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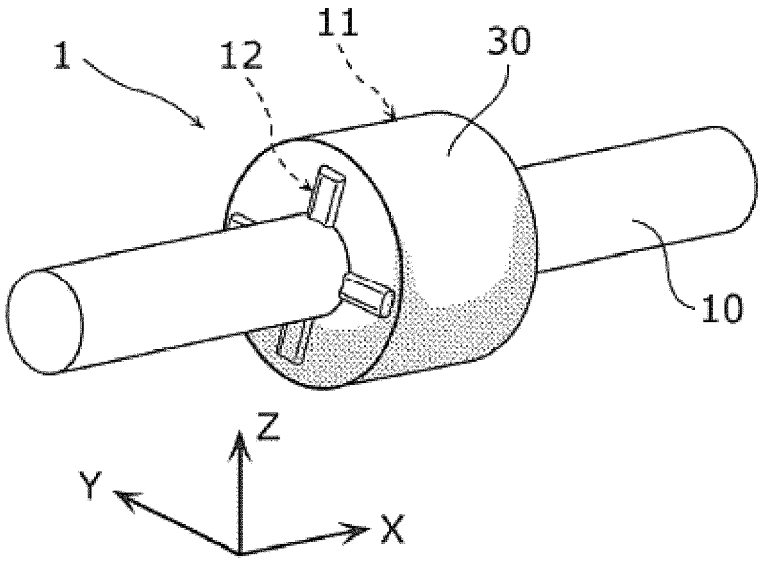
(54) Conveyance roller and printing device

(57) A conveyance roller (1; 2) comprises a shaft body (10; 20) comprising a cylindrical roller base body (11; 21) having a center axis coinciding with a rotational axis of the shaft body (10; 20), and an elastic member (30) covering the roller base body (11; 21). The roller base body (11; 21) may comprise at least one protrusion (12) covered by the elastic member (30) and provided on at least one lateral surface of the roller base body (11), and/or at least one through-hole (22) that penetrates the roller base body (21) in a direction parallel to a diameter of the roller base body (21) and into which the elastic member (30) is inserted.

[FIG. 6]



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Description

[Technical Field]

[0001] The present invention relates generally to a conveyance roller and a printing device comprising the conveyance roller. The conveyance roller may be for example intended to convey a recording medium.

[Background Technology]

[0002] In conventional printing devices, for example, a conveyance roller is configured by forming an elastic member enclosing a roller base body. The roller base body has a cylindrical shape and is mounted on a shaft body. Typically, the conveyance roller includes a rotation stopper on the shaft body of the conveyance roller.

[0003] For example, in the section "Background Technology" of Patent Document 1, such a conveyance roller having a rotation stopper is described.

[0004] FIG. 20, for example, shows a perspective view of a shaft body of the conveyance roller described in the section of "Background Technology" of Patent Document 1.

[0005] The shaft body 80 illustrated in FIG. 20 has a rotational axis parallel to an x-axis and has a protrusion 82 that extends in an x-axis direction on a circumferential surface of a roller base body 81.

[0006] FIG. 21 shows a perspective view of an example of a conveyance roller 8 formed with an elastic member 91 that covers the roller base body 81. The elastic member 91 is formed by outsert molding, for example, so as to cover the roller base body 81. The roller base body 81 covered by the elastic member 91 functions as a roller, after the elastic member 91 is solidified by cooling. Moreover, the protrusion 82, by fitting with the elastic member 91, functions as a rotation stopper on the shaft body 80, thus stopping rotation of the elastic member 91.

[0007] However, as pointed out in Patent Document 1, the elastic member 91, when cooled, contracts unevenly in a region of the protrusion with respect to a region other than the protrusion of the circumferential surface of the roller base body 81. This is due to a difference in thickness of the elastic member 91. As a result, a shape of the protrusion 82 is transferred slightly on a top surface of the elastic member 91, thus generating a protuberance 92. Further, the circularity of a cross section parallel to a y-z plane of the elastic member 91 (referred to hereinafter as a cross section) is impaired, thereby reducing conveyance precision.

[0008] Patent Document 1 discloses a structure for a conveyance roller used together with a driven roller to improve conveyance precision.

[0009] FIG. 22 shows a perspective view of an example of the shaft body of the conveyance roller disclosed in Patent Document 1.

[0010] On a shaft body 83 illustrated in FIG. 22, a groove 86 is cut along a circumference of a roller base body 85 in a position that does not oppose a driven roller 84. By forming the elastic member on an outer peripheral surface of the roller base body 85, one or more steps 87, resulting from not cutting the groove 86 all the way, function as a rotation stopper on the shaft body 83, thus stopping rotation of the elastic member.

[0011] There is no protrusion in a region of a circumferential surface of the roller base body 85 that opposes the driven roller 84, and the elastic member contracts evenly in this region. As a result, the elastic member is formed into a substantially perfectly circular shape the cross section of which at a circumference that contacts the driven roller 84 is acceptable.

[Related Art Documents]

[Patent Documents]

[0012] [Patent Document 1] Japanese Patent No. 4,438,954

[0013] However, reliably stopping the rotation of the elastic member relative to roller and providing a substantially perfectly circular cross section may be difficult to accomplish with the structure taught by Patent Document 1. For example, when a deeper groove is cut to obtain a greater rotation stopping effect by means of the rotation stopper, contraction of the elastic member near the groove becomes larger, and the cross section of the roller will eventually deviate from the perfectly circular shape.

[Summary of the Invention]

[0014] One or more embodiments of the present invention relate to a conveyance roller that can, for example, reliably stopping the rotation of an elastic member relative to the roller and provide a substantially perfectly circular cross section.

[0015] In one aspect, a conveyance roller according to one or more embodiments of the present invention may comprise a shaft body having a rotational axis, a roller base body, which may be of cylindrical shape, and an elastic member covering the roller base body. The shaft body may comprise the roller base body. The roller base body has a center axis coinciding with the rotational axis of the shaft body. The roller base body may comprise at least one protrusion provided on at least one lateral surface other than a circumferential surface of the roller base body and covered by the elastic member. Alternatively, instead of the at least one protrusion, according to one or more embodiments of the present invention, the roller base body may comprise one or more through-holes, into which the elastic member may be inserted. The one or more through-holes may penetrate the roller base body, for example in a direction parallel to a diameter thereof. According to one or more embodiments of the present invention, the roller base body may comprise one or more radially extending through-holes, into which the elastic member may be inserted.

[0016] According one or more embodiments of the conveyance roller, the at least one protrusion is described as alternative to the at least one through-hole. However, according to one or more embodiments of the conveyance roller, the roller base body may comprise both at least one protrusion provided on at least one lateral surface other than a circumferential surface of the roller base body and covered by the elastic member, and at least one through-hole penetrating the roller base body in a direction parallel to a diameter thereof and into which the elastic member is inserted.

[0017] According to one or more embodiments of the conveyance roller, an effect of stopping the rotation of the elastic member relative to the roller can be obtained by the at least one protrusion and/or the at least one through-hole.

[0018] According to one or more embodiments, because the at least one protrusion may be disposed on the lateral surface other than the circumferential surface of the roller base body, the at least one protrusion may have various shapes and heights to stop rotation without impairing the circular shape of a cross section of the roller. According to one or more embodiments, more than one such protrusion may be provided on the lateral surface other than the circumferential surface of the roller base body.

[0019] According to one or more embodiments, when the roller base body is provided with at least one through-hole, because a thickness of a thick portion decreases, shape irregularities in the roller base body due to contraction of the elastic member, which may for example be made of resin, can be suppressed. Since the roller base body covered by the elastic member is formed into a more accurate true cylindrical shape, the cross section of the roller at the roller base body covered by the elastic member is formed into a more accurate true circular shape.

[0020] In this manner, for example, a conveyance roller capable of providing both the effect of stopping rotation of the elastic member relative to the roller and of having a true circular-shaped cross section can be obtained.

