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(71) Applicant: **SHIMA SEIKI MFG., LTD.**
Wakayama 641-8511 (JP)

(72) Inventors:
• **ASHIBE, Shinsuke**
Wakayama-shi, Wakayama 641-8511 (JP)
• **FUJIMURA, Tadashi**
Wakayama-shi, Wakayama 641-8511 (JP)

- **HOKUTO, Masaki**
Wakayama-shi, Wakayama 641-8511 (JP)
- **TAMAKI, Satoshi**
Wakayama-shi, Wakayama 641-8511 (JP)
- **TSUJI, Ryosuke**
Wakayama-shi, Wakayama 641-8511 (JP)
- **YAMASHITA, Takuma**
Wakayama-shi, Wakayama 641-8511 (JP)
- **HELLMANN, Sven**
01067 Dresden (DE)
- **TRUMPER, Wolfgang**
01067 Dresden (DE)
- **CHERIF, Chokri**
01067 Dresden (DE)

(74) Representative: **Carstens, Dirk Wilhelm**
Wagner & Geyer Partnerschaft mbB
Patent- und Rechtsanwälte
Gewürzmühlstraße 5
80538 München (DE)

(54) **WARP-FEEDING DEVICE**

(57) A warp feeding device that can make a warp easily knitted down and suppress complication around a yarn feeding path is provided.

A warp feeding device 1 that feeds a warp 3b from above to a flat knitting machine 2, the warp feeding device 1 including: a jacquard shedding machine 11 (motor 11a) that generates a driving force, a driving roller 20 provided

rotatably below the jacquard shedding machine 11 and having a peripheral surface in contact with the warp 3b fed from a yarn source reel 3a so as to bend a yarn feeding direction downward, and a transmission mechanism 30 that transmits the driving force so as to rotate the driving roller 20 only in one direction and feeds the warp 3b downward.

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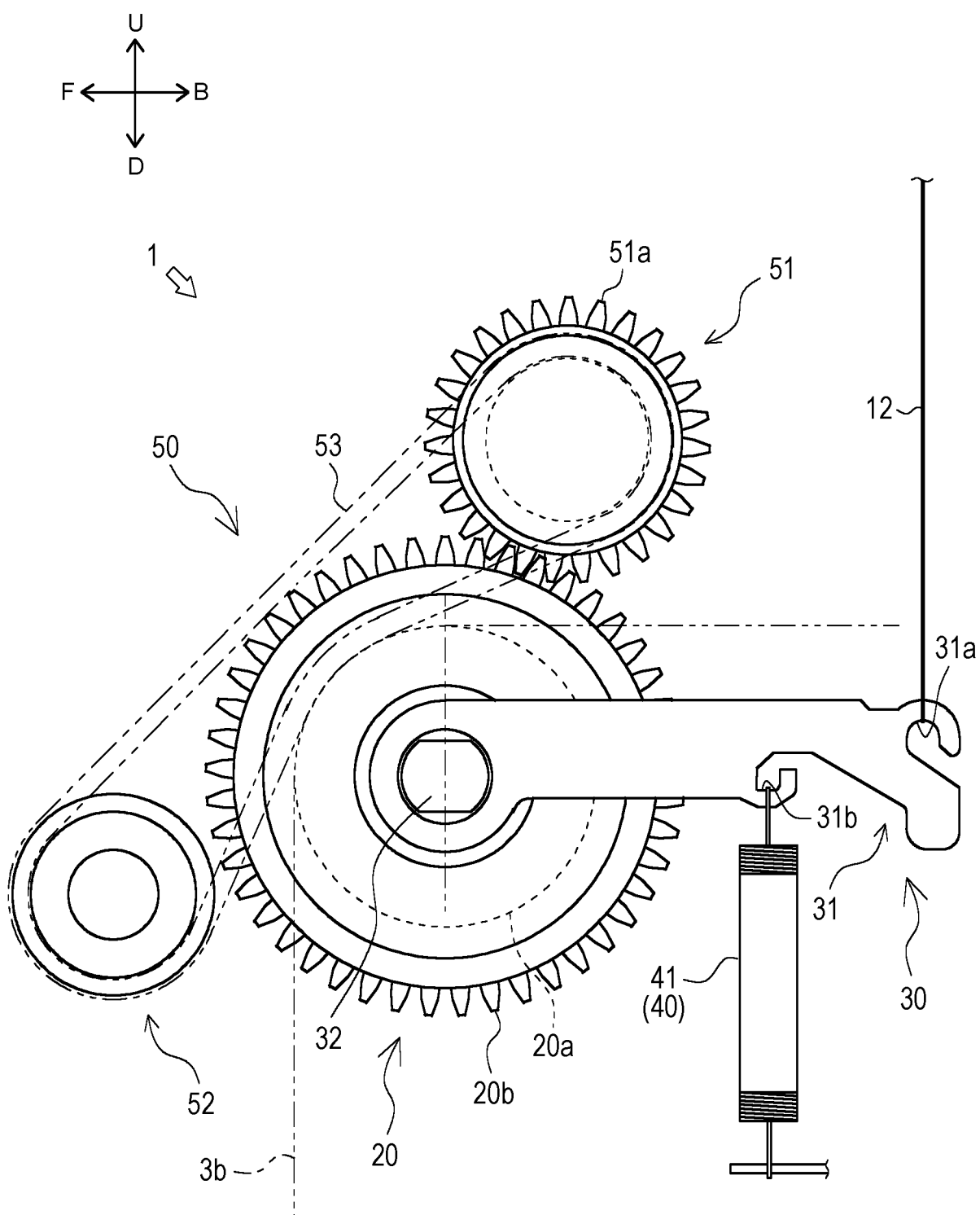


Fig. 2

Description

TECHNICAL FIELD

[0001] The present invention relates to a technique of a warp feeding device that feeds a warp to a flat knitting machine.

BACKGROUND ART

[0002] Conventionally, a technique of a warp feeding device that feeds a warp to a flat knitting machine is known. For example, Patent Literature 1 discloses such technique.

[0003] Patent Literature 1 discloses a technique for sandwiching a warp and a weft between flat knitted knitting yarns. Specifically, in Patent Literature 1, a plurality of first base yarns (warps) arranged in parallel in the knitting width direction and a second base yarn (weft) arranged in parallel in a longitudinal direction intersecting the first base yarns are sandwiched by flat knitting a knitting yarn.

[0004] In a fabric knitted as described above, the weft is inserted by inlay or the like in the knitting width direction by, for example, a yarn feeder, and is reliably knitted. On the other hand, the warp is fed from above the knitting machine, for example, and is basically knitted down together with the fabric depending on the friction between the weft and the knitting yarn. That is, feeding of the warp to the knitting machine is passively carried out. In such a case, for example, if the tension due to the release resistance at the time of taking out the warp from a yarn source reel or the tension due to the downward deflection due to the own weight of the warp is high, a necessary amount is not knitted down, and intervals between the wefts arranged in parallel in the longitudinal direction are reduced. Reduction in the intervals between the wefts causes strength unevenness to occur in a case where the fabric is used as a base material of FRP.

[0005] In order to individually feed the warps, it is necessary to provide a large number of feeding rollers, and in this case, a large number of warps are passed from a creel stand to the knitting machine. Therefore, there has been a problem of complication around the yarn feeding path and difficulty in direct drive of the feeding roller.

CITATION LIST

PATENT LITERATURE

[0006] Patent Literature 1: JP 2014-34737 A

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0007] The present invention has been made in view of the above circumstance, and an object thereof is to

provide a warp feeding device that can make a warp easily knitted down and suppress complication around a yarn feeding path.

5 SOLUTION TO PROBLEM

[0008] The problem to be solved by the present invention is as described above, and means for solving the problem will be described below.

10 **[0009]** That is, a warp feeding device according to the present invention is a warp feeding device that feeds a warp from above to a flat knitting machine, the warp feeding device including: a drive source that generates a driving force; a driving roller rotatably provided below the drive source, the driving roller having a peripheral surface in contact with the warp fed from a yarn source so as to bend a yarn feeding direction downward; and a transmission mechanism that transmits the driving force so as to rotate the driving roller only in one direction and feeds the warp downward.

20 **[0010]** Such a configuration can actively carry out feeding of the warp to the flat knitting machine by the rotation of the driving roller using the driving force from the drive source, and therefore can make a warp easily knitted down. The drive source is disposed higher than the driving roller, that is, relatively far from the driving roller, whereby complication around the yarn feeding path can be suppressed.

30 **[0011]** A plurality of driven rollers rotatable with rotation of the driving roller; and a belt that is endless, is spanned over the plurality of driven rollers, and having an outer peripheral surface in contact with the peripheral surface of the driving roller are further included, and the driving roller sandwiches the warp between the peripheral surface and the outer peripheral surface of the belt, and feeds the warp downward.

35 **[0012]** Such a configuration sandwiches and feeds the warp by the driving roller and the belt, and thus can suppress the warp from being broken, for example, even if the warp is not twisted as a carbon fiber, and can more suitably feed the warp to the flat knitting machine.

40 **[0013]** The transmission mechanism includes a coupling member that is coupled integrally rotatably in the one direction with the driving roller and relatively rotatably in another direction with respect to the driving roller, and the driving roller feeds the warp downward by rocking of the coupling member caused by the driving force.

45 **[0014]** Such a configuration can continuously carry out feeding of the warp to the flat knitting machine with a relatively simple configuration.

50 **[0015]** The transmission mechanism includes a rack portion that can reciprocate due to the driving force, and a pinion gear that is provided to be engaged with the rack portion, is integrally rotatable in the one direction with the driving roller due to reciprocation of the rack portion, and is relatively rotatable in another direction with respect to the driving roller, and the driving roller rotates in the one direction due to the driving force transmitted through the

pinion gear, and feeds the warp downward.

[0016] Such a configuration can feed the warp to the flat knitting machine using a rack and pinion.

[0017] The drive source is a motor whose rotation amount is adjustable.

[0018] Such a configuration can adjust the amount of warp to be fed to the knitting machine as necessary. Specifically, for example, the amount of the warp of one part in the knitting width direction of the fabric can be increased or decreased compared to another part.

[0019] The drive source is a moving body including a cam mechanism that can move in accordance with knitting by a carriage of the flat knitting machine and can generate a driving force with movement.

[0020] Such a configuration can achieve relatively space saving and cost reduction.

ADVANTAGEOUS EFFECTS OF INVENTION

[0021] As an effect of the present invention, it is possible to make a warp easily knitted down.

BRIEF DESCRIPTION OF DRAWINGS

[0022]

Fig. 1 is a schematic side view illustrating a yarn feeding mechanism applied with a warp feeding device according to a first embodiment of the present invention.

Fig. 2 is a side view illustrating the warp feeding device.

Fig. 3 is a side view illustrating an operation of the warp feeding device, and is (a) a view illustrating a state where a lever pivots upward. (b) a view illustrating a state where the lever pivots downward.

Fig. 4 is a side view illustrating a warp feeding device according to a second embodiment.

Fig. 5 is a side view illustrating a warp feeding device according to a third embodiment.

Fig. 6 is a side view illustrating a warp feeding device according to a fourth embodiment.

Fig. 7 is a side view illustrating a warp feeding device according to a fifth embodiment.

Fig. 8 is a side view illustrating a warp feeding device according to a sixth embodiment, the warp feeding device including a slack eliminating mechanism.

Fig. 9 is a side view illustrating the slack eliminating mechanism.

Fig. 10 is a side view illustrating the operation of the slack eliminating mechanism, and is (a) a view illustrating a state where the warp is slack. (b) is a view illustrating a state where the warp is wound and yarn slack is eliminated.

Fig. 11 is a side view illustrating a warp feeding device according to a seventh embodiment, the warp feeding device including a slack eliminating mechanism of another example.

DESCRIPTION OF EMBODIMENTS

[0023] In the following, description will be given with directions indicated by arrow U, arrow D, arrow F, and arrow B in the drawing defined as an upward direction, a downward direction, a forward direction, and a backward direction, respectively. Description will be given with a front direction on the paper surface and a depth direction on the paper surface in the side view of Fig. 1 and the like defined as a right direction and a left direction, respectively. The left-right direction corresponds to the knitting width direction of a flat knitting machine 2. In the drawings, illustration of each component is appropriately omitted for simplification of illustration.

