

VIBRATORY CONVEYING APPARATUS AND ROTATIONAL VIBRATOR

Description

[Technical Field]

[0001]

The present invention relates to a vibratory conveying apparatus and a rotational vibrator, more particularly, it relates to an inner structure of a rotational vibrating mechanism suitable when using a plate-shaped piezoelectric vibration body as a vibrating body.

[Background Art]

[0002]

Various kinds of vibratory conveying apparatuses have been generally used which convey electronic components and the like. In such a type of vibratory conveying apparatuses, recently, high feed speed and feed precision have been required, and high speed and high performance have been urgently required. Generally, it has been required to convey the components at high speed with conveyance postures of them perfectly uniformed, and therefore, it is necessary to efficiently and stably convey the components by vibration. In order to realize such an efficient and stable conveyance mode, it is necessary to reduce the unevenness of the vibrating directions of a vibrating table forming a component conveying passage and set the vibrating direction at high precision, in addition to raising the frequency of

vibration.

[0003]

As a conventional vibratory conveying apparatus, a bowl type conveying apparatus including a screw-shaped component conveying passage is known. For the bowl type conveying apparatus, a rotational vibrator is used in which a vibrating mechanism constituted by connecting an electro-magnetic type or piezoelectric type vibrating body to a amplifying plate spring for amplifying vibration generated by the vibrating body is connected between a base and the vibrating table (conveying body), and a plurality of vibrating mechanisms are set around an axis line in the same posture so as to generate rotational vibration. In particular, a piezoelectric vibration body has been frequently used as the vibrating body with advances in downsizing the apparatus and raising the frequency.

[0004]

As the above rotational vibrator, a rotational vibrator has been conventionally generally used in which the vibrating body, a plate spring and the like are inclined in a longitudinal direction and attached between the base and the vibrating table. However, in accordance with requests of downsizing and high frequency, a rotational vibrator has been recently proposed in which the vibrating body and plate spring are arranged so as to horizontally or extend radially. All the following Patent Documents 1 to 6 relate to the bowl

type conveying apparatus, and disclose a rotational vibrator in which the vibrating mechanisms horizontally extending are provided so that the height is reduced or mount stability can be raised. For example, a structure has been proposed that a post is erected at the center of the base, an inner end of the vibrating mechanism constituted by connecting a piezoelectric vibration body (a piezoelectric body is adhered to a surface of an elastic plate) and the plate spring to each other in series is attached to the post, the vibrating mechanism is horizontally extended radially outward and an outer end of the mechanism is connected to a bottom of the vibrating table or conveying body (bowl).

Patent Document 1: Japanese Published Unexamined Utility Model Application No. S57-46517

Patent Document 2: Japanese Published Examined Patent Application No. S60-45084

Patent Document 3: Japanese Published Unexamined Patent Application No. S62-201709

Patent Document 4: Japanese Published Unexamined Patent Application No. S62-201710

Patent Document 5: Japanese Published Unexamined Patent Application No. H01-104508

Patent Document 6: Japanese Published Unexamined Patent Application No. H09-110133

[Disclosure of the Invention]

[Problem to be Solved by the Invention]

[0005]

On the other hand, as described above, in a bowl type vibratory conveying apparatus, it is necessary to raise the frequency of vibration and optimize a vibration mode in accordance with a request for downsizing of a component to be conveyed or high conveyance speed. However, vibrating directions easily become uneven when the frequency of vibration is raised, and feeding directions of the components to be conveyed easily become uneven due to the unevenness of the vibrating directions by downsizing the component to be conveyed. Accordingly, it is necessary for improvement of conveyance efficiency to raise the frequency of vibration and simultaneously reduce the unevenness of the vibrating directions.