[0021] According to one or more embodiments, the roller base body may be produced separate from the shaft body and, subsequently, the roller base body and the shaft body may be mechanically connected to each other. Alternatively, the shaft body and the roller base body may be formed in one piece.

[0022] According to one or more embodiments, at least one protrusion may be provided on at least one lateral side of the roller base body. According to one or more embodiments, the roller base body may comprise at least two protrusions, namely a first protrusion, for example provided on a first lateral surface of the roller base body, and a second protrusion, for example provided on a second lateral surface of the roller base body. The first and second protrusions are covered by the elastic member.

[0023] According to one or more embodiments, due to the one or more protrusions that may be provided on each of the lateral sides of the roller base body, a greater effect of stopping the rotation of the elastic member may be obtained.

[0024] According to one or more embodiments, the roller base body may comprise a plurality of through-holes. The plurality of through-holes may penetrate the roller base body in a direction parallel to a diameter of the roller base body and into which the elastic member may be inserted. According to one or more embodiments, a thickness between adjacent through-holes among the plurality of through-holes, a thickness between at least one of the plurality of through-holes and the circumferential surface closest to the at least one of the plurality of through-holes, and a thickness between the at least one of the plurality of through-holes and the lateral surface may be substantially equal. For example, these thicknesses may be substantially equal when they differ, at the most, by 20%, 15%, 10%, 5% or 1% from each other.

[0025] According to one or more embodiments, because the thicknesses of the roller base body may be constant, unevenness of a contraction amount of the elastic member may be further reduced, and irregularities in the shape of the roller base body due to contraction of the elastic member may be more effectively suppressed.

[0026] According to one or more embodiments, a diameter of the at least one through-hole may be less than or equal to a thickness of the elastic member at the circumferential surface of the roller base body.

[0027] According to one or more embodiments, no dent or irregularity arises on a top surface of the elastic member positioned above the at least one through-hole by the elastic member contracting toward an inside of the at least one through-hole.

[0028] According to one or more embodiments, the at least one through-hole may be partially or completely filled with the elastic member.

[0029] According to one or more embodiments, because the entirety of the through-hole may be filled with the elastic member, a greater effect of stopping rotation may be obtained.

[0030] According to one or more embodiments, the elastic member may be outsert molded on the roller base body.

[0031] According to one or more embodiments, the conveyance roller may comprise the elastic member outsert molded on the roller base body.

[0032] According to one or more embodiments, the shaft body and the roller base body may be made of the same material, such as for example a resin, or may be made of different materials. According to one or more embodiments, the elastic member may be made of an elastic resin.

[0033] According to one or more embodiments, the shaft body, the roller base body and the elastic member may each be made of a suitable material as known by one of ordinary skill in the art. The shaft body, the roller base body and the elastic member body may be also made of different materials.

[0034] According to one or more embodiments, a printing device may comprise a conveyance roller according to any of the embodiments defined above. The conveyance roller may comprise a shaft body having a rotational axis, a cylindrical roller base body, the center axis of which may coincide with the rotational axis of the shaft body, and an elastic member that may cover the roller base body. The roller base body may comprise at least one protrusion that is covered by the elastic member and that may be provided on one lateral surface of the roller base body that is not a circumferential surface of the roller base body and/or at least one through-hole that may penetrate the roller base body, for example in a direction parallel to a diameter of the roller base body and into which the elastic member may be inserted.

[0035] The conveyance roller of the present invention is capable of providing both the effect of stopping the rotation of the elastic member relative to the roller and of having a true circular-shaped cross section.

[Brief Description of Drawings]

[0036] FIG. 1 is a perspective view illustrating an example of a printing device according to one or more embodiments.

FIG. 2 is a perspective view illustrating an example of a conveyance mechanism of the printing device according to one or more embodiments.

FIG. 3 is a perspective view illustrating an example of a shaft body of a conveyance roller according to one or more embodiments.

FIG. 4 is a front view of the example of shaft body of Fig. 3.

FIG. 5 is a side view of the example of shaft body of Fig. 3.

FIG. 6 is a perspective view illustrating an example of a conveyance roller comprising the shaft body of Fig. 3.

FIG. 7A is a side view illustrating an example of a shaft body of a conveyance roller according to one or more embodiments.

FIG. 7B is a side view illustrating an example of a shaft body of a conveyance roller according to one or more embodiments.

FIG. 7C is a side view illustrating an example of a shaft body of a conveyance roller according to one or more embodiments.

FIG. 8 is a perspective view illustrating an example of a shaft body of a conveyance roller according to one or more embodiments.

FIG. 9 is a side view of the example of shaft body of Fig. 8.

FIG. 10 is a perspective view illustrating an example of a shaft body of a conveyance roller according to one or more embodiments.

FIG. 11 is a side view of the example of shaft body of Fig. 10.

FIG. 12 is a perspective view illustrating an example of a shaft body of a conveyance roller according to one or more embodiments.

FIG. 13 is a cross-sectional view of the example of shaft body of Fig. 12.

FIG. 14 is a perspective view illustrating an example of a conveyance roller comprising the shaft body of Fig. 12.

FIG. 15 is a perspective view illustrating an example of a shaft body of a conveyance roller according to one or more embodiments.

FIG. 16 is a perspective view illustrating an example of a shaft body of a conveyance roller according to one or more embodiments.

FIG. 17 is a perspective view illustrating an example of a shaft body of a conveyance roller according to one or more embodiments.

FIG. 18 is a perspective view illustrating an example of a shaft body of a conveyance roller according to one or more embodiments.

FIG. 19 is a perspective view illustrating an example of a shaft body of a conveyance roller according to one or more embodiments.

FIG. 20 is a perspective view illustrating an example of a shaft body of a conventional conveyance roller.

FIG. 21 is a perspective view illustrating an example of a conventional conveyance roller comprising the shaft body of FIG. 20.

FIG. 22 is a perspective view illustrating an example of a shaft body of a conventional conveyance roller.

[Detailed Description of Embodiments]

[0037] Embodiments of the present invention will be described in detail below with reference to the drawings. Each embodiment that will be described below illustrates an example of the present invention and is provided for mere illustrative purposes. However, these embodiments can be combined with each other and are not intended to be limited to the specific combinations of features disclosed herein. Also, numerical values, shapes, materials, components, disposition positions and connection modes of the components, and the like are examples and are not intended to limit the present invention.

[0038] A conveyance roller according to one or more embodiments of the present invention may be a conveyance roller comprising: a shaft body comprising a cylindrical roller base body having a center axis coinciding with a rotational axis of the shaft body, and an elastic member covering the roller base body. According to one or more embodiments, the rotation of the elastic member relative the roller base body may be stopped, while maintaining a substantially perfect circular shape of a cross section of the roller. The conveyance roller may be used, for example, for conveying a recording medium, for example in printing devices.

[0039] First, a printing device comprising a conveyance roller according to one or more embodiments of the

present invention will be described, and afterward the conveyance roller will be described in detail.

[0040] FIG. 1 is a perspective view showing an example of a printing device comprising a conveyance roller according to one or more embodiments of the present invention.

[0041] A printing device 100 illustrated in FIG. 1 comprises an enclosure body 101. The enclosure body 101 may comprise a feed and discharge tray 102 for feeding the recording medium before printing and for receiving the recording medium after printing, respectively. The recording medium may be, for example, normal paper, photographic paper, a plastic film, or any other printable medium. A front surface of the enclosure body 101 may further comprise a control unit or controller 103 for performing various types of operations selected by a user.

[0042] FIG. 2 is a perspective view showing an example of a structure of a main portion of the printing device 100. In FIG. 2, a conveyance mechanism 200, located inside the enclosure body 101, and the feed and discharge paper tray 102 are shown. The conveyance mechanism 200 may feed, transfer, and discharge the recording medium.

[0043] The conveyance mechanism 200 shown in FIG. 2 may comprise a frame 201. The frame 201 may comprise, along with the printing mechanism (not shown), a pick roller 202 for pulling in the printing medium from the feed and discharge paper tray 102 before printing; a feed roller 203 for sending the recording medium to a position where it will be printed; a discharge roller 204 for discharging the recording medium after printing to the feed and discharge paper tray 102; and a motor 205 that drives the pick roller 202, the feed roller 203, and the discharge roller 204.