[0024] As illustrated in Fig. 1, a warp feeding device 1 according to an embodiment of the present invention feeds a warp 3b used for knitting of a fabric to the flat knitting machine 2. The flat knitting machine 2 can knit a fabric by fixing, by flat knitting the knitting yarns, a plurality of the warps 3b arranged in parallel in a knitting width direction and a weft arranged in parallel in a longitudinal direction intersecting the warps 3b. In the fabric, the weft is inserted as an inlay yarn. Thus, the warps 3b and the weft do not constitute a stitch, and are fixed to each other by friction by being sandwiched by a knitting yarn as a retaining yarn. A creel stand 3 is provided behind the flat knitting machine 2. A plurality of yarn source reels 3a around which the warps 3b are wound are housed in the creel stand 3. When the flat knitting machine 2 knits the fabric, the warps 3b wound around the yarn source reels 3a are fed to the flat knitting machine 2 through the warp feeding device 1. As the warp 3b, for example, a bundle of a plurality of reinforcing fibers (e.g., carbon fibers) is used.

[0025] The flat knitting machine 2 includes a front needle bed 2a and a rear needle bed 2b so as to face front and rear across a needle bed gap 2c. In the flat knitting machine 2, a hook of a knitting needle not illustrated advances and retreats to the needle bed gap 2c from the distal end side of the front needle bed 2a or the rear needle bed 2b. A weft and a knitting yarn are fed from a plurality of yarn feeders (not illustrated) to the needle bed gap 2c.

[0026] The flat knitting machine 2 includes a warp pipe 2d that can simultaneously feed the plurality of warps 3b when knitting the fabric. The warp pipes 2d are arranged in three rows in the front-rear direction and in a plurality of rows in the knitting width direction by the number of the warps 3b to be knitted. The warp pipe 2d is disposed at a position not interfering with the yarn feeder moving in the knitting width direction, and feeds each of the warps 3b to the needle bed gap 2c from above by passing the warps 3b therein.

[0027] Hereinafter, the configuration of the warp feeding device 1 will be described with reference to Figs. 1 to 3. Hereinafter, there is a case where the yarn source reel 3a side of the yarn feeding path of the warp 3b is referred to as "upstream side", and the flat knitting ma-

chine 2 side is referred to as "downstream side".

[0028] The warp feeding device 1 feeds the plurality of warps 3b used for knitting of the fabric to the flat knitting machine 2 by controlling a feeding amount for each of the warps 3b. The warp feeding device 1 mainly includes a driving device 10, a driving roller 20, a transmission mechanism 30, an operation regulation portion 40, and a driven mechanism 50.

[0029] The driving device 10 illustrated in Fig. 1 drives the driving roller 20 described later through the transmission mechanism 30 described later. The driving device 10 includes a jacquard shedding machine 11 and a harness 12.

[0030] The jacquard shedding machine 11 illustrated in Fig. 1 serves as a drive source for the operation of the warp feeding device 1 when feeding each of the warps 3b to the flat knitting machine 2. The jacquard shedding machine 11 individually controls the feeding amount of each of the warps 3b. As the jacquard shedding machine 11, for example, a known jacquard shedding machine used in a general shuttle loom can be employed. The jacquard shedding machine 11 performs control based on a program incorporated in advance. The jacquard shedding machine 11 is disposed on a table 4 disposed between the flat knitting machine 2 and the creel stand 3. The jacquard shedding machine 11 is disposed higher than the flat knitting machine 2. The jacquard shedding machine 11 is disposed higher than the driving roller 20, the transmission mechanism 30, the operation regulation portion 40, and the driven mechanism 50, which will be described later. The jacquard shedding machine 11 includes a motor 11a.

[0031] The motor 11a generates a driving force. The motor 11a is provided so that the rotation amount can be adjusted, and the displacement amount of the harness 12 described later can be adjusted by adjustment of the rotation amount. A plurality of the motors 11a are provided. More specifically, the motors 11a are provided for the respective warps 3b. The motor 11a originally included in the jacquard shedding machine 11 can be used. The operation of the motor 11a is controlled by a control unit not illustrated.

[0032] The harness 12 illustrated in Figs. 1 to 3 is for vertically pivoting a lever 31 described later. One harness 12 is provided for each motor 11a. An upper end part of the harness 12 is connected to the motor 11a through an appropriate member. A lower end part of the harness 12 is connected to the lever 31 described later. The harness 12 is provided so as to extend forward from the motor 11a and be bent downward by a direction changing member not illustrated.

[0033] In the driving device 10 configured as described above, a plurality of the harnesses 12 can be individually displaced upward or downward by driving each motor 11a in accordance with individually preset patterns.

[0034] The driving roller 20 illustrated in Figs. 2 and 3 feeds the warps 3b to the downstream side. The driving roller 20 is provided on the yarn feeding path of the warp

3b rotatably about an axis extending in the left-right direction. The driving roller 20 is provided for each of the warps 3b. As illustrated in Fig. 1, the driving rollers 20 adjacent in the knitting width direction are disposed with the height shifted from one another in order to secure an arrangement space.

[0035] The warp 3b fed out from the rear of the driving roller 20 (the yarn source reel 3a housed in the creel stand 3) is fed to the upper end part of a peripheral surface 20a of the driving roller 20. The warp 3b is fed to the peripheral surface 20a from a direction along a tangential direction of the upper end part of the peripheral surface 20a. The warp 3b is brought into contact with the peripheral surface 20a, and guided so as to be bent downward by the peripheral surface 20a.

[0036] The outer peripheral surface of the driving roller 20 is provided with a plurality of teeth 20b over the entire periphery. The plurality of teeth 20b are provided at equal intervals to one another in the circumferential direction.

[0037] The driving roller 20 configured as described above can feed the warps 3b to the downstream side by rotating counterclockwise in the right side view illustrated in Figs. 2 and 3. Hereinafter, regarding the rotation direction of the driving roller 20, there is a case where a counterclockwise direction in a right side view, that is, a direction in which the warps 3b are fed to the downstream side is referred to as "forward direction", and a clockwise direction in a right side view, which is a direction opposite to the forward direction, is referred to as a "reverse direction".

[0038] The transmission mechanism 30 illustrated in Figs. 2 and 3 transmits the driving force from the driving device 10 to the driving roller 20. The transmission mechanism 30 includes the lever 31 and a ratchet mechanism 32.

[0039] The lever 31 is for rotating the driving roller 20, and is provided pivotally (rockably up and down) coaxially with the driving roller 20. The lever 31 is provided so as to extend in the longitudinal direction substantially rearward from a pivot center. The lever 31 includes a first hook portion 31a and a second hook portion 31b.

[0040] The first hook portion 31a is a portion on which the harness 12 is hooked, and is formed in a substantially inverted U-shaped hook shape. The first hook portion 31a is formed at the rear end part of the lever 31.

[0041] The second hook portion 31b is a portion on which a spring 41 described later is hooked, and is formed in a substantially U-shaped hook shape. The second hook portion 31b is formed in a front-rear middle portion of the lever 31 (forward relative to the first hook portion 31a).

[0042] The ratchet mechanism 32 regulates a rotation direction of the driving roller 20, is incorporated in a pivot center part of the lever 31, and is formed to pivot along with the pivot of the lever 31. The ratchet mechanism 32 is formed so as to be engaged with the driving roller 20 when the lever 31 pivots upward, but not to be engaged with the driving roller 20 when the lever 31 pivots down-

ward.

[0043] That is, the driving roller 20 rotates in the forward direction along with upward pivot of the lever 31 by the ratchet mechanism 32. On the other hand, the driving roller 20 does not rotate in the reverse direction along with downward pivot of the lever 31 by the ratchet mechanism 32.

[0044] The operation regulation portion 40 illustrated in Figs. 2 and 3 regulates or controls the operation of the lever 31, and includes the spring 41 and a movement range regulation portion 42.

[0045] The spring 41 biases the lever 31 downward, and a tension coil spring is used. The upper end of the spring 41 is fixed to the second hook portion 31b of the lever 31. The lower end of the spring 41 is fixed to a discretionary part of the warp feeding device 1. The discretionary part is a part that does not move even when the lever 31 pivots.

[0046] The movement range regulation portion 42 illustrated in Fig. 3 regulates a pivot range of the lever 31, and includes an upper regulation portion 42a and a lower regulation portion 42b.

[0047] The upper regulation portion 42a regulates an upward pivot range of the lever 31, and is provided above the lever 31. More specifically, the upper regulation portion 42a is formed at a position in contact with the lever 31 when the lever 31 pivots upward by a predetermined angle, and regulates the upward pivot range of the lever 31.

[0048] The lower regulation portion 42b regulates a downward pivot range of the lever 31, and is provided below the lever 31. More specifically, the lower regulation portion 42b is formed at a position in contact with the lever 31 when the lever 31 pivots downward by a predetermined angle, and regulates the downward pivot range of the lever 31.

[0049] Here, when the driving roller 20 is rotated, the harness 12 operates linearly, whereas the lever 31 operates in an arc shape. Therefore, when the stroke of the harness 12 becomes too large, the displacement amount of the harness 12 and the feeding amount of the warps 3b are not proportional. Therefore, in the warp feeding device 1 according to the present embodiment, the movement range regulation portion 42 regulates the pivot range of the lever 31. The upward pivot range of the lever 31 is regulated, whereby it is possible to suppress plastic deformation of the spring 41.

[0050] The driven mechanism 50 illustrated in Figs. 2 and 3 operates with the rotation of the driving roller 20, and includes a first driven roller 51, a second driven roller 52, and an endless belt 53.

[0051] The first driven roller 51 is provided rotatably about an axis extending in the left-right direction, and is disposed substantially above the driving roller 20.

[0052] The outer peripheral surface of the first driven roller 51 is provided with a plurality of teeth 51a over the entire periphery of the outer peripheral surface of the first driven roller 51. The plurality of teeth 51a are provided

at equal intervals to one another in the circumferential direction. The first driven roller 51 is provided such that the teeth 51a mesh with the teeth 20b of the driving roller 20. Due to this, the first driven roller 51 rotates with the rotation of the driving roller 20.

[0053] The second driven roller 52 is provided rotatably about an axis extending in the left-right direction, in lower front of the first driven roller 51 and substantially in front of the driving roller 20. The second driven roller 52 rotates with the rotation of the first driven roller 51 through the endless belt 53 described later.

[0054] The endless belt 53 is provided so as to span over the first driven roller 51 and the second driven roller 52 and so as to have the outer peripheral surface in contact with the driving roller 20. More specifically, the outer peripheral surface of the endless belt 53 is provided so as to abut on a part of the peripheral surface 20a of the driving roller 20 that comes into contact with the warps 3b.

[0055] Hereinafter, the operation of the warp feeding device 1 when feeding the warps 3b to the flat knitting machine 2 will be described with reference to Fig. 3.

[0056] When feeding the warps 3b to the flat knitting machine 2, the motor 11a of the driving device 10 is first driven to displace the harness 12 upward by a predetermined amount. Then, as illustrated in Fig. 3(a), the lever 31 connected to the harness 12 pivots upward and rotates the driving roller 20 in the forward direction. Due to this, the warps 3b are fed to the downstream side. The displacement amount of the harness 12 that determines the feeding amount of the warps 3b is set in consideration of the amount necessary for knitting of the fabric.

[0057] Here, as described above, since the teeth 51a are provided to mesh with the teeth 20b of the driving roller 20, the first driven roller 51 rotates clockwise in a right side view with rotation in the forward direction of the driving roller 20. Then, the second driven roller 52 connected to the first driven roller 51 through the endless belt 53 also rotates clockwise in a right side view.

[0058] Due to this, the driving roller 20 can feed the warps 3b downward in a state where the warps 3b are sandwiched between the peripheral surface 20a and the outer peripheral surface of the endless belt 53. By doing so, the warps 3b are less likely to come off from the driving roller 20, and the warps 3b can be reliably fed downstream. It is possible to suppress only a part of the plurality of reinforcing fibers constituting the warps 3b that is in contact with the peripheral surface 20a from being fed to the downstream side. Even if the warps 3b are only a bundle of carbon fibers and are not twisted yarns, the warps 3b can be suppressed from being broken, and the warps 3b can be more suitably fed to the flat knitting machine 2.

