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(54) **TAPE DRIVE**

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(73) Proprietor: **Videojet Technologies Inc.**
Wood Dale, IL 60191-1073 (US)

(72) Inventor: **MCNESTRY, Martin**
Belper, Derbyshire DE56 1JJ (GB)

(74) Representative: **Marks & Clerk LLP**
15 Fetter Lane
London EC4A 1BW (GB)

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Description

[0001] The present invention relates to a tape drive, and more particularly, but not exclusively, to a tape drive suitable for use in a transfer printer such as a thermal transfer printer.

[0002] Tape drives find a wide variety of uses. One such example is in thermal transfer printers - in which ink is transferred from an ink carrying tape, often referred to as a ribbon - which require a means for transporting the ribbon from a supply spool to a take-up spool past a print head. A tape drive typically comprises two tape spool supports on which spools of tape, such as ink ribbon, may be mounted, and may also include one or more motors for rotating one or both of the spool supports and a controller for operating the motors. In a printing operation, ink carried on the ribbon is transferred to a substrate which is to be printed. To effect the transfer of ink, a print head is brought into contact with the ribbon, and the ribbon is brought into contact with the substrate. The print head contains printing elements which, when heated, whilst in contact with the ribbon, cause ink to be transferred from the ribbon and onto the substrate. Ink will be transferred from regions of the ribbon which are adjacent to printing elements which are heated. An image can be printed on a substrate by selectively heating printing elements which correspond to regions of the image which require ink to be transferred, and not heating printing elements which correspond to regions of the image which require no ink to be transferred. Once the printhead has removed the ink from the ribbon, the print head is removed from the used ribbon, and the ribbon is advanced so as to present unused ribbon to the printhead. The print head is then brought into contact with the unused ribbon as described above.

[0003] US2019/009596 A1 describes a tape drive having a spool support for supporting a tape spool, wherein the spool support comprises a support surface mounted to a tape drive base plate such that the support surface is fixed against rotation relative to the base plate, the support surface being configured such that, in use, as tape is removed from or wound onto the spool, the spool rotates relative to the spool support such that the spool rotates around the support surface.

[0004] It is an object of some embodiments of the present invention to provide an improved tape drive.

[0005] According to a first aspect of the invention there is provided a tape drive. The tape drive comprises a base, a supply spool support extending from the base on which a ribbon supply spool, comprising ink carrying tape, or ribbon, may be installed, the supply spool support being rotationally fixed with respect to the base, the supply spool support defining a spool rotation axis about which the ribbon supply spool may be caused to rotate to allow ribbon to travel along a ribbon path, and a spring. The spring is configured to provide a first spring action, the first spring action configured to generate a braking force by friction and thereby resist relative rotation between the ribbon supply spool and the supply spool support, provide a second spring action configured to provide compliance in a length of the ribbon path during printing.

[0006] Advantageously, the spring provides two functions; i) provides a braking force, e.g. a drag on the rotation of the supply spool, which helps provide ribbon tension in the ribbon during printing, and ii) provides a dancing arm effect by providing compliance in the ribbon path length during printing. Such a spring is particularly useful in low cost printers, as the need to provide a complex braking arrangement or dancing arm arrangement which sits in the ribbon path is obviated.

[0007] Providing compliance in a length of the ribbon path during printing may reduce the risk of ribbon breakage and/or prevent the ribbon from going slack when the ribbon path length changes, such as when a print head engages the ribbon to remove ink from the ribbon onto a substrate.

[0008] The supply spool support may be generally cylindrical, extending along the spool rotation axis. The supply spool support may be integrally formed with the base. The spring may be described as being elastically deformable. That is, the spring will deform under the application of a predefined force, and will return to its original shape following removal of the predefined force.

[0009] The tape drive may comprise a take-up spool support. The take up spool support may be arranged to support a ribbon take-up spool core upon which used ink ribbon is wound following printing.

[0010] The first spring action may be configured to generate the braking force by generating friction between a portion of the spring and a portion of the ribbon supply spool.

[0011] The first spring action may be configured to generate the braking force by generating friction between a portion of the base and a portion of the ribbon supply spool. For example, the first spring action may generate a force which is applied to the supply spool so as to push the portion of the supply spool against a portion of the base.

[0012] The first spring action may be further configured to retain the ribbon supply spool on the spool support. For example, the first spring action may generate a force which is applied to the supply spool so as to resist removal of the supply spool from the supply spool support.

[0013] The supply spool support may comprise the spring. The spring may be housed within the supply spool support.

[0014] The spring may be configured to elastically compress when the ribbon supply spool is installed on the spool support, providing the first spring action.

[0015] For example, when no spool is installed on the supply spool support, the spring may be in a relaxed position. Placement of a spool on the supply spool support may cause the spring to compress, generating the first spring action. The spring may compress along an axis generally perpendicular to the spool rotation axis.

[0016] The spring may be configured to elastically deform about the spool rotation axis so as to provide a torque on the ribbon supply spool which resists removal of ribbon from the ribbon supply spool, providing the second spring action.

[0017] For example, rotation of the ribbon supply spool so as to remove ribbon from the ribbon supply spool may cause the spring to deform in a twisting manner, about the spool rotation axis, providing the second spring action. The elastic deformation about the spool rotation axis may be configured to be caused by the friction between a portion of the spring and a portion of the ribbon supply spool. That is, as the ribbon supply spool rotates, friction between the supply spool and the spring may cause the spring to elastic deform about the spool rotation axis.

[0018] The spring may comprise a first end and a second end, the first end configured to engage a supply spool core of the ribbon supply spool and direct a first force, provided by the spring, on to the supply spool core, and the second end configured to engage the supply spool core and direct a second force, provided by the spring, on to the supply spool core.

[0019] The first and second forces may be generated by the first spring action. The first end and second end may be located at a proximal end of the spring, where a distal end of the spring may be secured to a base portion of the supply spool support or the base plate. The first and second ends may also be referred to as first and second elbows. The magnitude of the first and second forces may be generally be equal. For example, the spring may act between the first and second elbows to provide equal force, in opposite directions, to the first and second ends.

[0020] The first and second ends may be located on generally opposite sides of the spring. Arrangement in this way results in an easier construction method for forming the spring. That is, the spring may be formed in a single plane.

[0021] The spring may be configured to elastically deform about the spool rotation axis when subjected to torque caused by friction between the first end and the supply spool core of the ribbon supply spool, and friction between the second end and the supply spool core of the ribbon supply spool when the ribbon supply spool core rotates.

[0022] That is, the spring may be caused to twist about the spool rotation axis, which loads the second spring action, when subjected to an applied torque caused as the ribbon supply spool is rotated to remove ribbon during ribbon advancement.

[0023] The first and second ends may be configured to be displaced from a first rotational position to a second rotational position when subjected to the torque, so as to elastically deform about the spool rotation axis.

[0024] The first end may be configured to direct the first force on to the spool core at a first angle from the spool rotation axis, and the second end may be configured to direct the second force on to the spool core at a second angle from the spool rotation axis, the first and second angles being different.

[0025] The first angle may be about 45 degrees from the spool rotation axis in a distal direction, and the second angle may be generally perpendicular to the spool rotation axis.

[0026] The spring may be housed within the supply spool support, the supply spool support comprising a first aperture and a second aperture, and wherein the first end is configured to extend through the first aperture, and the second end is configured to extend through the second aperture.

[0027] That is, the spring may be configured such that, when in a relaxed state, the first and second ends extend through the first and second apertures respectively. When a ribbon supply spool is installed on the ribbon supply spool, the first and second ends may engage with the spool core of the ribbon supply spool through the first and second apertures. The first and second apertures may be arranged circumferentially, e.g. on a cylindrical surface of the supply spool support.

[0028] Each of the first and second apertures may subtend an angle of between about 10 to 15 degrees over the circumferential surface of the supply spool support.

[0029] In other implementations, the first and second apertures may subtend an angle of between about 5 to 20 degrees.

[0030] The first and second apertures may be arranged to limit the extent to which the spring can be rotationally deformed about the spool rotation axis.

[0031] For example, the first aperture may be defined by a first surface and a second surface, and the second aperture may be defined by a third surface and a fourth surface. The spring and apertures may be arranged such that when the spring is not deformed about the spool rotation axis (e.g. is not twisted) the first elbow generally abuts the first surface and the second elbow generally abuts the third surface, the first and third surfaces being generally opposite on another, but offset by about the width of the first and second ends such that the first and second ends may abut the first and third surfaces without being substantially deformed. In this way, the direction of rotational deformation is restricted about the spool rotation axis to one rotational direction when starting from a state in which the spring is not rotationally deformed. This particular rotational direction may be opposite the rotational direction travelled by the spool when ribbon is removed from the spool.

[0032] The first, second, third and fourth surfaces may be arranged generally parallel with the spool rotation axis. The surfaces may be arranged in the rotational path of the first and second ends, so as to limit the deformation of the spring. The first, second, third and fourth surfaces may be known as stop surfaces.

[0033] The spring may be configured to provide compliance in the ribbon length of between about 1 to 2 mm.

[0034] In other implementations, the compliance may be between about 1 to 3 mm. In other implementations, the compliance may be between about 1 to 5 mm. It will be appreciated that the compliance required will be specific to the particular tape drive. Other levels of compliance may be used based on the specific circumstances.

[0035] The spring may comprise a foot, the foot being fixed relative to the base of the tape drive.

[0036] The foot may be located at a distal end of the spring. The spring may comprise two feet, both fixed relative to the base of the tape drive. The feet may be opposite the first and second ends.

[0037] The spring may be a substantially planar wire spring.

[0038] The spring may be formed from a single piece.

[0039] A plane of the spring may pass through the spool rotation axis. That is, in an untwisted state, the plane of the spring may pass through the spool rotation axis

[0040] The tape drive may further comprise the ribbon supply spool, the supply spool configured to be installed on the supply spool support. The ribbon supply spool may comprise a spool core and ribbon wound on the spool core.

[0041] In a second aspect there is provided a thermal transfer printer comprising a tape drive according to the first aspect and a printhead arranged to transfer ink from the ribbon to a substrate.

[0042] In a third aspect there is provided a tape spool for being driven by a tape drive according to the first aspect.

[0043] The tape spool may be a supply spool.

[0044] The tape spool may comprise a first spool core surface configured to engage with the first end of the spring, the first spool core surface arranged at an incline relative to the tape spool axis. For example, the incline may be about 45 degrees from the tape spool axis.

[0045] The first spool core surface may be located at an end of the supply core. The first spool core surface may be located at a proximal end of the supply core. That is, an end opposite an end closest to tape drive when the tape spool is installed on a spool support.

[0046] The tape spool may comprise a second spool core surface configured to engage the second end of the spring, the second spool core surface arranged substantially parallel relative to the tape spool axis.

[0047] The second spool core surface may be located on an inner cylindrical surface of the tape spool.