[0044] The conveyance roller according to one or more embodiments of the present invention can be used, for example, as a discharge roller of a printing device, for example the discharge roller 204 of the exemplary printing device 100. The use of the conveyance roller according to one or more embodiments of the present invention, however, is not limited to a discharge roller. According to one or more embodiments of the present invention, the conveyance roller may also be used as a pick roller or as a feed roller, for example the pick roller 202 or the feed roller 203 described above.

[0045] The conveyance roller according to one or more embodiments of the present invention will be described in detail below.

[0046] FIG. 3 is a perspective view showing an example of a shaft body and a roller base body of the conveyance roller according to one or more embodiments of the present invention.

[0047] A shaft body 10 shown in FIG. 3 has a rotational axis parallel to an x-axis. The shaft body 10 of Fig. 3 has a circular cross section. However, other cross sections are possible. A roller base body 11 of cylindrical shape has a center or cylinder axis coinciding with the rotational axis of the shaft body 10. One or more protrusions 12 are provided on at least one lateral surface of the cylindrical roller base body 11. The lateral surface is distinct from a circumferential surface. For example, the lateral surface of the roller base body 11 corresponds to a bottom surface of the cylindrical roller base body 11 and is represented by a surface parallel to a y-z plane in the example of FIG. 3. According to one or more embodiments of the present invention, the shaft body 10 and the roller base body 11 may be made of a resin or other suitable materials and may be formed by injection molding or other suitable manufacturing methods. However, the shaft body 10 and the roller base body 11 may be made of different materials.

[0048] FIG. 4 is a front view showing the shaft body 10 in a y-direction. As illustrated in FIG. 4, at least one or more protrusions 12 may be provided on both lateral surfaces of the roller base body 11.

[0049] FIG. 5 is a side view showing the shaft body 10 in an x-direction. As illustrated in FIG. 5, on the lateral surface of the roller base body 11, four protrusions 12 of a rectangular parallelepiped shape extending in a radial direction and orthogonal to each other may be provided.

[0050] FIG. 6 is a perspective view showing an example of the conveyance roller according to one or more embodiments of the present invention.

[0051] On a conveyance roller 1 illustrated in FIG. 6, an elastic member 30 that covers the roller base body 11 may be formed. The elastic member 30 may be made of an elastic resin and formed on a periphery of the roller base body 11 by outsert molding, but other material and/or manufacturing method may be used. The roller base body 11 covered by the elastic member 30 may function as a roller, after the elastic member 30 is solidified by cooling. Moreover, the protrusion 12, by fitting with the solidified elastic member 30, may function as a rotation stopper provided on the shaft body 10, thus stopping rotation of the elastic member 30.

[0052] According to one or more embodiments, because there is no unevenness on the circumferential surface of the roller base body 11, the elastic member 30 has an even thickness on the circumferential surface of the roller base body 11 and contracts evenly. As a result, a cross section of the roller at the roller base body 11 covered by the elastic member 30 can have a substantially perfectly circular shape.

[0053] Furthermore, because the protrusion 12may be disposed on the lateral surface of the roller base body 11, any number of protrusions 12 of a shape and height suitable to stop rotation may be provided without impairing the circular shape of the cross section of the roller, thus enabling the conveyance roller to convey an object such as paper with high precision.

[0054] As a result, the conveyance roller according to one or more embodiments can convey an object such as paper with high precision.

[0055] An example where four protrusions 12 of a cubic shape are provided on one lateral surface of the roller base body 11 is illustrated above, but the number and

the shape of the protrusions shall not be limited to this example. Several other examples where the number and the shape of the protrusions differ will be described below.

[0056] For example, as shown in each side view of FIG. 7A, FIG. 7B, and FIG. 7C, one, two, or three protrusions 12 may be provided on the lateral surface of the roller base body 11.

[0057] Furthermore, for example, as shown in the perspective view of FIG. 8 and the side view of FIG. 9, a protrusion 13 may be shaped as a semicircular column of a quarter sphere of the same diameter.

[0058] Furthermore, for example, as shown in the perspective view of FIG. 10 and the side view of FIG. 11, two of the four protrusions 12, illustrated in FIG. 5, may be replaced with protrusions 14 of a shape comprising a plurality of branches extending in a direction orthogonal to a diameter.

[0059] A height from the lateral surface of the roller base body 11 of these protrusions is not limited, but as an example, these protrusions may be provided at a height greater than or equal to a thickness of the elastic member 30 on the lateral surface of the roller base body 11. A higher protrusion may be provided for enhancing the effect of stopping rotation without adversely affecting the substantially perfectly circular shape of the cross section of the roller.

[0060] Furthermore, a root or base of the at least one protrusion may be greater than or equal to a height commensurate with the advantageous effect of stopping rotation and covered by the elastic member 30. The at least one protrusion may not be covered by the elastic member 30 as long as sufficient stopping of rotation is provided. In other words, only a portion of the at least one protrusion may be covered by the elastic member 30. For example, an apex of the at least one protrusion may not be covered by the elastic member.

[0061] The conveyance roller according to one or more embodiments of the present invention may also comprise one or more through-holes instead of the one or more protrusions to provide both stopping of rotation of the elastic member relative the roller base body and a substantially circular-shaped cross section of the roller.

[0062] When one or more through-holes are defined in the roller base body, as for example in the exemplary embodiments described below, the conveyance roller 1 according to one or more embodiments may have a regular shape due to the reduction of the irregularities in the shape that may arise due to contraction of the resin in the roller base body 11 having the comparatively large thickness, and may comprise an accurately formed roller base body 11 having a substantially perfectly cylindrical shape.

[0063] Next, a conveyance roller in accordance with one or more embodiments of the present invention will be described.

[0064] FIG. 12 is a perspective view showing an example of a shaft body of the conveyance roller according to one or more embodiments of the present invention.

[0065] A conveyance roller may comprise a shaft body 20 as illustrated in FIG. 12 having a rotational axis parallel to the x-axis and a roller base body 21 of a cylindrical shape the center or cylinder axis of which coincides with the rotational axis of the shaft body 20. The shaft body 20 of Fig. 12 has a cross-shaped cross section. However, other cross sections are possible. The roller base body 21 may comprise one or more through-holes 22, that for example penetrate the roller base body 21 in a direction parallel to a diameter thereof. However, the one or more through-holes 22 may be defined in a radial direction in the roller base body 21. Independently from the direction, number and form of the through-holes, the shaft body 20 and the roller base body 21 may be formed in one piece. For example, the shaft body 20 and the roller base body 21 may be made of a resin, for example by injection molding, but other suitable materials and/or manufacturing methods may be used. The shaft body 20 and the roller base body 21 may also be made of a first and a second material, respectively.

[0066] Providing at least one through-hole 22 in the roller base body 21 can reduce the thickness of the roller base body 21, thereby preventing irregularities in the shape of the roller base body 21, which are caused in the prior art rollers by uneven contraction of the resin, without requiring adjustment of the molding parameters.

[0067] FIG. 13 is a cross-sectional view of the AA cross section of the roller base body 21 illustrated in FIG. 12 viewed in the direction of the arrows.

[0068] In FIG. 13, a thicknesses of a thick portion of the roller base body 21, a thickness a between adjacent through-holes 22, a thickness b between each through-hole 22 and a circumferential surface of the roller base body 21, and a thickness c between each through-hole 22 and a lateral surface of the roller base body 21 are illustrated.

[0069] For example, the through-holes 22 may be provided such that these thicknesses a, b, c are substantially equal to each other. By doing so, because the material distribution of the roller base body 21 becomes uniform, unevenness due to a contraction of the resin can be further reduced, and any irregularity of the shape of the roller base body 21 due to a contraction of the resin can be more effectively suppressed.

