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(54) ADJUSTABLE TAPER ROLLER AND STRIP CONVEYING DEVICE

(57) The present disclosure relates to the field of strip conveying technologies, and in particular, to a tape-adjustable roller and a strip conveying device. The taper-adjustable roller includes a support shaft, a plurality of support sheets, and a first push member. The plurality of support sheets is arranged circumferentially around the support shaft. Circumferential surfaces of the plurality of support sheets at sides of the plurality of support sheets facing away from the support shaft are assembled to form a roll surface. Each of the plurality of support sheets has a first end and a second end in an axial direction of the support shaft, and the plurality of support sheets is swingable relative to the support shaft. The first push member is disposed on the support shaft, and is configured to push the first ends of the plurality of support sheets in a substantially radial direction, to move the first ends towards the support shaft and move the second ends away from the support shaft, or to move the first ends away from the support shaft and move the second ends towards the support shaft, enabling a diameter of the roll surface to gradually vary from the first ends to the second ends. A taper of the roll surface of the taper-adjustable roller according to the present disclosure can be adjusted based on tightness of a strip at two sides. When the strip passes the roll surface, a tension difference between the two sides of the strip and occurrence of wrinkling, tearing or deformation of the strip can be reduced.

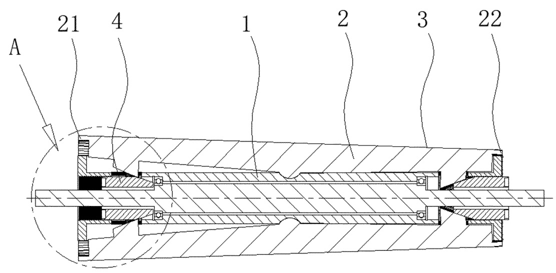

FIG. 3

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Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims a priority to Chinese Patent Application No. 202111414886.0, titled "TAPER-ADJUSTABLE ROLLER AND STRIP CONVEYING DEVICE", and filed with China National Intellectual Property Administration on November 25, 2021, the entire contents of which are incorporated herein by reference.

FIELD

[0002] The present disclosure relates to the field of strip conveying technologies, and in particular, to a tape-adjustable roller and a strip conveying device.

BACKGROUND

[0003] Roller members are required in the battery manufacturing industry, paper industry, coating industry, etc. The roll members are not only configured to wind a strip, but also are configured to convey the strip.

[0004] In a conveying process of the strip, since there is a tension difference between left and right sides of the strip or a difference in device commissioning, a wrinkle phenomenon often occurs in the conveying process of the strip, i.e., the two sides in a width direction of the strip is inconsistent with tightness. The strip may be wrinkled in a looser side of the strip, or the strip may be torn or deformed in a tighter side of the strip.

SUMMARY

[0005] In view of the above problems, embodiments of the present disclosure provide a taper-adjustable roller and a strip conveying device. A taper of a roll surface of the taper-adjustable roller can be adjusted based on tightness of a strip at two sides. When the strip passes the roll surface, an end of the roll surface with a larger diameter corresponds to a looser side of the strip, and an end of the roll surface with a smaller diameter corresponds to a tighter side of the strip, thereby reducing a tension difference between the two sides of the strip, and reducing occurrence of wrinkling, tearing, or deformation of the strip.

[0006] According to one embodiment of the embodiments of the present disclosure, a taper-adjustable roller is provided. The taper-adjustable roller includes a support shaft, a plurality of support sheets, and a first push member. The plurality of support sheets is arranged circumferentially around the support shaft. Circumferential surfaces of the plurality of support sheets at sides of the plurality of support sheets facing away from the support shaft are assembled to form a roll surface. Each of the plurality of support sheets has a first end and a second end in an axial direction of the support shaft, and the plurality of support sheets is swingable relative to the support shaft. The first push member is disposed on the support shaft, and is configured to push the first ends of the plurality of support sheets in a substantially radial direction, to move the first ends towards the support shaft and move the second ends away from the support shaft, or to move the first ends away from the support shaft and move the second ends towards the support shaft, enabling a diameter of the roll surface to gradually vary from the first ends to the second ends.

[0007] With the above solution, when the taper-adjustable roller is configured to convey the strip, the end of the roll surface with the larger diameter is configured to contact with the looser side of the strip, and the end of the roll surface with the smaller diameter is configured contact with the tighter side of the strip. A contact area between the looser side of the strip and the roll surface is larger, and a contact area between the tighter side of the strip and the roll surface is smaller, which enables the looser side of the strip to be tightened by the taper-adjustable roller, to balance the tightness of the strip at the two sides in a width direction of the strip and reduce the tension difference between the two sides of the strip, thereby reducing occurrence of wrinkling, tearing, or deformation of the strip.

[0008] In some embodiments, the taper-adjustable roller further includes a converging member configured to press and/or tension the plurality of support sheets towards the support shaft, enabling the plurality of support sheets to tend to converge towards the support shaft

[0009] With the above solution, the converging member enables the plurality of support sheets to tend to converge towards the support shaft, to prevent the plurality of support sheets from being disengaged from the support shaft and being dispersed due to the pushing of the first push member, which ensures structural integrity and stability of the taper-adjustable roller.

[0010] In some embodiments, the taper-adjustable roller further includes a second push member configured to support the second ends of the plurality of support sheets in the substantially radial direction.

[0011] With the above solution, the diameter of the roll surface of the taper-adjustable roller can be adjusted to gradually decrease from the first ends to the second ends or gradually increase from the first ends to the second ends based on requirements through the engagement between the first push member and the second push member. Therefore, without changing a mounting position and a mounting direction of the taper-adjustable roller, the taper-adjustable roller can be configured to adjust the tightness of the strip at the two sides in different tensions, which allows the taper-adjustable roller to be more adaptable, have a wider range of disclosures, and be more convenient to use.

[0012] In some embodiments, each of the plurality of support sheets is provided with a swing support portion. The swing support portion is engaged with the support shaft to support the support sheet to swing on the support shaft about the swing support portion.

[0013] With the above solution, the plurality of support sheets swings on the support shaft about the swing support portion, which enables a swing region and a swing amplitude of the support sheets to be more controllable, and facilitates the taper-adjustable roller to be applied in actual production.

[0014] In some embodiments, the taper-adjustable roller further includes a limit portion provided at the support shaft and configured to limit the swing support portion to swing within a range limited by the limit portion.

[0015] With the above solution, the swing support portion engages with the limit portion, which enables the plurality of support sheets to drive the swing support portion to swing within the range limited by the limit portion, and further improves controllability of the swing region and the swing amplitude of the plurality of support sheets.

[0016] In some embodiments, the limit portion has a recess formed at the support shaft, and the swing support portion partially swings in the recess.

[0017] With the above solution, the recess defines a position of the swing support portion at the support shaft, which allows the plurality of support sheets to swing within the groove and not easy to disengage from the recess in the axial direction of the support shaft when the plurality of support sheets is pushed by the first push member or the second push member. The roll surface formed by the plurality of support sheets is therefore substantially constant in the axial direction of the taper-adjustable roller, which facilitates conveying of the strips on a fixed path.

[0018] In some embodiments, a contact portion between the swing support portion and the recess has an arc shape.

[0019] With the above solution, the swing support portion swings more smoothly in the recess.

[0020] In some embodiments, the first push member has a first push conical surface, and the first push conical surface has an axis direction parallel to the axial direction of the support shaft. The first push member is movable in the axial direction of the support shaft, to bring the first ends of the plurality of support sheets to be into sliding contact with the first push conical surface, and to push the first ends of the plurality of support sheets by the first push conical surface to move close to or away from the support shaft.

[0021] With the above solution, when the first push member moves in the axial direction of the support shaft and the plurality of support sheets does not move in the axial direction of the support shaft, the first push conical surface can convert a movement of the first push member in the axial direction of the support shaft into swing of the plurality of support sheets. That is, when the first push member moves in the axial direction of the support shaft, the first push conical surface slides relative to the plurality of support sheets, bringing the first ends of the plurality of support sheets to gradually move close to or away from the support shaft.

[0022] In some embodiments, each of the plurality of support sheets is provided with a first adjustment portion protruding towards the first push member, and the first adjustment portion has a first contact surface in sliding contact with the first push conical surface.

[0023] With the above solution, a relative movement between the plurality of support sheets and the first push member is realized through the sliding contact between the first contact surface and the first push conical surface, which makes the plurality of support sheets and the first push member to have a larger force surface and less wear during the relative movement therebetween.

[0024] In some embodiments, the first push member is threadedly connected to the support shaft in the axial direction of the support shaft.

[0025] With the above solution, when the first push member rotates around the support shaft, a position of the first push member in the axial direction of the support shaft can be adjusted, thereby enabling the first push member to push the first ends of the plurality of support sheets to move close to or away from the support shaft. When the first push member moves to a position, self-locking can be performed by the threaded connection. Therefore, the first push member cannot move under the pushing of the plurality of support sheets, ensuring stability of the taper of the roll surface formed by the plurality of support sheets.

[0026] In some embodiments, the second push member has a second push conical surface, and the second push conical surface has an axis direction parallel to the axial direction of the support shaft. The second push member is movable in the axial direction of the support shaft, to bring the second ends of the plurality of support sheets to be into sliding contact with the second push conical surface.

[0027] With the above solution, when the second push member moves in the axial direction of the support shaft and the plurality of support sheets does not move in the axial direction of the support shaft, the second push conical surface can convert a movement of the second push member in the axial direction of the support shaft into the swing of the plurality of support sheets in the radial direction of the support shaft. That is, when the second push member moves in the axial direction of the support shaft, the second push conical surface slides relative to the plurality of support sheets, bringing the second ends of the plurality of support sheets to gradually move close to or away from the support shaft.

[0028] In some embodiments, each of the plurality of support sheets is provided with a second adjustment portion protruding towards the second push member, and the second adjustment portion has a second contact surface in sliding contact with the second push conical surface.

[0029] With the above solution, a relative movement between the plurality of support sheets and the second push member is realized through the sliding contact between the second contact surface and the second push conical surface, which makes the plurality of support sheets and the second push member to have a larger force surface and less wear during the relative movement therebetween.

[0030] In some embodiments, each of the plurality of support sheets includes a roll surface forming portion and a positioning portion. A surface of the roll surface forming portion at least partially forms the roll surface. The positioning portion is located at a radially inner side of the roll surface forming portion. The support shaft is provided with stop portions, and the stop portions are respectively disposed at two ends of the support shaft. The stop portions are engaged with the positioning portion to limit an axial movement of the support sheet.

[0031] With the above solution, the stop portions can position the plurality of support sheets in the axial direction of the support shaft, enabling each of the plurality of support sheets to swing only within a range limited by the stop portion. Under an action of the first push member or second push member, the plurality of support sheets cannot easily move in the axial direction of the support shaft, and the taper-adjustable roller is more structurally stable. In addition, the roll surface formed by the plurality of support sheets is more regular, and the taper of the roll surface is more controllable.

[0032] In some embodiments, the support shaft includes an inner shaft and an outer shaft having a through hole in an axial direction of the outer shaft. The inner shaft is disposed in the through hole and configured to rotatably support the outer shaft, and the plurality of support sheets is connected to the outer shaft.

