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(71) Applicant: **Synztec Co., Ltd.**
Shinagawa-ku
Tokyo 140-0013 (JP)

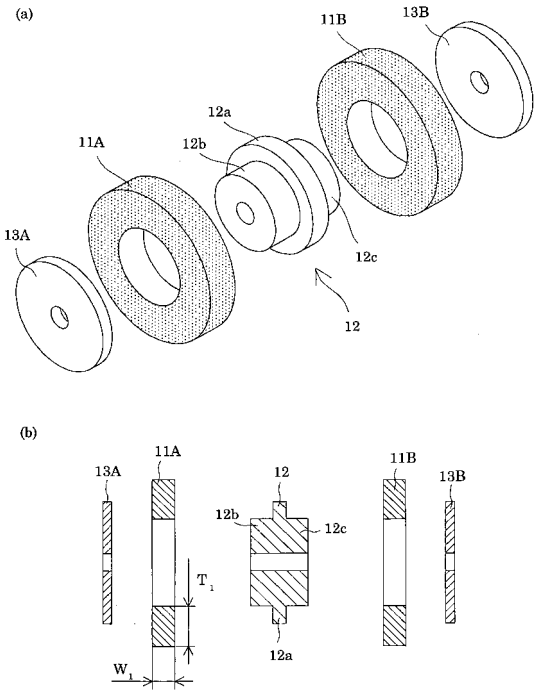
(72) Inventors:
- **KIRIYAMA Takahiro**
  Tokyo 140-0013 (JP)
- **NISHIMURA Masayuki**
  Tokyo 140-0013 (JP)
- **NOJIMA Yoshiaki**
  Tokyo 140-0013 (JP)

(74) Representative: **Strehl Schübel-Hopf & Partner**
Maximilianstraße 54
D-80538 München (DE)

(54) PAPER SHEET SEPARATION/CONVEYANCE ROLLER

(57) A paper-sheet-separating/conveying roller 10 includes a rubber member (conveying member 11A or 11B) having a specific diameter and a through-hole at the center thereof; a core (protrusion 12b or 12c) inserted in the through-hole; and supports which have a diameter greater than that of the core and smaller than that of the rubber member and which sandwich the rubber member from both sides, wherein a member (fixing member 12) having the support which is in close contact with one side surface of the rubber member and a member (holding member 13) having the support which is in close contact with the other side surface of the rubber member are aligned and fixed in an axial direction.

FIG. 2



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Description

Technical Field

[0001] The present invention relates to a rubber roller for separating or conveying paper sheets employed in, for example, an automatic ticket gate, a cash depositing/dispensing machine, or a bill changer (hereinafter the roller may be referred to as a "paper-sheet-separating/conveying roller"). As used herein, the term "paper sheet" encompasses a variety of paper sheets, PPC sheets, a variety of films, magnetic cards, tickets, banknotes, and similar products.

Background Art

[0002] In an automatic ticket gate, a cash depositing/dispensing machine, a bill changer, an automatic ticketing machine, etc., a paper sheet (e.g., a banknote, a magnetic card, or a ticket) is sandwiched between rollers provided so as to face each other, and is then conveyed by means of sandwiching force between the rollers. For example, as shown in Fig. 9, in the case of a machine for conveying a magnetic card 20 having a printed surface, a paper-sheet-separating/conveying roller 1 having a groove and a paper-sheet-separating/conveying roller 2 having a projection corresponding to the groove are positioned so as to face each other and to provide therebetween a specific gap g which is slightly smaller than the thickness of the magnetic card 20.

[0003] When a paper sheet is sandwiched between the aforementioned facing paper-sheet-separating/conveying rollers which have one roller having a projection on the surface thereof and the other having a groove corresponding to the projection, the tip ends of the projections come into contact with the paper sheet at an appropriate pressure (see, for example, Patent Documents 1 and 2).

[0004] The roller shown in Fig. 9 or 10 of Patent Document 1 has a structure including disks formed of polyurethane sponge or fluorine-containing resin and having a relatively small width, and spacers having a relatively large width, wherein the disks and the spacers are alternately provided. A paper-sheet-separating/conveying roller having such a structure poses a problem in that the disks are likely to deflect in an axial direction.

[0005] A feed roller 4 shown in Patent Document 2 has a groove 4b around its entire circumference, and friction members 4c formed of, for example, rubber and having a specific length are attached to large-diameter portions provided on both sides of the groove 4b. A paper-sheet-separating/conveying roller having such a structure poses a problem in that high cost is required for forming a groove.

Prior Art Document

Patent Document

[0006]

Patent Document 1: Japanese Patent Application Laid-Open (*kokai*) No. S57-131651
Patent Document 2: Japanese Patent Application Laid-Open (*kokai*) No. S58-11443

Summary of the Invention

Problems to be Solved by the Invention

[0007] In view of the foregoing, an object of the present invention is to provide a paper-sheet-separating/conveying roller which is produced at low cost and exhibits excellent conveying performance.

Means for Solving the Problems

[0008] In a first mode of the present invention for solving the aforementioned problems, there is provided a paper-sheet-separating/conveying roller characterized by comprising a rubber member having a specific diameter and a through-hole at the center thereof; a core provided in the through-hole; and supports which have a diameter greater than that of the core and smaller than that of the rubber member and which sandwich the rubber member from both sides, wherein a member having the support which is in close contact with one side surface of the rubber member and a member having the support which is in close contact with the other side surface of the rubber member are aligned and fixed in an axial direction.

[0009] A second mode of the present invention is drawn to the paper-sheet-separating/conveying roller of the first mode, wherein the area of a portion of each side surface of the rubber member, the portion being covered with the

corresponding support, is 27% or more of the entire area of the side surface.

[0010] A third mode of the present invention is drawn to the paper-sheet-separating/conveying roller of the first or second mode, wherein the supports and the core are formed of a metal or a resin.

[0011] A fourth mode of the present invention is drawn to the paper-sheet-separating/conveying roller of any of the first to third modes, wherein, in the rubber member, the ratio of thickness T_1 as measured in a radial direction to width W_1 as measured in an axial direction (i.e., T_1/W_1) is 0.5 to 2.3.

[0012] A fifth mode of the present invention is drawn to the paper-sheet-separating/conveying roller of any of the first to fourth modes, wherein the rubber member exhibits a percent expansion of 0 to 7%.

[0013] A sixth mode of the present invention is drawn to the paper-sheet-separating/conveying roller of any of the first to fifth modes, wherein the rubber member exhibits a percent compression of 0 to 13%.

Effects of the Invention

[0014] The paper-sheet-separating/conveying roller of the present invention has a structure in which a member having the support which is in close contact with one side surface of the rubber member and a member having the support which is in close contact with the other side surface of the rubber member are aligned and fixed in an axial direction. Therefore, the paper-sheet-separating/conveying roller exhibits excellent conveying performance, since the rubber member is sandwiched between the supports at a specific pressure applied to the side surfaces, whereby elastic deflection of the rubber member in a horizontal direction (i.e., lateral deflection of the paper-sheet-separating/conveying surface of the rubber member) is reduced. In addition, the paper-sheet-separating/conveying roller (i.e., the rubber member) can be produced at low cost and can readily achieve a specific dimensional accuracy.

Brief Description of the Drawings

[0015]

[Fig. 1]
Fig. 1 is a schematic representation of a paper-sheet-separating/conveying roller according to Embodiment 1.
[Fig. 2]
Fig. 2 is an exploded perspective view and an exploded cross-sectional view of the paper-sheet-separating/conveying roller according to Embodiment 1.
[Fig. 3]
Fig. 3 is a cross-sectional view of the paper-sheet-separating/conveying roller according to Embodiment 1.
[Fig. 4]
Fig. 4 shows a process for producing the paper-sheet-separating/conveying roller according to Embodiment 1.
[Fig. 5]
Fig. 5 shows a process for producing the paper-sheet-separating/conveying roller according to Embodiment 1.
[Fig. 6]
Fig. 6 shows a process for producing the paper-sheet-separating/conveying roller according to Embodiment 1.
[Fig. 7]
Fig. 7 is cross-sectional views of paper-sheet-separating/conveying rollers according to other embodiments.
[Fig. 8]
Fig. 8 is cross-sectional views of paper-sheet-separating/conveying rollers according to other embodiments.
[Fig. 9]
Fig. 9 shows an example of a conventional paper-sheet-separating/conveying roller.

Best Modes for Carrying Out the Invention

[0016] Next will be described best modes for carrying out the invention with reference to the drawings. However, the below-described embodiments are for illustrative purpose only, and the present invention is not limited to the embodiments.

(Embodiment 1)

[0017] Fig. 1 is a schematic representation of a paper-sheet-separating/conveying roller according to Embodiment 1 of the present invention.

