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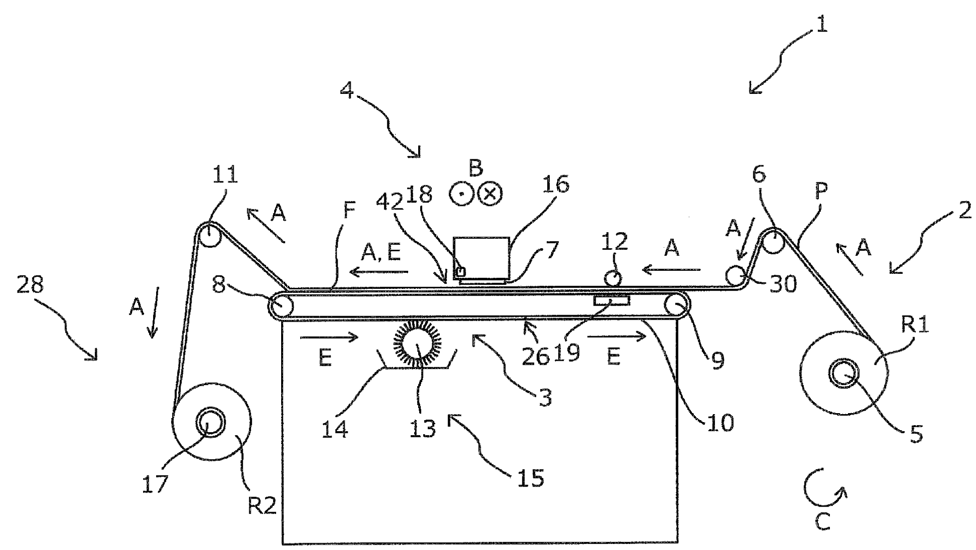
(54) **PRINTING APPARATUS AND TRANSPORTING METHOD**

(57) A printing apparatus includes a transport belt that is formed as a loop and capable of supporting a medium, a drive roller that rotates the transport belt and thereby transports the medium in a transport direction, a printing section that prints an image onto the medium, and a control section that controls a transport action for transporting the medium. In the printing apparatus, the transport belt extends around a plurality of rollers that include the drive roller, and the control section accepts input of belt tension that is a tension generated due to the transport belt extending around a plurality of the rollers. The tension is imparted to the transport belt. The control section controls the transport action in accordance with a correction table in which the belt tension and traveling rate of the transport belt corresponding to the belt tension correlate with each other.

FIG. 1



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Description

BACKGROUND

1. Technical Field

[0001] The present invention relates to a printing apparatus and a transporting method.

2. Related Art

[0002] Various types of printing apparatuses have been used. Among such printing apparatuses, a type of printing apparatus that includes a transport belt for transporting a medium and prints images onto the medium that is transported by the transport belt has been disclosed. Such a printing apparatus including the transport belt for transporting a medium typically has a type of transport belt that extends around a plurality of rollers. For example, JP-A-2006-267487 discloses an image forming apparatus (printing apparatus) in which an elastic transfer belt (transport belt) extends around two rolls (rollers) and a correction roll is provided.

[0003] In the printing apparatus including the transport belt that extends around a plurality of rollers, however, the tension of the transport belt may change for reasons such as the transport belt elongating over time. When the tension of the transport belt changes, the traveling rate of the transport belt may change, and thereby the transporting rate of a medium may deviate from a desired value. According to the configuration proposed in JP-A-2006-267487, the tension of the elastic transfer belt can be adjusted by using the correction roll. However, an adjustment operation for adjusting the tension to a desired value requires not only experience and skill, but also a considerable amount of time and effort.

SUMMARY

[0004] An advantage of some aspects of the invention is that a change in traveling rate of the transport belt, which is caused by a change in tension of a transport belt that extends around a plurality of rollers, is suppressed in a simple manner.

[0005] A printing apparatus according to an aspect of the invention includes a transport belt that is formed as a loop and capable of supporting a medium, a drive roller that rotates the transport belt and thereby transports the medium in a transport direction, a printing section that prints an image onto the medium, and a control section that controls a transport action for transporting the medium. In the printing apparatus, the transport belt extends around a plurality of rollers that include the drive roller, and the control section accepts input of belt tension that is a tension generated due to the transport belt extending around a plurality of the rollers, the tension being imparted to the transport belt. In addition, the control section controls the transport action in accordance with a correction table in which the belt tension and traveling rate of the transport belt corresponding to the belt tension correlate with each other.

[0006] According to this configuration, the printing apparatus accepts input of the belt tension and is able to perform the transport action in accordance with the correction table in which the belt tension and traveling rate of the transport belt corresponding to the belt tension correlate with each other. This can easily suppress a change in traveling rate of the transport belt in conjunction with a change in tension of the transport belt without performing an adjustment operation for adjusting the tension to a desired value.

[0007] It is preferable that in the printing apparatus, the control section provide an instruction to perform an alarm action when the belt tension that has been input is beyond a range covered by the correction table.

[0008] According to this configuration, the printing apparatus is able to perform an alarm action if the belt tension is beyond the range covered by the correction table. If the traveling rate of the transport belt is changed from a desired traveling rate (i.e., if the traveling rate cannot be recovered to the desired value), the printing action can be prevented.

[0009] It is preferable that the printing apparatus include a tension-adjusting section capable of changing the belt tension.

[0010] According to this configuration, the printing apparatus further includes the tension-adjusting section capable of changing the belt tension. Thus, even if the belt tension is beyond the range of the correction table, the printing apparatus can adjust the belt tension into the range of the correction table. The printing apparatus can thereby easily suppress a change in traveling rate of the transport belt caused by a change in tension of the transport belt.

[0011] In the printing apparatus, the transport belt has a joint portion at which one end and the other end of the transport belt in a circumferential direction thereof are joined to each other. It is preferable that the control section be able to accept a measurement instruction to measure the belt tension and that upon accepting the measurement instruction, the control section move the joint portion to a position that is not included in one of span regions in which the belt tension is measured, where the span regions denote a plurality of regions between a plurality of the rollers, each of the regions including the transport belt.

[0012] The joint portion can be a factor for generating an error in measuring the belt tension. With this configuration, the printing apparatus can measure the belt tension when the joint portion is moved to a position that is not included in the span region in which the belt tension is measured. This enables high accuracy-measurement of the belt tension.

[0013] It is preferable that in the printing apparatus, a position at which the belt tension is measured be included in one of span regions that opposes the printing section, where the span regions denote a plurality of regions between a plurality of the rollers, each of the regions including the transport belt.

[0014] With this configuration, the belt tension can be measured at a position that is included in the span region that opposes the printing section, which provides easy access to the transport belt and thereby facilitates belt tension measurement. This enables easy measurement of the belt tension.

[0015] It is preferable that the printing apparatus further include a tension measurement section that measures the belt tension and that the control section accept input of a measurement result from the tension measurement section.

[0016] According to this configuration, the printing apparatus includes the tension measurement section that measures the belt tension, and the control section accepts input of the measurement result from the tension measurement section and is able to control the transport action accordingly. Thus, the printing apparatus can measure the belt tension easily without providing a tension measurement section separately.

[0017] It is preferable that in the printing apparatus, the tension measurement section include a microphone that can detect sound waves generated by causing the transport belt to vibrate and that the tension measurement section measure the belt tension in accordance with frequencies of sound waves that have been detected by the microphone.

[0018] With this configuration, the tension measurement section measures the belt tension in accordance with frequencies of sound waves detected by the microphone capable of detecting sound waves generated by causing the transport belt to vibrate. With this configuration, the belt tension can be measured with high accuracy.

[0019] It is preferable that in the printing apparatus, the microphone be disposed in the printing section.

[0020] According to this configuration, the microphone is disposed in the printing section that is located near the transport belt. Thus, the belt tension can be measured near the transport belt, which enables high-accuracy measurement of the belt tension.

[0021] It is preferable that in the printing apparatus, the tension measurement section include a hammer that causes the transport belt to vibrate.

[0022] According to this configuration, the tension measurement section includes a hammer that causes the transport belt to vibrate, which eliminates the necessity of separately providing an instrument that causes the transport belt to vibrate and thereby enables easy measurement of the belt tension.

[0023] A transporting method according to another aspect of the invention includes providing a printing apparatus that has a transport belt that is formed as a loop and capable of supporting a medium, a drive roller that rotates the transport belt and thereby transports the medium in a transport direction, and a printing section that prints an image onto the medium. The transport belt extends around a plurality of rollers including the drive roller. The transporting method further includes accepting input of belt tension that is a tension generated due to the transport belt extending around a plurality of the rollers, the tension being imparted to the transport belt, and transporting the medium in accordance with a correction table in which the belt tension and traveling rate of the transport belt corresponding to the belt tension correlate with each other.

[0024] According to this configuration, the printing apparatus accepts input of the belt tension and is able to perform the transport action in accordance with the correction table in which the belt tension and traveling rate of the transport belt corresponding to the belt tension correlate with each other. This can easily suppress a change in traveling rate of the transport belt in conjunction with a change in tension of the transport belt without performing an adjustment operation for adjusting the tension to a desired value.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] Embodiments of the invention will now be described by way of example only with reference to the accompanying drawings, wherein like numbers reference like elements.