[0006]

The unevenness of the vibrating directions occurs in the case where an unnecessary vibration mode, for example, a vibration mode (twist vibration mode, longitudinal vibration mode or the like) other than a vibration mode having an original frequency and vibrating direction arises, and such an unnecessary vibration mode is easily caused by lack of rigidity of each part. In particular, in order to efficiently vibrate a conveying body such as a bowl, it is necessary to efficiently transmit vibration generated by vibrating mechanisms by increasing the inertia weight of a base to a vibrating table or conveying body, and therefore,

an attachment part of the base to the vibrating mechanism is required to have sufficient rigidity. This is effective for reducing the unnecessary mode. However, in the above conventional rotational vibrator, a post is projected at the center of the base, and inner ends of the vibrating mechanisms are attached to the post. Accordingly, since the rigidity of the post cannot be sufficiently raised, it is necessary to increase an outer diameter of the post or increase an attachment area thereof in the case of sufficiently raising the rigidity of the post, and thus the rotational vibrator is upsized, and this is contrary to a request of downsizing.

[0007]

Thereupon, the present invention was made in view of the above problem, and aims at providing a rotational vibrator and a vibratory conveying apparatus including the same capable of realizing high frequency of vibration, reducing the unevenness of the vibrating directions, raising the conveyance efficiency and being downsized.

[Means for Solving the Problem]

[0008]

In view of the above circumstances, the present invention provides a vibratory conveying apparatus including: a base; a conveying body which is arranged on the base and includes a ring-shaped or screw-shaped component conveying passage; and a vibrating mechanism which is

interposed between the base and the conveying body to vibrate the conveying body in a rotating direction, wherein the vibrating mechanism is arranged so as to extend radially from its inner end connected to the base side to its outer end connected to the conveying body side, and a connecting component is interposed between the vibrating mechanism and the base, the connecting component being connected to the inner end of the vibrating mechanism, and having a base side connection part extending radially outward parallel with the vibrating mechanism.

[0009]

According to the present invention, the base end side connection part of the connecting component extends radially outward to be connected to the base side and thus the vibrating mechanism can be fixed to the base over a radially wide range through the connecting component, and therefore, the vibrating mechanism, even if no post is projected at the center of the base, can be securely and strongly attached, the post itself is unnecessary, and the inner end of the vibrating mechanism can be arranged near to an axis line. Accordingly, an unnecessary vibration mode is prevented from occurring, unevenness of vibrating directions can be reduced, the outer diameter of the apparatus is reduced and the apparatus can be downsized.

[0010]

In the present invention, it is preferable that a

plurality of the vibrating mechanisms are provided at a plurality of places around the axis line respectively and the inner ends of the plurality of the vibrating mechanisms horizontally directly face each other in the vicinity of the axis line. If the inner ends of the vibrating mechanisms arranged around the axis line thus horizontally directly face each other in the vicinity of the axis line, the inner ends of the vibrating mechanisms can be made closer to the axis line, and the apparatus can be wholly made compact. Thus, the mode of vibration of the vibrating mechanism becomes similar to arc-shaped vibration around the axis line. Accordingly, inconsistency of the vibration modes between the plurality of vibrating mechanisms can be reduced, and the unevenness of the vibrating directions can be prevented from occurring.

[0011]

In the present invention, it is preferable that the connecting component includes a projecting vibrating mechanism side connection part connected to the vibrating mechanism and the base side connection part extended radially, whereby the connecting component has an approximately L-shape. Thus, the inner end of the vibrating mechanism can be securely and strongly fixed and arranged in the vicinity of the axis line by the connecting component, the connecting component can be arranged within a small angle range in the rotating direction. Accordingly, the apparatus

can be further downsized.

[0012]

In the present invention, it is preferable that, in the vibrating mechanism, a plate-shaped vibrating body including a piezoelectric vibration body, and an elastic plate connected to the vibrating body in series are arranged so as to extend radially approximately linearly, and the vibrating body is radially longer than the elastic plate. If the vibrating body and the elastic plate, which are connected to each other in series in the vibrating mechanism, are thus radially arranged approximately linearly, the conveying body can be efficiently vibrated in the rotating direction. Additionally, since the vibrating body is formed radially longer than the elastic plate and thus the spring constant of the vibrating mechanism is raised, the frequency of vibration can be easily increased and the unevenness of the vibrating directions can be further reduced.