[0033] With the above solution, the inner shaft can be configured to fix the taper-adjustable roller to an external device. Since the inner shaft rotatably supports the outer shaft, when the inner shaft is fixedly connected to the external device, the outer shaft is able to rotate around the inner shaft to convey the strip under a friction of the strip and reduce the tear of the strip to avoid damage to the strip.

[0034] In some embodiments, the first push member is disposed between the outer shaft and the inner shaft. The plurality of support sheets at least partially penetrates a sidewall of the outer shaft to be in sliding contact with the first push member.

[0035] With the above solution, the first push member is arranged between the inner shaft and the outer shaft. Therefore, the first push member does not occupy the space between the support shaft and the plurality of support sheets, allowing a larger range for taper adjustment of the plurality of support sheets to be possible outside the support shaft.

[0036] According to another embodiment of the embodiments of the present disclosure, a strip conveying device is provided. The strip conveying device includes the taper-adjustable roller according to any one of the above embodiments of the present disclosure.

[0037] With the above solution, the tightness of the strip at the two sides can be adjusted by the taper-adjustable roller during the conveying process, which reduces problems of wrinkling, deformation, and tearing of the strip.

[0038] According to the embodiments of the present disclosure, the first push member pushes the plurality of support sheets, which allows the diameter of the roll surface formed by the plurality of support sheets to change gradually from the first ends to the second ends to form a conical surface. When the tape-adjustable roller is configured to convey the strip, the end of the roll surface with the larger diameter can be configured to contact the looser side of the strip, and the end of the roll surface with the smaller diameter can be configured to contact the tighter side of the strip. The contact area between the looser side of the strip and the roll surface is larger, and the contact area between the tighter side of the strip and the roll surface is smaller, which enables the looser side of the strip to be tightened by the taper-adjustable roller, to balance the tightness of the strip at the two sides in the width direction of the strip and to reduce the tension difference between the two sides of the strip, thereby reducing occurrence of wrinkling, tearing, and deformation of the strip.

[0039] The above description is merely an overview of the technical solutions of the embodiments of the present disclosure. To facilitate a clear understanding of technical means of the embodiments of the present disclosure to implement the technical solutions in accordance with the contents of the specification, and to clarify and explain the above and other objects, features, and advantages of the present disclosure, specific embodiments of the present disclosure will be described below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0040] In order to clearly explain technical solutions of embodiments of the present disclosure, drawings used in the description of the embodiments are briefly described below. The drawings as described below are merely some embodiments of the present disclosure. Based on these drawings, other drawings can be obtained by those skilled in the art without creative effort.

FIG. 1 is a schematic view of an overall structure of a tape-adjustable roller according to an embodiment of the present disclosure.

FIG. 2 is a sectional view of the tape-adjustable roller in a first state according to the embodiment of the present disclosure.

FIG. 3 is a sectional view of the taper-adjustable roller in a second state according to the embodiment of the present disclosure.

FIG. 4 is a schematic exploded view of the tape-adjustable roller according to an embodiment of the present disclosure.

FIG. 5 is a sectional view of a tape-adjustable roller according to another embodiment of the present disclosure.

FIG. 6 is a sectional view of a tape-adjustable roller according to further another embodiment of the present disclosure.

FIG. 7 is a sectional view of a tape-adjustable roller according to still another embodiment of the present disclosure.

FIG. 8 is a schematic view of a structure of a first push member according to an embodiment of the present disclosure.

FIG. 9 is an enlarged view of a portion A in FIG. 3.

FIG. 10 is a schematic view of a structure of a second push member according to an embodiment of the present disclosure.

FIG. 11 is an enlarged view of a portion B in FIG. 6.

FIG. 12 is a schematic view of a structure of support sheets according to an embodiment of the present disclosure.

FIG. 13 is a sectional view of a support shaft according to an embodiment of the present disclosure.

FIG. 14 is a schematic view of a structure of a support shaft according to an embodiment of the present disclosure.

[0041] Reference numbers of the accompanying drawings are illustrated below:

1 support shaft; 11 limit portion; 111 recess; 12 positioning groove; 13 inner shaft; 14 outer shaft; 141 through hole; 15 bearing; 16 stop portion; 2 support sheet; 21 first end; 22 second end; 23 swing support portion; 24 first adjustment portion; 241 first contact surface; 25 roll surface forming portion; 26 positioning portion; 27 second adjustment portion; 271 second contact surface; 3 roll surface ; 4 first push member; 41 first push conical surface; 5 converging member; 6 second push member; 61 second pushing conical surface.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0042] In order to make objectives, technical solutions and advantages of embodiments of the present disclosure clearer, the technical solutions of embodiments of the present disclosure will be clearly and completely described below in conjunction with accompanying drawings in the present disclosure. Obviously, the embodiments described below are only part of the embodiments of the present disclosure and are not all embodiments of the present disclosure. Based on the embodiments of the present disclosure, other embodiments obtained by those skilled in the art without creative labor are within scope of the present disclosure.

[0043] Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by those skilled in the art of the present disclosure. Terms in a specification of the present disclosure herein are only used for the purpose of describing specific embodiments, and are not intended to limit the present disclosure.

[0044] Terms "including", "having", and any variations thereof in the specification, claims, and accompanying drawings of the present disclosure are intended to cover non-exclusive inclusions. The word "one" or "a" does not preclude the existence of more than one.

[0045] In the present disclosure, reference to "embodiment" means that a particular feature, structure, or characteristic described in conjunction with the embodiment or implementation may be included in at least one embodiment of the present disclosure. The presence of the term at each place in the specification does not necessarily refer to the same embodiment, nor does it refer to a separate or alternative embodiment that is mutually exclusive of other embodiments. It should be understood by those skilled in the art, both explicitly and implicitly, that the embodiments described herein may be combined with other embodiments.

[0046] In the present disclosure, the term "and/or" only represents a relationship between correlated objects, including three relationships. For example, "A and/or B" may mean three situations: A only, B only, or both A and B. In addition, the character "/" in the present disclosure generally represents an "or" relationship between the correlated objects preceding and succeeding the symbol.

[0047] Orientation words shown in the following descriptions are in the directions shown in the drawings and are not intended to limit a specific structure of a taper-adjustable roller or a strip conveying device of the present disclosure. For example, in the description of the embodiments of the present disclosure, the orientation or the position indicated by terms such as "center", "longitudinal", "lateral", "length", "width", "thickness", "over", "below", "front", "rear", "left", "right", "vertical", "horizontal", "top", "bottom", "inner", "outer", "clockwise", "anti-clockwise", "axial", "radial", and "circumferential" should be construed to refer to the orientation and the position as shown in the drawings, and is only for the convenience of describing the embodiments of the present disclosure and simplifying the description, rather than indicating or implying that the pointed device or element must have a specific orientation, or be constructed and operated in a specific orientation, and therefore cannot be understood as a limitation of the embodiments of the present disclosure.

[0048] In addition, in the specification and claims of the present disclosure or in the above-mentioned drawings, the terms "first", "second", etc. are used to distinguish different objects, rather than describing a particular order, and may expressly or impliedly include one or more of such features.

[0049] In the description of the embodiments of the present disclosure, unless otherwise specifically defined, "a plurality of' refers to more than two (including two). Similarly, "a plurality of groups" refers to more than two groups (including two groups).

[0050] In the description of the present disclosure, it should be noted that terms such as "installed", "connected", and "coupled" should be understood in a broad sense, unless otherwise clearly specified and limited. For example, the "connected" or "coupled" of a mechanical structure may refer to a physical connection. The physical connection may be a fixed connection, e.g., by means of fixing members. The connection may be fixed by screws, bolts or other fixings. The physical connection may also be a detachable connection, such as a mutual snap-fit or snap-fit connection. In addition, the physical connection may also be an integral connection, such as welded, bonded, or integrally molded to form a connection to attachment. The "connected" or "coupled" of a circuit structure may refer not only to a physical connection, but also to an electrical or signaling connection. For example, it may be a direct connection, i.e., a physical connection, or an indirect connection through at least one intermediate element. As long as the circuit is connected, the connection may be internal to the two elements. In addition to a signal connection through a circuit, the signal connection can also refer to a signal connection through a media medium such as radio waves. For those of ordinary skill in the art, the specific meaning of the above-mentioned terms in the present disclosure can be understood according to specific circumstances.

[0051] Common strips in production include paper, clothes, plastic films, battery electrode plates, battery isolation films, etc. These strips need to be transferred from one process to another process in a production process, or need to be unwound, transported, and wound in the same process.

[0052] Taking battery manufacturing as an example, an electrode plate of a battery needs to undergo many processes in the production process, such as coating, cold pressing, die cutting, striping, and winding, and each of the processes needs to be carried out during a conveying process of the electrode plate. However, it has been found in the production process that the electrode plate often appears wrinkles, deformation, or tears.

[0053] It was found through research that the above problems are due to an inevitable occurrence of different tension at two sides in a width direction in a process of conveying the electrode plate in a length direction. Since there is a tension difference between the two sides of the electrode plate, the strip does not have the same tightness at the two sides of the strip in the conveying process. The electrode plate may be wrinkled in a looser side of the electrode plate, and the electrode plate may be torn or deformed due to a larger force in a tighter side of the electrode plate.

[0054] In view of the above problems, embodiments of the present disclosure provide a tape-adjustable roller. A taper of a roll surface of the tape-adjustable roller is adjustable based on tightness at the two sides of the strip. When the strip passes the roll surface, an end of the roll surface with a larger diameter corresponds to the looser side of the strip, and another end of the roll surface with a smaller diameter corresponds to the tighter side of the strip, thereby reducing a tension difference between the two sides of the strip, and reducing occurrence of wrinkling, tearing, or deformation of the strip.

[0055] As shown in FIG 1, FIG 2, FIG 3, and FIG 4, the taper-adjustable roller of the embodiments of the present disclosure includes a support shaft 1, a plurality of support sheets 2, and a first push member 4. The plurality of support sheets 2 is arranged circumferentially around the support shaft 1. Circumferential surfaces of the plurality of support sheets 2 at sides of the plurality of support sheets 2 facing away from the support shaft 1 are assembled to form a roll surface 3. Each of the plurality of support sheets 2 has a first end 21 and a second end 22 in an axial direction of the support shaft 1, and the plurality of support sheets 2 is swingable relative to the support shaft 1. The first push member 4 is disposed on the support shaft 1. The first push member 4 is configured to push the first ends 21 of the plurality of support sheets 2 in a substantially radial direction, to move the first ends 21 toward the support shaft 1 and move the second ends 22 away from the support shaft 1, or to move the first ends 21 away from the support shaft 1 and move the second ends 22 toward the support shaft 1, such that a diameter of the roll surface 3 gradually varies from the first end 21 to the second end 22.

[0056] The entire support shaft 1 is in a shape of a shaft rod, which may be an integral member or an assembled member. The support shaft 1 provides support and positioning for the plurality of support sheets 2, enabling the plurality of support sheets 2 to be arranged with respect to the support shaft 1 as a center and to be converged or dispersed with respect to the support shaft 1 as the center. The support shaft 1 may further be configured to fix the tape-adjustable roller to an external device, such as a rack of a strip conveying device.

