



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
27.10.2021 Bulletin 2021/43

(51) Int Cl.:
D04B 15/56 (2006.01) D04B 15/48 (2006.01)

(21) Application number: **21169242.1**

(22) Date of filing: **19.04.2021**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(72) Inventors:
• **IMASATO, Akimitsu**
Wakayama, 641-8511 (JP)
• **FUJIMOTO, Hiromi**
Wakayama, 641-8511 (JP)
• **KOMURA, Yoshiyuki**
Wakayama, 641-8511 (JP)

(30) Priority: **23.04.2020 JP 2020076742**

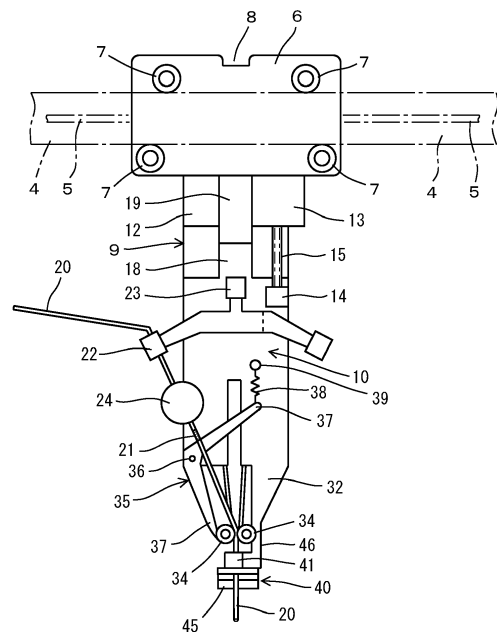
(74) Representative: **Emde, Eric**
Wagner & Geyer Partnerschaft mbB
Patent- und Rechtsanwälte
Gewürzmühlstrasse 5
80538 München (DE)

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

(54) **AN INSERTION DEVICE OF YARN-LIKE ARTICLES FOR A FLAT KNITTING MACHINE**

(57) An insertion device 2 of yarn-like articles 20 comprises a carrier 6 movable on a rail 4 of a flat knitting machine. The carrier 6 is provided with an electric power supply 16; a motor 25; a pair of rollers 34 sending out the yarn-like articles 20 and driven by the motor 25; and a cutting device 40 cutting the yarn-like articles 20 and provided at a downstream position than the pair of rollers 34.

FIG. 1



Description

Field of the Invention

[0001] The present invention relates to an insertion device of yarn-like articles, such as RFID (radio frequency identifier) yarns, metallic yarns, and yarns with color marks, into knitted fabrics, used in and attached to a flat knitting machine.

Background Art

[0002] When knitting knitted fabrics on flat knitting machines, articles other than usual knitting yarns are sometimes inserted into the knitted fabrics. For example, the insertion of a yarn-like article with an RFID is helpful for production management and distribution management of the knitted fabric. Other than the RFID yarn, yarns with color marks and ornamental metallic yarns are sometimes desired to be inserted. Articles to be inserted are yarn-like or strip-like and have a shorter length than knitting yarns. Therefore, they are called "yarn-like articles" in the specification.

[0003] Related pieces of the prior art will be described. Patent Document 1 (US 7246508B) discloses an insertion device of collar stays (stays for collar). The insertion device takes out collar stays one by one and pushes them out into knitted fabrics. Patent Document 2 (US 2018/282914A) discloses a yarn-feeding device with a cutter, a gripper, and a pipe of compressed air for sending knitting yarns out. This yarn-feeding device cuts the knitting yarns at desired positions and pulls out the knitting yarns by the airflow after the cutting.

Prior document List

[0004]

Patent Document 1: US 7246508B

Patent Document 2: US 2018/282914A

[0005] The device according to Patent Document 1 is not suitable for inserting yarn-like articles. The device according to Patent Document 2 is not suitable for inserting accurately yarn-like articles having a desired length, since yarns are sent out by airflow.

Summary of the Invention

Problem to be Solved by the Invention

[0006] The object of the invention is to provide a new insertion device capable of accurately inserting yarn-like articles having a desired length into knitted fabrics.