[0018] As shown in Fig. 1, the paper-sheet-separating/conveying roller 10 according to Embodiment 1 includes a conveying member 11A, a conveying member 11B, a fixing member 12, a holding member 13A, and a holding member

13B. The roller 10 has, at the center thereof, a shaft 14 inserted therein. As shown in Fig. 1, the shaft 14 is provided with one paper-sheet-separating/conveying roller 10. However, no particular limitation is imposed on the number of paper-sheet-separating/conveying rollers 10 provided on the shaft 14, and the number may be two or more.

[0019] The respective members of the paper-sheet-separating/conveying roller according to Embodiment 1 will now be described with reference to Figs. 2 and 3. Fig. 2(a) is an exploded perspective view of the paper-sheet-separating/conveying roller according to Embodiment 1 of the present invention; Fig. 2(b) is an exploded cross-sectional view of the paper-sheet-separating/conveying roller according to Embodiment 1; and Fig. 3 is a cross-sectional view of the paper-sheet-separating/conveying roller according to Embodiment 1.

[0020] As shown in Fig. 2, each of the conveying members 11A and 11B is formed of a rubber elastic member having a through-hole at the center thereof (i.e., a ring-shaped member). The conveying members 11A and 11B have the same shape (hereinafter the members may be collectively referred to as the "conveying member(s) 11"). In the present embodiment, the conveying members 11 correspond to the "rubber member."

[0021] The conveying members 11 have a diameter greater than that of the fixing member 12 or the holding members 13. That is, the conveying members 11 project in a radial direction so that they can separate or convey paper sheets.

[0022] The fixing member 12 includes a disk-shaped main body 12a having a diameter smaller than that of the conveying members 11, and protrusions 12b and 12c which are provided on both side surfaces of the main body and are fitted into the through-holes of the conveying members 11. The protrusions 12b and 12c correspond to the "core," and the main body 12a serves as one of the support members.

[0023] The end surfaces of each protrusion of the fixing member 12 have a circular shape, and the protrusion has a diameter almost equal to that of the through-hole of the corresponding conveying member 11 (preferably, a diameter slightly greater than that of the through-hole of the conveying member 11 into which the protrusion is not fitted).

[0024] A through-hole is provided at the center of the fixing member 12 so that the shaft 14 can be inserted therein.

[0025] Each of the holding members 13A and 13B is formed of a disk-shaped member having a diameter equal to that of the main body 12a of the fixing member 12. The holding members 13A and 13B have the same shape (hereinafter the members may be collectively referred to as the "holding member(s) 13"). In the present embodiment, the holding members 13 correspond to the other support member.

[0026] Specifically, the fixing member 12 of the roller according to the present embodiment corresponds to the "member having the support which is in close contact with one side surface of the rubber member," and each of the holding members 13 corresponds to the "member having the support which is in close contact with the other side surface of the rubber member." The fixing member 12 and the holding members 13 are aligned by abutting the end surface of each of the protrusions 12b and 12c to the side surface of the corresponding holding member 13, and the member 12 and the members 13 are fastened and fixed together by means of a non-illustrated bolt.

[0027] The holding members 13A and 13B sandwich the conveying members 11A and 11B via the fixing member 12. A through-hole is provided at the center of each holding member 13 so that the shaft 14 can be inserted therein.

[0028] As shown in Fig. 3, in the paper-sheet-separating/conveying roller 10 according to Embodiment 1, the protrusions 12b and 12c of the fixing member 12 are inserted into the through-holes of the conveying members 11A and 11B, respectively, and the holding members 13A and 13B are fixed onto the end surfaces of the conveying members 11A and 11B, respectively.

[0029] As shown in Fig. 3, in the paper-sheet-separating/conveying roller 10 according to Embodiment 1, one side surface of the conveying member 11A is in close contact with the fixing member 12, and the other side surface of the conveying member 11A is in close contact with the holding member 13A. Similarly, one side surface of the conveying member 11B is in close contact with the fixing member 12, and the other side surface of the conveying member 11B is in close contact with the holding member 13B. In the paper-sheet-separating/conveying roller 10, the end surfaces of the protrusions 12b and 12c of the fixing member 12 are in close contact with the end surfaces of the holding members 13A and 13B, respectively, such that the fixing member 12 and the holding members 13A and 13B are aligned and fixed in an axial direction. The fixing member 12 and the holding members 13 are aligned and fixed in an axial direction via the conveying members 11, and the width of the core (i.e., the protrusion 12b or 12c in the present embodiment) in an axial direction corresponds to the distance between the facing end surfaces of the fixing member 12 and the holding member 13A or 13B. The distance between the facing end surfaces of the fixing member 12 and the holding member 13A or 13B is adjusted to be equal to or slightly smaller than the width of the conveying member 11A or 11B in an axial direction, such that the conveying member 11A or 11B is sandwiched and fixed between the fixing member 12 and the holding member 13A or 13B at a specific pressure in an axial direction. Thus, surface deflection of the conveying members 11 can be reduced. Even when the conveying members have a relatively small width in an axial direction and a large thickness in a radial direction, surface deflection of the conveying members can be effectively reduced. As used herein, the term "surface deflection" refers to elastic deflection of the conveying members in a horizontal direction; i.e., lateral deflection of the paper-sheet-separating/conveying surfaces of the conveying members.

[0030] In the paper-sheet-separating/conveying roller 10, the rubber member (i.e., the conveying member 11) preferably exhibits a percent compression of 0 to 13%, particularly preferably 2 to 13%. When the percent compression falls

within the above range, surface deflection can be reduced. As used herein, "percent compression" is obtained by use of the following formula:

[F1]

$$\text{Percent compression (\%)} = (\text{the width of a conveying member} - \text{the distance between facing end surfaces of a fixing member and a holding member})/(\text{the width of the conveying member}) \times 100.$$

[0031] The area of a portion of each side surface of the conveying member 11A, the portion being covered with the fixing member 12 or the holding member 13A, is preferably 27% or more of the entire area of the side surface. When, in the conveying member 11A, the ratio of thickness T_1 as measured in a radial direction to width W_1 as measured in an axial direction (i.e., T_1/W_1) is 1.6 or more, more preferably, the area of a portion of each side surface of the conveying member 11A, the portion being covered with the fixing member 12 or the holding member 13A, is 45% or more of the entire area of the side surface. The area of a portion of the side surface of the conveying member 11A covered with the fixing member 12 is not necessarily equal to, but is preferably equal to the area of a portion of the side surface of the conveying member 11A covered with the holding member 13A. Similarly, the area of a portion of each side surface of the conveying member 11B, the portion being covered with the fixing member 12 or the holding member 13A, is preferably 27% or more of the entire area of the side surface. When, in the conveying member 11B, the ratio (T_1/W_1) is 1.6 or more, more preferably, the area of a portion of each side surface of the conveying member 11B, the portion being covered with the fixing member 12 or the holding member 13A, is 45% or more of the entire area of the side surface. In other words, the area of a portion of each side surface of the conveying member 11 (rubber member), the portion being covered with the corresponding support, is preferably 27% or more of the entire area of the side surface, and when the ratio (T_1/W_1) is 1.6 or more, the area of the portion covered with the support is preferably 45% or more of the entire area of the side surface. This is because, when these conditions are satisfied, the resultant paper-sheet-separating/conveying roller exhibits reduced surface deflection and excellent conveying performance.

[0032] The conveying member 11 is formed of a rubber elastic member, and the rubber elastic member is preferably formed of a rubber base which can impart good conveying performance to the conveying member. No particular limitation is imposed on the rubber base, so long as it has been conventionally used for producing paper-sheet-separating/conveying rollers. Examples of the rubber base include EPDM, nitrile rubber, and polyurethane. Of these, polyurethane is preferred, and caprolactone-based millable polyurethane is particularly preferred. This is because, when such a rubber base is employed for producing a paper-sheet-separating/conveying roller, wear of the roller surface, or adhesion due to the surface wear can be reduced to a minimum possible extent, and thus the roller can be reliably employed for conveying paper sheets over a long period of time. The rubber elastic member is formed by curing a rubber composition containing a rubber base and optionally a conductivity-imparting material. The composition for forming the rubber elastic member may optionally contain, for example, a foaming agent, a foaming aid, a vulcanizing agent, a vulcanization accelerator, or a filler.

[0033] Each of the fixing member 12 and the holding member 13 is formed of a resin or a metal. Examples of the resin include ABS resin, POM resin, nylon resin, urethane resin, and epoxy resin. From the viewpoint of strength, urethane resin is preferably employed. Examples of the metal include stainless steel, aluminum, brass, and copper. Since each of the fixing member 12 and the holding member 13 is formed of a resin or a metal, when the conveying member 11 is rotated in actual use, surface deflection of the conveying member 11 can be reduced. This is because, the conveying member 11 can be effectively fixed by means of such a resin or metal, which undergoes little change in dimension with temperature. The fixing member 12 and the holding member 13 may be formed of the same material or different materials. However, preferably, these members are formed of the same material, from the viewpoint of cost.