[0057] The plurality of support sheets 2 is arranged circumferentially around the support shaft 1. In FIG. 4, the plurality of support sheets 2 is partially illustrated to facilitate a clear view of a structure of the plurality of support sheets 2. It can be understood that more support sheets 2 are arranged more densely in an actual use process. When a distance between a side of the plurality of support sheets 2 away from the support shaft 1 and the support shaft 1 is approximately equal, connecting lines of the side of the plurality of support sheets 2 away from support shaft 1 forms an enclosed polygon. When the number of the support sheets 2 is large enough, the polygon may be approximately circle, i.e., the plurality of support sheets 2 is combined at the side facing away from the support shaft 1 to form an approximately cylindrical structure as the roll surface 3.

[0058] The first push member 4 is configured to push the first ends 21 of the plurality of support sheets 2 in the substantially radial direction. A pushing direction may be a direction toward the support shaft 1 in the substantially radial direction to move the first ends 21 toward the support shaft 1 and move the second ends 22 away from the support shaft 1, or may be a direction away from the support shaft 1 in the substantially radial direction to move the first ends 21 away from the support shaft 1 and move the second ends 22 toward the support shaft 1. The substantially radial direction refers to a direction that is within 90° with respect to a radial direction of the support shaft 1.

[0059] In order to always form a cylindrical or conical roll surface 3 among the plurality of support sheets 2, the first push member 4 needs to be able to push the plurality of support sheets 2 simultaneously and move the plurality of support sheets 2 in a substantially same displacement in respective radial directions where the plurality of support sheets 2 is located. On the basis of satisfying this condition, a shape and a structure of the first push member 4 can be arbitrarily selected, which is not limited by the embodiments of the present disclosure.

[0060] It should be noted that the first push member 4 is not limited to push the first ends 21 of the plurality of support sheets 2 by contacting tips of the first ends 21 of the plurality of support sheets 2, and the first push member 4 may contact a position within a region of a half length of the plurality of support sheets 2 close to the first ends 21 in a length direction, to push the first ends of the plurality of support sheets 2.

[0061] When a distance between different positions of the plurality of support sheets 2 and the support shaft 1 changes, the diameter of the roll surface 3 also changes. When different positions of the plurality of support sheets 2 have different distance from the support shaft 1, the roll surface 3 has different diameters at different positions. The embodiment of the present disclosure utilizes this principle to control the distances from the plurality of support sheets 2 to the support shaft 1 through the first push member 4, which enable the diameter of the roll surface 3 to vary. When the first push member 4 only pushes the first ends 21 of the plurality of support sheets 2, a diameter of each of the first ends 21 can be changed, which enables that the diameter of the roll surface 3 varies in a direction from the first end 21 to the second end 22 of the roll surface 3. This means that the roll surface 3 has a taper, and the taper of the roll surface 3 may be adjusted by the first push member 4 to allow the roll surface 3 to accommodate a tension difference between two sides of the strip in a width direction. The tape-adjustable roller in FIG. 2 is in an initial state, and in this case, the first push member 4 has not pushed the plurality of support sheets 2 outwards or inwards. Therefore, the roll surface 3 of the tape-adjustable roller is in a column shape. FIG. 3 shows a state after the first push member 4 pushes the first ends of the plurality of support sheets 2 outwardly, and in this case, the diameter of the roll surface 3 of the tape-adjustable roller gradually decreases from the first end 21 to the second end 22 of the roll surface 3. In addition, the roll surface 3 is a conical surface.

[0062] With the above solution, when the taper-adjustable roller is configured to convey the strip, the strip wraps a part of the roll surface 3 of the taper-adjustable roller. The end of the roll surface 3 with the larger diameter is configured to contact with the looser side of the strip, and the end of the roll surface 3 with the smaller diameter is configured to contact with the tighter side of the strip. In the case that a wrap angle between the width direction of the strip and the roll surface 3 is substantially unchanged, a contact area between the looser side of the strip and the roll surface is larger, and a contact area between the tighter side of the strip and the roll surface is smaller, which enables the looser side of the strip to be tightened by the taper-adjustable roller, to balance the tightness of the two sides of the strip in the width direction of the strip and reduce the tension difference between the two sides of the strip, thereby reducing occurrence of wrinkling, tearing or deformation of the strip.

[0063] As shown in FIG. 5, in some embodiments, the tape-adjustable roller further includes a converging member 5. The converging member 5 is configured to press and/or tension the plurality of support sheets 2 toward the support shaft 1, such that the plurality of support sheets 2 tends to converge toward the support shaft 1.

[0064] The converging member 5 may be disposed at the side of the plurality of support sheets 2 facing away from the support shaft 1. For example, as shown in FIG. 5, the converging member 5 is an elastic rubber sleeve arranged around the roll surface 3 at an outer side of the plurality of support sheets 2, and the plurality of support sheets 2 is converged toward the middle under a pressing action of the elastic rubber sleeve. The elastic rubber sleeve may be rubber, plastic, silicone, resin materials, and the like. In addition, the elastic rubber sleeve may be partially arranged around the plurality of support sheets 2, e.g., the elastic rubber sleeve may be arranged around an end of the plurality of support sheets 2, a middle portion of the plurality of support sheets 2, and the like. The elastic rubber sleeve may also be relatively wide to be arranged around the whole roll surface 3, which can not only be used to press the plurality of support sheets 2 toward the middle, but also cover gaps between adjacent support sheets 2, preventing the strip from being cracked in the gaps between the adjacent support sheets 2.

[0065] The converging member 5 may be disposed at the side of the plurality of support sheets 2 close to the support shaft 1. For example, the converging member 5 is a spring, and a plurality of springs is provided. Each of the plurality of springs is respectively connected to the support shaft 1 and one of the plurality of support sheets 2. The plurality of support sheets 2 tends to move towards the support shaft 1 under a pulling force of the plurality of springs. The converging member 5 may be a tension band, an elastic adhesive strip, and the like, which is not limited by the embodiments of the present disclosure.

[0066] In absence of an external force, the converging member 5 converges the plurality of support sheets 2 towards the support shaft 1 to form a compact and small diameter cylindrical or cylindrical-like, conical or conical-like structure around the support shaft 1. When the first push member 4 pushes the plurality of support sheets 2 in the direction away from the support shaft 1, the converging member 5 provides a force for pushing the plurality of support sheets 2 towards the support shaft 1 to resist the pushing force of the first push member 4. In this way, structural integrity of the plurality of support sheets 2 is maintained at a position away from the support shaft 1, preventing the plurality of support sheets 2 from separating from the support shaft 1 and ensuring the structural integrity and stability of the taper-adjustable roller. When the first push member 4 removes the pushing force on each of the plurality of support sheets 2, or when the pushing force applied on each of the plurality of support sheets 2 decreases, the plurality of support sheets 2 converges towards the support shaft 1 by the converging member 5 to reduce the taper of the roll surface 3, thereby achieving the purpose that the taper of the tapered surface of the tape-adjustable roller can be flexibly adjusted.

[0067] As shown in FIG. 6, in some embodiments, the tape-adjustable roller further includes a second push member 6, which is configured to support the second ends 22 of the plurality of support sheets 2 in the substantially radial direction.

[0068] The structure of the second push member 6 is the same as or similar to the structure of the first push member 4, and related descriptions of the first push member 4 in the embodiments of the present disclosure may be applied to the second push member 6. The structure and effect of the second push member 6 in the embodiments of the present disclosure are not described in detail.

[0069] It should be noted that the second push member 6 is not limited to push the second ends 22 of the plurality of support sheets 2 by contacting tips of the second ends 22 of the plurality of support sheets 2. Alternatively, the second push member 6 may contact the plurality of support sheets 2 at a position within the region of the half length of the plurality of support sheets 2 close to the second ends 22 in the length direction.

[0070] According to the above solution, the cooperation between the first push member 4 and the second push member 6 allows the diameter of the roll surface 3 of the tape-adjustable roller to be adjusted to gradually decrease from the first ends 21 to the second ends 22 or gradually increase from the first ends 21 to the second ends 22 based on requirements. Therefore, the taper-adjustable roller is configured to adjust the tightness at the two sides of the strip in different tensions without changing a mounting position and a mounting direction of the taper-adjustable roller. In addition, the mutual cooperation between the first push member 4 and the second push member 6 can not only allow the roll surface 3 of the tape-adjustable roller to form conical surfaces with different tapers, but also allow the roll surfaces 3 of the tape-adjustable roller to form cylindrical surfaces with different diameters, which allows the taper-adjustable roller to be more adaptable, have a wider application range, and be more convenient to use.

[0071] As shown in FIG. 6 and FIG. 7, in some embodiments, each of the plurality of support sheets 2 is provided with a swing support portion 23. The swing support portion 23 is engaged with the support shaft 1 to support the support sheet 2 to swing on the support shaft about the swing support portion 23.

[0072] The swing support portion 23 may be a protrusion provided at the support sheet. The protrusion may abut against the support shaft 1, or may be connected to the support shaft 1 in a hinged manner, which enables that the support sheet 2 can swing on the support shaft 1 about the swing support portion 23.

[0073] With the above solution, the support sheet 2 swings on the support shaft 1 about the swing support portion 23 as a fulcrum, which enables a swing region and a swing amplitude of the support sheet 2 to be more controllable, thereby facilitating the taper-adjustable roller to be applied in actual production.

[0074] As shown in FIG. 6 and FIG. 7, in some embodiments, the tape-adjustable roller further includes a limit portion 11 provided at the support shaft 1, and the limit portion 11 is configured to limit the swing support portion 23 to swing within a region defined by the limit portion 11.

[0075] The limit portion 11 may be a concave structure provided at the support shaft 1, or a hole or a groove provided at the support shaft 1 to be connected to the swing support portion 23 in a hinged manner. The limit portion 11 may be integrally formed with the support shaft 1, or may be a portion attached to the support shaft 1. The limit portion 11 may also be a flexible member, such as a rope. An end of the flexible member is connected to the support shaft 1, and another end of the flexible member is connected to the swing support portion 23, which allow the swing support portion 23 to be limited to swing within a region limited by the flexible member, and further improve controllability of the swing region and the swing amplitude of the plurality of support sheets 2.

[0076] As shown in FIG. 6, the limit portion 11 may be disposed at the middle of the support shaft 1 in the axial direction. As shown in FIG. 7, the limit portion 11 may be disposed close to any end of the support shaft 1.

[0077] It should be noted that, as shown in FIG. 6, a cooperating structure of the swing support portion 23 and the limit portion 11 may be disposed at the middle of the tape-adjustable roller in the length direction. As shown in FIG. 7, the cooperating structure of the swing support portion 23 and the limit portion 11 may also be disposed close to any end of the tape-adjustable roller in the length direction, which is not limited by the embodiments of the present disclosure.

[0078] As shown in FIG. 6 and FIG. 7, in some embodiments, the limit portion 11 has a recess 111 formed at the support shaft 1. The swing support portion 23 partially swings in the recess 111.

[0079] The recess 111 is a structure recessed from a surface of the support shaft 1. The recess 111 may be formed by removing materials from the support shaft 1. This form of limit portion 11 is unnecessary to occupy a space at an outer side of the surface of the support shaft 1.