Means for Solving the Problem

[0007] An insertion device of yarn-like articles for a flat

knitting machine according to the invention comprises: a carrier movable on a rail of a flat knitting machine. The insertion device further comprises; an electric power supply; a motor; a pair of rollers sending out yarn-like articles, at least one of the pair of rollers being a driving roller driven by the motor, all provided in the carrier; and a cutting device cutting the yarn-like articles sent out by the pair of rollers and provided at a downstream position from the pair of rollers in the carrier.

[0008] The insertion device according to the invention moves on a rail of a flat knitting machine, makes at least a driving roller driven by a motor, and inserts yarn-like articles into knitted fabrics. After the insertion of the desired length of the yarn-like articles, the yarn-like articles are cut by the cutting device. As a result, at desired positions in the knitted fabrics, yarn-like articles with the desired length are accurately inserted. When a battery is used, the battery is considered the electric power supply.

[0009] Preferably, an elevation means is further provided in the carrier for raising and lowering the motor, the pair of rollers, and the cutting device, relative to the carrier. When the motor, the cutting device, and so on, are raised, interference with other yarn feeding devices is avoidable. Therefore, it becomes not needed to move the insertion device on the rail of the flat knitting machine for preventing the insertion device from interfering with the other yarn feeding devices.

[0010] Preferably, a biasing means is further provided for biasing at least one of the pair of rollers in a direction to press the yarn-like articles. With this configuration, the slip of the yarn-like articles relative to the rollers and also deviations of the length of the inserted yarn-like articles are prevented.

[0011] Preferably, a control means is further provided for controlling the motor and the cutting device. When the motor and the cutting device are controlled remotely by the controller of the flat knitting machine or the like, jobs such as intercommunication are generated. On the contrary, when the controller of the insertion device receives instructions from the controller of the flat knitting machine or the like and controls the motor and the cutting device, the control is made simple.

[0012] Preferably, a sensor is further provided detecting an element in the yarn-like articles. Since the positions of the elements in the yarn-like articles are known to the controller, the elements in the yarn-like articles are inserted at desired positions into the knitted fabrics.

[0013] Preferably, at least a driving belt, driven by the motor, and driving at least a driving roller, is further provided. Particularly preferably, a pair of driving belts are provided and drive a pair of driving rollers. By the belt driving, the driving roller and the motor can be provided at mutually remote positions, and the transmission mechanism between them can be compactly provided. When the pair of driving belts are provided, both the pair of driving rollers can be driven.

Brief Description of the Drawings

[0014]

Fig. 1 indicates a front view of an insertion device according to an embodiment.

Fig. 2 indicates a rear view of the insertion device according to the embodiment.

Fig. 3 indicates a partial enlarged plan view of a cutting device in the insertion device according to the embodiment.

Fig. 4 indicates a block diagram of the control system of the insertion device according to the embodiment.

Fig. 5 indicates processes executed by the insertion device according to the embodiment.

Description of Embodiments

[0015] The best embodiment for carrying out the invention will be described. Embodiment

[0016] Figs. 1 to 5 indicate an insertion device 2 for flat knitting machines according to the embodiment. The insertion device 2 is used in and attached to a flat knitting machine, and the configuration of the insertion device 2 is indicated in Figs. 1 and 2. Indicated by 4 is a rail of the flat knitting machine for carriers to run for feeding knitting yarns and is preferably provided with a power supply line 5 for non-contact power feeding, a feeder line for the communication with the controller of the flat knitting machine, and so on. The way of communication between the insertion device 2 and the controller of the flat knitting machine is arbitrary.

[0017] The major structural elements of the insertion device 2 are a carrier 6, a fixed plate 9 fixed to the carrier 6, and an elevation plate 10 rising and lowering relative to the fixed plate 9. The carrier 6 is provided with plural rollers 7 and runs autonomously on the rail 4 or is caught and carried on the rail 4 by a carriage (not shown) of the flat knitting machine. In the embodiment, the carrier 6 is caught and carried by the carriage and is provided with an association groove 8. The carriage is provided with a carrying pin (not shown) to be made associated with the groove 8 for carrying the insertion device 2.