[0048] It will be appreciated that features described in the context of one aspect may be combined with other aspects of the invention.

[0049] Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a schematic plan illustration of a tape drive in accordance with the present invention;

Figure 2 is a perspective illustration showing the tape drive of Figure 1;

Figure 3 is a perspective illustration showing a spring in the form of a wire, the spring in a relaxed state;

Figure 4 is an enlarged view of a first elbow of the spring of Figure 3;

Figure 5 is an enlarged view of a second elbow of the spring of Figure 3;

Figure 6 is an enlarged perspective view of a spool support of the tape drive of Figure 1;

Figure 7 is a further enlarged perspective view of the spool support of Figure 6;

Figure 8a is an enlarged plan view of the spool support of Figure 6, showing the first and second elbows in a first rotational position; and

Figure 8b is an enlarged plan view of the spool support of Figure 6, showing the first and second elbows in a second rotational position; and

Figure 9 is a cut away view of the supply spool support of Figure 6, showing a spring in a compressed state.

[0050] Referring to Figure 1, there is illustrated a thermal transfer printer 1 having a base plate 2 (sometimes referred to as a base), a supply spool support 3, take-up spool support 4 and a printhead 5. The base plate 2 may, for example, be formed from die-cast metal or moulded plastic. The term 'base plate' may be used to refer to the main component of the body of the printer. It will be understood, however, that the base plate need not be arranged as a single planar component. Indeed the base plate may comprise a plurality of surfaces disposed at various angles relative to one another. The supply spool support 3 extends from and is rotationally fixed to the base plate 2 (e.g. cannot rotate relative to the base plate 2). In contrast, the take-up spool support 4 is rotatable relative to the base plate 2, driven by a motor (not shown).

[0051] The terms proximal and distal are used within this specification. The term distal relates to a direction pointing towards the base plate 2 and the term proximal relates to a direction pointing away from the base plate 2.

[0052] The supply spool support 3 is arranged to support a ribbon supply spool core 6, upon which is wound ink carrying ribbon 7. The supply spool core 6 and any ribbon 7 wound thereon may be referred to as a supply spool 8. While the supply spool support 3 is fixed with respect to the base 2, the supply spool 8 is able to rotate about the supply spool support 3 when the friction between the supply spool 8 and the supply spool support 3 is overcome. The supply spool support 3 comprises a spring 14 (see figure 3). The spring 14 provides a number of functions, which will be described below.

[0053] The take-up spool support 4 is arranged to support a ribbon take-up spool core 9, upon which used ink ribbon is wound following printing. The take-up spool core 9 and any ribbon wound thereon may be referred to as a take-up spool 10. The take-up spool support 4 comprises a retaining means (not shown) for retaining the take-up spool 10 on the take-up spool support 4. This may comprise, for example, a flat spring located on a circumferential surface of the take-up spool support 4, and which projects radially outward when relaxed, and grips an inner circumferential surface of the ribbon take-up spool core 9 when the ribbon take-up spool core 9 is installed on the take-up spool support 4. The proximal end 4a of the take-up spool support 4 comprises a knurled section for winding ribbon by hand, such as when webbing up with new ink ribbon 7.

[0054] When the motor coupled to the take-up spool support 4 causes the take-up spool support 4 to rotate in the anti-clockwise direction, the ribbon 7 is unwound from the supply spool 8, causing the supply spool 8 to rotate clockwise. The ribbon 7 travels along a ribbon path P past the printhead 5, and is wound on to the take up spool 10. There may be one or more rollers 13 in the ribbon path P which are used to help guide the ribbon 7. One of the rollers 13a may be a sticky roller, which may have an encoder for determining ribbon speed.

[0055] The printhead 5 may be any suitable printhead for use in a thermal printer. In an embodiment, the printhead 5 comprises a printhead ceramic upon which printing elements are arranged in a one-dimensional linear array. The printhead 5 further comprises a heatsink, to which the printhead ceramic is attached. The printhead is mounted in a printhead carriage 11 which is arranged to move linearly, back and forth, along an axis A1 parallel to the direction of travel of the ribbon 7. During printing, ink carried on the ribbon 7 is transferred to a substrate (not shown) which is to be printed on. To effect the transfer of ink, the printhead 5 is brought into contact with and pressed against the ribbon 7. In the implementation shown in the figures, a printhead in/out drive assembly 12 is used to move the printhead 5 to and from the ribbon 7. The printhead in/out drive assembly 12 may be an electromagnetic or pneumatic drive unit. During activation of the in/out drive assembly 12, the ribbon 7 is also brought into contact with the substrate (not shown) to be printed on. The printing elements, when heated, whilst in contact with the ribbon 7, cause ink to be transferred from the ribbon 7 and onto the substrate to be printed on. Ink will be transferred from regions of the ribbon 7 which correspond to (i.e. are aligned with) printing elements which are heated. The array of printing elements can be used to effect printing of an image on to the substrate by selectively heating printing elements which correspond to regions of the image which require ink to be transferred, and not heating printing elements which require no ink to be transferred. Printing a single row of dots on the substrate, parallel to the direction of travel of the printhead, is sometimes referred to as a printing operation.

[0056] The printhead carriage 11 moves along a length (along axis A1) of the substrate so that the printhead 5 may print along the length of the substrate. That is, a number of printing operations are carried out while the substrate to be printed on is stationary. A total number of printing operations carried out as the printhead carriage 11 moves along the length of the substrate is sometimes referred to as a printing stroke, where carrying out a printing stroke leads to a plurality of rows of dots being printed on the substrate as the printhead carriage 11 moves along the length of the substrate.

[0057] The operation of the printer 1 is controlled by a controller (not shown), which is provided on a printed circuit board (not shown). The printed circuit board may be mounted on the reverse side of the base plate 2. Although, it will be appreciated that the controller may be located elsewhere and coupled to the printer 1 via a wired or wireless connection. The controller can take any suitable form, including ASICs, FPGAs, or microcontrollers which read and execute instructions stored in a memory to which the controller is connected.

[0058] As described above, a motor (not shown) is provided for advancing the ink ribbon 7 between the ribbon supply spool 8 and the ribbon take-up spool 10. A second motor (not shown) is provided for providing the linear movement of the printhead carriage 11 along axis A1 during printing. The motors may be any suitable motors such as, for example, stepper motors.

[0059] Rotation of the supply spool 8 (which, as noted above, is not driven directly) is monitored by a sensor 32 mounted within the base plate 2 (see Figures 6, 7 and 8). The sensor 32 senses periodic features 33 of the supply spool core 6, and generates a sensor signal indicative of rotation of the supply spool 8. For example the sensor signal may comprise a plurality of pulses, each pulse indicating that a predetermined angular rotation has taken place. For example, if 36 periodic features are evenly distributed around the internal surface of the spool core 6 and a pulse is generated as each of the pulses passes the sensor 32, each pulse will indicate that the spool core 6 has rotated by 10 degrees. In the example shown in Figure 1, the periodic features 33 are in the form of 10 castellations (not all periodic features are marked in the figure for clarity).

[0060] There are generally two modes in which thermal transfer printers can be used, which are sometimes referred to as a "continuous" mode and an "intermittent" mode. In both modes of operation, the apparatus performs a regularly repeated series of printing cycles, each cycle including a printing phase during which ink is transferred to a substrate, and a further non-printing phase during which the printer is prepared for the printing phase of the next cycle.

[0061] In continuous printing, the print head 5 is brought into contact with the ribbon 7, the other side of which is brought into contact with the substrate onto which an image is to be printed. The print head 5 is held stationary during this process - the term "stationary" is used in the context of continuous printing to indicate that although the print head will be moved into and out of contact with the ribbon, it will not move relative to the ribbon path in the direction in which ribbon is advanced along that path (e.g. along axis A1). Both the substrate and ribbon 7 are transported past the print head, generally but not necessarily at the same speed.

[0062] In intermittent printing, a substrate is advanced past the printhead 5 in a stepwise manner such that during the printing phase of each cycle the substrate and generally but not necessarily the ribbon 7 are stationary. Relative movement between the substrate, the ribbon 7 and the printhead 5 are achieved by displacing the printhead 5 relative to the substrate and ribbon along axis A1. Between the printing phases of successive cycles, the substrate is advanced so as to present the next region to be printed beneath the print head and the ribbon 7 is advanced so that an unused section of ribbon is located between the printhead 5 and the substrate. Accurate transport of the ribbon 7 is, therefore, necessary to ensure that unused ribbon is always located between the substrate and printhead 5 at a time that the printhead 5 is caused to conduct a printing operation. It will be appreciated that where the intermittent mode is used, the printhead carriage 11 is caused to move so as to allow its displacement along the ribbon path P (e.g. axis A1). The printer 1 is generally used in intermittent mode, but can also be used in continuous mode.

[0063] During printing, it is desirable to maintain ribbon tension in the ribbon 7 in order to avoid ribbon breakage and/or a slack ribbon, for example during ribbon advance or when the printhead 5 is brought into, and out of, contact the ribbon 7. This can be achieved by providing a level of compliance in the length of the ribbon path. A known method of providing compliance is to place a dancing arm in the ribbon path. The dancing arm is able to respond to changes in ribbon tension so as to increase or decrease the ribbon path length, thus providing control of the ribbon tension. It is also desirable to provide a means of retaining the supply spool 8 on the supply spool support 3 such that the supply spool 8 does not come off the supply spool support 3 during use, but which can be removed if sufficient force is applied, e.g. when a user wishes to remove the supply spool.

[0064] According to an embodiment of the present invention, the supply spool support 3 comprises a spring 14 which is configured to generate a braking force on the supply spool 8, through friction, which resists relative rotation between the supply spool 8 and the supply spool support 3, and provide compliance in a length of the ribbon path during printing (e.g. provide a dancing arm action). The spring 14 is also configured in an embodiment to retain the supply spool 8 on the supply spool support 3. In the example shown in the Figures, the spring comprises a planar wire. A perspective view of the spring 14, depicted in isolation and in a relaxed state, is shown in Figure 3. The spring 14 may comprise any resiliently deformable material, such as stainless steel. As can be seen most clearly in Figure 9, the spring 14 is substantially located within the spool support 3. That is, the spring 14 may be described as being integrated within the spool support 3.

[0065] In the embodiment shown, the spring 14 is configured to retain the supply spool 8 on the supply spool support 3 by exerting a force on the supply spool core 6 which resists removal of the supply spool core 6 from the supply spool support 3. The spring 14 is also configured to generate a frictional force between the spring 14 and the supply spool core 6. The frictional force provides a braking force (e.g. a drag) which generates ribbon tension during ribbon advancement. Additionally, in response to said frictional force, the spring 14 is configured to elastically deform (e.g. twist) about a supply spool support axis A2 (see Figure 9, the supply spool support axis A2 being inline with the spool rotation axis) so as to generate a torque acting on the supply spool core 6. This torque creates a dancing arm effect which will be described in greater detail below.