[0080] When the swing support portion 23 partially swings in the recess 111, an inner wall of the recess 111 abuts against a portion of the swing support portion 23 located in the recess 111. The recess 111 provides a resistance for the swing support portion 23, such that when the support sheet 2 is pushed by the first push member 4 or the second push member 6, the swing support portion 23 swings in the recess 111 and is not easy to disengage from the recess 111 to move in the axial direction of the support shaft 1. In this way, the position of the roll surface 3 formed by the plurality of support sheets 2 is substantially fixed in the axial direction of the tape-adjustable roller, which facilitates conveying of the strips on a fixed path.

[0081] As shown in FIG. 6 and FIG. 7, in some embodiments, a contact portion between the swing support portion 23 and the recess 111 is in an arc shape.

[0082] When the swing support portion 23 rotates along with the support sheet 2 in the recess 111, a contact surface between the swing support portion 23 and the recess 111 is smoother, and rotation resistance is smaller, which enable the swing support portion 23 to swing more smoothly in the recess 111.

[0083] As shown in FIG. 8 and FIG. 9, in some embodiments, the first push member 4 has a first push conical surface 41, which has an axis direction parallel to the axial direction of the support shaft 1. The first push member 4 is movable in the axial direction of the support shaft 1, to bring the first ends 21 of the plurality of support sheets 2 to be into sliding contact with the first push conical surface 41 and push the first ends 21 of the plurality of support sheets 2 against the first push conical surface 41 to move close to or away from the support shaft 1.

[0084] With the above solution, when the first push member 4 moves in the axial direction of the support shaft 1 and the plurality of support sheets 2 cannot move in the axial direction of the support shaft 1, the first push conical surface 41 is configured to convert a movement of the first push member 4 in the axial direction of the support shaft 1 into swing of the plurality of support sheets 2. That is, when the first push member 4 moves in the axial direction of the support shaft 1, the first push conical surface 41 slides relative to the plurality of support sheets 2, to bring the first ends 21 of the plurality of support sheets 2 to move gradually close to or away from the support shaft 1.

[0085] Since the axis direction of the first push conical surface 41 is parallel to the axial direction of the support shaft 1, when the axial direction of the first push conical surface 41 coincides with the axial direction of the support shaft 1, a distance between a generatrix of the first push conical surface 41 and the axial direction of the support shaft 1 is constant. When the first push member 4 moves in the axial direction of the support shaft 1, the first push conical surface 41 drives the plurality of support sheets 2 to simultaneously swing in the same amplitude or similar amplitudes, which enables the plurality of support sheets 2 to form a relatively smooth conical surface at any angle.

[0086] As shown in FIG. 9, in some embodiments, each of the plurality of support sheets 2 is provided with a first adjustment portion 24 protruding towards the first push member 4. The first adjustment portion 24 has a first contact surface 241 in sliding contact with the first push conical surface 41.

[0087] The first adjustment portion 24 protrudes towards the support shaft 1, and the first contact surface 241 is located at an end surface of the first adjustment portion 24 close to an end of the support shaft 1. The first contact surface 241 may be a partial region of the end surface or an entire end surface.

[0088] The first contact surface 241 may be an inclined surface or a curved surface. When the first contact surface 241 is the inclined surface, an inclined direction of the first contact surface 241 is substantially the same as an inclined direction of the first push conical surface 41, which means that the first push conical surface 41 is configured to be gradually close to the support shaft 1 in the direction from the first end 21 to the second end 22. An inclined surface of each of the plurality of support sheets 2 is configured to be gradually close to the support shaft 1 in the direction from the first end 21 to the second end 22. An inclination degree of the first push conical surface 41 and an inclination degree of the inclined surface are not specifically limited. When the first contact surface 241 is the curved surface, an axis of the curved surface is located at a side of the curved surface away from the support shaft 1.

[0089] Although a relative angle between the first contact surface 241 and the first push conical surface 41 may change during the movement of the first push member 4 in the axis of the support shaft 1, engagement between the first contact surface 241 and the first push conical surface 41 can still increase the contact area between the plurality of support sheets 2 and the first push member 4 and absorbing impact when the plurality of support sheets 2 and the first push member 4 move relative to each other, thereby reducing wear between the plurality of support sheets 2 and the first push member 4.

[0090] As shown in FIG. 9, in some embodiments, the first push member 4 is threadedly connected to the support shaft 1 in the axial direction of the support shaft 1.

[0091] With the above solution, when the first push member 4 rotates around the support shaft 1, a position of the first push member 4 in the axial direction of the support shaft 1 can be adjusted, thereby enabling the first push member 4 to push the first ends 21 of the plurality of support sheets 2 to move close to or away from the support shaft 1. When the first push member 4 moves to a position, self-locking can be performed by the threaded connection. Therefore, the first push member 4 cannot move under the pushing of the plurality of support sheets 2, ensuring stability of the taper of the roll surface 3 formed by the plurality of support sheets 2.

[0092] Furthermore, when the first contact surface 241 coincides with the axis of the support shaft 1 and an axis of the threaded connection coincides with the axis of the support shaft 1, distances from the first contact surface

241 to the axis of the support shaft 1 in various directions are the same or substantially the same during the rotation of the first push member 4 relative to the support shaft 1. Therefore, the plurality of support sheets 2 controlled by the first contact surface 241 has the same or substantially same inclination angle from the first ends 21 to the second ends 22, i.e., the first push member 4 pushes each of the plurality of support sheets 2 at the same inclination angle from the first end 21 to the second end 22 during the movement. In this way, the plurality of support sheets 2 forms a more regular conical roll surface 3.

[0093] As shown in FIG. 10 and FIG. 11, in some embodiments, the second push member 6 has a second push conical surface 61, which has an axis direction parallel to the axial direction of the support shaft 1. The second push member 6 is movable in the axial direction of the support shaft 1 to bring the second ends 22 of the plurality of support sheets 2 to be into sliding contact with the second push conical surface 61.

[0094] Possible structures and functions of the second push conical surface 61 are the same as or similar to those of the first push conical surface 41, and are not described in detail in this embodiment of the present disclosure.

[0095] With the above solution, when the second push member 6 moves in the axial direction of the support shaft 1 and the plurality of support sheets 2 does not move in the axial direction of the support shaft 1, the second push conical surface 61 can convert the movement of the second push member 6 in the axial direction of the support shaft 1 into the swing of the plurality of support sheets 2. That is, when the second push member 6 moves in the axial direction of the support shaft 1, the second push conical surface 61 slides relative to the plurality of support sheets 2, to bring the second ends 22 of the plurality of support sheets 2 to move gradually close to or away from the support shaft 1.

[0096] As shown in FIG. 11, in some embodiments, each of the plurality of support sheets 2 is provided with a second adjustment portion 27 protruding towards the second push member 6. The second adjustment portion 27 has a second contact surface 271 in sliding contact with the second push conical surface 61.

[0097] Possible structures and functions of the second adjustment portion 27 are the same as or similar to those of the first adjustment portion 24, and possible structures and functions of the second contact surface 271 are the same as or similar to those of the first contact surface 241. For details, it can refer to descriptions of the related embodiments of the first adjustment portion 24 and the first contact surface 241, and this embodiment of the present disclosure will not be described again.

[0098] With the above solution, a relative movement between the plurality of support sheets 2 and the second push member 6 is achieved through the sliding contact between the second contact surface 271 and the second push conical surface 61, which makes the plurality of support sheets 2 and the second push member 6 to have a larger force surface and less wear during the relative movement therebetween.

[0099] As shown in FIG. 12 and FIG. 13, in some embodiments, each of the plurality of support sheets 2 includes a roll surface forming portion 25 and a positioning portion 26. A surface of the roll surface forming portion 25 at least partially forms the roll surface 3. The positioning portion 26 is located at a radially inner side of the roll surface forming portion 25. The support shaft 1 is provided with stop portions 16, which are disposed respectively at two ends of the support shaft 1. The stop portions 16 are engaged with the positioning portion 26 to limit the axial movement of the support sheet 2.

[0100] The roll surface forming portion 25 extends in the length direction of the tape-adjustable roller, and a portion of the roll surface forming portion 25 that is configured to form the roll surface 3 may be a plane or a curved surface. When a plurality of roll surface forming portions 25 are arranged evenly, the plurality of roll surface forming portions 25 forms a shape approximate to a cylindrical surface or a conical surface between every two adjacent roll surface forming portions.

[0101] The positioning portion 26 may have a length and a width, both of which are smaller than the roll surface forming portion 25. The number of positioning portions 26 may be one or more. The positioning portion 26 may be mounted the outside of the support shaft 1, or a groove may be formed in the support shaft to mount the positioning portion 26 in the groove.

[0102] For example, in an embodiment as shown in FIG. 14, a positioning groove 12 is provided at an outer wall of the support shaft 1. A length direction of the positioning portion 26 is parallel to the length direction of the support shaft 1, and a width direction of the positioning portion 26 is perpendicular to the length direction of the support shaft 1. A width of the positioning portion 26 is smaller than a width of the positioning groove 12, and a length of the positioning portion 26 is smaller than a length of the positioning groove 12, enabling the positioning portion 26 to fit into positioning groove 12. One positioning portion 26 is provided. A bottom surface of the positioning groove 12 has a circular arc shape in the length direction thereof, and the positioning portion 26 has a circular arc shaped surface that engages with the bottom surface of the positioning groove 12. When the plurality of support sheets 2 is pushed by the first push member 4 or the second push member 6, the positioning portion 26 rotates in the positioning groove 12. The positioning portion 26 and the positioning groove 12 can always maintain a circular arc surface contact therebetween in the rotation process. The positioning groove 12 has a better support effect on the plurality of the support sheets 2, and is conducive to the smooth rotation of the plurality of the support sheets 2.

[0103] With the engagement between the positioning portion 26 and the positioning groove 12, each of the plurality of support sheets 2 can only move or rotate within a range limited by the positioning groove 12. The positioning groove 12 can not only position the plurality of support sheets 2 in a circumferential direction of the support shaft 1, but also position the plurality of support sheets 2 in the axial direction of the support shaft 1. The roll surface 3 formed by the plurality of support sheets 2 is more regular, and the structure of the taper-adjustable roller is more stable.

[0104] The support shaft 1 is provided with the stop portions 16 at each of the two ends thereof. A distance between the two stop portions 16 may be greater than a maximum length of the positioning portion 26. Alternatively, a maximum distance exists between two positioning portions 26 of a plurality of positioning portions 26 that are located at two distal ends of the plurality of support sheets 2 in the length direction. In this way, the plurality of support sheets 2 has a movable space in the axis direction of the support shaft 1 in the swing process, to facilitate the plurality of support sheets 2 to swing freely to form the roll surface 3 with different tapers.

[0105] In addition, when the movement region of the plurality of support sheets 2 exceeds a space limited by the two stop portions 16, the two stop portions 16 can position the plurality of support sheets 2 in the axial direction of the support shaft 1. In this way, each of the plurality of support sheets 2 can only swing within the range limited by the stop portions 16. Under an action of the first push member 4 or the second push member 6, the plurality of support sheets 2 cannot easily move in the axial direction of the support shaft 1. Therefore, the structure of the tape-adjustable roller is more stable, and the roll surface 3 formed by the plurality of support sheets 2 is more regular. The taper of the roll surface 3 is more controllable.

[0106] As shown in FIG. 12, in some embodiments, the positioning portion 26 has a width perpendicular to the axial direction of the support shaft 1, which is smaller than a width of the roll surface forming portion 25.