[0018] The fixed plate 9 is fixed to the carrier 6 and extends vertically downward. Of course, they may be an integrated member, while they are separate members in the embodiment. A guide groove 19 of the fixed plate 9 guides a slider 18 of the elevation plate 10. Further, an elevation motor 13, for example, provided in the fixed plate 9 and a female screw 14, for example, provided in the elevation plate 10 are connected by a threaded rod 15. In this way, the elevation motor 13 raises and lowers the elevation plate 10 while the slider 18 is guided. In addition to the aforementioned members, a controller 12 and an electric power supply or a power receiving unit 16 are provided in the fixed plate 9. The power receiving unit 16 may be replaced by an electric battery, and, instead of the non-contact feeding, a brush or the like can

be used for receiving power from the power supply line 5.

[0019] Indicated by 20 is a yarn-like article to be inserted and is fed from a yarn package not shown through a buffer such as a side-tension device. At an upstream position of the side-tension device, a positive yarn-feeding device that feeds and pull backs inversely the yarn-like article by a desired length, or the like, can be provided. According to the embodiment, the yarn-like article 20 is a yarn fixed with RFIDs 21 (the elements of the yarn-like article) at a predetermined pitch. The pitch of the RFIDs 21 fixed to the yarn-like article is the same to the desired length of the article 20 when inserted into a knitted fabric.

[0020] The elevation plate 10 is provided with an eyelet 22 for the yarn-like article 20. The elevation plate 10 is further provided with a yarn-feeding motor 25, a transmission device 26, a pair of pulleys 27, a pair of gears 28, a pair of belts 29, and a pair of pulleys 30, as shown in Fig. 2. The rotation of the yarn-feeding motor 25 is reduced by the transmission device 26 and rotates the mutually engaged gears 28, 28 by the same rotation number in the opposite directions and pulleys 30, 30 by the same angle in the opposite directions via the belts 29, 29. A pair of driving rollers 34, 34 are provided coaxially with the pulleys 30, 30 (Fig. 1) and send out the yarn-like article 20.

[0021] The yarn-feeding motor 25 is controlled by the controller 12. The rotation number of the yarn-feeding motor 25 is monitored by an encoder not shown, or the yarn-feeding motor 25 is made a pulse motor so that a desired length of the yarn-like article 20 is sent out.

[0022] The elevation plate 10 has a lowermost portion 32 in one of the lower two branches and further has one pulley 30 and one driving roller 34 at the lower end of the lowermost portion 32. The elevation plate 10 has a biasing member 35 in the other lower branch. The biasing member 35 is provided with an arm 37 rotatably pivoted at its center by a pin 36. The upper portion of the arm 37 is biased upwardly by a tension spring 38, and the other end of the tension spring 38 is fixed to a pin 39. At the lowermost portion of the arm 37, one pulley 30 and one driving roller 34 are provided, and the yarn-like article 20 is sent out from the gap between the pair of driving rollers 34, 34.

[0023] The pulleys 30 and the driving rollers 34 are coaxial, and the driving rollers 34 rotate by the rotation of the pulleys 30. Further, the biased arm 37 applies an adequate nip pressure to the driving rollers 34, 34. By the way, the structure of the biasing member 35 is arbitrary.

[0024] At the lowermost portion of the elevation plate 10, in the embodiment, at the lowest end of the lowermost portion 32 and at a downstream position from the driving rollers 34 along the feeding direction, a cutting device 40 is provided. Indicated by 41 is an eyelet for guiding the yarn-like article 20 into the cutting device 40. The structure of the cutting device 40 is shown in Fig. 3. The yarn-like article 20 passes between a fixed blade 42 and a movable blade 43, and an axial member 44 of the mov-

able blade 43 is rotated by a driver 45 such as a small motor or a solenoid, to cut the yarn-like article 20. Indicated by 46 is a support member for attaching the cutting device 40 to the lowermost portion 32.