[0034] In the rubber member (the conveying member 11), the ratio of thickness T_1 as measured in a radial direction to width W_1 as measured in an axial direction (i.e., T_1/W_1) is preferably 0.5 to 2.3, more preferably 1.0 to 2.0. When the ratio T_1/W_1 is 2.3 or less, the paper-sheet-separating/conveying roller is less likely to deflect in a radial direction, and exhibits excellent conveying performance. When the ratio T_1/W_1 is less than 0.5, the rubber member may undulate during conveyance of paper sheets, resulting in formation of irregularities in a radial direction.

[0035] Preferably, the paper-sheet-separating/conveying roller 10 is produced by moving the holding members 13 and the conveying members 11 in an axial direction so that the protrusions of the fixing member 12 are press-fitted into

the through-holes of the conveying members 11. Specifically, preferably, the holding members 13 and the conveying members 11 are slid in an axial direction by, for example, abutting the holding members 13 to plate-like members and applying a specific pressure to the members 13, to thereby fit the protrusions of the fixing member 12 into the through-holes of the conveying members 11. Thus, the fixing member 12, the holding member 13A, and the holding member 13B are aligned and fixed in an axial direction with high accuracy. Thus, the conveying members 11 of the paper-sheet-separating/conveying roller 10 exhibit uniform percent expansion in a circumferential direction. In actual use of the paper-sheet-separating/conveying roller, the conveying members exhibit reduced elastic deflection both in radial and horizontal directions.

[0036] In the paper-sheet-separating/conveying roller 10, the rubber member (the conveying member 11) preferably exhibits a percent expansion of 0 to 7%, particularly preferably 1 to 6%. When the percent expansion exceeds 7%, strain may occur in the rubber member, resulting in an increase in radial deflection or surface deflection. As used herein, "percent expansion" is obtained by use of the following formula:

[F2]

$$\text{Percent expansion (\%)} = (\text{the diameter of a core} - \text{the inner diameter of a conveying member into which the core is not inserted}) / (\text{the inner diameter of the conveying member into which the core is not inserted}) \times 100.$$

[0037] For example, the paper-sheet-separating/conveying roller 10 preferably exhibits a surface deflection of 0.11 mm or less, more preferably 0.10 mm or less, which may vary with the diameter of the roller.

[0038] Next will be described a method for producing the paper-sheet-separating/conveying roller according to Embodiment 1. Figs. 4 to 6 are perspective views of the paper-sheet-separating/conveying roller according to Embodiment 1.

[0039] As shown in Fig. 4(a), a cylindrical rubber elastic member having a through-hole at the center thereof is formed, and then the cylindrical member is cut into ring-shaped members having a specific width (i.e., conveying members 11A and 11B). No particular limitation is imposed on the method for producing such a cylindrical rubber elastic member, and the member is readily formed through, for example, injection molding or extrusion molding.

[0040] As shown in Fig. 4(b), there is formed, from a resin or a metal, a fixing member 12 including a disk-shaped main body 12a having, on both side surfaces thereof, protrusions 12b and 12c which are fitted into the through-holes of the conveying members 11. No particular limitation is imposed on the method for producing the fixing member 12, and the member 12 is formed through, for example, injection molding.

[0041] As shown in Fig. 4(b), there are formed, from a resin or a metal, disk-shaped holding members 13A and 13B having a diameter equal to that of the main body 12a of the fixing member 12. No particular limitation is imposed on the method for producing the holding members 13, and the members 13 are formed through, for example, injection molding. From the viewpoint of cost, the holding members 13 are preferably formed from the same material as the fixing member 12.

[0042] Subsequently, as shown in Fig. 5, the holding members 13A and 13B and the conveying members 11A and 11B are moved in an axial direction, so that the protrusion 12b of the fixing member 12 is press-fitted into the conveying member 11A, and the protrusion 12c of the fixing member 12 is press-fitted into the conveying member 11B. Thus, the conveying members 11A and 11B fitted with the fixing member 12 exhibit uniform percent expansion in a circumferential direction. In actual use of the resultant paper-sheet-separating/conveying roller, the conveying members exhibit elastic deflection neither in a radial direction nor in a horizontal direction (i.e., no surface deflection).

[0043] Then, as shown in Fig. 6, the holding members 13A and 13B are fastened and fixed to the protrusions 12b and 12c of the fixing member 12, respectively, by means of non-illustrated bolts. Thus, the holding member 13A, the fixing member 12, and the holding member 13B are aligned and fixed in an axial direction.

[0044] Thereafter, although not illustrated, a shaft is inserted into the paper-sheet-separating/conveying roller 10 at the center thereof.

[0045] Finally, if necessary, the conveying members 11A and 11B are polished while being rotated about the shaft, so that the paper-sheet-separating/conveying roller 10 has specific dimensions.

[0046] As described above, the paper-sheet-separating/conveying roller 10 according to Embodiment 1 includes the rubber members (the conveying members 11A and 11B) each having a specific diameter and a through-hole at the center thereof; the cores (the protrusions 12b and 12c) inserted in the through-holes; and the supports which have a diameter greater than that of the cores and smaller than that of the rubber members and which sandwich the rubber

members from both sides, wherein the member (the fixing member 12) having the support which is in close contact with one side surface of each rubber member and the member (the holding member 13) having the support which is in close contact with the other side surface of the rubber member are aligned and fixed in an axial direction. Therefore, the rubber members exhibit reduced elastic deflection in a horizontal direction (surface deflection) and excellent conveying performance.

[0047] Since the rubber members (the conveying members 11A and 11B) are moved in an axial direction so that the cores (the protrusions 12b and 12c) are press-fitted into the through-holes of the rubber members, the rubber members exhibit reduced elastic deflection both in horizontal and radial directions. Therefore, the paper-sheet-separating/conveying roller exhibits excellent conveying performance.

[0048] In the paper-sheet-separating/conveying roller, the rubber members can be readily formed with a specific dimensional accuracy. That is, the paper-sheet-separating/conveying roller can be readily produced without use of a special grinding wheel for processing; i.e., the roller can be produced at low cost.

(Other embodiments)

[0049] Other embodiments will next be briefly described. Components corresponding to those of Embodiment 1 are denoted by common reference numerals, and repeated description is omitted.

[0050] In Embodiment 1, the paper-sheet-separating/conveying roller 10 includes the fixing member 12 having the disk-shaped main body 12a and the protrusions 12b and 12c which are provided on both side surfaces of the main body 12a and are fitted into the through-holes of the conveying members 11; and the disk-shaped holding members 13 having a diameter equal to that of the main body 12a of the fixing member 12. However, the present invention is not limited to this roller.

[0051] For example, the paper-sheet-separating/conveying roller of the present invention may be configured as shown in Fig. 7(a). Specifically, the width of protrusions of a fixing member 22 is adjusted to be smaller than that of the conveying members 11 in an axial direction; holding members 23 (23A and 23B) are also provided with protrusions which are fitted into the through-holes of the conveying members 11; and the end surface of the protrusion 22b of the fixing member 22 is abutted to the protrusion of the holding member 23A and the end surface of the protrusion 22c of the fixing member 22 is abutted to the protrusion of the holding member 23B, whereby the fixing member 22 and the holding members 23 are aligned and fixed. In this case, when the holding members 23 and the conveying members 11 are moved in an axial direction so that the core is press-fitted into the through-holes of the conveying members 11, the end surface of the protrusion 22b of the fixing member 22 is abutted to the protrusion of the holding member 23A, and the end surface of the protrusion 22c of the fixing member 22 is abutted to the protrusion of the holding member 23B, whereby the fixing member 22 and the holding members 23A and 23B are aligned in an axial direction. The fixing member 22 and the holding members 23A and 23B are fastened and fixed by means of a non-illustrated bolt. In this case, the protrusions 22b of the fixing member 22 and the protrusion of the holding member 23B together serve as the "core."

[0052] Alternatively, the paper-sheet-separating/conveying roller of the present invention may be configured as shown in Fig. 7(b). Specifically, the width of protrusions of a fixing member 32 is adjusted to be greater than that of the conveying members 11 in an axial direction so that the protrusions project from the outer surfaces of the conveying members 11; holding members 33 (33A and 33B) are provided with dents into which the protrusions of the fixing member 32 are fitted; and the end surface of the protrusion 32b of the fixing member 32 is abutted to the holding member 33A and the end surface of the protrusion 32c of the fixing member 32 is abutted to the holding member 33B, whereby the fixing member 32 and the holding members 33 are aligned and fixed. In this case, the fastening bolt employed in Embodiment 1 may be omitted. In this case, when the holding members 33 and the conveying members 11 are moved in an axial direction so that the core is press-fitted into the through-holes of the conveying members 11, the end surface of the protrusion 32b of the fixing member 32 is abutted to the holding member 33A, and the end surface of the protrusion 32c of the fixing member 32 is abutted to the holding member 33B, whereby the fixing member 32 and the holding members 33A and 33B are aligned and fixed in an axial direction. In this case, a portion of the protrusions 32b and 32c of the fixing member 32 corresponds to the "core"; the main body 32a of the fixing member 32 serves as one of the supports; and the protrusions of the holding members 33 serve as the other support.

