frame 50 and rollers 60 will be explained in more detail with reference to Fig. 4 and Fig.
10 5.

As shown in Fig. 4, main frame 50 roughly includes three parts, that is, a front frame unit 51, a rear frame unit 52 and a connection unit 53. Here, although front frame 51, rear frame unit 52 and connection unit 53 are classified
15 according to their locations for convenience of description, it is desirable that they are formed into a unitary body.

Front frame unit 51 has a disk configuration oriented toward planetary gear train 30. Front frame unit 51 is provided with a plurality of first roller insertion holes 51a
20 for insertion of rollers 60. The number of the first roller insertion holes 51a corresponds to the number of rollers 60, and the first roller insertion holes 51a are equidistantly spaced apart from each other along the circumferential direction of front frame unit 51.

Rear frame unit 52 has a disk configuration oriented toward motor adapter 11 and arranged in parallel to front frame unit 51. Rear frame unit 52 is also provided with a plurality of second roller insertion holes 52a for insertion
5 of rollers 60, wherein second roller insertion holes 52a are communicated to the respective first roller insertion holes 51a.

As a result, the rollers 60 are connected to main frame 50 in such a manner that both ends of each of rollers 60 are
10 inserted into first and second roller insertion holes 51a and 52a, respectively, as shown in Fig. 2 and Fig. 3.

Connection unit 53 interconnects front frame unit 51 and rear frame unit 52, and has a diameter smaller than those of front frame unit 51 and rear frame unit 52, thereby
15 preventing interferences between connection unit 53 and rollers 60 during rotation of rollers 60.

The interior of such a connection unit 53 is provided with a ring gear connection rib 54 for connection of ring gear 40. Ring gear connection rib 54 has a structure
20 protruded radially inwardly from the interior of connection unit 53. Ring gear 40 surface-contacts the ring gear connection rib 54 having thus-formed protrusion, and is fastened through a bolt or a pin, whereby being connected to main frame 50 and formed integrally with main frame 50 into a

unitary body. It is possible to produce ring gear 40 and main frame 50 into a unitary body in the embodiment.

As described above, because ring gear 40 is formed integrally with main frame 50 into a unitary body, and
5 rollers 60 are coupled to main frame 50, planetary gear train 30 rotates by the rotating power applied to input gear 20, and ring gear 40 in turn rotates relatively to planetary gear train 30, and consequently, main frame 50 which is formed integrally with ring gear 40 into a unitary body rotates.

10 Power transmission device 100 of the embodiment of the present invention further comprises main bearings 57a and 57b as means for promoting rotation of main frame 50. That is, rear main bearing 57a is interposed between non-rotating rear side fixture 70 and main frame 50, and front main bearing 57b
15 is interposed between main frame 50 and non-rotating front side fixture 80, thereby promoting rotation of main frame 50. Main bearings 57a and 57b may be ball bearings, and any other bearing can be applied.

Meanwhile, if rollers 60 are coupled to main frame 50
20 through a press-fitting method or the like, rollers 60 merely revolves along with main frame 50 during rotation of main frame 50.

However, in the embodiment of the present invention, rollers 60 are coupled to main frame 50 such that rollers 60

are rotatable on their respective axes relatively to main frame 50.

Thus, rollers 60 revolve along with main frame 50 and also rotate on their respective axes during rotation of main frame 50. Certainly, rotation of rollers 60 on their respective axes is implemented only when rollers 60 are brought into contact with rack 15 and interact with rack 15, as shown in Fig. 6 and Fig. 7.

To couple rollers 60 to main frame 50 in such a manner that rollers 60 can revolve and also rotate, it is desirable to apply a structure for rotating rollers 60 on main frame 50 together with a lubrication structure for maintaining rotation of rollers 60 smooth.

The lubrication structure will be explained. As shown in Fig. 5, each of rollers 60 has a lubricant flow hole 61 formed in a lengthwise direction thereof through an interior thereof.

In addition, each of rollers 60 has a side wall on which a lubricant outlet 62 and a lubricant inlet 63 are formed and communicated to lubricant flow hole 61.

Although not necessarily, lubricant outlet 62 and lubricant inlet 63 can be formed in a mutually opposite direction along the radial direction of roller 60 in both end areas of lubricant flow hole 61, as shown in Fig. 5.

In addition to the lubrication structure of rollers 60,

a lubricant flow channel 51b is formed to interconnect first roller insertion holes 51a such that a lubricant flows through first roller insertion holes 51a, as shown in Fig. 5. Lubricant flow channel 51b can be provided in both or any one of front frame unit 51 and rear frame unit 52, and the embodiment of the present invention has a configuration in which lubricant flow channel 51b is formed in front frame unit 51.