[0066] At a distal end (an end closest to the base 2) the spring 14 comprises two feet 21, which are received within holes 25 provided at the base of the supply spool support 3, and act to secure the spring 14 in position. That is, like the supply spool support 3, the feet 21 are fixed relative to the base 2 of the tape drive 1. At a proximal end opposite the distal end, the spring 14 comprises a first end 15 (also referred to herein as a first elbow) and a second end 16 (also referred to herein as a second elbow), which are connected to the feet 21 via first and second legs 26, 27 respectively. The first and second elbows 15, 16 are located at opposite ends to the feet 21 and can move relative to the feet 21 through elastic deformation of the spring 14.

[0067] The first and second elbows 15, 16 are connected to each other via an intermediate portion 28. The intermediate portion 28 comprises first and second extended portions 29, 30 which extend distally from the first and second elbows 15, 16 and are arranged generally parallel with the legs 26, 27. The intermediate portion 28 also comprises a torsion bar 31 arranged generally perpendicular to the first and second extended portions 29, 30, and which connects the first and second extended portions 29, 30. While a particular form is described for the intermediate portion 28, it will be recognised that any suitable form may be used to achieve the desired deformation characteristics. Additionally, It will be appreciated that any number of feet may be used, including one. For example, both the first and second elbows 15, 16 may each be directly connected to one foot.

[0068] The spring 14 is configured to provide a first spring action, the first spring action being generated when the first and second elbows 15, 16 are pushed inward towards each other. In the spring's 14 relaxed state, the distance between the first and second elbows 15, 16 is greater than the diameter of the supply spool core 6. As such, when the supply spool core 6 is installed on the spool support 3 (as shown in Figure 9), the first and second elbows 15, 16 are pushed inward towards each other, elastically deforming and loading the first spring action. The first spring action generates an outward, radial, force to resist the pushing together of the elbows 15, 16. When this outward force is applied to a supply spool core 6, as described below, a braking force is generated via friction so as to resist relative rotation between the supply spool and the supply spool support.

[0069] The spring 14 is further configured to provide a second spring action when the spring 14 is subjected to an applied torque. Due to the friction generated between the first elbow 15 and the supply spool core 6, and the second elbow 16 and the supply spool core 6, an applied torque is applied to the spring 14 when the supply spool 8 (and hence the supply spool core 6) is rotated. That is, when the supply spool 8 is rotated, friction between the supply spool core 6 and each of the first and second elbows 15, 16 causes the spring 14 to elastically deform in a twisting motion about the spool support axis A2, displacing the first and second elbows 15, 16 in the direction of rotation of the supply spool 8. This deformation provides the second spring action which provides a torque acting on the supply spool core 6 in an opposite direction to the direction of the applied torque causing the rotation of the supply spool 8. The first and second spring actions will be described in further detail below.

[0070] The first and second elbows 15, 16 are shaped differently to each other in order to direct different components of force, generated by the spring 14, to the supply spool core 6. In particular, it has been found by the inventor that a particular optimal arrangement is one where a greater component of force is directed outward (radially), generally perpendicular to an axis A2 of the spool support 3, than directed distally (towards the base 2), generally parallel to the axis A2. It has further been found to be generally optimal to split the component of force directed by the first elbow such that around 50% of the force is directed perpendicular to the axis A2 and around 50% of the force is directed parallel to the axis A2 (towards the base 2, .e.g. in the distal direction), and arrange the second elbow 16 to direct all of the force directed by the second elbow 16 generally perpendicular to the axis A2 (e.g. radially outwards). This split generally allows around 75% of the force generated by the spring 14 to be directed radially outward, and around 25% of the force generated by the spring 14 to be directed towards the base 2. It should be noted that other arrangements are possible, depending on the desired characteristics of the apparatus. For example, the first and second elbows may be configured so as to each direct 25% of the force distally and 75% of the force radially. In other examples, a different ratio of forces may be used. For example, 60% of the force may be directed distally and 40% may be directed radially. It will be appreciated that the distal component of the force provides both a retaining effect, resisting removal of the supply spool 8, and pushes the supply spool core 6 against a portion of the base 2 causing additional frictional force which provides a braking force (e.g. a drag), generating ribbon tension during ribbon advancement.

[0071] Figure 4 shows an enlarged view of the first elbow 15. The first elbow 15 comprises a first spool support engaging portion 19. The first spool engaging portion 19 is arranged to direct force onto the spool supply core 6, generated by the spring 14. The first spool engaging portion 19 comprises a surface which is arranged at a 48 degree angle from the axis A2 of the spool support when the spring 14 is in a relaxed state (see Figure 9 for axis A2). As described above, it is generally preferable to split the force directed by the first spool support engaging portion 19, with roughly 50% of the force imparted by the first elbow 15 being directed radially (e.g. perpendicular to the axis A2) and 50% of the force directed distally (e.g. parallel to the axis A2). In order to achieve this split, the first elbow should direct the force distally at an angle of 45 degrees from the axis A2 and onto an upper, or proximal, end of the spool core 6. However, as can be seen in Figure 9, when the spool core 6 is installed on the spool support 3, the spring 14 is deformed to load the first spring action. By bending the elbows 15, 16 inwards, the angle presented by the first spool support engaging portion 19 to the supply spool core 6 is changed from when the spring 14 in a relaxed state. As such, it can be beneficial to offset the angle of the surface of the first spool support engaging portion 19 from the desired angle of 45 degrees to the angle of 48 degrees, such that when the spool core 6 is installed on the spool support 3, the angle presented by the first spool support engaging portion 19 to the supply spool core 6 is around 45 degrees. In the example shown, the first spool support engaging portion 19 has an angle of 48 degrees. However, it will be appreciated that other angles can be chosen dependent on, for example, the particular dimensions and arrangement of the spring 14.

[0072] Figure 5 shows an enlarged view of the second elbow 16. The second elbow 16 comprises a second spool support engaging portion 23. The second spool engaging portion 23 is arranged to direct force, generated by the spring 14, onto the spool supply core 6. The second spool engaging portion 23 comprises a surface which is arranged at a 6 degree angle to the axis A2 of the spool support when the spring 14 is in a relaxed state. As described above, the angle chosen for the second spool support engaging portion 23 when in a relaxed state may take into account the deformation of the spring 14. In the present example, the angle presented by the second spool support engaging portion 23 to the supply spool core 6 when the spring 14 is deformed is to be generally parallel to the axis A2, such that all of the force directed by the second spool support engaging portion 23 is generally directed radially, perpendicular to the axis A2 of the spool support. As such, the angle of the second spool support engaging portion 23 has been offset from 0 degrees to 6 degrees to take into account the deformation of the spring 14. While the specific embodiment shown has a second spool support engaging portion 23 which is arranged at a 6 degree angle to the axis A2 of the spool support, it will be appreciated that other angles may be chosen, dependent, for example, on the particular dimensions and arrangement of the spring 14.

[0073] Referring now to Figures 6, 7 and 8 there is shown perspective views of the spool support 3 and spring 14, with no supply spool 8 installed on the supply spool support 3. The spring 14 is shown in a relaxed state. As can be seen, the first spool support engaging portion 19 of the first elbow 15 extends radially through a first aperture 17 in the spool support 3, and the second spool support engaging portion 23 of the second elbow 16 extends radially through a second aperture 18 in the spool support 3. The first and second apertures 17, 18 are located at generally opposing sides of the supply spool support 3. Providing the first and second apertures 17, 18 at generally opposing sides allows for a more simple construction of the spring 14, as a planer spring may be used. However, it will be appreciated that this may not be required in all embodiments and in some embodiments the first and second apertures 17, 18 are not located opposite each other. Providing the apertures 17, 18 allows the first and second elbows 15, 16 to radially extend through the first and second apertures 17, 18 so as to engage with a supply spool core 6 when installed on the supply spool support 3 (as shown in Figure 9).

[0074] As perhaps best shown in Figures 8a and 8b, the first aperture 17 is formed between a first stop surface 40 and a second stop surface 41, and the second aperture 18 is formed between a third stop surface 42 and a fourth stop surface 43. The stop surfaces 40, 41, 42, 43 are arranged in the rotational path of the first and second elbows 15, 16 so as to provide a limit as to how far the spring 14 can deform rotationally (that is, restrict the torsion that can be applied to the spring 14). In other words, the first elbow 15 may move circumferentially between the first and second stop surfaces 40, 41, and the second elbow 16 may move circumferentially between the third and fourth stop surfaces 42, 43.

[0075] The first stop surface 40 and the third stop surface are arranged such that when the spring 14 is not subjected to torsion, the first elbow 15 substantially abuts the first stop surface 40 and the second elbow 16 substantially abuts the third stop surface 42. That is, the first and third stop surfaces 40, 42 prevent the first and second elbows 15, 16 moving past the first and third stop surfaces 40, 42. This restricts the deformation that the spring 14 can undergo to only allow deformation from a relaxed state in one direction. In the present example, the direction in which deformation occurs is the direction of rotation of the supply spool 8 when ribbon 7 is unwound from the supply spool core 6, e.g. clockwise.

[0076] The angle over which each aperture 17, 18 extends over the circumferential surface of the supply spool 3 may be any suitable angle. For example, the angle may be 15 degrees. The angle chosen dictates the maximum compliance provided by spring 14. For example, the angle may be chosen so as to provide a compliance in the ribbon path length of around 1-2 mm. Additionally, the angle may be chosen so as to prevent the spring 14 being twisted beyond its elastic limit. As such, the specific value chosen may depend on the material used for the spring 14.

[0077] Referring now to Figure 9, there is shown a cross section of a spool support 3 with a supply spool core 6 installed thereon, and shows the spring 14 in a compressed state, e.g. where the first spring action is loaded. As can be seen, the first spool support engaging portion 19 of the first elbow 15 engages a first spool core surface 20 of the supply spool core 6. The second spool support engaging portion 23 of the second elbow 16 engages a second spool core surface 24 of the supply spool core 6. The portion through which the spool core 6 is cut through in Figure 9 shows voids in the spool core 6 (e.g. the unhatched portions). These voids correspond with channels that may run along a portion of the length of the spool core 6, and which may define a series of periodic features 33, described above. Of course, it will be appreciated that such voids are entirely optional.

[0078] As described above, the first elbow 15 is configured to direct around 50% of the force outward, perpendicular to the axis A2 and 50% directed distally, parallel to the axis A2 (towards the base 2). This is achieved by directing the force F1 generally 45 degrees from the axis A2 in the distal direction. In an embodiment, this is achieved by arranging the surface of the first spool support engaging portion 19 to be arranged at a substantially 45 degree angle from the axis A2 of the spool support when the spring 14 is in a compressed state. As can be seen in Figure 9, the first spool support engaging portion 19 extends through the first aperture 17 and engages the first spool core surface 20 of the supply spool core 6 located at the proximal end of the supply core 6. Additionally, a portion of the first spool support engaging portion 19 lies in the path of removal of the supply spool core 6 (e.g. the path taken to remove the supply spool core 6 from the supply spool support 3). As such, when a user wishes to remove the supply spool core 6, they must apply a force great enough to overcome the component of force directed in the distal direction, and which is also great enough such that the spring 14 is further deformed (e.g. further compressed) during removal such that the first spool support engaging portion 19 does not lie in the path of removal.