[0013]

Next, a rotational vibrator of the present invention includes: a base; a vibrating table arranged on the base; and a vibrating mechanism which is interposed between the base and the vibrating table to vibrate the vibrating table in a rotating direction, wherein the vibrating mechanism is arranged so as to extend radially from its inner end connected to the base side to its outer end connected to the vibrating table side, and a connecting component is

interposed between the vibrating mechanism and the base, the connecting component being connected to the vibrating mechanism, and having a base side connection part extending radially outward parallel with the vibrating mechanism and connected to the base.

[Best Mode for Carrying Out the Invention]

[0014]

Hereinafter, an embodiment of the present invention will be described with reference to an example illustrated in the drawings. Fig. 1 is a schematic side view of a rotational vibrator used for a vibratory conveying apparatus of a first embodiment, Fig. 2 is a schematic plan view of the vibrator from which a vibrating table is detached, Fig. 3 is a schematic perspective view of a vibrating mechanism of the vibrator, Fig 4(a) is a side view of the vibrating table of the vibrator, Fig. 4(b) is a bottom view of the same, Fig. 4(c) is a vertical cross sectional view of the same, and Fig. 5 is a plan view of a base of the vibrator from which components are detached. As well known, the vibratory conveying apparatus is formed in a manner that a conveying body 112 (see Fig. 6) having a screw-shaped or circle-shaped conveying passage is attached to an upper part (vibrating table 15) of a rotational vibrator 10 shown in the Figures.

[0015]

The rotational vibrator 10 of the embodiment, as shown in Fig. 1, has an attachment base 11, and a base 13 mounted

on the attachment base 11 via an elastic member 12 such as vibration-proof rubber or a coil spring. Additionally, the vibrating table 15 is attached and supported onto the base 13 via vibrating mechanisms 14. Moreover, an elastic supporting member (plate spring, etc) may be attached, in addition to the vibrating mechanisms 14, between the base 13 and the vibrating table 15, but the vibrating table 15 is supported only by the vibrating mechanisms 14 in the embodiment.

[0016]

As shown in Fig. 2, connecting components 16 are attached and fixed to an upper surface of the base 13. It is preferable that the connecting component 16 is made of a material having a modulus of elasticity (Young's modulus) or modulus of rigidity higher than that of a material of the base 13. In particular, it is effective for efficient transmission of vibration or prevention of an unnecessary vibration mode (described below) that the connecting component is composed of the material having a high modulus of rigidity. An inner end of the vibrating mechanism 14 is attached and fixed to the connecting component 16. The vibrating mechanism 14 extends radially from an axis line 10x, and an outer end thereof is attached and fixed to the vibrating table 15. The vibrating mechanism 14 is constituted in a manner that a vibrating body 14A and an elastic plate 14B formed of a plate spring or the like are

connected to each other in series, the vibrating body 14A being a piezoelectric vibration body constituted by adhering a piezoelectric body 14A2 to an outer surface (both outer surfaces in the example illustrated) of an elastic substrate (shim plate) 14A1.

[0017]

As shown in Fig. 3, the vibrating body 14A side of the vibrating mechanism 14 is connected to the connecting component 16, and the elastic plate 14B side thereof is connected to the vibrating table 15. The elastic substrate 14A1 of the vibrating body 14A and the elastic plate 14B are, via a resin spacer 17, connected and fixed to each other by use of a connecting fixture 18 including bolts or the like. Additionally, the elastic substrate 14A1 of the vibrating body 14A and the connecting component 16 are connected and fixed to each other, and the elastic plate 14B and the vibrating table 15 are connected and fixed to each other, respectively, via the resin spacers 17, by use of the connecting fixtures 18 including the bolts or the like. Moreover, a connection mode of the components is not limited to the above connection mode, the components can be fixed to each other by any of various fixing methods, and the elastic substrate 14A1 and the elastic plate 14B can be integrated with each other so as to form into one elastic body. However, in the embodiment, it is considered that metal fatigue or the like hardly causes a breakage to an

attachment part of the elastic substrate 14A1 or elastic plate 14B of the vibrating body 14A by inserting the resin spacer 17 into each connection part.