[0070] FIG. 14 is a perspective view illustrating an example of a conveyance roller according to one or more embodiments of the present invention, for example a conveyance roller comprising the shaft body 20 and the roller base body 21 of FIG. 12. However, further examples of conveyance rollers having the appearance of the conveyance roller of Fig. 14 may comprise different through-holes in terms of number, shape and/or direction and/or may have different thicknesses a, b and c.

[0071] According to the exemplary conveyance roller 2 illustrated in FIG. 14, the elastic member 30 may cover or enclose the roller base body 21 and may enter the at least one through-hole 22. The elastic member 30 may

be made by outsert molding the elastic member on the roller base body 21 and inside the through hole 22, or by other suitable manufacturing methods. The roller base body 21 covered by the elastic member 30 may function as a roller, after the elastic member 30 is solidified by cooling. Moreover, by fitting the solidified elastic member 30 in the at least one through-hole 22, rotation of the elastic member 30 relative to the shaft body 20 may be stopped.

[0072] To stop rotation between the elastic member 30 and the roller base body 21, the elastic member 30 may enter the at least one through-hole 22 to a limited depth only, or may completely fill the at least one through-hole 22.

[0073] According to one or more embodiments, the roller base body 21 in which the at least one through-hole 22 is defined, when covered by the elastic member 30, has a more accurate truly cylindrical shape. As a result, the cross section of the roller at the roller base body 21 covered or enclosed by the elastic member 30 can be formed into a substantially perfectly circular shape. Moreover, the elastic member 30 at least partially extending into the at least one through-hole 22 can stop rotation.

[0074] To avoid a dent or any other irregularity in the surface of the elastic member 30 in the area where the elastic member 30 extends into the at least one through-hole 22, the at least one through-hole 22 may have a small diameter. For example, the diameter of the at least one through-hole 22 may be smaller than the thickness of the elastic member 30 at the circumferential surface of the roller base body 21.

[0075] However, even when the diameter of the at least one through-hole 22 is small, by completely filling the at least one through-hole 22 with the elastic member 30, and fitting the elastic member 30 in the entirety of the at least one through-hole 22, improved rotation stopping may be obtained. Moreover, even when the diameter of the at least one through-hole 22 is small, by providing multiple through-holes 22, improved rotation stopping may be obtained, thus enabling the conveyance roller to convey an object such as paper with high precision.

[0076] As a result, the conveyance roller according to one or more embodiments can convey the object such as paper with high precision.

[0077] Although FIGs. 12 and 13 show conveyance rollers with two through-holes 22 of cylindrical shape in the roller base body 21, the number and shape of the through-holes shall not be not limited by this example. Several additional examples with differing numbers and shapes of through-holes will be described below. For example, only one through-hole may be provided in the roller base body. According to further examples, two, three, four or more through-holes may be provided in the roller base body. Independently from the number of through-holes, the one or more through-holes may have a hexagonal cross section, a pentagonal, a square cross section, a triangular cross section or a circular cross section may be provided.

[0078] For example, as shown in the perspective view of FIG. 15, two through-holes 23, for example of a hexagonal column shape, may be provided in the roller base body 21.

[0079] Furthermore, for example, as shown in the perspective view of FIG. 16, four through-holes 24, for example of a square column shape, with chamfered edges may be provided in the roller base body 21.

[0080] Furthermore, for example, as shown in the perspective view of FIG. 17, a single through-hole 25, for example of a square column shape, may be provided in the roller base body 21.

[0081] Furthermore, for example, as shown in the perspective view of FIG. 18, four through-holes 26, for example of a square column shape, may be provided in the roller base body 21.

[0082] Furthermore, for example, as shown in the perspective view of FIG. 19, three through-holes 27, for example of a square column shape, may be provided in the roller base body 21 at irregular orientations and dispositions.

[0083] The present invention is not limited to the above-described embodiments. To an extent that they do not depart from the scope of the claims, embodiments based on various modifications of the features of the exemplary embodiments described therein or on various combinations of the different embodiments described therein are also possible.

[0084] According to one or more embodiments of the present invention, the conveyance roller may be applied widely to various types of conveyance mechanisms for conveying an object, such as a conveyance mechanism of a printing medium in a printing device, for example.

Although the disclosure has been described with respect to only a limited number of embodiments, those skilled in the art, having benefit of this disclosure, will appreciate that various other embodiments may be devised without departing from the scope of the present invention. Accordingly, the scope of the invention should be limited only by the attached claims.

[Explanation of Reference Numbers]

[0085]

1, 2, 8 Conveyance roller
10, 20, 80, 83 Shaft body
11, 21, 81, 85 Roller base body
12 to 14, 82 Protrusion
22 to 27 Through-hole
30, 91 Elastic member
84 Driven roller
86 Groove
87 Step
92 Protuberance
100 Printing device
101 Enclosure body
102 Feed and discharge paper tray

103 Control unit (or controller)
200 Conveyance mechanism
201 Frame
202 Pick roller
203 Roller
204 Discharge roller
205 Motor

Claims

1. A conveyance roller (1; 2) comprising:

a shaft body (10; 20) comprising a cylindrical roller base body (11; 21) having a center axis coinciding with a rotational axis of the shaft body (10; 20); and
an elastic member (30) covering the roller base body (11; 21), wherein
the roller base body (11; 21) comprises:

at least one protrusion (12) covered by the elastic member (30) and provided on at least one lateral surface of the roller base body (11), and/or
at least one through-hole (22) that penetrates the roller base body (21) in a direction parallel to a diameter of the roller base body (21) and into which the elastic member (30) is inserted.

2. The conveyance roller (1) according to claim 1, wherein the roller base body (11) comprises a first and a second protrusion (12) covered by the elastic member (30) and provided on a first and on a second lateral surface of the roller base body (11), respectively.

3. The conveyance roller (2) according to claim 1 or claim 2, wherein the roller base body (21) comprises a plurality of through-holes (22).

4. The conveyance roller (2) according to claim 3, wherein a thickness (a) between adjacent through-holes (22) among the plurality of through-holes (22), a thickness (b) between at least one of the plurality of through-holes (22) and the circumferential surface closest to the at least one of the plurality of through-holes (22), and a thickness (c) between the at least one of the plurality of through-holes (22) and the lateral surface are substantially equal.

5. The conveyance roller (2) according to any of claims 1-4, wherein a diameter of the at least one through-hole (22) is less than or equal to a thickness of the elastic member (30) at the circumferential surface of the roller base body (21).

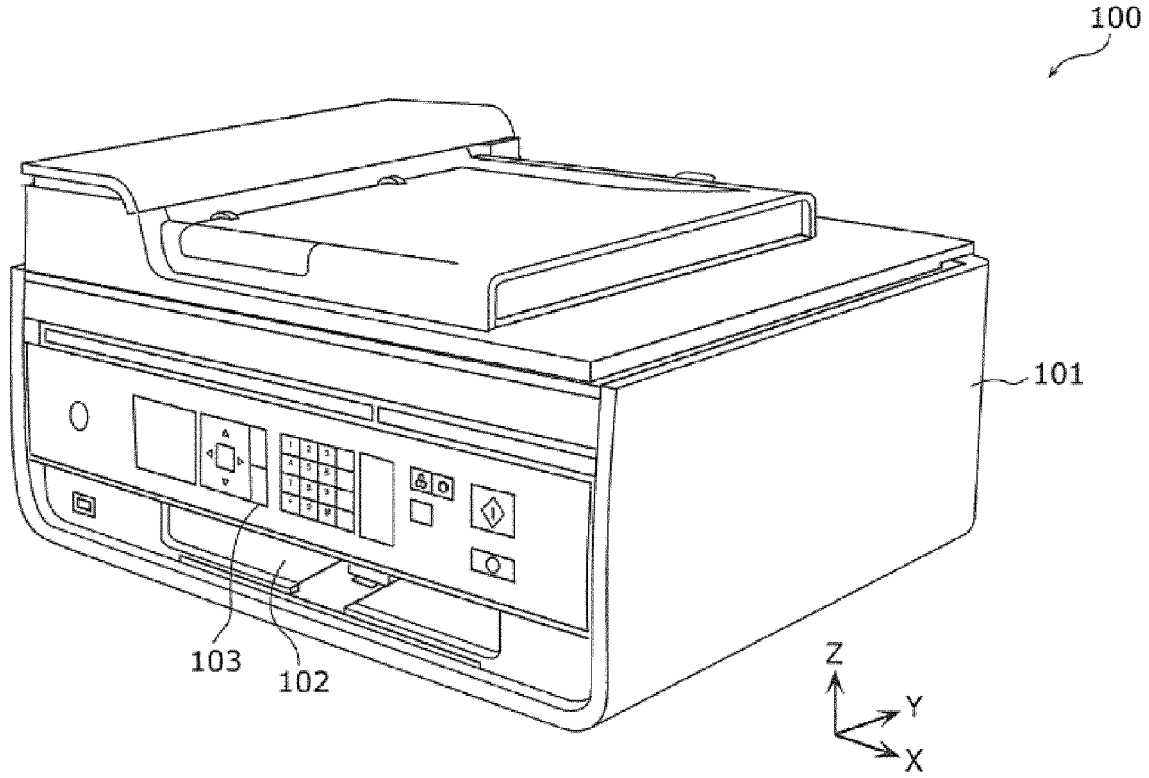
6. The conveyance roller (2) according to any of claims 1-5, wherein the at least one through-hole (22) is at least partially filled with the elastic member (30).