[0107] The roll surface forming portion 25 is configured to form the roll surface 3. The positioning portion 26 is configured to engage with the positioning groove 12 of the support shaft 1. Therefore, the positioning portion 26 is located closer to the support shaft 1 than the roll surface forming portion 25. That is, when the axis of the support shaft 1 is an axle center, a circumference diameter of the roll surface forming portion 25 is larger, and a circumference diameter of the positioning portion 26 is smaller. Therefore, when the width of the positioning portion 26 in a direction perpendicular to the axial direction of the support shaft 1 is smaller than the width of the roll surface forming portion 25, adjacent positioning portions 26 are unlikely to contact before adjacent roll surface forming portions 25 in a process of reducing the diameter of the roll surface 3 formed by the plurality of support sheets 2. Therefore, roll surface forming portions 25 of two adjacent support sheets 2 can freely move close to or away from each other. The diameter of the roll surface 3 of the tape-adjustable roller depends on a spacing between the adjacent roll surface forming portions 25, which enables that flexibility of diameter and taper adjustment of the roll surface forming portion 25 is greater and an adjustment region is wider.

[0108] As shown in FIG. 13 and FIG. 14, in some embodiments, the support shaft 1 includes an inner shaft 13 and an outer shaft 14. The outer shaft 14 has a through hole 141 in an axial direction of the outer shaft 14. The inner shaft 13 is disposed in the through hole 141 and rotatably supports the outer shaft 14, and the plurality of support sheets 2 is connected to the outer shaft 14.

[0109] The inner shaft 13 may be a step shaft, and the through hole 141 of the outer shaft 14 may be a step hole. The inner shaft 13 and the outer shaft 14 may be rotatably engaged in the circumferential direction, i.e., the outer shaft 14 may rotate only and the inner shaft 13 does not move, or only the inner shaft 13 rotates and the outer shaft 14 does not move. This engagement can be realized by a clearance cooperation between the inner shaft 13 and the outer shaft 14 or by mounting a bearing 15 between the inner shaft 13 and the outer shaft 14. In this mounted state, the inner shaft 13 may be fixedly mounted to an external device. In addition, under a friction force of the strip, the outer shaft 14 rotates relative to the inner shaft 13 to convey and tension the strip, and reduces tearing of the strip to prevent damage to the strip.

[0110] As shown in FIG. 12, in some embodiments, the first push member 4 is arranged between the outer shaft 14 and the inner shaft 13. The plurality of support sheets 2 at least partially penetrates a sidewall of the outer shaft 14 to be in sliding contact with the first push member 4.

[0111] With the above solution, the first push member 4 is arranged between the inner shaft 13 and the outer shaft 14. Therefore, the first push member 4 does not occupy the space between the support shaft 1 and the plurality of support sheets 2, allowing a larger region for taper adjustment of the plurality of support sheets 2 to be achieved outside the support shaft 1.

[0112] According to another embodiment of embodiments of the present disclosure, a strip conveying device is provided. The strip conveying device includes the tape-adjustable roller according to any one of the above embodiments of the present disclosure.

[0113] With the above solution, the tightness of the strip at the two sides can be adjusted by the taper-adjustable roller during the conveying process, which reduces problems of wrinkling, deformation and tearing of the strip.

[0114] In conclusion, according to the embodiments of the present disclosure, the first push member 4 pushes the plurality of support sheets 2, which allows the diameter of the roll surface 3 formed by the plurality of support sheets 2 to change gradually from the first ends 21 to the second ends 22 to form a conical surface. When the tape-adjustable roller is configured to convey the strip, the end of the roll surface 3 with the larger diameter can be configured to contact the looser side of the strip, and the end of the roll surface 3 with the smaller diameter can be configured to contact the tighter side of the strip. The contact area between the looser side of the strip and the roll surface 3 is larger, and the contact area between the tighter side of the strip and the roll surface 3 is smaller, which enables the looser side of the strip to be tightened by the taper-adjustable roller, to balance the tightness of the strip at the two sides in the width direction of the strip and reduce the tension difference between the two sides of the strip, thereby reducing occurrence of wrinkling, tearing or deformation of the strip.

[0115] It can be appreciated by those skilled in the art that although some embodiments herein include certain features included in other embodiments, combinations of features of different embodiments are meant to be within the scope of the present disclosure and form different embodiments. For example, any one of the embodiments claimed to be protected may be used in any combination in the claims.

[0116] Each of the above embodiments is used only to illustrate, rather than to limit, the technical solutions of the present disclosure. Although the present disclosure has been described in detail with reference to the foregoing embodiments, it is conceivable for those skilled in the art that modifications can be made to the technical solutions described in the foregoing embodiments, or equivalent replacements can be made to some or all of the technical features in the technical solutions described in the foregoing embodiments. These modifications or equivalent replacements do not depart the essence of corresponding technical solutions from the scope of the technical solutions of the embodiments of the present disclosure.

Claims

1. A taper-adjustable roller, comprising:

   a support shaft;
   a plurality of support sheets arranged circumferentially around the support shaft, circumferential surfaces of the plurality of support sheets at sides of the plurality of support sheets facing away from the support shaft being assembled to form a roll surface, each of the plurality of support sheets having a first end and a second end in an axial direction of the support shaft, and each of the plurality of support sheets being swingable relative to the support shaft; and
   a first push member provided on the support shaft, the first push member being configured to push the first ends of the plurality of support sheets in a substantially radial direction, to move the first ends towards the support shaft and move the second ends away from the support shaft, or to move the first ends away from the support shaft and move the second ends towards the support shaft, enabling a diameter of the roll surface to gradually varying from the first ends to the second ends.

2. The taper-adjustable roller according to claim 1, further comprising:
   a converging member configured to press and/or tension the plurality of support sheets towards the support shaft, enabling the plurality of support sheets to tend to converge towards the support shaft.

3. The taper-adjustable roller according to claim 1 or 2, further comprising:
   a second push member configured to support the second ends of the plurality of support sheets in the substantially radial direction.

4. The taper-adjustable roller according to any one of claims 1 to 3, wherein each of the plurality of support sheets is provided with a swing support portion, the swing support portion being engaged with the support shaft to support the support sheet to swing on the support shaft about the swing support portion.

5. The taper-adjustable roller according to claim 4, further comprising:
   a limit portion provided at the support shaft and configured to limit the swing support portion to swing within a range limited by the limit portion.

6. The taper-adjustable roller according to claim 5, wherein the limit portion has a recess formed at the support shaft, the swing support portion partially swinging in the recess.

7. The taper-adjustable roller according to claim 6, wherein a contact portion between the swing support portion and the recess has an arc shape.

8. The taper-adjustable roller according to any one of claims 1 to 7, wherein the first push member has a first push conical surface, the first push conical surface having an axis direction parallel to the axial direction of the support shaft; and
   the first push member is movable in the axial direction of the support shaft, to bring the first ends of the plurality of support sheets to be into sliding contact with the first push conical surface, and to push the first ends of the plurality of support sheets by the first push conical surface to move close to or away from the support shaft.

9. The taper-adjustable roller according to claim 8, wherein each of the plurality of support sheets is provided with a first adjustment portion protruding towards the first push member, the first adjustment portion having a first contact surface in sliding contact with the first push conical surface.

10. The taper-adjustable roller according to claim 8, wherein the first push member is threadedly connected to the support shaft in the axial direction of the support shaft.

11. The taper-adjustable roller according to claim 3, wherein the second push member has a second push conical surface, the second push conical surface having an axis direction parallel to the axial direction of the support shaft; and
the second push member is movable in the axial direction of the support shaft, to bring the second ends of the plurality of support sheets to be into sliding contact with the second push conical surface.

12. The taper-adjustable roller according to claim 11, wherein each of the plurality of support sheets is provided with a second adjustment portion protruding towards the second push member, the second adjustment portion having a second contact surface in sliding contact with the second push conical surface.

13. The taper-adjustable roller according to any one of claims 1 to 12, wherein each of the plurality of support sheets comprises:

a roll surface forming portion, a surface of the roll surface forming portion at least partially forming the roll surface; and
a positioning portion located at a radially inner side of the roll surface forming portion; and
the support shaft is provided with stop portions, the stop portions being respectively disposed at two ends of the support shaft, the stop portions being engaged with the positioning portion to limit an axial movement of the support sheet.

14. The taper-adjustable roller according to any one of claims 1 to 13, wherein the support shaft comprises:

an inner shaft; and
an outer shaft having a through hole in an axial direction of the outer shaft, the inner shaft being disposed in the through hole and configured to rotatably support the outer shaft, and the plurality of support sheets being connected to the outer shaft.

15. The taper-adjustable roller according to claim 14, wherein the first push member is disposed between the outer shaft and the inner shaft; and
the plurality of support sheets at least partially penetrates a sidewall of the outer shaft to be in sliding contact with the first push member.