[0018]

The connecting component 16 includes a base side connection part 16A extending radially, and a vibrating mechanism side connection part 16B projecting from an inner end of the base side connection part 16A in a rotating direction around the axis line 10x (clockwise viewed from above in the example illustrated, and hereinafter, "counterclockwise" will be referred to as "normal rotating direction," and "clockwise" will be referred to as "reverse rotating direction"). The base side connection part 16A is in a shape of extending radially outward from the vibration mechanism side connection part 16B side, that is, in a plane shape linearly extending radially outward. Thus, the connecting component 16 has an approximately L-shaped plane. Fixation holes 16a (see Fig. 3) are formed in two positions, inside and outside in the radial direction, in the base side connection part 16A. Bolts or the like are inserted into the fixation holes 16a and screwed into screw holes 13e dug in an attachment surface 13a (see Fig. 5) of the base 13 so that the base side connection part 16A is attached and fixed to the base 13.

[0019]

Additionally, as shown in Fig. 3, the connecting

component 16 supports and arranges the vibrating mechanism 14 at a position shifted upward by a gap G from a lower end of the component 16, and thus the vibrating mechanism 14 is not in contact with an inner surface of the base 13 and arranged so as to have a sufficient interval from the inner surface. An attachment surface 16b with a step is formed on the vibrating mechanism side connection part 16B of the connecting component 16, and the elastic substrate 14A1 of the vibrating body 14A is fitted to the attachment surface 16b (via the resin spacer 17 in the example illustrated) and fixed in both the rotating and radial directions.

[0020]

In the vibrating mechanism 14, which is formed radially longer than the elastic plate 14B, a required vibration is generated by the vibrating body 14A, and the elastic plate 14B performs a part of removing slight inconsistencies between the provided multiple vibrating mechanisms 14 by flexibility or the like, differently from a conventional constitution that vibration generated by the vibrating body 14A is amplified by the elastic plate 14B to be transmitted to the vibrating table 15. That is, in the embodiment, since the plurality of vibrating mechanisms 14 are provided along a plurality (three in the example illustrated) of set-up axes 10y (angles between them are equal to each other in the example illustrated) extending radially from the axis line 10x, there is a possibility that a load is applied to each

vibrating mechanism 14 by a deformation in a vibrating direction and the piezoelectric body is broken with an increase in the load, unless the vibrating mechanisms 14 generate arc-shaped vibrations, which are perfectly consistent with each other around the axis line 10x, to the vibrating table 15. Thereupon, in the embodiment, the elastic plate 14B is made to perform a part of absorbing the deformation.

[0021]

However, since the inner ends of the vibrating mechanisms 14 are arranged in the vicinity of the axis line 10x in the embodiment as described below, approximately an arc-shaped vibration mode around the axis line 10x is realized by the vibrating mechanisms 14 each extending radially approximately linearly. Accordingly, even if the plurality of vibrating mechanisms 14 are provided around the axis line 10x, the inconsistency of the vibrating directions between the vibrating mechanisms 14 is greatly reduced compared with that of a conventional apparatus. Accordingly, the elastic plate 14B can also be shortened, and thus various effects can be simultaneously obtained that the apparatus, of course, is made compact, the unevenness of the vibrating directions is reduced and the frequency is easily raised.

[0022]

As shown in Fig. 5, the attachment surfaces 13a, to each of which the connecting component 16 is fixed, are provided

in the base 13, and each attachment surface 13a is basically formed to have a configuration corresponding to a connection surface of the base side connection part 16A of the connecting component 16 (flat surface in the example illustrated). The attachment surface 13a is slightly inclined in the reverse rotating direction, and thus the vibrating mechanism 14 connected thereto via the connecting component 16 is similarly inclined clockwise and the vibrating direction of the vibrating table 15 is obliquely upward in the normal rotating direction. An attachment inclination angle of the vibrating mechanism 14 (an inclination angle in the vibrating direction) is preferably set to, for example, 1 to 20°, more preferably to 3 to 15°.