[0053] Alternatively, the paper-sheet-separating/conveying roller of the present invention may be configured as shown in Fig. 7(c). Specifically, each of holding members 43 (43A and 43B) is formed of a disk-shaped main body provided, on one surface thereof, with a protrusion which is fitted into the through-hole of the corresponding conveying member 11; a fixing member 42 is formed of a disk-shaped member having a diameter equal to that of the main bodies of the holding members 43; and the end surfaces of the fixing member 42 are respectively abutted to the end surfaces of the protrusions of the holding members 43A and 43B, whereby the fixing member 42 and the holding members 43 are aligned and fixed. In this case, when the holding members 43 and the conveying members 11 are moved in an axial direction so that the core is press-fitted into the through-holes of the conveying members 11, the end surfaces of the fixing member 42 are respectively abutted to the end surfaces of the protrusions of the holding members 43A and 43B,

whereby the fixing member 42 and the holding members 43A and 43B are aligned in an axial direction, and these members are fastened and fixed by means of a non-illustrated bolt. In this case, the protrusions of the holding members 43 correspond to the "core."

[0054] In Embodiment 1, the conveying members 11A and 11B have the same shape. However, the conveying members 11A and 11B may have different widths, so long as they have the same diameter.

[0055] In Embodiment 1, the conveying surface of the conveying member 11 is flat (i.e., the conveying member 11 has uniform diameter in a thickness direction). However, the conveying surface of the conveying member 11 may be convex (i.e., a portion of the conveying member 11 has a larger diameter at the center in a thickness direction).

[0056] In Embodiment 1, the conveying members 13A and 13B have the same shape. However, the members 13A and 13B do not necessarily have the same shape. For example, the conveying members 13A and 13B may have different diameters, although it is preferred that they have the same diameter. The conveying members 13A and 13B may have different widths or different shapes.

[0057] For example, the paper-sheet-separating/conveying roller of the present invention may be configured as shown in Fig. 8(a). Specifically, a fixing member 52 is formed so as to have, on one side thereof, a protrusion which has a width almost equal to that of the conveying member 11A and is fitted into the through-hole of the conveying member 11A, and to have, on the other side, a protrusion having a width greater than that of the conveying member 11B in an axial direction; a holding member 53A is formed of a disk-shaped member having a diameter equal to that of the main body of the fixing member 52, and a holding member 53B is provided with a dent into which the protrusion of the fixing member 52 is fitted; and the protrusion 52b of the fixing member 52 is abutted to the end surface of the holding member 53A and the protrusion 52c is abutted to the dent of the holding member 53B, whereby the fixing member 52 and the holding members 53 are aligned and fixed. In this case, a portion of the protrusions 52b and 52c of the fixing member 52 corresponds to the "core"; the main body of the fixing member 32 serves as one of the supports; and the side surface of the holding member 53A or the protrusion of the holding member 53B serves as the other support.

[0058] Alternatively, as shown in Fig. 8(b), the paper-sheet-separating/conveying roller of the present invention may be configured to include a disk-shaped holding member 63A having a diameter equal to that of the main body of the fixing member 12; and a holding member 63B which has, on the side in contact with the conveying member 11B, a circular shape having a diameter equal to that of the main body of the fixing member 12 and which tapers toward the side opposite the side in contact with the member 11B.

[0059] The fixing member 12 and the holding member 13 may have different outer diameters, although it is preferred that they have the same outer diameter.

[0060] As exemplified in Embodiment 1, the paper-sheet-separating/conveying roller 10 includes two conveying members 11. However, three or more conveying members 11 may be provided. Although not illustrated, when three or more conveying members 11 are provided, additional fixing members are provided, and at least one of the fixing members is provided with a core which is fitted into the through-hole of a conveying member 11. One end surface of the fixing member is abutted to one end surface of another fixing member, and the other end surface of each fixing member is abutted to the corresponding holding member, whereby these members are aligned and fixed in an axial direction.

[0061] In Embodiment 1, fastening (fixation) is carried out by means of a bolt. However, fixation is not necessarily performed by this means, and may be performed by means of, for example, an adhesive.

[0062] The present invention will next be described by way of examples, which should not be construed as limiting the invention thereto.

(Example 1)

[0063] A rubber elastic member was formed from ethylene propylene rubber (EPDM), and then cut into conveying members (40 mm in outer diameter $\times$ 28 mm in inner diameter $\times$ 3.4 mm in width).

[0064] A fixing member having a main body (Φ35 mm $\times$ 2.95 mm in width) and protrusions (Φ30 mm $\times$ 2.95 mm in width) was formed from ABS resin.

[0065] Holding members (Φ35 mm $\times$ 4.0 mm in thickness) were formed from ABS resin.

[0066] The holding members and the conveying members 11 were moved in an axial direction; the protrusions of the fixing member were press-fitted into the through-holes of the conveying members; and each of the holding members was provided on the end surface of the corresponding conveying member, to thereby produce a paper-sheet-separating/conveying roller of Example 1.

(Example 2)

[0067] The procedure of Example 1 was repeated, except that conveying members (40 mm in outer diameter $\times$ 29 mm in inner diameter $\times$ 3.2 mm in width) were employed, to thereby produce a paper-sheet-separating/conveying roller of Example 2.

(Example 3)

[0068] The procedure of Example 1 was repeated, except that conveying members (40 mm in outer diameter × 30 mm in inner diameter × 3.0 mm in width) were employed, to thereby produce a paper-sheet-separating/conveying roller of Example 3.

(Example 4)

[0069] The procedure of Example 1 was repeated, except that conveying members (44 mm in outer diameter × 28 mm in inner diameter × 3.4 mm in width) were employed, to thereby produce a paper-sheet-separating/conveying roller of Example 4.

(Example 5)

[0070] The procedure of Example 2 was repeated, except that conveying members (44 mm in outer diameter × 29 mm in inner diameter × 3.2 mm in width) were employed, to thereby produce a paper-sheet-separating/conveying roller of Example 5.

(Example 6)

[0071] The procedure of Example 3 was repeated, except that conveying members (44 mm in outer diameter × 30 mm in inner diameter × 3.0 mm in width) were employed, to thereby produce a paper-sheet-separating/conveying roller of Example 6.

(Example 7)

[0072] The procedure of Example 2 was repeated, except that a fixing member having a main body (Φ33 mm × 2.95 mm in width) and protrusions (Φ30 mm × 2.95 mm in width) was employed, and holding members (Φ33 mm × 4.0 mm in thickness) were employed, to thereby produce a paper-sheet-separating/conveying roller of Example 7.

(Example 8)

[0073] The procedure of Example 7 was repeated, except that a fixing member having a main body (Φ32 mm × 2.95 mm in width) and protrusions (Φ30 mm × 2.95 mm in width) was employed, and holding members (Φ32 mm × 4.0 mm in thickness) were employed, to thereby produce a paper-sheet-separating/conveying roller of Example 8.

(Example 9)

[0074] The procedure of Example 1 was repeated, except that conveying members (32 mm in outer diameter × 29 mm in inner diameter × 3.2 mm in width) were employed, a fixing member having a main body (Φ30.6 mm × 2.95 mm in width) and protrusions (Φ30 mm × 2.95 mm in width) was employed, and holding members (Φ30.6 mm × 4.0 mm in thickness) were employed, to thereby produce a paper-sheet-separating/conveying roller of Example 9.

(Example 10)

[0075] The procedure of Example 1 was repeated, except that conveying members (33 mm in outer diameter × 29 mm in inner diameter × 3.2 mm in width) were employed, a fixing member having a main body (Φ30.9 mm × 2.95 mm in width) and protrusions (Φ30 mm × 2.95 mm in width) was employed, and holding members (Φ30.9 mm × 4.0 mm in thickness) were employed, to thereby produce a paper-sheet-separating/conveying roller of Example 10.

(Example 11)

[0076] The procedure of Example 1 was repeated, except that conveying members (44.4 mm in outer diameter × 29 mm in inner diameter × 3.2 mm in width) were employed, a fixing member having a main body (Φ34.4 mm × 2.95 mm in width) and protrusions (Φ30 mm × 2.95 mm in width) was employed, and holding members (Φ34.4 mm × 4.0 mm in thickness) were employed, to thereby produce a paper-sheet-separating/conveying roller of Example 11.

(Example 12)

[0077] The procedure of Example 1 was repeated, except that conveying members (46 mm in outer diameter × 29 mm in inner diameter × 3.2 mm in width) were employed, a fixing member having a main body (Φ35 mm × 2.95 mm in width) and protrusions (Φ30 mm × 2.95 mm in width) was employed, and holding members (Φ35 mm × 4.0 mm in thickness) were employed, to thereby produce a paper-sheet-separating/conveying roller of Example 12.