Fig. 1 is a side view schematically illustrating a printing apparatus according to Example 1 of the invention.

Fig. 2 is a block diagram illustrating a printing apparatus according to Example 1 of the invention.

Fig. 3 is a side view illustrating a principal part of the printing apparatus according to Example 1 of the invention.

Fig. 4 is a side view illustrating a principal part of the printing apparatus according to Example 1 of the invention.

Fig. 5 is a perspective view schematically illustrating a hammer that can be used in the printing apparatus according to Example 1 of the invention.

Fig. 6 is a side view schematically illustrating a printing apparatus according to Example 2 of the invention.

Fig. 7 is a side view schematically illustrating a principal part of the printing apparatus according to Example 2 of the invention.

Fig. 8 is a side view schematically illustrating a principal part of the printing apparatus according to Example 2 of the invention.

Fig. 9 is a side view schematically illustrating a principal part of the printing apparatus according to Example 2 of the invention.

Fig. 10 is a side view schematically illustrating a principal part of the printing apparatus according to Example 2 of the invention.

Fig. 11 is a side view schematically illustrating a principal part of the printing apparatus according to Example 2 of the invention.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0026] An example of a printing apparatus according to the invention will be described in detail with reference to the accompanying drawings.

Example 1 (see Fig. 1 to Fig. 5)

[0027] First, the printing apparatus according to Example 1 of the invention will be outlined. Fig. 1 is a side view schematically illustrating a printing apparatus 1 according to the present example.

[0028] The printing apparatus 1 of the present example includes a supply section 2, a transport mechanism 3, a printing mechanism 4, a washing mechanism 15, and a winding mechanism 28. The supply section 2 is capable of supplying a roll R1 of medium P for printing (i.e., medium P on which printing is performed). The transport mechanism 3 is a mechanism that transports a medium P in a transport direction A by using an adhesive belt 10 (a transport belt constituted by an endless belt) that has a support surface F. The support surface F, to which an adhesive is applied, supports the medium P. The printing mechanism 4 includes a printing section that prints an image on a medium P. The printing section is constituted by components, such as a printing head 7 and a carriage 16 on which the printing head 7 is mounted. The printing mechanism 4 is a mechanism that prints an image (i.e., that ejects ink) onto a medium P such that the carriage 16 having the printing head 7 that ejects ink is caused to perform reciprocal scanning (reciprocal movement) in the scanning direction B that intersects the transport direction A of a medium P. The washing mechanism 15 is a mechanism for washing the adhesive belt 10. The winding mechanism 28 is a mechanism that has a winding shaft 17 for winding up a medium P. Note that "scanning" means that the carriage 16 is caused to move in the scanning direction B. For example, during printing, the carriage 16 is caused to move in the scanning direction B while the printing head 7 ejects ink.

[0029] Note that a textile material to be printed on can serve as a medium P. Textile materials to be printed on include pieces of cloth, clothes, and other products to be used for textile printing. Cloth includes woven fabric, knitted fabric, or nonwoven fabric that are made of natural fibers, such as cotton, linen, silk, and wool, or synthetic fibers, such as nylon, or composite fibers in which the above materials are combined in various ways. Moreover, clothes and other products include sewn products, such as T-shirts, handkerchiefs, scarfs, towels, cloth bags, curtains, sheets, or bedcovers, as well as materials such as pieces of cloth in the state of parts before sewing.

[0030] In addition to the textile materials to be printed on, paper for ink jet printers, such as standard paper, high-quality paper, and glossy paper, can be used as medium P. Moreover, materials that can also be used as a medium P include, for example, plastic films that are not surface treated for use in ink jet printing (i.e., no ink-absorbing layer is formed), and substrates, of which paper is an example, that are coated with plastic or that have a plastic film adhering thereto. For example, such plastic includes, but is not limited to, polyvinyl chloride, polyethylene terephthalate, polycarbonate, polystyrene, polyurethane, polyethylene, or polypropylene.

[0031] The supply section 2 includes a rotation shaft 5 that serves as a setting position at which a roll R1 of medium P is installed for printing. The supply section 2 is formed so as to be able to supply a medium P from the roll R1 set on the rotation shaft 5 toward the transport mechanism 3 via idler rollers 6 and 30. Note that the rotation shaft 5 rotates in a rotational direction C when the medium P is supplied to the transport mechanism 3.

[0032] The transport mechanism 3 includes the adhesive belt 10, a drive roller 8, and an idler roller 9. The adhesive belt 10 transports the medium P that is supplied from the supply section 2 and placed on the adhesive belt 10, and the drive roller 8 moves the adhesive belt 10 in a direction E. The adhesive belt 10 extends around the drive roller 8 and the idler roller 9. In the printing apparatus 1 of the present example, the drive roller 8 and the idler roller 9 are aligned horizontally, and thus the span direction G of the adhesive belt 10 corresponds to the horizontal direction (see Fig. 3). The medium P is placed on the adhesive belt 10 such that a pressing roller 12 presses the medium P against the support surface F of the adhesive belt 10 and causes the medium P to adhere thereto. Note that the drive roller 8 rotates in the rotational direction C when transporting the medium P. However, the endless belt serving as the transport belt is not limited to the adhesive belt. For example, an endless belt capable of electrostatic adsorption may be used. A support portion 19 capable of supporting the adhesive belt 10 is provided in a region that is under the adhesive belt 10 of the present example. The support portion 19 opposes the pressing roller 12 with the adhesive belt 10 sandwiched therebetween. When the adhesive belt 10 travels, the adhesive belt 10 may vibrate. The vibration can be reduced by the support portion 19 that supports the adhesive belt 10. If the pressing roller remains in contact with the medium P at the same location for a certain amount of time, a contact mark may be left on the medium P by the pressing roller. To prevent a contact mark from being formed on the medium P, the pressing roller 12 of the present example is formed so as to be able to move reciprocally (to move back and forth) in the transport direction A. The pressing roller 12, however, is not limited to this construction.

[0033] The printing mechanism 4 includes a carriage operating section 29 (see Fig. 2) that can cause the carriage 16 with the printing head 7 thereon to move reciprocally in the scanning direction B. Note that the scanning direction B is the direction perpendicular to the image of Fig. 1. During printing, the carriage 16 with the printing head 7 thereon is caused to perform reciprocal scanning. During reciprocal scanning (during the movement of the carriage 16) for printing, the transport mechanism 3 stops transporting the medium P. In other words, during printing, reciprocal scanning of the carriage 16 and transport of the medium P are performed alternately. During printing, the transport mechanism 3 transports the medium P (i.e., moves the adhesive belt 10) intermittently in synchronization with reciprocal scanning of the carriage 16. Note that a microphone 18 is attached to the carriage 16, which will be described below.

[0034] The washing mechanism 15 for the adhesive belt 10 includes a washing brush 13 constituted by a plurality of washing rollers that are connected to each other in the direction of the rotation shaft. The washing mechanism 15 also includes a tray 14 that contains detergent for washing the washing brush 13.

[0035] The winding mechanism 28 is a mechanism that winds up the medium P that is transported, after printing, from the transport mechanism 3 via an idler roller 11. The medium P can be wound around a paper tube or the like that is set on the winding shaft 17, thereby forming a roll R2 of medium P. Fig. 1 illustrates a state in which the printing apparatus 1 uses a roll R1 in which the outside surface of the medium P is the surface for printing, and the medium P is wound up such that the printed surface becomes the outside surface of the roll R2. Thus, both of the rotation shaft 5 and the winding shaft 17 rotate in the rotational direction C. However, the printing apparatus 1 of the present example can use a roll R1 in which the inside surface of the medium P is the surface for printing, and the medium P can be wound up such that the printed surface faces inward. Accordingly, either or both of the rotation shaft 5 and the winding shaft 17 can rotate in a direction opposite to the rotational direction C.

[0036] Next, an electrical configuration of the printing apparatus 1 of the present example will be described. Fig. 2 is a block diagram illustrating a printing apparatus 1 of the present example. A control section 31 is a control unit for controlling the printing apparatus 1. The control section 31 includes an I/F (interface) 32, a CPU 33, a storage unit 45, and so forth. The I/F 32 is provided for transmission and reception of data, such as print data, to and from a PC 46 serving as an external device. The CPU 33 is a processing unit for controlling the entire printing apparatus 1 in response to input signals from detection devices 47 including a microphone 18. The storage unit 45 includes a ROM that stores various control programs to be executed by the CPU 33. The storage unit 45 also includes a RAM, an EEPROM, and the like, which provide areas for temporarily storing a program to be executed by the CPU 33, work areas for the program, and so forth.

[0037] CPU 33 controls, via a control circuit 44, actuation of the drive roller 8, the carriage operating section 29, the printing head 7, and other devices (not shown). The drive roller 8 moves the adhesive belt 10 in the transport direction A. The carriage operating section 29 moves the carriage 16 with the printing head 7 thereon in the scanning direction B, and the printing head 7 ejects ink onto a medium P.