[0059] On the other hand, when the upward driving force of the harness 12 is released, as illustrated in Fig. 3(b), the lever 31 connected to the harness 12 pivots downward by the biasing force of the spring 41. However, even when the lever 31 pivots downward by the action of the ratchet mechanism 32, the driving roller 20 does

not rotate in the reverse direction. Therefore, the warps 3b can be suppressed from being returned to the upstream side.

[0060] In this manner, by rotating the driving roller 20 using the driving force from the driving device 10, the warp feeding device 1 can actively feed each of the warps 3b used for knitting of the fabric to the flat knitting machine 2. Due to this, the warps 3b can be knitted down by an amount necessary for the knitting of the fabric against the tension (tension due to release resistance at the time of taking out the warps 3b from the yarn source reel 3a or tension due to downward deflection due to the own weight of the warps 3b) applied to the warps 3b. Therefore, it is possible to suppress the interval between the wefts arranged in parallel in the longitudinal direction from being reduced. Feeding of the warps 3b to the flat knitting machine 2 can be continuously carried out with the relatively simple configuration such as the driving roller 20 and the transmission mechanism 30.

[0061] A large number of the driving rollers 20 need to be disposed in the knitting width direction in order to individually control the warps 3b, and in this case, a large number of warps pass from the creel stand to the knitting machine. Therefore, the degree of freedom of disposition of the driving device 10 is relatively low. Therefore, in the present embodiment, by disposing the driving device 10 for rotating the driving roller 20 at a position relatively distant from the flat knitting machine 2, a large number of the warps 3b can be individually and actively fed without complicating around the yarn feeding path. More specifically, by configuring not such that the driving device 10 directly rotates the driving roller 20 but such that the driving device 10 and the lever 31 are coupled through the harness 12, the driving device 10 does not need to be disposed around the yarn feeding path, and the driving device 10 can be disposed at a position relatively distant from the flat knitting machine 2. Therefore, it is possible to suppress complication around the yarn feeding path.

[0062] Since the feeding amount of each of the warps 3b can be individually adjusted using each motor 11a of the jacquard shedding machine 11, for example, the amount of the warps 3b of one part in the knitting width direction of the fabric can be increased or decreased as compared with another part.

[0063] Although an embodiment of the present invention has been described above, the present invention is not limited to the above embodiment, and appropriate changes can be made within the scope of the technical idea of the invention described in the claims.

[0064] For example, in the present embodiment, the flat knitting machine 2 in which the warp feeding device 1 feeds the warp 3b is configured to knit the fabric by fixing the warps 3b and the weft using a knitting yarn, but may be configured to knit the fabric without using the weft. Specifically, as illustrated in Fig. 1 of Japanese Patent No. 5955197, for example, the flat knitting machine 2 may sandwich the warp depending on a positional relationship between the knitting yarn and the warp fed

from two carriers that move the front and back phases with respect to the warp.

[0065] The warps 3b are fed to the upper end part of the peripheral surface 20a of the driving roller 20, but the warps 3b may be fed to a part at rear relative to the upper end part of the peripheral surface 20a, pass through the upper end part of the peripheral surface 20a, and then be guided so as to bend downward by the peripheral surface 20a. Due to this, the length of the warp 3b in contact with the peripheral surface 20a increases, and therefore slippage of the warps 3b with respect to the peripheral surface 20a can be reduced, and the feeding accuracy of the warps 3b can be improved.

[0066] Each of the warps 3b is fed to the flat knitting machine 2 by a necessary amount for the next course at a timing when the knitting direction is reversed. Thus, the warps 3b are sent to the flat knitting machine 2 at the same timing. The present invention is not limited to this, and the warps 3b fixed with the retaining yarn by the knitting needle may be fed to the flat knitting machine 2 at a timing, for example, when each knitting needle advances to the needle bed gap 2c. That is, the warps 3b may be fed to the flat knitting machine 2 at different timings.

[0067] In the present embodiment, the motor 11a is used as the drive source, but a solenoid may be used.

[0068] In the present embodiment, the ratchet mechanism 32 regulates the rotation direction of the driving roller 20, but any configuration may be used as long as force can be transmitted only in one direction and force is not transmitted in another direction, and for example, a one-way clutch may be used.

[0069] Next, the configuration of the warp feeding device 1 according to the second embodiment of the present invention will be described with reference to Fig. 4.

[0070] The warp feeding device 1 according to the second embodiment is different from the warp feeding device 1 according to the first embodiment in including a driving device 60 in place of the driving device 10. Hereinafter, this difference will be described. In Fig. 4 and Figs. 5 to 7 described later, the driven mechanism 50 is not illustrated.

[0071] The driving device 60 includes the harness 12, a moving body 61, a needle-shaped body 62, a needle bed 63, and a direction changing roller 64. Note that the harness 12 is the same as that of the first embodiment, and thus the description thereof is omitted.

[0072] The moving body 61 can reciprocate in the knitting width direction in synchronization with a carriage (not illustrated) of the flat knitting machine 2, and is driven by a motor and a timing belt that are not illustrated. The lower surface of the moving body 61 is provided with a cam surface 61a.

[0073] The needle-shaped body 62 is formed in a needle shape whose longitudinal direction is oriented in the front-rear direction, and is provided for each harness 12. The front end of the needle-shaped body 62 is formed in a hook shape, and the harness 12 is engaged. The nee-

dle-shaped body 62 includes a bat 62a formed such that a front-rear middle portion protrudes upward. A plurality of needle-shaped bodies 62 are provided on the needle bed 63 so as to be arranged in the left-right direction.

[0074] The driving device 60 includes an actuator (not illustrated), and is configured to be able to switch the needle-shaped body 62 between a needle selection state and a non-needle selection state by the actuator. The switching between the needle selection state and the non-needle selection state is determined based on a program incorporated in advance. In the needle selection state, when the moving body 61 moves in the knitting width direction, the bat 62a is guided by the cam surface 61a, whereby the needle-shaped body 62 advances and retreats back and forth. On the other hand, in the needle-shaped body 62, in the non-needle selection state, the bat 62a is sunk in the needle bed 63. Therefore, even if the moving body 61 moves in the knitting width direction, the bat 62a is not guided by the cam surface 61a. Therefore, the needle-shaped body 62 does not advance and retreat back and forth. In this manner, the cam surface 61a generates a driving force for moving the needle-shaped body 62 with the movement of the moving body 61.

[0075] The direction changing roller 64 changes the direction of the harness 12, and is formed to change the extending direction of the harness 12 so as to bend and extend downward the harness 12 extending forward from the front end of the needle-shaped body 62.

[0076] In the warp feeding device 1 according to the second embodiment configured as described above, when the moving body 61 reciprocates in the knitting width direction in synchronization with the carriage of the flat knitting machine 2, only the needle-shaped body 62 in the needle selection state advances and retreats back and forth. Due to this, the harness 12 is displaced up and down, and the lever 31 is pivoted upward. This can rotate the driving roller 20 in the forward direction and feed the warps 3b on the downstream side.

[0077] By driving the driving roller 20 using the driving device 60 configured as described above, it is possible to achieve relatively space saving and cost reduction.

[0078] Next, the configuration of the warp feeding device 1 according to the third embodiment of the present invention will be described with reference to Fig. 5.

[0079] The warp feeding device 1 according to the third embodiment is different from the warp feeding device 1 according to the first embodiment in including a driving device 70 in place of the driving device 10. Hereinafter, this difference will be described.

[0080] The driving device 70 includes the moving body 61, a needle-shaped body 72, a needle bed 73, an actuation link 74, and an actuation bar 75. Note that the moving body 61 is the same as that of the second embodiment, and thus the description thereof is omitted. The needle-shaped body 72 and the needle bed 73 correspond to the needle-shaped body 62 and the needle bed 63 of the second embodiment, respectively.

[0081] The actuation link 74 constitutes a part of the link mechanism, and includes a pivot member 74a, a first connection portion 74b, and a second connection portion 74c.

[0082] The pivot member 74a is formed rotatably about an axis extending in the left-right direction. The pivot member 74a is connected rockably to the front end part of the needle-shaped body 72 by the first connection portion 74b, and is connected rockably to the upper end part of the actuation bar 75 described later by the second connection portion 74c.

[0083] The actuation bar 75 operates the lever 31, is formed in a rod shape made of a material such as metal or resin, and is provided with the longitudinal direction oriented in the up-down direction. As described above, the actuation bar 75 has the upper end connected to the pivot member 74a, and the lower end connected to the first hook portion 31a of the lever 31.

[0084] In the warp feeding device 1 according to the third embodiment configured as described above, when the needle-shaped body 72 in the needle selection state advances and retreats with the reciprocation movement in the knitting width direction of the moving body 61, the actuation link 74 pivots to vertically displace the actuation bar 75. More specifically, when the needle-shaped body 72 moves backward and the actuation link 74 pivots clockwise in a right side view, the actuation bar 75 is displaced upward and pivots the lever 31 upward. This can rotate the driving roller 20 in the forward direction and feed the warps 3b on the downstream side.

[0085] In the example illustrated in Fig. 5, the lever 31 is biased downward by the spring 41, but the spring 41 is not necessarily included because the lever 31 can be displaced also downward by the pivot of the actuation link 74. The same applies to the example illustrated in Fig. 6 described later.

[0086] In Fig. 5, the first connection portion 74b and the second connection portion 74c are illustrated to have substantially the same length, but for example, the length of the second connection portion 74c may be longer than the length of the first connection portion 74b. This can increase the displacement amount of the actuation bar 75 with respect to the advancing and retracting movement amount of the needle-shaped body 72, and eventually can downsize the cam mechanism.

[0087] Next, the configuration of the warp feeding device 1 according to the fourth embodiment of the present invention will be described with reference to Fig. 6.

[0088] The warp feeding device 1 according to the fourth embodiment is different from the warp feeding device 1 according to the first embodiment in including a driving device 80 in place of the driving device 10. Hereinafter, this difference will be described.

[0089] The driving device 80 includes the moving body 61, the needle-shaped body 72, the needle bed 73, a slide member 84, and an actuation bar 86. Note that the moving body 61 is the same as that of the second embodiment, and thus the description thereof is omitted.

Note that the needle-shaped body 72 and the needle bed 73 are the same as those of the third embodiment, and thus the description is omitted.

[0090] The slide member 84 is a member provided slidably back and forth and fixed to the front end part of the needle-shaped body 72. Due to this, the slide member 84 reciprocates back and forth with advance and retreat movement back and forth of the needle-shaped body 72. The slide member 84 is provided with a long hole 84a formed such that the longitudinal direction is oblique with respect to the front-rear direction. More specifically, the long hole 84a is formed to be inclined so as to be positioned downward as it goes rearward.

[0091] The configuration of the actuation bar 86 is substantially the same as that of the actuation bar 75 of the third embodiment. The actuation bar 86 is guided by a guide member not illustrated so as not to move in the front-rear direction, that is, so as to be movable only in the up-down direction. The upper end of the actuation bar 86 is provided with a pin 86a. The pin 86a is formed so as to extend leftward from the upper end of the actuation bar 86, and is inserted into the long hole 84a of the slide member 84.

[0092] In the warp feeding device 1 according to the fourth embodiment configured as described above, when the needle-shaped body 72 in the needle selection state advances and retreats with the reciprocation movement in the knitting width direction of the moving body 61, the slide member 84 reciprocates back and forth, and the pin 86a is guided to the long hole 84a. Then, the actuation bar 86 is displaced upward, and the lever 31 is pivoted upward. This can rotate the driving roller 20 in the forward direction and feed the warps 3b on the downstream side.

[0093] Although the second embodiment to the fourth embodiment of the present invention have been described above, the present invention is not limited to the above embodiments, and appropriate changes can be made within the scope of the technical idea of the invention described in the claims.

[0094] For example, as long as the moving body 61 operates in accordance with the knitting by the carriage of the flat knitting machine 2, the moving body 61 is not limited to one that operates in synchronization with the carriage of the flat knitting machine 2 as in the second to fourth embodiments, and may be one that operates prior to the operation of the carriage.