16. A strip conveying device, comprising the taper-adjustable roller according to claims 1 to 15.

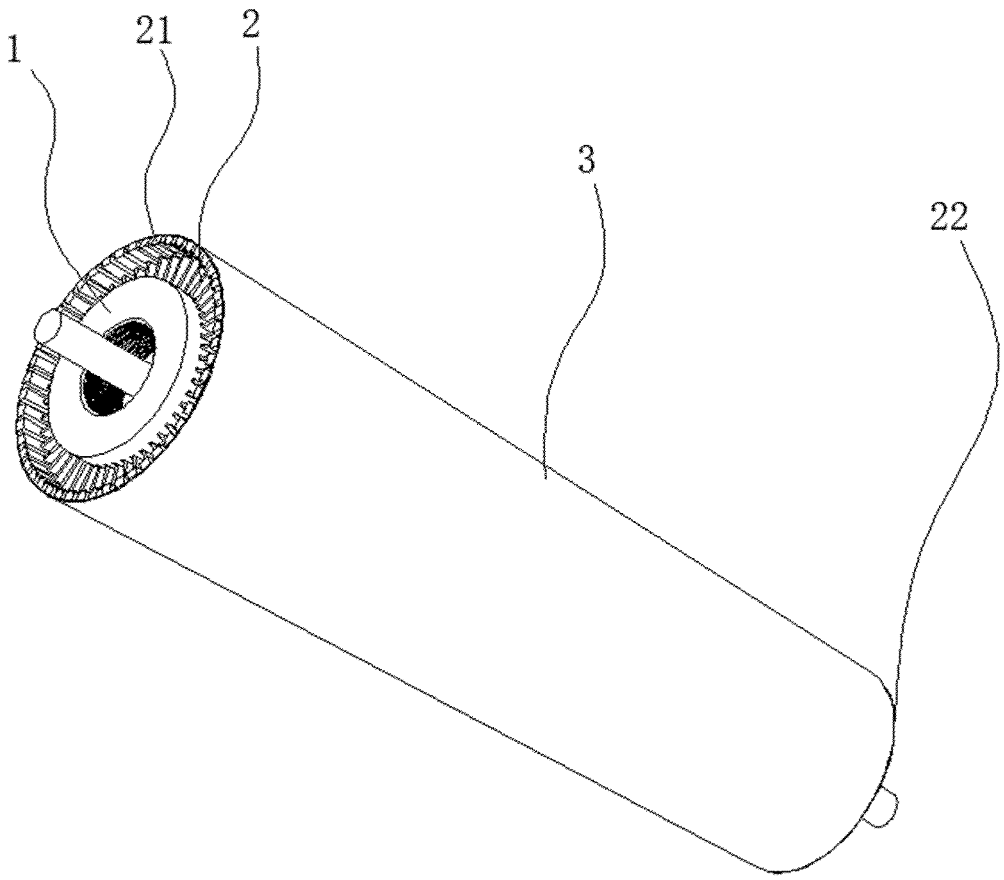


FIG. 1

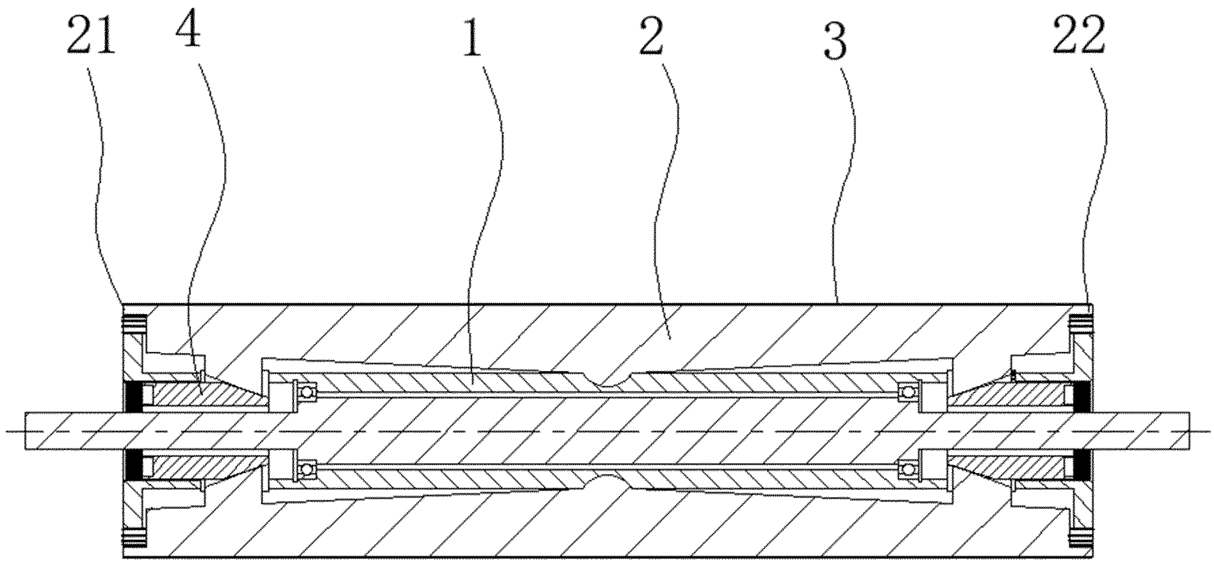


FIG. 2

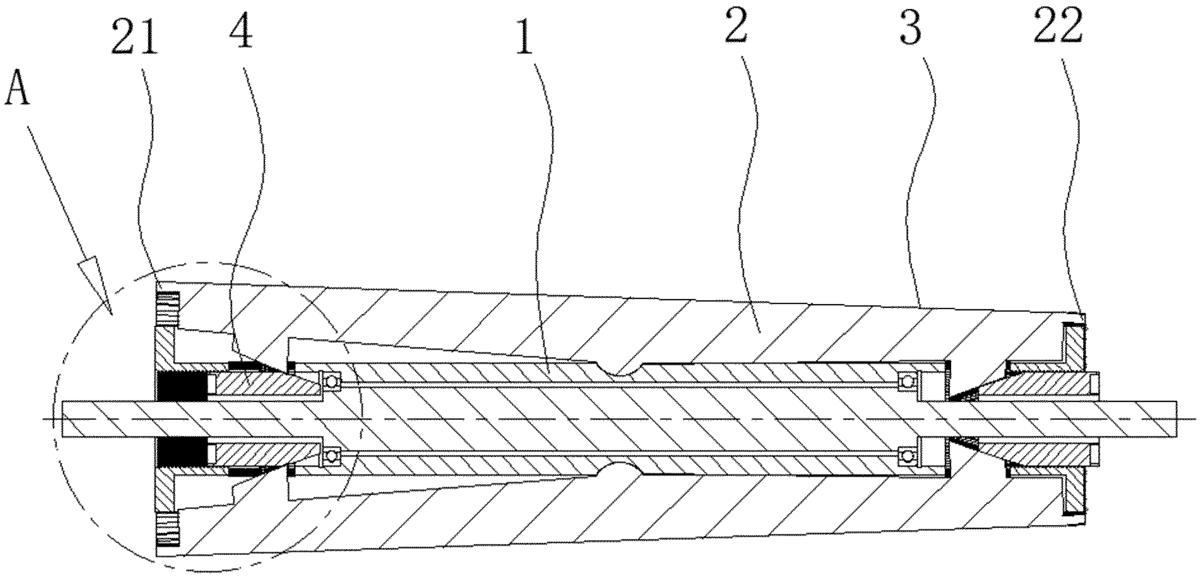


FIG. 3