[0038] The control section 31 of the present example, which is configured as above, can control a printing action (including a transport action for transporting a medium P and an ejection action for ejecting ink from the printing head 7) for forming images on a medium P. Note that "transport action for transporting a medium P" is an action in which a medium P is transported in the transport direction A. The adhesive belt 10 extends around a plurality of rollers (drive roller 8 and idler roller 9), which thereby imparts tension to the adhesive belt 10. This tension is referred to as "belt tension". The microphone 18 serves as a tension measurement section that can measure the belt tension. More specifically, the microphone 18 can detect sound waves that are generated by causing the adhesive belt 10 to vibrate by using a hammer 27 (see Fig. 5) or the like, which will be described below, and can be used to measure the belt tension on the basis of frequencies of detected sound waves. In addition, the storage unit 45 stores a correction table in which the belt tension and the traveling rate of the adhesive belt 10 corresponding to the belt tension correlate with each other.

[0039] In summary, the printing apparatus 1 of the present example includes the adhesive belt 10 that is formed as a loop and capable of supporting a medium P, the drive roller 8 that rotates the adhesive belt 10 and thereby transports the medium P in the transport direction, the printing head 7 that prints images onto the medium P, and the control section 31 that controls the transport action for transporting the medium P. In addition, the adhesive belt 10 extends around a plurality of rollers (including the drive roller 8 and the idler roller 9). The control section 31 accepts input of belt tension, which results from the adhesive belt 10 extending around a plurality of the rollers. The control section 31 controls the transport action in accordance with a correction table in which the belt tension and traveling rate of the adhesive belt 10 corresponding to the belt tension correlate with each other. The printing apparatus 1 of the present example is formed so as to be able to accept input of the belt tension and perform the transport action in accordance with the correction table in which the belt tension and traveling rate of the adhesive belt 10 corresponding to the belt tension correlate with each other. This can easily suppress a change in traveling rate of the adhesive belt 10 in conjunction with a change in tension of the adhesive belt 10 without performing an adjustment operation for adjusting the tension to a desired value.

[0040] Put another way, the printing apparatus 1 of the present example includes the adhesive belt 10 that is formed as a loop and capable of supporting the medium P, the drive roller 8 that rotates the adhesive belt 10 and thereby transports the medium P in a transport direction, and the printing head 7 that prints images onto the medium P, the adhesive belt 10 extending around a plurality of rollers including the drive roller 8. By using the printing apparatus 1, a transporting method of transporting a medium P can be executed by way of accepting input of the belt tension and in accordance with the correction table in which the belt tension and the traveling rate of the adhesive belt 10 corresponding to the belt tension correlate with each other. According to this configuration, by accepting input of the belt tension and performing the transport action in accordance with the correction table in which the belt tension and the traveling rate of the adhesive belt 10 corresponding to the belt tension correlate with each other, a change in traveling rate of the adhesive belt 10 caused by a change in tension of the adhesive belt 10 can be easily suppressed without performing an adjustment operation for adjusting the tension to a desired value.

[0041] As described above, the printing apparatus 1 of the present example includes the microphone 18 serving as the tension measurement section that is used to measure the belt tension, and the control section 31 can accept measurement results of the microphone 18 and control the transport action in accordance with the measurement results. As a result, the printing apparatus 1 of the present example can measure the belt tension easily without having a tension measurement section separately.

[0042] In addition, the printing apparatus 1 of the present example includes the microphone 18, as the tension measurement section, that can be used to detect sound waves generated by causing the adhesive belt 10 to vibrate. Accordingly, the printing apparatus 1 can measure the belt tension on the basis of frequencies of sound waves that have been detected by the microphone 18. With this configuration, the belt tension can be measured with high accuracy.

[0043] As illustrated in Fig. 1, in the printing apparatus 1 of the present example, the microphone 18 is disposed in the carriage 16 in which the printing head 7 is disposed. The carriage 16, which constitutes the printing section, is disposed at a position close to the adhesive belt 10. The microphone 18, which is thereby provided at a position close to the adhesive belt 10, can be used to measure the belt tension near the adhesive belt 10, which enables high-accuracy measurement of the belt tension.

[0044] Regions between a plurality of rollers (i.e., between the drive roller 8 and the idler roller 9) in each of which the adhesive belt 10 is present are referred to as "span regions". More specifically, the span regions include two regions, in other words, an upper span region (that opposes the printing head 7) and a lower span region (that does not oppose the printing head 7) between the drive roller 8 and the idler roller 9. The adhesive belt 10 of the present example is formed to be able to move in the direction E in response to rotation of the drive roller 8 in the rotational direction C. The adhesive belt 10 has a joint portion 26 at which one end of the adhesive belt 10 and the other end of the adhesive belt 10 in the circumferential direction thereof are joined to each other (see Fig. 1). As illustrated in Fig. 1, in the printing apparatus 1 of the present example, the position 42 at which the belt tension is measured is a position included in one of the span regions that opposes the printing head 7 (i.e., the upper span region). By adopting this arrangement, the belt tension can be measured in the span region that opposes the printing head 7, which provides easy access to the adhesive belt 10 and thereby facilitates belt tension measurement. Thus, the printing apparatus 1 of the present example can measure the belt tension with high accuracy. During measurement, the control section 31 is ready to accept a measurement instruction to measure the belt tension. Upon receiving the measurement instruction, the control section 31 moves the joint portion 26 to the span region that is not opposing the printing head 7 (i.e., the lower span region). In other words, the control section 31, which has accepted the measurement instruction, moves the joint portion 26 to a position that is not included in the span region in which the belt tension is measured. The joint portion 26 can be a factor for generating an error in measuring the belt tension. The printing apparatus 1 of the present example is formed so as to be able to measure the belt tension after the joint portion 26 is moved to a position that is not included in the span region in which the belt tension is measured. This enables the printing apparatus 1 of the present example to measure the belt tension with high accuracy. Note that the belt tension may be measured at a position that is not included in the span region that opposes the printing head 7. Also note that the position to which the joint portion 26 is moved may be any position, preferably provided that it is not included in the span region in which the belt tension is measured.

[0045] If a belt tension that the microphone 18 serving as the tension measurement section has measured and sent to the control section 31 is beyond the range covered by the correction table that is stored in the storage unit 45, the control section 31 of the present example can issue an instruction to perform an alarm action that causes, for example, an alarm to sound from a speaker (not shown) or an alert to be displayed on a monitor screen (not shown) of the printing apparatus 1 or the PC 46. Thus, the printing apparatus 1 of the present example can perform an alarm action if the belt tension is beyond the range covered by the correction table, so that the printing action can be suppressed in the case that the traveling rate of the adhesive belt 10 is changed from a desired traveling rate (i.e., if the traveling rate cannot be recovered to a desired value).

[0046] Note that the printing apparatus 1 of the present example includes a tension-adjusting section 21 (see Fig. 3 and Fig. 4) that can adjust the belt tension in the case that, for example, the belt tension is beyond the range of the correction table. Accordingly, even if the belt tension is beyond the range of the correction table, the printing apparatus 1 of the present example can adjust the belt tension to fall within the range of the correction table. Thus, the printing apparatus 1 can easily suppress a change in traveling rate of the adhesive belt 10 caused by a change in tension of the adhesive belt 10.

[0047] The tension-adjusting section 21, which is a principal part of the printing apparatus 1 of the present example, will be described below. Fig. 3 is a side view illustrating the transport mechanism 3 including the tension-adjusting section 21, which is a principal part of the printing apparatus 1 of the present example. Fig. 4 is a side view illustrating the region X in Fig. 3.

[0048] As illustrated in Fig. 3, the transport mechanism 3 of the present example includes the tension-adjusting section 21 on the side thereof near the idler roller 9 in the span direction G. The tension-adjusting section 21 can adjust the position of the idler roller 9 in the span direction G.

[0049] As illustrated in Fig. 4, the tension-adjusting section 21 includes a base portion 22, an urging portion 24, a motor mechanism 23, and a guide portion 25. The base portion 22 supports the idler roller 9, and the urging portion 24 urges the base portion 22 in a direction G1, which is one direction of the span direction G. The motor mechanism 23 can change the position of the urging portion 24 in the span direction G. The guide portion 25 guides the movement of the base portion 22 in the span direction G in conjunction with the movement of the urging portion 24 in the span direction G. The tension that is imparted due to the adhesive belt 10 extending around the idler roller 9 applies a force to the base portion 22 in a direction G2 (i.e., toward the urging portion 24), which is the other direction of the span direction G. With this configuration, the belt tension can be adjusted by actuating a motor of the motor mechanism 23 and thereby adjusting the position of the urging portion 24 (i.e., base portion 22) in the span direction G.