Thus, lubricant flows through lubricant inlet 63, lubricant flow hole 61 and lubricant outlet 62, and flows through roller insertion holes 51a along the lubricant flow channel 51b, thereby enabling rollers 60 to smoothly rotate on their axes on main frame 50.

Referring to Fig. 2 to Fig. 4, oil seals 55a and 55b are fitted to respective both end areas of roller 60, and centrifugal bearings 56a and 56b are coupled to respective both ends of roller 60 with oil seals 55a and 55b there between, so as to promote rotation, that is, rotation on its axis, of roller 60.

As described above, oil seals 55a and 55b are coupled to both end areas of rollers 60, and a rear side sealing cover 96a and a front side sealing cover 96b are finally fastened to both ends of the power transmission device of the present invention, which will be described later, thus preventing problems of leakage of lubricant and contamination

of environment, which otherwise might occur in conventional devices.

Non-rotating rear side fixture 70 and non-rotating front side fixture 80 are coupled with each other such that
5 ring gear 40, main frame 50 and main bearings 57a and 57b interposed between the two fixtures 70 and 80 are formed into a single assembly.

As aforementioned, non-rotating rear side fixture 70 and non-rotating front side fixture 80 do not rotate and thus
10 are maintained at a fixed state differently from main frame 50 which rotates.

Specifically, in the embodiment of the present invention, non-rotating front side fixture 80 which is also referred to as a carrier, does not rotate along with
15 planetary gear train 30 and is maintained at a fixed state, and therefore, ring gear 40 as an opponent to planetary gear train 30 rotates relatively to planetary gear train 30 when planetary gear train 30 rotates by the rotating power applied to input gear 20, thereby inducing rotational motion of main
20 frame 50 to which rollers 60 are coupled.

Non-rotating front side fixture 80 is provided with a plurality of protrusions 81 extending toward non-rotating rear side fixture 70. Needle bearings 82 are coupled to the respective protrusions 81, and protrusions 81 are connected
25 to planetary gear train 30. By this configuration, non-

rotating front side fixture 80 does not rotate along with planetary gear train 30, and thus the location thereof is fixed.

5 Rear side sealing cover 96a and front side sealing cover 96b are coupled to outer surfaces of non-rotating rear side fixture 70 and non-rotating front side fixture 80, respectively.

 Rear side sealing cover 96a and front side sealing cover 96b provide sealing at the respective location thereof.

10 Oil seals 98a and 98b are coupled between rear side sealing cover 96a and non-rotating rear side fixture 70 and between front side sealing cover 96b and non-rotating front side fixture 80, respectively.

15 Thus-configured power transmission device 100 operates as follows.

 When motor 10 starts operation, input gear support member 21 connected to motor 10 rotates, and thereby input gear 20 rotates in one direction.

20 When input gear 20 rotates in one direction, planetary gear train 30 which consists of three planetary gears 30a gear-teeth engaged with input gear 20 rotates.

 Here, as repeatedly described above, needle bearings 82 are coupled to protrusions 81 of non-rotating front side fixture 80, and connected to planetary gear train 30, and
25 therefore, non-rotating front side fixture 80 does not rotate

along with planetary gear train 30 and the location thereof is thus fixed. For this reason, planetary gear train 30 rotates at the same place when planetary gear train 20 rotates, and thus the opposed ring gear 40 rotates.

5 Ring gear 40 is integrally formed with main frame 50 into a unitary body by ring gear connection rib 54, and therefore, main frame 50 also rotates when ring gear 40 rotates by the action of planetary gear train 30. When main frame 50 rotates, main bearings 57a and 57b may promote
10 rotation of main frame 50.

When main frame 50 thus-rotates, rollers 60 coupled to main frame 50 revolve along with main frame 50.

Meanwhile, power transmission device 100 of the embodiment of the present invention shown in Fig. 2 may not
15 be used alone, and generally is attached to the device shown in Fig. 6 and Fig. 7 and used together with rack 15. In this case, rollers 60 are engaged with rack 15 to linearly move with respect to rack 15 or to allow linear or curved motion of rack 15. When rollers 60 rotate engaged with rack 15,
20 rollers 60 also rotate on their respective axes.

Now, use of power transmission device 100 of the embodiment of the present invention when it is applied to semiconductor equipment, system or the like, will be explained in detail with reference to Fig. 6 and Fig. 7.

Fig. 6 is a perspective view illustrating the use of the power transmission device according to one embodiment of the present invention. Fig. 7 is a side view illustrating the power transmission device shown in Fig. 6.

5 For instance, power transmission device 100 of this embodiment can be used when it is required to move slider 13 coupled, via rail 14, to base plate 12 having one side to which rack 15 is fixed, linearly in the direction of arrow represented in Fig. 6.

10 Herein, rollers 60 of power transmission device 100 are arranged to be engaged with rack 15, and power transmission device 100 is fastened onto slider 13 by means of bolt B.