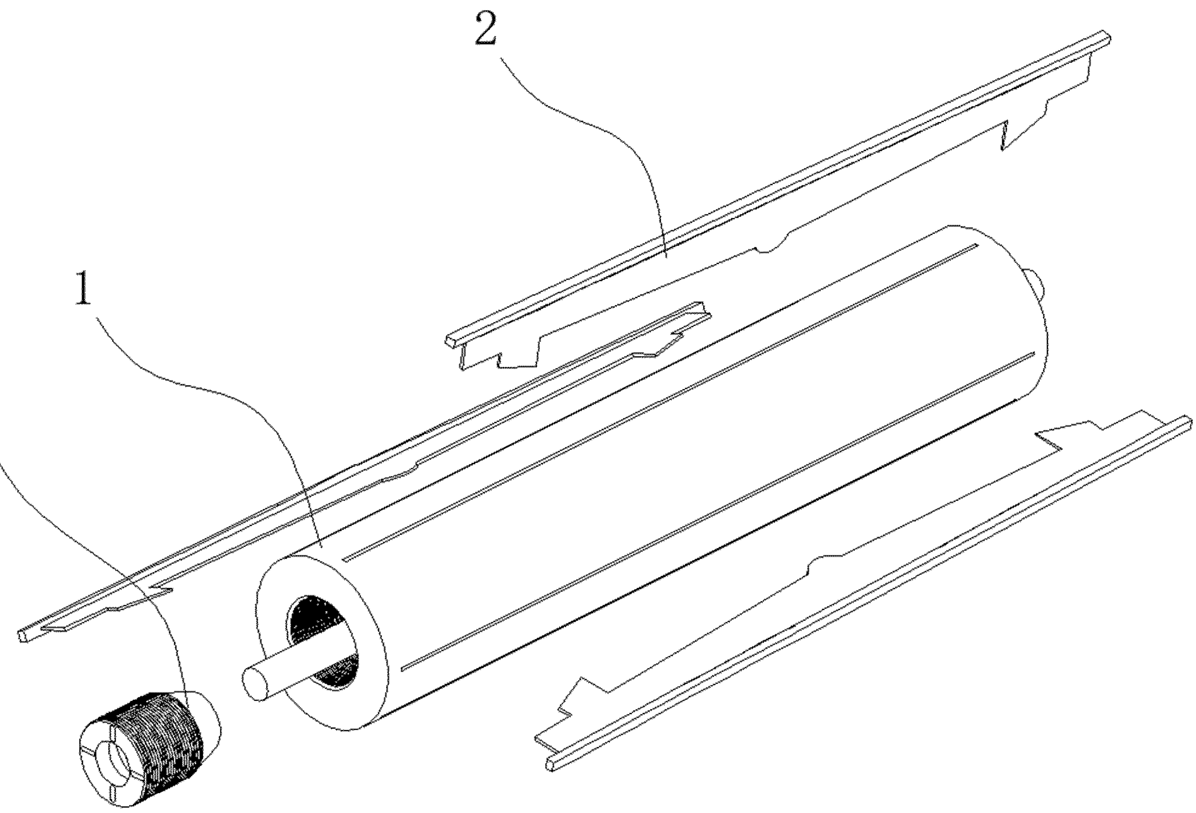


FIG. 4

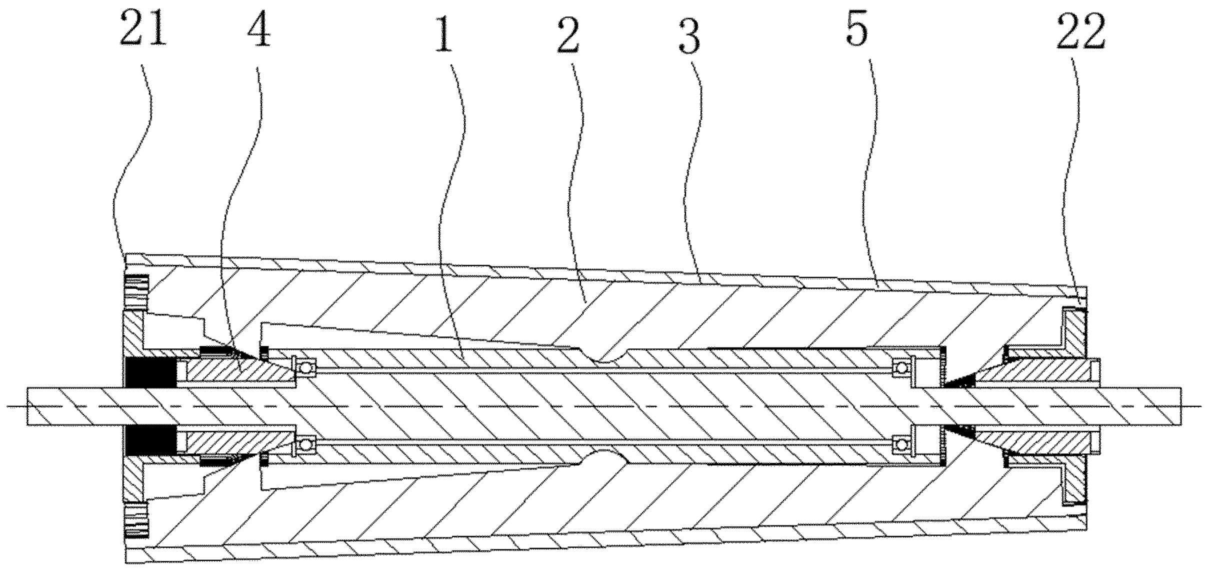


FIG. 5

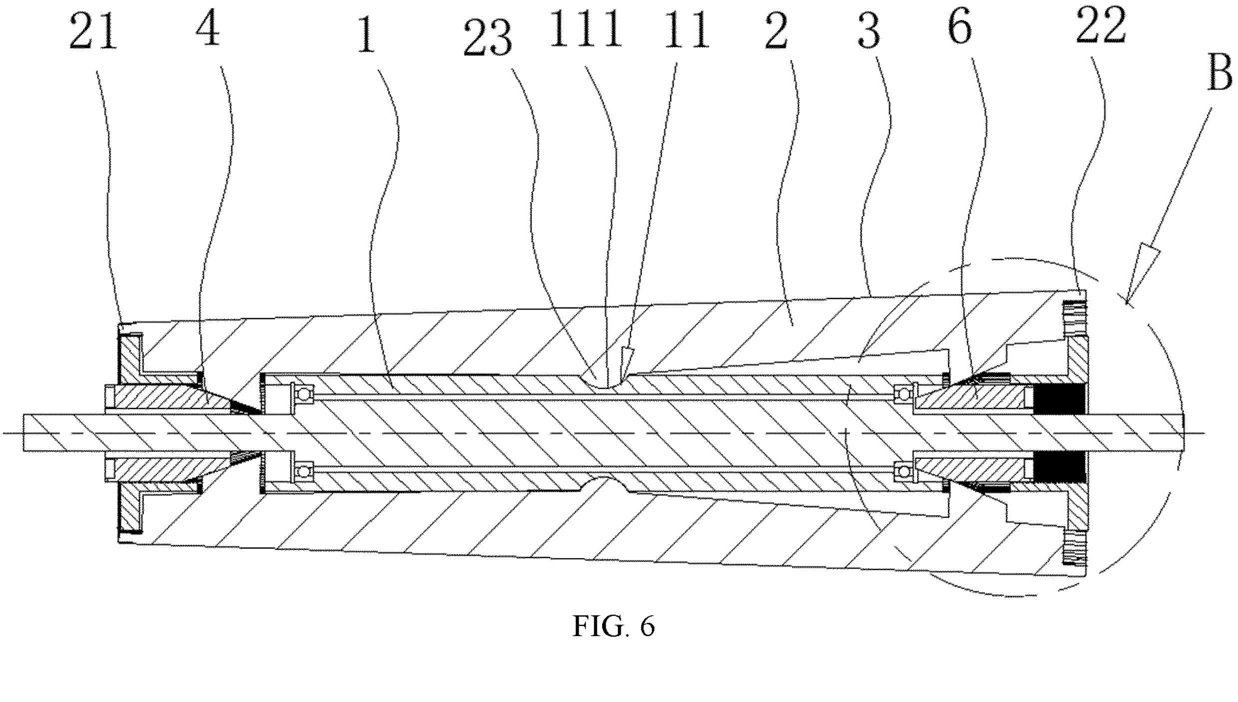


FIG. 6

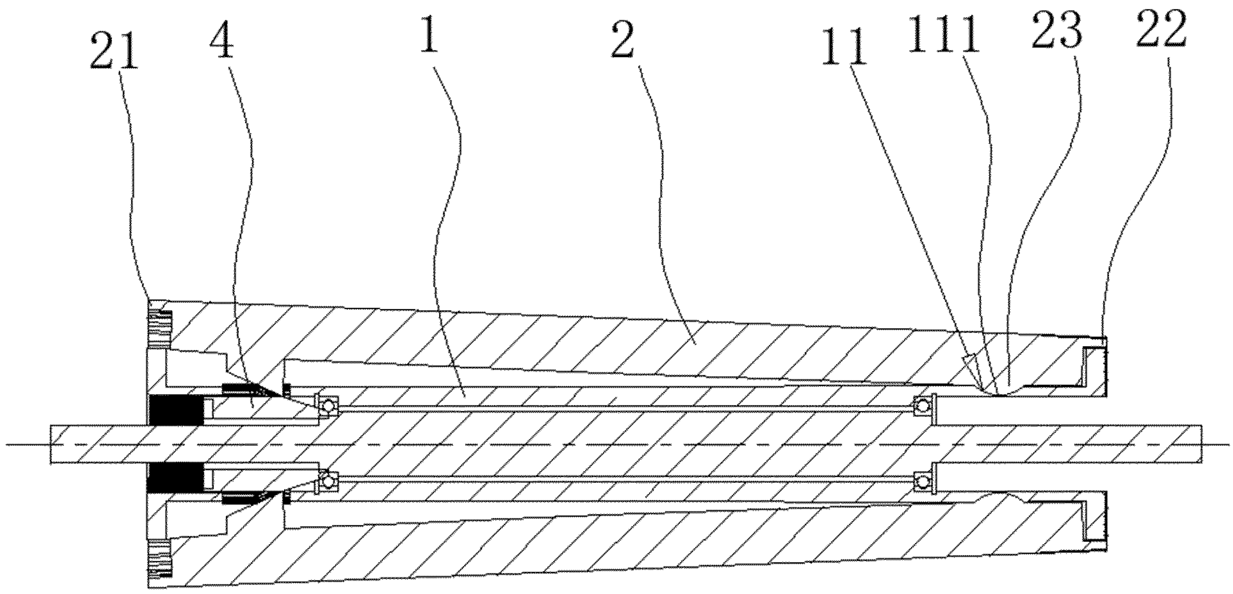


FIG. 7

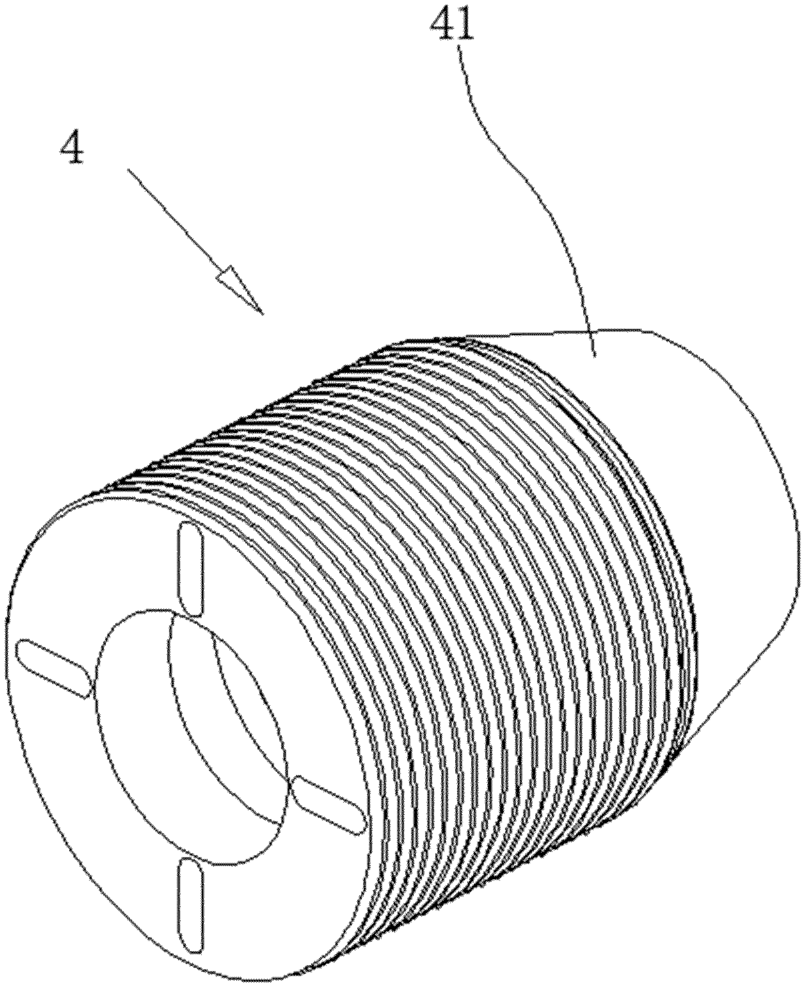
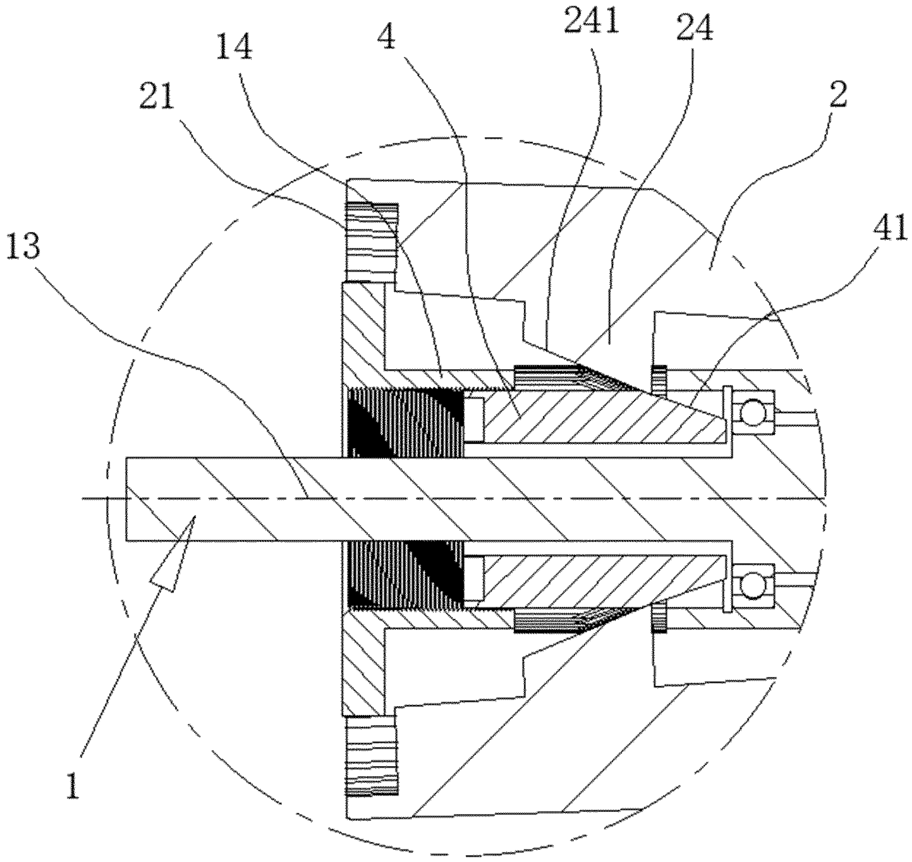