[0050] A transport belt that extends around a plurality of rollers, such as the adhesive belt 10 of the present example, may elongate due to aging, leading to a change in tension. When the tension (belt tension) of the transport belt changes, the traveling rate of the transport belt may change (in general, the smaller the belt tension becomes due to elongation of the transport belt, the smaller the traveling rate of the transport belt tends to be). Consequently, the transporting rate of the medium P may deviate from a desired value. The printing apparatus 1 of the present example is thus formed so that even if the adhesive belt 10 elongates due to aging, the printing apparatus 1 is able to perform the transport action (or more specifically, to adjust the rotation rate of the drive roller 8) in accordance with the correction table stored in the storage unit 45. However, the adhesive belt 10 may elongate more than a predetermined range and deviate from the range of the correction table. In this case, the position of the idler roller 9 (i.e., base portion 22) can be adjusted so as to cause the belt tension to return to within the range covered by the correction table.

[0051] The microphone 18, which is the tension measurement section of the present example, is capable of detecting sound waves that are generated by causing the adhesive belt 10 to vibrate. For this purpose, any method can be used provided that the adhesive belt 10 is caused to vibrate. However, it is preferable, for example, to use a hammer 27 as illustrated in Fig. 5. As illustrated in Fig. 5, the hammer 27 is constituted by a hammerhead 34, which is brought into contact with the adhesive belt 10, and a grip 35. A user can vibrate the adhesive belt 10 by using the hammer 27 shaped as illustrated in Fig. 5. More specifically, for example, when measuring the belt tension of the adhesive belt 10, a user first inputs, from the PC 46, an instruction to execute a measurement mode for measuring the belt tension. Next, under the control of the control section 31, the position of the adhesive belt 10 is adjusted (i.e., the joint portion 26 is moved to the lower side) and a message is displayed on the monitor of the PC 46 to prompt the user to vibrate the adhesive belt 10 or the like. The user subsequently vibrates the adhesive belt 10 by using the hammer 27 and enters, via the PC 46, information that the adhesive belt 10 has been vibrated. Next, under the control of the control section 31, the carriage 16 is caused to move in the scanning direction B and the microphone 18 is caused to detect sound waves. It is preferable to vibrate the adhesive belt 10 multiple times (for example, an average result of multiple trials is adopted). It is also preferable to detect sound waves at multiple positions in the scanning direction B. In addition, when the belt tension of the adhesive belt 10 is measured, it is preferable that the printing apparatus 1 does not perform any impeding actions that impede measurement of the belt tension. More specifically, such impeding actions include a transport action of the transport mechanism 3 (i.e., the drive roller 8 moving the adhesive belt 10), a washing action of the washing mechanism 15 that washes the adhesive belt 10, an action of a fan disposed in the printing apparatus 1 (for example, a suction action of a suction fan or an exhaust action of an exhaust fan), and the like. During such actions, the belt tension may not be measured accurately. For this reason, the printing apparatus 1 is formed so as to stop such impeding actions in the case that the impeding actions are being performed when the instruction to execute the measurement mode for measuring the belt tension is entered. The belt tension is measured while the impeding actions are not performed. Thus, the belt tension can be measured with high accuracy. The printing apparatus 1 may be formed such that when the belt tension is measured, not all the impeding actions but some of the impeding actions are stopped.

[0052] As described above, the printing apparatus 1 of the present example includes the microphone 18 serving as the tension measurement section and does not include the hammer 27 (this is not an element of the printing apparatus 1). However, the printing apparatus 1 is not limited to this configuration. For example, the entire tension measurement section may be formed as a separate element that is not included in the printing apparatus 1, and the printing apparatus 1 may be formed such that the control section 31 is capable of accepting the belt tension via the PC 46 or the like. Alternatively, the printing apparatus 1 may include the microphone 18 and the hammer 27, both of which serve as the tension measurement section. Example 2 (see Fig. 6 to Fig. 11)

[0053] Next, the printing apparatus 1 according to Example 2, which includes both the microphone 18 and the hammer 20 as the tension measurement section, will be described with reference to the accompanied drawings. Fig. 6 is a side view schematically illustrating a printing apparatus 1 according to the present example. Fig. 6 corresponds to Fig. 1 that illustrates the printing apparatus 1 according to Example 1. In addition, Figs. 7 to 11 are side views schematically illustrating a hammer 20 that serves as the tension measurement section included by the printing apparatus 1 of the present example. Note that components similar to those in Example 1 are denoted by the same numerals, and duplicated description will be omitted. The printing apparatus 1 of the present example includes the hammer 20, in addition to the microphone 18, as the tension measurement section. Except this, the printing apparatus 1 of the present example is formed so as to be the same as the printing apparatus 1 according to Example 1.

[0054] As illustrated in Fig. 6, the printing apparatus 1 of the present example includes, as the tension measurement section, the hammer 20 that causes the adhesive belt 10 to vibrate. Thus, the printing apparatus 1 of the present example can measure the belt tension easily without separately providing an instrument for causing the adhesive belt 10 to vibrate.

[0055] Next, the hammer 20 according to the present example will be described in detail. As illustrated in Fig. 7, the hammer 20 of the present example is constituted by a pressing member 36 and a rotating member 37. The pressing member 36 has a hammerhead portion 41 that hits the support surface F of the adhesive belt 10 and a hook portion 38. The rotating member 37 is formed so as to be able to rotate in the rotational direction C relative to a rotation shaft 39. The rotating member 37 has three abutting portions 40. The pressing member 36 is urged in a direction D1 (in a direction toward the adhesive belt 10) by an urging member (not shown). While the rotating member 37 rotates in the rotational direction C, an abutting portion 40 abuts the hook portion 38 and causes the pressing member 36 to move in a direction D2 (in a direction away from the adhesive belt 10). Further rotation of the rotating member 37 in the rotational direction C unhooks the hook portion 38 from the abutting portion 40, causing the pressing member 36 to move in the direction D1 and the hammerhead portion 41 to hit the support surface F of the adhesive belt 10.

[0056] Fig. 8 illustrates a state in which the hook portion 38 is unhooked from an abutting portion 40. As illustrated in Fig. 8, in the state in which the hook portion 38 is unhooked from an abutting portion 40, the hammerhead portion 41 is positioned at a contact position S1 at which the hammerhead portion 41 is in contact with the support surface F of the adhesive belt 10.

[0057] Fig. 9 illustrates a state at the moment when an abutting portion 40 touches the hook portion 38. While the rotating member 37 rotates in the rotational direction C from the state in Fig. 9, the pressing member 36 moves in the direction D2.

[0058] Fig. 10 illustrates a state in which the pressing member 36 has moved to a space-keeping position S2 by rotating the rotating member 37 in the rotational direction C from the state in Fig. 9. Note that the space-keeping position S2 illustrated in Fig. 10 is the home position of the pressing member 36 (home position when the vibration action of the adhesive belt 10 is not performed, such as when the printing action is performed).

[0059] Fig. 11 illustrates a state in which the vibration action of (process for vibrating) the adhesive belt 10 has been started and the pressing member 36 has moved to a striking-start position S3 by rotating the rotating member 37 in the rotational direction C from the state in Fig. 10. In subsequent execution of the vibration action of the adhesive belt 10, the rotating member 37 rotates in the rotational direction C from the state in Fig. 11, and the hook portion 38 is unhooked from an abutting portion 40, causing the pressing member 36 to move in the direction D1 and the hammerhead portion 41 to hit the support surface F of the adhesive belt 10 (returning to the state in Fig. 8).

[0060] The hammer 20 of the present example is thus formed (three abutting portions 40 are disposed on the rotating member 37 with an equal spacing therebetween). Accordingly, a vibration action of the adhesive belt 10 can be executed by rotating the rotating member 37 each one-third of a rotation. The position of the rotating member 37 in the rotational direction C can be detected by a sensor (not shown).

[0061] For example, when the belt tension of the adhesive belt 10 is measured by using the printing apparatus 1 of the present example, a user first inputs, from the PC 46, an instruction to execute the measurement mode for measuring the belt tension. Next, under the control of the control section 31, the printing apparatus 1 adjusts the position of the adhesive belt 10 (i.e., moves the joint portion 26 to the lower side). Under the control of the control section 31, the printing apparatus 1 subsequently rotates the rotating member 37 in the rotational direction C and thereby moves the pressing member 36 consecutively from the state in Fig. 10 to the state in Fig. 11, the state in Fig. 8, the state in Fig. 9, and then back to the state in Fig. 10. The hammerhead portion 41 thus hits the support surface F of the adhesive belt 10 and causes the adhesive belt 10 to vibrate. Under the control of the control section 31, the printing apparatus 1 subsequently moves the carriage 16 in the scanning direction B and causes the microphone 18 to detect sound waves. It is preferable to vibrate the adhesive belt 10 multiple times (for example, an average result of multiple trials is adopted). It is also preferable to detect sound waves at multiple positions in the scanning direction B. In addition, when the belt tension of the adhesive belt 10 is measured, it is preferable that the printing apparatus 1 does not perform any impeding actions that impede measurement of the belt tension. More specifically, such impeding actions include a transport action of the transport mechanism 3 (i.e., the drive roller 8 moving the adhesive belt 10), a washing action of the washing mechanism 15 that washes the adhesive belt 10, an action of a fan disposed in the printing apparatus 1 (for example, a suction action of a suction fan or an exhaust action of an exhaust fan), and the like. During such actions, the belt tension may not be measured accurately. For this reason, the printing apparatus 1 is formed so as to stop such impeding actions in the case that the impeding actions are being performed when the instruction to execute the measurement mode for measuring the belt tension is entered. The belt tension is measured while the impeding actions are not performed. Thus, the belt tension can be measured with high accuracy. The printing apparatus 1 may be formed such that when the belt tension is measured, not all the impeding actions but some of the impeding actions are stopped.