[0095] Although the inclination angle of the long hole 84a can be discretionary, the long hole 84a may be formed so that the inclination angle with respect to the horizontal direction becomes relatively large, that is, the long hole may be formed to be relatively vertically long. This can increase the displacement amount of the actuation bar 86 with respect to the advancing and retracting movement amount of the needle-shaped body 72, and eventually can downsize the cam mechanism.

[0096] As the driving device, a combination of the jacquard shedding machine 11 of the first embodiment and the mechanism illustrated in Figs. 5 and 6 may be used.

[0097] Next, the configuration of the warp feeding device 1 according to the fifth embodiment of the present invention will be described with reference to Fig. 7.

[0098] The warp feeding device 1 according to the fifth embodiment is different from the warp feeding device 1 according to the first embodiment in including a transmission mechanism 90 in place of the transmission mechanism 30. Hereinafter, this difference will be described.

[0099] The transmission mechanism 90 includes a pinion gear 91, a ratchet mechanism 92, and a rack 93.

[0100] The pinion gear 91 is for rotating the driving roller 20, and is provided on the right side of the driving roller 20 rotatably coaxially with the driving roller 20. The outer peripheral surface of the pinion gear 91 is provided with a plurality of teeth 91a over the entire periphery. The plurality of teeth 91a are provided at equal intervals to one another in the circumferential direction.

[0101] The ratchet mechanism 92 regulates the rotation direction of the driving roller 20, is incorporated in a rotation center part of the pinion gear 91, and is formed to pivot with the rotation of the pinion gear 91. The ratchet mechanism 92 is formed so as to be engaged with the driving roller 20 when the pinion gear 91 rotates counterclockwise in a right side view, but not to be engaged with the driving roller 20 when the pinion gear 91 rotates clockwise in a right side view.

[0102] That is, by the ratchet mechanism 92, the driving roller 20 rotates in the forward direction with the rotation of the pinion gear 91 counterclockwise in a right side view. On the other hand, by the ratchet mechanism 92, the driving roller 20 does not rotate in the reverse direction with the rotation of the pinion gear 91 clockwise in a right side view.

[0103] The rack 93 is for rotating the driving roller 20, and is provided at rear of the driving roller 20 with the longitudinal direction oriented in the up-down direction. The rack 93 is guided by a guide member not illustrated so as not to move in the front-rear direction, that is, so as to be movable only in the up-down direction.

[0104] The front surface of the rack 93 is provided with a plurality of teeth 93a at equal intervals with one another in the up-down direction. The rack 93 is provided such that the teeth 93a mesh with the teeth 91a of the pinion gear 91.

[0105] The rack 93 has the upper end connected with the lower end of the harness 12. The rack 93 has the lower end engaged with the upper end of the spring 41, and is biased downward by the spring 41.

[0106] In the warp feeding device 1 according to the fifth embodiment configured as described above, when the motor 11a of the driving device 10 is driven to displace the harness 12 upward by a predetermined amount, the rack 93 connected to the harness 12 moves upward. Here, as described above, the rack 93 is provided such that the teeth 93a mesh with the teeth 91a of the pinion gear 91. Therefore, when the rack 93 moves upward, the pinion gear 91 rotates counterclockwise in a right side

view along with this, and the driving roller 20 rotates in the forward direction. This can feed the warps 3b on the downstream side.

[0107] By adjusting the gear ratio, the feeding amount of the driving roller 20 can be made larger than the up-down movement amount of the harness 12 by the drive source. This can downsize the cam mechanism.

[0108] Next, the configuration of the warp feeding device 1 according to the sixth embodiment of the present invention will be described with reference to Figs. 8 and 9.

[0109] The warp feeding device 1 according to the sixth embodiment is different from the warp feeding device 1 according to the first embodiment in further including a slack eliminating mechanism 200. Hereinafter, this difference will be described.

[0110] In the warp feeding device 1, there is a case where a feeding error occurs in a case where the warps 3b are not used as expected in the knitting of the fabric, for example. If this feeding error accumulates, slack of the warps 3b occurs on the downstream side relative to the driving roller 20, the warps 3b may come into contact with another object and the like, which may affect the knitting of the fabric and is not preferable. The slack eliminating mechanism 200 is provided to eliminate the slack of this warp 3b, and includes a first magnet portion 210, a second magnet portion 220, and a shielding member 230.

[0111] The first magnet portion 210 is a magnet provided in the second driven roller 52, and is formed in a cuboid shape. A plurality of the first magnet portions 210 are provided with the longitudinal direction oriented in the radial direction of the second driven roller 52. The first magnet portions 210 are provided at equal intervals to one another in the circumferential direction of the second driven roller 52. In the present embodiment, six of the first magnet portions 210 are provided at intervals of 60° from one another. The first magnet portion 210 is provided such that the radially outer surface thereof is substantially at the same position as the outer peripheral surface of the second driven roller 52 in a side view. The first magnet portion 210 includes an S pole portion 211 and an N pole portion 212.

[0112] The S pole portion 211 is disposed counterclockwise in a right side view of the first magnet portion 210. Specifically, the S pole portion 211 is provided so as to be positioned in a front side part of the first magnet portion 210 when the second driven roller 52 rotates and the first magnet portion 210 is positioned at the uppermost position.

[0113] The N pole portion 212 is disposed clockwise in a right side view of the first magnet portion 210. Specifically, the N pole portion 212 is provided so as to be positioned in a rear side part of the first magnet portion 210 when the second driven roller 52 rotates and the first magnet portion 210 is positioned at the uppermost position. The N pole portion 212 is provided so as to be adjacent to the S pole portion 211.

[0114] The second magnet portion 220 is a magnet

provided independently of the second driven roller 52, and is fixed to the flat knitting machine 2 below the second driven roller 52. More specifically, the second magnet portion 220 is provided such that the front-rear center thereof is positioned slightly behind the center of the second driven roller 52. The second magnet portion 220 is formed in a substantially rectangular shape in a side view. The second magnet portion 220 includes the S pole portion 221 and the N pole portion 222.

[0115] The S pole portion 221 is provided so as to constitute a rear side part of the second magnet portion 220.

[0116] The N pole portion 222 constitutes a front side part of the second magnet portion 220, and is provided so as to be adjacent to the S pole portion 221. The N pole portion 222 is provided at a position closer to the second driven roller 52 than the S pole portion 221.

[0117] The shielding member 230 shields or demagnetizes the magnetic force of the first magnet portion 210. More specifically, the shielding member 230 shields the magnetic force acting to rotate the second driven roller 52 in the opposite direction with respect to the second magnet portion 220. The shielding member 230 is formed of an iron piece that is a ferromagnetic material, and is provided so as to cover a magnetic pole surface of the N pole portion 212 of the first magnet portion 210.

[0118] Next, the operation of the slack eliminating mechanism 200 will be described with reference to Figs. 9 and 10. Hereinafter, regarding the rotation direction of the second driven roller 52, there is a case where the counterclockwise direction in a right side view, that is, the direction in which the slack of the warps 3b is wound is referred to as a "winding direction".

[0119] Fig. 10(a) illustrates a state where slack of the warp 3b occurs on a downstream side relative to the driving roller 20 due to a feeding error or the like. In the case where slack of the warp 3b occurs as described above, when the first magnet portion 210 and the second magnet portion 220 are in the positional relationship illustrated in Fig. 9, the attraction force by the N pole portion 222 of the second magnet portion 220 acts on an S pole portion 211a of a first magnet portion 210a positioned at the front lower part among the six first magnet portions 210.

[0120] At this time, in a case where the lever 31 is stopped or while pivoting upward, the second driven roller 52 does not rotate in the winding direction even if the attraction force by the N pole portion 222 acts on the S pole portion 211a by the action of the ratchet mechanism 32.

[0121] On the other hand, while the lever 31 is pivoting downward, the S pole portion 211a is attracted to the N pole portion 222, whereby the second driven roller 52 rotates in the winding direction to a position where the S pole portion 211a and the N pole portion 222 substantially face each other.

[0122] At this time, the magnetic pole surface of an N pole portion 212b of a first magnet portion 210b positioned in the rear lower part among the six first magnet portions 210 is covered with the shielding member 230.

Therefore, the attraction force of the N pole portion 212b with respect to the S pole portion 221 is shielded or demagnetized. Therefore, the second driven roller 52 is suppressed from rotating in the direction opposite to the winding direction.

[0123] When the second driven roller 52 rotates in the winding direction in this manner, the driving roller 20 rotates in the reverse direction. Due to this, the warps 3b on the downstream side of the driving roller 20 are wound, and the slack of the warps 3b can be eliminated. Along with the rotation of the driving roller 20, the endless belt 53 also operates in the direction of winding the warps 3b. Therefore, the warps 3b can be wound in a state where the warps 3b are sandwiched between the peripheral surface 20a of the driving roller 20 and the outer peripheral surface of the endless belt 53.

[0124] As described above, the slack eliminating mechanism 200 uses a magnetic force for winding the warps 3b. Therefore, unlike a case of torque application by physical connection, for example, problems such as wear between members do not occur, and maintainability and durability can be improved.

[0125] Next, the configuration of the warp feeding device 1 according to the seventh embodiment of the present invention will be described with reference to Fig. 11.

[0126] The warp feeding device 1 according to the seventh embodiment is different from the warp feeding device 1 according to the sixth embodiment in that the disposition of the first magnet portion 210 of the slack eliminating mechanism 200 is different. Hereinafter, this difference will be described.

[0127] As illustrated in Fig. 11, the first magnet portion 210 is provided in a state where the longitudinal direction thereof is inclined with respect to the radial direction of the second driven roller 52. More specifically, the first magnet portion 210 is provided such that the S pole portion 211 faces the outer diameter side of the N pole portion 212.

[0128] In the case where slack of the warp 3b occurs, when the first magnet portion 210 and the second magnet portion 220 are in the positional relationship illustrated in Fig. 11, the magnetic pole surface of an S pole portion 211c of a first magnet portion 210c positioned at the front lower part of the six first magnet portions 210 substantially faces the N pole portion 222 of the second magnet portion 220. On the other hand, the magnetic pole surface of an N pole portion 212d of a first magnet portion 210d positioned in the rear lower part among the six first magnet portions 210 does not face the S pole portion 221 of the second magnet portion 220. Therefore, the second driven roller 52 rotates in the winding direction by the attraction force of the S pole portion 211c and the N pole portion 222.

[0129] When the second driven roller 52 rotates in the winding direction in this manner, the driving roller 20 rotates in the reverse direction. Due to this, the warps 3b on the downstream side of the driving roller 20 are wound,

and the slack of the warps 3b can be eliminated.

[0130] In the slack eliminating mechanisms 200 of the warp feeding devices 1 according to the sixth embodiment and the seventh embodiment, the ratio of the rotation amount is the driving roller 20: the first driven roller 51: the second driven roller 52 = 1:2:2. That is, the rotation amount of the second driven roller 52 by the first magnet portion 210 and the second magnet portion 220 is half in the driving roller 20. The feeding amount of the warp 3b per course is about 3.5 mm, and the feeding error is estimated to be about ± 0.1 to 0.2 mm. Here, due to the relative positional relationship between the first magnet portion 210 and the second magnet portion 220, not performing winding ("no winding") of the warps 3b can occur. However, since the winding amount per one time is about 2 to 3 mm, even if "no winding" of +0.2 mm occurs for consecutively 10 times, for example, the accumulated feeding error can be eliminated by one winding.

[0131] Although the slack eliminating mechanisms 200 of the warp feeding devices 1 according to the sixth embodiment and the seventh embodiment of the present invention have been described above, the present invention is not limited to the above embodiments, and appropriate changes can be made within the scope of the technical idea of the invention described in the claims.

[0132] For example, in the sixth embodiment and the seventh embodiment, the second magnet portion 220 is fixed to the flat knitting machine 2, but similarly to the first magnet portion 210, the magnets may be provided in the roller at equal intervals in the circumferential direction, and may be configured to always rotate to generate a force for rotating the second driven roller 52 in the winding direction. However, this force is set to be smaller than the rotational force of the driving roller 20 when feeding the warps 3b to the downstream side, and is set so as not to hinder the feeding of the warps 3b.