7. The conveyance roller (1, 2) according to any of claims 1-6, wherein the elastic member (30) is outsert molded on the roller base body (11; 21).

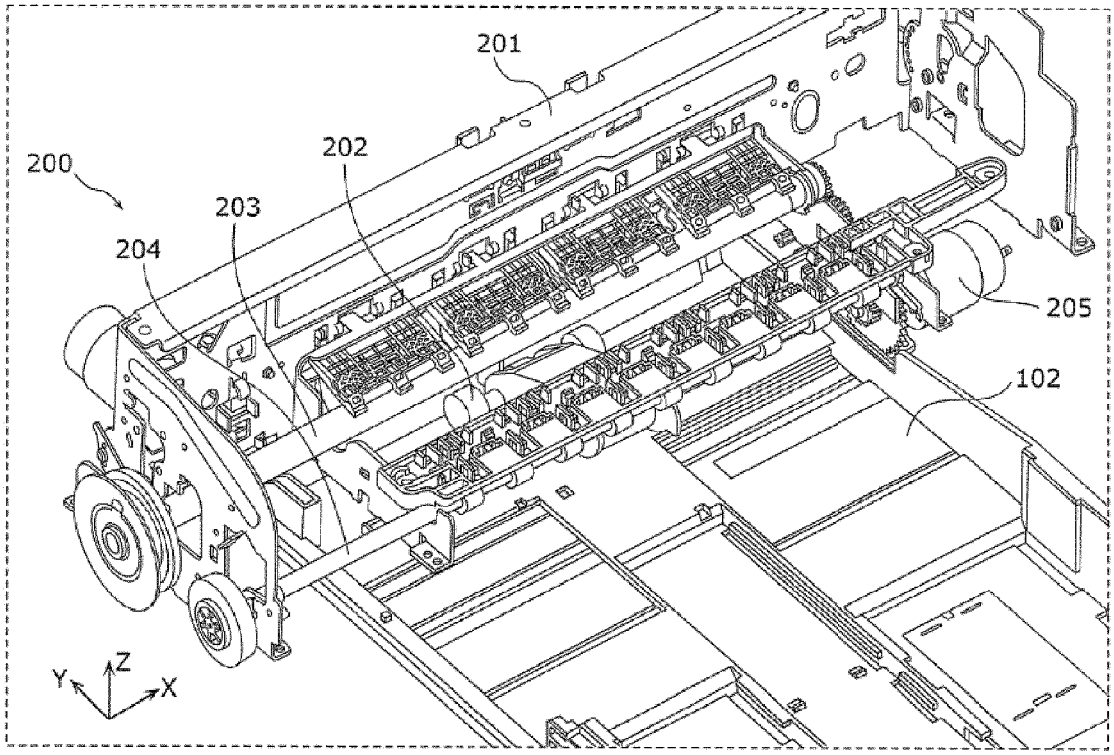
8. The conveyance roller (1, 2) according to any of claims 1-7, wherein the shaft body (10; 20) is made of a resin, and the elastic member (30) is made of an elastic resin.

9. A printing device (100) comprising the conveyance roller (1; 2) according to any of claims 1-8.

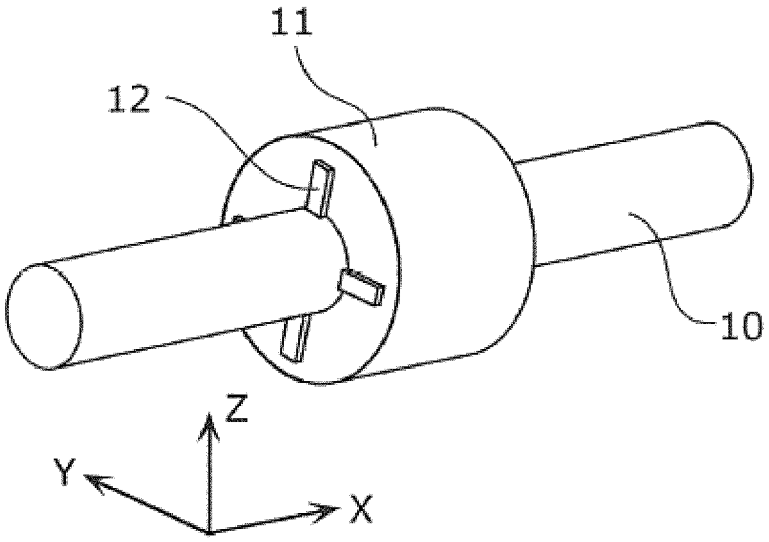
[FIG. 1]



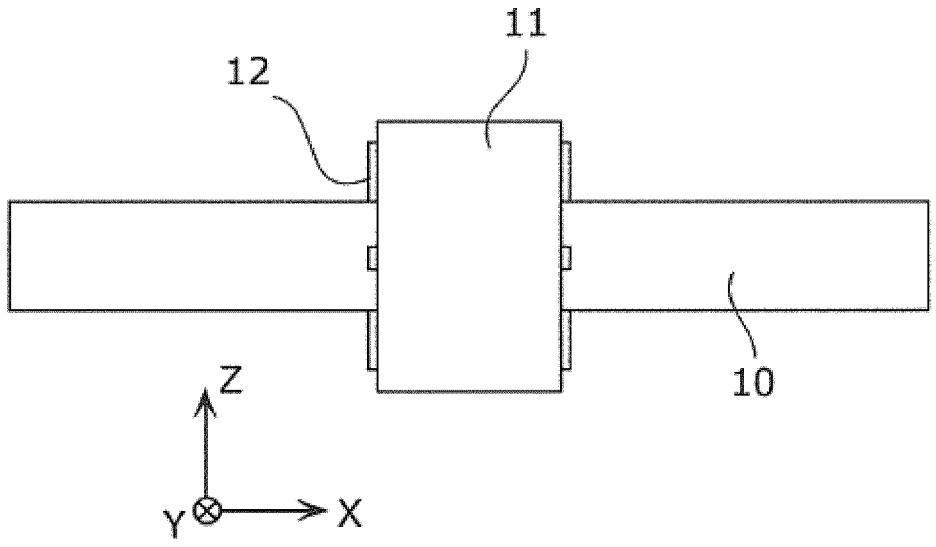
[FIG. 2]