FIG. 8



A
FIG. 9

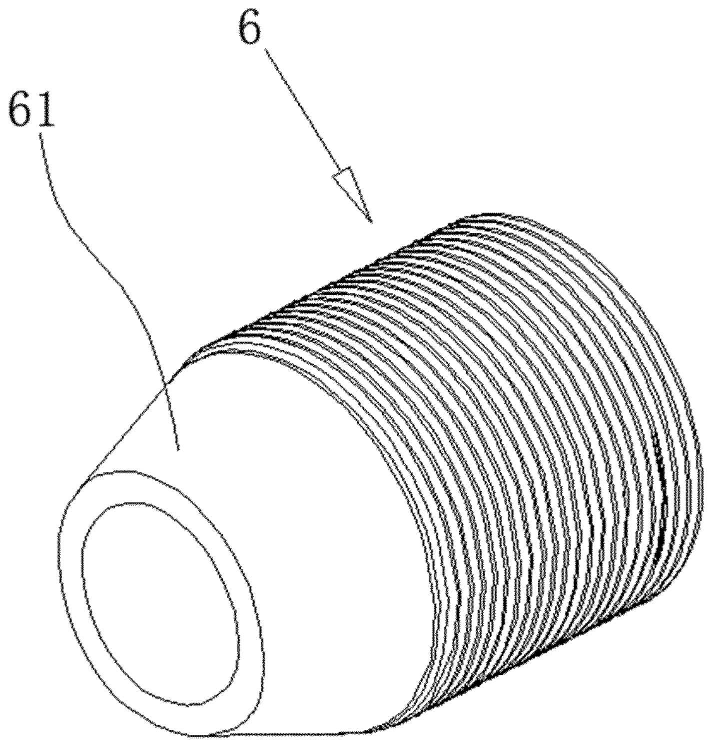
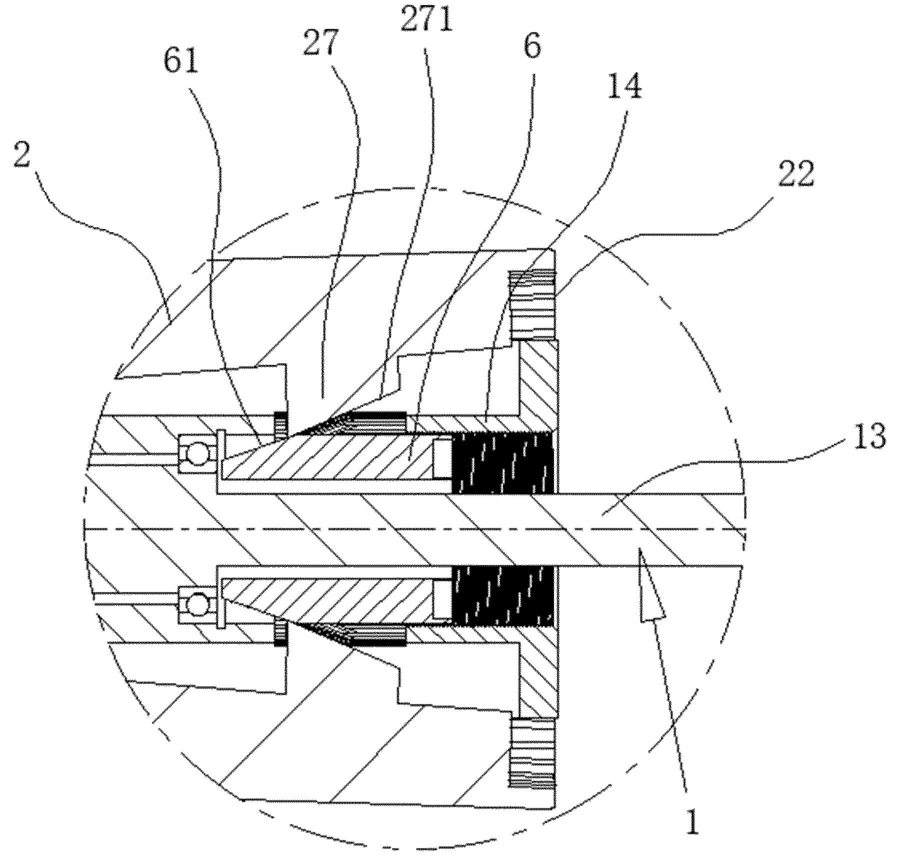


FIG. 10



B
FIG. 11

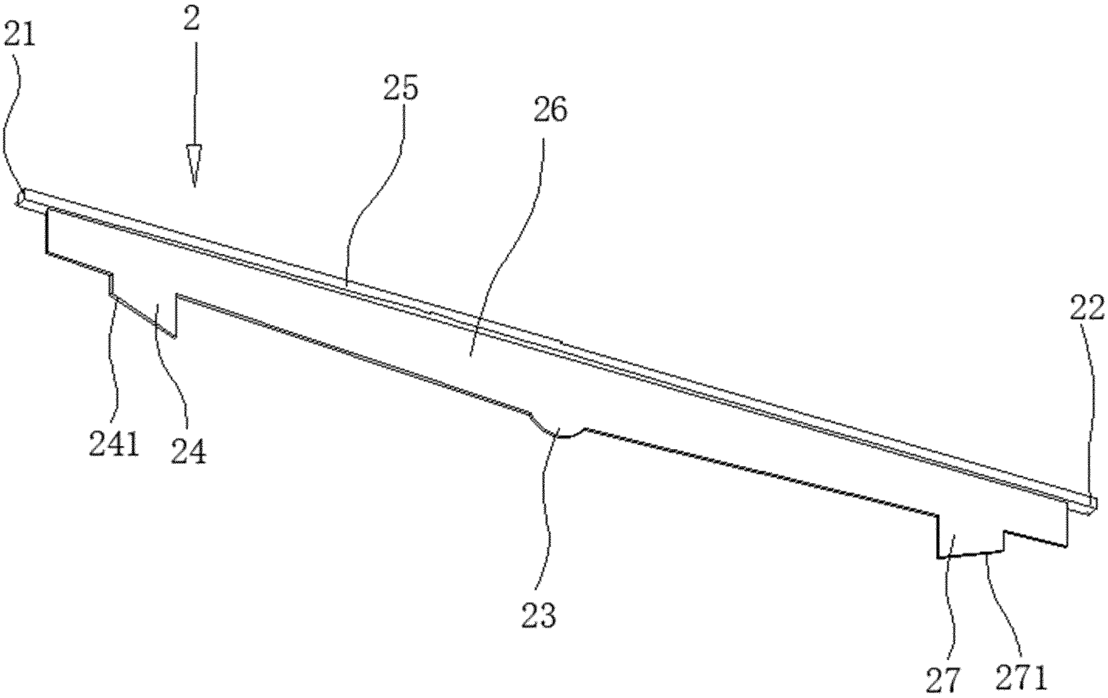


FIG. 12

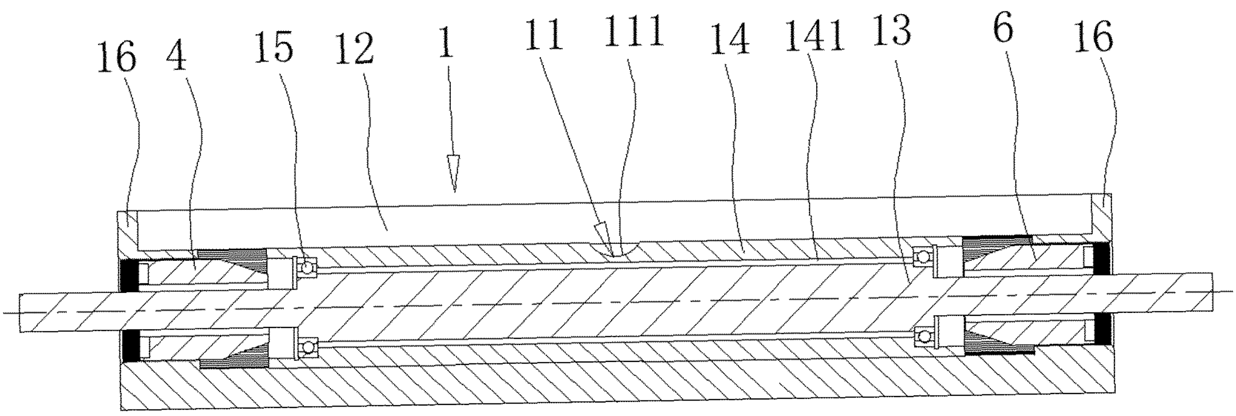


FIG. 13

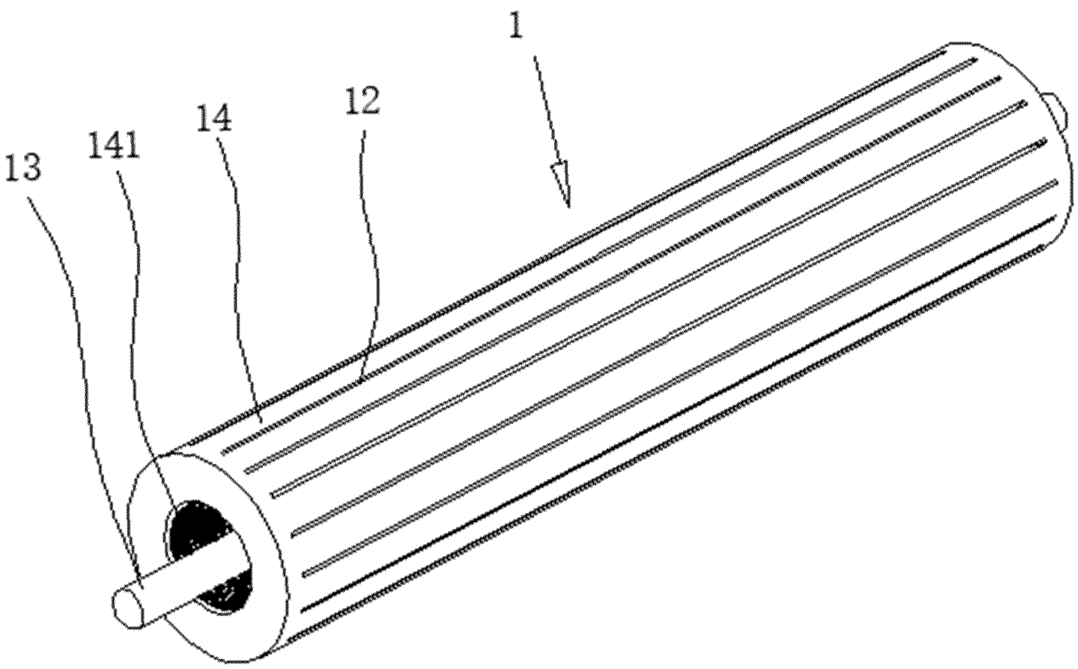


FIG. 14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2022/127585

A. CLASSIFICATION OF SUBJECT MATTER

B65H 27/00(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)

B65H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

CNABS; CNKI; CNTXT; VEN; WOTXT; EPTXT; USTXT: 锥度, 锥面, 调节, 张力, 松, 紧, 褶皱, 摆动, 螺纹, 滑动, taper, adjust, tension, wrinkle, tight, pivot, slide, slip, screw

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6110093 A (HEIDELBERGER DRUCKMASCH AG) 29 August 2000 (2000-08-29) description, column 3, line 35-column 5, line 17, and figures 1-3	1-16
X	CN 106029535 A (HONEYWELL INTERNATIONAL INC.) 12 October 2016 (2016-10-12) description, paragraphs [0011]-[0032], and figures 1-8	1-16
A	CN 209957144 U (CHENGDU LIAN SHI TECHNOLOGY CO., LTD.) 17 January 2020 (2020-01-17) entire document	1-16
A	JP 2009227446 A (FUJIFILM CORP.) 08 October 2009 (2009-10-08) entire document	1-16

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

* Special categories of cited documents:
- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
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- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed
- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
07 December 2022	**28 December 2022**

Name and mailing address of the ISA/CN	Authorized officer
China National Intellectual Property Administration (ISA/CN) **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088, China**	
Facsimile No. **(86-10)62019451**	Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2022/127585

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
US	6110093	A	29 August 2000	DE	19916254	A1	13 January 2000
				DE	59900576	D1	31 January 2002
				EP	0970807	A1	12 January 2000
				EP	0970807	B1	19 December 2001
CN	106029535	A	12 October 2016	US	2015210497	A1	30 July 2015
				WO	2015116432	A1	06 August 2015
CN	209957144	U	17 January 2020	None			
JP	2009227446	A	08 October 2009	None			

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- CN 202111414886 **[0001]**