[0062] It should be understood that the invention is not limited to the examples described above and various modifications can be made, and thereby included, within the scope of the invention set forth in the claims.

Claims

1. A printing apparatus (1), comprising:

a transport belt (10) that is formed as a loop and is capable of supporting a medium (P);
a drive roller (8) configured to rotate the transport belt and thereby transport the medium in a transport direction;
a printing section (4) configured to print an image onto the medium; and
a control section (31) configured to control a transport action for transporting the medium, wherein
the transport belt extends around a plurality of rollers (8,9) that include the drive roller,
the control section is configured to accept input of belt tension that is a tension generated due to the transport belt extending around a plurality of the rollers, the tension being imparted to the transport belt, and
the control section is configured to control the transport action in accordance with a correction table in which the belt tension and traveling rate of the transport belt corresponding to the belt tension correlate with each other.

2. The printing apparatus according to Claim 1, wherein the control section is configured to provide an instruction to perform an alarm action when the belt tension that has been input is beyond a range covered by the correction table.

3. The printing apparatus according to Claim 1 or Claim 2, further comprising a tension-adjusting section (21) capable of changing the belt tension.

4. The printing apparatus according to any one of the preceding claims, wherein
the transport belt has a joint portion (26) at which one end and the other end of the transport belt in a circumferential direction thereof are joined to each other,
when span regions denote a plurality of regions between a plurality of the rollers, each of the regions including the transport belt, the control section can accept a measurement instruction to measure the belt tension, and
upon accepting the measurement instruction, the control section is configured to move the joint portion to a position that is not included in one of the span regions in which the belt tension is measured.

5. The printing apparatus according to any one of the preceding claims, wherein when span regions denote a plurality of regions between a plurality of the rollers, each of the regions including the transport belt, a position at which the belt tension is measured is included in one of the span regions that opposes the printing section.

6. The printing apparatus according to any one of the preceding claims, further comprising
a tension measurement section (18) configured to measure the belt tension, wherein
the control section is configured to accept input of a measurement result from the tension measurement section.

7. The printing apparatus according to Claim 6, wherein the tension measurement section includes a microphone (18) that can detect sound waves generated by causing the transport belt to vibrate, and
the tension measurement section is configured to measure the belt tension in accordance with frequencies of sound waves that have been detected by the microphone.

8. The printing apparatus according to Claim 7, wherein the microphone is disposed in the printing section.

9. The printing apparatus according to any one of Claims 6 to 8, wherein the tension measurement section includes a hammer (20) that causes the transport belt to vibrate.

10. A transporting method, comprising:

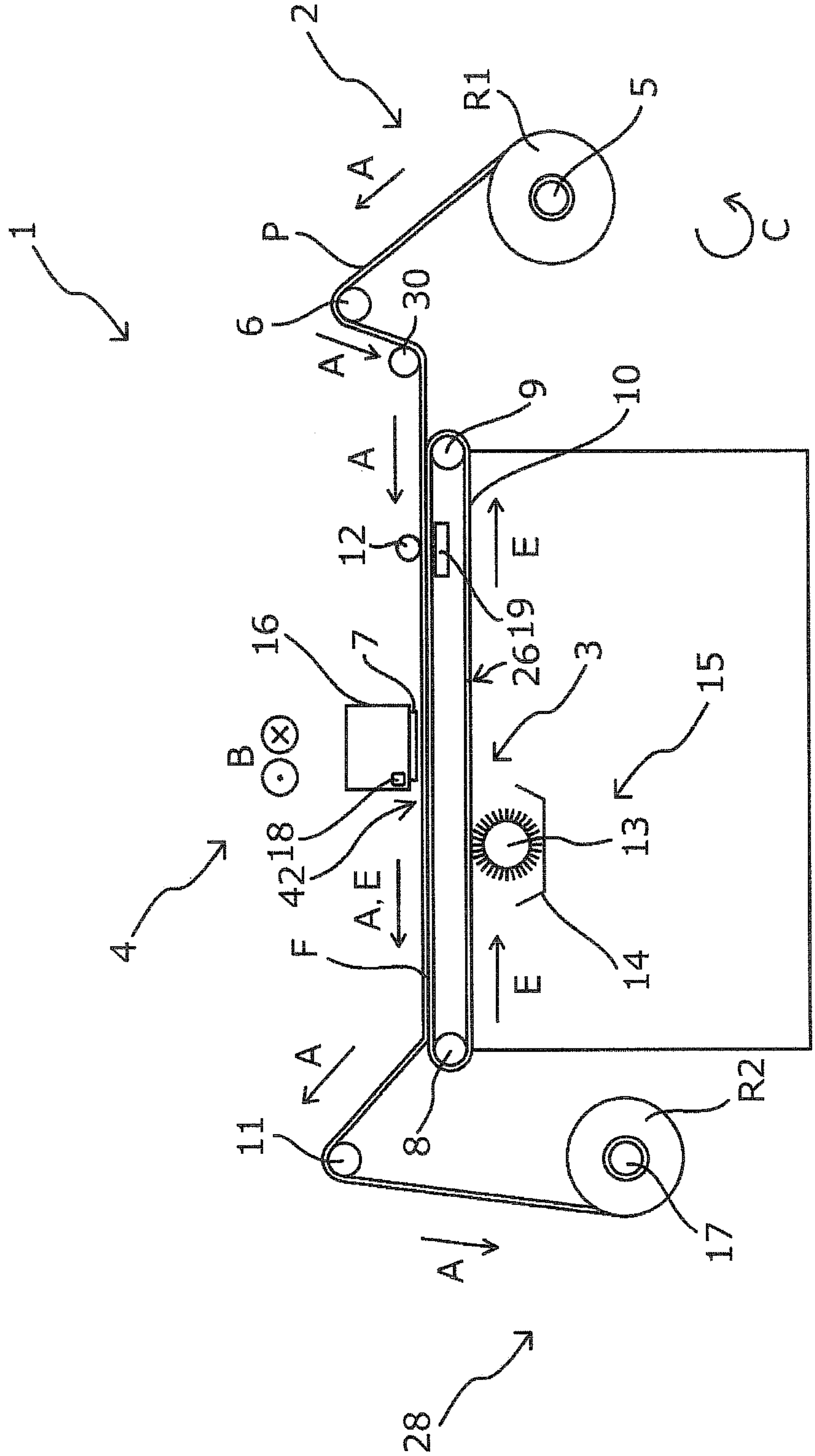
providing a printing apparatus (1) that includes

a transport belt (10) that is formed as a loop

and capable of supporting a medium (P),
a drive roller (8) that rotates the transport belt and thereby transports the medium in a transport direction, and
a printing section (4) that prints an image onto the medium,
the transport belt extending around a plurality of rollers (8,9) including the drive roller,

accepting input of belt tension that is a tension generated due to the transport belt extending around a plurality of the rollers, the tension being imparted to the transport belt, and
transporting the medium in accordance with a correction table in which the belt tension and traveling rate of the transport belt corresponding to the belt tension correlate with each other.