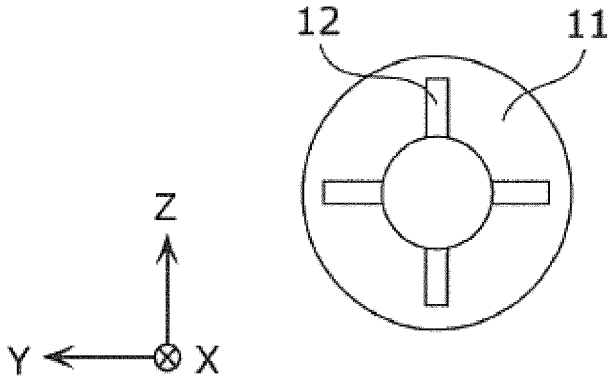
[FIG. 3]



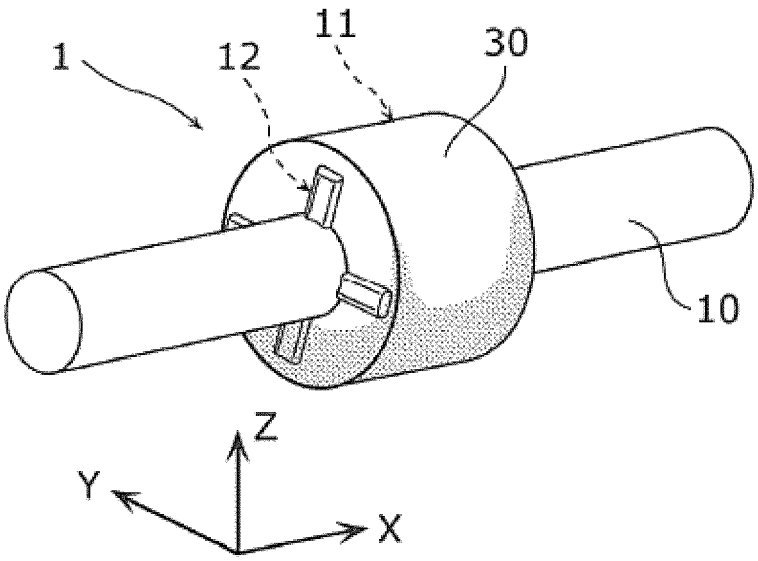
[FIG. 4]



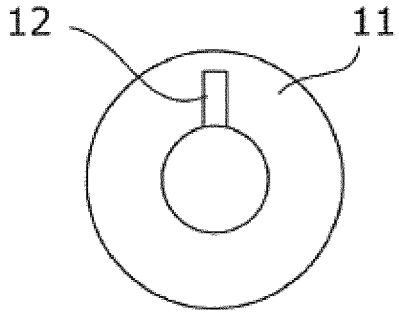
[FIG. 5]



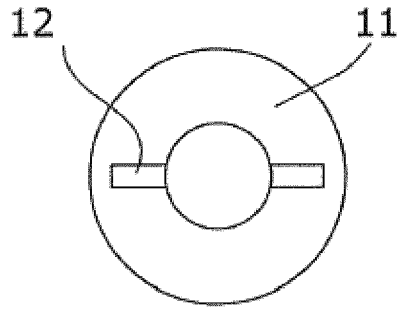
[FIG. 6]



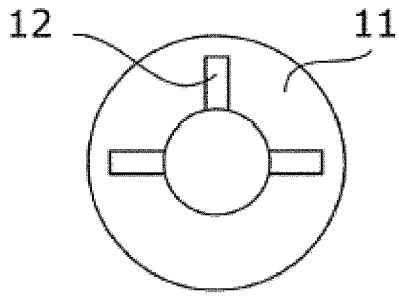
[FIG. 7A]



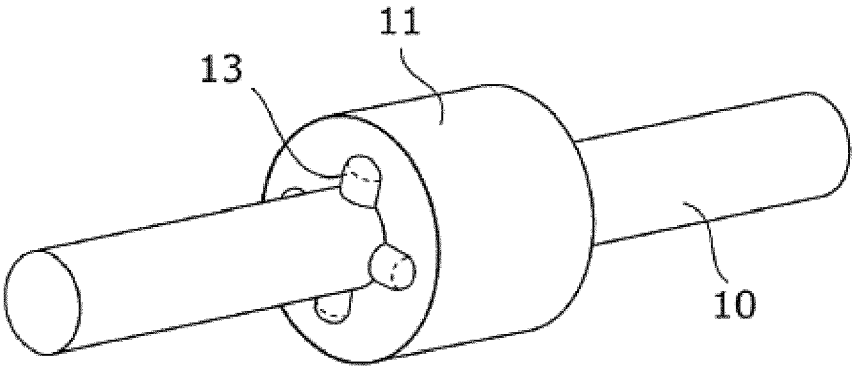
[FIG. 7B]



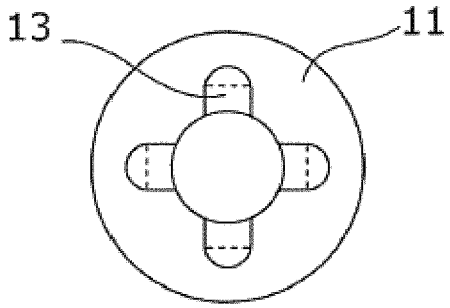
[FIG. 7C]



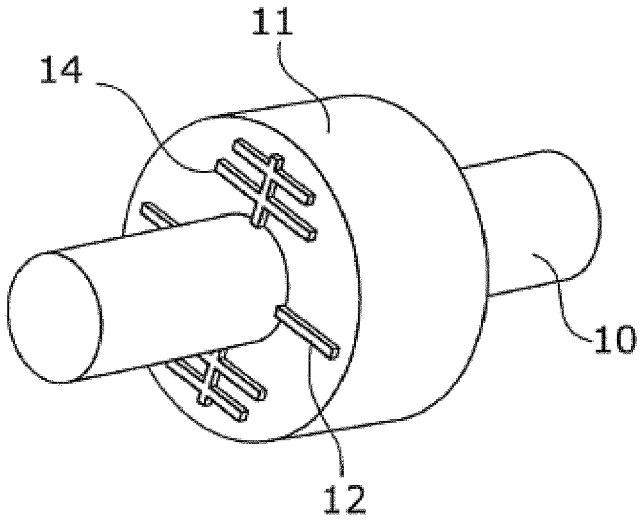
[FIG. 8]



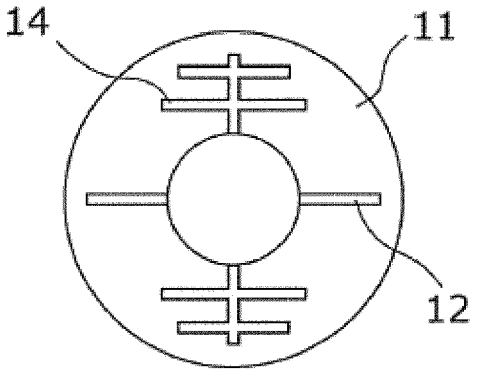
[FIG. 9]



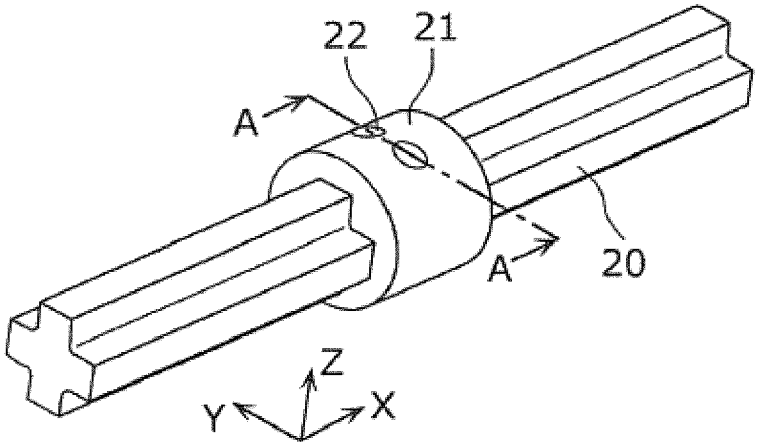
[FIG. 10]