[0079] The first spool core surface 20 is arranged at an incline relative to the axis A2 so as to present a surface in a similar plane to the surface of the first spool support engaging portion 19 (e.g. at about 45 degrees from the axis A2 of the spool support 3). Directing the force distally at a 45 degree angle causes a first component of the force F1 to be directed distally so as to retain the supply spool 8 on the supply support 3, and a second component of the force F1 to be directed radially outward. The force F1 also generates friction between the first spool support engaging portion 19 and the first spool core surface 20. Additionally, the first component of the force F1 directed distally also creates friction between a distal portion of the supply spool core 6 and a step 3a of the support spool 3 (shown in Figure 2), where the distal portion of the supply spool core 6 abuts the step 3a. That is, friction is generated between the supply spool 8 and a portion of the base 2 (e.g. step 3a).

[0080] As described above, the second elbow 16 is configured to direct all of the force F2 imparted by the second elbow 16 generally radially outwards (e.g. perpendicular to the axis A2). In an embodiment, this is achieved by arranging the surface of the second spool support engaging portion 23 to be arranged substantially parallel to the axis A2 of the spool support when the spring 14 is in a compressed state. As can be seen in Figure 9, the second spool support engaging portion 23 extends through the second aperture 18 engages a second spool core surface 24 of the supply spool core. The second spool core surface 24 is an inner cylindrical surface of the supply core whose axis is arranged substantially parallel to the axis A2. The force F2 generates friction between the second spool support engaging portion 23 and the second spool core surface 24 of supply spool core 6.

[0081] The operation of the tapedrive 1 will now be described. The operation will relate to an intermittent printing process.

[0082] During printing, the printhead 5 is extended so as to be brought into contact with the ribbon 7, allowing the printhead to remove ink from the ribbon and onto a substrate to be printed on as described above. The act of extending the printhead 5 and bringing the printhead into contact with the ribbon 7 causes the length of the ribbon path to increase slightly. The amount by which the ribbon length increases differs depending on the arrangement of the printer, but is typically in the order of about 1-2 mm. The increase in ribbon path length causes increased tension in the ribbon, which in turn causes the supply spool 8 to rotate clockwise, removing excess ribbon 7 from the supply spool 8 to make up for the increased ribbon path length. It is noted that the take-up spool support 4 does not substantially rotate to reduce the ribbon tension due to resistance provided by the stationary motor that drives the take up spool support 4.

[0083] As the supply spool 8 rotates clockwise in response to the increased ribbon tension, the friction generated between the spring 14 and the ribbon core 6 (e. g. between the first spool support engaging portion 19 and the first spool core surface 20, and between the second spool support engaging portion 23 and the second spool core surface 24), causes the first and second elbows to be angularly displaced in the direction of rotation (e.g. clockwise), elastically deforming the spring 14 so as to generate the second spring action described above. That is, the spring 14 is twisted about the spool rotation axis A2 so as to provide a torque on the ribbon supply spool 3 which resists removal of ribbon 7 from the ribbon supply spool 8. The first and second elbows 15, 16 can be said to have been displaced from a first rotational position, as shown in Figure 8a to a second rotational position, as shown in Figure 8b. In Figure 8b, the first and second elbows 15, 16 are shown abutting the second stop surface 41 and fourth stop surface 43 respectively. That is, the elbows 15, 16 have travelled through their maximum angular displacement. It will be appreciated that in some cases, the angular displacement caused by, for example, the printhead 5 engaging the ribbon 7 may be less than the maximum angular displacement. The specific angular displacement of the first and second elbows 15, 16 will depend on a number of factors, such as the magnitude and direction of the various forces involved and the dimensions and materials used. In an example, the elbows 15, 16 may travel through between 5 to 10 degrees when the printhead engages the ribbon 7.

[0084] When the printhead 5 is subsequently removed from the ribbon 7 by retracting the printhead 5, the length of free ribbon (e.g. not wound onto a spool) is greater than the shortest ribbon path length between the supply spool 8 and take up spool 10. The second spring action, caused by the twisting of the spring 14, applies a torque on the supply spool core 6 in the anticlockwise direction. As such, and in response to the reduction in ribbon path length, the supply spool core 6 is rotated in the anticlockwise direction under the influence of the second spring action, taking up excess ribbon 7 that was removed from the supply spool when the printhead 5 was brought into contact with the ink ribbon 7. That is, the spring 14 is able to "untwist", releasing the stored energy that was generated when the spring 14 was rotationally deformed. That is, the first and second elbows 15, 16 may return, from the second rotational position, to the first rotational position. In this way, the spring 14 provides a dancing arm effect which provides a level of compliance in the ribbon path length allowing the supply spool 8 to feed a small length of ribbon 7 into the ribbon path P when the path length P is increased, and take back the small length of ribbon 7 when the path length P is reduced. In an embodiment, the level of compliance may be 1-2 mm. However, it will be appreciated that other levels of compliance may be used, for example 1-5 mm. It will further be appreciated that the level of compliance will be determined based on the particular materials and configuration used.

[0085] While various embodiments of the invention and variations thereof have been described above, it will be appreciated that various further modifications and variations can be made to the described embodiments without departing from the scope of the present invention, as defined by the appended claims.

[0086] While a specific form of the spring 14 has been described, e.g. a single piece planer spring, it will be appreciated that other forms may be used to achieve the desired deformation characteristics. Additionally, while a specific form of tape drive 1 has been described, it will be appreciated that other configurations of tape drives may be used.

[0087] The described and illustrated embodiments are to be considered as illustrative and not restrictive in character, it being understood that only the preferred embodiments have been shown and described and that all changes and modifications that come within the scope of the inventions as defined in the claims are desired to be protected. In relation to the claims, it is intended that when words such as "a," "an," "at least one," or "at least one portion" are used to preface a feature there is no intention to limit the claim to only one such feature unless specifically stated to the contrary in the claim. When the language "at least a portion" and/or "a portion" is used the item can include a portion and/or the entire item unless specifically stated to the contrary.

Claims

1. A tape drive comprising:

a base (2);
a supply spool support (3) extending from the base on which a ribbon supply spool (8) may be installed, the supply spool support being rotationally fixed with respect to the base, the supply spool support defining a spool rotation axis (A2) about which the ribbon supply spool may be caused to rotate to allow ribbon to travel along a ribbon path (P);
characterised by a spring (14) configured to:

provide a first spring action, the first spring action configured to generate a braking force by friction and thereby resist relative rotation between the ribbon supply spool and the supply spool support, the first spring action further configured to retain the ribbon supply spool on the spool support;
provide a second spring action configured to provide compliance in a length of the ribbon path during printing.

2. The tape drive of claim 1, wherein, the first spring action is configured to generate the braking force by generating friction between a portion (19, 23) of the spring (14) and a portion (20, 24) of the ribbon supply spool (8).

3. The tape drive of claim 1 or 2, wherein the first spring action is configured to generate the braking force by generating friction between a portion (3a) of the base (2) and a portion of the ribbon supply spool (8).

4. The tape drive as in any preceding claim, wherein the supply spool support (3) comprises the spring (14) and/or, wherein the spring is configured to elastically compress when the ribbon supply spool (8) is installed on the supply spool support, providing the first spring action.

5. The tape drive as in any preceding claim, wherein the spring (14) is configured to elastically deform about the spool rotation axis (A2) so as to provide a torque on the ribbon supply spool (8) which resists removal of ribbon from the ribbon supply spool, providing the second spring action.

6. The tape drive of any preceding claim, wherein the spring (14) comprises a first end (15) and a second end (16);

the first end configured to engage a spool core (6) of the ribbon supply spool (8) and direct a first force, provided by the spring, on to the spool core;
the second end configured to engage the spool core and direct a second force, provided by the spring, on to the spool core and optionally, wherein the first and second ends are located on generally opposite sides of the spring.

7. The tape drive of claim 6, wherein the spring (14) is configured to elastically deform about the spool rotation axis (A2) when subjected to torque caused by friction between the first end (15) and spool core (6) of the ribbon supply spool (8), and friction between the second end (16) and spool core of the ribbon supply spool when the spool core rotates, and optionally, wherein the first and second ends are configured to be displaced from a first rotational position to a second rotational position when subjected to the torque, so as to elastically deform about the spool rotation axis.

8. The tape drive of any one of claims 6 to 7, wherein:

the first end (15) is configured to direct the first force on to the spool core (6) at a first angle from the spool rotation axis (A2);
the second end (16) is configured to direct the second force on to the spool core at a second angle from the spool rotation axis, the first and second angles being different and optionally, wherein the first angle is about 45 degrees from the spool rotation axis in a distal direction;
the second angle is generally perpendicular to the spool rotation axis.

9. The tape drive of any one of claims 6 to 8, wherein the spring (14) is housed within the supply spool support (3), the supply spool support comprising a first aperture (17) and a second aperture (18), and wherein:

the first end (15) is configured to extend through the first aperture; and
the second end (16) is configured to extend through the second aperture.

10. The tape drive of claim 9, wherein the each of the first and second apertures (17, 18) subtend an angle of between about 10 to 15 degrees over the circumferential surface of the supply spool support (3).

11. The tape drive of any one of claims 9 or 10, wherein the first and second apertures (17, 18) are arranged to limit the extent to which the spring (14) can be rotationally deformed about the spool rotation axis (A2).

12. The tape drive of any preceding claim, wherein the spring (14) is configured to provide compliance in the ribbon length of between about 1 to 2 mm.

13. The tape drive of any preceding claim, the spring (14) comprising a foot (21), the foot being fixed relative to the base (2) of the tape drive, and/or, wherein the spring is a substantially planar wire spring, and/or, wherein the spring is formed from a single piece, and/or, a plane of the spring passes through the spool rotation axis (A2) and/or, further comprising the ribbon supply spool (8), the ribbon supply spool configured to be installed on the supply spool support.

14. A thermal transfer printer (1) comprising:

a tape drive according to any one of claims 1 to 13; and
a printhead (5) arranged to transfer ink from ribbon (7) to a substrate.

15. A tape spool configured to be driven by a tape drive according to claims 6 to 11, the tape spool comprising:

a first spool core surface (20) configured to engage with the first end (15) of the spring (14), the first spool core surface arranged at an incline relative to the tape spool axis (A2), and
a second spool core surface (24) configured to engage the second end (16) of the spring, the second spool core surface arranged substantially parallel relative to the tape spool axis.