[0025] Fig. 4 indicates the control system of the insertion device 2. The insertion device 2 operates with the electricity from the power receiving unit 16 or the like and by the instructions from the controller 50 of the flat knitting machine. The controller 12 communicates with the controller 50 of the flat knitting machine and makes the elevation motor 13 raise or lower the elevation plate 10. Furthermore, the controller 12 makes the yarn-feeding motor 25 rotate the driving rollers 34 such that a desired length of yarn-like article 20 is sent out from the eyelet 41. The cutting device 40 operates by the instructions of the controller 12 to cut the yarn-like article 20 such that an RFID 21 is present at a predetermined distance from the leading end of the yarn-like article 20 and the portion of the yarn-like article 20 to be inserted into a knitted fabric has a predetermined length. When an RFID reader 24 detects an RFID 21 in the yarn-like article 20 the RFID reader 24 informs the controller 12 of the ID of the detected RFID 21 or a tag indicating the ID and detection signal of RFID 21. When only the ID is informed, the controller 12 is noticed that an RFID 21 is detected by the information. In addition, when the insertion device 2 runs autonomously on the rail 4, a travelling motor is provided in the insertion device 2.

[0026] The operations of the insertion device 2 according to the embodiment are indicated in Fig. 5. The insertion device 2 carries out, for example, the following processes:

- while moving along the course direction of the knitted fabric, sending out the yarn-like article 20 such that the article is inserted into the knitted fabric without forming a stitch ("inlay");
- while stopping, sending out the yarn-like article 20 vertically along the wale direction of the knitted fabric and inserting the yarn-like article as a warp yarn into the knitted fabric; or
- feeding the yarn-like article 20 with another knitting yarn so as to form a stitch.

[0027] The yarn-like article 20 having the RFID 21 is inserted for the production management and the delivery management of the knitted fabric, and so on. The RFID 21 is inserted at a predetermined position into the knitted fabric, the ID of the RFID 21 is retrieved by the RFID reader 24, and the ID is stored in an RFID server not shown. The RFID server associates data regarding the production management of the knitted fabric and delivery and sales data of the knitted fabric with the individual ID and stores those data. In shipment and in sales of the knitted fabric, the ID of the RFID 21 is retrieved and informed to the RFID server, and then, the data regarding the production management of the knitted fabric, data regarding delivery and sales of the knitted fabric are in-

formed by the server. In place of the RFID reader 24, an RFID reader/writer can be provided to store those data such as production management in the RFID 21.

[0028] In the embodiment, the pitch of RFID in the yarn-like article 20 is equal to the length of the yarn-like article 20 when inserted (the insertion length). When the pitch of RFID is longer than the insertion length, after the previous RFID was inserted, the yarn-like article 20 is taken out until the next RFID is detected by the RFID reader and is cut. An unneeded portion of the yarn-like article is disposed of, for example, by suction. The insertion device 2 waits at the end portions of the needle beds of the flat knitting machine or another position not interfering with knitting and draws out the yarn-like article 20 from its yarn package. The RFID reader 24 informs the controller 12 of detection of an individual RFID 21. The above process is called the standby process P1.

[0029] In the embodiment, the controller 50 of the flat knitting machine controls the carriage (not shown) and moves the insertion device 2 to desired positions by making a carrying pin of the carriage associated with the association groove 8. In synchronization with the movement of the insertion device 2, a desired length of the yarn-like article 20 is drawn out by the driving rollers 34 and is cut by the cutting device 40. Thus, an RFID 21 is inserted at a desired position into the knitted fabric. Since the yarn-like article 20 is drawn out by the pair of driving rollers 34, 34, and since the rollers 34, 34 are pressed with each other by the biasing member 35, the yarn-like article 20 having accurately a desired length is inserted. By the way, when being inserted, the yarn-like article 20 can be knit to form a stitch. The above process is called the insertion process P2.