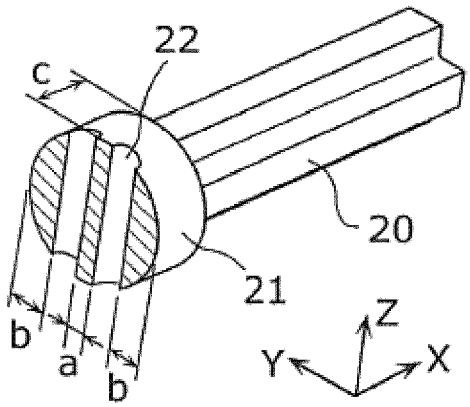
[FIG. 11]



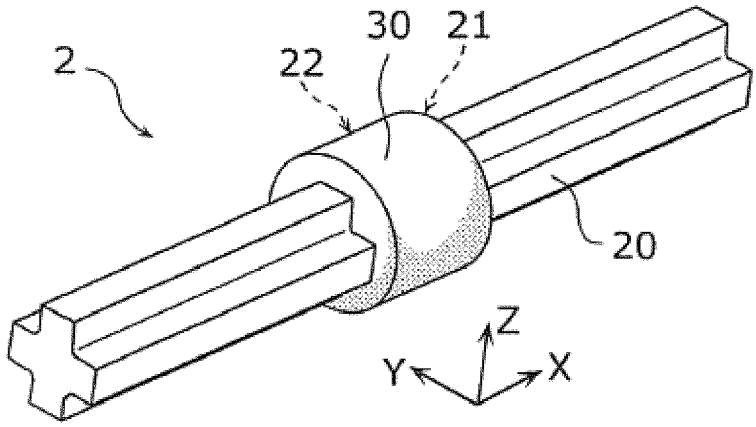
[FIG. 12]



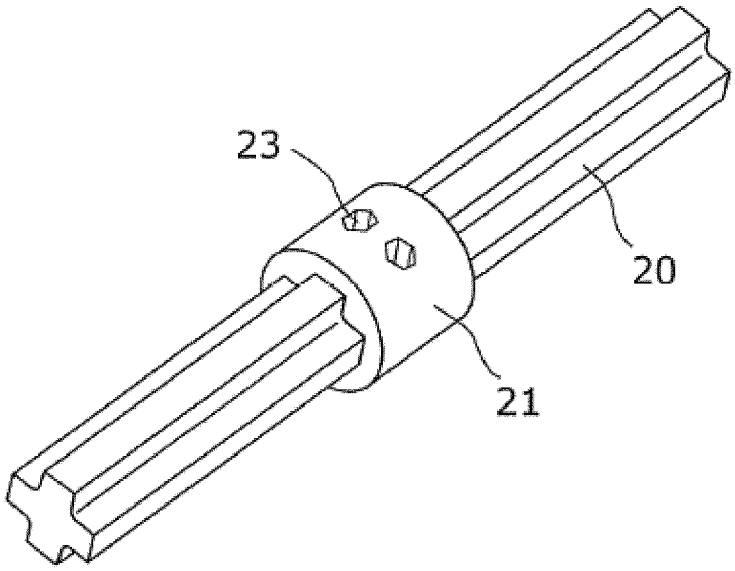
[FIG. 13]



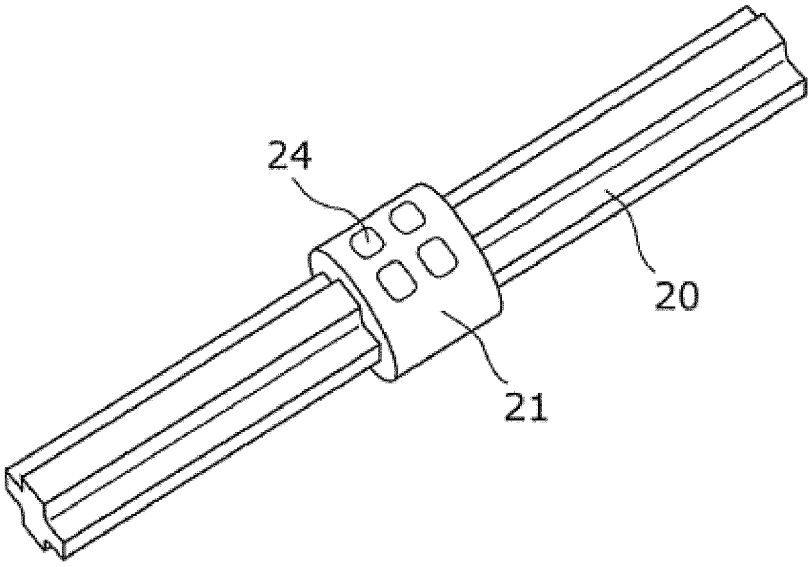
[FIG. 14]



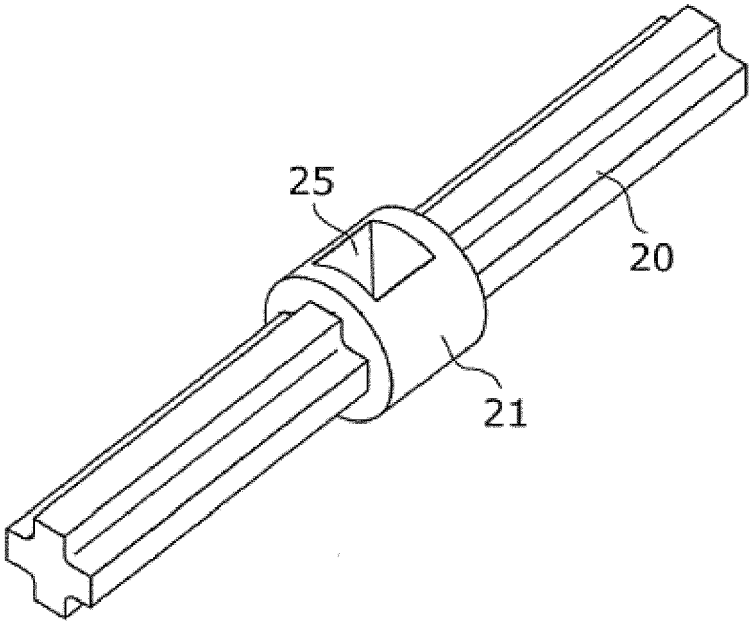
[FIG. 15]



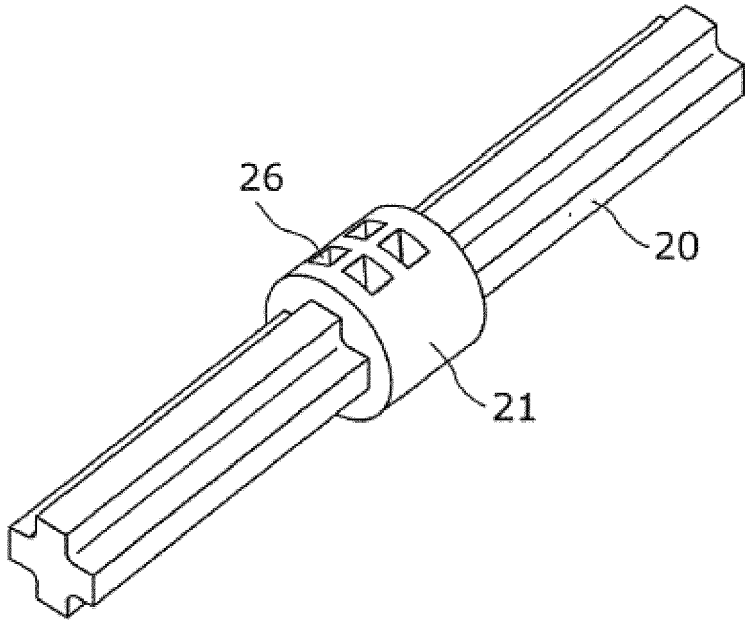
[FIG. 16]