FIG. 1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P
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16
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3
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A,E
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E
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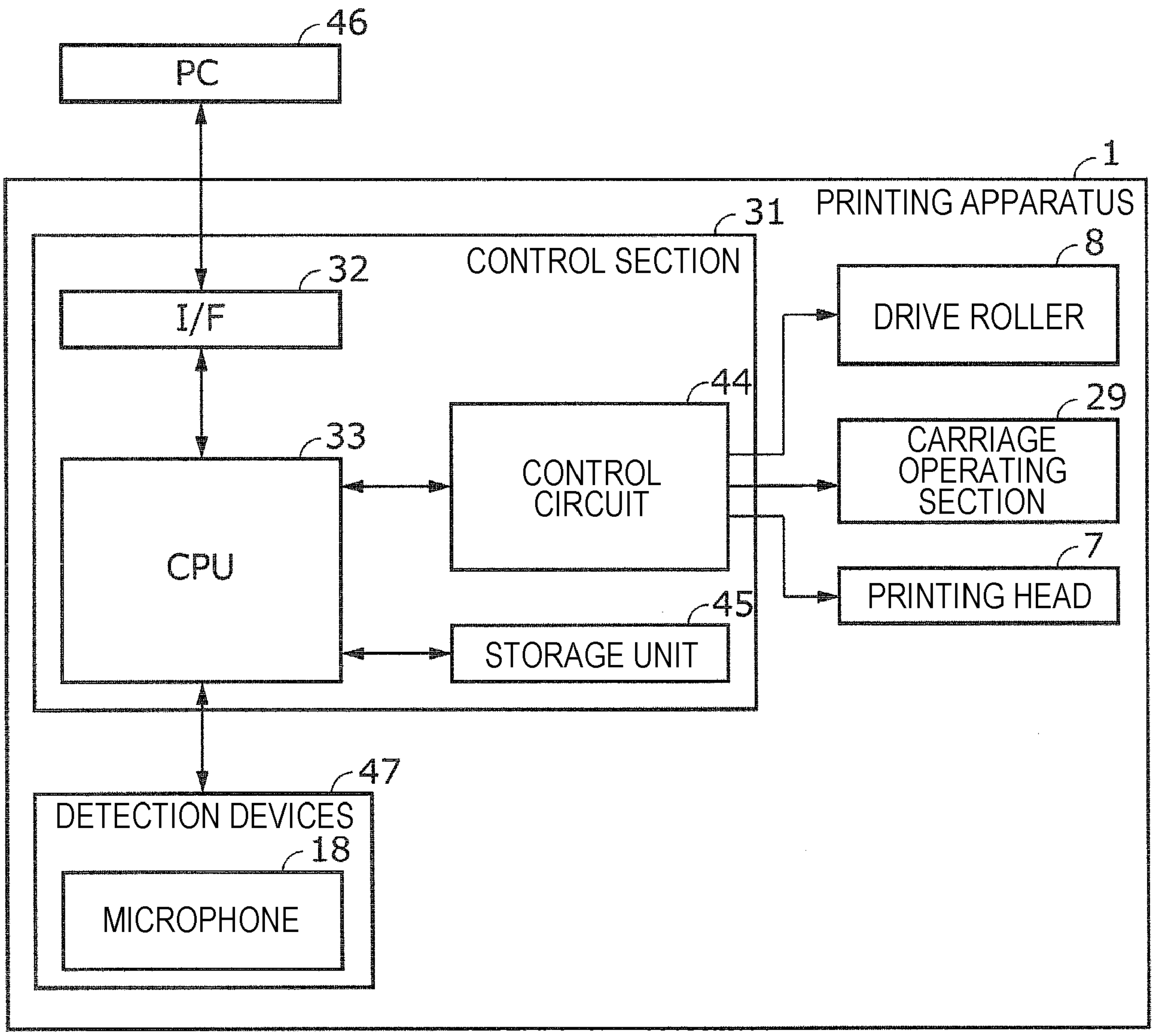
R2
11
8
17
A
28

FIG. 2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DRIVE ROLLER
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OPERATING
SECTION
CPU
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PRINTING HEAD
45
STORAGE UNIT
47
DETECTION DEVICES
18
MICROPHONE