Patentansprüche

1. Bandantrieb, Folgendes umfassend:

eine Basis (2);
einen Abwickelspulenträger (3), der sich von der Basis erstreckt, auf dem eine Bandabwickelspule (8) installiert sein kann, wobei der Abwickelspulenträger in Bezug auf die Basis drehbar befestigt ist, wobei der Abwickelspulenträger eine Spulendrehachse (A2) definiert, um die herum die Bandabwickelspule veranlasst werden kann, sich zu drehen, um es zu ermöglichen, dass Band entlang eines Bandwegs (P) wandert;
gekennzeichnet durch eine Feder (14), die zu Folgendem konfiguriert ist:

eine erste Federwirkung bereitzustellen, wobei die erste Federwirkung dafür konfiguriert ist, eine Bremskraft durch Reibung zu erzeugen und dadurch einer relativen Drehung zwischen der Bandabwickelspule und dem Abwickelspulenträger zu widerstehen, wobei die erste Federwirkung ferner dafür konfiguriert ist, die Bandabwickelspule auf dem Spulenträger zu halten;
eine zweite Federwirkung bereitzustellen, die dafür konfiguriert ist, während des Druckens eine Nachgiebigkeit auf einer Länge des Bandwegs bereitzustellen.

2. Bandantrieb nach Anspruch 1, wobei die erste Federwirkung dafür konfiguriert ist, die Bremskraft durch Erzeugen von Reibung zwischen einem Abschnitt (19, 23) der Feder (14) und einem Abschnitt (20, 24) der Bandabwickelspule (8) zu erzeugen.

3. Bandantrieb nach Anspruch 1 oder 2, wobei die erste Federwirkung dafür konfiguriert ist, die Bremskraft durch Erzeugen von Reibung zwischen einem Abschnitt (3a) der Basis (2) und einem Abschnitt der Bandabwickelspule (8) zu erzeugen.

4. Bandantrieb nach einem der vorhergehenden Ansprüche, wobei der Abwickelspulenträger (3) die Feder (14) umfasst, und/oder wobei die Feder dafür konfiguriert ist, elastisch zusammengedrückt zu werden, wenn die Bandabwickelspule (8) auf dem Abwickelspulenträger installiert ist, wodurch die erste Federwirkung bereitgestellt wird.

5. Bandantrieb nach einem der vorhergehenden Ansprüche, wobei die Feder (14) dafür konfiguriert ist, sich um die Spulendrehachse (A2) elastisch zu verformen, um ein Drehmoment auf die Bandabwickelspule (8) bereitzustellen, das einem Entfernen von Band von der Bandabwickelspule widersteht, wodurch die zweite Federwirkung bereitgestellt wird.

6. Bandantrieb nach einem der vorhergehenden Ansprüche, wobei die Feder (14) ein erstes Ende (15) und ein zweites Ende (16) umfasst,

wobei das erste Ende dafür konfiguriert ist, einen Spulenkern (6) der Bandabwickelspule (8) in Eingriff zu nehmen und eine erste Kraft, die von der Feder bereitgestellt wird, auf den Spulenkern zu lenken, wobei das zweite Ende dafür konfiguriert ist, den Spulenkern in Eingriff zu nehmen und eine zweite Kraft, die von der Feder bereitgestellt wird, auf den Spulenkern zu lenken, und optional wobei sich das erste und das zweite Ende auf im Allgemeinen entgegengesetzten Seiten der Feder befinden.

7. Bandantrieb nach Anspruch 6, wobei die Feder (14) dafür konfiguriert ist, sich um die Spulendrehachse (A2) elastisch zu verformen, wenn sie einem Drehmoment unterworfen wird, der durch Reibung zwischen dem ersten Ende (15) und dem Spulenkern (6) der Bandabwickelspule (8) und durch Reibung zwischen dem zweiten Ende (16) und dem Spulenkern der Bandabwickelspule bewirkt wird, wenn sich der Spulenkern dreht, und optional wobei das erste und das zweite Ende dafür konfiguriert sind, von einer ersten Drehposition zu einer zweiten Drehposition verlagert zu werden, wenn sie dem Drehmoment unterworfen werden, um sich um die Spulendrehachse elastisch zu verformen.

8. Bandantrieb nach einem der Ansprüche 6 bis 7, wobei:

das erste Ende (15) dafür konfiguriert ist, die erste Kraft in einem ersten Winkel zu der Spulendrehachse (A2) auf den Spulenkern (6) zu lenken,
das zweite Ende (16) dafür konfiguriert ist, die zweite Kraft in einem zweiten Winkel zu der Spulendrehachse auf den Spulenkern zu lenken, wobei sich der erste und der zweite Winkel unterscheiden und optional, wobei der erste Winkel etwa 45 Grad zu der Spulendrehachse in einer distalen Richtung liegt;
der zweite Winkel im Allgemeinen senkrecht zu der Spulendrehachse ist.

9. Bandantrieb nach einem der Ansprüche 6 bis 8, wobei die Feder (14) innerhalb des Abwickelspulenträgers (3) aufgenommen ist, wobei der Abwickelspulenträger eine erste Öffnung (17) und eine zweite Öffnung (18) umfasst, und wobei:

das erste Ende (15) dafür konfiguriert ist, sich durch die erste Öffnung zu erstrecken; und
das zweite Ende (16) dafür konfiguriert ist, sich durch die zweite Öffnung zu erstrecken.

10. Bandantrieb nach Anspruch 9, wobei jede von der ersten und der zweiten Öffnung (17, 18) einem Winkel von zwischen etwa 10 bis 15 Grad über der Umfangsfläche des Abwickelspulenträgers (3) gegenüberliegt.

11. Bandantrieb nach einem der Ansprüche 9 oder 10, wobei die erste und die zweite Öffnung (17, 18) so angeordnet sind, dass sie das Ausmaß, bis zu dem die Feder (14) drehbar um die Spulendrehachse (A2) verformt werden kann, begrenzen.

12. Bandantrieb nach einem der vorhergehenden Ansprüche, wobei die Feder (14) dafür konfiguriert ist, eine Nachgiebigkeit auf der Bandlänge von zwischen 1 bis 2 mm bereitzustellen.

13. Bandantrieb nach einem der vorhergehenden Ansprüche, wobei die Feder (14) einen Fuß (21) umfasst, wobei der Fuß relativ zu der Basis (2) des Bandantriebs befestigt ist, und/oder wobei die Feder eine im Wesentlichen planare Drahtfeder ist, und/oder wobei die Feder aus einem einzelnen Stück gebildet ist und/oder eine Ebene der Feder durch die Spulendrehachse (A2) hindurchgeht, und/oder ferner umfassend die Bandabwickelspule (8), wobei die Bandabwickelspule dafür konfiguriert ist, auf dem Abwickelspulenträger installiert zu werden.

14. Thermotransferdrucker (1), Folgendes umfassend:

einen Bandantrieb nach einem der Ansprüche 1 bis 13; und
einen Druckkopf (5), der so angeordnet ist, dass er Tinte von einem Band (7) auf ein Substrat überführt.

15. Bandspule, die dafür konfiguriert ist, von einem Bandantrieb nach den Ansprüchen 6 bis 11 angetrieben zu werden, wobei die Bandspule Folgendes umfasst:

eine erste Spulenkernfläche (20), die dafür konfiguriert ist, das erste Ende (15) der Feder (14) in Eingriff zu nehmen, wobei die erste Spulenkernfläche in einer Neigung relativ zu der Bandspulenachse (A2) angeordnet ist, und
eine zweite Spulenkernfläche (24), die dafür konfiguriert ist, das zweite Ende (16) der Feder in Eingriff zu nehmen, wobei die zweite Spulenkernfläche im Wesentlichen parallel relativ zu der Bandspulenachse angeordnet ist.

Revendications

1. Dérouleur de bande comprenant :

une base (2) ;
un support de bobine débitrice (3) s'étendant depuis la base sur lequel une bobine débitrice en ruban (8) peut être installée, le support de bobine débitrice étant fixe en rotation par rapport à la base, le support de bobine débitrice définis-

sant un axe de rotation de bobine (A2) autour duquel la bobine débitrice en ruban peut être amenée à effectuer une rotation pour permettre le déplacement d'un ruban le long d'une voie de ruban (P) ;
caractérisé par un ressort (14) configuré pour :

fournir une première action de ressort, la première action de ressort étant configurée pour générer une force de freinage par friction et pour ainsi résister à une rotation relative entre la bobine débitrice en ruban et le support de bobine débitrice, la première action de ressort étant en outre configurée pour retenir la bobine débitrice en ruban sur le support de bobine ;
fournir une seconde action de ressort configurée pour fournir une souplesse sur une longueur de la voie de ruban pendant l'impression.

2. Dérouleur de bande selon la revendication 1, dans lequel la première action de ressort est configurée pour générer la force de freinage en générant une friction entre une partie (19, 23) du ressort (14) et une partie (20, 24) de la bobine débitrice en ruban (8).

3. Dérouleur de bande selon la revendication 1 ou 2, dans lequel la première action de ressort est configurée pour générer la force de freinage en générant une friction entre une partie (3a) de la base (2) et une partie de la bobine débitrice en ruban (8).

4. Dérouleur de bande selon l'une quelconque des revendications précédentes, dans lequel le support de bobine débitrice (3) comprend le ressort (14) et/ou dans lequel le ressort est configuré pour être comprimé élastiquement lorsque la bobine débitrice en ruban (8) est installée sur le support de bobine débitrice, fournissant la première action de ressort.

5. Dérouleur de bande selon l'une quelconque des revendications précédentes, dans lequel le ressort (14) est configuré pour être déformé élastiquement autour de l'axe de rotation de bobine (A2) de manière à fournir un couple sur la bobine débitrice en ruban (8) qui résiste à un enlèvement de ruban hors de la bobine débitrice en ruban, fournissant la seconde action de ressort.

6. Dérouleur de bande selon l'une quelconque des revendications précédentes, dans lequel le ressort (14) comprend une première extrémité (15) et une seconde extrémité (16) ;

la première extrémité étant configurée pour se mettre en prise avec un noyau de bobine (6) de la bobine débitrice en ruban (8) et pour diriger une première force, fournie par le ressort, sur le noyau de bobine ;
la seconde extrémité étant configurée pour se mettre en prise avec le noyau de bobine et pour diriger une seconde force, fournie par le ressort, sur le noyau de bobine et optionnellement, dans lequel les première et seconde extrémités sont localisées sur des côtés généralement opposés du ressort.

7. Dérouleur de bande selon la revendication 6, dans lequel le ressort (14) est configuré pour être déformé élastiquement autour de l'axe de rotation de bobine (A2) lorsqu'il est soumis à un couple généré par friction entre la première extrémité (15) et le noyau de bobine (6) de la bobine débitrice en ruban (8) et par friction entre la seconde extrémité (16) et le noyau de bobine de la bobine débitrice en ruban lorsque le noyau de bobine est entraîné en rotation et optionnellement, dans lequel les première et seconde extrémités sont configurées pour être déplacées depuis une première position de rotation jusqu'à une seconde position de rotation lorsqu'elles sont soumises au couple, de manière à ce qu'elles soient déformées élastiquement autour de l'axe de rotation de bobine.