As described above, when motor 10 operates, and planetary gear train 30 by input gear 20, and resultantly, 15 main frame 50 rotates by ring gear 40, thus enabling rollers 60 coupled to main frame 50 to rotate along with main frame 50 and to linearly move in the lengthwise direction of rack 15.

As power transmission device 100 of the embodiment is 20 fixed at slider 13, rollers 60 rotate along with main frame 50 and linearly move in the lengthwise direction of rack 15, thus enabling slider 13 to linearly move in the direction of arrow represented in Fig. 6.

Power transmission device 100 of this embodiment is 25 similar to the conventional power transmission device

explained with reference to Fig. 1 in view of the fact the linear motion of slider 13 is induced. However, power transmission device 100 of this embodiment is configured differently from the configuration of the conventional power transmission device of Fig. 1 in that shaft 7 is outwardly projected, and pinion 6 is coupled to the end of shaft 7.

That is to say, power transmission device 100 of this embodiment is configured in that rollers 60 which substantially interact with rack 15 are fitted to main frame 50, and main frame 50 with rollers 60 is assembled in a compact manner between non-rotating rear side fixture 70 and non-rotating front side fixture 80, thereby reducing the size of the device, specifically the overall height of the device. Therefore, the device of the present invention can be applied to compact equipment.

Furthermore, power transmission device 100 of this embodiment has a simple structure in that rotational motion of rollers 60 is induced by the mutual relative rotation of input gear 20, planetary gear train 30 and ring gear 40 arranged within power transmission device 100. Therefore, power transmission device 100 of this embodiment eliminates the necessity of using complicated peripheral components such as a gear box, shrink fitting coupling and the like, differently from the conventional power transmission device 1 shown in Fig. 1.

As described above, power transmission device 100 of this embodiment has a simple structure, which significantly reduces the frequency of maintenance and cleaning work as compared with conventional devices, thereby preventing a
5 process delay.

According to the embodiment, power transmission device 100 has a simple structure and a low height when installed, and thus can be easily applied to compact equipment, and reduces use of complicated peripheral components differently
10 from conventional devices, and further significantly reduces the frequency of maintenance and cleaning work as compared with conventional devices, to thereby prevent a process delay.

Fig. 8 is a perspective view illustrating another use of the power transmission device according to one embodiment
15 of the present invention. Fig. 9 is a side view illustrating the power transmission device shown in Fig. 8.

Fig. 6 and Fig. 7 illustrate power transmission device 100 coupled onto slider 13.

However, as shown in Fig. 8 and Fig. 9, a portion of
20 power transmission device 100 of this embodiment, that is, an area of main frame 50 is interposed between a base plate 12a and a slider 13a, such that rollers 60 interact with a rack 15a.

It is also natural to use power transmission device 100 in the form shown in Fig. 8 to linearly move slider 13a in the direction of arrow represented in Fig. 8.

Fig. 10 to Fig. 12 is perspective views illustrating various uses of the power transmission device according to one embodiment of the present invention.

In the above-described embodiments, descriptions on the power transmission device 100 which linearly moves sliders 13, 13a (refer to Fig. 6 and Fig. 8), are provided. However, the opposite case can be implemented as well.

For example, as shown in Fig. 10, power transmission device 100 of this embodiment is fixed, and rollers 60 may rotate to enable a rack 15b to linearly move.

Similarly, as shown in Fig. 11 and Fig. 12, power transmission device 100 of this embodiment is brought into contact with an internal surface or an external surface of racks 15c and 15d, and fixed, and then rollers 60 rotate to enable racks 15c and 15d to rotate.

As a result, power transmission device 100 of this embodiment itself moves linearly or can be employed to linearly move sliders 13, 13a (refer to Fig. 6 and Fig. 8), or can be employed to move linearly or to rotate opponent racks 15b to 15d. These uses of power transmission device 100 can be suitably selected in accordance with the environment of equipment or system to use.

The various embodiments described above are merely exemplary and are not meant to limit the idea and scope of the invention. It is to be appreciated that numerous modifications and variations of the invention have been contemplated as would be obvious to one of ordinary skill in the art. Accordingly, it is intended to embrace all such modifications and variations as fall within the appended claims of the invention.