[0030] Other yarn feeders run on the rails 4 and feed knitting yarns for knitting the knitted fabric. The lower ends of the other yarn feeders can interfere with the lower ends of the insertion device 2, in particular, the cutting device 40, the yarn-feeding motor 25, and the driving rollers 34. Therefore, the elevation motor 13 raises the elevation plate 10 to prevent the interference with the other yarn feeders. This process is called the retraction process P3. By the way, the mechanism for raising and lowering the elevation plate is arbitrary, other mechanisms such as a combination of a solenoid and a double-speed mechanism can be used.

[0031] When inserting the yarn-like article 20 by inlay, sometimes, the yarn-like article floats in the knitted fabric and is not stably fixed at the desired position. In such a case, the elevation plate 10 is made lowered, and the inserted yarn-like article 20 into the knitted fabric is pushed down by the bottom face of the cutting device 40 to prevent the yarn-like article 20 from floating in the knitted fabric. This process is called the pushing-down process P4. Instead of pushing-down by the bottom face of the cutting device 40, airflow from an air pipe not shown can be used for the pushing-down.

[0032] The modifications of the embodiment will be described. Instead of the elevation and retraction of the el-

elevation plate 10, the insertion device 2 is moved along the knitting width direction to a position where it does not interfere with the other yarn feeders. The biasing member 35 can be replaced by an arbitrary member applying pressure between the driving rollers 34, 34. While the biasing member 35 can be omitted, the biasing member 35 or the like prevents the yarn-like article 20 from slipping relative to the driving rollers 34. When the insertion device 2 is moved toward the yarn source, such as a side-tension device or a positive yarn-feeding device, the yarn-like article 20 is relaxed, and therefore, the extra yarn-like article is preferably absorbed by these devices.

[0033] Without the controller 12, the controller 50 of the flat knitting machine can control various elements of the insertion device 2, by the communications via the rail 4 or the like. However, when the controller 12 controls the elements of the insertion device 2, the control is made simpler than the control by the controller 50 of the flat knitting machine.

[0034] In the embodiment, the yarn-like article 20 having an RFID is inserted, but the kind of yarn-like articles are arbitrary. The RFID reader 24 can be replaced by another sensor according to the kind of yarn-like articles. The examples of other sensors are a color sensor for detecting colored portions in yarn-like articles and a thickness sensor for detecting thick portions provided at particular portions of yarn-like articles.

[0035] The pair of belts 29, 29 are used for rotating the driving rollers 34, 34 at the same speed by the yarn-feeding motor 25 at a somewhat remote position. However, the kind of the transmission devices between the yarn-feeding motor 25 and the driving rollers 34 is arbitrary. The slip of the yarn-like article 20 is made smaller by driving both the driving rollers 34, 34, but only one of the rollers can be driven. In the embodiment, only one of the driving rollers 34 is biased, but both the driving rollers 34, 34 can be biased.

List of Symbols

[0036]

2 insertion device
4 rail
5 power supply line
6 carrier
7 roller
8 association groove
9 fixed plate
10 elevation plate
12 controller
13 elevation motor
14 female screw
15 threaded rod
16 power receiving unit
18 slider
19 guide groove
20 yarn-like article

21 RFID
22 eyelet
24 RFID reader
25 yarn-feeding motor
5 26 transmission device
27 pulley
28 gear
29 belt
30 pulley
10 32 lowermost portion
34 driving roller
35 biasing member
36 pin
37 arm
15 38 tension spring
39 pin
40 cutting device
41 eyelet
42 fixed blade
20 43 movable blade
44 axial member
45 driver
46 support member
50 controller of the flat knitting machine

Claims

1. An insertion device (2) of yarn-like articles (20) for a flat knitting machine, comprising:
 - a carrier (6) movable on a rail (4) of the flat knitting machine;
 - an electric power supply (16) provided in the carrier (6);
 - a motor (25) provided in the carrier (6);
 - a pair of rollers (34) sending out yarn-like articles (20) provided in the carrier (6), wherein at least one of the pair of rollers (34) is a driving roller driven by said motor (25);
 - and
 - a cutting device (40) cutting the yarn-like articles (20) sent out by said pair of rollers (34) and provided at a downstream position from said pair of rollers (34) in the carrier (6).
2. The insertion device (2) of yarn-like articles (20) for a flat knitting machine according to claim 1, being **characterized by** an elevation means (13) for raising and lowering said motor (25), said pair of rollers (34), and said cutting device (40), relative to said carrier (6), and provided in said carrier (6).
3. The insertion device (2) of yarn-like articles (20) for a flat knitting machine according to claim 1 or 2, being **characterized by** a biasing means (35) for biasing at least one of said pair of rollers (34) in a direction to press the yarn-like articles (20).