[0023]

Here, the attachment surface 16b of the connecting component 16 and a connection surface of the vibrating mechanism 14 being in close contact with the attachment surface 16b are planes directed in the vibrating direction of the vibrating mechanism 14 or in a direction orthogonal to a normal of a surface of the vibrating body 14A or elastic plate 14B. Thus, integration of the connecting component 16 with the vibrating mechanism 14 can be raised regarding a mechanical influence on a normal vibration mode. Accordingly, generation of the unnecessary vibration mode can be reduced.

[0024]

The attachment surface 13a and an inner part on the normal rotating direction side thereof are formed in a groove shape as a whole, and thus a housing space is secured in which the vibrating mechanisms 14 and the connecting components 16 are housed. In the housing space, openings 13c are formed around the outer periphery of the base 13. Additionally, tables 13b are thickly formed on the reverse rotating direction sides of the attachment surfaces 13a respectively, and thus the weight of the base 13 can be increased without making the appearance of the apparatus large. Additionally, a center recess 13d, in which no table 13b is formed, is provided in the vicinity of the axis line 10x of the base 13, the inner ends of the vibrating mechanisms 14 and the vibrating mechanism side connection parts 16B of the connecting components 16 are arranged in the housing space provided by the center recess 13d.

[0025]

As shown in Fig. 4, the vibrating table 15 has a disc-shaped upper plate 15a and projections 15b projecting downward from the outer periphery of the upper plate 15a, and the outer ends of the vibrating mechanisms 14 are attached and fixed to the projections 15b respectively. The projection 15b is housed in a groove-shaped housing space provided in the opening 13c of the base 13 via a sufficient gap, and the table 13b of the base 13 faces a part, in which no projection 15b is provided, of the outer periphery of the

upper plate 15a of the vibrating table 15. and then, the base 13 and the vibrating table 15 are vertically oppositely arranged so as to keep a minimum distance from each other and not be in contact with each other.

[0026]

A wheel-shaped thick part 15c and a plurality of thin parts 15d are provided at a bottom surface (surface facing the base 13) of the upper plate 15a of the vibrating table 15, the part 15c having a ring-shaped rim at an outer circumference through a plurality of spokes extending radially from a center hub, and the part 15d being formed in a recess shape between the thick parts 15c. Thus, the weight of the vibrating table 15 is reduced while sufficient rigidity is secured. Moreover, the projections 15b are provided corresponding to connection parts between the spokes and the rim. Thus, the rigidity against the vibration received from the vibrating mechanisms 14 can be further improved.

[0027]

Fig. 6 is a plan view of a component feeding apparatus 100 including a bowl type vibratory conveying apparatus 110 using the rotational vibrator 10. In the component feeding apparatus 100, the bowl type vibratory conveying apparatus 110 and a linear type vibratory conveying apparatus 120 are supported on a mount table 101. The vibratory conveying apparatus 110 has the rotational vibrator 10 and a

bowl-shaped conveying body 112 attached and fixed on the vibrating table 15, and a screw-shaped component conveying passage 112b is formed so as to gradually extend upward from an inner bottom 112a of the conveying body 112. Additionally, the vibratory conveying apparatus 120 has a linear vibrator 121 linearly vibrating and a conveying body 122 fixed on the linear vibrator 121, and a linear component conveying passage 122a, to which the component conveying passage 112b is connected, is formed in the conveying body 122.

[0028]

A great number of components (not shown) deposited on the inner bottom 112a of the bowl-shaped conveying body 112 gradually move upward along the screw-shaped component conveying passage 112b, and shift to the component conveying passage 122a at an exit of the passage 112b to linearly move. In such a component feeding apparatus 100, since small components are required to be fed at an extremely high speed, high conveying ability is particularly required for the vibratory conveying apparatus 110 which is frequently mounted at the most upstream side. In the embodiment, by use of the rotational vibrator 10, the components on the component conveying passage 112a are efficiently conveyed in a vibration mode where the unevenness of the vibrating directions is small at a high frequency.