FIG. 3

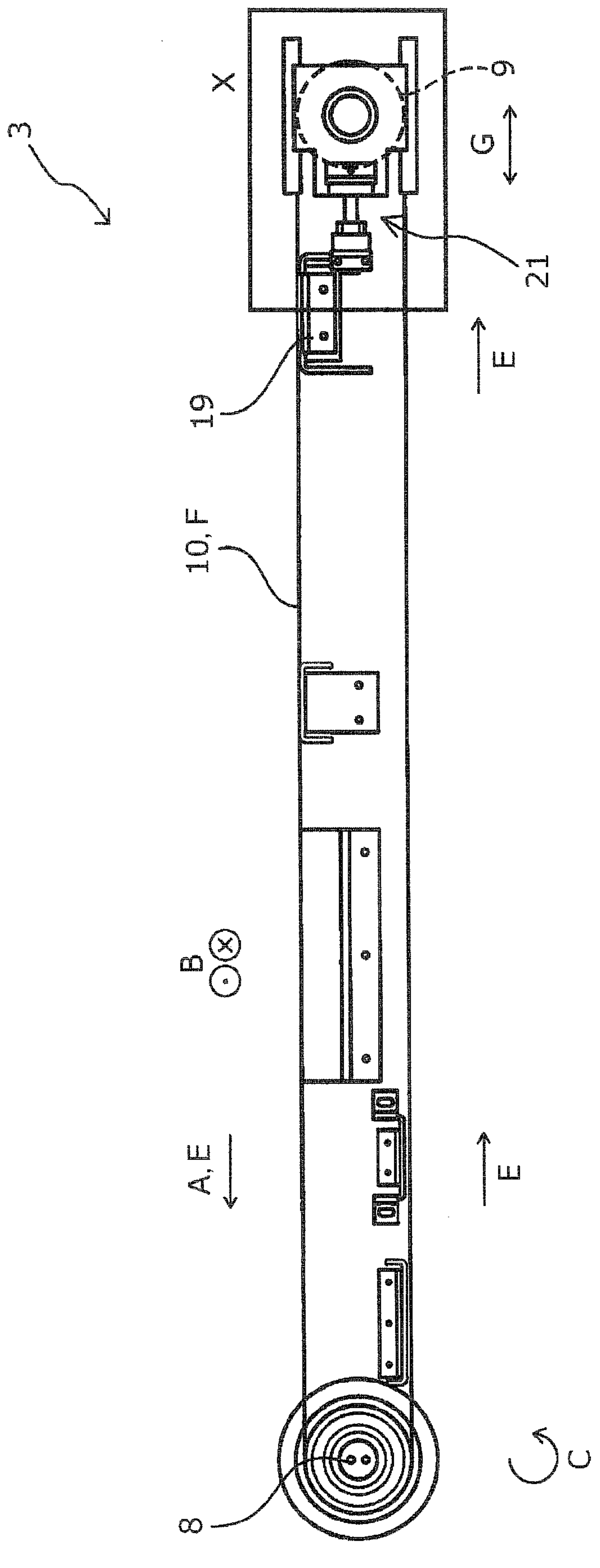


FIG. 4

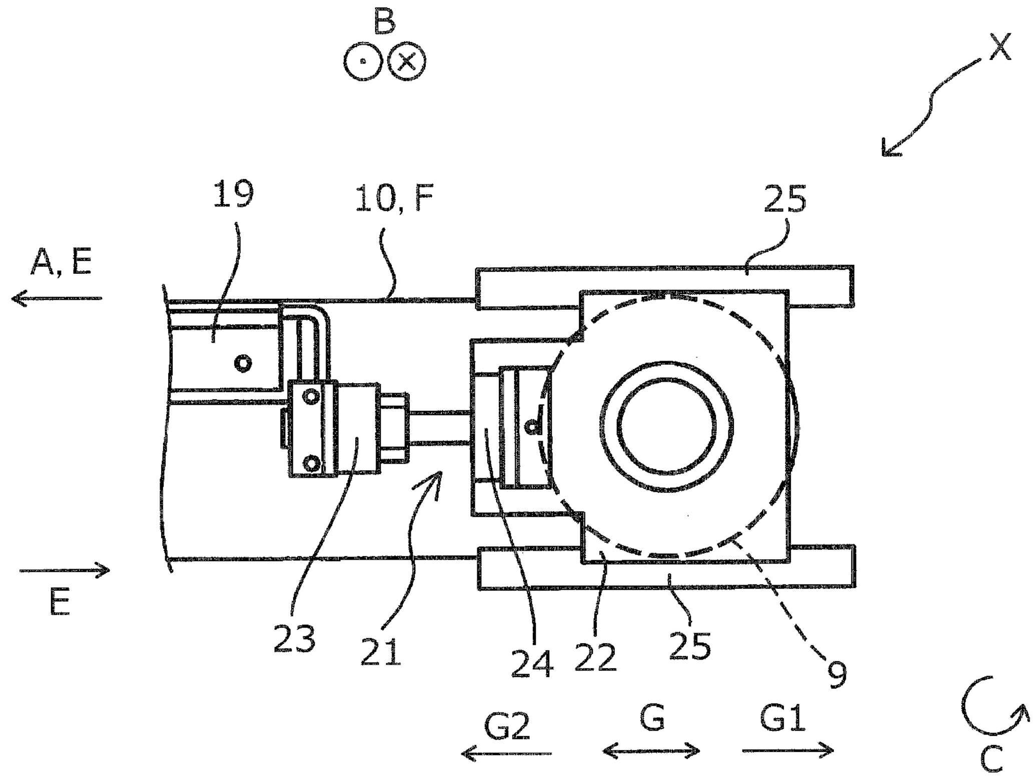


FIG. 5

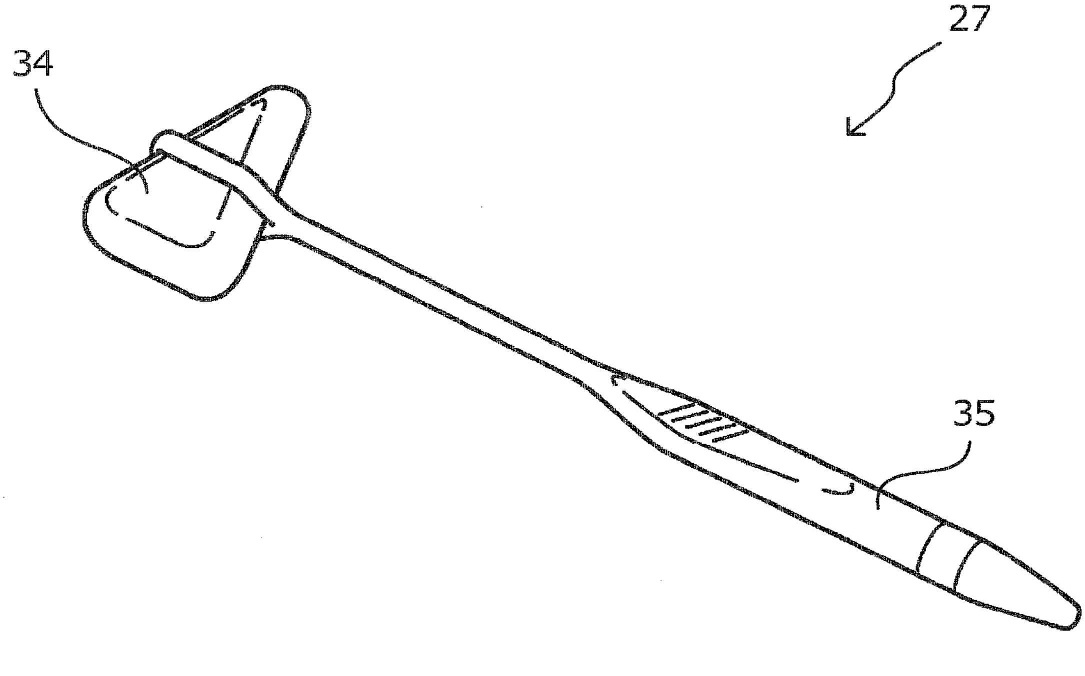


FIG. 6

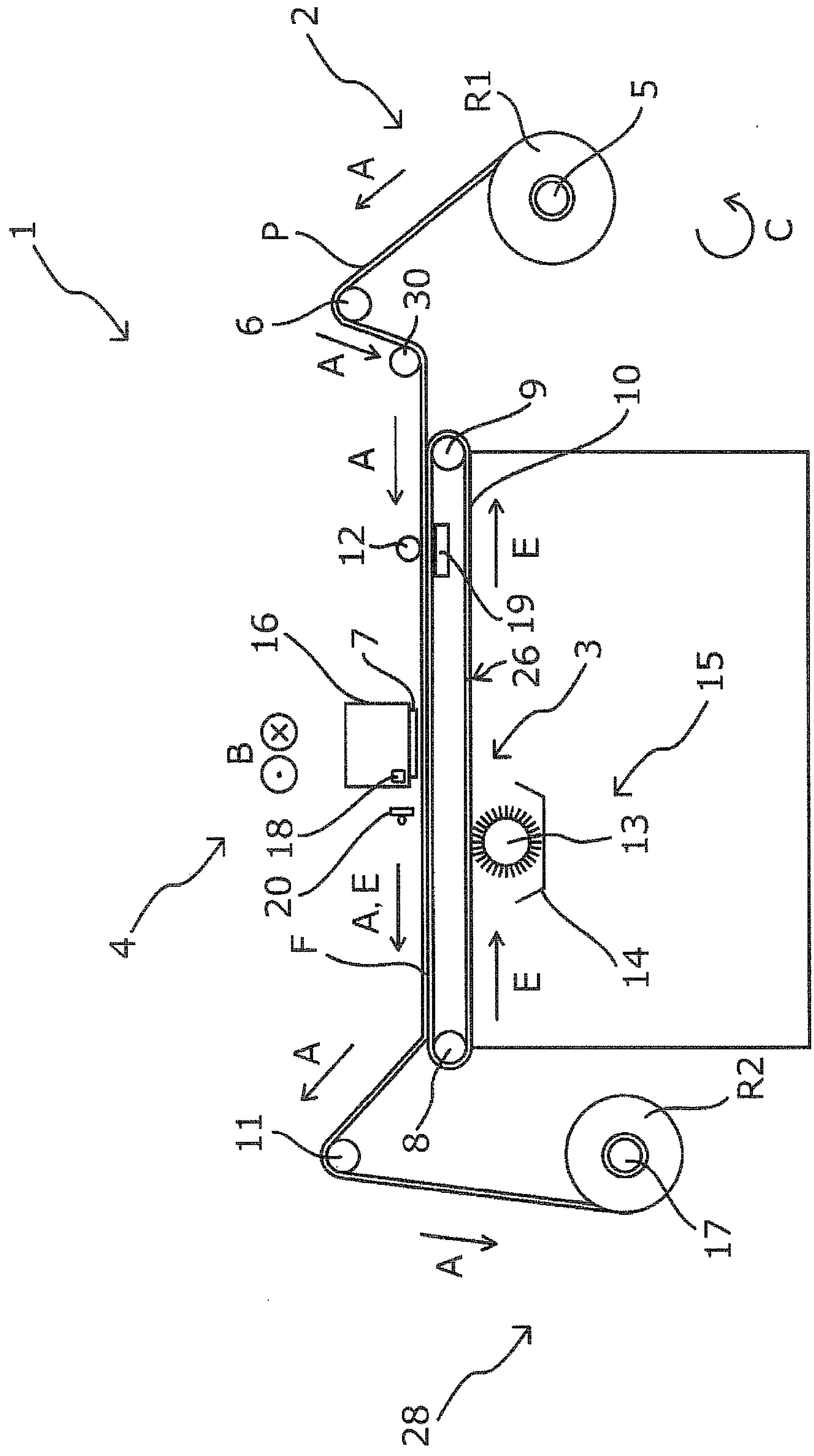


FIG. 7

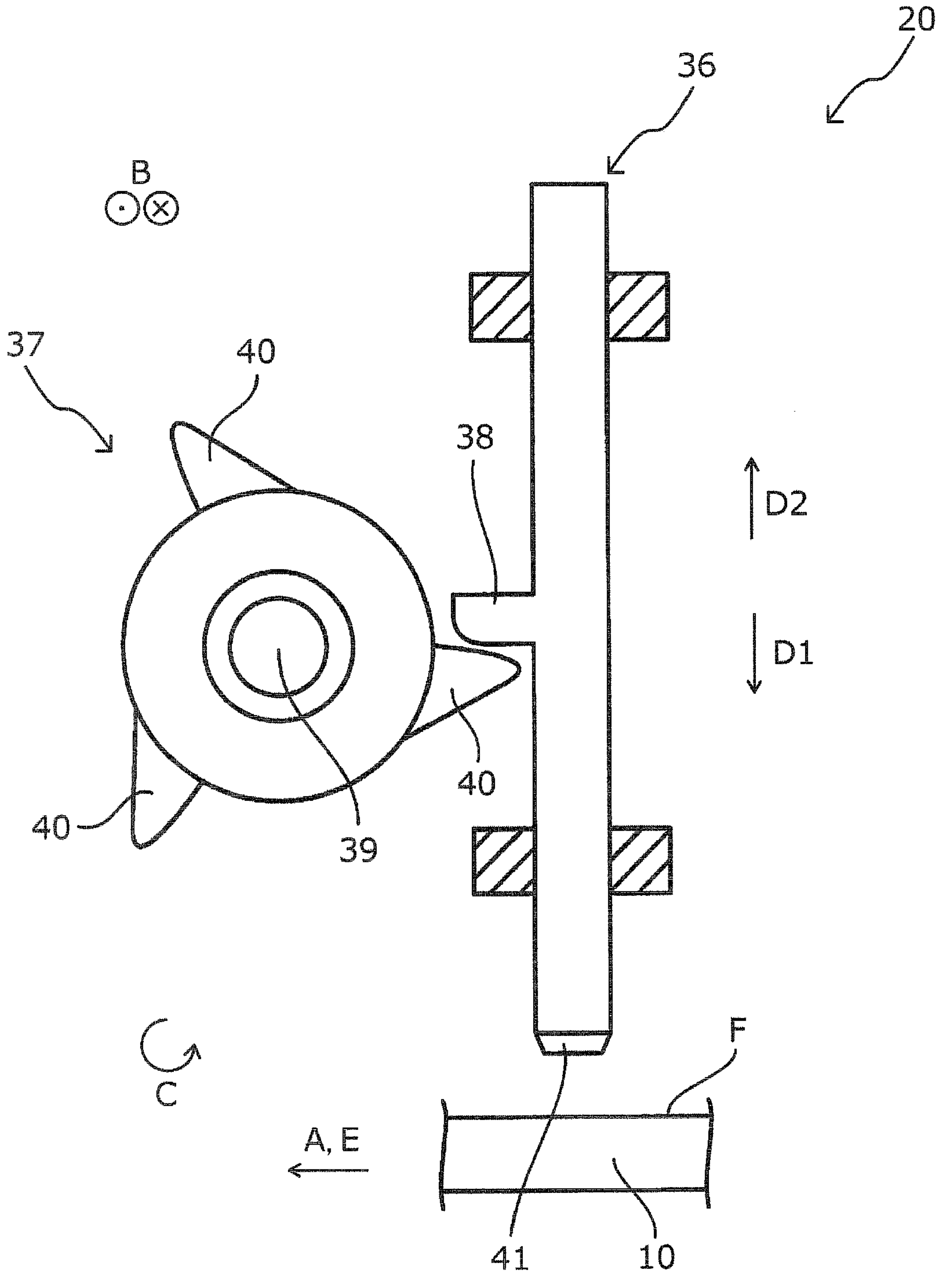
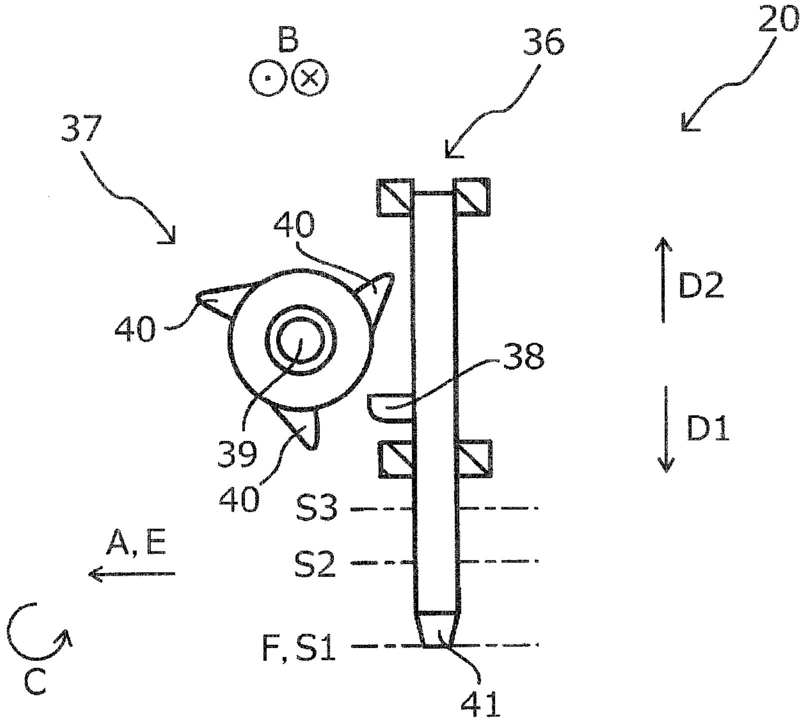