10 **Explanation of Reference numerals**

- 10 Motor
- 11 Motor adapter
- 15 Rack
- 20 Input gear
- 15 30 Planetary gear train
- 40 Ring gear
- 50 Main frame
- 51 Front frame unit
- 52 Rear frame unit
- 20 53 Connection unit
- 54 Ring gear connection rib
- 57a Rear main bearing
- 57b Front main bearing
- 60 Roller
- 25 61 Lubricant flow hole

62 Lubricant outlet

63 Lubricant inlet

70 Non-rotating rear side fixture

80 Non-rotating front side fixture

5 96a Rear side sealing cover

96b Front side sealing cover

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【CLAIMS】**【Claim 1】**

A power transmission device comprising:

an input gear which is connected to a motor in such a
5 manner as to be rotatable in forward and reverse directions
by the motor;

a planetary gear train or an internal contact planetary
gear train, which is brought into contact with an outer
surface of the input gear around the input gear so as to be
10 rotated in connection with the rotation of the input gear;

a ring gear an inner surface of which is contacted with
the planetary gear train, and which rotates by the planetary
gear train relatively to the planetary gear;

a main frame which has a plurality of rollers coupled
15 thereto in a circumferential direction such that the rollers
are rotated relatively to a rack, and which is coupled to the
ring gear at the periphery of the ring gear;

a non-rotatable rear side fixture which is arranged in
the area where the input gear is located; and

20 a non-rotatable front side fixture which is arranged
oppositely from the non-rotatable rear side fixture with the
ring gear and the main frame interposed there between, and
which is coupled to the non-rotatable rear side fixture.

【Claim 2】

25 The power transmission device according to claim 1,

wherein the main frame comprises:

a front frame unit having a plurality of first roller insertion holes for insertion of the plurality of rollers;

a rear frame unit which has a plurality of second
5 roller insertion holes communicated with the first roller insertion holes, and which is arranged in parallel with the front frame unit; and

a connection unit for interconnecting the front frame unit and the rear frame unit.

10 【Claim 3】

The power transmission device according to claim 2, wherein the interior of the connection unit is further provided with a ring gear connection rib to which the ring gear is connected.

15 【Claim 4】

The power transmission device according to claim 2, wherein the interior of each of the rollers is provided with a lubricant flow hole through which a lubricant flows in the lengthwise direction of the rollers.

20 【Claim 5】

The power transmission device according to claim 4, wherein a side wall of each of the rollers is provided with a lubricant outlet and a lubricant inlet which is communicated with the lubricant flow hole, and through which the lubricant
25 flows in and out.

【Claim 6】

The power transmission device according to claim 5, wherein the lubricant outlet and the lubricant inlet are arranged in opposite sides along the radial direction of the roller in both end areas of the lubricant flow hole.

【Claim 7】

The power transmission device according to claim 4, further comprising a lubricant flow channel formed between the first roller insertion holes or between the second roller insertion holes to allow flow of the lubricant.

【Claim 8】

The power transmission device according to claim 7, wherein the lubricant flow channel is provided in the front frame unit and connected to the first roller insertion holes.

15 【Claim 9】

The power transmission device according to claim 1, further comprising oil seals fitted respectively to the both end areas of the roller to maintain air tight at the respective relevant sites; and centrifugal bearings coupled respectively to the both ends of the roller with the oil seals there between to promote the rotation of the rollers.

【Claim 10】

The power transmission device according to claim 1, further comprising at least one main bearing interposed between the non-rotating rear side fixture and the main frame

or between the main frame and the non-rotating front side fixture to promote the rotation of the main frame.

【Claim 11】

The power transmission device according to claim 10,
5 wherein the main bearing comprises a rear main bearing interposed between the non-rotating rear side fixture and the main frame; and a front main bearing interposed between the main frame and the non-rotating front side fixture.

【Claim 12】

10 The power transmission device according to claim 1, wherein the non-rotating front side fixture is provided with a plurality of protrusions extending toward the non-rotating rear side fixture, and each of the protrusions is coupled to a needle bearing and connected to the planetary gear train.

15 **【Claim 13】**

The power transmission device according to claim 1, further comprising a rear side sealing cover arranged outside the non-rotating rear side fixture to support the non-rotating rear side fixture; and a front side sealing cover
20 arranged outside the non-rotating front side fixture to support the non-rotating front side fixture.

【Claim 14】

The power transmission device according to claim 13, further comprising auxiliary rings which are arranged between
25 the rear side sealing cover and the non-rotating rear side

fixture and between the front side sealing cover and the non-rotating front side fixture, respectively.

【Claim 15】

The power transmission device according to claim 1,
5 further comprising an input gear support member for supporting the input gear; a motor adapter for accommodating the motor; and at least one connector for connecting the input gear support member to the motor adapter such that the input gear support member is rotatable.

10 **【Claim 16】**

The power transmission device according to claim 15, wherein the connector comprises a connection ring fitted to the input gear support member and connected to a flange area of the input gear support member; a clamp fitted to the input
15 gear support member together with the connection ring; and a holder fixed at an end of the input gear support member to fix a motor shaft of the motor to the input gear support member.

【Claim 17】

20 The power transmission device according to claim 1, wherein the planetary gear train includes three planetary gears which are teeth-engaged with an outer surface of the input gear and with an inner surface of the ring gear to rotate in connection with the rotation of the input gear.