(Example 13)

[0078] The procedure of Example 7 was repeated, except that conveying members (40 mm in outer diameter × 29 mm in inner diameter × 3.5 mm in width) were employed, to thereby produce a paper-sheet-separating/conveying roller of Example 13.

(Example 14)

[0079] The procedure of Example 7 was repeated, except that conveying members (40 mm in outer diameter × 29 mm in inner diameter × 2.95 mm in width) were employed, to thereby produce a paper-sheet-separating/conveying roller of Example 14.

(Example 15)

[0080] The procedure of Example 7 was repeated, except that conveying members (40 mm in outer diameter × 27.2 mm in inner diameter × 3.2 mm in width) were employed, to thereby produce a paper-sheet-separating/conveying roller of Example 15.

(Example 16)

[0081] The procedure of Example 7 was repeated, except that conveying members (40 mm in outer diameter × 28 mm in inner diameter × 3.2 mm in width) were employed, to thereby produce a paper-sheet-separating/conveying roller of Example 16.

(Comparative Example 1)

[0082] The conveying members, fixing member, and holding members of Example 1 were employed. The fixing member and the holding members were fixed, and then the conveying members were manually inserted between the fixing member and the holding members, to thereby produce a paper-sheet-separating/conveying roller of Comparative Example 1.

(Comparative Example 2)

[0083] The conveying members, fixing member, and holding members of Example 2 were employed. The fixing member and the holding members were fixed, and then the conveying members were manually inserted between the fixing member and the holding members, to thereby produce a paper-sheet-separating/conveying roller of Comparative Example 2.

(Comparative Example 3)

[0084] The conveying members, fixing member, and holding members of Example 3 were employed. The fixing member and the holding members were fixed, and then the conveying members were manually inserted between the fixing member and the holding members, to thereby produce a paper-sheet-separating/conveying roller of Comparative Example 3.

(Comparative Example 4)

[0085] The conveying members, fixing member, and holding members of Example 4 were employed. The fixing member and the holding members were fixed, and then the conveying members were manually inserted between the fixing member and the holding members, to thereby produce a paper-sheet-separating/conveying roller of Comparative Example 4.

(Comparative Example 5)

[0086] The conveying members, fixing member, and holding members of Example 5 were employed. The fixing member and the holding members were fixed, and then the conveying members were manually inserted between the fixing member and the holding members, to thereby produce a paper-sheet-separating/conveying roller of Comparative Example 5.

(Comparative Example 6)

[0087] The conveying members, fixing member, and holding members of Example 6 were employed. The fixing member and the holding members were fixed, and then the conveying members were manually inserted between the fixing member and the holding members, to thereby produce a paper-sheet-separating/conveying roller of Comparative Example 6.

(Comparative Example 7)

[0088] The conveying members, fixing member, and holding members of Example 7 were employed. The fixing member and the holding members were fixed, and then the conveying members were manually inserted between the fixing member and the holding members, to thereby produce a paper-sheet-separating/conveying roller of Comparative Example 7.

(Comparative Example 8)

[0089] The conveying members, fixing member, and holding members of Example 8 were employed. The fixing member and the holding members were fixed, and then the conveying members were manually inserted between the fixing member and the holding members, to thereby produce a paper-sheet-separating/conveying roller of Comparative Example 8.

(Comparative Example 9)

[0090] The conveying members, fixing member, and holding members of Example 9 were employed. The fixing member and the holding members were fixed, and then the conveying members were manually inserted between the fixing member and the holding members, to thereby produce a paper-sheet-separating/conveying roller of Comparative Example 9.

(Comparative Example 10)

[0091] The conveying members, fixing member, and holding members of Example 10 were employed. The fixing member and the holding members were fixed, and then the conveying members were manually inserted between the fixing member and the holding members, to thereby produce a paper-sheet-separating/conveying roller of Comparative Example 10.

(Comparative Example 11)

[0092] The conveying members, fixing member, and holding members of Example 11 were employed. The fixing member and the holding members were fixed, and then the conveying members were manually inserted between the fixing member and the holding members, to thereby produce a paper-sheet-separating/conveying roller of Comparative Example 11.

(Comparative Example 12)

[0093] The conveying members, fixing member, and holding members of Example 12 were employed. The fixing member and the holding members were fixed, and then the conveying members were manually inserted between the fixing member and the holding members, to thereby produce a paper-sheet-separating/conveying roller of Comparative Example 12.

(Comparative Example 13)

[0094] The conveying members, fixing member, and holding members of Example 13 were employed. The fixing member and the holding members were fixed, and then the conveying members were manually inserted between the fixing member and the holding members, to thereby produce a paper-sheet-separating/conveying roller of Comparative Example 13.

(Comparative Example 14)

[0095] The conveying members, fixing member, and holding members of Example 14 were employed. The fixing member and the holding members were fixed, and then the conveying members were manually inserted between the fixing member and the holding members, to thereby produce a paper-sheet-separating/conveying roller of Comparative Example 14.

(Comparative Example 15)

[0096] The conveying members, fixing member, and holding members of Example 15 were employed. The fixing member and the holding members were fixed, and then the conveying members were manually inserted between the fixing member and the holding members, to thereby produce a paper-sheet-separating/conveying roller of Comparative Example 15.

(Comparative Example 16)

[0097] The conveying members, fixing member, and holding members of Example 16 were employed. The fixing member and the holding members were fixed, and then the conveying members were manually inserted between the fixing member and the holding members, to thereby produce a paper-sheet-separating/conveying roller of Comparative Example 16.

(Test Example 1): Evaluation of surface deflection

[0098] There was measured, by means of a pick gauge, the elastic deflection (in a horizontal direction) of side surfaces of the conveying members 11 of each of the paper-sheet-separating/conveying rollers of the Examples and the Comparative Examples. The results are shown in Tables 1 and 2.

[0099] Tables 1 to 4 show data regarding each of the paper-sheet-separating/conveying rollers of the Examples and the Comparative Examples: the ratio (%) of the area of a portion of each side surface of the conveying members, the portion being covered with the corresponding support (i.e., the fixing member or the holding member), to the entire area of the side surface (hereinafter the ratio will be referred to as the "percent support of each side surface of the conveying members"); the ratio of thickness T_1 of each conveying member as measured in a radial direction to width W_1 thereof as measured in an axial direction (i.e., T_1/W_1); the percent compression (%) of each conveying member; and the percent expansion (%) of each conveying member.

[0100]

[Table 1]

	Ex. 1	Ex. 2	Ex. 3	Ex. 4	Ex. 5	Ex. 6	Ex. 7	Ex. 8
Thickness of conveying member in radial direction (T_1)	5	5	5	7	7	7	5	5
Width of conveying member in axial direction (W_1)	3.4	3.2	3	3.4	3.2	3	3.2	3.2
Percent support of each side surface of conveying member (%)	46	46	46	31	31	31	27	18
(T_1/W_1)	1.5	1.6	1.7	2.1	2.2	2.3	1.6	1.6
Percent compression (%)	13	8	2	13	8	2	8	8
Percent expansion (%)	7	3	0	7	3	0	3	3
Surface deflection (mm)	0.08	0.08	0.08	0.10	0.09	0.11	0.10	0.17

[0101]

[Table 2]

	Ex. 9	Ex. 10	Ex. 11	Ex. 12	Ex. 13	Ex. 14	Ex. 15	Ex. 16
Thickness of conveying member in radial direction (T_1)	1	1.5	7.1	8	5	5	5	5
Width of conveying member in axial direction (W_1)	3.2	3.2	3.2	3.2	3.5	2.95	3.2	3.2
Percent support of each side surface of conveying member (%)	29	29	27	27	27	27	27	27
(T_1/W_1)	0.3	0.5	2.2	2.5	1.4	1.7	1.6	1.6
Percent compression (%)	8	8	8	8	16	0	8	8
Percent expansion (%)	3	3	3	3	3	3	10	7
Surface deflection (mm)	0.14	0.10	0.09	0.19	0.17	0.08	0.16	0.10

[0102]

[Table 3]

	Comp. Ex. 1	Comp. Ex. 2	Comp. Ex. 3	Comp. Ex. 4	Comp. Ex. 5	Comp. Ex. 6	Comp. Ex. 7	Comp. Ex. 8
Thickness of conveying member in radial direction (T_1)	5	5	5	7	7	7	5	5
Width of conveying member in axial direction (W_1)	3.4	3.2	3	3.4	3.2	3	3.2	3.2
Percent support of each side surface of conveying member (%)	46	46	46	31	31	31	27	18
(T_1/W_1)	1.5	1.6	1.7	2.1	2.2	2.3	1.6	1.6
Percent compression (%)	13	8	2	13	8	2	8	8
Percent expansion (%)	7	3	0	7	3	0	3	3
Surface deflection (mm)	0.15	0.14	0.14	0.23	0.16	0.15	0.16	0.25