FIG. 8


B
36
20
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D2
38
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D1
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S3
A, E
S2
C
F, S1
41

FIG. 9

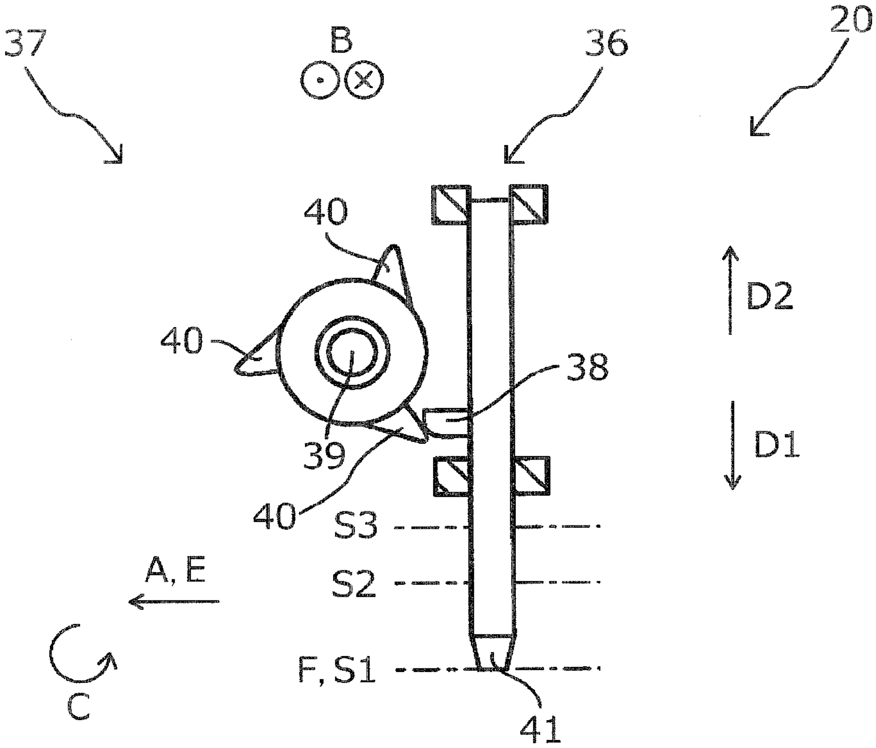
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FIG. 10

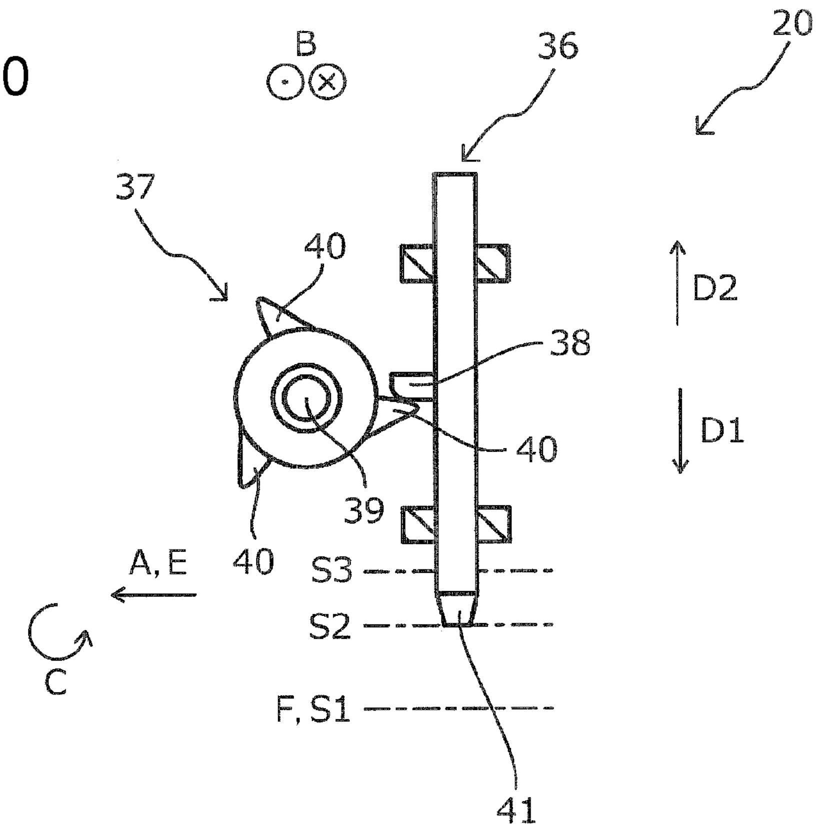
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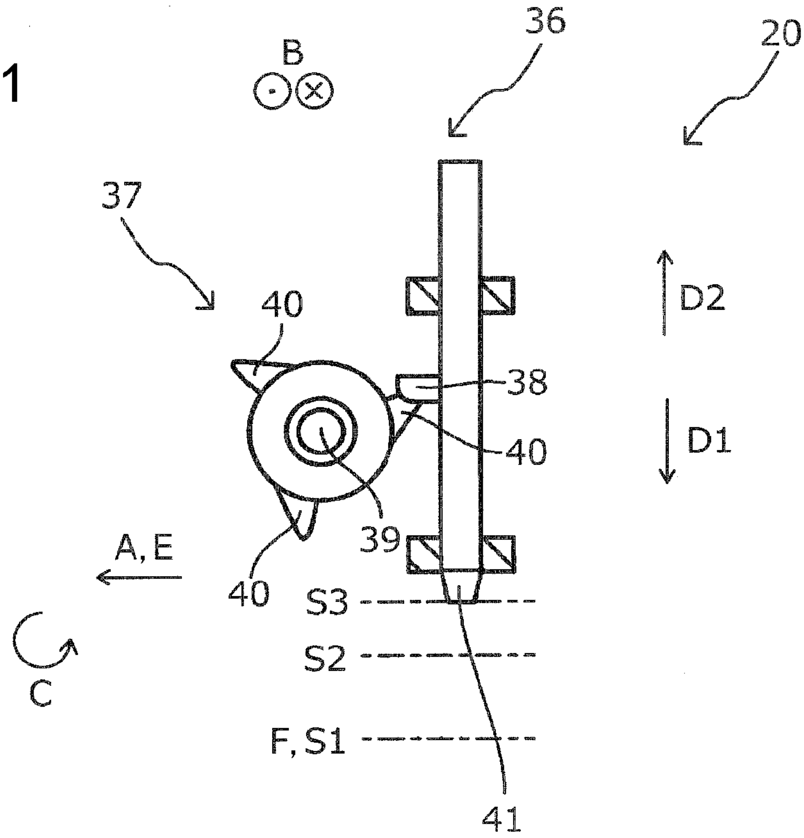
FIG. 11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EUROPEAN SEARCH REPORT

Application Number
EP 18 16 2067

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	8 August 2018	Herbreteau, D

2

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08-08-2018

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