[0133] In the sixth embodiment and the seventh embodiment, the six first magnet portions 210 are provided, but the number of first magnet portions 210 may be discretionary.

INDUSTRIAL APPLICABILITY

[0134] The present invention can be applied to a warp feeding device that feeds a warp to a flat knitting machine.

REFERENCE SIGNS LIST

[0135]

- 1: Warp feeding device
- 2: Flat knitting machine
- 3a: Yarn source reel
- 3b: Warp
- 10, 60, 70, 80, 90, 100: Driving device
- 11: Jacquard shedding machine
- 11a: Motor
- 20: Driving roller

30: Transmission mechanism

31: Lever

51: First driven roller

52: Second driven roller

53: Endless belt

61: Moving body

61a: Cam surface

103: Rack

104: Pinion gear

200: Slack eliminating mechanism

210: First magnet portion

220: Second magnet portion

230: Shielding member

wherein

the transmission mechanism includes

a rack portion that can reciprocate due to the driving force, and

a pinion gear that is provided to be engaged with the rack portion, is integrally rotatable in the one direction with the driving roller due to reciprocation of the rack portion, and is relatively rotatable in another direction with respect to the driving roller, and

the driving roller

rotates in the one direction due to the driving force transmitted through the pinion gear, and feeds the warp downward.

Claims

1. A warp feeding device that feeds a warp from above to a flat knitting machine, the warp feeding device comprising:

a drive source that generates a driving force;
a driving roller rotatably provided below the drive source, the driving roller having a peripheral surface in contact with the warp fed from a yarn source so as to bend a yarn feeding direction downward; and

a transmission mechanism that transmits the driving force so as to rotate the driving roller only in one direction and feeds the warp downward.

2. The warp feeding device according to claim 1, further comprising:

a plurality of driven rollers rotatable with rotation of the driving roller; and
a belt that is endless, is spanned over the plurality of driven rollers, and having an outer peripheral surface in contact with the peripheral surface of the driving roller, wherein
the driving roller sandwiches the warp between the peripheral surface and the outer peripheral surface of the belt, and feeds the warp downward.

3. The warp feeding device according to claim 1 or 2, wherein

the transmission mechanism includes
a coupling member that is coupled integrally rotatably in the one direction with the driving roller and relatively rotatably in another direction with respect to the driving roller, and
the driving roller feeds the warp downward by rocking of the coupling member caused by the driving force.

4. The warp feeding device according to claim 1 or 2,

5. The warp feeding device according to any one of claims 1 to 4, wherein
the drive source is a motor whose rotation amount is adjustable.

6. The warp feeding device according to any one of claims 1 to 4, wherein
the drive source is a moving body including a cam mechanism that can move in accordance with knitting by a carriage of the flat knitting machine and can generate a driving force with movement.

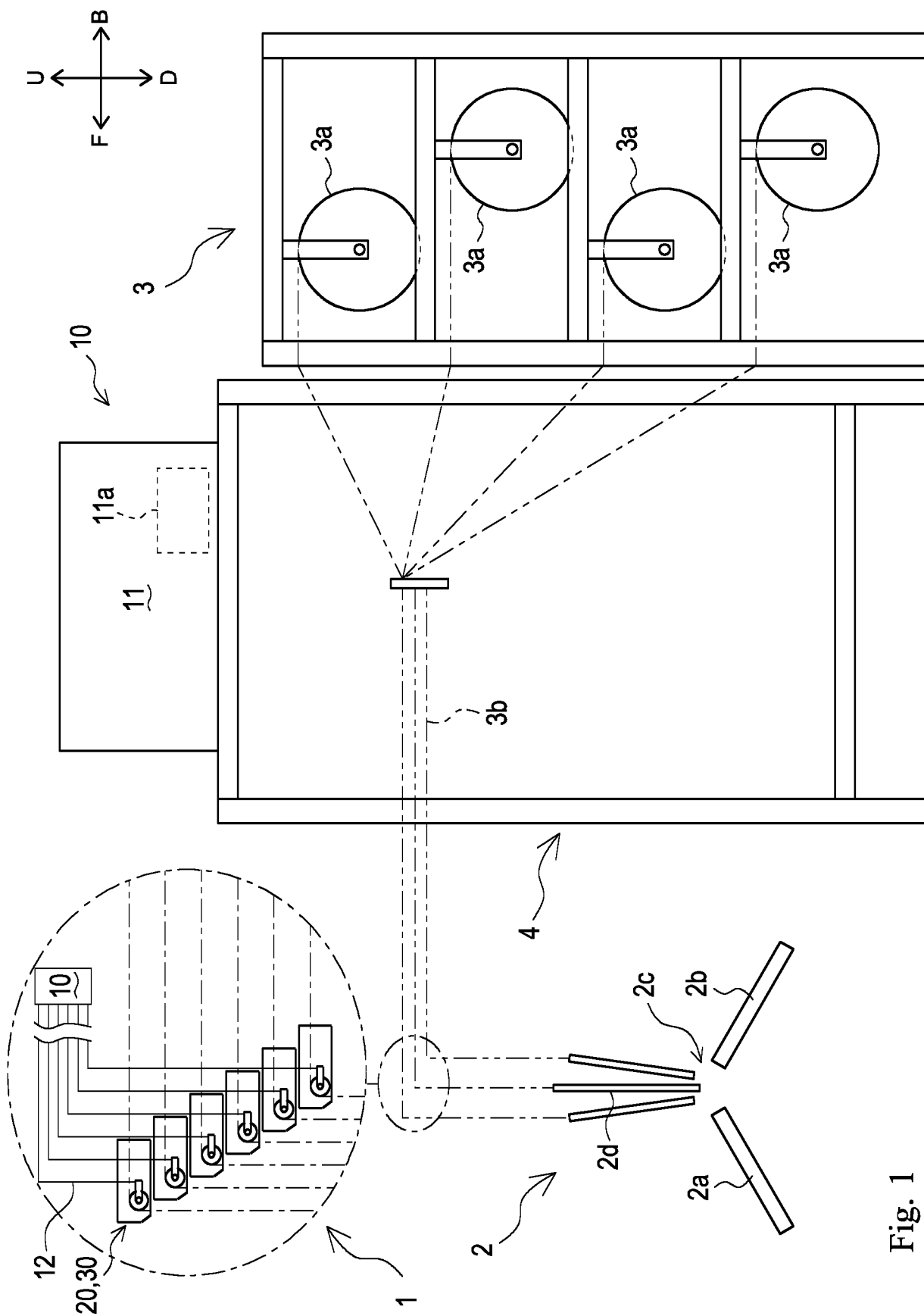


Fig. 1

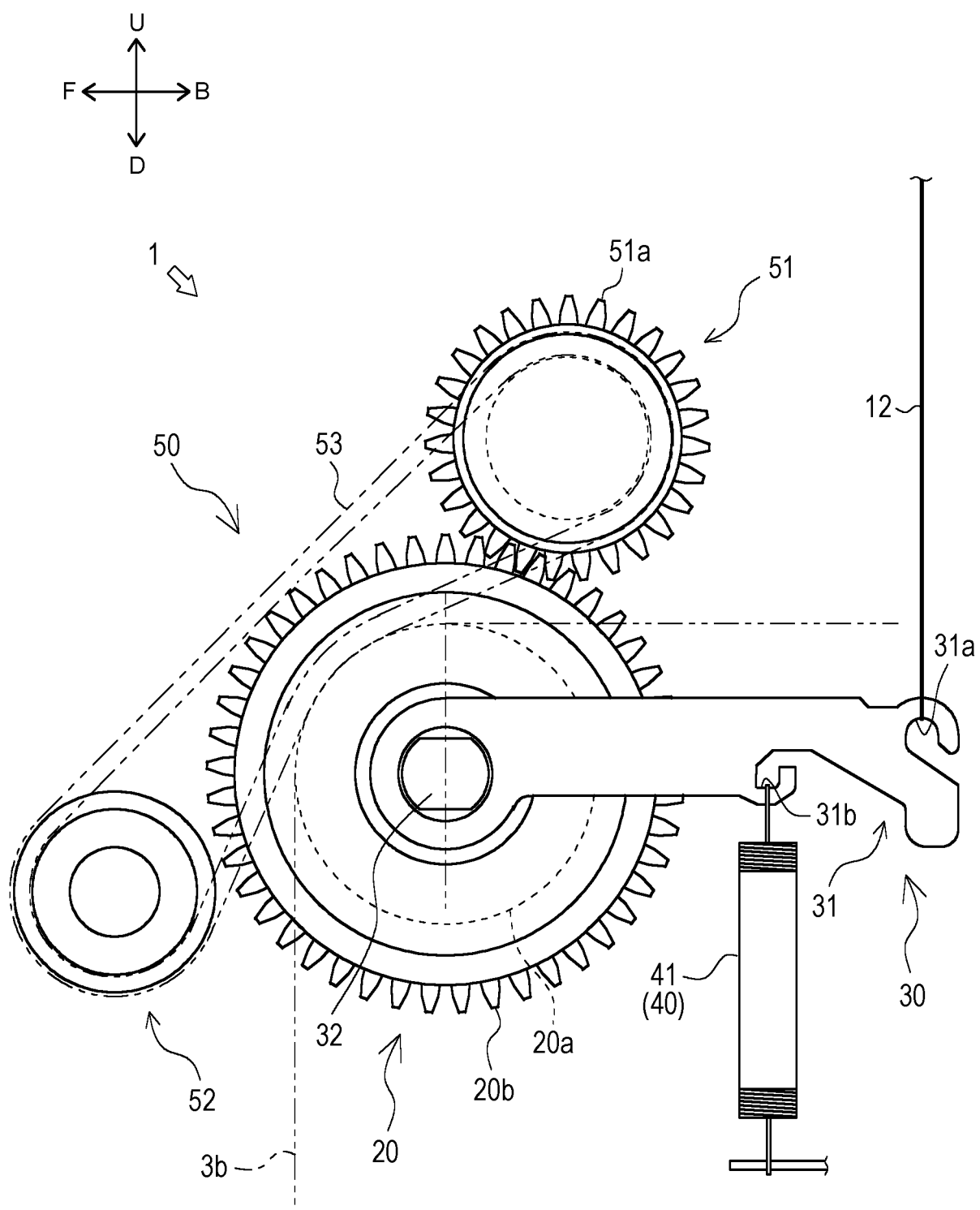


Fig. 2

Fig. 3(a)