[0029]

The rotational vibrator 10 and vibratory conveying

apparatus 110 of the embodiment described above has the following effects. In such a rotational vibrator and vibratory conveying apparatus, generally, it is important to efficiently vibrate the vibrating table 15 and/or the conveying body 112 by use of the inertia weight of the base 13, and it is effective to increase the weight of the base 13 and reduce the weight(s) of the vibrating table 15 and/or the conveying body 112. However, there is a limitation to reducing the weight(s) of the vibrating table 15 and/or the conveying body 112 since it is necessary to secure rigidity for preventing it (them) from being deformed. Additionally, there is a limitation to increasing the weight of the base 13 since it is necessary to reduce the height and outer diameter of the apparatus and downsize the apparatus. Accordingly, in the embodiment, rigidity of the attachment part of the base 13, on which the vibrating mechanisms 14 are mounted, is raised, and thus the vibration is efficiently transmitted by effective use of the inertia weight of the base 13, the unevenness of the vibrating directions is reduced by optimizing the vibration mode, and conveyance efficiency of the component can be raised.

[0030]

That is, in the conventional apparatus, the vibrating mechanisms are attached to the post projected at the center of the base, and thus rigidity of the post itself is likely to be lacking and an inertia moment of the base in the

rotating direction cannot be used. Therefore, substantial attachment rigidity of the vibrating mechanism is low, and thus vibration energy generated by the vibrating mechanisms is likely to escape to the base side, the vibration cannot be efficiently transmitted, the unnecessary vibration mode arises due to partial vibration of the post, the unevenness of the vibrating directions is increased, and the components cannot be efficiently conveyed.

[0031]

On the other hand, in the embodiment, since the vibrating mechanisms 14 are attached to the base 13 via the connecting components 16, and thus the above projected post is unnecessary, and the vibrating mechanisms 14 can be attached to parts, each of which has high rigidity, of the base 13 (flat part of the inner surface of the base 13) and can be fixed, via the connecting components 16, within a wide range of the radially outward. Thus, the inertia weight of the base 13 can be effectively used by the inertia moment in the rotating direction. Accordingly, the vibration can be efficiently transmitted to the vibrating table 15 and/or the conveying body 12, and optimization of the vibration mode, suppression of the unevenness of the vibrating directions, can be realized by suppressing the unnecessary vibration mode.

[0032]

On the other hand, in view of another point, in the

embodiment, the post described above is unnecessary, and the inner ends of the plurality of vibrating mechanisms 14 directly face each other (directly adjacently arranged without obstruction of the post of the base 13) and thus can be made close to the axis line 10x. Therefore, the outer diameter of the apparatus can be reduced, the mode of vibration applied to the vibrating table 15 or conveying body 112 approximates arc vibration around the axis line 10x by approach of fulcrums of vibrating motion of the vibrating mechanisms 14 to the axis line 10x, and thus an ideal vibration mode of the vibrating table 15 or conveying body 112 can be obtained. In particular, since the plurality of vibrating mechanisms 14 respectively apply approximately concentric arc vibration to the vibrating table 15 or conveying body 112, the unevenness of the vibrating directions is prevented from occurring. Naturally, as a reflective effect of the above effective use of the inertia weight of the base 13, the base 13 can be downsized, and thus the whole apparatus can be downsized.

[0033]

Additionally, since a material having a high modulus of rigidity other than the material of the base 13 can be used in the connecting component 16 by interposing the connecting components 16 other than the base 13 between the base 13 and the vibrating mechanisms 14, cost can be saved and performance can be improved, and the shape of the

connecting component 16 is made so as to adapt to the normal vibrating direction, that is, as a block structure including an inclined posture adapting to inclination directions of the vibrating body 14A, elastic plate 14B and the like of the vibrating mechanism 14, and thus the normal vibration mode can be easily maintained and a prevention effect of the unnecessary vibration mode can be raised.

[0034]

Moreover, in the embodiment, the base side connection part 16A of the connecting component 16 is arranged parallel on the reverse rotating direction side of the vibrating mechanism 14. However, the present invention is not limited to this, for example, conversely, the base side connection part 16A may be arranged parallel on the normal rotating direction side of the vibrating mechanism 14, or may be arranged at a lower position of planarly overlapping with the vibrating mechanism 14.