[0103]

[Table 4]

	Comp. Ex. 9	Comp. Ex. 10	Comp. Ex. 11	Comp. Ex. 12	Comp. Ex. 13	Comp. Ex. 14	Comp. Ex. 15	Comp. Ex. 16
Thickness of conveying member in radial direction (T_1)	1	1.5	7.2	8	5	5	5	5
Width of conveying member in axial direction (W_1)	3.2	3.2	3.2	3.2	3.5	2.95	3.2	3.2
Percent support of each side surface of conveying member (%)	29	29	26	27	27	27	27	27
(T_1/W_1)	0.3	0.5	2.3	2.5	1.4	1.7	1.6	1.6
Percent compression (%)	8	8	8	8	16	0	8	8
Percent expansion (%)	3	3	3	3	3	3	10	7
Surface deflection (mm)	0.33	0.21	0.24	0.33	0.28	0.23	0.26	0.19

(Summary of results)

[0104] As is clear from Tables 1 to 4, the paper-sheet-separating/conveying rollers of Examples 1 to 16 tend to exhibit reduced surface deflection, as compared with the paper-sheet-separating/conveying rollers of Comparative Examples 1 to 16, in which the conveying members are inserted after fixation of the fixing member and the holding members. Conceivably, the reason for this is attributed to the fact that a variation in horizontal width occurs in the conveying members by manually inserting the conveying members between the fixing member and the holding members. These data indicate that when the fixing member which is in close contact with one side surface of the conveying member and the holding member which is in close contact with the other side surface of the conveying member are aligned and fixed in an axial direction, the resultant roller exhibits reduced surface deflection. Thus, the paper-sheet-separating/conveying rollers of Examples 1 to 16 exhibit reduced surface deflection and excellent conveying performance.

[0105] The paper-sheet-separating/conveying roller of Example 2 or 7, in which the percent support of each side surface of the conveying members is 27% or more, exhibits a surface deflection of 0.08 mm or 0.10 mm, respectively; i.e., the surface deflection is considerably reduced as compared with the case of Example 8 in which the percent support is 18%. These data indicate that when the percent support of each side surface of the conveying members is 27% or more, surface deflection is further reduced.

[0106] The paper-sheet-separating/conveying roller of Example 10 in which (T_1/W_1) is 0.5 or the paper-sheet-separating/conveying roller of Example 11 in which (T_1/W_1) is 2.2 exhibits a surface deflection of 0.10 mm or 0.09 mm, respectively; i.e., the surface deflection is lower than that of the paper-sheet-separating/conveying roller of Example 9 in which (T_1/W_1) is 0.3 or the paper-sheet-separating/conveying roller of Example 12 in which (T_1/W_1) is 2.5. The paper-sheet-separating/conveying rollers of Examples 4 to 6 in which (T_1/W_1) is 2.1 to 2.3 exhibit a surface deflection of 0.11 mm or less. These data indicate that when (T_1/W_1) is 0.5 to 2.3, surface deflection is further reduced.

[0107] The paper-sheet-separating/conveying rollers of Examples 4 to 6 and 14 in which percent compression is 0 to 13% exhibit a surface deflection lower than that of the paper-sheet-separating/conveying roller of Example 13 in which percent compression is 16%. These data indicate that when percent compression is 0 to 13%, surface deflection is further reduced.

[0108] The paper-sheet-separating/conveying roller of Example 7 in which percent expansion is 3% or the paper-sheet-separating/conveying roller of Example 16 in which percent expansion is 7% exhibits a surface deflection of 0.10 mm; i.e., the surface deflection is lower than that of the paper-sheet-separating/conveying roller of Example 15 in which percent expansion is 10%. These data indicate that when percent expansion is 7% or less, surface deflection is further reduced.

Description of Reference Numerals

[0109]

10: Paper-sheet-separating/conveying roller
11: Conveying member
12, 22, 32, 42, 52: Fixing member
13, 23, 33, 43, 53, 63A, 63B: Holding member
14: Shaft

Claims

1. A paper-sheet-separating/conveying roller **characterized by** comprising:

   a rubber member having a specific diameter and a through-hole at the center thereof;
   a core provided in the through-hole; and
   supports which have a diameter greater than that of the core and smaller than that of the rubber member and which sandwich the rubber member from both sides, wherein a member having the support which is in close contact with one side surface of the rubber member and a member having the support which is in close contact with the other side surface of the rubber member are aligned and fixed in an axial direction.

2. A paper-sheet-separating/conveying roller according to claim 1, wherein the area of a portion of each side surface of the rubber member, the portion being covered with the corresponding support, is 27% or more of the entire area of the side surface.

3. A paper-sheet-separating/conveying roller according to claim 1 or 2, wherein the supports and the core are formed of a metal or a resin.

4. A paper-sheet-separating/conveying roller according to any one of claims 1 to 3, wherein, in the rubber member, the ratio of thickness T_1 as measured in a radial direction to width W_1 as measured in an axial direction, represented by T_1/W_1, is 0.5 to 2.3.

5. A paper-sheet-separating/conveying roller according to any one of claims 1 to 4, wherein the rubber member exhibits a percent expansion of 0 to 7%.

6. A paper-sheet-separating/conveying roller according to any one of claims 1 to 5, wherein the rubber member exhibits a percent compression of 0 to 13%.

FIG. 1

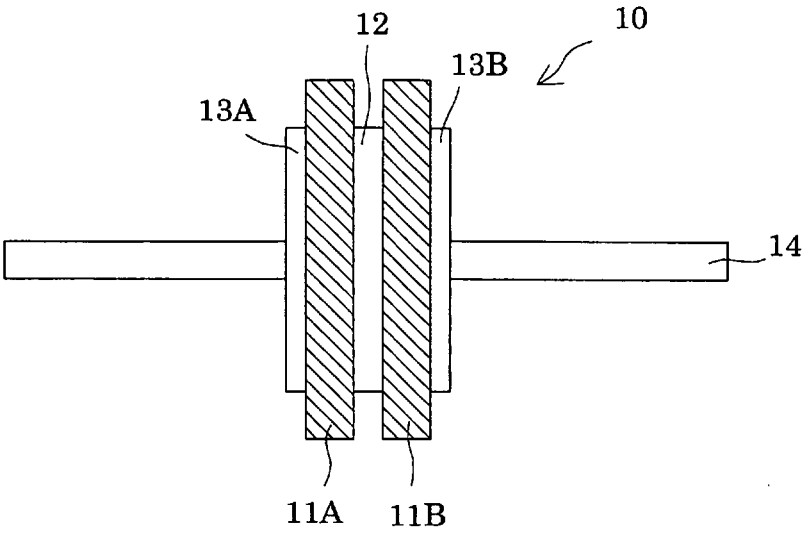
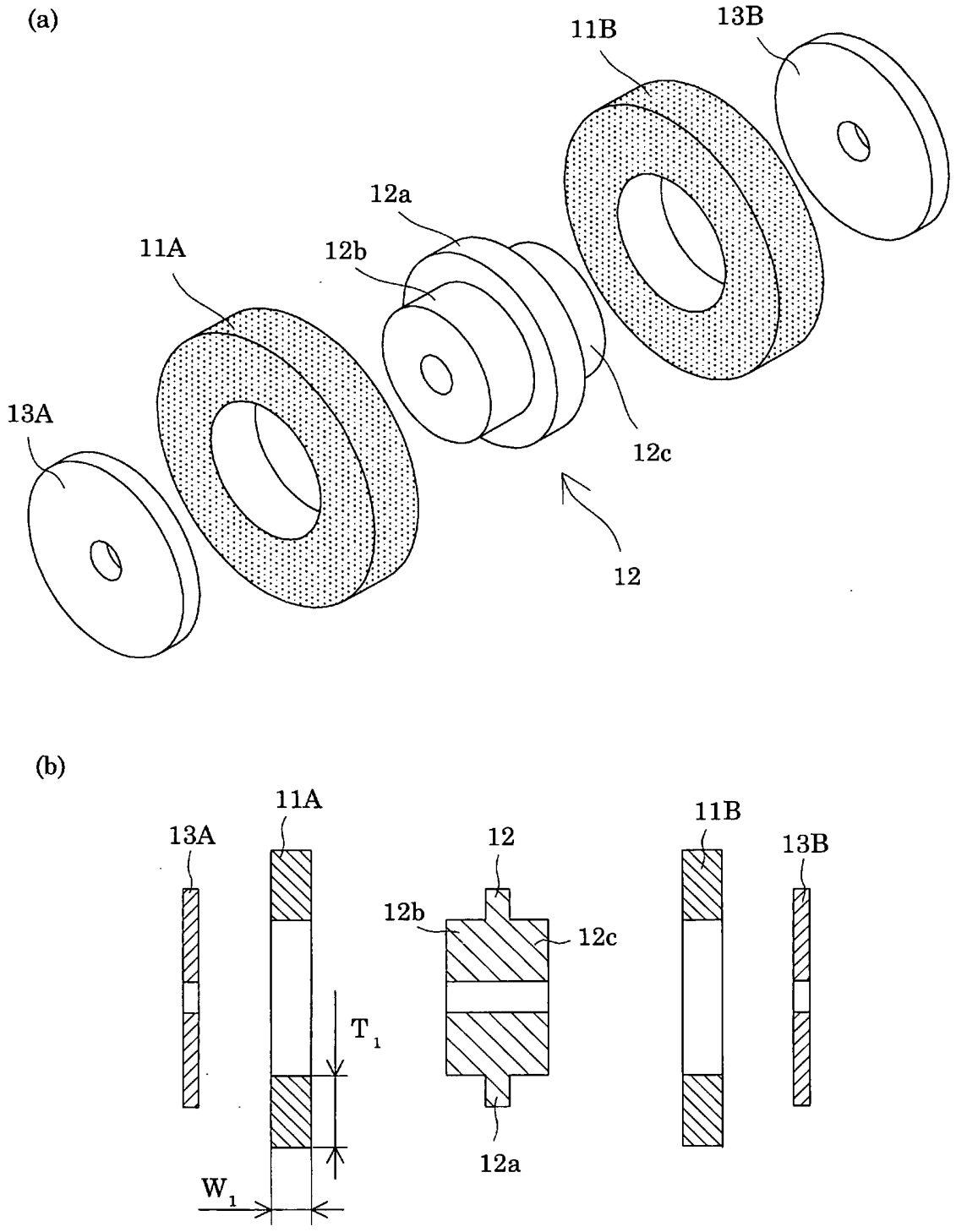