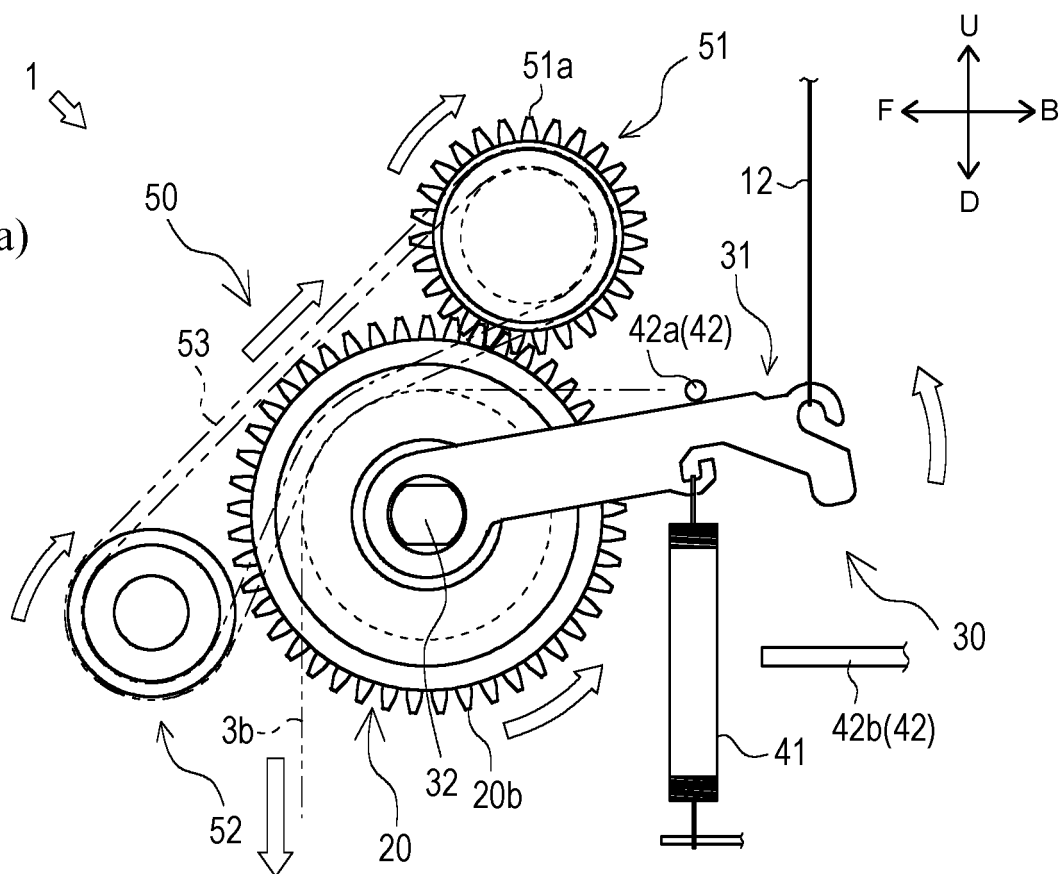
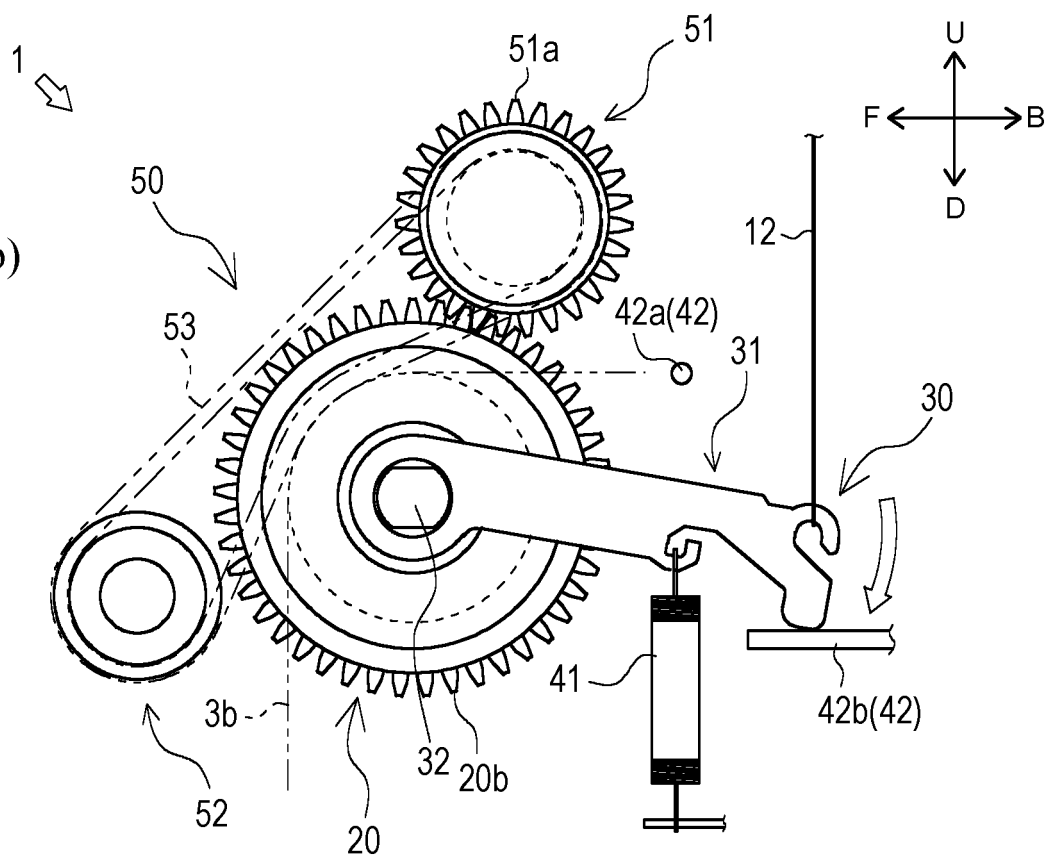


Fig. 3(b)