[0035]

Additionally, although the vibrating mechanisms 14 are attached and fixed to the base 13 via the L-shaped connection parts 16 in the above-described embodiment, the present invention is not limited to this. As long as a part corresponding to the vibrating mechanism 14 and the connecting component 16 is finally constituted in a U-shape as a whole, the base side connection part 16A extending radially parallel with the vibrating mechanism 14 is

provided in the connecting component 16 and is connected and fixed to the base 13, for example, a linear connecting component may be attached to an L-shaped vibrating mechanism. Additionally, the shape of the base side connection part 16A is not limited to the shape of extending radially linearly as shown in the example illustrated, and may be in a disc shape, column shape or rectangular block shape if extending radially.

[0036]

Further, although the vibratory conveying apparatus 110, in which the conveying body 112 is fixed on the vibrating table 15 of the rotational vibrator 10, is described in the above-described embodiment, the present invention is not limited to this constitution, for example, the conveying body 112, in place of the vibrating table 15, may be directly connected to the outer ends of the vibrating mechanisms 14.

[Brief Description of the Drawings]

[0037]

Fig. 1 is a side view of a rotational vibrator constituting a vibratory conveying apparatus of an embodiment.

Fig. 2 is a plan view of the rotational vibrator from which a vibrating table is detached.

Fig. 3 is a perspective view of a connecting component and vibrating mechanism of the rotational vibrator.

Fig. 4(a) is a side view of the vibrating table of the

rotational vibrator, Fig. 4(b) is a bottom view of the same, and Fig. 4(c) is a vertical cross sectional view of the same.

Fig. 5 is a plan view of a base of the rotational vibrator.

Fig. 6 is a schematic plan view of a component feeding apparatus including the vibratory conveying apparatus of the embodiment.

[Description of Symbols]

[0038]

10 ... Rotational vibrator, 13 ... Base, 14 ... Vibrating mechanism, 14 ... Vibrating body (piezoelectric vibration body), 14A1 ... Elastic substrate, 14A2 ... Piezoelectric body, 14B ... Elastic plate, 15 ... Vibrating table, 16 ... Connecting component, 16A ... Base side connection part, 16B ... Vibrating mechanism side connection part, 17 ... Resin spacer, 18 ... Connecting fixture, 110 ... Vibratory conveying apparatus

Claims:

1. A vibratory conveying apparatus comprising:

a base;

a conveying body which is arranged on the base and includes a ring-shaped or screw-shaped component conveying passage; and

a vibrating mechanism which is interposed between the base and the conveying body to vibrate the conveying body in a rotating direction,

wherein the vibrating mechanism is arranged so as to extend radially from its inner end connected to the base side to its outer end connected to the conveying body side, and

a connecting component is interposed between the vibrating mechanism and the base, the connecting component being connected to the inner end of the vibrating mechanism, and having a base side connection part extending radially outward parallel with the vibrating mechanism.

2. The vibratory conveying apparatus according to claim 1, wherein a plurality of the vibrating mechanisms are provided at a plurality of places around an axis line respectively, and inner ends of the plurality of the vibrating mechanisms horizontally directly face each other in the vicinity of the axis line.

3. The vibratory conveying apparatus according to claim 1 or 2, wherein the connecting component includes a projecting vibrating mechanism side connection part

connected to the vibrating mechanism and the base side connection part extended radially, whereby the connecting component has an approximately L-shape.

4. The vibratory conveying apparatus according to any one of claims 1 to 3, wherein, in the vibrating mechanism, a plate-shaped vibrating body including a piezoelectric vibration body, and an elastic plate connected to the vibrating body in series are arranged so as to extend radially approximately linearly, and the vibrating body is radially longer than the elastic plate.

5. A rotational vibrator comprising:

a base;

a vibrating table arranged on the base; and

a vibrating mechanism which is interposed between the base and the vibrating table to vibrate the vibrating table in a rotating direction,

wherein the vibrating mechanism is arranged so as to extend radially from its inner end connected to the base side to its outer end connected to the vibrating table side, and

a connecting component is interposed between the vibrating mechanism and the base, the connecting component being connected to the vibrating mechanism, and having a base side connection part extending radially outward parallel with the vibrating mechanism and connected to the base.