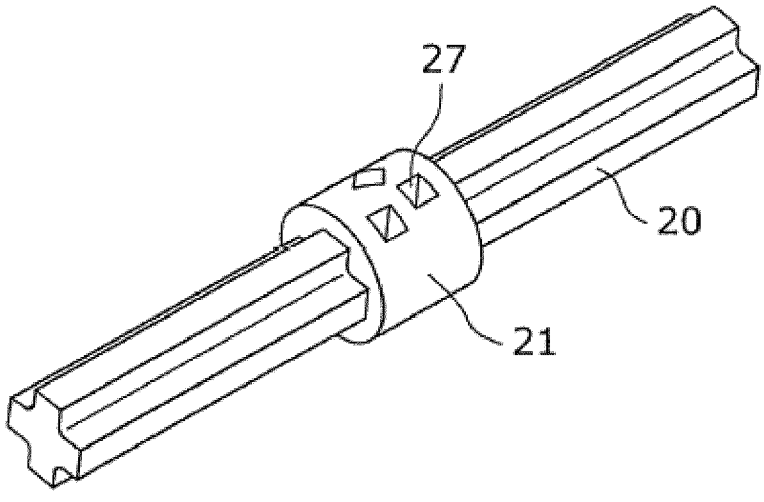
[FIG. 17]



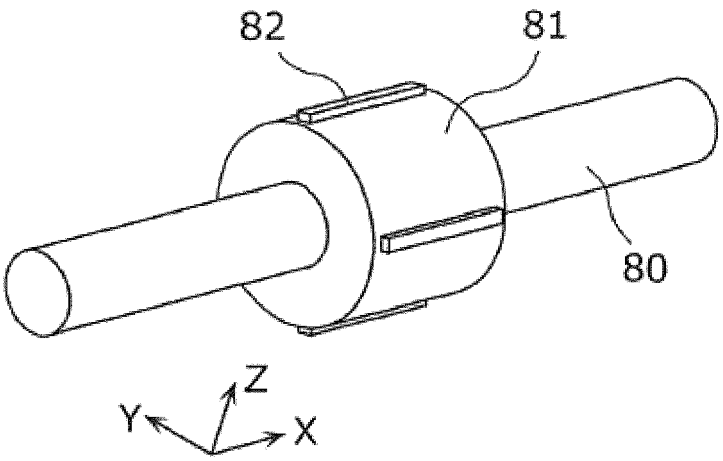
[FIG. 18]



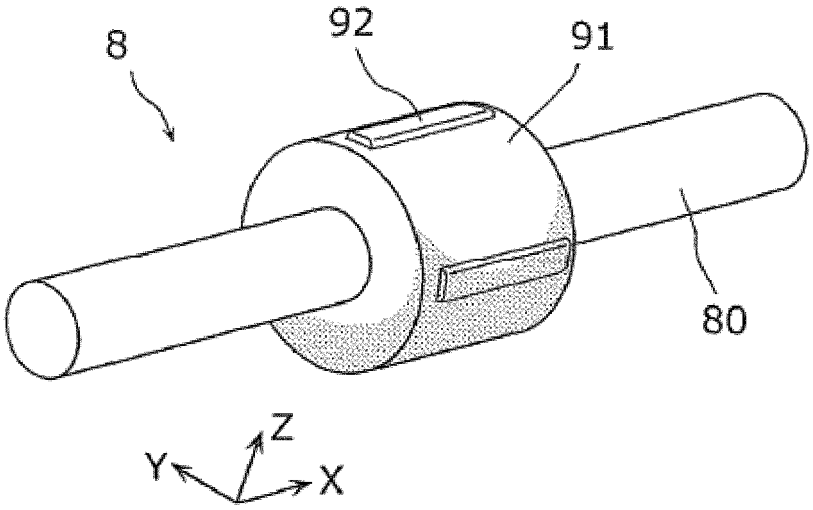
[FIG. 19]



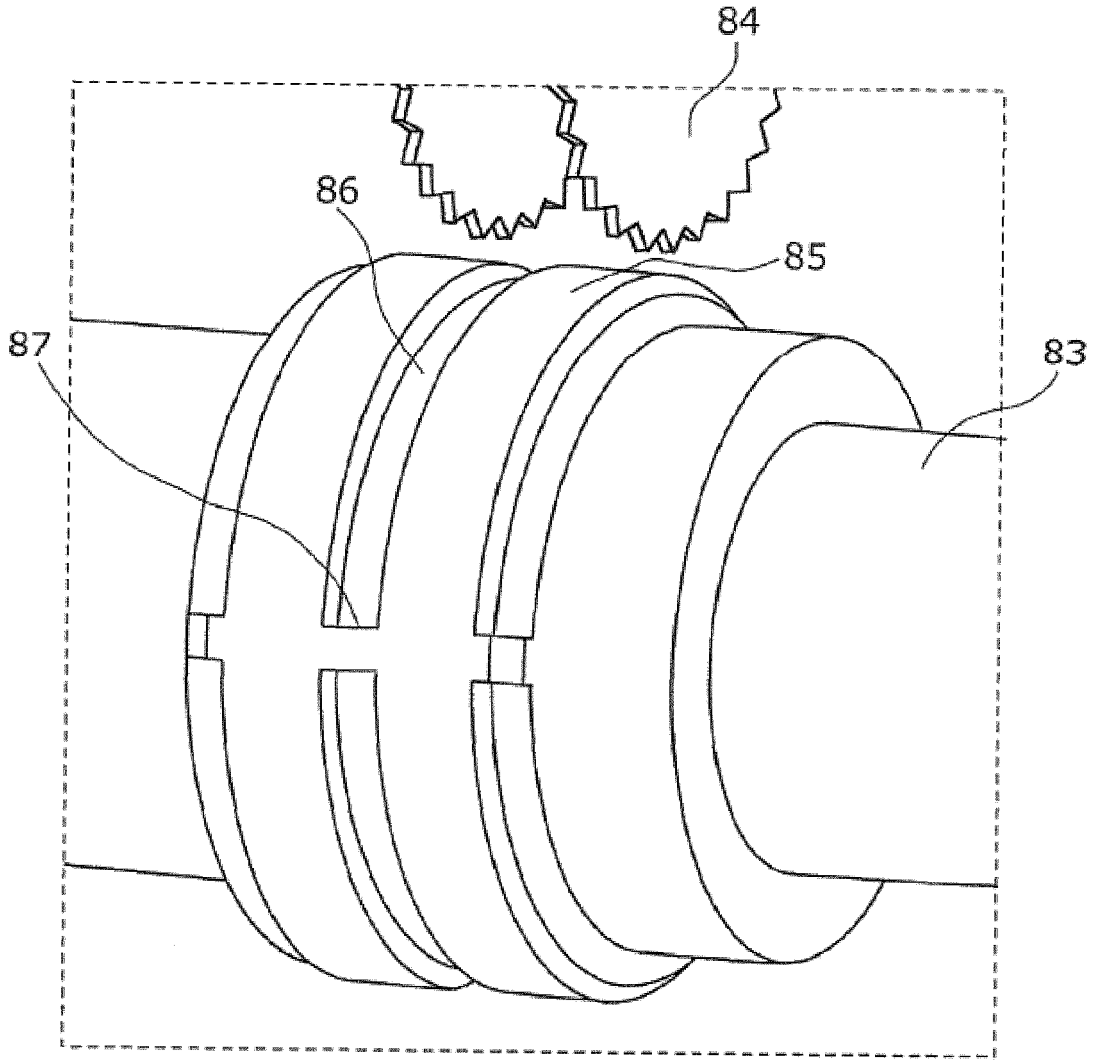
[FIG. 20] PRIOR ART



[FIG. 21] PRIOR ART



[FIG. 22] PRIOR ART



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EUROPEAN SEARCH REPORT

Application Number
EP 14 19 6810

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2013/217554 A1 (HANYU ATSUSHI [JP]) 22 August 2013 (2013-08-22) * paragraphs [0062] - [0067], [0076] - [0115]; figures 1-6 *	1,3-6,8, 9	INV. G03G15/00
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TECHNICAL FIELDS SEARCHED (IPC)
G03G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	20 May 2015	Kys, Walter

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20-05-2015

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