FIG. 2


(a)
11B
13B
12a
11A
12b
13A
12c
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(b)
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13A
12
11B
13B
12b
12c
T_1
12a
W_1

FIG. 3

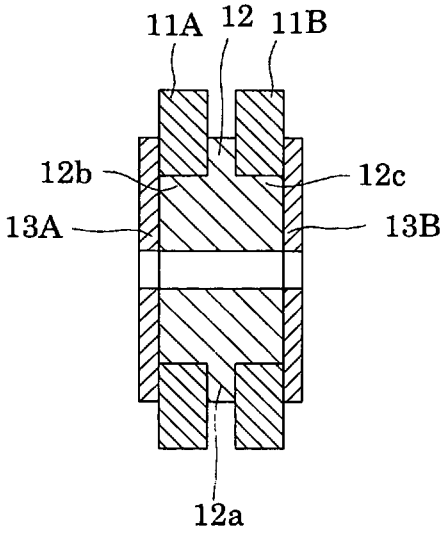


FIG. 4

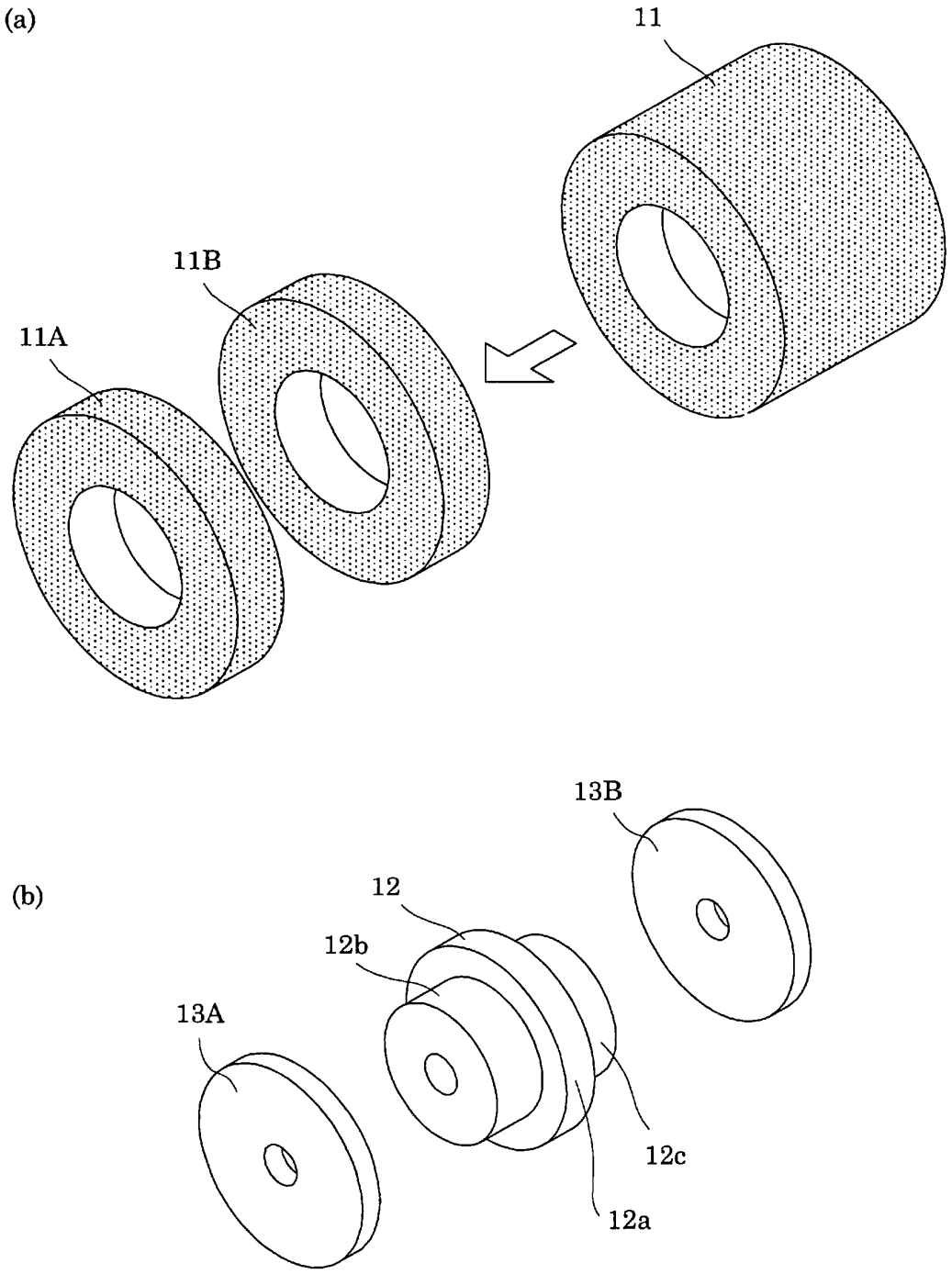


FIG. 5

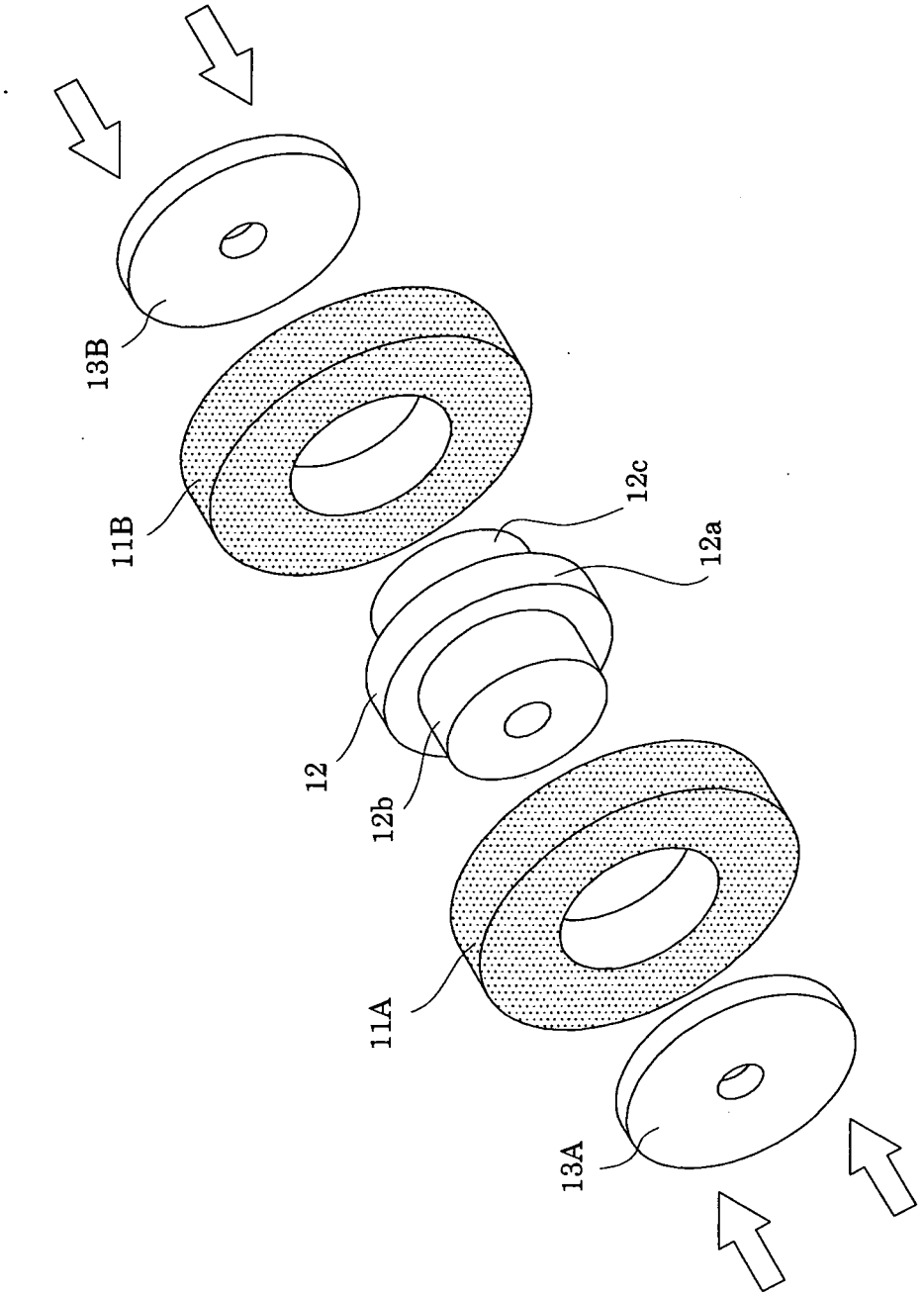


FIG. 6

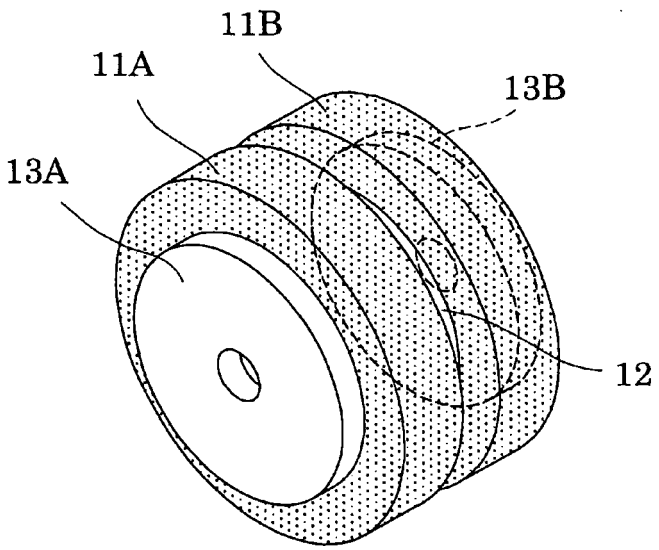
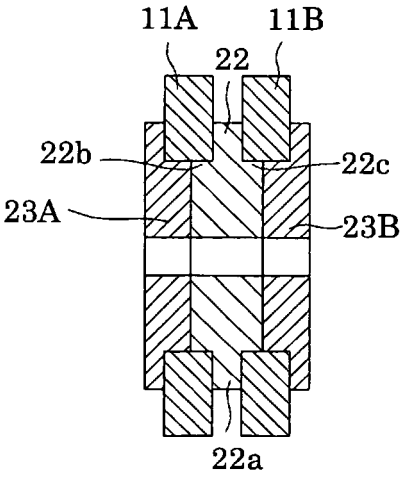
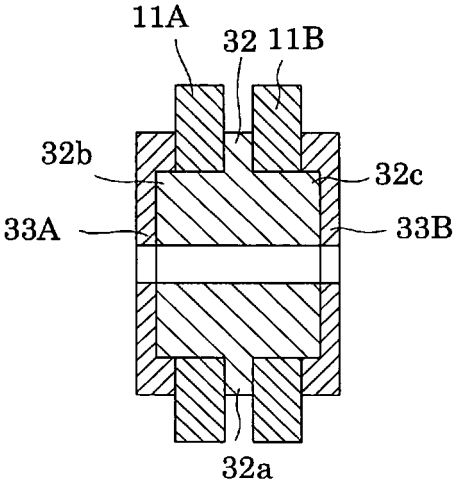


FIG. 7

(a)


11A
11B
22
22b
22c
23A
23B
22a

(b)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32c
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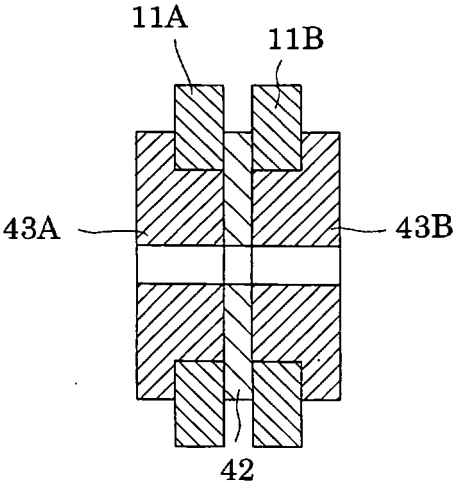
33B
32a

(c)


11A
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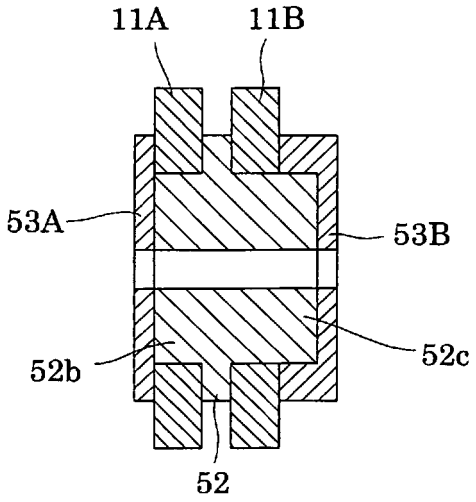
43B
42

FIG. 8

(a)



(b)

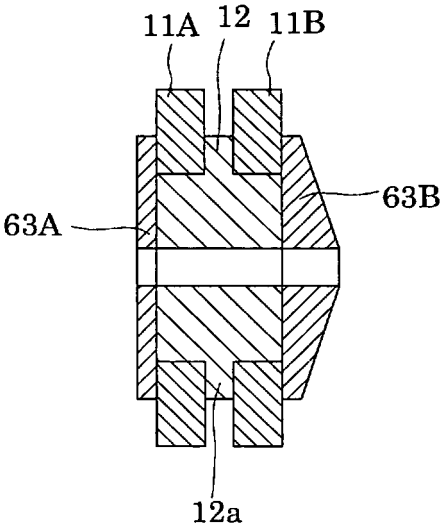
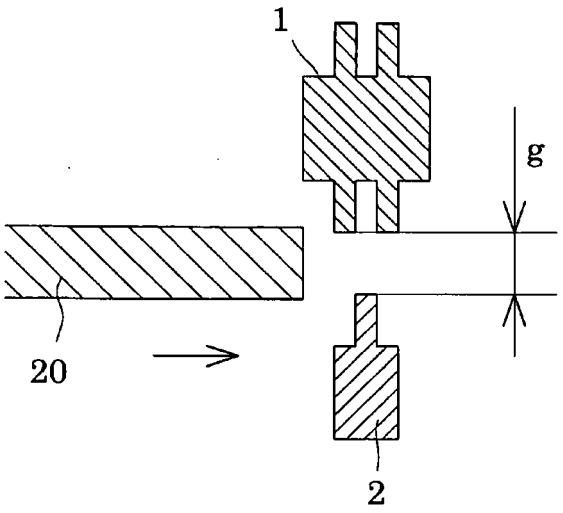


FIG. 9



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/053923

A. CLASSIFICATION OF SUBJECT MATTER
B65H5/06(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B65H5/06

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2010
Kokai Jitsuyo Shinan Koho 1971-2010 Toroku Jitsuyo Shinan Koho 1994-2010

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2006-168965 A (Ricoh Co., Ltd.), 29 June 2006 (29.06.2006), paragraphs [0006] to [0014]; fig. 1 to 17 (Family: none)	1-6
A	JP 2003-327320 A (Japan Storage Battery Co., Ltd.), 19 November 2003 (19.11.2003), entire text; all drawings & WO 2003/095341 A1 & CN 1652986 A & TW 277588 B	1-6

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
10 June, 2010 (10.06.10)	22 June, 2010 (22.06.10)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/053923

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 84279/1984(Laid-open No. 195851/1985) (Ricoh Co., Ltd.), 27 December 1985 (27.12.1985), entire text; all drawings (Family: none)	1-6

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP S57131651 B **[0006]**
- JP S5811443 B **[0006]**