4. The insertion device (2) of yarn-like articles (20) for a flat knitting machine according to one of claims 1 to 3, being **characterized by** a control means (12) for controlling said motor (25) and said cutting device (40). 5
5. The insertion device (2) of yarn-like articles (20) for a flat knitting machine according to one of claims 1 to 4, being **characterized by** a sensor (24) detecting an element (21) in the yarn-like articles (20). 10

15

20

25

30

35

40

45

50

55

FIG. 1

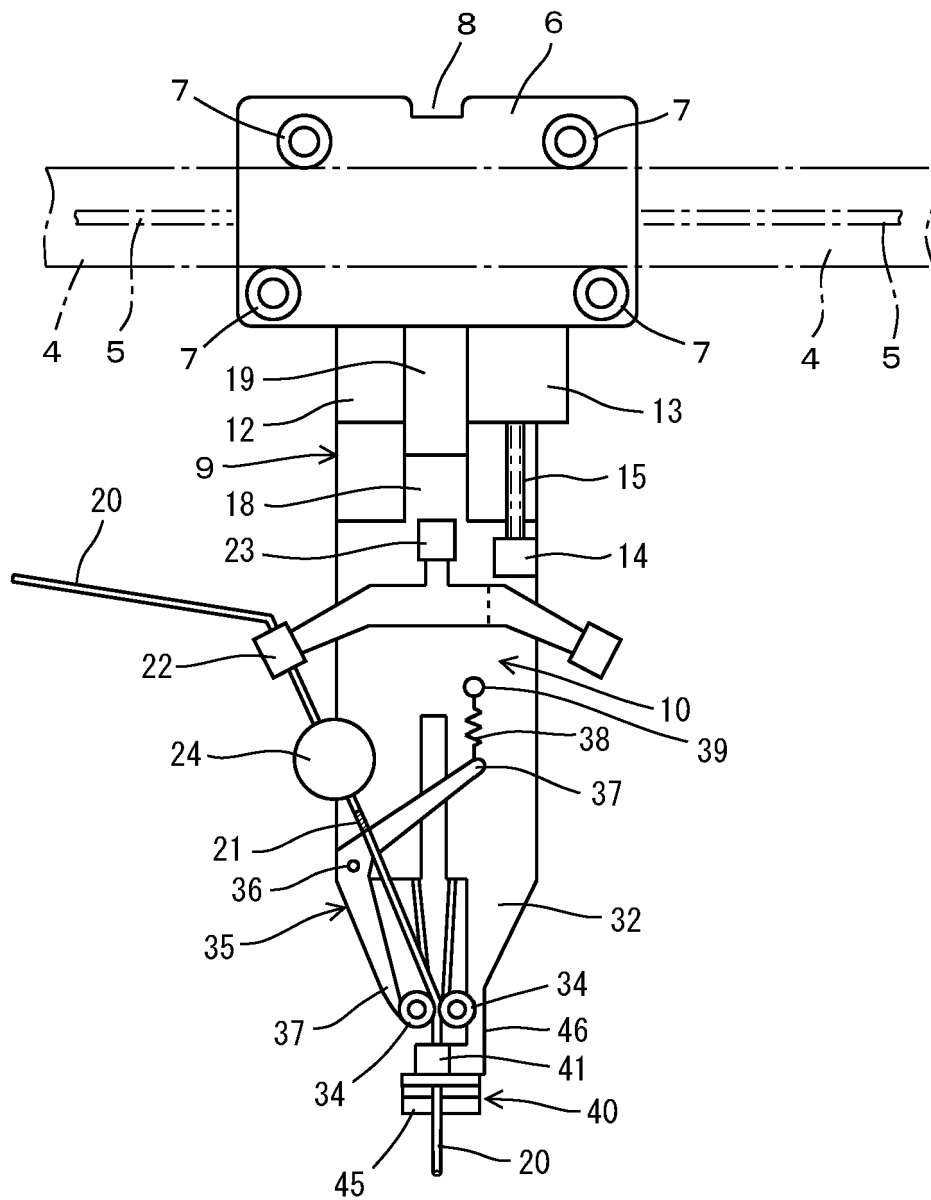
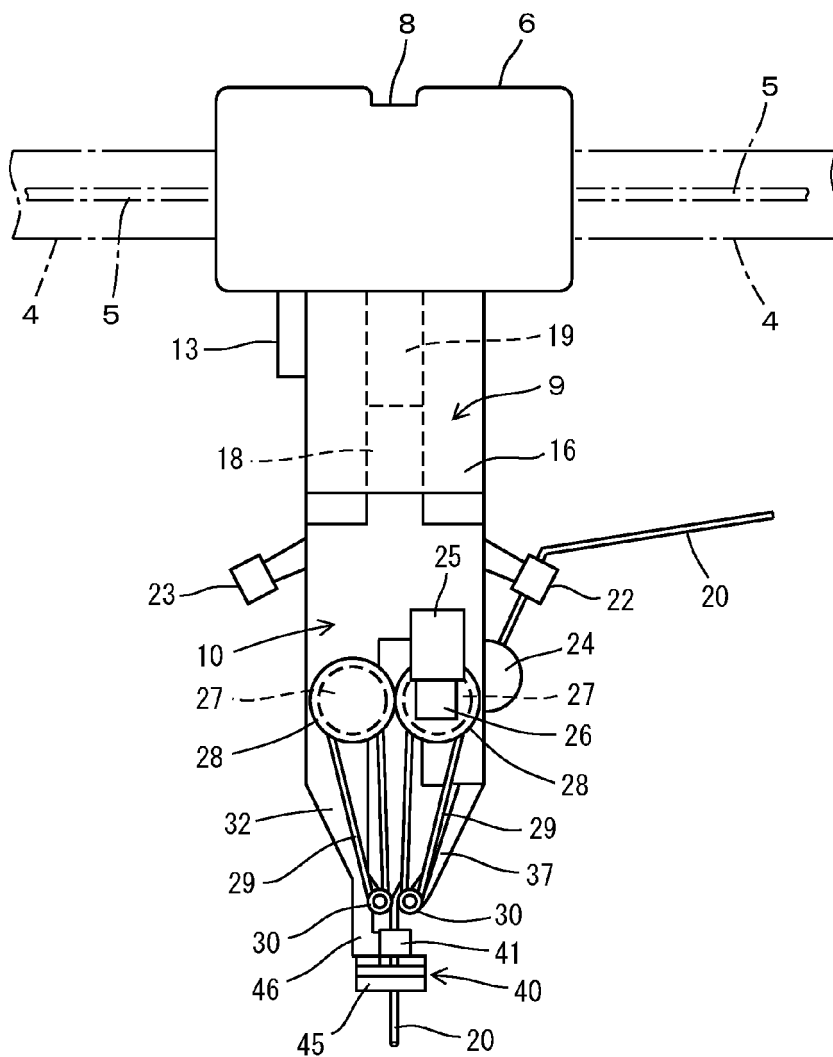
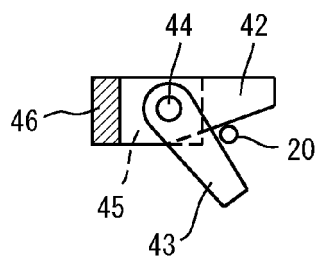