8. Dérouleur de bande selon l'une quelconque des revendications 6 et 7, dans lequel :

la première extrémité (15) est configurée pour diriger la première force sur le noyau de bobine (6) selon un premier angle par rapport à l'axe de rotation de bobine (A2) ;
la seconde extrémité (16) est configurée pour diriger la seconde force sur le noyau de bobine selon un second angle par rapport à l'axe de rotation de bobine, les premier et second angles étant différents et optionnellement, dans lequel le premier angle est d'environ 45 degrés par rapport à l'axe de rotation de bobine dans une direction distale ;
le second angle est généralement perpendiculaire à l'axe de rotation de bobine.

9. Dérouleur de bande selon l'une quelconque des revendications 6 à 8, dans lequel le ressort (14) est logé à l'intérieur du support de bobine débitrice (3), le support de bobine débitrice comprenant une première ouverture (17) et une seconde ouverture (18), et dans lequel :

la première extrémité (15) est configurée pour s'étendre au travers de la première ouverture ; et
la seconde extrémité (16) est configurée pour s'étendre au travers de la seconde ouverture.

10. Dérouleur de bande selon la revendication 9, dans lequel chacune des première et seconde ouvertures (17, 18) sous-tend un angle d'une valeur entre environ 10 et 15 degrés sur la surface circonférentielle du support de bobine débitrice (3).

11. Dérouleur de bande selon l'une quelconque des revendications 9 ou 10, dans lequel les première et seconde ouvertures (17, 18) sont agencées pour limiter l'étendue selon laquelle le ressort (14) peut être déformé en rotation autour de l'axe de rotation de bobine (A2).

12. Dérouleur de bande selon l'une quelconque des revendications précédentes, dans lequel le ressort (14) est configuré pour fournir une souplesse sur la longueur de ruban entre environ 1 et 2 mm.

13. Dérouleur de bande selon l'une quelconque des revendications précédentes, le ressort (14) comprenant un pied (21), le pied étant fixe par rapport à la base (2) du dérouleur de bande, et/ou dans lequel le ressort est un ressort filaire sensiblement plat et/ou, dans lequel le ressort est formé à partir d'une unique pièce et/ou, un plan du ressort passe par l'axe de rotation de bobine (A2) et/ou, comprenant en outre la bobine débitrice en ruban (8), la bobine débitrice en ruban étant configurée pour être installée sur le support de bobine débitrice.

14. Imprimante à transfert thermique (1) comprenant :

un dérouleur de bande selon l'une quelconque des revendications 1 à 13 ; et
une tête d'impression (5) agencée pour transférer de l'encre depuis le ruban (7) sur un substrat.

15. Bobine de bande configurée pour être entraînée par un dérouleur de bande selon les revendications 6 à 11, la bobine de bande comprenant :

une première surface de noyau de bobine (20) configurée pour se mettre en prise avec la première extrémité (15) du ressort (14), la première surface de noyau de bobine étant agencée selon une inclinaison par rapport à l'axe de bobine de bande (A2), et
une seconde surface de noyau de bobine (24) configurée pour se mettre en prise avec la seconde extrémité (16) du ressort, la seconde surface de noyau de bobine étant agencée sensiblement parallèlement par rapport à l'axe de bobine de bande.