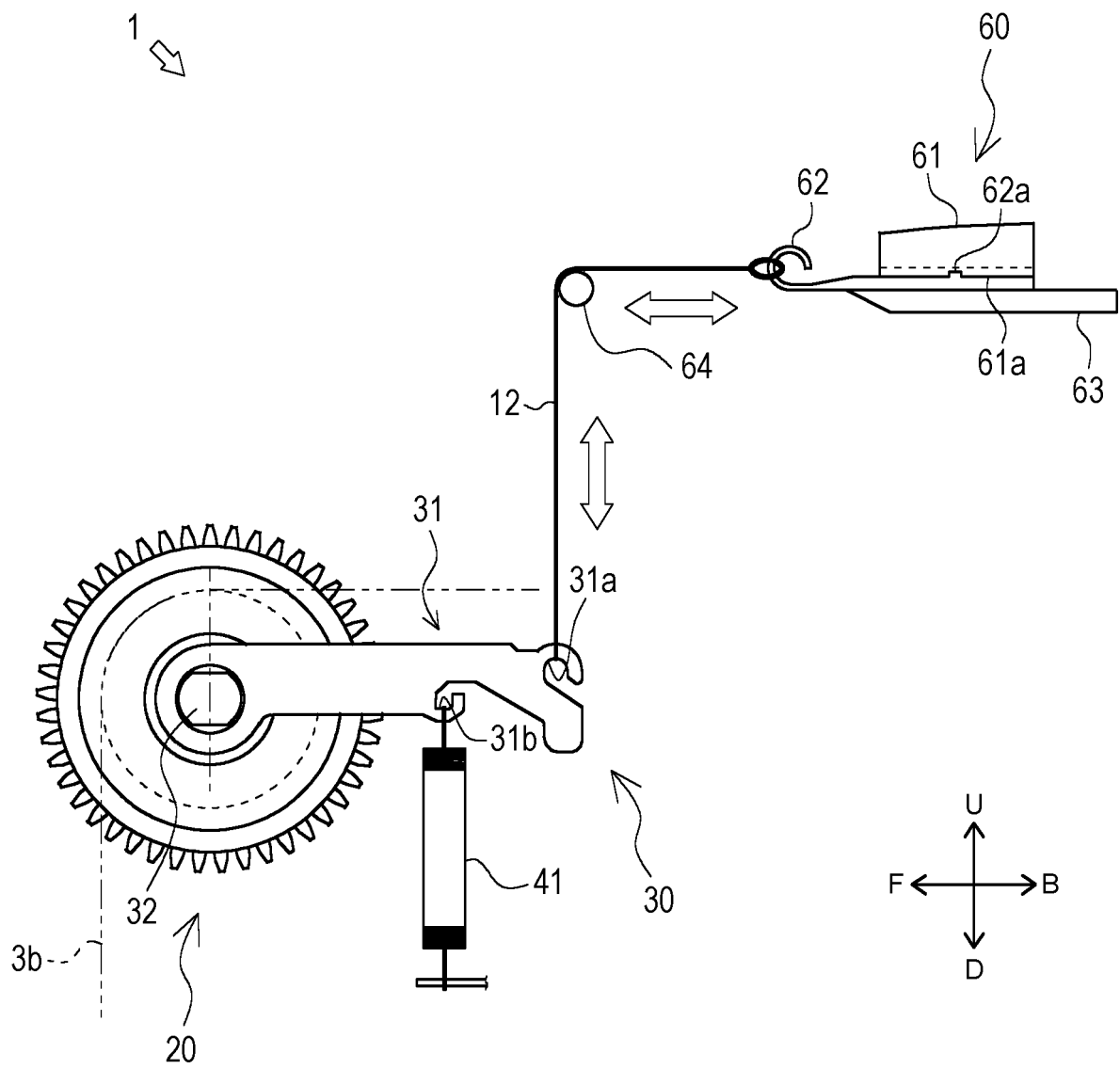


Fig. 4

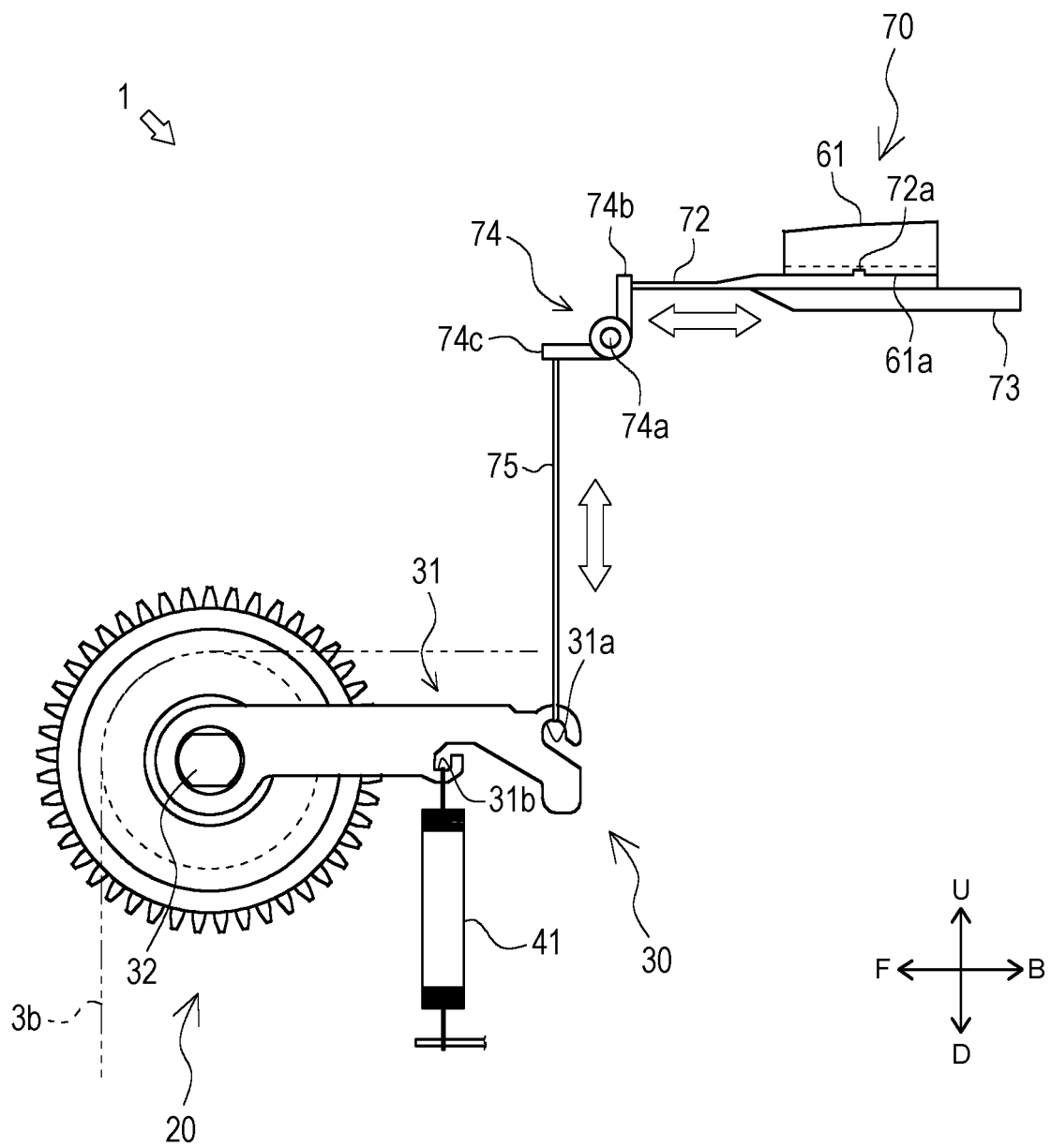


Fig. 5

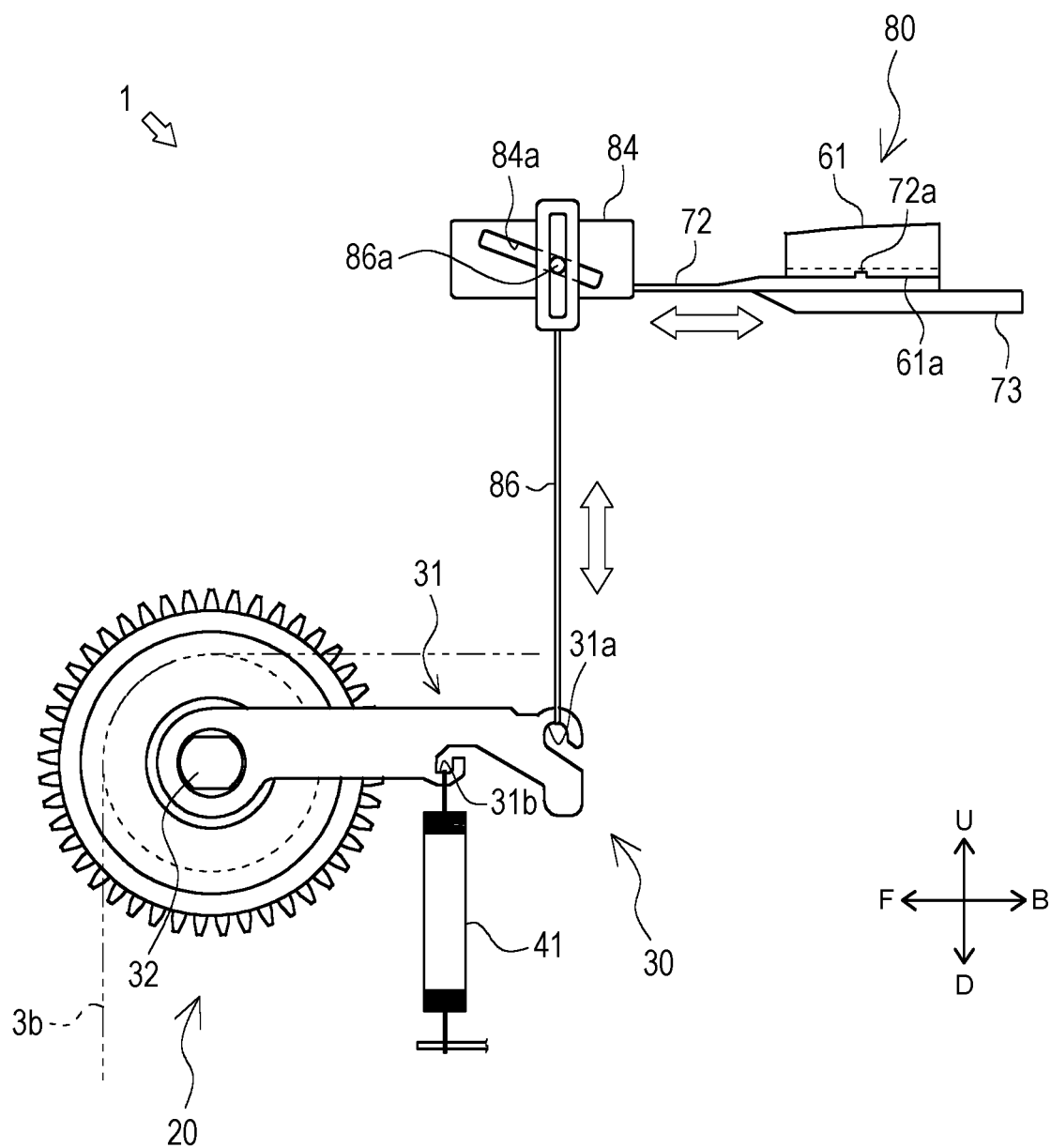


Fig. 6

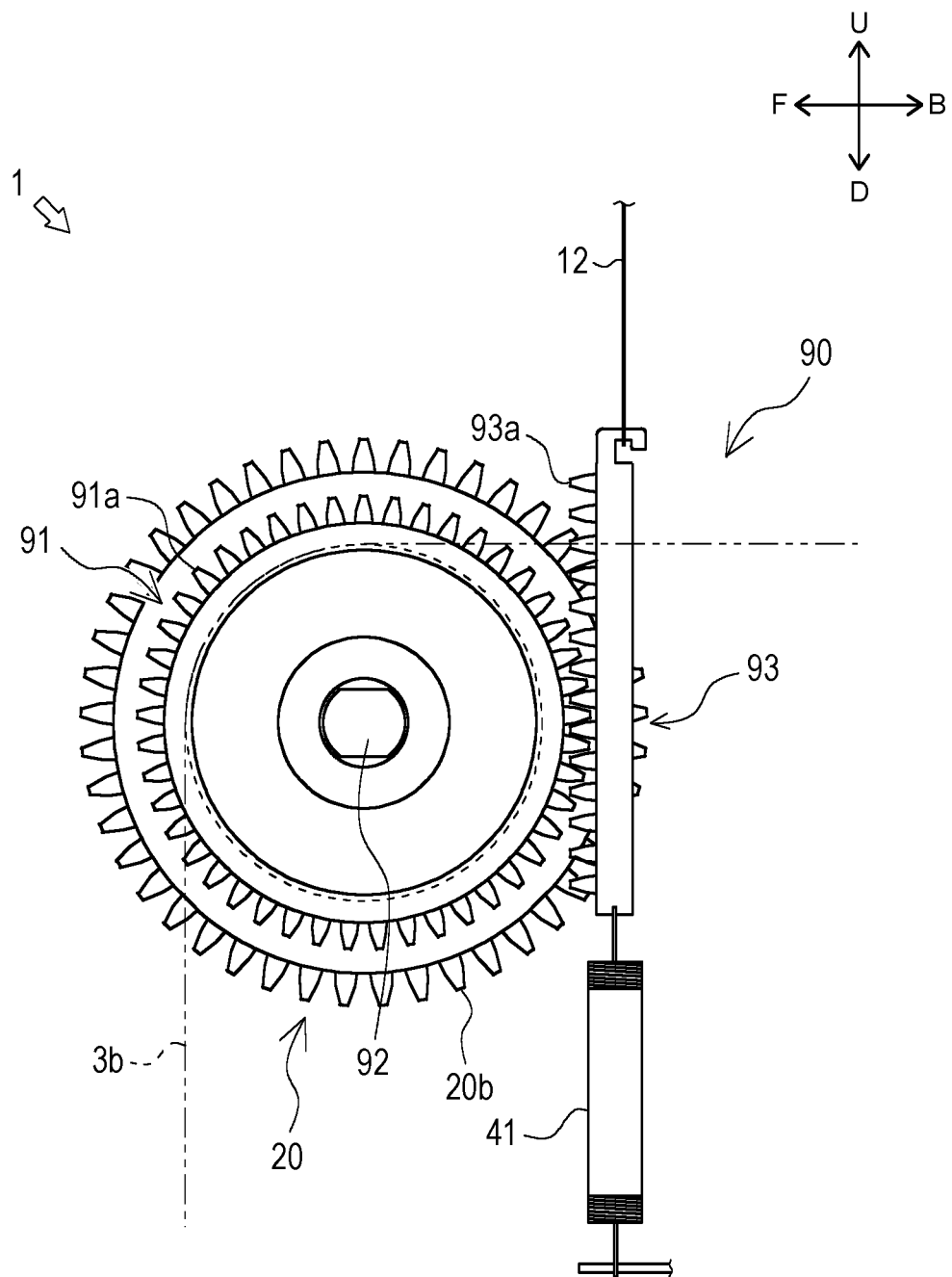


Fig. 7

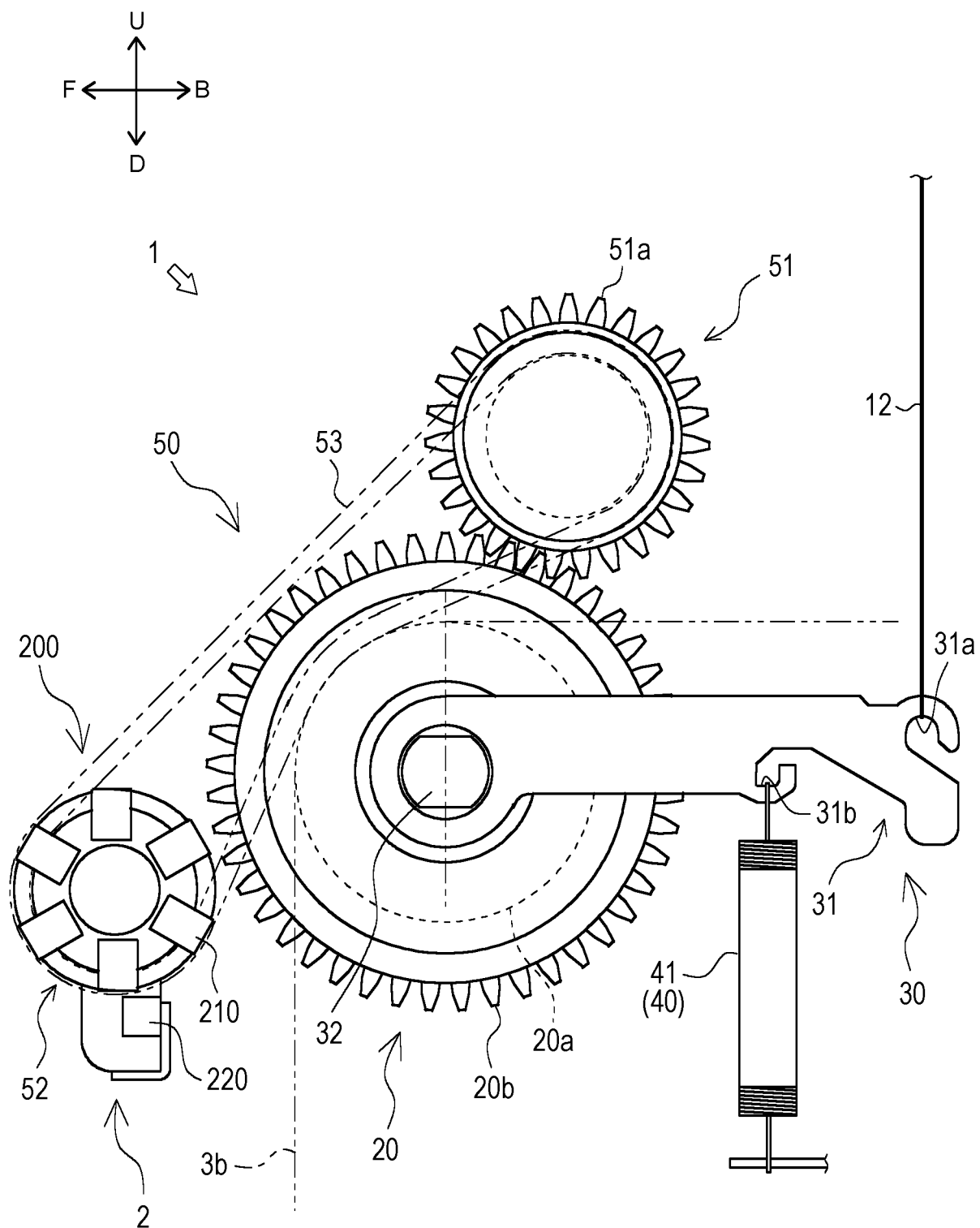


Fig. 8

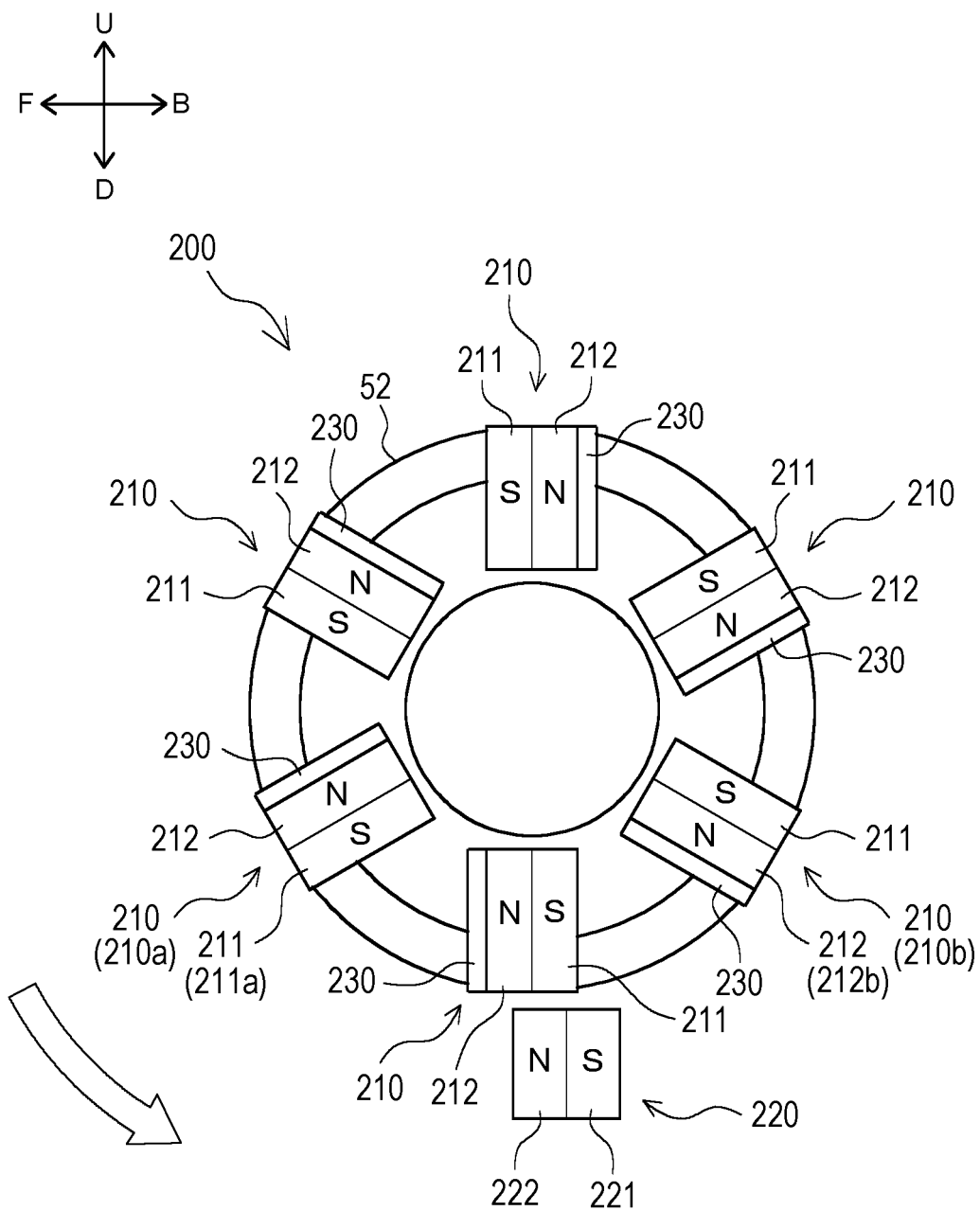


Fig. 9

Fig. 10(a)

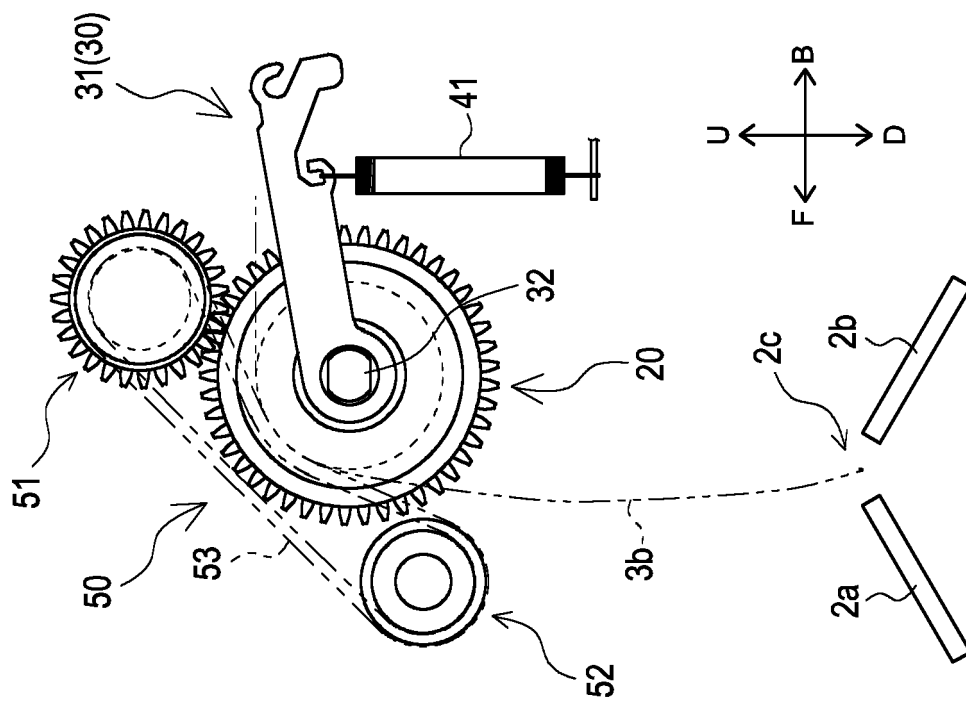
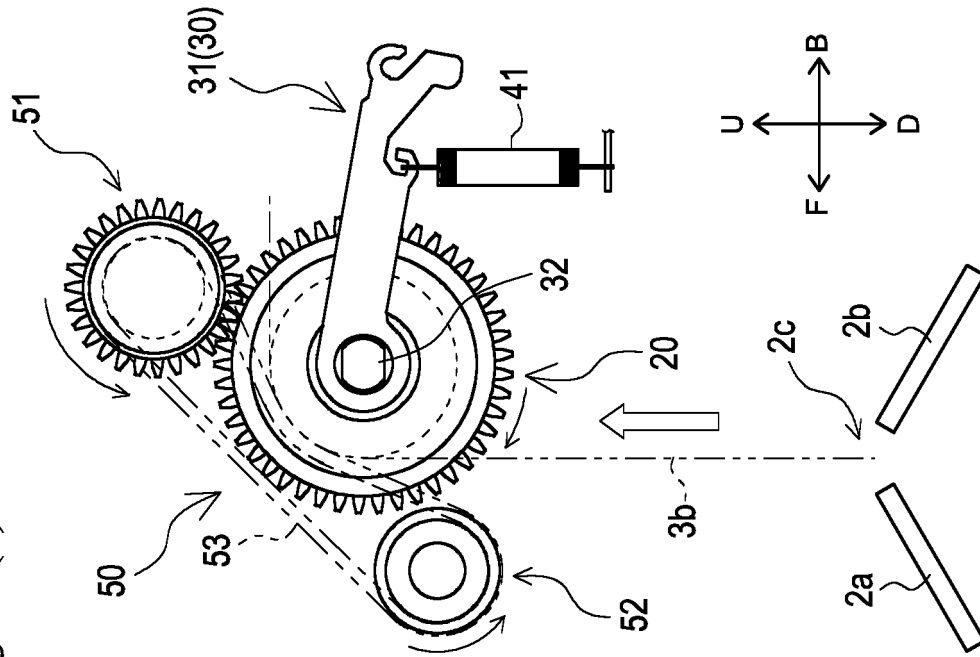


Fig. 10(b)



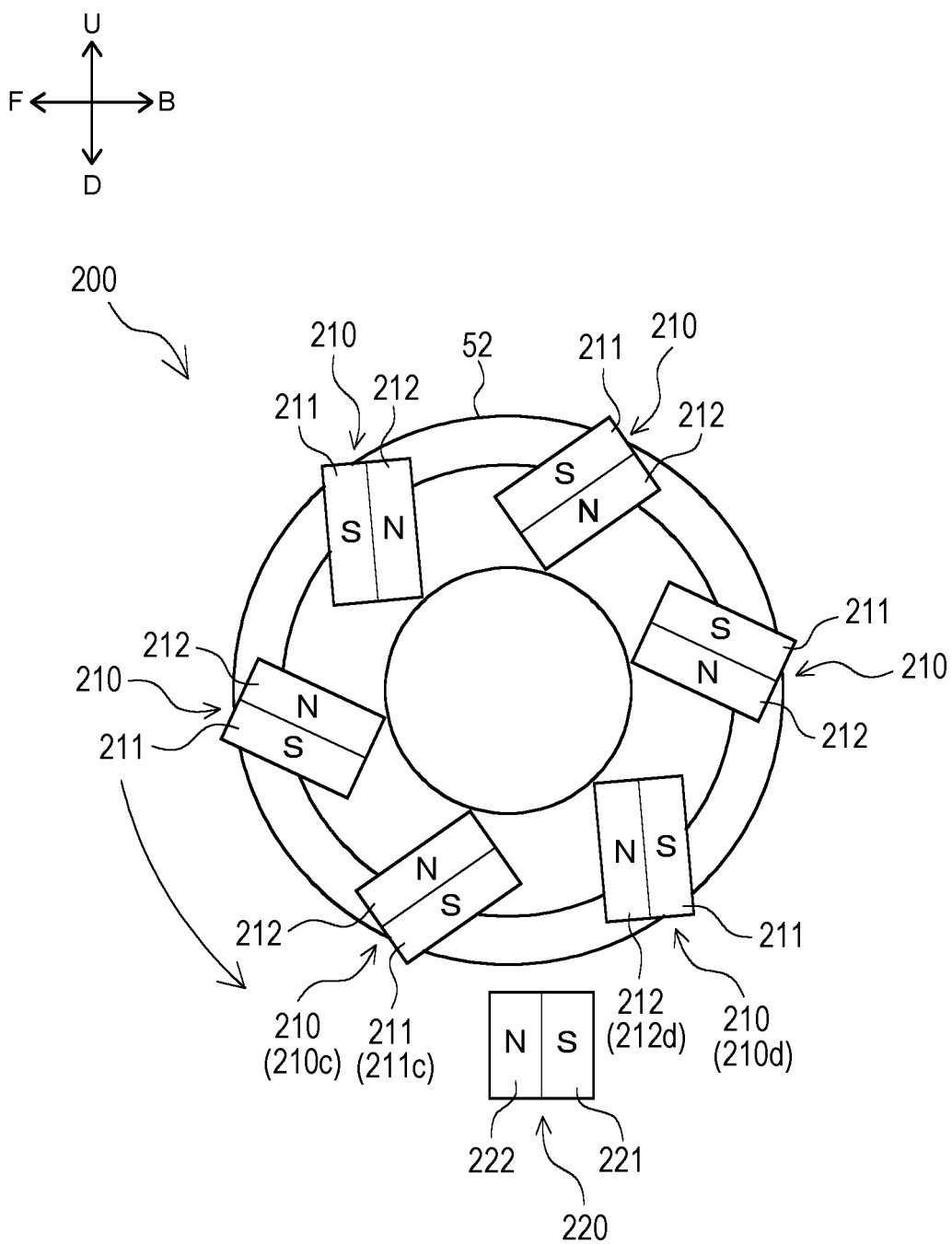


Fig. 11

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2022/047201

A. CLASSIFICATION OF SUBJECT MATTER**D04B 15/38**(2006.01)i; **D04B 15/54**(2006.01)i

FI: D04B15/38; D04B15/54

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D04B15/38; D04B15/54

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

Published examined utility model applications of Japan 1922-1996
 Published unexamined utility model applications of Japan 1971-2023
 Registered utility model specifications of Japan 1996-2023
 Published registered utility model applications of Japan 1994-2023

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2014-34737 A (SHIMA SEIKI MFG LTD) 24 February 2014 (2014-02-24)	1-6
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 113591/1980 (Laid-open No. 37956/1982) (OKUMA MACHINERY WORKS LTD.) 27 February 1982 (1982-02-27)	1-6
A	CN 110331510 A (WUHAN TEXTILE UNIVERSITY) 15 October 2019 (2019-10-15)	1-6

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

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

01 March 2023

Date of mailing of the international search report

14 March 2023

Name and mailing address of the ISA/JP

Japan Patent Office (ISA/JP)
 3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915
 Japan

Authorized officer

Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2022/047201

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP	2014-34737	A	24 February 2014	(Family: none)	
JP	57-37956	U1	27 February 1982	(Family: none)	
CN	110331510	A	15 October 2019	(Family: none)	

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2014034737 A [0006]
- JP 5955197 B [0064]