FIG. 2



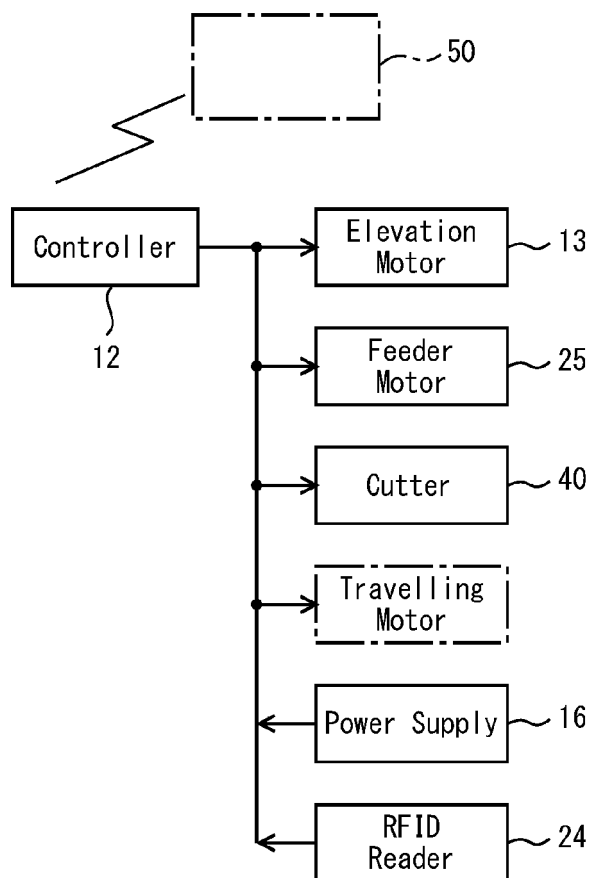
2

FIG. 3



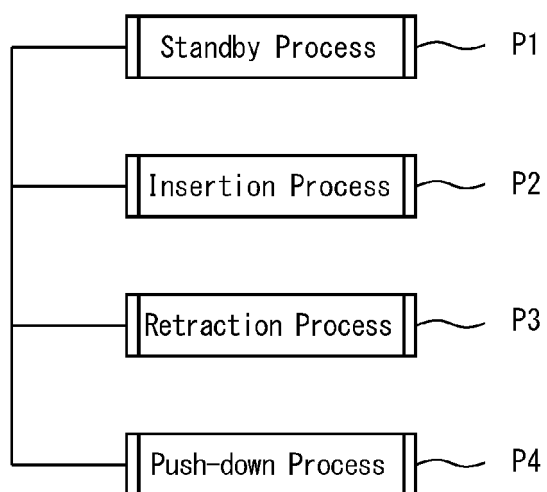
40

FIG. 4



2

FIG. 5





EUROPEAN SEARCH REPORT

 Application Number
 EP 21 16 9242

5

10

15

20

25

30

35

40

45

50

55

1

EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 5 623 840 A (ROELL FRIEDRICH [DE]) 29 April 1997 (1997-04-29) * column 1, line 29 - line 39 * * column 2, line 53 - line 58 * * column 4, line 41 * * column 5, line 8 - line 12 * * column 6, line 50 - line 56 * * column 7, line 1 - line 5 * -----	1-5	INV. D04B15/56 D04B15/48
Y	WO 2019/170952 A1 (HAPPY PUNT S L U [ES]) 12 September 2019 (2019-09-12) * figures 1-3 * * page 12, line 24 * * page 13, line 1 - line 14 * -----	1-5	
Y	US 6 094 945 A (LONATI FRANCESCO [IT] ET AL) 1 August 2000 (2000-08-01) * paragraph [0029]; figure 1 * -----	3	
			TECHNICAL FIELDS SEARCHED (IPC)
			D04B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 17 August 2021	Examiner Messai, Sonia
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 21 16 9242

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

17-08-2021

10

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5623840 A	29-04-1997	US 5615562 A	01-04-1997
		US 5623840 A	29-04-1997

WO 2019170952 A1	12-09-2019	NONE	

US 6094945 A	01-08-2000	DE 69819861 T2	04-11-2004
		EP 0933457 A1	04-08-1999
		ES 2210602 T3	01-07-2004
		JP H11217755 A	10-08-1999
		US 6094945 A	01-08-2000

15

20

25

30

35

40

45

50

55

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 7246508 B [0003] [0004]
- US 2018282914 A [0003] [0004]