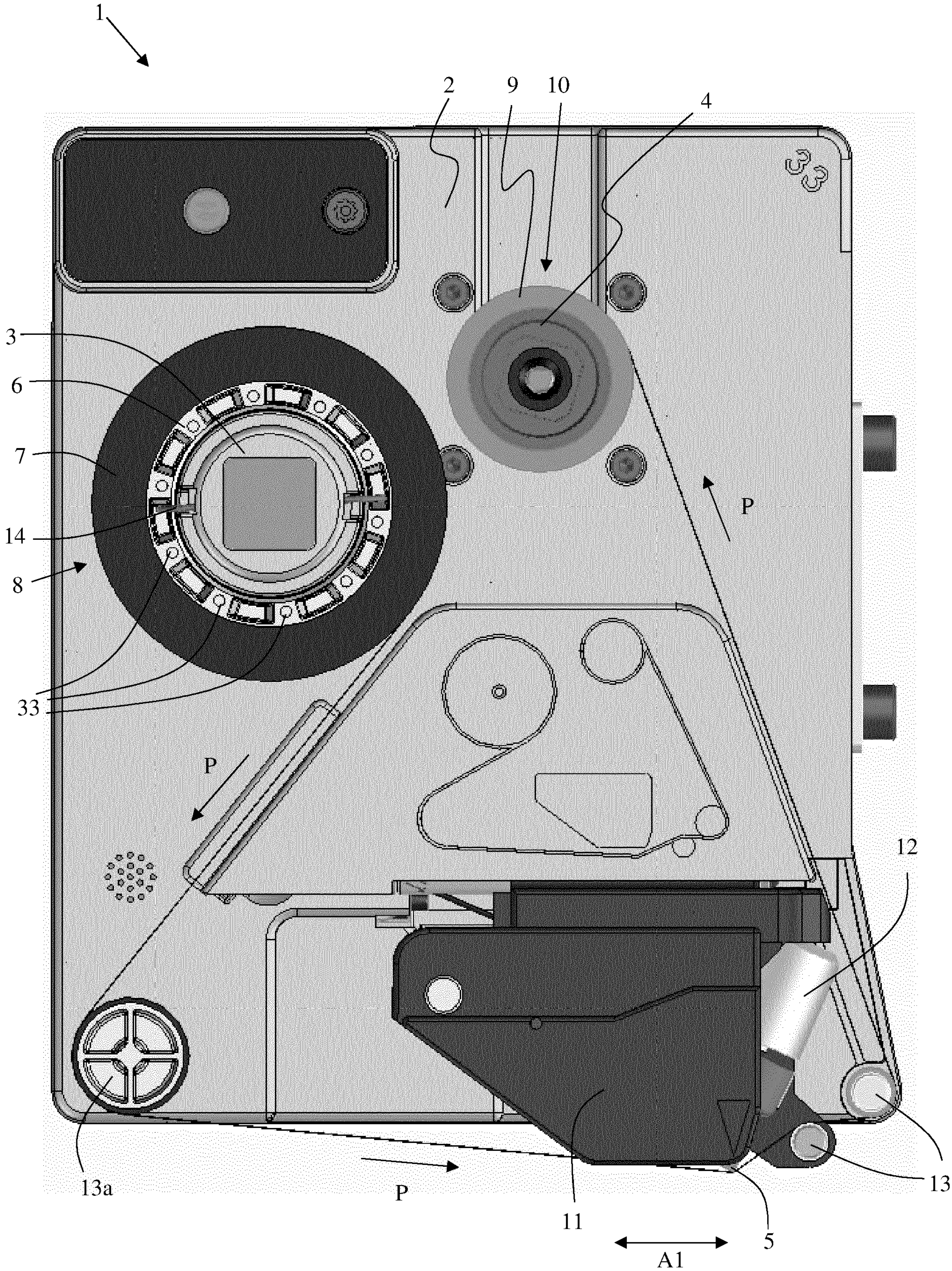

Figure 1

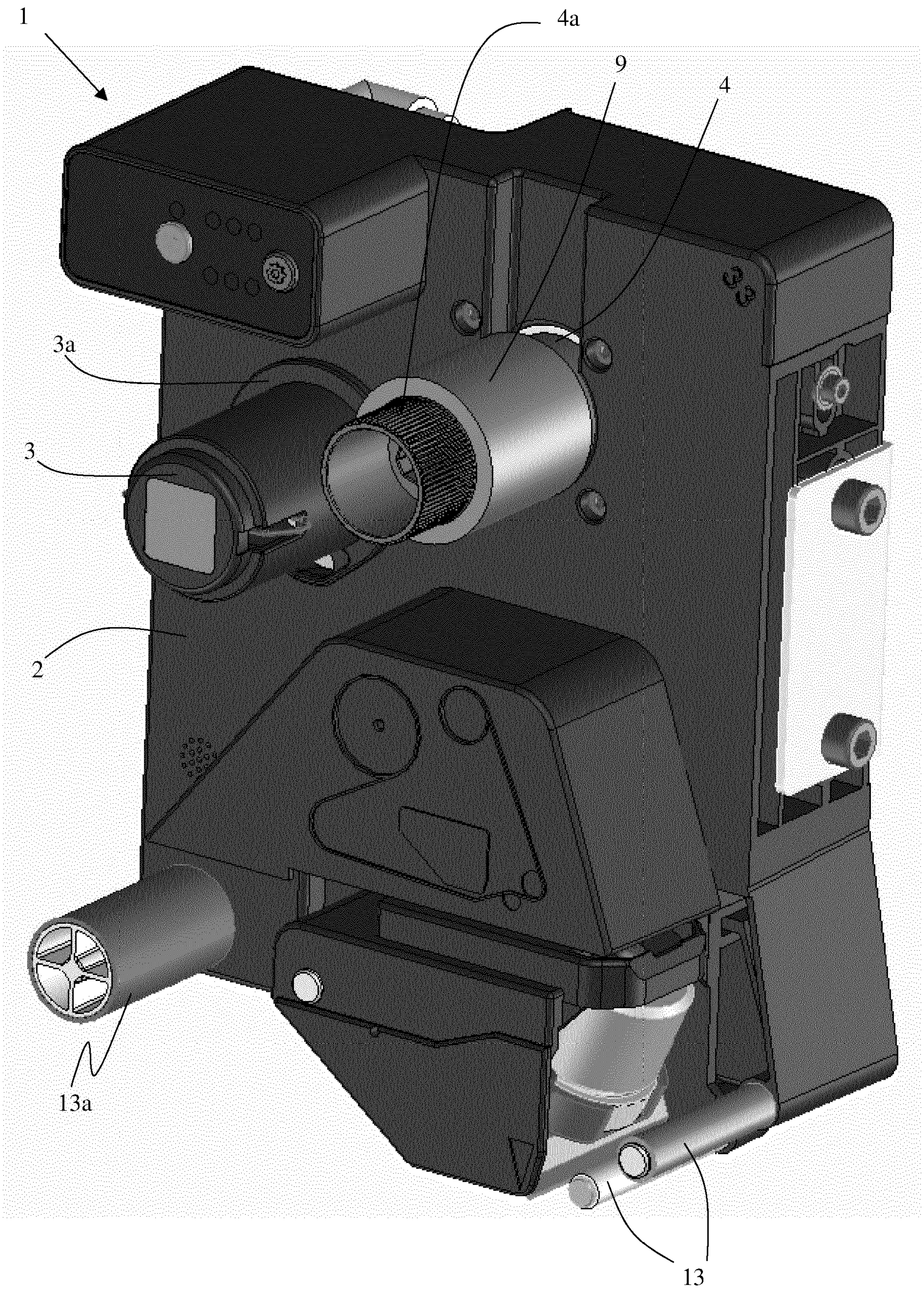

Figure 2

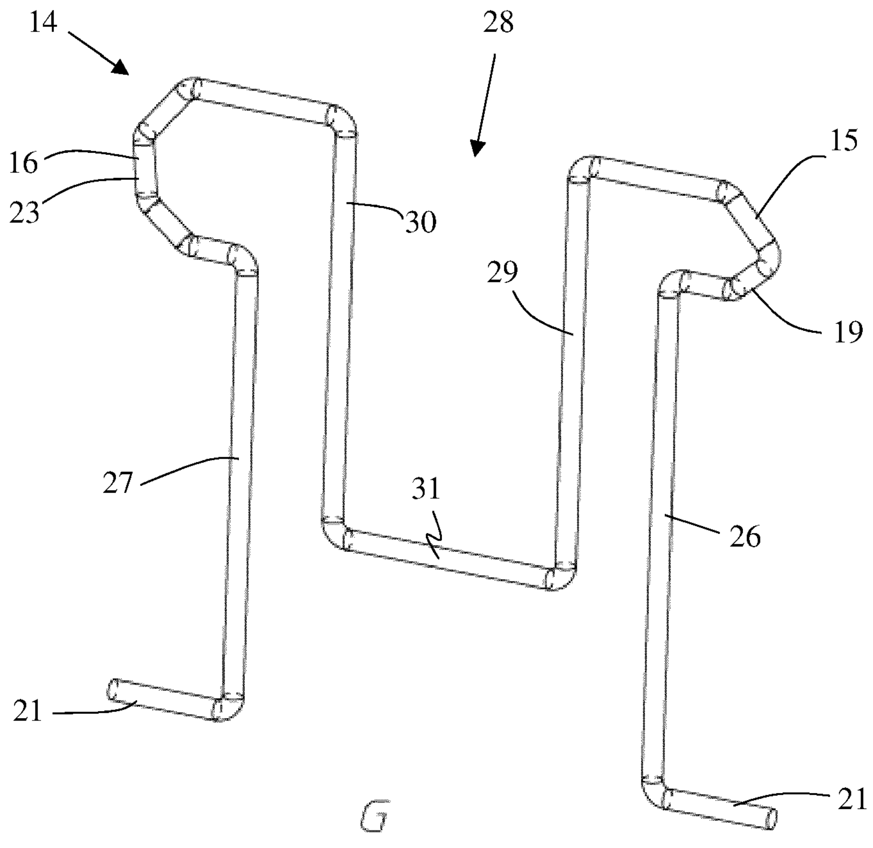

Figure 3

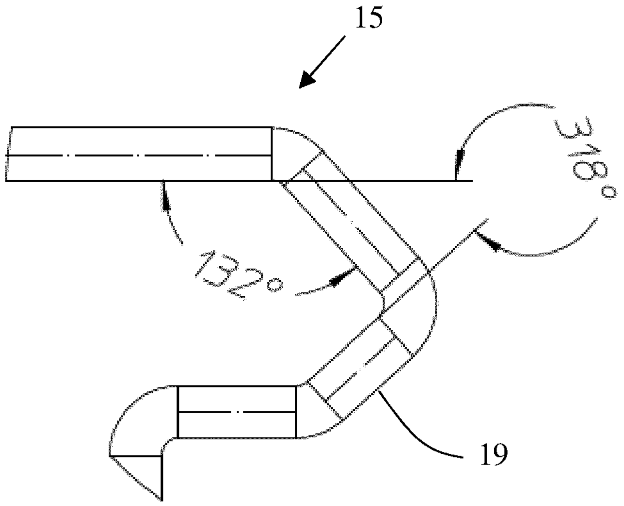

Figure 4

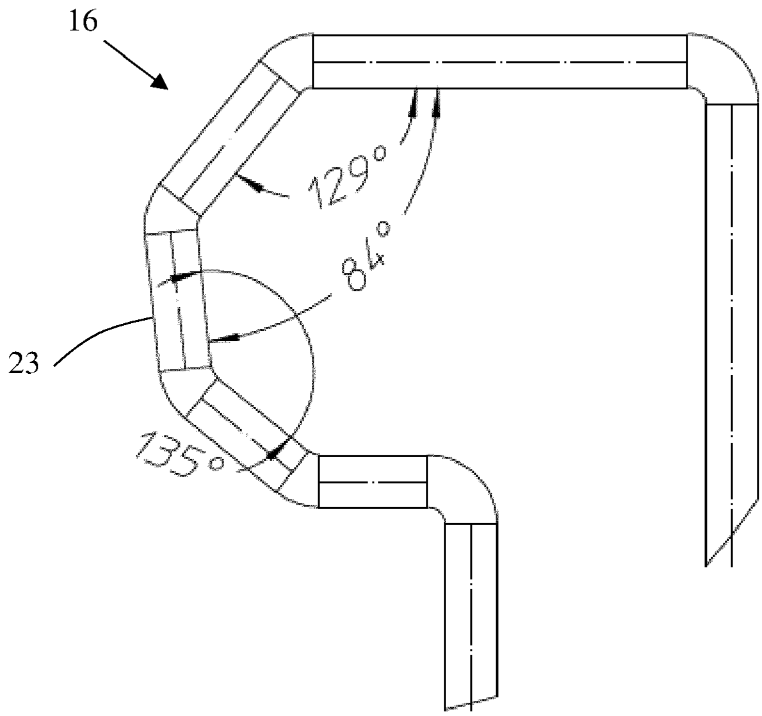

Figure 5

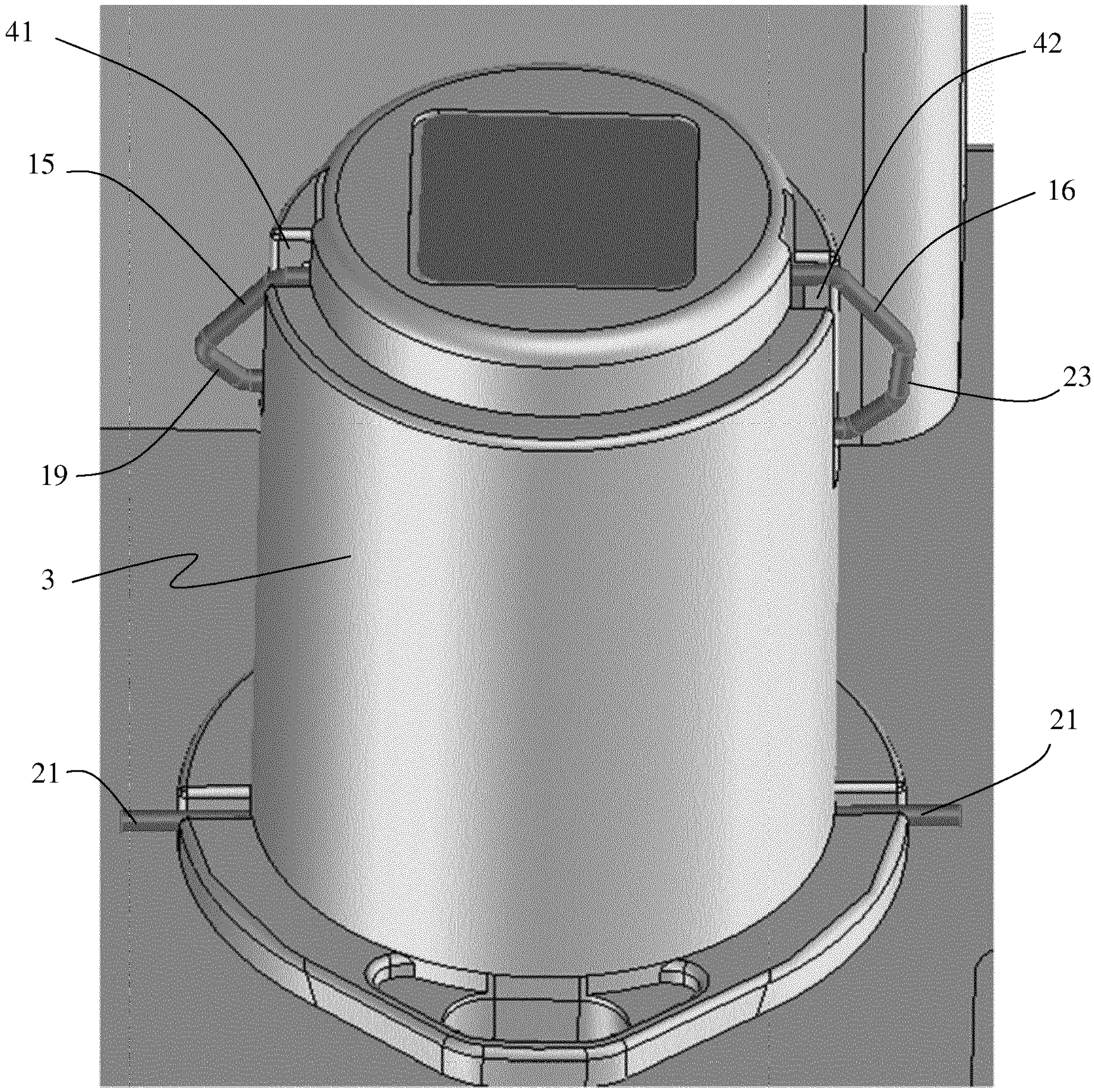

Figure 6

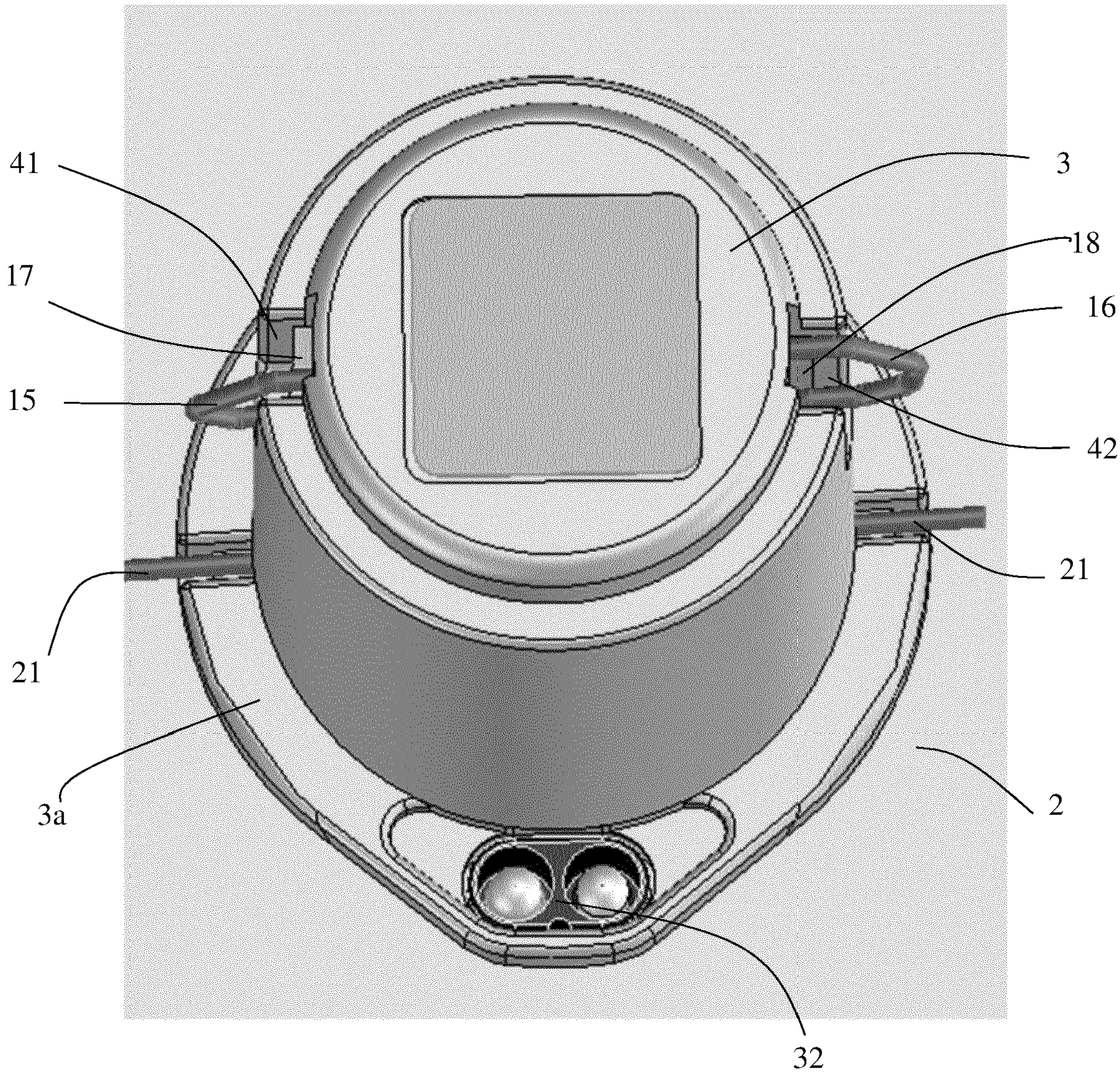

Figure 7

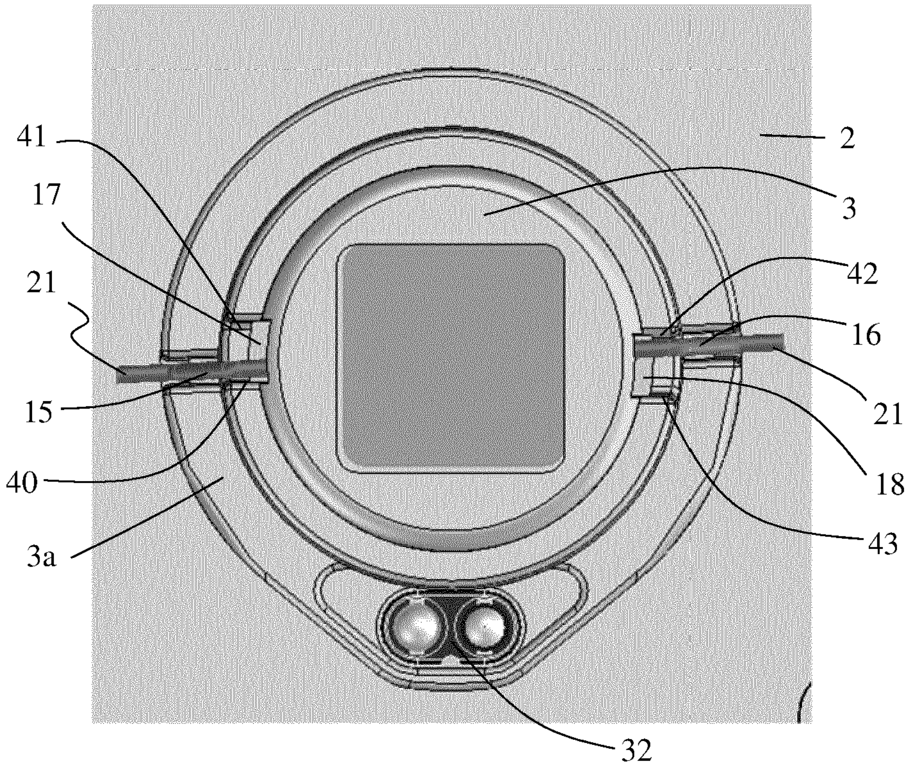

Figure 8a

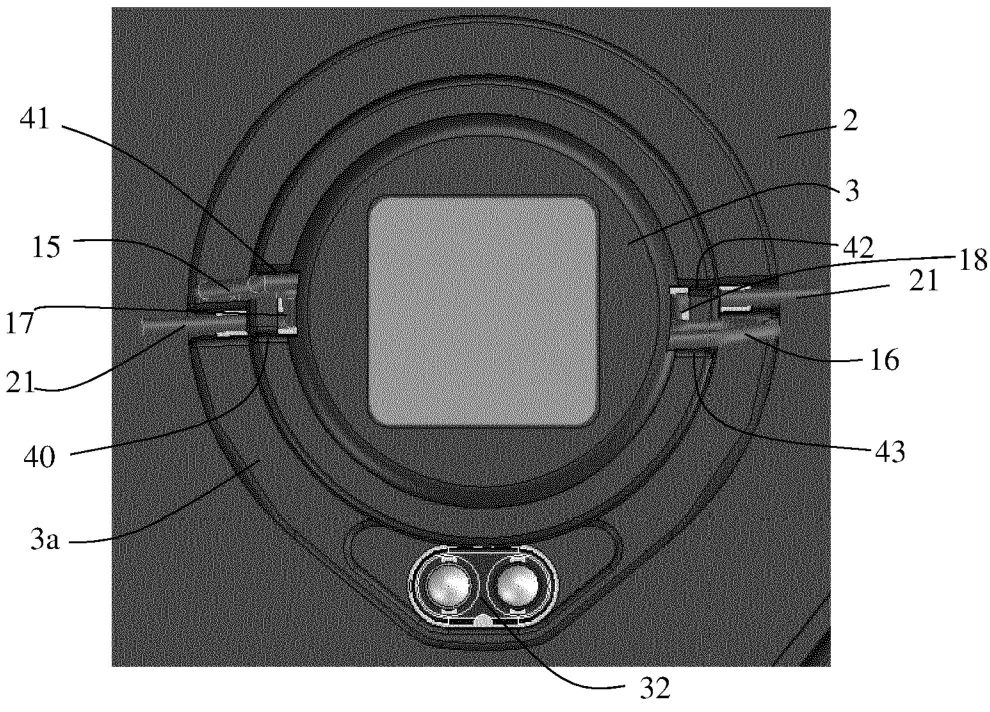

Figure 8b

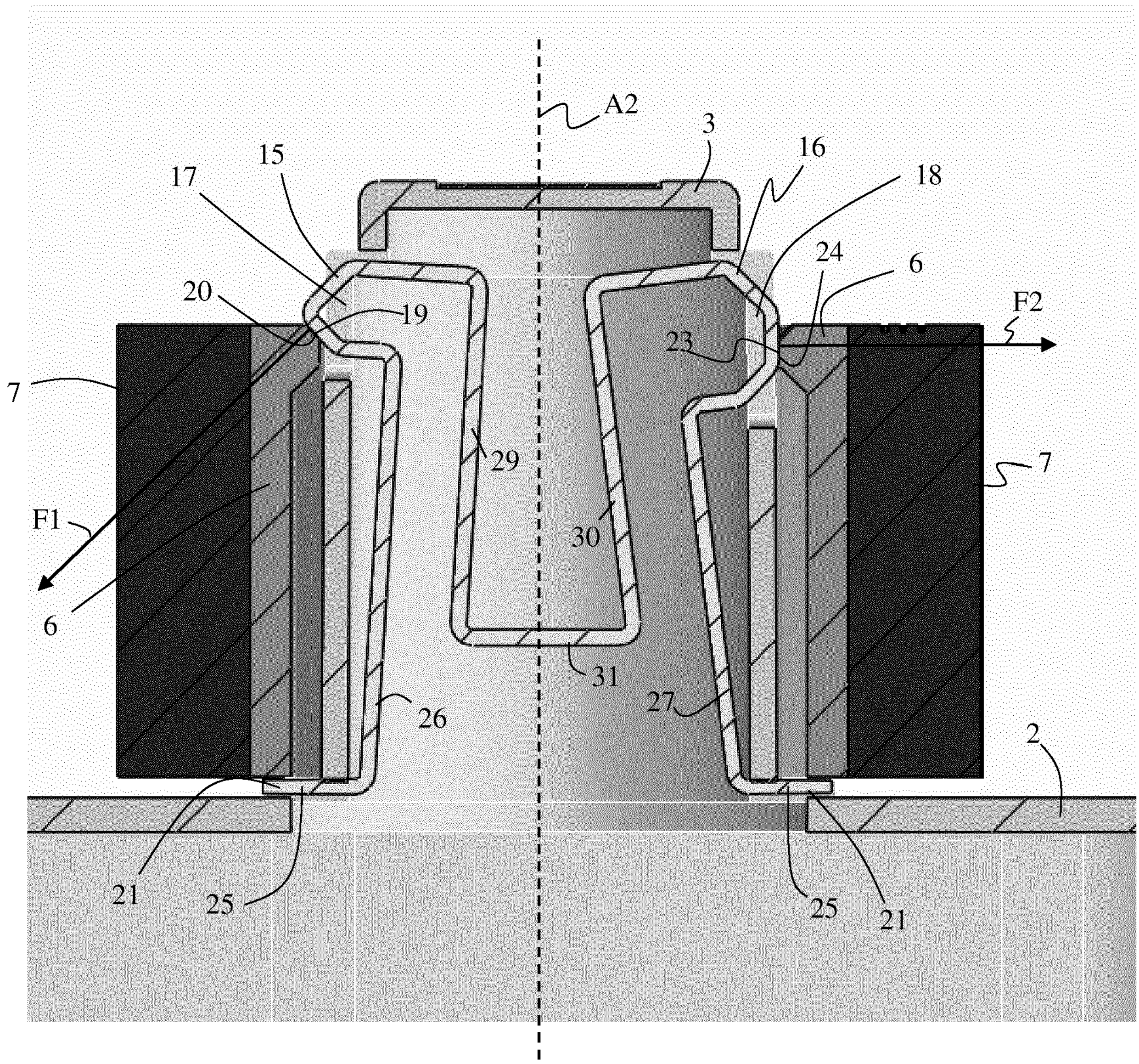

Figure 9

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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